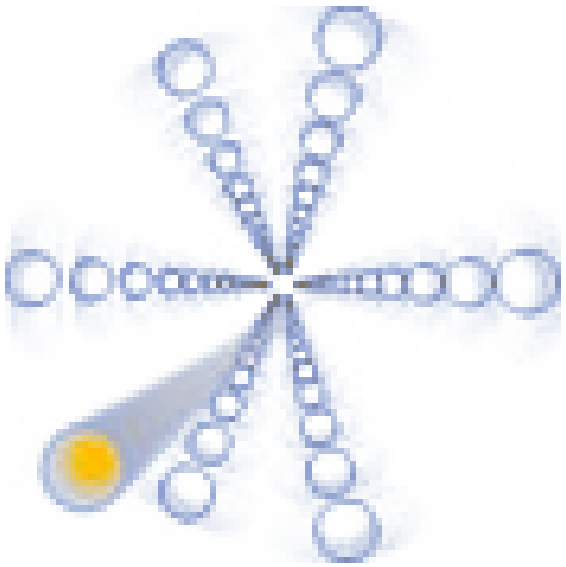
Channeling 2014



Report of Contributions

https://agenda.infn.it/e/7409

Contribution ID: **0** Type: **Oral**

The Features of Transition and Cherenkov Radiation of Multi-Charged Ions

Monday, 6 October 2014 10:30 (15 minutes)

The influence of the processes electrons capture (or loss) by the high-energy multiply charged ions on the Cherenkov and transition electromagnetic radiation are discussed. Multiply charged ion charge fluctuations in the targets lead to an additional contribution to spectral- angular density of radiation (the correlation effect [1]). If the threshold condition for the occurrence of Cherenkov radiation is not satisfied, as it might be expected, spectral- angular density coincides with the formula of radiation from a charge that begins to suddenly move with constant velocity [2]. Radiation described by distribution function is directed forward in a strongly smeared cone near the Cherenkov angle and exists in a subthreshold region of ion velocities. A similar picture of the angular distribution subthreshold radiation observed in the experiments described in [3]. Spectral-angular density of the radiation does not depend on the initial charge of the ion, its mass and thickness of the target. This can serve as a test for the detection of the effect described subthreshold radiation of high-energy multiply charged ions in targets. If the radiation formation length is much greater than the length of the trajectory on which the electron capture or loss, we can assume that the change in the ion charge is instantaneous. Then to analyze the emerging transition radiation can use the method of crosslinking the normal and tangential component of the ion field at the interface between two media. The generalizations of Ginsburg and Frank formulas [4] to the case of the electron capture or loss by multiply charged ions are obtained. In particular for the backward radiation from entry neutral particles in the target and the loss of one electron the spectral-angular density of the transition radiation has the form:

(Formula)

If the singly charged ion enters a target and as a result of electron capture becomes neutral in the target, then for backward transition radiation we have:

(Formula)

Comparisons of the intensity of the Ginsburg-Frank transition radiation and arising one during the capture and loss of electrons have been done.

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Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **1** Type: **Oral**

Small Amplitude Short Period Crystal Undulators

Monday, 6 October 2014 09:45 (15 minutes)

We present an experimental demonstration of a Small Amplitude Short Period (SASP) Crystal Undulator, proposed by A. Kostyuk. Such a device produces MeV radiation from 6-800 MeV electrons, and observed spectra are in good agreement with calculated values.

Primary author: Dr UGGERHOEJ, Ulrik (Dept. Physics and Astronomy)

Presenter: Dr UGGERHOEJ, Ulrik (Dept. Physics and Astronomy)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **2** Type: **Poster**

PS2-24: Kinetics of the Wave Propagation in the System of Parallel Fibers

Tuesday, 7 October 2014 17:00 (1h 30m)

The scattering of the plane electromagnetic wave on the fiber-like target is considered. The formula for the scattering cross section is used for building the kinetic equation that describes the propagation of the radiation in the rope of parallel fibers. The approach to building the kinetic equation is analogous to one applied in the description of multiple scattering of particles in amorphous medium [1].

The radiation intensity evolution is considered for two cases: under propagation through the rope of straight fibers and of bent ones. The possibility of the situation when the intensity maximum of the incident radiation follows the rope bent is demonstrated.

References
[1] H. Bethe, Phys. Rev. 89 (1953) 1256.

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Presenter: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Session Classification: PS: Poster Session

Contribution ID: **3** Type: **Oral**

Polycapillary Lenses for Soft-X-Ray Transmission: Model, Comparison with Experiments and Potential Application for Tomographic Measurements in Tokamaks

Tuesday, 7 October 2014 09:45 (15 minutes)

In Tokamaks, plasma emits as a volumetric Soft-X-Ray (SXR) source and can give very useful information about plasma stability, shape and impurity content. Measuring the SXR radiation ([0.1 keV; 20 keV]) of magnetic fusion plasmas is a standard way of accessing
valuable information on particle transport and MagnetoHydroDynamic (MHD).Unfortunately, the strong constraints imposed by the environment of a tokamak reactor (high neutron fluxes, gamma and hard X-ray emission, high magnetic field and high radiofrequency powers) do not authorize to install in a close vicinity of the machine such detectors.We have thus investigated the possibility of using polycapillary lenses to transport the SXR information to several meters from the plasma. The idea is to protect the SXR
detector from the entire environment by a proper shielding.Different polycapillary lenses have been tested in collaboration with CELIA at Bordeaux and results will be shown.In parallel a model of polycapillary transmission has been developed and validated against
experiment. Results are presented confirming the great potential of polycapillary lenses for SXR transmission in tokamak plasma.

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Presenter: Dr MAZON, Didier (CEA Cadarache)

Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **4** Type: **Invited talk**

Magnetic Confinement Principles in Tokamak Devices and Actual Challenges

Sunday, 5 October 2014 15:45 (45 minutes)

After more than fifty research years on different implementations, the concept of the tokamak is a very good candidate to lead to a fusion reactor. In fact, certain regimes of functioning allow today the tokamaks to attain performances close to those requested by a reactor. However, these performances are acquired on extremely short duration only and means to acquire and maintain them are not always clearly identified. The general frame of this paper treats the perspective of a real-time control of tokamak plasmas in view to attaining continuous operation. This means to be able to maintain the plasma in a stable and quasi stationary state for several hours. It is also necessary to keep a sufficient efficiency so as to produce at least 10 times more energy than what is requested for the functioning of the tokamak. These extremely ambitious objectives are absolutely essential to get closer to a viable reactor and require first of all an experimental and theoretical understanding of the relevant physical phenomena. In fact, before defining any control algorithm, it is necessary to know the domains in which conditions are favorable to an increase of performances, while identifying the main actors responsible for this improvement. From a practical point of view, this objective of operation of a tokamak in continuous regime requires numerous technical developments, particularly from the point of view of the diagnostics which must be adapted to real time applications. This paper will underline particularly, on concrete examples, the impact of diagnostics on the identification of plasma models, on which the control algorithms are based.

Primary author: Dr MAZON, Didier (CEA Cadarache)

Presenter: Dr MAZON, Didier (CEA Cadarache)

Session Classification: ”CHANNELING PRIMER”

Contribution ID: **6** Type: **Poster**

PS2-15: Rainbow Scattering of Neutral Atoms by the Crystal Surface

Tuesday, 7 October 2014 17:00 (1h 30m)

The features of the angular distributions of accelerated neutral atoms at grazing incidence on the surface of Al (001) [1,2] are theoretically investigated. Interaction of accelerated atoms with atoms of the crystal lattice, electronic properties and atomic structure of the surface of the Al (001) are calculated using the DFT methods. Simulation of angular distributions of scattered atoms performed taking into account the interaction of atoms with several layers of atoms in the crystal lattice. It is found that the effect on rainbow scattering is significantly affected by the relaxation of the surface layers of the crystal, i.e. unlike the distances between the planes at the surface and in the volume. The possibilities of using the effect of rainbow scattering for the study of structural features of the crystal surface have been discussed.

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2. V.S. Malyshevsky. NIM , B 309 (2013) 151.

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Presenter: Mr MALYSHEVSKY, Vyacheslav (Southern Federal University, 344090, Rostov-on-Don, Russia)

Session Classification: PS: Poster Session

Contribution ID: **7** Type: **Oral**

Study of Crystal Extraction of Circulating Beam from U-70 at Injection Energy

Wednesday, 8 October 2014 12:30 (15 minutes)

Phenomenon of deflection of charged particle beam due to channeling in a bent crystal is good investigated and successfully applied for extraction of beam in high-energy accelerators, at the energies of about 10 GeV and higher. However, a big practical interest presents the task of bending and extraction of charged particles with energies below 1 GeV, for example, production of ultrastable beams of low emittance for medical and biological applications. That's why two novel crystal technique, namely: thin sequential straight crystal targets, and array of short bent crystal strips were investigated in this report as elements for extraction of beam from U-70 accelerator. Experimental results were obtained for extraction of 1.3 GeV protons and six-charged carbon ions with energy 450 MeV/nuleon.

Primary author: Prof. CHESNOKOV, Yury (IHEP)

Presenter: Prof. CHESNOKOV, Yury (IHEP)

Session Classification: S4: Charged Beams Shaping

Contribution ID: **8** Type: **Oral**

Investigations on a Hybrid Positron Source with a Granular Converter

Monday, 6 October 2014 12:00 (15 minutes)

X.Artru(a), I.Chaikovskab(b), R.Chehab(a), M.Chevallier(a), O.Dadoun(b), K.Furukawa(c), H.Guler(b), T.Kamitani(c), F.Miyahara(c), M.Satoh(c), P.Sievers(d), T.Suwada(c), K.Umemori(c), A.Variola(b)
(a)IPNL/IN2P3/CNRS and Universite Lyon-1 (France)
(b)LAL/IN2P3/CNRS and Universte Paris-Sud (France)
(c)KEK, Tsukuba (Japan)
(d)CERN, Geneva (Switzerland)

Promising results obtained with crystal targets for positron production led to the elaboration of a hybrid source made of an axially oriented tungsten crystal, as a radiator, and an amorphous tungsten converter. If the converter is granular, made of small spheres, the heat dissipation is greatly enhanced allowing the consideration of such device for the future linear colliders. A positron source of this kind is investigated. Previous simulations have shown very promising results for the yield as for the energy deposition and the PEDD (Peak Energy Deposition Density). Here, we present detailed simulations made in this granular converter with emphasis on the energy deposition density, which is a critical parameter as learned from the breakdown of the SLC target. A test on the KEKB linac is foreseen; it will allow a determination of the energy deposited in the converter through temperature measurements. Four granular converters, made of W spheres of mm radius have been built at LAL-Orsay; they will be installed at KEK and compared to compact converters. A description of the experimental lay-out at KEK is provided. Applications to future linear colliders as CLIC and ILC are considered.

Primary author: Dr CHEHAB, Robert (IPNL/IN2P3)

Presenter: Dr CHEHAB, Robert (IPNL/IN2P3)

Session Classification: S1: Channeling & Radiation in Crystals

Contribution ID: **9** Type: **Oral**

Future challenges in Multi Petawatt High Repetition Rate Laser System

Thursday, 9 October 2014 15:30 (15 minutes)

The development of the ultrafast laser technology has enabled the generation of laser pulses with peak powers in the 1PW regime, opening up new fields of research and possible applications. Projects have been established to go beyond the 1PW level pushing laser technology to the limit.

Whilst, there have been significant advances in the peak power of laser systems, the repetition rate of high-energy laser systems has limited the possible applications of these systems.

At the Central Laser Facility there are two different interrelated projects to push these limits: the 20PW project and Dipole 100. The 20PW project is aimed at reaching 20PW peak power at a relatively low repetition rate using a novel amplification technique (OPCPA), while Dipole 100 is aiming to obtain laser pulses of 100J at 10Hz.

In this paper these two projects will be presented, focussing on the advantages and limitations for possible applications. The challenges in combining these two goals, obtaining high peak power and high repetition rate, will then be discussed.

Primary author: Dr GALIMBERTI, Marco (Science and Technology Facilities Council)

Presenter: Dr GALIMBERTI, Marco (Science and Technology Facilities Council)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **10** Type: **Oral**

Innovative Technique for the Characterization of Ultra-Short Laser Pulses

Thursday, 9 October 2014 15:45 (15 minutes)

The characterization of the ultra-short high power laser pulses has always been a challenge.
It requires using the same pulse to measure itself because do not exist an event shorter to compare to.
In addition to that, there are also many other difficulties both for the pulse itself (no-linear effects, distortion, etc.) and for the complexity of the set up (alignment, devices, etc.) necessary to perform measurements.
One of the most promising techniques about characterization is GRENOUILLE [1], that simplifies the set up compared to other popular full intensity-phase measurement technique like FROG, SPIDER and others.
This new technique has many advantages: it is considerably more sensitive, extremely simple to set up and align.
It provides us a trace that yields the full pulse intensity and phase, a spectrogram, that involve temporal and frequency resolution simultaneously.
In this poster we present the development of the analysis software for the data acquired by a GRENOUILLE.
This innovative diagnostic program is based on the acquisition of this measurement in the form of experimental image, which will be cleaned up (subtraction of the background) and calibrated before being used in the program so it can be compared to the calculated analytic image.
Starting from an arbitrary pulse, we create a simulated image and we compared it to the experimental data.
By using a minimisation algorithm changing the arbitrary pulse, we minimise the distance between the two images, obtaining the laser pulse shape.
The software will be tested on experimental images acquired in the Front-End at low-power and in the Target Area Petawatt, at full power, at the Vulcan Facility at RAL.

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Primary author: Mr GALLETTI, Mario (Univeristà di Pisa)

Co-authors: Dr GIULIETTI, Danilo (Università di Pisa); Dr GALIMBERTI, Marco (Science and Technology Facilities Council)

Presenters: Dr GALIMBERTI, Marco (Science and Technology Facilities Council); Mr GALLETTI, Mario (Univeristà di Pisa)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **11** Type: **Invited talk**

Laser-Induced Plasma Channels by Nanosecond to Femtosecond Pulses

Thursday, 9 October 2014 16:30 (30 minutes)

The importance of stable and reproducible plasma channels is strongly connected to the need of guiding high intensity laser pulses in different experimental contexts from the remote sensing, to Inertial Confinement Fusion and Laser Plasma Acceleration. In particular, one of the major tasks for the progress of laser acceleration of electrons in plasmas is the guiding of focused pulses along path lengths much larger than the depth of focus. However the propagation of laser pulses in plasmas is accompanied by physical phenomena deeply depending on the pulse duration and intensity, as well as on the chemical composition and structure of the target from which the plasma is produced. Self-focusing and self-phase modulation of the laser pulse, electron relativistic motion, high amplitude self-generated magnetic fields, generation of electron plasma waves with the consequent electron acceleration and the related Betatron Radiation are the major effects to be considered and carefully monitored to improve their comprehension and the consequent control.

Primary author: Prof. GIULIETTI, Danilo (University and INFN, Pisa)

Presenter: Prof. GIULIETTI, Danilo (University and INFN, Pisa)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **12** Type: **Oral**

Ion Acceleration Enhancing from Advanced TNSA Laser–Generated Plasma

Thursday, 9 October 2014 17:45 (15 minutes)

Laser-matter interaction in regime of Target Normal Sheath Acceleration (TNSA) confers to ions energies above 1.0 MeV per charge state. The ion acceleration strongly depends on the laser parameters (intensity, wavelength, pulse duration,⋯), irradiation conditions (spot size, incidence angle, focalization with respect to the target surface,⋯) and target properties (composition and structure).
In order to increase the laser radiation absorption in thin foils, peculiar nanostructures were embedded to induce resonant absorption effects and plasma wave excitation, reducing the reflection and transmission components.
Measurements obtained at about 1016 W/cm2 laser intensity, 1.3 μm wavelength and 300 ps pulse duration demonstrate that, in simple hydrogenated targets, the energy of emitted ions is about 1.0 MeV/charge state, while in advanced absorbed targets the ions energy reaches values as high as 4.0 MeV/charge state. .
The ion energy was measured using different techniques as SiC detectors in time-of-flight configuration, Thomson parabola spectrometer coupled to phosphorous screen and fast CCD streak camera imaging. The obtained results will be presented and discussed.

Primary author: Prof. TORRISI, Lorenzo (University of Messina)

Co-authors: Prof. GIULIETTI, Danilo (University and INFN Pisa); Prof. CALCAGNO, Lucia (University and INFN Catania)

Presenter: Prof. TORRISI, Lorenzo (University of Messina)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **13** Type: **Oral**

Innovative X-Gamma Ray Sources Based on Laser-Produced Plasmas

Thursday, 9 October 2014 18:00 (15 minutes)

Developments in laser technology with regard to infrared and visible light have been a rather fast and fairly easy process, for the availability of technologies capable of producing coherent, brilliant light in those ranges from the very beginning. Not the same fate befell ultraviolet and X-rays light technologies that had been stuck in their initial stage, not so much progressed since the days of their discovery, due to Röntgen towards the end of the nineteenth century. On the other hand, synchrotron light proved to be very interesting for the spectacular properties of brilliance, directionality, monochromaticity, tunability and coherence, which are all together interconnected and make these kind of sources the only capable of working in the X-rays range with so high efficiency and versatility. Behind the process of radiation emission that's realized in the storage rings, there's the presence of magnetic devices, namely bending magnets, undulators and wigglers, which interact with ultra-relativistic electron bunches, accelerating them in radial direction and stimulating energetic and collimated radiation beams. We don't describe exactly what synchrotron facilities actually are, nor we do an overview of the possibilities they offer to their users, but we want to talk about several new X-rays sources, whose mechanisms are in close analogy to those of synchrotrons. Two key points must be clear, in fact synchrotron experience teach us that in order to obtain high quality radiation, with really useful properties, we need a radial acceleration field and relativistic electronic bunches which interact with it. One could think: is it really necessary to put up large buildings, or even use macroscopic magnetic devices to achieve radial acceleration of relativistic charges ? We surely know that the to date developed technologies work well, but new trends in particle acceleration field are taking hold, actually bringing innovative ideas to radiation emission processes on their wake. In particular we're going to focus on the Thomson Scattering and on Betatron Radiation in plasmas. Clearly, the Thomson Scattering has all ingredients for the synchrotron radiation recipe, namely ultra-relativistic travelling electrons transversally accelerated by a counter-propagating electromagnetic field. On the other hand, riding the wave of new acceleration experiences, in which high intensity laser plasma interactions are involved, we can easily imagine, in a not too distant future, to get rid of the LINACs, giving birth to new X-rays Thomson sources that work with the only laser devices. Betatron radiation in Laser-plasma acceleration experiments is the radiation emitted by longitudinally accelerated electronic bunches which interact, in the so-called bubble regime, with an electrostatic ionic radial field, generated by ion charges, in a region deeply depleted of electrons by the high intensity laser ponderomotive forces. Even if its characteristics have been only recently investigated, Betatron radiation seems to be a very promising pulsed source in the X-gamma ray range.

Primary authors: Mr CURCIO, Alessandro (University and INFN Pisa); Prof. GIULIETTI, Danilo (University and INFN Pisa)

Presenter: Mr CURCIO, Alessandro (University and INFN Pisa)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **14** Type: **Poster**

PS2-07: The Radiation from a Charge Moving along a Helical Trajectory with an Arbitrary Cross section

Tuesday, 7 October 2014 17:00 (1h 30m)

We investigate the radiation intensity for a charged particle moving along a helical trajectory with an arbitrary cross section around a dielectric cylinder immersed into a homogeneous medium. The corresponding formulae generalize our previous results for the special case of a coaxial circular orbit. For the latter geometry, under certain conditions for the charge velocity and dielectric permittivity of the cylinder, strong narrow peaks appear in the angular distribution of the radiation intensity in the exterior medium. We discuss the influence of the shift of the charge motion from the circular one on the characteristics of the radiation peaks. As an application of general formulae we consider the radiation from a charged longitudinal oscillator moving along a coaxial circular helix. It is shown that the presence of oscillations essentially influences the radiation intensity compared with the case of synchrotron radiation.

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Presenter: Dr KOTANJYAN, Anna (Yerevan State University)

Session Classification: PS: Poster Session

Contribution ID: **15** Type: **Poster**

PS1-22: CST Simulations of Smith-Purcell Radiation from lamellar and Echelle Gratings for Sub-THz Frequencies

Monday, 6 October 2014 17:00 (1h 30m)

THz frequency region is very challenging part of electromagnetic spectrum for radiation generation and detection because of relatively low maturity level of components and systems that operate in this region. Although situation is improving with more and more advances in the field, much of challenging and exciting potential still remains untapped [1].

Recent advances in generation of short (hundreds of femtoseconds) pre-bunched beams have a potential to generate coherent THz radiation with high signal-to-noise ratio occurring via Smith-Purcell radiation (SPR) from diffraction grating in super-radiant regime. Measurements of frequency locked coherent SPR in sub-THz frequency region were demonstrated in [2, 3]. Currently LUCX accelerator at High Energy Accelerator Research Organisation (KEK) is being upgraded by introducing femtosecond Ti-Sapphire laser system and ultimately it will generate short few tens of femtosecond electron bunches [4, 5].

In this report we present simulations of SPR from gratings of lamellar and echelle profiles, that later on will be used in the experiment at LUCX facility. The simulations are performed in Computer Simulation Technology (CST) Particle Studio (PS) software package. Spectral-angular characteristics of SPR are investigated for various parameters of the gratings: number of periods, groove depth in the case of lamellar grating, groove tilt in the case of echelle grating. The results are compared with the Resonant Diffraction Radiation theory developed in [6]. Frequencies nearing towards 1 THz are considered in the simulations. Characteristics of SPR for micro-bunch beam and beam size effects are investigated.

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6. A.P. Potylitsyn, Smith-Purcell effect as resonant diffraction radiation, NIMA 145 (1998) 60.

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Presenter: Dr LEKOMTSEV, Konstantin (High Energy Accelerator Research Organisation (KEK))

Session Classification: PS: Poster Session

Contribution ID: **16** Type: **Oral**

A Model for the Interaction of High-Energy Particles in Straight and Bent Crystals Implemented in Geant4

Friday, 10 October 2014 10:10 (15 minutes)

Monte Carlo simulations of the interaction of particles with matter are usually done with downloadable toolkits such as Geant4 and Fluka. We present a general model for the simulation of orientational effects in straight and bent crystals for high energy charged particles. It allows the manipulation of particle trajectories by means of straight and bent crystals and the scaling of the cross sections of hadronic and electromagnetic processes for channeled particles. Based on such a model, an extension of the Geant4 toolkit has been developed. The extension of the Geant4 and the model have been validated by comparison with published experimental data.

Primary author: BAGLI, Enrico (FE)

Co-authors: Dr DOTTI, Andrea (SLAC); Dr BRANDT, Daniel (SLAC); Dr WRIGHT, Dennis H (SLAC); Dr ASAI, Makoto (SLAC); GUIDI, Vincenzo (FE)

Presenter: BAGLI, Enrico (FE)

Session Classification: S6: Crystal Simulation Routines for Particle Accelerators: Comparison and Benchmarking with Experimental Data

Contribution ID: **17** Type: **Poster**

PS3-05 Study of the Influence of Defects on Channeling and Volume Reflection with DYNECHARM++

Thursday, 9 October 2014 17:00 (1h 30m)

Various kinds of defects may affect the displacement of the atoms in a crystal. The probability to undergo dechanneling, i.e., to leave the channeling state, rises up because of the presence of dislocations. On the contrary, the deflection efficiency for volume reflection is very much the same as for a perfect bent crystal. In order to simulate the influence of the defects on channeling and volume reflection, a routine has been specifically developed for the DYNECHARM++ toolkit. Because of the strong centrifugal force in the neighborhood of defects, the step size of the integration of particle trajectory has to be small compared to crystal length. As a consequence, the computation of the trajectories of many particles requires an high computational cost.. Thus, a model for the parallelization and the vectorization of the DYNECHARM++ is underway in collaboration with Colfax International, partner of the Intel corporation

Primary author: BAGLI, Enrico (FE)

Co-author: GUIDI, Vincenzo (FE)

Presenter: BAGLI, Enrico (FE)

Session Classification: Poster Session

Contribution ID: **18** Type: **Invited talk**

Channeling for Advanced Electronic Materials Research

Sunday, 5 October 2014 13:30 (45 minutes)

Channeling for Advanced Electronic Materials Research

Leonard C. Feldman*

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History: Ion channeling as applied to electronic materials research dates from the 1970s (1). This development was a fortuitous coincidence of needs and discovery. Classical channeling had reached a peak of understanding with extensive and worldwide experimental research and the theoretical treatment of J. Lindhard. Fundamental experiments required high quality single crystals, most easily found in the electronics community. Channeling applications were an ideal fit to the semiconductor technology needs of the time. Ion implantation was replacing diffusion as the source of dopants. Channeling provided the keys to dopant profiles, dopant atomic sites, and implantation damage annealing. The surface interaction of channeling was recognized and understood more quantitatively. This understanding was applied to the most important materials interface in technology, namely that of Si/SiO2—the material couple that has allowed the miraculous development of Si technology for the last 60 years. Channeling has accompanied silicon semiconductor development to the present day, with studies of strained layers used in current technology, exploration of "alternate dielectrics"and development of semiconductor/dielectric interfaces for III-V/Si semiconductors.

Current status: Two factors drive current electronic materials research: (1) recognition that (plain old) silicon cannot sustain its amazing evolution and (2) silicon cannot do all we desire of a semiconductor device. Ion beam technology continues to contribute to the research addressing these issues, in coordination with many other materials probes. The development of the silicon carbide (SiC) power MOSFETS, discussed in this talk, is one recent example. I will make some comments on the newest ion beam probes at the sub-nano-meter regime—a significant advance in ion beam nano-technology, necessary to contribute to the forefront efforts in materials science.

SiC MOSFETS: Modern technology, particularly energy applications, requires devices that operate at higher voltages and at higher temperatures than can be sustained in silicon. SiC, with its 3.3 eV band gap, compared to silicon, (Eg=1.1eV) is a candidate. The limiting issue for a successful device is the semiconductor/dielectric interface which limits electron transport and mobility. Channeling, along with a myriad of additional electronic and physical probes, has revealed the characteristics and the deficiencies of the critical dielectric/semiconductor interface. Results and improvements have led to a SiC commercial technology creating more efficient energy systems spanning photovoltaic technology to motor drives. .

Reference: (1)"Materials Analysis by Ion Channeling: Submicron Crystallography", L.C. Feldman, J.W. Mayer, S.T. Picraux, Academic Press (1982)

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Presenter: Prof. FELDMAN, Leonard (Rutgers University)

Session Classification: ”CHANNELING PRIMER”

Contribution ID: **19** Type: **Poster**

PS3-15 Modelling the Deflection of 855 MeV Relativistic Electrons by a Bent Silicon Crystal Using TROPICS Software Package

Thursday, 9 October 2014 17:00 (1h 30m)

Modeling the deflection of 855 MeV electrons in (111) the planar channels bent crystal silicon performed by numerically solving the kinetic Fokker–Planck equation in the phase space of the transverse coordinates and velocities. It is shown that the simulation results do not describe the experiment.

Primary author: Mr SHTANOV, Yuriy (Nikolaevich)

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Presenter: Mr SHTANOV, Yuriy (Nikolaevich)

Session Classification: Poster Session

Contribution ID: **20** Type: **Poster**

PS3-06 Observation of Channeling Effects for Relativistic Electrons in a Polycrystal

Thursday, 9 October 2014 17:00 (1h 30m)

Channeling phenomena have been extensively studied using mainly single crystals as targets. In this report, we present experimental results on channeling effects for 255-MeV electrons in a Mo polycrystal. Its applications to beam manipulation techniques and radiation sources are also discussed.

Primary author: Dr TAKABAYASHI, Yuichi (SAGA Light Source)

Presenter: Dr TAKABAYASHI, Yuichi (SAGA Light Source)

Session Classification: Poster Session

Contribution ID: **21** Type: **Oral**

Background X-Ray Scattering in Wavelength Dispersive Absorptiometry

Tuesday, 7 October 2014 12:15 (15 minutes)

The detailed information about x-ray spectrum is of highly importance for the x-ray analysis, especially for a used standardless algorithm. This paper provides a comparison between simulation results and experimental studies of the background X-ray scattering performed for the dual wave x-ray absorptiometry where integral value of the background plays a dominant role. In this case, the scattering background radiation achieves values of the order of the useful signal that leads to undesirable increase in the load of detector [1]. This problem is suggested to solve by reducing the background radiation using wave dispersion scheme and high-speed counters [2]. Experiments were carried out using a scintillation counters based on silicon photomultipliers [3] allowed to achieve the counting rate over 107 of pulses per second, which is highly relevant in terms of increasing the intensity of modern light sources. The simulation results using Monte-Carlo techniques have been obtained using the Geant 4 [4].

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Primary author: GOGOLEV, Alexey

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Presenter: GOGOLEV, Alexey

Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **22** Type: **Poster**

PS3-18 Beam Reflection by Planar and Curved Laser Channels

Thursday, 9 October 2014 17:00 (1h 30m)

Since the first work on the phenomenology of charged beams channeling in the field of aligned crystals the interest of physicists to this feature of the beam motion in solids is defined by the possibilities of beam manipulation that aims in the beam shaping (crystal collimation) as well as in the radiation release (channeling radiation) [1, 2, 3].

Known and recent studies on interaction of charged particles with laser beams have demonstrated that at specific conditions in combined laser fields well defined potential channels, similar to those in crystals by the potential depth and gradient, are formed [4, 5, 6]. These potential channels could be used to trap the charged beams, both relativistic and nonrelativistic, the beams become channeled in the field of standing laser waves.

In this work we are going to report first results on the deflection of charged beams by multichannel laser structure ("laser sandwich"). Studies on the dynamics of charged particles reflection by such a surface multilayer, which consists of multiple parallel laser channels, proves the feasibility of efficient beam reflection not only by the flat surfaces but by the curved ones. We have shown that in the case of curved laser multichannel structure the angle of deflection could much exceed the angel for the flat surface. Our calculations have also revealed the efficient beam filtering by the particles energy.

Finally, in our work we will discuss various applications of new laser technique for beam deflection.

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Presenter: Mr DIK, Alexey (Lebedev Physical Institute of Russian Academy of Science)

Session Classification: Poster Session

Contribution ID: **23** Type: **Poster**

PS1-02: Generation of Electron Excitations by Quantum Channeled Particle in Crystal

Monday, 6 October 2014 17:00 (1h 30m)

In the channeled regime a particle loses its energy to generate the collective and single-particle excitations in the crystal at the same time with the emission of photons. This process is accompanied with transitions of particle from one transverse energy discrete state into another. A theory of energy losses and the corresponding excitation of the crystal for the quantum channeled particle is constructed. The theory generalized for the account of the peculiar properties of the electron Green function for the finite zone width electron-phonon (EP) system, the electron-hole nonequivalence, chemical potential variation with doping, and electron correlations in the vertex function is used for the study the generation of plasmons and electron excitations by channeled particle in the crystal. The frequency, temperature and doping dependent complex mass renormalization , complex chemical potential renormalization , density of electron states have been used to calculate the electron Green function in the excited crystal. The existence of a fixed energy of the plasmon as well as the dependence of the energy levels of the transverse motion of a relativistic particle on the energy make the inevitable situation in which, for some values of transverse energy of the particle the plasmon frequency coincides with the transition frequency of a particle between any two levels of transverse motion in the rest frame of the fast particle. In this case, the particle plasmon generation can strongly perturb the transverse motion of the particle. The usual assumption that the energy loss has little effect on the motion of a particle should be incorrect. Therefore, in this report the probability of generating a plasmon in the case of channel-plasmon resonance is calculated. Such a response leads to the appearance of sharp peaks in the curve of energy loss on the particle energy , fixing that one can directly measure the distance between the transverse levels of cross-motion. The transition probabilities with the change of the quantum level of the transverse motion are investigated.

Primary author: Dr MAZUR, Evgeny (NATIONAL RESEARCH NUCLEAR UNIVERSITY MEPHI)

Presenter: Dr MAZUR, Evgeny (NATIONAL RESEARCH NUCLEAR UNIVERSITY MEPHI)

Session Classification: PS: Poster Session

Contribution ID: **24** Type: **Oral**

Crystal Excitation Features in the Photon Emission Spectra of the Quantum Channeled Particle

Tuesday, 7 October 2014 17:00 (15 minutes)

The mutual influence of the processes of radiation and generation of excitations in the quantum crystal with the channeled particle (electron or positron) is considered. The emergence of new peaks in the emission spectrum of such a channeled particle associated with the processes of simultaneous resonant hard gamma-quantum and plasmon excitation during its motion in the crystal is predicted. The distance between the particle transverse motion levels should be equal to the sum of the photon energy and quantum plasmon energy in the coordinate system associated with the moving particle. Plasmon energy in such a system increases with the Lorentz factor , comparing the characteristic energy depth of the crystal potential well . The energy-momentum conservation laws in the comoving coordinates system are feasible. After the transition to the laboratory coordinate system the plasmon energy $\hbar\omega_{pl}$ is reduced to the values of about 20 eV, while the energy of a photon $\hbar\omega$ emitted within a narrow cone of directions near the angle θ, coaxial with the motion direction of a channeled particle is determinated in accordance with the energy-momentum conservation laws in this process $\hbar\omega = \frac{\Delta E_{\perp} \pm \hbar\omega_{pl}}{1-(v/c)\cos\theta}$.

Essentially, this effect represents the record of the Doppler effect for the process of the simultaneous emission of a photon and a plasmon with the channeled particle. In this case, however, the resulting emission peaks have a large half-width due to the plasmon momentum carryover, in contrast to the conventional channeled particle radiation process without plasmon emission. Thus a cone of the emitted photons undergoes blurring. The probability of the discussed process with the transition of fast particles in the virtual state after the emission of the plasmon and with the subsequent emission of photons is calculated . It is found that the photon-plasmon radiation probability is of the same order order of magnitude with a known standard radiation process probability. The possibility of the experimental observation of the effect is estimated.

Primary author: Dr MAZUR, Evgeny (NATIONAL RESEARCH NUCLEAR UNIVERSITY MEPHI)

Presenter: Dr MAZUR, Evgeny (NATIONAL RESEARCH NUCLEAR UNIVERSITY MEPHI)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **25** Type: **Poster**

PS1-01: Cooperative Parametric (Quasi-Cherenkov) Radiation Produced by Electron Bunches in Natural or Photonic Crystals

Monday, 6 October 2014 17:00 (1h 30m)

We study the features of cooperative parametric (quasi-Cherenkov) radiation arising when an electron bunch passes through a crystal (natural or artificial) under the conditions of dynamical diffraction of electromagnetic waves in the presence of shot noise.

It is shown that the intensity of cooperative quasi-Cherenkov radiation emitted at small angles to the particle velocity direction reaches saturation at a sufficiently smaller number of particles than that emitted at large angles (in two- and three-wave diffraction cases, parametric radiation consists of two and three strong pulses, respectively). The presence of shot noise causes strong fluctuations in the intensity of cooperative parametric radiation at saturation.

A detailed analysis is given for cooperative parametric X-ray radiation in LiH crystals and quasi-Cherenkov THz radiation in photonic crystals.

Primary author: Mr ANISHCHENKO, Sergei (Research Institute for Nuclear Problems)

Co-author: Prof. BARYSHEVSKY, Vladimir (Research Institute for Nuclear Problems)

Presenter: Mr ANISHCHENKO, Sergei (Research Institute for Nuclear Problems)

Session Classification: PS: Poster Session

Contribution ID: **26** Type: **Invited talk**

Synchroron-Cherenkov Radiation Observed in Laboratory Being Predicted in Astronomy

Monday, 6 October 2014 16:30 (30 minutes)

The theory of Synchrotron-Cherenkov Radiation (SCR) is proposed by Rynne et al. in 1978 in the field of Astronomy, but actual radiations have never been observed. We had to wait this observation until a tabletop synchrotron light source (TSLS) was developped. By hitting light materials by energetic electrons under magnetic field in linear accelerator it could be observed, but SCR is hided behind of transition radiation (TR). A tiny target in the TSLS well separated SCR from TR. The observed SCR is more like laser light and quite powerful. In many academic as well as industrial fields not only in Astronomy but also in material science and semiconductor fabrication we will find applications of SCR. I will give introductory talk in this conference.

Primary author: Prof. YAMADA, Hironari (Ritsumeikan University)

Presenter: Prof. YAMADA, Hironari (Ritsumeikan University)

Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **27** Type: **Oral**

Unified Beam Dynamics and Radiation in Potential Channels Formed by Lasers of Arbitrary Polarisation.

Thursday, 9 October 2014 10:00 (15 minutes)

The questions of electron beam-laser interaction form a vast research area involving a great number of scientists all over the world. Thomson scattering, charged particles laser acceleration, laser wakefield acceleration and beam longitudinal phase space manipulation are probably the most popular aspects of laser-beam interaction research.

Nevertheless more and more work these days is devoted to describing charged particles dynamics in the field of crossed lasers [1, 2]. It was shown that such a field could cause charged particles channeling in its periodic potential [3, 4]. Namely, in the region of crossed laser fields interference potential channels parallel to lasers summarized wave vector are formed. Putting aside particles reflection from such a laminate potential, charged particles moving in this region could be either trapped in channeling regime [4, 5, 6], or become quasichanneled if their transverse energy exceeds channel barrier.

Unifying the results provided for different laser polarisations before, the arbitrary polarisation case description will be presented together with the latest results of electron beam radiation modelling in such a system. Also, questions of possible channeled particles acceleration will be discussed.

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Presenter: Mr FROLOV, Evgenii (LPI RAS and NR TPU)

Session Classification: S2: Channeling & Radiation in Various Fields

Contribution ID: **28** Type: **Invited talk**

Quasi-Cherenkov Parametric Radiation in a Photonic Crystal

Monday, 6 October 2014 11:30 (30 minutes)

Parametric X-Ray radiation in natural crystals is well known [1-4]. The similar radiation mechanism arises when a charged particle moves in a photonic crystal [5, 6].

Quasi-Cherenkov parametric radiation in a photonic crystal is considered. The expressions for spectral-angular distribution of quasi-Cherenkov radiation emitted by a relativistic particle traversing a photonic crystal are derived. It is shown that for a relativistic particle, passing through a photonic crystal formed by periodically strained threads, the intensity of quasi-Cherenkov radiation emitted at small angles to the direction of particle motion, as contrasted to ordinary Cherenkov radiation, exhibits anisotropic properties as the photon momentum is rotated about the direction of particle motion (as the crystal is rotated about the direction of particle motion at fixed-angle observation of the outcoming photon).

The intensity of quasi-Cherenkov radiation in terahertz and optical ranges is shown to be high enough to allow the experimental study of quasi-Cherenkov radiation in these frequency ranges.

When passing through a photonic crystal, the particle bunches obtained at acceleration with ultraintense and ultrashort laser pulses [7-9] are promising for the creation of a terahertz radiation source with significant power.

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Primary author: Prof. BARYSHEVSKY, Vladimir (Research Institute for Nuclear Problems)

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Presenter: Prof. BARYSHEVSKY, Vladimir (Research Institute for Nuclear Problems)

Session Classification: S1: Channeling & Radiation in Crystals

Contribution ID: **29** Type: **Oral**

Spectroscopy of Excited X-Ray Radiation Channeling through Micro-Channel Plates

Tuesday, 7 October 2014 12:00 (15 minutes)

Capillary optics is a basic X-ray technology capable to deliver a high flux density with a sub-micrometer spot. This compact optics could be easily used used to guide and shape a X-ray beam characterized by a high intensity, a small spot, a low divergence and high homogeneity. We present here synchrotron radiation soft X-ray experiments performed in transmission with different types of micro-channel plates (MCP). The MCPs we used have a regular structure with a thickness of ~0.3 mm and are made on a SiO2 glass substrate with a hexagonal structure in the transverse cross-section with holey cylindrical channels (pore) of 3 micron in diameter.
X-ray reflection and fluorescence yield spectra have been collected at the exit of different micro-capillary structures under the condition of the total X-ray reflection. The fine structures of x-ray spectra, as well as the angular distribution of the field through microchannels have been analyzed for the energy corresponding to the anomalous dispersion region of the Si L2,3 absorption edge. The propagation of the excited fluorescence x-rays through these capillary waveguides, satisfying the multimode conditions, have been studied with a theoretical model including the transition layer at the surface of the sample.

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Presenters: MARCELLI, Augusto (LNF); Dr MAZURITSKIY, Mikhail (Southern Federal University)

Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **30** Type: **Oral**

Channeling Effect in Polycrystalline Deuterium-Saturated CVD Diamond Target Bombarded by Deuterium Ion Beam

Wednesday, 8 October 2014 10:45 (15 minutes)

At the ion accelerator HELIS [1-4] at the LPI, the neutron yield is investigated in DD reactions within a polycrystalline deuterium-saturated CVD diamond, during an irradiation of its surface by a deuterium ion beam with the energy less than 30 keV. The measurements of the neutron flux in the beam direction are performed in dependence on the target angle, β, with respect to the beam axis. These measurements are performed using a multichannel detector based on He3 counters. A significant anisotropy in neutron yield is observed, it was higher by a factor of 3 at β=0 compared to that at β = ±45. The possible reasons for the anisotropy, including ion channeling, are discussed.

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Presenters: Dr RUSETSKII, Alexey (Lebedev Physical Institute RAS, Moscow, Russia); Dr NEGODAEV, Mikhail (Lebedev Physical Institute RAS, Moscow, Russia)

Session Classification: S4: Charged Beams Shaping

Contribution ID: **31** Type: **Invited talk**

Observation of a Remarkable Deflection of Multi-GeV Electron Beams by a thin Crystal

Wednesday, 8 October 2014 09:00 (30 minutes)

Comparatively little data exists for channeling and volume-reflection of electrons in the 1 to 10 GeV energy range. In this talk I will report on recent experiments at SLAC on channeling and volume reflection of a high-energy electron beam using a 60 micron thick quasimosaic Si(111) crystal. The experiments were done at several beam energies in the range of 3 to above 10 GeV. We have observed deflections of the beam of more than 400 microrad with about 23% efficiency in channeling orientation, while volume-reflection deflects almost the whole beam with 86-95% efficiency by angles close to the Lindhard critical angle. Quantitative measurements of channeling efficiency, surface transmission and dechanneling length were taken for all energies. The amount and precision of the data allow us to investigate the shape of the dechanneling tail function and, thus, investigate the physics of the dechanneling process in some detail. Scattering angles in the non-channeling plane indicate the degree of change of density of the beam electrons at the nuclear positions in the crystal lattice while channeling. I will report on the experimental results and comparison to simulations as well as the plans for successor experiments at SLAC, involving both beam-collimation experiments as well as experiments designed for spectroscopy of the gamma radiation emitted during channeling and volume reflection.

Primary author: Dr WIENANDS, Uli (SLAC)

Presenter: Dr WIENANDS, Uli (SLAC)

Session Classification: S4: Charged Beams Shaping

Contribution ID: **32** Type: **Oral**

Multiple Filamentation of Supercritical UV Laser Beam in Atmospheric Air

Thursday, 9 October 2014 17:30 (15 minutes)

Multiple filamentation of UV picosecond pulses being amplified in hybrid Ti:Sapphire/KrF laser facility GARPUN-MTW was investigated under propagation in atmospheric air over ~100 m. Peak pulse power attained 0.3 TW, which is in 3000 times higher than the critical value (~0.1 GW) for filamentation of 248 nm wavelength radiation. In contrast to 100-fs pulses significant distinctive features (3 times bigger filament diameter, several orders of magnitude lower clamped intensity and electron density, linear whole beam focusing behavior) were observed being probably caused by Resonance Enhanced Multi-Photon Ionization of gas via two-photon resonance excitation of oxygen molecules and stimulated Raman scattering.

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Presenter: Dr ZVORYKIN, Vladimir (P.N. Lebedev Physical Institute)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **33** Type: **Poster**

PS3-22 Two-Elliptic Coordinates for Study the Scattering of Particles in Arbitrary Bent Crystal

Thursday, 9 October 2014 17:00 (1h 30m)

It is well known that main source of orthogonal coordinate systems is a conformal transformation, but the use of analytical functions
for separation of Schrodinger or Helmholtz equations in 2D space is restricted to only 4 coordinate systems: Cartesian, polar, parabolic and elliptic. The first 3 coordinate systems are unique and can be considered as degenerated cases of the last one. In fact, the elliptic coordinate system includes an infinite number of coordinate systems, each of which is generated by one focal distance f.

We show that the combination of several elliptic coordinate systems with different foci is a new unlimited source of orthogonal coordinate systems which can admit the separation of variables for Schrodinger, Helmholtz and similar equations.

The eigenfunctions and eigenvalues are constructed for these systems and compared with Mathieu's. The results are illustrated by classical examples: the vibration of an asymmetrical membrane, asymmetrical quantum pendulum, and particular the problem of scattering of relativistic particles in bent crystals.

Primary author: Dr KOVALEV, Gennady (UofM)

Presenter: Dr KOVALEV, Gennady (UofM)

Session Classification: Poster Session

Contribution ID: **34** Type: **Oral**

Orientation Dependence of Electron-Positron Pair Production in Single Crystals

Monday, 6 October 2014 12:15 (15 minutes)

One of the important problems in today's astrophysics and gamma–astronomy is the construction of detectors for high energy photons (more than 1GeV) with the high angle resolution. In this energy range the dominating effect in interaction of photons with matter is e-e+ pair production.The high angle resolution may be achieved using single crystals as an effective converter of photons into electron-positron pairs,
In this report the cross section of pair production in single crystal is analysed for the ultrarelativistic case. It is shown that this cross section sufficiently increases when the photon is propagating through the crystal under small angles (~ mec2/ħω_ɣ) to the crystallographic axises due to coherent interaction with many atoms simultaneously. This effect can not be considered within the frameworks of a perturbation theory, when the lepton wave functions are the exact wave functions in the continuos potential of the crystallographic lattice. However, if to take into account the possibility for one or the both of leptons to be born in the channeling regime, when their transverse motion is bound to certain axis or plane of atoms, the wave functions of leptons have to be calculated precisely as the decision of Schrödinger equation with averaged channeling potential. It is shown that this mode leads to additional sufficient increase of pair production when photon is propagating through the crystall under the angles less than the crytical Lindhard angle. The angular maximum half-width coincides by an order of magnitude with the the crytical Lindhard angle.

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Presenter: Prof. KALASHNIKOV, Nikolay (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, Russia)

Session Classification: S1: Channeling & Radiation in Crystals

Contribution ID: **35** Type: **Poster**

PS1-03: Single Photon Annihilation of Positrons in the Channeling Regime

Monday, 6 October 2014 17:00 (1h 30m)

It is well known that the energy and momentum conservation laws forbid positron-electron annihilation, producing the single photon only. It can produce two photons in vacuum, or the process is possible with a participation of the third body.
The situation can be essentially changed in a single crystal when one or the both leptons are moving in the channeling regime when the transverse motion of a particle is bound. It appears the possibility of the single photon positron-electron annihilation process, described by the Feynman diagram with the single vertex only. In this report we analyze the different configurations of the single photon positron-electron annihilation process when one or the both leptons are in channeling regime and outline the conditions when the one-photon process may be a source of the high energy gamma-radiation.

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Co-author: Dr OLCHAK, Andrei (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, Russia)

Presenter: Prof. KALASHNIKOV, Nikolay (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, Russia)

Session Classification: PS: Poster Session

Contribution ID: **37** Type: **Poster**

PS2-05: Channeling Radiation of Moderate Energy Electrons in the Presence of Laser Beams

Tuesday, 7 October 2014 17:00 (1h 30m)

Though the influence of the laser field on channeling radiation (ChR) of electrons with energies up to ~100 MeV has been studied quantum mechanically in many works [1-7], nevertheless, up to now there are no experimental results on such effect. With the purpose to accelerate the necessary experiments and developing the results of [8-10] carried out with the help of the methods [11] for nonlinear optics, in this work it is carried out numerical calculations of the spectral distributions of ChR under the influence of laser beams for various parameters of the electron beams (energy, emittance, orientation with respect to the crystallographic planes, etc) and of laser beams (laser photon wavelenth, angle with respect to the electron beam, intensity, etc). In particular, the obtained results (on spectral distributions and their dependence on laser field intensity of ChR under the influence of laser beams) show that the intensity of ChR is increased or decreased in certain regions. It is of interest to study experimentally these variation of the characteristics of ChR for comparison of various theoretical models.

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Session Classification: PS: Poster Session

Contribution ID: **38** Type: **Poster**

PS3-13 Numerical Simulations of Transversal Deflections of Electrons in Tightly Focused Gaussian Laser Beams Necessary for Production of Femtosecond Oscilloscopes and Trains of Attosecond Bunches

Thursday, 9 October 2014 17:00 (1h 30m)

Many recent analytical and numerical calculations show that stable electron acceleration in vacuum and production of attosecond electron bunches are possible only with the help of very high intensity laser beams, while the calculations [1] carried out only in plane wave approximation show that weaker laser beams are required in order to obtain significant transversal deflection of high energy electron beams. Before the construction of femtosecond oscilloscopes and production of attosecond high energy electron pulses which will have wide applications in many fields, in this work the equations of motion of electron beams with various parameters are solved numerically using expressions for various laser beam polarizations [2]. The simulations of the trajectories confirm the results of [1] about the possibility of time domain measurements and production of subfemtosecond electron bunches.

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Session Classification: Poster Session

Contribution ID: **39** Type: **Invited talk**

Channeling, Dechanneling and Focusing of Charged Particle beams in Hollow Laser Beams

Thursday, 9 October 2014 09:30 (30 minutes)

It is given a short discussion of the existing publications [1] devoted to the analytical and numerical study of the motion of electrons in various laser fields as well as a consideration of the complicated expressions of the laser fields and relatively simple expressions which are satisfactory approximations corresponding to the measured intensity profiles of really existing beams. Then developing the considerations of [2] the trajectories of high energy electrons in laser hollow beams (HB) with simple Gaussian intensity distribution and radial and azimuthal polarizations are calculated numerically by solving the equations of motion. It is shown that depending on the parameters of the particle and laser beams the particles can be captured (channeled) in HB, thrown away (dechaneled) from HB and focused at certain distances. The obtained results can find some applications for handling of moderate energy and high energy particle beams.

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Session Classification: S2: Channeling & Radiation in Various Fields

Contribution ID: **40** Type: **Poster**

PS3-23 Hydrogen Atoms Channeling through Carbon Nanotubes

Thursday, 9 October 2014 17:00 (1h 30m)

Using molecular dynamics method with Brenner interatomic potential [1], we studied the channeling of ideally collimated beam of hydrogen atoms (1000 atoms, 100-250eV/atom) through carbon nanotubes (CNT). CNT with diameter of 13.6 angstroms were placed in one plane, parallel to each other at a distance apart 3 angstroms. Hydrogen atoms are directed along the axes of the tubes. During H interaction with CNT a part of H atoms is scattered by the face of the tube, some of them (having undergone one or more collisions inside the tube) are dissipated through the wall, and other part of H atoms is channeled through tubes. We studied these channeled atoms. As results show that these atoms consist of 40-53% of the total number of H atoms.

We have analyzed the angular distributions of H atoms channeled through the tubes. These H atoms are slightly deflected from an initial direction, basically, in the range from 0 to 20 degrees. 20-25% (of total) atoms is scattered in the range from 0 to 1 degree. 20-28% (of total) atoms is scattered, mainly, in the range from 1 to 20 degrees. Distribution is continuous with main peak at 0 degree. With sequential increase of the energy of the incident beam (from 100 to 250 eV/atom), the number of hydrogen atoms channeled through the CNTs is increased, however, the range of scattering angles remained the same - 0-20 degrees.

Setting a screen at some distance (100-1000 angstroms) from the ends of the nanotubes, we got a projection of H atoms on the screen after channeling them through CNT. Diameter of these projections is 10-11 angstroms, which is slightly smaller than the diameter of nanotubes (13.6 angstroms). Diameter of these projections does not depend on the energy of beam (in 100-250eV/atom range). Dispersion of these projections is not significant and the reason of this is the small scattering angles of atoms channeled through the CNTs.

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Session Classification: Poster Session

Contribution ID: **41** Type: **Poster**

PS2-08: X-Ray Polarization Radiation from Electrons Moving through Hole with Variable Radius

Tuesday, 7 October 2014 17:00 (1h 30m)

The nature of polarization radiation is the dynamic polarization of the material by the Coulomb field of passing particles [1]. Depending on the conditions the different types of polarization radiation can occur: Cherenkov radiation (CR), transition radiation, diffraction radiation, Smith-Purcell radiation (SPR) and so on. Sometimes simultaneously two or more mechanisms can take place and then the question arise about the optimal conditions of radiation. For example, in our previous work [2] we showed that in tube with variable radius (SPR+CR) there may occur more intensive sourse in Thz frequence domain then a tube with constant radius (CR). Now we explore the same situation in X-ray range of frequencies and compare relative contributions of Cherenkov and Smith-Purcell mechanisms.

We investigate theoretically radiation in X-ray frequency range in conditions when electrons move inside the hole with variable radius. Because of periodicity the electrons can excite not only CR, but also Smith-Purcell (SPR) radiation along with CR. CR and SPR radiations can serve for noninvasive bunch diagnostics purposes and also as a good sourse of UV and X-Ray radiation, including, e.g., Free-electron laser based on the SPR effect [3]. In our calculations we use the method of polarization current density [1]. Electrons in bunch are considered to be distributed by the Gaussian law. The spectral-angular distribution is investigated for various parametrs of tube and bunch: sizes and frequency of radiation, numbers of strips, energy of electrons. The intensity of radiation from tube with variable radius is compared with radiation from tube with constant radius.

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Session Classification: PS: Poster Session

Contribution ID: **42** Type: **Oral**

Conceptual Design Project:Accelerator Complex for Nuclear Physics Studies and Boron Neutron Capture TherapyApplication at the Yerevan Physics Institute (YerPhI)

Tuesday, 7 October 2014 09:30 (15 minutes)

The final goal of the proposed Project is the creation of a Complex of Accelerator Facilities at the Yerevan Physics Institute (CAF YerPhI) for nuclear physics basic researches, as well as for applied programs including Boron Neutron Capture Therapy (BNCT) and radiation therapy with proton and carbon beams. The CAF will include the following facilities: Cyclotron C70, target/ion source, mass-separator, LINAC1 (0.15-1.5 MeV/u), LINAC2 (15-20 MeV/u). For the energy discrimination of the neutrons will be used Bragg scattering on crystal.

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Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **43** Type: **Poster**

PS3-21 Interaction of Ions with Graphene on a Substrate

Thursday, 9 October 2014 17:00 (1h 30m)

In this paper analyzes the process of dynamic screening of external charges, moving over the surface of graphene disposed on a substrate. We are considered here relatively slow ions with velocities from thermal speeds to Bohr velocity. We explore here the effects of dynamic polarization of graphene on a substrate by ion motion parallel to its surface. We limited the study of the effects associated with the presence of an insulating substrate, such as , with a dielectric constant of . Ishigami et al. [1] have found that the distance h between graphene and substrate is on the order of the distance between graphene layers in graphite or even larger. Only (according to our information) in the paper [2] considered the effects of finite h. Our principal goal was to demonstrate how strong are the effects of finite h on the degree of dynamic polarization of graphene moving ions. This meant the need to include the gap size graphene-substrate as a parameter in modeling phenomena screening graphene. The simulation was performed by molecular dynamics using ReaxFF potential of free package for classical molecular dynamics LAMMPS (Large-scale Atomic/Molecular Massively Parallel Simulator).

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Session Classification: Poster Session

Contribution ID: **44** Type: **Poster**

PS1-25: Enhancing Interference in the Spectrum of Bremsstrahlung on a Composite Target

Monday, 6 October 2014 17:00 (1h 30m)

Interference pattern in the spectrum of non-dipole bremsstrahlung on two amorphous foils is investigated. Apart from suppression at lowest photon energies, there is also an enhancement in the adjacent spectral region, and in classical electrodynamics, the net effect of suppression and enhancement must to be zero. We study the location and origin of the spectral features, comparing predictions of full Molière averaging and Gaussian averaging with Coulomb corrections to the r.m.s. multiple scattering angle. Comparison with experimental data [1], and with previous theoretical predictions is presented.

[1] K.K. Andersen et al., Phys. Lett. B 732 (2014) 309.

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Session Classification: PS: Poster Session

Contribution ID: **45** Type: **Oral**

Multiphoton Effects in Channeling Radiation

Monday, 6 October 2014 15:15 (15 minutes)

Multiphoton spectra for channeling radiation are calculated based on techniques developed in [1], with the addition of averaging over charged particle impact parameters posterior to the calculation of the radiation straggling. Cases of planar and axial channeling in harmonic wells are considered, for which high photon multiplicity approximations for channeling radiation spectra are derived. The corresponding spectral shapes are drastically different from Gaussian. Comparison with experiments [2,3] is made. A method for estimation of the fraction of channeled particles by their radiation spectra is proposed.

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Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **46** Type: **Poster**

PS3-08 Turning of Electron Beam by Pyroelectric Crystals

Thursday, 9 October 2014 17:00 (1h 30m)

Turning of non-relativistic electron beam in the transverse electric field created by pyroelectic crystals is shown experimentally for the first time. The angle of the beam bending is measured and the value of the transverse electric field is estimated. Prospects for application of pyroelectric crystals for steering of particle beams are discussed.

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Session Classification: Poster Session

Contribution ID: **47** Type: **Poster**

PS1-04: Optimal Conditions for Positron Radiation in Crystal Undulators

Monday, 6 October 2014 17:00 (1h 30m)

Though crystal undulators (CUs) were devised long ago, reliable realistic description of their functioning has become possible only after the recent development and experimental validation of the corresponding simulation tool. A thorough numerical analysis of both conducted and suggested experiments reveals limited perspectives of development of electron CUs and stimulates a return to the investigation of the positron case. We demonstrate that both optimal undulator parameters and maximal positron energy exist for the latter. Among other matters, positron energy is limited by the radiation line broadening caused by the longitudinal velocity dispersion. A method of suppression of the latter, allowing to narrow the CU radiation spectrum, is suggested.

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Session Classification: PS: Poster Session

Contribution ID: **48** Type: **Oral**

Development and Test of Germanium Bent Crystals for Channeling Applications.

Friday, 10 October 2014 13:10 (15 minutes)

Most of the experimental knowledge about channeling and related phenomena in bent crystals has been gathered with Si, thanks to its high crystalline quality and mature micro-machining technology. Silicon is not optimized as a far as it concerns the interaction strength with beams since of it's relatively low z-number. We recently demonstrated that germanium can be a concrete alternative. It is nowadays produced in high quality wafer and its machining can be improved by accurate technological development.
We recently demonstrated the fabrication of Ge strips optimized for 400 GeV proton deflection [1].Planar channeling and volume reflection for (110) and (111) planes at various curvatures and axial channeling along [110] was measured by dedicated experiment at H8-SPS [2,3]. We evidenced that strips can perform very close to the limit of a perfect crystal allowing for better efficiency than Si especially at high curvature [3].
In the framework of ICE-RAD INFN project we are developing crystalline bending devices optimized for GeV electrons. We already reach relevant results with Si quasi mosaic crystals [4], and we are now engaging the development of quasi mosaic Ge devices. This is a challenge since negative particles and low energy force the machining procedure to micron scale. We show the production of 15 micron Ge slabs with a record primary curvature radius of 6mm, thanks to the development of innovative fabrication and bending procedures.

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Session Classification: S6: Crystal Simultaion Routines for Particle Accelerators : Comparison and Benchmarking with Experimental Data

Contribution ID: **49** Type: **not specified**

"Crystal Calorimetry"for the FCC and HE-LHC

Recently a start for the 100 TeV p-p Future circular collider (FCC) project was given. Earlier a proton energy increase up to 33/2 TeV began to be studied in the framework of the high-energy phase of the LHC upgrade. The energies of the secondary e± and ɣ will reach many TeVs in the high pseudorapidity regions at both FCC and HE-LHC. The point is that these e±, ɣ energies are high enough to give rise to the drastic increase of the e+-e− pair production and hard ɣ-emission probabilities in oriented crystals related with their synchrotron-like mechanism. The development rate of electromagnetic showers will increase and the length decrease, accordingly, allowing to devise principally new electromagnetic calorimeters (ECAL) of reduced length. The radiation cooling phenomenon will also pronounsly manifest itself at such energies, additionally accelerating shower development and allowing to discriminate e+, e− and ɣ.

Primary author: Prof. TIKHOMIROV, Viktor (Research Institute for Nuclear Problems)

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Contribution ID: **50** Type: **Oral**

Conical Effect in Optical and X-Ray Diffraction Radiation

Monday, 6 October 2014 17:45 (15 minutes)

In this work we consider the radiation from a thin target in X-Ray, optical and lower frequencies regions for two cases: the particle moves in the plane which is perpendicular to the screen; the particle moves in plane which is parallel to the screen. It is the geometry that is important for calculating of horizontal divergence of the bunch. We give analytical description of diffraction radiation. In particular, we obtain the expressions for the spectral-angular distribution and analyse them. It is shown that the radiation for these two orientations of the target is different mainly in direction of mirror reflection to the trajectory of the particle. We derive the condition for obtaining the maximal intensity of radiation and show that if the particle moves at constant distance from the edge of the target and at some angle to the target edge, then the radiation is distributed over a cone surface. This effect is common for cases where the existence of the target edge is important for generation of radiation. For example, the similar effects should arise for transition radiation when the particle crosses the target near its edge.

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Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **51** Type: **Poster**

PS1-26: Influence of Beam Divergence on Form-Factor in X-Ray Diffraction Radiation

Monday, 6 October 2014 17:00 (1h 30m)

In this work the X-Ray diffraction radiation from the bunch with Gaussian distribution of the particles is considered. The expressions for coherent and incoherent form-factors are obtained with taking into account the particles moving parallel to the surface of the target at arbitrary angles to the general direction of the bunch velocity. The quantitative and qualitative changes in the spectral and angular distribution of radiation are analysed.

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Session Classification: PS: Poster Session

Contribution ID: **52** Type: **Oral**

Element-Sensitive Computed Tomography by Fine Tuning of PXR-Based X-ray Source

Tuesday, 7 October 2014 10:00 (15 minutes)

To demonstrate the element-sensitive computed tomography (CT), CT scanning experiments were carried out for several specimens containing strontium using a parametric X-ray (PXR) beam having energies near the Sr K-shell edge of 16.1keV. The three-dimensional distributions of Sr were successfully obtained from the difference between the CT images taken on opposite sides of the absorption edge. The result suggests that the measurement method is effective for elemental analysis of considerably thick samples and could be a method complementary to X-ray fluorescence analysis.

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Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **53** Type: **Oral**

Collective Parametric (Quasi-Cherenkov) Radiation from Quantum Noise

Parametric (quasi-Cherenkov)radiation mechanism utilizes crystal periodicity, which provides Cherenkov condition for wave synchronism with electron beam and, simultaneously, two-wave(or multi-wave) distributed feedback. As result, generation process can develop on shorter “beam - wave” interaction length. This mechanism was proposed earlier as the candidate for XFEL generation [1, 2]. The present work considers dynamics of quasi-Cherenkov radiation, beginning from quantum noise, on the base of dynamics of quantum field creation/annihilation operator. Modified by dynamical Bragg diffraction dependence of intensity on length and other features of collective quasi-Cherenkov radiation are theoretically studied.
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Presenter: Dr BATRAKOV, Konstantin (Institute for Nuclear Problems, Belarus State University)

Contribution ID: **54** Type: **Oral**

Peculiarities of Parametric Gamma-Rays in Condition of Anomalous Transmission

Tuesday, 7 October 2014 12:30 (15 minutes)

Dynamical diffraction theory of the parametric gamma-rays is presented in the current contribution.

Primary author: Prof. FERANCHUK, Ilya (Belarusian State University)

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Presenter: Prof. LOBKO, Alexander (Institute for Nuclear Problems)

Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **55** Type: **Poster**

PS2-17: Nanodiamond Targets for Accelerator X-Ray Experiments

Tuesday, 7 October 2014 17:00 (1h 30m)

In the report we will describe fabrication and characterisation of nanodiamond targets for accelerator x-ray experiments.

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Presenter: Prof. LOBKO, Alexander (Institute for Nuclear Problems, Belarus State University)

Session Classification: PS: Poster Session

Contribution ID: **56** Type: **Oral**

Quasi-mosaic Silicon Crystal Deflectors for LHC Beams (on behalf of UA9 Collaboration)

Friday, 10 October 2014 11:50 (15 minutes)

In 2013-2014, the advanced quasi-mosaic silicon crystal deflectors for UA9/LUA9 Collimation Project were developed and installed in LHC ring. The design of deflectors is based on elastic quasi-mosaicity effect firstly discovered in quartz [1] and later observed in silicon [2]. This effect arises from anisotropic properties of crystal lattice and results in the curving of the normal cross sections of the crystal plate under bending for certain plate cuts respect to crystallographic axes. In dependence on specific plate cut and plate bending radius, the achievable deflection angles for high energy charged particle beams change from zero to several hundred microradians. This range satisfies requirements to crystal deflectors in beam collimation problem at SPS and LHC energies. The hystory, theory and main recent results [3,4,5] obtained with quasi-mosaic crystals will be reviewed.

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Session Classification: S6: Crystal Simultaion Routines for Particle Accelerators : Comparison and Benchmarking with Experimental Data

Contribution ID: **57** Type: **Oral**

Similarity Between Synchroton Radiation and Photons Leaving Bent Optical Fibers

Thursday, 9 October 2014 10:30 (15 minutes)

Synchroton radiation and light escaping a bent optical fiber are very similar. In both cases the photons are emitted at some impact parameter (IP) away from the electron trajectory or from the fiber. The IP profile is a Airy function, the fringes of which are interferences between two emission points. Optical systems for observing these fringes are suggested.

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Session Classification: S2: Channeling & Radiation in Various Fields

Contribution ID: **58** Type: **Poster**

PS2-06: Radiation of Relativistic Electrons in a Periodic Wire Structure

Tuesday, 7 October 2014 17:00 (1h 30m)

The interaction of relativistic electron field with periodic wire structure was considered theoretically in [1] for semi-infinite wire structure. We present in this work the experimental investigation of the interaction of relativistic electron field with periodic wire structure. The used target represented the right triangular prism. The measurements were done in millimeter wavelength region (10-40 mm) on the relativistic electron beam with energy of 6.2 MeV in far-field zone. Cherenkov radiation characteristics from sandwich wire target was compared with radiation characteristics from dielectric target in the similar geometry of experiment [2] and with backward transition radiation from flat wire structure.

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Session Classification: PS: Poster Session

Contribution ID: **59** Type: **Poster**

PS1-12: Coherent Diffraction and Cherenkov Radiation of Relativistic Electrons from a Dielectric Target in the Millimeter Wavelength Range

Monday, 6 October 2014 17:00 (1h 30m)

The diffraction and Cherenkov radiation have been observed in the millimeter wavelength range from 8 to 30 mm emitted by bunched electron beams of 6.1 MeV passing near a Teflon target. The radiation intensity at wavelength mm is enhanced by a factor in comparison incoherent radiation, the value of this factor equal to the number of electrons in the bunch. Properties of the radiations have been experimentally investigated in far-field zone. The angular distributions of the observed radiation at various angles of rotation target show an interference of diffraction radiation an Cherenkov radiation in total yield. The simple geometry of experiment is useful for a test of different theoretical models of diffraction and Cherenkov radiation in dielectric targets. The comparison of experimental results with the model of polarization currents is done.

The work was partially supported by the RFBR grant No. 14-02-31642-mol_a.

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Session Classification: PS: Poster Session

Contribution ID: **60** Type: **Poster**

PS2-10: Peculiarities of the Oscillations of Electromagnetic Field of a Charged Particle Rotating About a Metallic Ball

Tuesday, 7 October 2014 17:00 (1h 30m)

Some characteristic features in the electromagnetic field of a charged particle uniformly revolving along an equatorial orbit around a metallic ball has been studied. The obtained numerical results are based on the corresponding exact solutions of the Maxwell equations. They have been derived in [1,2] by means of the Green functions method, and earlier in [3] for special cases when the revolving particle is either non relativistic or ultra relativistic. In these solutions there are no limitations on the value of dielectric permittivity of the ball material.

In the present work the results obtained in [1-3] are supplemented by new non-trivial conclusions. Namely, it is shown that (i) if the particle revolves at small distance from the surface of metallic ball, it may generate high power oscillations of electromagnetic field localized near the ball-vacuum interface, and (ii) at large distances from the particle trajectory, these surface oscillations of electromagnetic field are accompanied by intense quasi-monochromatic radiation.

A visual explanation of this effect is given and its possible application for generation of surface plasmons in spasers [4] is discussed.

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Session Classification: PS: Poster Session

Contribution ID: **61** Type: **Oral**

Coherent Radiation of Relativistic Electrons in Dielectric Fibers

Monday, 6 October 2014 17:00 (15 minutes)

The usefulness of a radiation of relativistic electrons in optical fibers in beam diagnostics was proposed by X. Artu at the symposium RREPS-11 (see also [1]). In this work the properties of different types of radiation, such as diffraction and Cherencov radiation, induced in fibers by an electromagnetic field of relativistic electron were considered. We present in this report the results of experimental investigation of this phenomenon in millimeter wavelength region in coherent condition. The nature and properties of radiation in fibers was analyzed experimentally for different geometries of fiber position in respect to the electron beam. The radiation in flexible fiber was investigated as a function of curvature radius of the fiber. The role of surface waves in the radiation transport in fibers was experimentally analyzed on the real photon beam.

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Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **62** Type: **Poster**

PS2-21: Comparison of One- and Two-Crystals Schemes for Dual Wave X-Ray Absorptiometry

Tuesday, 7 October 2014 17:00 (1h 30m)

Nowadays X-ray absorptiometry is widely used in the X-ray structural analysis [1]. Moreover, this approach can be applied to elemental analysis of substance [2]. Another important applied task in which X-ray absorption approach is used is content control of components in media containing limited number of fractions, e.g. composition control of two- and three-component media that industry needs [3]. The authors have proposed the method of dual wave x-ray absorptiometry [4] which means absorption factors analysis in two X-ray spectral lines. Since the primary radiation, which penetrates an investigated object and weakens in a varying degree depending on component composition of the object, is information carrier, the main limiting factor for sensitivity of the method is registered X-ray beam intensity. Two approaches can be used to increase the intensity. The first one is concentrating X-ray optics such as multicapillary half-lenses. Besides, use of optics makes it possible to carry out analysis with lower current of the source and therefore extend its lifespan. The second approach is optimization of X-ray monochromatization scheme. In this report possibility of multicapillary optics use for increased initial X-ray beam intensity is reviewed and comparison of the one- and two-crystals monocromatization schemes is made.

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Session Classification: PS: Poster Session

Contribution ID: **63** Type: **Oral**

CRYSTAL Simulation Code and New Coherent Effects in Bent Crystal at the LHC

Friday, 10 October 2014 12:30 (15 minutes)

Both long-lasting UA9 studies and coming Large Hadron Collider collimation and extraction experiments strengthen the need to develop reliable codes for the modelling of the proton interaction with bent crystals.

A CRYSTAL simulation code [1] for particle tracking in crystal is introduced. Its essence consists in both adequate and fast evaluation of proton trajectories in crystals with all the peculiarities of incoherent scattering in order to provide correct predictions for the wide range of charged particle energies up to 7 TeV and above.

The new effects of dechanneling peaks in the deflection angle distribution and of excess of the amorphous level of ionization losses in the channeling mode will be observed for the LHC case.

The dechanneling peaks appear due to the continuously conserving phase correlations of transverse motion of near-barrier channelling particles which dechannel mainly after their scattering near the atomic planes where the nuclei and electron densities are high. These particles give rise to the peaks in angular distribution if the typical inter-peak separation angle exceeds the r.m.s. Coulomb scattering angle at the crystal length. This condition is easier to satisfy when crystal bending radius does not exceed much the critical crystal bending radius. Since this situation is typical for the LHC 7 TeV case, the dechanneling peaks were accidentally found in the simulations. At the same time, as is known, such peaks have not been observed in the multiple SPS experiments conducted earlier [2]. Nevertheless, we found them at 400 GeV, when the tested crystal curvature was increased.

The second effect of the excess of channelling particle ionization losses over the amorphous level arises at highest amplitudes of channeling oscillations. This effect arises at the close approach of particles to the crystal planes where the electron density and local ionisation loss rate are high and reaches observable values due to the nuclear dechanneling length increase at the LHC energy.

A comprehensive study of the 7 TeV beam deflection peculiarities is provided. In addition the single-pass deflection efficiency of the channeling mode is compared with the multiple volume reflection in one bent crystal effect and its modifications [3] for different angular divergences of the incident beam.

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Session Classification: S6: Crystal Simultaion Routines for Particle Accelerators : Comparison and Benchmarking with Experimental Data

Contribution ID: **64** Type: **Oral**

Focusing of High Energy Particles with the Help of Bent Single Crystal.

Wednesday, 8 October 2014 12:45 (15 minutes)

The mathematical description of focusing of high energy paricles with the help of bent single crystals are presented. The obtained quations describe the transformation of two dimensional phase volume of beam at its motion in a focusing crystal. The carried out measurements of focusing are discussed. The experimental results are compared with our calculations. The possible applications of crystal focusing are considered.

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Session Classification: S4: Charged Beams Shaping

Contribution ID: **65** Type: **Poster**

PS1-07: Simulation of Positron Energy Spectra Generated by Axial Channeling Radiation of GeV Electrons in a Thick Tungsten Single Crystal

Monday, 6 October 2014 17:00 (1h 30m)

Positron production based on the generation of channeling radiation by relativistic electrons channeled along the <100> axis of a W crystal and the subsequent conversion of radiation into e+e−pairs in an amorphous tungsten target is described. Electron dechanneling is considered by solving of the Fokker-Planck equation which describes the passage of axially channeled electrons through a thick single W crystal. The calculation takes into account the diffusion in the transverse energy and angular momentum due to multiple scattering by electrons and thermal vibrations of nuclei. Diffusion coefficients and characteristic dechanneling length in W is given and the dechanneling function obtained as the result of numerical solution of the Fokker-Planck equation. The trajectories, velocities and accelerations of axially channeled electrons are obtained by solving the classical equation of motion. In the framework of classical electrodynamics, the spectral-energy distribution of radiation is obtained from the Fourier transforms of realistic electron trajectories, velocities and accelerations within the W crystal. The calculations of channeling radiation and dechanneling are carried out by means of our Mathematica codes. The conversion of the calculated radiation into e+e−pairs in an amorphous W target has been simulated by means of the GEANT4 package. Positron energy spectrum resulting from the conversion of CR generated in the <100> W radiator is presented and compared with the (100) W planar radiator.

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Session Classification: PS: Poster Session

Contribution ID: **66** Type: **Oral**

Manufactuing of Advanced Laue Optics for Gamma ObservationS (LOGOS)

Wednesday, 8 October 2014 13:00 (15 minutes)

X- and ɣ-ray detection is currently a hot topic for a wide scientific community, spanning from astrophysics to nuclear medicine. However, lack of optics capable of focusing photons of energies in the energy range 0.1-1 MeV, leaves their detection to a direct-view approach, resulting in a limited efficiency and resolution. The main scope of the INFN-LOGOS project is the development of technologies that enable manufacturing highly performing optical elements to be employed in the realization of hard X-ray lenses. Such a lenses, typically named "Laue lenses", consist of an ensemble of crystals disposed in concentric rings in order to diffract the incident radiation to the focus of the lens, where a detector is placed.
The possibility to realize an efficient Laue lens is strongly dependent from the quality of its components. In the last years various crystals types were proposed as optical elements for a Laue lens. Nevertheless, their performance have not allowed the construction of an efficient Laue lens so far. Crystals having curved diffracting planes (CDP) are very promising for high-performance Laue lenses. In fact, they allow the concentration of a large fraction of the incident X-rays. Furthermore, crystalline anisotropy can be exploited to shape the crystal into a focusing element. In fact, for particular lattice orientations, a primary curvature imparted to a crystal slab result in a secondary curvature in a different lying of planes. The phenomenon, known as quasi-mosaicity [3], allows the combination of a high diffraction efficiency, occurring in the interaction with the curved lattice planes, and a focusing effect. This technology enables a diffracting element to have a smaller diffraction spot, thus leading to an increased resolution for a Laue lens employing these objects.
The INFN-LOGOS project aims at the realization of intrinsically bent silicon and germanium crystals exploiting the quasi-mosaic effect for focusing hard X-rays. Crystals manufacturing relies on a proper revisitation of techniques typically employed in silicon micromachining, such as thin film deposition and patterning or ion implantation.

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Session Classification: S4: Charged Beams Shaping

Contribution ID: **67** Type: **Oral**

Diagnostics of Polycrystals Using Polarization Bremsstrahlung from Relativistic Electrons in Backscattering Geometry

Monday, 6 October 2014 17:30 (15 minutes)

Polarization bremsstrahlung (PB) appears as a result of scattering of a relativistic particle Coulomb field on atoms. The PB spectrum contains Bragg coherent peaks when the particle moves in a structured medium. The position of the peaks is determined by the distance between crystallographic planes, which makes it possible to determine the parameters of the lattice similarly to XRD methods. The spectral width and position of the peak are determined by the angle between the particle propagation direction and the direction of PB observation. The width of the peak has a minimal value at about 1-10eV in the case when the PB signal is detected in the opposite direction to the direction of particles velocity. This circumstance allows measuring the parameters of the lattice with accuracy better than 0.1%.
The presented work presents the results of PB spectra measurements in backscattering geometry at interaction of a 7MeV electron beam with Al, Ni, Cu, Nb, Mo, Ag and W polycrystalline foils. The results show the possibility to use PB to develop a new energy dispersive method for diagnostics of the atomic structure of the medium.

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Presenter: Dr KUBANKIN, Alexander (Belgorod National Research University)

Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **68** Type: **Poster**

PS3-10 Channeling of Fast Ions in Nanotubes with Weak Chaotic Curvature

Thursday, 9 October 2014 17:00 (1h 30m)

A great number of papers are devoted to theoretical investigation of the atomic particle channeling in nanotubes. As a rule the nanotubes with ideal structure are considered for which thin effects connected with the scattering on atoms and electrons are taken into account. Actually the real nanotubes always have imperfections one of them is their curved shape. In this work we attempt to simulate the random curvature of the tubes within the framework of the theory of random processes. The continuous potential approximation are used for describing the interaction of particles with the walls of the nanotubes. Effect of curvature of the tube on the motion of channeled particles was taken into account by introducing an effective force of inertia, which is determined by the local curvature of the tube at the current value of the longitudinal coordinates. When correlation length is much smaller than the characteristic distance at which in the absence of random deviations the ion trajectory significantly changing, one can go to the kinetic description of ion motion in the transverse plane.

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Session Classification: Poster Session

Contribution ID: **69** Type: **Poster**

PS1-06: Asymmetry in Generation of Near-surface X-rays by 33 MeV Electrons at Grazing Interaction with Thin Si Plate in Magnetic Field

Monday, 6 October 2014 17:00 (1h 30m)

The effect of asymmetric near-surface X-rays generation, observed recently at a grazing interaction of 33 MeV electrons with a 56 μm Si plate placed along the electron beam in a goniometer into the betatron chamber in a magnetic field, is presented. The evolution of the angular patterns of X-rays generated when changing the orientation of the Si plate relative to the electron beam showed preferential generation of the radiation on the surface of the Si plate, which was outside with respect to the center of the accelerator. At grazing incidence of electrons on this surface of the Si plate, the additional radiation emitted along the surface in the cone, which is several times narrower than that of ordinary bremsstrahlung, was observed. At grazing interaction of electrons with the Si plate surface, facing towards the center of the accelerator, the generation of the near-surface radiation was not observed.

In the formation of the observed effect the surface effects for photons and electrons (such as photon emission, reflection and diffraction, as well, the electron diffraction and/or channeling) together with the influence of the magnetic field of the accelerator on the electron motion may be responsible. That influence may create on the outer surface of the Si plate a specific periodic "jumping" motion of electrons because the magnetic field can return back the electrons reflected from the Si plate. At the surface facing towards the center of the accelerator such a quasiundulator motion of electrons is impossible because the electrons reflected from the Si plate are immediately deflected from this surface by the magnetic field of accelerator.

In [1] it was shown that such a magneto-crystalline undulator can be realized with periodicity until micron region. The frequency and intensity of radiation from the magneto-crystalline undulator can be estimated using the corresponding formulas of the theory of radiation generated in ordinary magnetic undulator, which takes into account the Doppler effect and the coherent summation of radiation from different parts of the particle trajectory formed by magnetic field and by the average fields of the atomic planes or axis. In the case of high-energy electrons or positrons and strong enough magnetic field the radiation generated in magneto-crystalline undulator can be in the range of X-rays. But, in our case of 33 MeV electrons the radiation by this mechanism is very soft and such magneto-crystalline undulator can give additional components in the overall distribution of X-rays only due to multiple interactions of returning electrons with crystal surface. The comparison of the magneto-crystalline undulator, a deformed crystal undulator [2] and a multicrystal undulator [3] consisted of a periodic set of ultrathin crystals with thicknesses of half period of trajectories of channeling particles is carried out.

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Session Classification: PS: Poster Session

Contribution ID: **70** Type: **Poster**

PS2-19: Analogue of Anomalous Reflection of X-Rays from Rough Surface in X-Ray Transition Radiation

Tuesday, 7 October 2014 17:00 (1h 30m)

The phenomenon of anomalous reflection of X-rays, i.e. origination of non-mirror peak of angular spectrum of scattered radiation from rough surface near angle of total reflection, was discovered about fifty years ago [1]. The same phenomenon was discovered for thermal and diffusive Compton-scattered gamma-rays as well [2]. Later works demonstrated that when grazing angle is close to angle of total reflection, the fact that the crest of wave field is located at the boundary of two medias leads to non-symmetrical profile of angle distribution [3,4].

For being present a lot of modern researches have something to do with the problem of wave scattering from rough surfaces. In most of them numerical methods of solution are used (as Monte-Carlo modelling). However, even such accurate methods like Monte-Carlo do not reveal the anomalous behaviour described above, probably because the theory which it is based on [5] was not completed, or because of having comparison with not appropriate experimental data [6].

In this report we present both theoretical and mathematical theory of X-ray transition radiation in conditions that lead to the anomalous reflection. This theory is of practical interest in the channelling phenomena of charged particles. Capillary systems are well-known to have non-ideal inner surface that could lead to the phenomenon discussed in this report, especially if the process of channelling is long. The non-symmetrical profile of angle distribution in this case is a potential source of extra radiation that can be caught by capillary the same or the other channel and therefore may increase the intensity of the radiation channelled.

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Session Classification: PS: Poster Session

Contribution ID: **71** Type: **Poster**

PS1-11: RADCHARM++: a Software to Simulate Electromagnetic Radiation Generated by Relativistic Electrons and Positrons in Crystals and Complex Structures

Monday, 6 October 2014 17:00 (1h 30m)

When relativistic electrons and positrons transverse a medium bremsstrahlung radiation is emitted. The anisotropy of a crystalline medium can modify the dynamics of the charged particles and so the photon emission. Indeed, if the angle between a charged particle and crystalline planes or axes is small, the particle suffers a series of correlated collision with atoms in the same plane or row, i.e. coherent interaction, and its dynamics can be described by the continuous planar or axial approximations [1]. This results in an increase in radiation generation compared to the case of the Bethe-Heitler process.
The analytical theory of coherent bremsstrahlung [2] and channeling radiation [3,4] can describe well the process of radiation generation in crystals for some special cases. However, the treatment of complex situations requires the usage of a general approach.
In this report we present a Monte Carlo code named RADCHARM++ to simulate the e. m. radiation emitted by electrons and positrons in crystals and complex structures. RADCHARM++ is an expansion of the DYNECHARM++ code [5]. The model for the computation of radiation generation [6] is based on the direct integration of the quasiclassical formula of Baier and Katkov [7]. Such approach allows taking into account real trajectories, and so the contribution of incoherent scattering, which is very important in many cases, for instance for channeling of electrons.
The generality of the Baier-Katkov operator method permits to simulate the electromagnetic radiation emitted by e± in very different cases, e.g., straight, bent and periodically bent crystals, and for different beam energy range, from sub-GeV to TeV.

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Session Classification: PS: Poster Session

Contribution ID: **72** Type: **Invited talk**

Spectral Characteristics of Radiation from Thomson and Compton Scattering of an Intense Laser Field by Relativistic Electrons

Thursday, 9 October 2014 09:00 (30 minutes)

The mechanisms of Thomson and Compton scattering under linear and nonlinear interactions between relativistic electrons and counter propagated intense laser wave are considered. The quantum consideration of the Compton scattering process allows to calculate a probability of a few successive collisions k of an electron with laser photons accompanying by absorption of n photons (nonlinear regime for n more than unit) when the number of collisions and the number of absorbed photons are random quantities. The cross-section of the nonlinear Thomson scattering process was obtained from the classical formula for intensity using the Planck's law. An electron interacts with a few laser photons subsequently, emitting a "hard photon"in each collision if a laser pulse intensity is high enough (multiple Compton scattering process, MCS) [1]. A mean number of emitted photons κ is determined by a luminosity of the MCS process and its cross-section. We have showed that spectra of emitted photons can be described by the classical Thomson formula if the condition $4\kappa\gamma\hbar\omega/E \ll 1$ (γ is Lorentz-factor, $\hbar\omega$ is energy of laser photon, E is electron rest energy) is fulfilled. In opposite case one has to use the Compton cross-section formula.
We developed an approach based on Monte-Carlo technique allowing to simulate spectral distributions of photons emitted into a narrow aperture for both linear and nonlinear MCS processes. In contrast with other models we took into account a multiplicity of collisions of an electron with laser photons and showed that monochromaticity of radiation is worsening due to such a reason. In each collision an electron loses an energy during emission process and a subsequent photon will have an energy less than the first one (in the average).
For modern projects (such as the ELI-NP [2, 3]) the average number of emitted photons by each electron can enhance the value $\kappa \geq 1$.
For typical parameters of the ELI-NP project (κ = 1.1, the electron energy 720 MeV (γ = 1409), acceptance angle 0.1 mrad) we have simulated the spectral line shape and found that the line has a "tail"of soft photons (about 20% from the total number of photons accepted into an aperture). Such an effect should be taken into account for design of monochromatic gamma-beam.

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Session Classification: S2: Channeling & Radiation in Various Fields

Contribution ID: **73** Type: **Poster**

PS3-20 Influence of Carbon Nanotube Walls Elastic Waves on Slow Particles Channeling

Thursday, 9 October 2014 17:00 (1h 30m)

Slow particles channeling in carbon nanotubes (CNT) is applicable to physical vapor deposition processes (PVD), ion beam assisted deposition (IBAD), focused ion beam (FIB) modification of thin film materials and driving of ion beam. Slow moving channeling particles in CNTs may excite elastic waves of the nanotube walls [1]. We provide molecular dynamic simulation of 100 eV Ar+ ion channeling in single wall CNT with similar diameters but different chiralities (10,10), (11,9) and (17,0). Ions starts from axis with angles 10-30° relatively to axis of nanotube. Scanning in the azimuthally angle was provided. It is possible, that velocity of elastic wave propagation and the particle's velocity match when the last one moves under high angle to the nanotube axis. The phase of channeling particle trajectory in the carbon nanotube determines its interaction with elastic deformation of CNT wall. This fact leads to decreasing particle energy losses in scattering with carbon nanotube. Decreasing energy losses in 1.5-3 times provides increasing traversed path of the channeling particle. Discovered regularities can applied in low energy ion beam driving devices engineering.

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Session Classification: Poster Session

Contribution ID: **74** Type: **Oral**

The Effect of Space Dispersion on Polarization Field at Channeling in Nanotube

Wednesday, 8 October 2014 10:30 (15 minutes)

The paper is devoted to analysis of influence of spatial dispersion on a point charge imagination near a surface of a dielectric or a metal. The charge imagination sufficiently well describes the polarization field which occurs near a surface in the presence of the external point charge. Usually, in classical electrodynamics (see, e.g. [1]), this problem is solved without taking into account the spatial dispersion. As a rule, in this theory the maximal bond energy between the external charge and the image tends to infinity when the charge tends to the surface. We try to investigate which significant corrections should be made if the medium obey the spatial dispersion. Consider first the calculation of the interaction of a point charge with an uniform semi-infinite dielectric medium with a flat surface, based on the concept of the surface elementary excitations of electric type (field of surface plasmons). In this case, we go beyond the classical electrodynamics. At small distances of the order of de Broglie wave length of electrons on the Fermi surface of a solid the image charge isn't point (in opposite to the external charge). It is displaced in the volume with the characteristic size of de Broglie wave length. In particular, within the model dielectric permeability approach with the cut-off in the momentum space the potential energy of interaction between the external charge and the image obeys the regular behavior. In the neighborhood of the minimum the potential has a more complex behavior than it can be anticipated. In particular, the first derivative in the normal direction don't equal to zero at the boundary. Consider now a case of a dielectric/metal tube. In this case we assume the external point charge is moving with the constant velocity in the inner part of a tube parallel to the tube's axis. At the presence of spatial dispersion, when the Fourier components of the dielectric function depends on the all components of the wave vector, the expressions should be changed. Here we will present a some general consideration. But within an used simplest dispersion model with the cut-off we could transform the cut-off in the wave vector space into an equivalent cut-off in the angular momentum space. Therefore to any critical wave vector correspond the appropriate critical angular momentum. This angular momentum depends on the distance from the tube's axis. The momenta which exceed the critical value, should be excluded from calculations of the polarization potential as in the inner as well as in the outer part of the tube. In result the image charge should be the more smooth the less the radius of a tube.

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Session Classification: S4: Charged Beams Shaping

Contribution ID: **76** Type: **Oral**

Transition Radiation Formed on a Smoothly Varying Boundary Between a Medium and Vacuum: Exact Solution of the Problem

Monday, 6 October 2014 17:15 (15 minutes)

The radiation generated by a charged particle uniformly moving along Z axis is studied under assumption that the particle first travels inside a semi-infinite homogeneous medium (range ...), then passes an intermediate layer of inhomogeneous matter (...) and eventually to vacuum (...). Inside the intermediate layer the homogeneous medium (...) smoothly transforms into vacuum (...).

Spectral-angular distribution ... of the energy of radiation in vacuum (...) at large distances from the boundary between the matter and vacuum is derived. Two cases are studied when the charged particle is flying from the homogeneous medium (...) to vacuum and back, - from vacuum to medium. The obtained expressions for ... are based on corresponding exact solutions of the Maxwell equations with no limitations on amplitudes and profiles of variations of the dielectric permittivity ... and magnetic permeability ... of the matter inside the intermediate range ... (except that ... and ... are to be smooth functions of z).

The obtained final expression for ... is compared with the known approximate expressions (see, e.g., [1,2]) for the spectral-angular distribution of radiation. The final expression for ... at ... transforms to the spectral-angular distribution of transition radiation formed at the sharp interface between medium and vacuum [1,2].

Some characteristic features of the function ... due to the presence of a smoothly varying boundary between the medium and vacuum are revealed. A visual explanation of these peculiarities is given and its possible practical application is discussed.

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Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **77** Type: **Oral**

Interference Effects in the Radiation of the Relativistic Electron in the Structure of "Amorphous Matter Layers - Single Crystal"

Tuesday, 7 October 2014 17:15 (15 minutes)

In the present work a theory of coherent radiation of a relativistic electron moving at a constant speed in a combined target, consisting of several amorphous matter layers and a monocrystalline layer is built. The expressions describing the amplitudes of diffracted transition radiation (DTR) and parametric X-ray radiation (PXR) are derived in the framework of two-wave approach of the dynamic diffraction theory. The cases of the one and two amorphous substance layers in the structure were considered. Also the extreme case is investigated, when vacuum is considered as the second amorphous layer in the structure. The expressions obtained describe a spectral-angular distribution of DTR, PXR and theirs interference in such a structure. The X-Ray wave generation and propagation processes in crystalline layer are considered in Laue scattering geometry for the general case of asymmetric reflection. The expression of DTR spectral-angular density contains the summands describing the contributions of the transition radiation (TR) on surfaces of amorphous layer and on the boundary of vacuum-crystal, and their interference.
The possibility of substantial increase of the DTR spectral-angular density because of constructive interference of TR waves generated on the above mentioned boundaries is shown.

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Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **78** Type: **Poster**

PS1-19: Influence of the Divergence of Ultrarelativistic Electron Beam on Spectral-Angular Characteristics of Coherent X-Radiation Generated by it in a Single-Crystal Target

Monday, 6 October 2014 17:00 (1h 30m)

The dynamical theory of coherent X-ray radiation generated in a single-crystal target by the beam of relativistic electrons with a finite divergence is developed in the scattering geometry Laue. Coherent X-ray emission is considered in the general case of asymmetric reflection of the Coulomb field of the electron in the form of two emission mechanisms contributions: of the parametric X-ray radiation (PXR) and diffracted transition radiation (DPI). The averaging method of the radiation cross section by the angular distribution of electrons in the beam is used. The influence of the electron beam divergence on the spectral and angular characteristics of coherent radiation is studied. The dramatic difference of the effects of electron beam divergence in PXR and DPI is shown. The possibilities of practical use of DPI from single-crystal target for indication of beam divergence of the ultrarelativistic electrons are investigated.

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Session Classification: PS: Poster Session

Contribution ID: **79** Type: **Poster**

PS1-13: X-Ray Cherenkov Radiation: Theory Limitations and Inconsistency of Experimental Results

Monday, 6 October 2014 17:00 (1h 30m)

The Cherenkov radiation (ChR) is generated in the soft X-ray region in the vicinity of the absorption edges, where the well-known Cherenkov condition is fulfilled [1]. This X-ray ChR peculiarity can be useful for different applications such as development of the compact, narrow-band, and intense soft X-ray sources [2, 3]. Authors of the experiments [3, 4] have measured the X-ray yield in the vicinity of Cherenkov angles $\cos(\theta) = 1/(n\cdot\beta)$ (n is the refractive index, β is the particle relative velocity) and showed the reasonable agreement with a model based on classical theory of transition radiation [5]. From our viewpoint such an approach is insufficient and the model used is inconsistent. We show that the process of the X-ray ChR should be described using more universal theory [6], where the origin of the radiation field is a polarization current induced in a bulk of the medium by Coulomb field of the initial particle. We compare the results obtained by our approach with previous ones and show that there are contributions from ChR and transition radiation for the experimental conditions [2-4].

The work was partially supported by the RFBR grants No. 14-02-31642-mol_a and No. 14-02-01032-A.

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Session Classification: PS: Poster Session

Contribution ID: **80** Type: **Poster**

PS1-23: Coherent Radiation from Bunch Sequences: Theory Background

Monday, 6 October 2014 17:00 (1h 30m)

Nowadays the electron micro-train beams are useful for different applications such as multibunch resonant plasma wakefield acceleration [1], particle acceleration by stimulated emission of radiation [2], generation of intense coherent electromagnetic radiation [3, 4] and etc. Therefore bunch-to-bunch interaction investigation becomes essential. In the general case micro-train is from 2 up to a few tens bunch sequences with gaps between them. Recently the possibility to diagnose the micro-train electron beam using the double diffraction radiation target interferometry was discovered [5, 6]. However there is no common theoretical approach describing such a micro-train. In most theoretical studies the single-particle calculations are performed where the bunch-to-bunch interactions are not taken into account. Following this need, we offer quite simple technique which can be useful for numerical estimations of the processes in the beam physics of above mentioned systems. In this report the bunch interactions within the beam are considered and some generalized expression is proposed. The expression limit transitions for various parameters are also presented. The transition radiation case is discussed as an example.

The work was partially supported by the RFBR grant No. 14-02-31642-mol_a.

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Session Classification: PS: Poster Session

Contribution ID: **81** Type: **Invited talk**

The ELI-NP Facility for Nuclear Physics

Sunday, 5 October 2014 15:00 (45 minutes)

Extreme Light Infrastructure –Nuclear Physics (ELI–NP) is one of the three pillars of the pan–European ELI initiative, aiming to use extreme electromagnetic fields for nuclear physics research. The pillar, currently under construction at Magurele –Bucharest, will comprise a high power laser system and a very brilliant gamma beam system. Both systems are at the edge of the present–day' s technology. The high power laser system will consist of two 10 PW lasers and it will produce intensities of up to 10^23 –10^24 W/cm^2. The gamma beam, produced via Compton backscattering of a laser beam on a relativistic electron beam, will be characterized by a narrow bandwidth (< 0.5%) and tunable energy of up to 20 MeV. The research program of the facility is the result of the common effort of two scientific communities, high–power lasers and nuclear physics, acting together to uncover a broad range of key topics in frontier fundamental physics and new nuclear physics. A particular attention is also given to the development of innovative applications.
The status of the project and the overall performance characteristics will be reported. The main fundamental physics and applied research topics proposed to be studied at ELI–NP will be discussed together with the instruments for their investigation.

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Session Classification: "CHANNELING PRIMER"

Contribution ID: **82** Type: **Poster**

PS2-04: Interference Effects in Angular Distributions of X-Ray Transition Radiation from Relativistic Heavy Ions Crossing a Plate: Influence of Absorption and Slowing-Down

Tuesday, 7 October 2014 17:00 (1h 30m)

When the relativistic heavy ions (RHI) penetrate through the thin solid amorphous target (plate) with a constant velocity, two types of electromagnetic radiation may appear: Cherenkov radiation (ChR) (optically transparent plate) and transition radiation (TR) –in optical and/or in X-Ray regions. The RHI bremsstrahlung is strongly suppressed (compared to relativistic electrons) due to large mass of RHI. In fact, the velocity of RHI slightly decreases during penetration through a plate due to ionization energy loss (slowing-down) and it changes the spectral-angular distributions both of ChR and TR. The influence of the slowing-down on the spectral-angular properties of ChR has been recently investigated, see e.g. [1-4] and references therein. According [1-4], the slowing-down of RHI in a plate leads to specific broadening of ChR ring and appearance of diffraction-like ChR spectral and angular distributions, which are different compared to the Tamm-Frank distributions.

Here, we present theoretical analysis and calculations of X-Ray TR angular distributions from RHI crossing a plate. The physical reason for appearance of new peculiarities is connected with interference of two waves emitted at entrance and exit of the plate. These waves are emitted by RHI crossing the boundary vacuum-plate and plate-vacuum with slightly different velocities, as it first considered in [5]. Besides, a first wave is partially absorbed during penetration through a plate. Both two factors may change the condition of constructive interference compared to a case of relativistic electrons, see, e.g. [6].

The key parameters here are the plasma frequency, photon energy, attenuation length and thickness of the plate, and slowing down (stopping) of RHI, which in turn is a complicated function of the energy, charge and mass of RHI.

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Session Classification: PS: Poster Session

Contribution ID: **83** Type: **Oral**

A Crystal Routine for Collimation Studies in Circular Proton Accelerators

Friday, 10 October 2014 10:50 (15 minutes)

A routine has been developed to simulate interactions of protons with bent crystals in the collimation version of SixTrack. This routine is optimized in view of producing high-statistics tracking simulations for the highly efficient LHC collimation system. The routine has recently been reviewed after detailed comparison with experimental data, benchmark with other codes and improved modelling of low-probability interactions. The data taken with 400 GeV proton beams at the CERN-SPS North Area are used, including the results of a more recent analysis. Comparisons with other simulations tools are used to benchmark the scaling of our models to higher energies relevant for the LHC and not covered by experimental data. The predicted beam loss patterns for the first crystal-assisted collimation tests at the LHC are also discussed.

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Session Classification: S6: Crystal Simulation Routines for Particle Accelerators: Comparison and Benchmarking with Experimental Data

Contribution ID: **84** Type: **Poster**

PS3-07 Electron Channeling Resonance and de Broglie's Internal Clock

Thursday, 9 October 2014 17:00 (1h 30m)

Louis de Broglie predicted that the electron has an internal clock oscillating with frequency ν_B=(m_e c^2)/h determined by its rest mass me [1]. He then deduced that the frequency of a moving electron observed in a laboratory will be ν_L=ν_B/γ where γ is the relativistic time dilation factor. Detecting the internal electron clock seemed out of the question because of the ultrahigh frequency ν_B~〖10〗^20 s^(-1). The possibility of direct detection as a resonance in electron channeling has been investigated in reference [2, 3]. An early experiment showed a resonance for Si <110> at electron momentum 81 MeV/c [4, 5, 6]. An experiment is under way at DAFNE-BTF (Frascati) with <110> Ge at electron momentum 84 MeV/c to confirm it.

In this work we simulated the structure of the internal clock model in considerable detail with the aim of identifying new experimental implications. The properties of both angular and spatial distribution of electrons under resonance condition at <100> and <110> channeling in germanium crystal have been investigated. The simulation of trajectories, angular and spatial distributions of electrons on the screen monitor has been performed taking into account initial spatial of electron beam with and without resonance.

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Session Classification: Poster Session

Contribution ID: **85** Type: **Poster**

PS2-26: Study Elastic Properties of the Carbyne Method of Molecular Dynamics

Tuesday, 7 October 2014 17:00 (1h 30m)

We study the mechanical properties of the carbine. Model is an array of long chains of 13 nm, located in the cell with periodic boundaries on the sides. At a temperature of 300K, the model is the longitudinal tension. Results on the change of the interatomic bonds, calculated Young's modulus ≈ 0.15 TPa whose order is consistent with the recently published work [1].

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Session Classification: PS: Poster Session

Contribution ID: **86** Type: **Oral**

Recent Advances in the FLUKA Event Generator for Crystal Channeling

Friday, 10 October 2014 10:30 (15 minutes)

Channeling in bent crystals is more and more frequently considered as an option for collimating high-energy beams. The installation of crystals in the LHC, having taken place during this past year, aims at demonstrating the feasibility of multi-stage crystal-assisted collimation and possibly improving cleaning efficiency [1]. Energy deposition studies in the LHC are routinely performed with the Monte Carlo transport code FLUKA [2,3], which allows to assess the beam loss impact on collimators and magnets as well as to calculate monitor signals. A new model of crystal channeling has been developed specifically for integration into FLUKA, aiming to extend these studies to the case of crystal-assisted collimation [4].

The event generator is tailored to work in conjunction with FLUKA's interaction models and transport capabilities, in any given geometry. It is capable of handling any positively charged particles, reproducing all coherent effects in crystals with possible miscut angle or torsion. In this paper, latest developments having been brought to the model are discussed. The distribution of deflection angles for non-channeled particles incoming at small incoming angles has been improved and reproduces more accurately experimental results. Other advances are related to the adaptation of FLUKA models of nuclear and Coulombian interaction to channeled particles. Obtained interaction rates are smaller than in amorphous mode, reflecting the oscillatory nature of the channeled particles trajectory, implying in most cases larger impact parameters to the atomic lattice. Benchmarking of the simulation tool has been conducted against data from the UA9-H8 experiment at CERN.

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Session Classification: S6: Crystal Simulation Routines for Particle Accelerators: Comparison and Benchmarking with Experimental Data

Contribution ID: **87** Type: **Poster**

PS2-20: Manufacturing and Characterization of Ultra Thin and Bent Silicon Crystals for Studies of Coherent Interactions with Negatively Charged Particle Beams

Tuesday, 7 October 2014 17:00 (1h 30m)

In the last years, thanks to innovative techniques for crystals design and fabrication, based on silicon micromachining, it was possible to realize bent crystals for beam manipulation through coherent interactions, thin enough to avoid the loss of deflection efficiency caused by dechanneling, while maintaining the crystal structure perfectly intact. The realization of such thin bent crystals has opened the way to the investigation of all the coherent interactions phenomena in bent crystals well known for positively charged particles also for the case of negatively charged particles. Such investigation have been performed at the external lines of SPS with hundred-GeV negative pions and electrons [1].
While at CERN energies (a few hundred GeV) the interest in negatively charged beam manipulation is mainly connected with halo collimation for future linear e± colliders, a particular interest in such phenomena is present also at lower energies (~ GeV), for the realization of a periodically bent crystal for miniature electron crystalline undulator. However, because dechanneling scales with beam energy, the technology for bent crystal fabrication need to be pushed to its extreme limit, from the 2 mm long bent crystals for CERN applications, we reduced crystal length along the beam to 30 μm for experiments carried at MAMI [2].
We produced such crystals starting from a SOI bonded wafers, adopting proper revisitations of silicon micromachining techniques such as low pressure chemical vapour depositions, photolithography and anisotropic chemical etching.
The crystals realized were mounted onto mechanical holders, which allow to properly bend the crystal and to reduce unwanted torsions. Crystallographic directions and crystal holder design are optimized in order to excite quasi-mosaic effect [3] of the (111) planes
Prior to experimenting the crystal on particle beams a full set of characterizations were performed. Infrared interferometry were used to measure crystal thickness with accuracy of a few nm. White-light interferometer is employed to characterize surface deformational state and its torsion. High-resolution X-rays diffraction, were employed to precisely measure the crystal bending angle along the beam.
Manufactured crystals were recently installed at the MAMI Mainz MIcrotron to steer sub-GeV electrons [2] (thickness 30.5 μm, bending angle 905 μrad), and at SLAC, to deflect an electron beam in the 1 to 10 GeV range [4] (thickness 60 μm, bending angle 402 μrad).

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Presenter: GERMOGLI, Giacomo (FE)

Session Classification: PS: Poster Session

Contribution ID: **88** Type: **Oral**

Investigation on the Radiation Emitted by Sub-GeV Electrons in a Bent Crystal

Tuesday, 7 October 2014 15:15 (15 minutes)

We report an investigation on the electromagnetic radiation emitted by channeled and volume reflected sub-GeV electrons in an ultra-thin bent crystal performed at MAMI accelerator (Germany).
In the last years, different studies on the coherent interactions of negative charged particles with bent crystals have been carried out at CERN at ultra-high energies (~100 GeV) [1]. In particular, the effect of channeling and volume reflection were deeply investigated in connection with high-energy beam collimation (for LHC or future ILC) both in terms of steering capability and high intensity electromagnetic radiation generation.
On the other hand, an interest on such effects is present also at lower energies (~GeV) for which one of the most appealing application is represented by the possibility to realize an innovative intense source of X-ray via channeling in a periodically bent crystal. However, since the contribution of dechanneling scales with the particle energy, to efficiently deflect a GeV negatively charged beam a very thin crystal is required (some tens of microns vs. some millimeters for the CERN energies).
Thanks to the exploitation of the quasi-mosaic effect caused by the crystal anisotropy, it was possible to bent a ultra-thin Si crystal along the (111) crystallographic planes; the crystal thickness (30.5 μm) is of the order of the dechanneling length (15-20 μm) that was later measured directly with the same crystal [2]. The deflecting power of the crystal was measured with a high-resolution Si microstrip detector, while the emitted electromagnetic radiation was measured by a NaI detector. Two different collimators were used to study different portions of the electromagnetic spectra.
An evident channeling peak and an intense volume reflection region have been found in the deflection profile of the 855 MeV MAMI electron beam. The deflected beam distribution vs. the beam-to-crystal orientation very much resembles the one obtained in the hundreds-GeV energy range [1]. The measured electromagnetic radiation resulted to be much more intense than for the amorphous case both for channeling and volume reflection. The high intensity of radiation accompanying volume reflection is maintained in the whole angular acceptance, which is equal to the bending angle of the crystal.
The experimental results on the dynamics and on the radiation generation were critically compared to Monte Carlo simulations. It was shown that, on the contrary to the higher energy case, the rechanneling mechanism plays an important role by increasing both the deflection efficiency and the electromagnetic radiation generation.

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Presenter: BANDIERA, LAURA (FE)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **89** Type: **Poster**

PS2-01: Observation of Quasimonochromatic EUV Radiation Generated by 5.7 MeV Electrons in Periodic Structure of Multilayer Mo/Si Mirror

Tuesday, 7 October 2014 17:00 (1h 30m)

The dynamics of changing the form of angular distribution and intensity of EUV radiation emitted from a multilayer Mo/Si mirror with changing the angle of grazing incidence o of 5.7 MeV electrons on the mirror surface has been investigated. Two series of angular distributions of radiation have been measured in the region of detection angle 60o< D <160o with and without use a 1 μm Al absorption filter. The Mo/Si mirror consisted of 50 Mo/Si bi-layers with the thicknesses of 11.32 nm was used in the experiment. The measured results have shown that the maximum intensity of EUV radiation in the angular distributions measured without the Al filter decreases at increase of the angle o, while the similar characteristic measured with the Al filter increases. Comparison of the observed tendencies of changing the maximum intensity of the angular distributions of EUV radiation with the results of model calculations of a back transition radiation [1] and diffracted transition radiation [2] has shown that in the experiment the contribution of narrow-directed quasimonochromatic component in the spectrum of radiation emitted in the Bragg direction has been observed. Earlier, the observation of such type of EUV radiation was carried out on the base of simple comparison of the intensities of radiations generated in a homogeneous target and a multilayer mirror [3]. The demonstration of existence of quasimonochromatic EUV component in radiation generated in multilayer mirror carried out in this work is more reliable because the used approach is based on the analysis of behavior of the spectral-angular characteristics of radiation that is specific namely for coherent radiation generated by charged particles in periodic structures [4].
This work was partially supported by the Russian Ministry of Education and Science program “Nauka”, Grant 2456, and by the Russian Foundation for Basic Research, Grant 14-02-01032.

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Session Classification: PS: Poster Session

Contribution ID: **90** Type: **Oral**

Guiding of the Beam of 10 keV Electrons by Micro Size Tapered Glass Capillary

Wednesday, 8 October 2014 10:00 (15 minutes)

Elastic and inelastic processes take place in tapered glass capillaries within the guiding of the beam of electrons. We represent the study of the energy spectrum and intensity dependence of the guided beam of 10 keV electrons on the tilt angle of the tapered glass tube with respect to the beam axis. Experimental results show not only the possibility to guide electrons using macro size tapered channels, but also the focusing capability of the channels.

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Presenter: Mr IRRIBARRA, Esteban (BelSU)

Session Classification: S4: Charged Beams Shaping

Contribution ID: **91** Type: **Poster**

PS2-11: Source of Circularly Polarized, Monoenergetic X-Ray Photons

Tuesday, 7 October 2014 17:00 (1h 30m)

The problem of the radiation of channeled positron beam in a system nanotubes is solved. The polarization of the medium imposes a ban on the value of the beam energy for the formation of radiation. The energy threshold increases with increasing amplitude of the oscillations of positrons. The case is considered whenthe beam energy coincides with the threshold energy for the maximum amplitude of the oscillations of positrons. The formula is derivedfor the spectrum of the total number of emitted photons. Due to the symmetry of the problem with respect to the azimuthal angle, the beam of circularly polarized photons is formed.The threshold energy for a nanotube with the radius 7 Å approximately equals 50 MeV.For this energy, directed and quasi-monochromatic beamof photons is generated with an energy of 3 keV.

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Session Classification: PS: Poster Session

Contribution ID: **92** Type: **Poster**

PS2-12: Energy Losses of Positrons in Wiggler Nanotubes and Spectrum of Emitted Photons

Tuesday, 7 October 2014 17:00 (1h 30m)

We investigate the undulator radiation from relativistic positrons channeled in wiggler nanotub.It is shown that the main contribution to the radiation intensity comes from higher harmonics.The energy range of the total spectrum of the number of emitted photons is wide.Both the number of emitted photons and the radiation angle do not depend on the photon energy.However, the spectral distribution of the number of photons depends on the azimuthal angle. It has a maximum in the plane of oscillations, which gradually disappears when the angle is approaching π / 4.Spectrum has the form of lunates symmetrically disposed with respect to the nanotubeaxis. The radiation intensity increases linearly with increasing photon energy.Energy losses of the positron on the total radiation of higher harmonics are significant.

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Session Classification: PS: Poster Session

Contribution ID: **93** Type: **Poster**

PS2-13: Microbunched Beam as a Source of Monochromatic X-Rays

Tuesday, 7 October 2014 17:00 (1h 30m)

The problem of coherent radiation from microbunchedFEL beam passing through the plasma and interacting with laser beat waves (LBW) is considered. The interaction of plasma with LBWgenerates harmonic modulation of longitudinal density with increasing amplitude and also alongitudinal periodic electric field.Therefore, the beam electrons are influenced by the inhomogeneity of the medium and by the periodic electric field.As a result, the formed radiation has properties of the both transition and undulator radiations (hybrid radiation).The interaction of microbunched electron beam with the modulated plasma leads to the formation of partially coherent radiation.The intensity of the hybrid coherent radiation essentially exceeds the intensities forthe other types of coherent radiation and can be comparable or greater than the intensity in FEL.

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Session Classification: PS: Poster Session

Contribution ID: **94** Type: **Poster**

PS1-10: Cherenkov Radiation from 255 MeV Electrons in a Diamond Crystal

Monday, 6 October 2014 17:00 (1h 30m)

Unless it's long history and successful applications in detector physics, many fundamental properties of Cherenkov radiation from different types of relativistic particles still are not studied in detail, see e.g. [1-3] and references therein. Here, we report on recent first experiment on Cherenkov light measurements from 255 MeV electrons at SAGA-LS accelerator facility [4]. The target used was 50 micrometers-thick diamond crystal and the band-pass filter allowed transmission of Cherenkov light with λ ~ 500 nm (FWHM). At definite inclination angle, the Cherenkov light can be extracted to 90 degrees from the beam direction. The CCD camera was focused on the crystal. The first experiment showed that the Cherenkov light intensity detected by CCD camera depends on the inclination angle, with a sharply-defined maximum. It agrees with our calculations, taking account of the Fresnel reflection and transmission coefficients of diamond.

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Session Classification: PS: Poster Session

Contribution ID: **95** Type: **Oral**

Cherenkov Radiation from Relativistic Channelled Particles

Tuesday, 7 October 2014 17:30 (15 minutes)

The well-known Tamm-Frank theory [1] describes the Cherenkov radiation (ChR) from relativistic charged particles moving uniformly and rectilinearly in an optically transparent radiator. There are two main reasons leading to deviations from this ideal character of motion: 1) multiple scattering –particle's velocity vector changes [2]; 2) stopping in a radiator –particle's velocity magnitude changes. This second effect is more significant in the case of relativistic heavy ions (RHI) when the stopping in a radiator leads to appearance of the specific diffraction-like structure of the ChR spectral and angular distributions [3-6]. The third reason, which breaks the condition of uniform and rectilinear motion of relativistic particle in a target is the channelling effect.
Here, we investigate in detail the ChR from channelled relativistic electrons, positrons and RHI in an optically transparent crystal. We analyze: a) broadening of the Cherenkov cone connected with periodic deviation of the channelled particle velocity vector from the average one; b) peculiarities of ChR spectral distribution at the fixed emission angle in vicinity of the Cherenkov cone; c) influence of slowing-down due to ionization energy loss in the case of RHI; d) breaking of the axial symmetry of angular distribution of ChR and even appearance of new features of ChR linear polarization at planar channelling. The effects predicted strongly depend on the channelled particle energy and are closely connected to the normal and anomalous Doppler effects in emission from an oscillator moving in the medium [7-10].
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Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **96** Type: **Oral**

Measurements of Coherent Interactions in Silicon Bent Crystals with 400 GeV Proton at CERN H8

Friday, 10 October 2014 09:30 (15 minutes)

The UA9 experiment is investigating the feasibility of crystal-assisted collimation for high-energy hadron colliders. A crucial milestone towards this goal is the characterization of single-pass response of crystals with high-energy hadron beams. At CERN, this is done by using beams from the Super Proton Synchrotron (SPS) extracted at 400 GeV/c in the H8 extraction line for fixed-target experiments. Since 2009, a couple of dozens crystals of different technologies and parameters have been tested. For the first time, a complete and systematic analysis of all the crystals tested in H8 has been carried out. The results of this work are presented, providing a unique set of data that is being used to benchmark several crystal simulation codes developed by different teams.

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Presenter: Mr ROSSI, Roberto (CERN)

Session Classification: S6: Crystal Simulation Routines for Particle Accelerators: Comparison and Benchmarking with Experimental Data

Contribution ID: **97** Type: **Poster**

PS2-03: Physical and CST Modelling for THz Radiation of Electrons in Tube with Periodically Changing Internal Radius

Tuesday, 7 October 2014 17:00 (1h 30m)

Diffraction radiation (DR) occurs when a charged particle moves near the target. Smith-Purcell effect in DR, or Smith-Purcell radiation (SPR), is caused by periodicity of the target. Both DR and Smith-Purcell radiation have a lot in common with the widely known Cherenkov radiation (CR): all these types of radiation arise due to the polarization of the target material by the Coulomb field of moving electrons. In case of DR the target is not damaged, because electrons move near the target surface and do not cross edges of the target. On the one hand, this fact can be useful for creating powerful source of THz radiation based on chain of bunches moving inside the tube. On the other hand, the problem of calculation of radiation in targets with complicated surface is not that simple and numerical simulation can be of great use to simulate such problems taking into account all target geometry features.

In our article [Ponomarenko et al, NIMB 2013] we investigated theoretically radiation in THz frequency range in conditions when electrons move inside the hole with variable radius. It was demonstrated that contribution of Smith-Purcell radiation in case of periodical internal radius of the hole can be very good mechanism, more intensive then Cherenkov radiation or Smith-Purcell radiation from flat gratings. In this report we present simulation of radiation from hole with variable radius. The simulations are performed in Computer Simulation Technology (CST) Particle Studio (PS) software package. Simulation results are compared with analytical expressions and investigated for various parameters of the target.

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Session Classification: PS: Poster Session

Contribution ID: **98** Type: **Oral**

Polarization Radiation from Metamaterials

Monday, 6 October 2014 15:30 (15 minutes)

Left-handed metamaterials are known to demonstrate unusual optical properties, like negative refractive index, inverse Doppler effect, backward waves (the waves with contrary directed phase and group velocities), focusing beyond the diffraction limit. On the other hand, polarization radiation of charged particles has much in common with the processes of scattering of light in matter. Correspondingly, some unusual effects in physics of radiation take place: inverse Vavilov-Cherenkov radiation, inverse Smith-Purcell radiation and so on. These phenomena have been predicted and experimentally investigated recently [1, 2]. Practical potential of these phenomena is caused by some interesting and important features: noticeably more intensive radiation in THz frequency region from left-handed metamaterials in comparison with the natural materials; the surface waves at interfaces between natural and meta-materials arise more readily which is important for Free Electron Lasers; unusual angular distribution of radiation opens new opportunities for bunch diagnostics.

In this article polarization radiation in metamaterials is investigated by the example of Cherenkov and Smith-Purcell radiations and compared with the same for usual materials [3]. Role of magnetic currents as against the usually considered electrical ones is considered. Nature of the enhancement of radiation from metamaterials compared with the usual materials is discussed.

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Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **99** Type: **Poster**

PS2-02: Parametric X-Ray Radiation from Composite Bunches

Tuesday, 7 October 2014 17:00 (1h 30m)

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Parametric X-ray radiation (PXR) occurring when charged particles move in a crystal was predicted theoretically by M.L. Ter-Mikaelyan in 1972 [1], and then observed experimentally at the Tomsk Synchrotron Sirius in 1985 [2]. Since then PXR has been studied very well, both theoretically and experimentally (see, for example, the monograph [3]). However, up to now PXR is not used in practice owing to rather weak brightness. Nevertheless, PXR is intensive enough to be detected experimentally, and can serve as a source of information about the radiating bunches of charged particles.

In this report we consider PXR from a composite bunch of ions passing a crystal, on the basis of the clear physically the picture of radiation based on polarization currents conception (see, for example, Chapter 4 in monograph [4]). The composite bunch is thought to be mixture of two bunches of charged particles with, generally speaking, different distributions and different properties of the single particles which they consist of. Interference between two fractions of the composite bunch can be a used to get the information of the structure and ionic composition of the bunch, and therefore this radiation. We suggest that PXR can be a good candidate for the composite bunch diagnostics in the processes of channeling of the charged particles beams in modern experiments on the beam control with help of channeling phenomenon in bent crystals [5]. The spectral-angular distribution of PXR from the composite bunch is obtained in kinematical approximation and analysed from point of view of control of the bunch composition.

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Session Classification: PS: Poster Session

Contribution ID: **100** Type: **Oral**

Backscattering/Transmission of 2 MeV He++ Ions Quantitative Correlation Study

Wednesday, 8 October 2014 12:00 (15 minutes)

As charged particles impinge on atomic planes of a crystalline structure at an angle lower than the so called "critical angle", planar channeling occurs. Under such condition the particle does not see the material as a disordered medium, and collisions with atoms of the crystal lattice are correlated. Particle is confined between two neighbor atomic planes, and its motion is characterized by oscillations between them. The oscillation wavelength for each particle depends on its impact parameter with respect to the atomic planes, nevertheless for the case of channeling of positively charged particles such dependence is very weak, leading to coherence between the trajectories of the channeled particles. Multiple scattering on core electrons and atomic nuclei (nuclear scattering) results in a loss of coherence between the trajectories of the channeled particles after a few oscillations of the particles in the channel and in "dechanneling"of previously channeled particles. In this work we report a detailed description of planar channeling oscillations of 2 MeV He++ particles channeled between (110) atomic planes of a silicon crystal. Backscattering/transmission experiments with 2 MeV He++ ions were performed to study the exact correlation between the confined particles oscillating trajectories. Regular patterns of channeled ion planar oscillations are shown to be dominated by the crystal harmonic-oscillator potential and multiple scattering effects. Quantitative estimation of channeling efficiency and electronic dechanneling length were performed.

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Session Classification: S4: Charged Beams Shaping

Contribution ID: **101** Type: **Poster**

PS1-20: Influence of Real Photon Diffraction on Parametric X-Ray Radiation Angular Distribution in thin Perfect Crystals

Monday, 6 October 2014 17:00 (1h 30m)

Influence of real photon diffraction on parametric X-ray radiation angular distribution in thin perfect crystals

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Recently it has been suggested to use parametric X-ray radiation (PXR) angular distribution of fast particles in thin crystals for determination of modern accelerators electron beam parameters [1,2]. It is well known, see e. g., [3], that PXR of fast electrons in crystals always is accompanied by diffracted real photons of transition radiation (DTR) and bremsstrahlung (DB). Contribution of these types of emission changes the PXR angular distribution. For description of diffracted real photons contribution into the total emission angular distribution on the base the work [4] approach it is suggested and realized a simple method of simulation of the diffracted real photons yield of bremsstrahlung and transition radiation from perfect crystals of arbitrary thickness up to some primary extinction lengths.
It is shown that for small thickness of crystals and observation angles concerning the center of the reflex, contribution of diffraction of real photon is comparable with the yield of parametric X-radiation and determines the shape of total emission angular distribution there. Influence of electron beam size and divergence on total emission angular distribution is analyzed. Dependence of PXR and DTR relative contribution from the electron energy, an observation angle and reflection order is discussed from the point of view of the above mentioned method sensitivity.

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Session Classification: PS: Poster Session

Contribution ID: **102** Type: **Oral**

Channeling of Sub-GeV Electrons in Bent and Periodically Bent Single Crystals

Tuesday, 7 October 2014 15:00 (15 minutes)

Experiments have been performed at the Mainz Microtron MAMI to investigate planar electron channeling in bent [1], and in periodically bent silicon single crystals [2-4]. The low emittance electron beam of MAMI providing energies below 0.855 GeV is well suited to prepare a beam with small angular divergence which is mandatory for channeling experiments.

A very important prerequisites for experimental studies of undulator-like radiation in periodically bent crystals is the knowledge of the dechanneling length of electrons for the (110) crystallographic plane. Because of the fact that even for undistorted plane crystals only little is known experimentally, we have performed and recently reanalyzed dechanneling length measurements at various beam energies [3]. Both, radiation spectra as well as dechanneling length measurements at low electron beam energies feature quantum state phenomena which enhance the dechanneling length.

Beam deflection studies at (111) channeling of electrons in a 30.5 thick curved crystal with a bending radius of 33.5 mm, produced at the Department of Physics of the Ferrara University, allows to extract information on the dechanneling length via simulation studies [1]. In addition, we have developed an analytical model with which the observed scattering distribution has been fitted. The scattering distribution as function of the crystal thickness has been derived from the solution of a differential equation which takes into account rechanneling. From this solution dechanneling, rechanneling, volume deflection, and ejection distributions can be derived. It turns out that the dechanneling and rechanneling lengths are strongly correlated. In order to restrict the parameter space, it has been tried to solve the Fokker-Planck equation in curved coordinates.

Radiation emission spectra have been studied from crystalline undulators at electron beam energies between 195 and 855 MeV [2,3]. The graded composition strained layer Si1-xGex undulator, epitaxially grown at the Department of Physics and Astronomy of the Aarhus University, had 4 periods with a period length of 9.9 μm and amplitudes between 2 and 4 Angstroms. All spectra taken at various beam energies at channeling in the undulating (110) planes exhibit a broad excess yield around the theoretically expected photon energies. Analysis with a simple analytical model suggests that the gross structure can be explained by synchrotron-like radiation emission component from small arc elements of the undulator. Why the coherent radiation component is so small is presently still an open question and will be discussed.

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Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **103** Type: **Invited talk**

Goals and Plans for Initial Crystal Collimation Tests at the LHC

Friday, 10 October 2014 09:00 (30 minutes)

Two bent crystals have been installed in the Large Hadron Collider (LHC) for crystal collimation studies of horizontal and vertical halos, with proton and ion beams at energies close to 7*Z TeV. In addition to demonstrating the feasibility of crystal channeling at these unprecedented beam energies, these tests are targeted at addressing specific beam collimation issues at the LHC and its High Luminosity (HL) upgrade, like beam cleaning requirements in the 1e-5 range and continuous collimation in dynamics machine conditions like ramp and squeeze. In this paper, the LHC crystal collimation layouts are reviewed and the plans for the first beam tests are presented. The timeline for possible machine studies in 2015 is reviewed.

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Session Classification: S6: Crystal Simulation Routines for Particle Accelerators: Comparison and Benchmarking with Experimental Data

Contribution ID: **104** Type: **Oral**

Channeling of Protons in Various Types of Radially Compressed Carbon Nanotubes

Wednesday, 8 October 2014 10:15 (15 minutes)

Channeling of 10 MeV protons in various types of radially compressed chiral carbon nanotubes is considered. Monte Carlo simulation program is used for the calculation of the trajectories, energy losses and angular distributions of protons in nanotubes of various lengths, where the potential in Doyle-Turner approximation is used to describe the interaction between a proton and a nanotube. Carbon nanotubes, which are considered, are radially compressed at the centre or at both ends. The results show that in some cases a decreased angular distribution of the beam is observed, compared with propagation through a straight nanotube. Furthermore, the energy distribution of channeled protons in nanotubes present a series of small peaks besides a main one, the number of which depends on the nanotube length and the angle of incidence, which in some cases are significantly high.

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Session Classification: S4: Charged Beams Shaping

Contribution ID: **105** Type: **Poster**

PS2-16: Results of Testing for Energy Dispersive Si Detector with Large Working Area

Tuesday, 7 October 2014 17:00 (1h 30m)

In the recent papers about the experimental study of parametric X-ray radiation (PXR) generated in the silicon crystal by the extracted proton beam with energy 50 GeV at the accelerator U70 PXR was observed by energy dispersive detector XR-100CR made by Amptek with sensitive surface area of 6 mm^2 [1, 2]. Later on because of the wide angular distribution of PXR, in order to increase the accuracy of measurements of the PXR yield it was proposed to use energy dispersive spectrometer with a large area of the sensitive surface (more than 130 mm^2) developed by Tomsk Polytechnic University jointly with the Petersburg Nuclear Physics Institute. However, in these experiments, the spectrometer went out of order at each pass of the beam through the target. The problem was solved by moving the detector to a considerable distance from the beam. However, even at large distances the detector was continuously overloaded due to the strong background radiation.
Analysis of the experimental results obtained at the U70 accelerator revealed the necessity of the preamp upgrading. Continuous feedback was replaced to resistive that resolved the problem of detector switch off at its overloading, and allowed increasing the counting rate up to 10^5 p/s as well as improving the resolution at high counting rates.
In this work we would like to present the testing results for the spectrometer with a large area of the sensitive surface after its upgrading. Tests were carried out at the XLab Frascati LNF laboratory. The main aim of the research was to study the shape of the surface radiation detection efficiency. According to the results obtained the detection efficiency is uniform with high accuracy throughout the sensor area.

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Presenter: GOGOLEV, Alexey

Session Classification: PS: Poster Session

Contribution ID: **107** Type: **Invited talk**

AWAKE - The Proton Driven PWFA Experiment at CERN

Thursday, 9 October 2014 11:30 (30 minutes)

AWAKE is a proton-driven PWFA experiment planned to start in late 2016 at CERN. It is in its planning and design phase. An update on the experimental setup as well as the current experimental plan will be presented.

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Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **108** Type: **Invited talk**

Channeling and Channeling Radiation from Imperfect Crystals with Dislocations and Anharmonic Interactions

Tuesday, 7 October 2014 16:30 (30 minutes)

The phenomenon of electron and positron channeling in a crystal affected by various imperfections has been investigated. We have continued our work on the quantum aspects of the positron channeling in a crystal bent by dislocations where the effects of longitudinal motion of the particle are also considered along with the transverse motion. These calculations are now extended to include anharmonic terms in the continuum potential and specific cases of stacking faults, dislocations and strains in the crystals are considered in the context of channeling radiations emitted by relativistic charged particles. The principle motivation of these investigations is to understand basic science influencing the emission of electromagnetic radiation from charged particles constrained to propagate through crystallographic channels in a realistic and imperfect medium. To this end we have also considered the applications of channeling radiation technique to situations like platelets as an application of results on stacking faults and periodically bent crystals as application of results on dislocations. Finally, we also extend the calculations to periodically bent crystals for applications in crystalline undulator problem.

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Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **109** Type: **Poster**

PS1-27: Abnormal Optical and X-Ray Phenomena at Motion of Fast Water Stream Through Thin Channels

Monday, 6 October 2014 17:00 (1h 30m)

The radiation processes associated with a supersonic liquid jet exhausting from narrow dielectric or metal channels are considered. During researches of different regimes of cavitation we have observed several anomalous radiative phenomena: very intensive optical glow of liquid jet and controlled X-ray radiation. It has been found for the first time that the output of the channel and the initial portion of the jet are sources of intense X-radiation, generation of which is related to cavitation processes in the liquid jet bulk and subsequent excitation of shock waves. The frequency (energy) of X-radiation depends on the types of atoms on a radiating surface (for a jet, it is water; for a channel, the metal atoms on the surface) and increases with the charge of atoms from up to for heavy metals). The total X-ray activity of an experimental setup in the mode of jet exhaust reaches 0.1 Ci.

It has been demonstrated that intense shock waves generated in air near the surface of objects with cavitating water may, during interaction with distant objects (screens), generate not only a secondary shock waves, but also a secondary X-ray waves. These waves are formed in the process of reflection of the secondary shock waves, which are generated in the volume of the screens, off the back surface of these objects. In this process, intense agitation of atoms and the electronic subsystem occurs, which results in the formation of X-ray emission from the back side of the objects. The spatial parameters of this radiation depend on the shape and cross section of the screen and the spatial characteristics of the shock wave.

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Session Classification: PS: Poster Session

Contribution ID: **110** Type: **Poster**

PS2-18: Modeling and Experimental Investigation of Refractive Short-focus ”(X-ray)-(Acousto)-(X-ray)” Lens for Pulse X-ray Radiation

Tuesday, 7 October 2014 17:00 (1h 30m)

The problem of creation of effective short-focus X-ray optics is discussed. In our works was investigated the problem of effective multiple transformation of pulse X-ray radiation to acoustic shock waves and acoustic shock waves to X-ray radiation at the interfaces of different media (e.g. air and metal) without phase distortion. In our experiments it was found that the impact of shock acoustic waves, which are formed in the air (e.g. during cavitation of water jet or in the result of action of short X-ray pulse) on distant screen leads to the generation of a quasi-coherent directional X-rays from the back side of this screen. The energy of final X-ray depends on the types of atoms on a radiating surface and increases with the charge of atoms from 0.7 keV up to 5 keV for heavy metals. These shock acoustic waves pass the screen volume and, being reflected off the back side, excite the atoms on it. Surface-distributed disturbances from each of the waves are mutually coherent and phased by the action of the shock wave. Spontaneous emission of these mutually phased sources results in generation of X-radiation with large transverse coherence.
Based on these results, it was concluded that there is mutual coherence of successive X-ray and shock acoustic waves, which could participate in a reciprocal transformation at the interfaces of different media. The problem of creation of X-ray lens by implementing an combined “(X-ray)-(Acousto)-(X-ray)” (”XAX”) was studied. We have conducted the series of both theoretical and experimental studies aimed at the creation and study of such metal and ceramic lens.

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Session Classification: PS: Poster Session

Contribution ID: **111** Type: **Poster**

PS3-29 Nuclear Fusion on Ordered Crystal Target with Participation of Monochromatic Beams of Light or Middle Isotopes

Thursday, 9 October 2014 17:00 (1h 30m)

The problem of optimization of "accelerating (beam)" fusion in crystal lattice is discussed. It is shown that in monocrystal targets like LiD the rate of fusion process with the participation of both target nuclei and beam of fast nuclei, directed at Lindhard angle, may be increased by 10-100 times compared to the alternative process of deceleration on atomic electrons. Such changes are based on the use of specific channeling physics regime of motion - "overbarrier motion".
Another method for radical optimization of "accelerating (beam)" fusion is connected with resonant tunneling effect. This leads, in combination with the use of particle beams with optimum energy and energy spread, which correspond to total transparency "window"of reaction barrier, to the possibility of positive nuclear fusion energy release on one atomic monolayer! Such effect can be regarded as nuclear super absorption of accelerated beam. The possibility of nuclear reactions C12+O16 and C12+O18 at such motion regime with positive energy release is examined.

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Session Classification: Poster Session

Contribution ID: **112** Type: **Oral**

Unknown Preconditions and Abnormal Features of Cherenkov Radiation and X-ray Laser Amplification in Realistic Media

Monday, 6 October 2014 15:45 (15 minutes)

The influence of the spatial distribution of electrons, atoms and nuclei in condensed media on medium's susceptibility and on the conditions of both X-ray Cherenkov radiation and laser X-ray (gamma-ray) generation are considered.
It was shown that the "traditional"condition of Cherenkov radiation is incorrect and takes place only in idealized case of a completely homogenous medium without atomic structure. It is shown that taking into account the inhomogeneous (on atomic level) structure of material media leads to very essential change in the effective susceptibility and permittivity as compared with cases of model homogeneous media with the same average concentration of electrons. It is seen that the effective susceptibility of a periodically inhomogeneous medium (including crystal) differs from the average susceptibility not only at Bragg diffraction but in all cases!
It follows from these results that the threshold energy of fast charged particles, which is required to generate Cherenkov radiation, increases by the essential value.
It is shown also that the function of the spatial distribution of electrons and nuclei in a target affects the conditions for laser generation in X- and gamma-ray ranges (on the problem of X- and gamma-ray lasers): in some cases the coefficient of stimulated (laser) amplification exceeds the analogous coefficient in the case of a model homogeneous medium.

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Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **113** Type: **Poster**

PS3-14 Energy Characteristics of Particles of Atomic Flux in Carbon Nanotube

Thursday, 9 October 2014 17:00 (1h 30m)

In modern works by channeling in carbon nanotubes treated basically the process of ion [1] and the proton channeling. In our work, we have attempted to examine the process of channeling atomic flux consisting of 50 or more particles. Basic atoms that were considered is O, H, N.
In the simulation, we used LAMMPS [2] with developing interatomic potentials ReaxFF. Currently, we investigated the losses of atomic flux energy in the CNT with different geometry and with different initial energy of the atoms. An assessment of the structure of the tube after a long channeling (2-3 picoseconds) . It is shown that the small part of the hydrogen atoms dechanneling through the tube. For the oxygen atoms characteristic deformation of the tube and its subsequent destruction.

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Session Classification: Poster Session

Contribution ID: **114** Type: **Poster**

PS1-05: Channeling and Quasi-Characteristic Radiation of Charged Particles in Charged Axis of Ionic Crystals of CsCl-Type

Monday, 6 October 2014 17:00 (1h 30m)

The given paper investigates the orientation motion of charged particles (electrons, positrons, ions) in charged [100] and [110] axes of CsCl-type crystals. Principle difference from previous work which investigated similar problems is in the usage of more correct and ground type of potential of charged axes for such crystals.
This potential is consists of the following steps: 1) the calculation is carried out on the basis of one-particle Coulomb potentials; 2) the calculation assumes the expansion of charged axes system potential by the reverse grid vectors; 3) this expansion transforms to the periodic function for the next calculations; 4) summarizing (with future approximation) of this potential with the potentials corresponding to neutral skeletons of the same axes is done; 5) method of Sturm-Liouville problem numerical calculation helps to find energy levels, corresponding wave functions and QCR spectrum.
Besides, the paper investigates temperature factor influence on the forms of potential pits and QCR spectrum in the crystals under consideration.

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Session Classification: PS: Poster Session

Contribution ID: **115** Type: **Poster**

PS3-16 Combination (Raman) Scattering Photons by the Channeling Particles

Thursday, 9 October 2014 17:00 (1h 30m)

The channeling particles is characterized by the bound quantum states of its transversal motion. Photon interactions with the channeling particles in a single crystal may be accompanied by the energy transitions between the transverse motion levels of channeling particles. The photon combination (Raman) scattering by the quasi-bound channeling particles leads to the appearance of a frequency combination of the incident photon frequency ω_0 and the frequency Δ ω_if , i.e.
ω = ω_0±Δ ω_if ,
where Δ ω_if= 〖ΔE〗_if/ℏγ; 〖ΔE〗_if is the transition energy between “i”and “f”transversal motion quantum states; γ = E/(mc^2) is the channeling particles Lorentz –factor. A “violet”satellite (“anti-Stokes”lines ω) analysis in the Raman combination scattering spectrum is suggested. Resonance conditions for observation of the second harmonics (ω = 2ω_0) is discussed.

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Session Classification: Poster Session

Contribution ID: **116** Type: **Invited talk**

Simulation of Direct Transport of X-Ray Photons Using the General Purpose Monte Carlo Code MCSHAPE: Main Features and Recent Developments

Tuesday, 7 October 2014 11:30 (30 minutes)

MCSHAPE [1] is a general purpose Monte Carlo code developed at the University of Bologna to simulate the multiple scattering of the prevailing photon-matter interactions in the energy range 1-1000 keV, including a detailed evolution of the polarization state of the radiation. MCSHAPE is particularly appropriate for describing the multiple scattering terms which, overlapped, build up the whole x-ray spectrum. All the aspects that characterize the computed multiple-scattering contributions can be suitably defined: (i) the intensity term, (ii) the full polarization state as a function of energy, (iii) the number of collisions, and (iv) the involved processes.
MCSHAPE3D, the 3D extension of the code [2], simulates the propagation of photons in complex heterogeneous media originating from either polarized or unpolarized sources and, therefore, represents a valuable tool for the simulation of scanning XRF experiments, XRF tomography and for the interpretation of the experimental results of any technique involving photon-matter interactions requiring a 3D description of the experiment.
The influence of the detector is considered by means of a two stage procedure [3]. In the first stage, MCSHAPE computes the diffusion of the incoming photons into the detector. In the second stage, the broadening and the energy resolution (which depends specifically on the detection mechanism) and the influence of the electronics (pulse-pile up) are included by means of the independent codes MCPPU [4] and RESOLUTION [5], respectively.
It is well known that the most accurate description of the radiation field in X-ray spectrometry requires the modelling of coupled photon-electron transport, because Compton scattering and photoelectric effect give both photons and electrons as secondary particles. Photon transport codes usually neglect electron contributions since the solution of the coupled problem is time consuming. Nevertheless, secondary electrons contribute to the photon field through electron-photon conversion mechanisms like bremsstrahlung (which produces a continuous photon spectrum) and inner-shell impact ionization (ISII) (which modifies the intensity of the characteristic lines). The approach adopted recently by Fernandez et al. [6] allows to introduce a new photon kernel comprising the correction due to ISII. The new kernel is suitable to be adopted in photon transport codes with a minimal effort. The study of the bremsstrahlung contribution is under development [7].
Simulations with the latest version of the code taking into account the detector response function and the energy resolution are compared with experimental data.

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Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **117** Type: **not specified**

Ionization Effect From Ultra Relativistic Electron-Positron Pair in Thin Plate

Monday, 6 October 2014 12:45 (15 minutes)

In the present work the theory of ultra relativistic electron-positron pair ionization loss in thin plate, situated on different distances from the substance in which the pair is created (which corresponds to the experimental situation of [1]) is developed. It is shown that in this case the transition radiation which occurs during the pair emission from substance may significantly influence upon the pair ionization loss in thin plate. In this case the effect of pair ionization loss reduction takes place on much larger distance from the pair creation point than in infinite medium. Moreover it shown that in this case the effect opposite to the one of Chudakov may occur, which means that the pair ionization loss in plate may exceed the sum of separated electron and positron losses. The conditions for manifestation of such effect are discussed.

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Session Classification: S1: Channeling & Radiation in Crystals

Contribution ID: **118** Type: **Oral**

Combined Effect in the Coherent Bremsstrahlung

Monday, 6 October 2014 10:15 (15 minutes)

In the present paper we investigate the combine effect in CB from axially channelled electrons. To study this combine effect we modified method of virtual photons, taking into account the channelling of the radiating particles.

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Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **119** Type: **Poster**

PS1-09: Creation of Electron-Positron Pairs by Channelled Positrons

Monday, 6 October 2014 17:00 (1h 30m)

In the present report we consider the cross - symmetrical process to the channelling radiation the electron - positron pair production by channelled positron. We derive the differential over emission angles cross - section of the electron - positron pair production by channelled positron. The angular distribution of created electron and positron is investigated. The dependence on initial positron longitudinal energy is studied.

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Session Classification: PS: Poster Session

Contribution ID: **120** Type: **Oral**

Bent Crystal Extraction from a 100 TeV Proton Collider

Wednesday, 8 October 2014 12:15 (15 minutes)

Proposal on the crystal assisted extraction of halo particles from a new 100 TeV proton collider which is under study in CERN is presented. It is suggested to produce a horisontal dogleg with the Lambertson magnet in a straight section of the collider as it was planned for a Super Fixed Target Beauty Fasility at the SSC. In this case the deflection angle of about 100 μrad or even smaller may be sufficient for the collider beam halo extraction. The critical bend radius Rc of the (110) silicon channels for channeling of 100 TeV/c protons is about 167 m. The crystal bend radius should be 5–10 Rc to ensure a maximal extraction efficiency. So, the crystal length should be 8–16 cm to obtain the required deflection of 100 μrad for channeled particles. The estimations show that the extraction efficincy of the collider beam halo can be about 90%. The extraction of a natural halo provides both the the collider beam collimation and the external beam for experiments with fixed targets.

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Presenter: Prof. KOVALENKO, Alexander (Joint Institute for Nuclear Research)

Session Classification: S4: Charged Beams Shaping

Contribution ID: **121** Type: **Invited talk**

Multivariable and Multiindex Bessel Functions: A computational tool for Electromagnetic Processe

Thursday, 9 October 2014 12:30 (30 minutes)

Scattering processes which cannot be treated in dipole approximation demand for the use of analytical tools going beyond the ordinary special functions and in particular beyond the use of cylindrical Bessel function of first kind. The emission of radiation by relativistic electrons in linearly magnetic undulator and the scattering by intense laser radiation as well require the use of "new"forms of Bessel functions, with many variables, which, albeit introduced in the last century, are not widespread popular as they should be.
Their use in QED and in processes associated with multi-photon ionization has been proven to be extremely useful and capable of providing the relevant physical quantities in an extremely concise and easily computable form.
Other forms of "exotic"Bessel functions concerning the case with many indices provides a powerful computational tool for processes involving the emission by charged particles interacting with multi-frequency oscillating fields or in magnetic structures like undulators with different periods.
In this seminar we review the essential properties of these families of special functions, their relationship with the ordinary forms and their use for specific applications.

Primary author: Dr DATTOLI, giuseppe (enea)

Presenter: Dr DATTOLI, giuseppe (enea)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **122** Type: **Oral**

Effective Mass of a Photon in Strong Fields

Monday, 6 October 2014 15:00 (15 minutes)

An effective mass of photon in a strong magnetic field of the same order or more than the Schwinger critical field is investigated. Obtained expressions include the singular terms with the root divergence at the thresholds of electron and positron creation on Landau levels. In high-energy range, when the number of thresholds is large, the quasiclassical approach is used. In this region the effective mass of photon and the radiation mass of created electron and positron can become much more than the bare mass. Then, for the particles involved in the process, we use the well-known Schwinger equation for the charged particles and the Dyson equation for the photon.

Primary author: Mr KATKOV, Valeriy (BINP)

Presenter: Mr KATKOV, Valeriy (BINP)

Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **123** Type: **Oral**

Non-Proliferation Research with Laser Backscattered X-rays.

Laser-Compton Scattering (LCS) is the exchange of energy between a relativistic electron beam and a laser beam. Laser photons interact with high-energy moving electrons (in the MeV region or higher) and the electrons scatter these low energy photons to a higher energy at the expense of the electrons'kinetic energy. This interaction results in the emission of highly directed, quasi-monochromatic, highly polarized and tunable x-ray beams. LCS x-ray energy tunability can be achieved by either changing the electron beam energy, the laser wavelength, interaction or observation angle. This allows LCS to be a truly versatile x-ray source for a variety of applications. We have shown in previous articles that LCS x-rays can be used for electron beam diagnostics and biomedical imaging. We will show in this presentation that LCS as an x-ray source can also be used as a non-invasive means for identification and quantification of actinide elements in Liquid Samples.

Primary author: Prof. CHOUFFANI, khalid (Idaho Accelerator Center)

Presenter: Prof. CHOUFFANI, khalid (Idaho Accelerator Center)

Contribution ID: **124** Type: **Oral**

Coherent Bremsstrahlung of 50 MeV Energy Relativistic Electrons in Quartz Single Crystal Under the External Acoustic Oscillations

Tuesday, 7 October 2014 18:00 (15 minutes)

The work is devoted to the suppression of a few peaks in spectral distribution of coherent bremsstrahlung radiation of the relativistic electrons with 40-50 MeV energy and obtaining of new coherent intensive peaks at the presence of external acoustic field of 1.024 GHz frequency. It was experimentally shown that a new peak appear in the range of ~1keV. The quartz single crystal of X cut with the thickness of 0.6 mm is used as a target. The obtained results well coincide with the theoretical calculations.

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Presenter: Dr GHALUMYAN, Arsen (A. Alikhanian National Laboratory (Yerevan Physics Institute), Armenia, 0036, Alikhanian Br. Str. 2)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **125** Type: **Oral**

Proposal of A Compact Coherent X-ray Source for The Medical Imaging Use Based on An Energy-Recovery Linac and Parametric X-ray Radiation

Monday, 6 October 2014 18:00 (15 minutes)

The development of compact x-ray generator based on the electron cryo-linear accelerator has been studied in collaboration with Nihon university, High energy accelerator research organization and Toyama. To realize highly sensitive phase contrast imaging at clinics, a parametric x-ray radiation (PXR)-based source is one of attractive candidates[1-3]. However, the monochromatic x-rays of 109 to 1010 flux are required for practical medical use. Since recent studies on PXR have shown that the available x-ray flux is increased by using an asymmetric cut crystal as a PXR radiator, it is supposed that the necessary x-ray flux should be sufficiently achieved using a 75 MeV high duty electron linac with average current of 20-30 uA. With respect to the electric power consumption, it is not so difficult to develop the linac of such performance. A significant problem for medical use is the dimension of the building in which the x-ray generator is installed, which is dominated by the size of liniac and the volume of the radiation shield. Therefore, a normal-conducting compact energy recovery liniac (ERL) for a PXR source has been planned in the design study to reduce the dimension of the machine and the surrounding radiation shield. Study on the element technologies is under way, including development of high Q-value accelerating cavities made of high purity copper materials. For the present, the specifications normal conducting ERL was determined on the basis of the results of the simulation study.

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Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **126** Type: **Oral**

Soft X-Ray Coherent Bremsstrahlung Induced by Hypersonic Waves

We investigate the coherent bremsstrahlung of soft X-rays from 50 MeV electrons moving in a single crystal under the influence of hypersonic waves. The consideration is done for an arbitrary profile of the deformation field generated by the hypersound. The coherent effectsdominate when the electron enters into the crystal at small angles with respect to a crystallographic axis. With dependence of the parameters, the hypersound can either enhance or reduce the bremsstrahlung cross-section. We show that the presence of the hypersound induces relatively strong peaks in the spectral distribution of the radiated photons in the range of soft X-rays. The numerical examples are given for the SiO2 crystal with the deformation field generated by a transversal wave of the S-type.

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Co-author: Prof. SAHARIAN, Aram (Institute of Applied Problems in Physics)

Presenter: Prof. SAHARIAN, Aram (Institute of Applied Problems in Physics)

Contribution ID: **127** Type: **Poster**

PS3-26 Low Energy Coherent Bremsstrahlung of 50 MeV Energy Relativistic Electrons in Quartz Single Crystal under the External Acoustic Oscillations

Thursday, 9 October 2014 17:00 (1h 30m)

A.R. Mkrtchyan, A.H. Mkrtchyan, A.A. Saharian, V.R. Kocharyan, A.S. Ghalumyan, V.Ts. Nikoghosyan, A.Z. Babayan, E.M. Harutyunyan, V.V. Nalbandyan, H.R. Muradyan, G.A. Ayvazyan, A.I. Soghomonyan, V.V. Margaryan, A.E. Movsisyan, E.H. Baghdasaryan, S.A. Miraqyan

The work is devoted to the suppression of noncoherent bremsstrahlung radiation of the relativistic electrons with 40-50 MeV energy and the obtaining of new coherent intensive peaks at the presence of external acoustic field of 1.024 GHz frequency. It was experimentally shown that a new peak appears in the range of ~1keV. The quartz single crystal of X cut with the thickness of 0.6 mm was used as a target. The obtained results well coincide with the theoretical calculations [1].

[1] A. R. Mkrtchyan, A. A. Saharian. Soft X-ray coherent bremsstrahlung induced by hypersonic waves. Channeling 2o14, 5-10 October 2014, Capri-Naples, Italy.

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Session Classification: Poster Session

Contribution ID: **129** Type: **Oral**

Deflection of Positively Charged Heavy Particles by the Crystal Miscut Surface

Friday, 10 October 2014 12:50 (15 minutes)

Let consider the beam of high-energy heavy particles (protons, ions or nuclei) propagates along crystal surface. Let suppose simultaneously the planar channeling conditions [1] are fulfilled for some crystallographic planes and these planes are forming the small angle with the crystal surface. This angle is namely so-called miscut angle [2]. It was shown the averaged potential approximation could be applied to describe the motion of particles when the beam hits the crystal surface at small glancing angle if the surface coincides with the crystallographic plane [3]. The particle can be reflected by the surface potential barrier or it penetrates into the crystal bulk where it moves in quasichanneling or channeling regime.

On the other hand when miscut angle exists the surface layer could be considered terrace-shaped: it consists of the number of planes that have successively decreasing length. Hence, the field of the surface layer consists of acute channel fields: when the particle penetrates into the crystal field first it will interact with the field of the single plane and after that it can interact with the channel field. It worth noting the deflection at the initial single-plane site could be large enough and particle will not reach the channel. If particle reaches the channel it will be further channeled or quasichanneled [4]. The miscut surface brings the possibility of multiple terrace deflection when the particle is successively deflected by several single-plane fields. This effect results in the deflection angle exceeding the deflection angle due to the interaction with the single planar barrier.

The theory of beam deflection by the terrace crystal field formed by the miscut surface was developed. The phenomenology of both channeling and quasichanneling has been applied to describe new features of the beam deflection. The computer experiment results on the beam deflection by the crystal miscut surface are presented. The analysis predicts efficient beam deflection by the acute crystal end due to repelling miscut potential. Results could be interesting in view of the beam collimation by crystals.

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Presenter: BABAEV, Anton (LNF)

Session Classification: S6: Crystal Simultaion Routines for Particle Accelerators : Comparison and Benchmarking with Experimental Data

Contribution ID: **130** Type: **Poster**

PS1-18: Continuous Potentials of Crystallographic Axes for a Series of Single Crystals

Monday, 6 October 2014 17:00 (1h 30m)

A two-dimensional periodic (the so-called continuous) potential ... is studied, that is obtained by replacing the true potential of a single crystal by the potential averaged (i) over all atomic chains, which are parallel to the selected crystallographic axis of a single crystal, and (ii) over the thermal vibrations of atomic cores of the single crystal: ...=... (Z-axis of the cylindrical coordinate system ...=... is parallel to the selected crystallographic axis).

The numerical results for different crystallographic axes of a series of single crystals (silicon, quartz, lithium niobate, etc.) are given in the form of tables, graphs, as well as analytical expressions (in which the deviation of ... from axial symmetry is taken into account). For evaluation of the accuracy of obtained results in numerical calculations different familiar approximations for the potentials of atomic cores of single crystal have been used. The obtained results are compared with previously made corresponding calculations (see, e.g.. [1-5]).

The obtained results may be used for investigation of the effect of the single crystal on high energy electromagnetic processes (e.g., the radiation from relativistic electrons and positrons axially channeled in single crystals [1-5]).

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Session Classification: PS: Poster Session

Contribution ID: **131** Type: **Poster**

PS1-14: Angular Momentum of Channeling Radiation from Relativistic Electrons and Positrons

Monday, 6 October 2014 17:00 (1h 30m)

Electromagnetic waves is proven [1] to possess an intrinsic angular momentum. Two alternative and concordant approaches to the definition of the theory of the angular momentum of the electromagnetic field and general properties of the angular momentum of synchrotron radiation are described in [2].
The computer code BCM-1 [3] is able to calculate the trajectories of electrons and positrons at planar and axial channeling, as well as the corresponding radiation spectra. Previously this code was applied to calculate the angular-of-incidence of the total yield of the channeling radiation from the electrons [4].
In this paper, using the developed code BCM-1 we consider the orbital and spin angular momentum of the radiation from (100) channeled electrons and positrons in the thin Si, C and W crystals. The energies of electrons and positrons is chosen to be 155 (INFN-LNF) and 255 MeV (SAGA-LS). The possibility of experimental detection of such properties of channeling radiation is discussed.
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Session Classification: PS: Poster Session

Contribution ID: **132** Type: **Poster**

PS2-27: Laue Lenses for Hard X-rays with Controllable Parameters

Tuesday, 7 October 2014 17:00 (1h 30m)

In the works [1] it was first observed that the phenomenon of the full pumping of X-rays from transmitted direction to the reflection direction in single quartz crystals in the Laue geometry under the influence of the temperature gradient or acoustic vibrations. In work [2] it is shown that the angular width of the full pumping radiation is directly proportional to the thickness of the sample. One of the important processes in the control of X-rays parameters in space and time is its focus. The papers [3] experimentally and theoretically show that with the help of acoustic field and temperature gradient it is possible to control the location of the focus of the diffracted beam in space and time, as well as convert a spherical wave into a plane wave.
In order to obtain monochromators and with the controllable parameters in the range of hard X-rays (30-200 Kev) we study the X-ray diffraction in the Laue geometry for white beams in single quartz crystals under the influences of the temperature gradient and acoustic vibrations. The high controllability of monochromaticity, intensity and focal length of the parameters of hard X-rays is shown.

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Session Classification: PS: Poster Session

Contribution ID: **133** Type: **Poster**

PS2-22: Generation of Neutrons by Channeling Radiation from Relativistic Electrons

Tuesday, 7 October 2014 17:00 (1h 30m)

We present the results of calculations of the neutron yield using CR generated by initial electrons with energies 200 - 1600. MeV (SPARC Facility, LNF) focused on Be and D targets. The comparison with other methods of generation of fast neutron beams (with neutron energy up to several MeV) is performed, especially with so called "neutron focus in the field of synchrotron radiation".

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Session Classification: PS: Poster Session

Contribution ID: **134** Type: **Poster**

PS1-15: Spatial-Angular Distributions of Relativistic Electrons Under Channeling in Half-Wave Crystals and Corresponding Radiation

Monday, 6 October 2014 17:00 (1h 30m)

We present the result of the experiments and comparison with computer simulation and analysis of channeling radiation spectra in HWC as well. The comparison with radiation spectrum from an electron moving in an arc(never studied experimentally) is also performed.

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Presenters: Dr TUKHFATULLIN, Timur (National Research Tomsk Polytechnic University); Prof. PIVOVAROV, Yury (National Research Tomsk Polytechnic University)

Session Classification: PS: Poster Session

Contribution ID: **135** Type: **Oral**

Investigation of Optical Diffraction Radiation for Non-invasive Diagnostics in Circular Accelerators

Thursday, 9 October 2014 10:45 (15 minutes)

Diffraction Radiation (DR) is generated when a charged particle moves in the vicinity of a medium (e.g. passes through an opening in a conducting screen in vacuum). Non-invasive nature and a broad DR radiation spectrum enables to develop non-invasive beam diagnostics instrumentation for a variety of particle beam parameters, e.g. transverse beam size and position, emittance, bunch length, beam energy, arrival time, etc.

Optical DR (ODR) has intensively been investigated over the past two decades as a tool for non-invasive transverse beam size measurements [1-3]. In [1] the resolution as small as 14 μm was demonstrated. Later in [3] the authors have claimed to have achieved a similar resolution. However, modern and future accelerators require an order of magnitude smaller resolution, which informs us that new technological ideas and solutions need to be found.

Recently we have proposed an ODR technique for a Cornell electron synchrotron radiation Test Accelerator (CesrTA). Usually diagnostics based on synchrotron radiation are used in circular machines. One aim of the experimental work is to investigate the feasibility of ODR as an alternative method for beam size diagnostics. The second aim is to study the effect of a small slit onto the circulating beam.

We have designed the hardware system consisting of a vacuum vessel including a replacement chamber for normal operation and target assembly, optical light transport and detection system, and data acquisition. A series of experimental tests has been performed. In this report we shall present the experimental investigation of the beam lifetime, contribution of synchrotron radiation and its suppression, observation of ODR image and angular distribution (including ODR interference pattern produced by the SR suppression mask), prospects for the beam size measurement and the plan for the next three years.

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Session Classification: S2: Channeling & Radiation in Various Fields

Contribution ID: **136** Type: **Poster**

PS2-09: Experimental Investigation of Interference Effects on Transverse Beam Profile Measurements using OTR Imaging

Tuesday, 7 October 2014 17:00 (1h 30m)

Optical Transition Radiation appearing when a charged particle crosses a boundary between two media with different dielectric properties has widely been used for transverse beam size, energy spread, position, and emittance diagnostics. Recent developments have demonstrated an ability to achieve sub-micrometre resolution for transverse beam size measurements [1]. However, a high power beam might generate a serious background (e.g. synchrotron radiation). The background is difficult to predict. On the other hand it might significantly distort the measured beam profile and create a false opinion about the beam parameters. At higher energies the situation might be even more severe. The integral OTR photon yield logarithmically depends on the beam energy, however the background radiation dependence could be much stronger, e.g. SR power depends on the beam energy as E4.

We propose to shield the OTR screen from any background radiation with a thin metallic film placed in front of the screen. However, the beam will generate forward OTR from the film, which might destructively interact with backward OTR from the screen distorting its characteristics. The initial interference of the backward and forward OTR were demonstrated in [2] and is known as Wartski interferometer.

In [3], where the authors studied diffraction radiation interference, they demonstrated that if the distance L between two screens is much less than a critical distance Lc = γ^2 λ/2π known as coherence or radiation formation length, the radiation photon yield is significantly suppressed. However, in this experiment the electron energy is low such that when the distance satisfies the requirement, it becomes comparable to the measured wavelength. In that case classical Wartski approach does not work. On the other hand, in [4] the authors have studied a possibility to use multi-OTR screens for single short emittance measurements at 3 GeV beam of Diamond booster synchrotron. They did not observe any affect on the beam profile by forward OTR from upstream screens.

We decided to investigate experimentally the effect of forward OTR on the beam size measurements in conventional OTR monitors at the CTF3 facility at CERN. The test will elucidate the mechanisms of OTR interference over a range of distances from “zero”up to approximately twice the coherence length LC. In addition, it will serve as a simulation benchmark for the more complicated ODR case. We shall represent the hardware status, theoretical expectations, and the near future experimental plan.

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Session Classification: PS: Poster Session

Contribution ID: **137** Type: **Oral**

Advanced Studies on the PolyCO Optics Use at XLab-Frascati

Tuesday, 7 October 2014 10:30 (15 minutes)

Review on the status of Polycapillary Optics from design and fabrication to various applications will be done performing comparative analysis of the results on the use of different X-ray optical elements by several groups.
The main accent will be highlighted to advance tools for X-ray Imaging and Spectroscopy based on combination of modern polycapillary optics and own reconstruction software together with commercially available systems.
Recent results obtained at XLab-Frascati will be discussed.

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Presenter: HAMPAI, Dariush (LNF)

Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **138** Type: **Oral**

Spatial-Angular Distributions of Reltivistic Electrons Under Channeling in Half-Wave Crystals and Corresponding Radiation

Wednesday, 8 October 2014 09:45 (15 minutes)

Primary author: Dr TUKHFATULLIN, Timur (National Research Tomsk Polytechnic University)

Session Classification: S4: Charged Beams Shaping

Contribution ID: **139** Type: **Poster**

PS2-28: Intensive Laue Monochromator for Hard X-rays

Tuesday, 7 October 2014 17:00 (1h 30m)

In the works [1,2] it was first observed that the phenomenon of the full pumping of X-rays from transmitted direction to the reflection direction in single quartz crystals in the Laue geometry under the influence of the temperature gradient or acoustic vibrations. In work [3] it was experimentally and theoretically shown that with the help of an acoustic field and temperature gradient it is possible to control the focus location of the diffracted radiation in the space and time.
For the purpose of obtaining a monochromator and a lens with controllable parameters in the range of hard X-rays (30-200 keV) the diffraction of X-radiation in Laue geometry form a quartz single crystal under the influence of a temperature gradient is considered. It is experimentally considered the dependence of the intensity of the diffracted X-radiation of 40 keV from the reflecting atomic planes (10-11) upon the temperature gradient value. The experiment was carried out on the white beam X-ray of Mo anode radiation. As a sample was used quartz single crystal of X-cut with the thickness of 6mm. It was observed the intensity increase of the reflected beam up to 35 times, simultaneously the focusing effect of the reflected beam was observed.

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Session Classification: PS: Poster Session

Contribution ID: **140** Type: **Poster**

PS3-17 Band Structure of Transverse Energy Levels of Relativistic Planar Channeled e- and e+

Thursday, 9 October 2014 17:00 (1h 30m)

It is shown that the band structure which calculated by the proposed method, agrees with the results obtained by the standard method - by the transformation of the Schrödinger equation with relativistic mass into an algebraic equation using the Fourier series [2-3]. Comparison carried out both for a periodic Pöschl-Teller potential and for the “real” average periodic potential of (220) planes of the Si crystal.

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Presenter: Mr EYKHORN, Yuri (National Research Tomsk Polytechnic University)

Session Classification: Poster Session

Contribution ID: **141** Type: **Oral**

Quantum Jumps in PXRC Angular Distributions from Relativistic Channeled Electrons and Positrons in a Crystal

Monday, 6 October 2014 12:30 (15 minutes)

The difference in angular distributions of the standard Parametric X-Radiation (PXR) from plane-wave electrons (without channeling) and Parametric X-Radiation from channeled electrons (PXRC) is connected with manifestation of two quantum effects: formfactors of transverse quantum channeling states and their initial populations. In the present work we showed that this difference has non-trivial dependence on the electron beam energy: it undergoes some quantum jumps with appearance of the new quantum channeling state following increase of the electron beam energy. The magnitude of the jump depends on the form-factor and initial population of next quantum state.

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Session Classification: S1: Channeling & Radiation in Crystals

Contribution ID: **142** Type: **Invited talk**

Main directions of Armenia's cooperation with other countries in the field of science and innovation. Scientific and Technical Achievements of IAPP NAS RA

Sunday, 5 October 2014 16:30 (45 minutes)

Main directions of Armenia's cooperation with other countries in the field of science and innovation

Primary authors: Dr MKRTCHYAN, Artak (Institute of Applied Problems of Physics NAS RA); Prof. HAROUTIUNIAN, Samvel (Chairman of the State Committee of Science Republic Armenia)

Presenters: Dr MKRTCHYAN, Artak (Institute of Applied Problems of Physics NAS RA); Prof. HAROUTIUNIAN, Samvel (Chairman of the State Committee of Science Republic Armenia)

Session Classification: "CHANNELING PRIMER"

Contribution ID: **143** Type: **Poster**

PS2-14: Full Structure of the Spectra of Polarization Bremstrahlung(PBR) by Fast Electron on Atoms

Tuesday, 7 October 2014 17:00 (1h 30m)

PBR is generated as result of the scattering own Coulomb's field of fast electron on matter electrons. This field can be represented as a stream of virtual photons, scattering them on atomic electrons generates PBR. Therefore PBR is very sensitive to electronic configuration that is of obvious interest to PBR as a possible method of diagnostics of the matter structure of. However, the spectrum PBR is very complicated that is explained by the peculiarities of interaction of the Coulomb field of fast electron with atomic electrons. Really the effectiveness of the scattering of a virtual photon depends on their energy, and also parameters of atom electron shells in the medium. So in the scattering of soft photons with energy smaller than the energy of the K-shell, photons do not provide the atomic electrons their energy and scattered on the atom as on the object if the effective mass was equal to the atom, keeping its frequency (see the effect Franck-Hertz). The same picture is observed with photons with energies that do not match the energies of intra-atomic transitions. The coincidence of the energy of photons and intra-atomic transitions may expect the appearance of the spectral peaks. Concurrently with radiation on linked in the atom electrons for photons with energies larger ionization thresholds will be observed the process of scattering on virtually free atomic electrons. Thus, the analysis PBR should consider the full range of processes, although in the literature only the last processes are usually considered. In the paper contribution of the reviewed processes is discussed.

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Session Classification: PS: Poster Session

Contribution ID: **144** Type: **Poster**

PS2-23: Dose Rate in One-Photon and Two-Photon X-Ray Investigations

Tuesday, 7 October 2014 17:00 (1h 30m)

Reduce the problem of dose loads on biological objects engaged for several decades, especially in the methods of X-ray computed tomography.

The problem of decreasing of dose rate for the biological objects is highly relevant for a last few decades. This is especially important in X-ray computer tomography methods. There are few approaches to solve this problem. One of the most effective of them is contrast-enhanced method [1]. The use of monochromatic X-ray allows to decrease dose rate for investigated objects as it is demonstrated in the works [2, 3]. Also it allows to improve X-ray image quality by increasing of contrast and signal-to-noise ratio in case of usage suitable energies of monochromatic X-ray.

In this work the dose rate of monochromatic X-ray beam produced by RAP 60-25 X-ray tube with power equal to 1200 W was measured. Recommendations for development and creation of visualization system based on advanced semiconductor multichannel detectors were defined.

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Co-authors: Dr WAGNER, Alexander (Tomsk Polytechnic University); GOGOLEV, Alexey; Ms KRASNYKH, Angelina (Tomsk Polytechnic University); Mr CHEREPENNIKOV, Yury (Tomsk Polytechnic University)

Presenter: Mr STUCHEBROV, Sergei (Tomsk Polytechnic University)

Session Classification: PS: Poster Session

Contribution ID: **145** Type: **Invited talk**

Advanced Accelerator Experiments at SPARC_LAB

Thursday, 9 October 2014 14:30 (30 minutes)

A test facility named SPARC_LAB (Sources for Plasma Accelerators and Radiation Compton with Lasers and Beams) is in operation at the INFN National Labs in Frascati, merging the potentialities of an ultra-brilliant electron beam photoinjector and of a high power Ti:Sa laser. The test facility is hosting a 150 MeV high brightness electron beam injector which feeds a 12 meters long undulator. Observation of FEL radiation in various configurations has been performed, including the recently demonstration of the two colors FEL operation. In parallel the 200 TW laser has been commissioned and linked to the linac. It is devoted to explore laser - matter interaction, in particular with regard to laser-plasma acceleration of electrons (and protons) in the self injection and external injection modes. The facility will be also used for particle driven plasma acceleration experiments with possibility to drive an FEL experiment. A Thomson scattering experiment coupling the electron bunch to the high-power laser to generate coherent monochromatic X-ray radiation is also in the commissioning phase and the first >50 keV radiation has been recently observed.
We report in this talk the recent results and the future perspectives of the SPARC_LAB facility in the context of advanced accelerators development.

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Presenter: FERRARIO, Massimo (LNF)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **146** Type: **Poster**

PS3-01 On X-Ray Channeling in a Vibrating Capillary

Thursday, 9 October 2014 17:00 (1h 30m)

A novel study about different types of polycapillary optics utilization is presented. The scope of this study is to achieve efficient radiation collimation that avoids total external reflection into the capillary channel. For this purpose a vibration is induced to emulate a "virtual roughness" on the channel surface.
The transmission properties of the system is studied at different vibrational states and temperatures.

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Presenter: LIEDL, Andrea (LNF)

Session Classification: Poster Session

Contribution ID: **147** Type: **Poster**

PS3-04 Computer Simulation of Low-Energy Ion Near-Surface Implantation at Channeling Conditions and Different Mass Ratio of Colliding Particles

Thursday, 9 October 2014 17:00 (1h 30m)

Ion implantation has become a very important technique for modifying surface and impurity doping of semiconductors. The ion implantation processes lead to change of a profile of composition and structure of the subsurface layers. Using glancing-angle ion implantation for surface modification rather than conventional near-normal incidence ions allows expanding the energy range up to ~10 keV and has the advantages of reducing damage (such as crater formation) and preferentially removing surface asperities leading to flat surfaces. This is due to the peculiarities of sputtering processes at grazing incidence. Channeling of low-energy ions in metal and semiconductor single crystals offers the opportunity to create the method of local ion implantation in ultrathin film nanotechnology and surface nanoengineering. Therefore, ranges, energy losses and profiles of distribution of low-energy ions channeling in crystals have receive considerable experimental and theoretical interest.

In the present work for revealing of the influence of colliding particles mass ratio (m2/m1 is the mass ratio of target atom and ion, respectively) on the ranges, energy losses and profiles of distribution the channeling of 1÷5keV P+ ions in Si(110) and SiC(110) at normal incidence and 1 keV Be+ and Se+ ions in GaAs(100) at glancing incidence is carried out by computer simulation in binary collision approximation.

The m2/m1 values for P+ ions colliding with Si and C target atoms are equal to 0.9 and 0.39, correspondingly, (m2/m1 <1: inverse mass ratio), for Be+ ions colliding with Ga and As atoms are equal to 7.74 and 8.31, correspondingly, (m2/m1 >1: direct mass ratio) and for Se+ colliding with Ga and As target atoms - to 0.88 and 0.95, correspondingly, (m2/m1 <1: inverse mass ratio). Si, SiC and GaAs crystals have a great importance, because of their use in semiconductor technologies. Especially, silicon carbide exhibits a large band gap, a higher break down field, a higher thermal conductivity, and a higher saturation velocity, compared to widely used silicon. Now β –SiC(110) is widely used as an heterogeneous catalyst.

The (100) surface of GaAs semiconductor is one of the most widely used surface in both homo- and hetero- epitaxial growth for the manufacturing of electronic devices. Implantation of Be and Se into GaAs allows to make the acceptor and donor impurities in this semiconductor. For small crystal depths the approaches which are used in the analytical theory of orientation effects on the large depths, become unacceptable and a computer simulation methods for the channeling process modeling appears to be the most preferable. So, the theoretical investigation of atomic collision processes in crystals caused by particle irradiation and deposition is usually done using computer simulation because real physical conditions (e.g. complicated inter-atomic interaction potential, surfaces, interfaces, defects) can be taken into account much easier than it possible by using analytical methods.

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Session Classification: Poster Session

Contribution ID: **148** Type: **Oral**

Accumulation of Thermal Neutrons

Tuesday, 7 October 2014 12:45 (15 minutes)

In the work [1] it was first observed the phenomenon of the full pumping of thermal neutron beams from transmitted direction to the reflection direction from the reflecting atomic planes (101 $^{-}$1) of single quartz crystal in the Laue geometry under the influence of the temperature gradient. In [2] considered theoretically the problem of diffraction of the neutron beam in single crystals under the influence of acoustic vibrations and temperature gradient in the Laue geometry. A good agreement between theoretical calculations and experimental results was observed.
In this paper we consider the possibility of accumulation of thermal neutrons using the phenomenon of complete transfer of thermal neutron beams in the direction of reflection under the influence of acoustic fields.
Estimates show that it is possible to accumulate neutrons, increasing the intensity of the 2-3 order.

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Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **149** Type: **Oral**

3D Structure of Liquid Sprays: X- Ray μ-Radiography and Tomography by Polycapillary Based Technique

Tuesday, 7 October 2014 10:45 (15 minutes)

This work reports the results of a X-ray μ-tomography for investigating the inner structure of high pressure fuel sprays. X-ray imaging is widely used in a multitude of industrial applications where non-destructive tests are required for high accuracy measurements of samples morphology. Synchrotron X-ray source is generally used for fuel sprays investigation because its high flux radiation can overcome the troubles linked to the low absorption of hydrocarbon chains as fossil fuels. Recently, a desktop facility has successfully used to characterize high pressure gasoline sprays for automotive applications [1]. A X-ray tube coupled with polycapillary optics provided low divergence, high flux beam. This paper reports the last improvement concerning the quantitative measurements preformed on fuel sprays.

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Presenter: Mr MARCHITTO, Luca (Istituto Motori - CNR)

Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **150** Type: **Oral**

Monte Carlo Simulation of a Collimation System for Low-Energy Beamline (1-5 MeV) of ELI-NP Gamma Beam System

Thursday, 9 October 2014 17:15 (15 minutes)

ELI-NP is one of the three pillars of ELI (Extreme Light Infrastructures) European Project, to be built in Bucharest, Romania. This facility will host the Gamma Beam System (GBS), an intense and monochromatic gamma beam source based on inverse Compton interaction between a high-power laser and an accelerated electron beam produced by a warm linac. The EuroGammaS association, composed by many European research institutes and companies, guided by INFN, will provide the design, manufacturing, installation, commissioning of the GBS, to be completed in 2018.
The gamma beam produced, with energy ranging from 1 to 20 MeV, an energy bandwidth 0.5% and a flux of about 10^8 photons/s, will be devoted to the investigation a broad range of applications, from nuclear physics and astrophysics, to material science and life sciences.
As a result of the inverse Compton interaction, the radiation emitted is not intrinsically monochromatic. In fact, the energy is related to the emission angle, it is maximum in the backscattering direction and decreases as the angle increase. Therefore, the required energy bandwidth can be obtained only by developing specific methods of collimation of the gamma beam, i.e. filtering out the radiation emitted at larger angles.
The angular acceptance of the collimation, needed obtain the required bandwidth, must be continuously adjustable in a range from few hundreds of micro-radians to 40 micro-radians, to operate in the entire energy range. The solution identified is a stack of linear tungsten slits, each with an adjustable aperture, arranged with a relative rotation around the beam axis to obtain, as result of the overlapping, a circular shaped hole.
In order to define the specifications and to design the collimation system for the low-energy beamline (1-5 MeV), a detailed MC simulation activity has been carried out using MCNPX and Geant4. The simulation included the transport of the gamma beam produced in the IP to the collimation system along the vacuum pipes and chambers and relative shielding.
The effectiveness of the collimation system to obtain the required energy distribution, avoiding the contamination due to secondary radiation production, was evaluated. Also, the background generated in the experimental area and the effectiveness of the shielding has been verified.
Furthermore, an analysis of the effects of possible collimation system misalignments, in order to define the mechanical tolerances requirements, was carried out.

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Presenter: GAMBACCINI, Mauro (FE)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **151** Type: **Poster**

PS2-25: Proposal for a Prototype of Portable Micro-XRF Spectrometer

Tuesday, 7 October 2014 17:00 (1h 30m)

Micro-XRF is a powerful instrument for the non-destructive characterization of materials of cultural interest.
At XLab Frascati this technique is already well performed thanks to polyCO set equipment. For instance, micro-XRF 2D mapping have been carried out on different samples, such as painting layers, adobe and pottery.
However, in the cultural heritage field "in situ" analysis are often required. For this reason, the design and realization of a new portable micro-XRF spectrometer equipped with a full lens is proposed.

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Presenter: POLESE, Claudia (LNF)

Session Classification: PS: Poster Session

Contribution ID: **152** Type: **Invited talk**

Compact X-Ray Beams Produced with Laser Plasma Accelerators

Thursday, 9 October 2014 12:00 (30 minutes)

Ultra-bright femtosecond X-ray pulses resulting from the laser beam interacting with a plasma medium have been successfully developed this last decade. An important role in the development of the compact X-ray sources, is given to the laser plasma accelerators, that deliver today high quality and high peak current electron beams. I present here a review of the different schemes that allow to produce such bright X ray beams (betatron, Compton, Bremsstrahlung) and I will discuss about their applications. I'll also discuss on a new concept that allows to extend and control the photon energy range and the number of the emitted X-ray using without requiring additional laser energy or additional laser beam. In the simplest case, electron and laser beams from a laser-plasma accelerator interact with a sub-millimeter structure of nano-wires that are periodically assembled. The driver laser pulse that precedes the electron bunch produces a strong charge separation field on the surfaces of the wires, which acts as an undulator on the following relativistic electrons. The characteristics of emitted light, for a 1 J laser system, can be controlled for example by changing the spatial distribution of the wires, to deliver photons of hundreds of keV energies in a collimated beam.

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Presenter: Prof. MALKA, Victor (LOA (CNRS/ENSTA/Ecole Polytechnique))

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **153** Type: **Invited talk**

Review of Scientific Works of the Institute of Applied Problems of Physics of NAS RA

Review of Scientific Works of the Institute of Applied Problems of Physics of NAS RA

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Presenter: Dr MKRTCHYAN, Artak (Institute of Applied Problems of Physics of NAS RA, 0014, Hr. Nersisyan str. 25, Yerevan, Armenia)

Contribution ID: **154** Type: **Poster**

PS1-17: Hybrid Scheme of Positron Source at SPARC LNF Facility

Monday, 6 October 2014 17:00 (1h 30m)

S.B. Dabagov a,b
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The problem of positron beam generation remains of interest during last decade, in connection with the physics of slow positrons, positronium atom beams and with a developing for effective positron source for electron–positron colliders. Several schemes are suggested for intense positron beam generation [1-4], and all of them use the initial intense photon beam generated in the different ways: bremsstrahlung (BS) and coherent bremsstrahlung, channelling radiation (CR), inverse Compton scattering and even undulator radiation. In the most of suggested schemes initial electron beam of several GeV energy is used.

Here we consider the hybrid scheme of the positron source for SPARC LNF facility (Frascati, Italy). The comparison of the positron yield in thin amorphous converter of 0.1 mm thickness produced by the bremsstrahlung and by planar and axial channeling radiation [5] is performed for the positron energy range 1 10 MeV. It is shown that in the case of using the channeling radiation from 200 MeV electrons (parameters SPARC LNF Frascati) in 10 μm W crystal and radiator of 0.1 mm thickness the rate positrons will be 104–105 s-1.

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Presenter: Mr ABDRASHITOV, Sergei (National Research Tomsk Polytechnic University)

Session Classification: PS: Poster Session

Contribution ID: **155** Type: **Invited talk**

Channeling and Radiation of Ultra-Relativistic Electrons and Positrons in Linear, Bent and Periodically Bent Crystals as Seen from Simulations with MBN Explorer

Tuesday, 7 October 2014 14:30 (30 minutes)

We report results of simulation of axial and planar channeling of electrons, positrons and muons in straight [1] and periodically [2, 3] bent Si crystals. The simulations of trajectories of channelled projectiles with accounting for the all-atom interactions have been performed by solution of the classical relativistic equations of motion using newly developed module of the universal MBN Explorer software package [4].

The efficient algorithms of particle trajectories simulation implemented in MBN Explorer has allowed us to describe planar and axial channeling and radiation processes for different type of charged particles and crystals (of different kind and shape) occurring at different energies. In these simulations we have analysed the particle dechanneling lengths, spectral and angular distributions of radiation emitted in the straight, bent and periodically bent crystals. These simulations elucidate all the elementary events of particle propagation through the crystal that contribute to the overall beam propagation and radiation effects.

The calculation of the spectra as well as the numerical analysis of channeling conditions and properties (acceptance, dechanneling length, etc) have been carried out for different beam energies in the rage between 855 MeV and 10 GeV. The obtained results are in a good agreement with the results of the performed experiments and provide predictions for the experiments on electron and positron channeling ongoing at SLAC [5].

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Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **156** Type: **Oral**

Radiation from Multi-GeV Electrons and Positrons in Periodically Bent Silicon Crystal

Tuesday, 7 October 2014 15:30 (15 minutes)

The channeling process in periodically bent Si crystals is shown [1-3] to efficiently serve for producing highly monochromatic radiation in a gamma-ray energy spectral range. A short-period small-amplitude bending yields narrow undulator-type spectral peaks in radiation spectrum from multi-GeV electrons and positrons channeling through the crystal. Benchmark theoretical results on the undulator are obtained by simulations of the channeling with a full atomistic approach to the projectile-crystal interactions over the macroscopic propagation distances.

The simulations are facilitated by employing the MBN Explorer [4] package for molecular dynamics calculations on the meso- bio- and nano-scales. The classical relativistic equations of motion are used in order to describe the motion of a projectile. The radiation from the ultra-relativistic channeling projectiles is computed within the quasi-classical formalism. The effects due to the quantum recoil are shown to be significantly prominent in the gamma-ray undulator radiation.

We report the results of simulations of channeling of electrons and positrons in low-amplitude crystalline undulator for energies of 855 MeV and 10 GeV. The parameters of projectiles beam and a crystal are matching the parameters in recent and ongoing experimental studies in Mainz Microtron and SLAC facilities.

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1. G. B. Sushko, V. G. Bezchastnov, I. A. Solov'yov, A. V. Korol, W. Greiner, A. V. Solovyov, Simulation of ultra-relativistic electrons and positrons channeling in crystals with MBN Explorer, Journal of Computational Physics 252 (2013) 404-418.
2. G. Sushko, A. Korol, W. Greiner, A. Solov'yov, Sub-GeV electron and positron channeling in straight, bent and periodically bent silicon crystals, Journal of Physics: Conference Series 438 (2013) 012018.
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Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **157** Type: **Poster**

PS1-16: Electron and Positron Channeling in Straight and Periodically Bent Axial Si Channels

Monday, 6 October 2014 17:00 (1h 30m)

In the talk the results of simulations of axial channeling of electrons and positrons in straight and periodically bent Si crystals will be reported and compared with the planar channeling case [1-3]. The simulations of trajectories of channelled projectiles with accounting for the all-atom interactions have been performed by solution of the classical relativistic equations of motion using newly developed module of the universal MBN Explorer software package [4].

The results of simulations were analysed in order to calculate parameters of channeling such as dechanneling length, fraction of channeling particles and its evolution with crystal length. The application of full atomistic approach for calculation of trajectories allows direct comparison of axial and planar cases of channeling. It was shown, that the dechanneling length in axial case is few times smaller than in planar case due to higher local density of atoms along the trajectories of projectiles.

The case of axial channeling of positrons in periodically bent crystal was also studied. It was shown, that the dechanneling length depends strongly on both direction of a beam and direction of crystal bending. This effect can be also described by analysis of the shape of a surface of an average potential energy of a projectile in a channel.

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Presenter: Mr SUSHKO, Gennady (Frankfurt Institute for Advanced Studies)

Session Classification: PS: Poster Session

Contribution ID: **158** Type: **Poster**

PS3-24 The Status of Goniometers for Crystal Collimation Experiment at CERN SPS

Thursday, 9 October 2014 17:00 (1h 30m)

Since experiment at circulating beam of CERN Super Proton Synchrotron has been started in 2009 the need of crystal positioning became a crucial for success of experiment. The present status of experiment on crystal collimation study, experience of development and using of goniometers at CERN SPS is presented.
The working principle, features and performance of goniometers which have been developed for UA9 crystal collimation experiment at CERN SPS are described. The possible improvement and future developments of goniometer are discussed in the presentation.

Primary authors: Prof. CHESNOKOV, Yury (IHEP); Mr GAVRIKOV, Yury (PNPI)

Presenter: Mr GAVRIKOV, Yury (PNPI)

Session Classification: Poster Session

Contribution ID: **159** Type: **Poster**

PS3-25 The Development of Angular Measurement System for Crystal Collimation and Channelling Experiments

Thursday, 9 October 2014 17:00 (1h 30m)

Crystal channelling and collimation experiments are based on precise angular orientation of crystals provided by linear and rotational stages. Autocollimation principle is one of the most optimal, direct and contactless method widely used for precise angular measurements.
In the frame of UA9 crystal collimation experiment at CERN different type of commercial and custom made autocollimators have been used for crystal orientation alignment, measurement as well as for goniometer characterization. The developing of radiation hard laser autocollimator will allow to get on-line and direct control of crystal orientation with possible close-loop operation. One of the important application is characterization of bending crystal parameters based on high-resolution optical scanning deflectometry which could be performed by the similar type of measurement system.
The status, working principle, characteristics of laser autocollimation measurement system for different area of crystal applications are described in the presentation.

Primary author: Mr GAVRIKOV, Yury (PNPI)

Presenter: Mr GAVRIKOV, Yury (PNPI)

Session Classification: Poster Session

Contribution ID: **160** Type: **Oral**

WD-XRS Imaging with Polycapillary Optics

Tuesday, 7 October 2014 10:15 (15 minutes)

A projection type XRF imaging has been studied. We have developed WD-XRF imaging spectrometer using WDS spectrometer, a straight polycapillary optics, and x-ray CCD camera. The advantage of WD-XRS is a high energy-resolution, approximately 40 eV. The problem of the present polycapillary optics will be discussed regarding spatial resolution. Similarly to WD-XRF imaging, XRD imaging spectrometer was developed in the laboratory. This technique will give us chemical imaging. The preliminary result will be shown.

Primary author: Prof. TSUJI, Kouichi (Osaka City University)

Co-authors: Mr YAMANASHI, Masaki (Osaka City University); Mr TAKIMOTO, Yuuki (Osaka City University)

Presenter: Prof. TSUJI, Kouichi (Osaka City University)

Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **161** Type: **Poster**

PS3-09 About the Probability of Close Collisions during Stochastic Deflection of Positively and Negatively Charged Particles by a Bent Crystal

Thursday, 9 October 2014 17:00 (1h 30m)

The probability of close interactions of high-energy positively and negatively charged particles with atoms in a bent crystal was considered as a function of the angle between the initial particle momentum and the bending plane. The results of simulation of positively charged particle motion in a bent crystal show the great efficiency of high-energy positively charged particle deflection by a bent crystal due to the stochastic deflection mechanism and strong reduction of the probability of close collisions during the stochastic deflection in comparison to the planar channeling in a bent crystal.

Primary author: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Co-author: Mr KIRILLIN, Igor (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Presenter: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Session Classification: Poster Session

Contribution ID: **162** Type: **Invited talk**

Status of QED in Radiation by Relativistic Electrons in Matter

Monday, 6 October 2014 09:00 (45 minutes)

Radiation by relativistic electrons in matter, near matter or in external field, from Channeling to Smith-Purcell radiations, are compared regarding
1) the emission mechanisms. Is it direct or via medium polarization? classical or quantum ? target-coherent ? bunch-coherent ? dipole or non-dipole ? in weak or critical QED field ?
2) the radiation qualities: intensity, hardness, line width or cutoff frequency, collimation, polarization.
3) the theoretical methods: Equivalent Photons, Reciprocity theorem, Synchrotron-approximation, Born approximation, etc.
The conflict between classical sum rule and quantum recoil is arbitrated. Effects associated to formation length, target density, impact parameter and shadowing, for instance the LPM effect, are briefly discussed.

Primary author: Mr ARTRU, Xavier (Université Lyon-1, CNRS/IN2P3, IPNL)

Presenter: Mr ARTRU, Xavier (Université Lyon-1, CNRS/IN2P3, IPNL)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **163** Type: **Oral**

About Multiple Scattering of High Energy Protons in Crystal Deflectors

Friday, 10 October 2014 09:50 (15 minutes)

The process of multiple scattering of high energy protons in a silicon crystal at its amorphous orientation was studied by simulation of proton trajectories in the model of binary collisions and by simulation of the sequences of proton collisions with atoms when their impact paramters are randomly and uniformly distributed on the symmetry cell for a given crystallography direction. The value of the deflection dispersion obtained by the simulation is in a good agreement with the experiment and allows to describe well the process of multiple scattering in channeling conditions. Different number of proton collisions with atoms are realized along the same crystal length for different crystal orientations. However, the change of the collision number is compensated by the corresponding change of the mean square of deflection angle in a single collision. Therefore, multiple scattering is the same for different crystal orientations. The generator of multiple scattering for amorphous crystal orientations was proposed.

Primary author: Dr TARATIN, Alexander (Joint Institute for Nuclear Research)

Co-author: Prof. SCANDALE, Walter (CERN, European Organization for Nuclear Research, CH-1211 Geneva 23, Switzerland)

Presenter: Dr TARATIN, Alexander (Joint Institute for Nuclear Research)

Session Classification: S6: Crystal Simulation Routines for Particle Accelerators: Comparison and Benchmarking with Experimental Data

Contribution ID: **164** Type: **Poster**

PS1-21: Parametric X-Ray Radiation of 50 MeV Electrons in Crystals

Monday, 6 October 2014 17:00 (1h 30m)

The results of experimental investigation of the phenomenon of parametric X-ray radiation (PXR) emitted by relativistic electrons with 40-50 MeV energy is presented. Comparison results of propagation of PXR either forward or beckward to the motion of relativistic electrons is analyzed. New opportunities for crystal structure analysis with light atoms is offered.

Primary authors: Prof. MKRTCHYAN, Alpik (Institute of Applied Problems of Physics NAS RA); Dr MKRTCHYAN, Artak (Institute of Applied Problems of Physics NAS RA)

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Presenter: Mr MOVSISYAN, Artur (Institute of Applied Problems of Physics NAS RA, Yerevan, Armenia)

Session Classification: PS: Poster Session

Contribution ID: **166** Type: **Poster**

PS1-08: Characteristic X-Ray Radiation Excited by 450 MeV/Nucleon C+6 Ions and 1 GeV Protons in Extracted and Circulated Beams of Accelerator U70

Monday, 6 October 2014 17:00 (1h 30m)

A.G. Afonin1, G.I. Britvich1, Yu.A. Chesnokov1, A.A. Durum1, M.Yu. Kostin1,
V.A. Maisheev1, D.A.Savin1, A.A. Yanovich1, R.M. Nazhmudinov2, A.S. Kubankin2,
N.F. Shul'ga3,4, A.V. Shchagin2,3, S.R. Uglov5, A.S. Gogolev5
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5Tomsk Polytechnic University, Tomsk, Russia

Results of experimental research on observation of characteristic X-ray radiation excited by the extracted beam of C+6 ions [1] and circulated beam of 1 GeV protons are presented. It was found that the background radiation of secondary particles [2] is not as an obstacle for observation of characteristic X-ray radiation spectral peaks at energies from a few to tens of keVs. Spectra of X-ray radiation from a few targets are presented. It is shown that characteristic X-ray radiation can be used for monitoring of the number of particles passed through a non-crystalline target. The applicability of the characteristic X-ray radiation for the monitoring in experiments on steering of proton and ion beams by crystalline deflector as well as for study of parametric X-ray radiation from crystalline deflector is discussed. Authors from Belgorod acknowledge the partial support by the MES of Russian Federation under project 3.2009.2014/K.

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Presenter: NAZHMUDINOV, Ramazan (Belgorod State Ubiversity)

Session Classification: PS: Poster Session

Contribution ID: **167** Type: **Poster**

PS3-11 Semiconductor Detectors with Smoothly Tunable Thickness for Study of Relativistic Charged Particles Ionization Loss

Thursday, 9 October 2014 17:00 (1h 30m)

A.V. Shchagin1,2, N.F. Shul'ga1,3, S.V. Trofymenko1
1Kharkov Institute of Physics and Technology, Kharkov, Ukraine
2Belgorod State University, Belgorod, Russia
3Kharkov National University, Kharkov, Ukraine

The thickness of the depleted zone in a partially depleted semiconductor detector can be smoothly changed by variation of high voltage power supply of the detector [1]. In present paper we propose application of partially depleted semiconductor detectors for measurements of ionization loss of ultra-relativistic charged particle as a function of its path inside the semiconductor. Results of preliminary measurements of most probable ionization loss in Si of electrons emitted from 207Bi radioactive source as a function of the power supply voltage of Si detector are presented. Prospects for application of such detectors for research of evolution of electromagnetic field of the particle which crosses a boundary of a solid target [2] are discussed. The paper became possible partially due to grant SFFR #58/17.

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2. N.F. Shul'ga, S.V. Trofymenko Nucl. Instrum. Meth. B 309 (2013) 167.

Primary author: Dr SHCHAGIN, Alexander (Kharkov Institute of Physics and Tecknology)

Presenter: Dr SHCHAGIN, Alexander (Kharkov Institute of Physics and Tecknology)

Session Classification: Poster Session

Contribution ID: **168** Type: **Poster**

PS3-12 Bent Glass Tube as a Deflector of Powerful Pulsed Moderately Relativistic Electron Beam

Thursday, 9 October 2014 17:00 (1h 30m)

O.C. Druj, V.V. Yegorenkov, A.V. Shchagin, V.B. Yuferov
Kharkov Institute of Physics and Technology, Kharkov 61108, Ukraine

The deflection of the electron beam passing through a bent glass tube without any external power supply is shown experimentally. The incident electron beam was produced by the inductive accelerator with energy 200 keV, current 10 kA, duration 100 ns. The glass tube of length 10 cm was smoothly bent for 170. The imprint of the beam turned for angle 170 in the tube has been observed. The average value of the transverse electric field induced in the tube is estimated. Peculiarities of applications of bent dielectric structures for manipulation of beams of negatively and positively charged particles with relativistic and non-relativistic energies are discussed.

References

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Primary author: Dr SHCHAGIN, Alexander (Kharkov Institute of Physics and Tecknology)

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Session Classification: Poster Session

Contribution ID: **169** Type: **Oral**

Parametric and Characteristic X-Ray Radiation for Diagnostics of Interaction of Ultra-Relativistic Particles with Crystalline Deflectors

Monday, 6 October 2014 10:00 (15 minutes)

A.V. Shchagin
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Belgorod State University, Belgorod, Russia

Usually, results of interaction of relativistic particles with a crystalline deflector are observed as a variation in the angular distribution of the particles. But for recent ten, the understanding of properties of X-ray radiation of relativistic particles moving in a bent crystal has bee developed. Some properties of the parametric X-ray radiation (PXR) emitted in a bent crystal were first considered in [1]. The application of the PXR for online diagnostics of the interaction of the beam with bent crystal was proposed in [2]. In [3], it was analyzed possibility to use PXR for control of the bent crystal degradation. Besides, characteristic X-ray radiation of crystal atoms were used for monitoring of number of electrons passed through crystalline target [4]. More recently, new experiments [5,6] were performed to study X-ray radiation excited by protons in crystalline and non-crystalline targets, but any manifestations of crystal curvature were not observed yet.

In present paper, we discuss different possibilities for application of parametric and characteristic X-ray radiation emitted from crystalline beam deflectors. Some peculiarities of X-rays emitted at different mechanisms of deflections, like channeling, volume reflection, and scattering on atomic rings are considered. Besides, applications of X-rays for monitoring of the beam intensity and for control of crystal alignment on a beam are discussed. The author acknowledges the partial support by the MES of RF under project 3.2009.2014/K.

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Primary author: Dr SHCHAGIN, Alexander (Kharkov Institute of Physics and Tecknology)

Presenter: Dr SHCHAGIN, Alexander (Kharkov Institute of Physics and Tecknology)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **170** Type: **Poster**

PS1-28: Ceramic Accelerator

Monday, 6 October 2014 17:00 (1h 30m)

A.V. Shchagin1,2, V.S. Miroshnik1, V.I. Volkov1
1Kharkov Institute of Physics and Technology, Kharkov, Ukraine
2Belgorod State University, Belgorod, Russia

Usually, pyroelectric crystals are applied in pyroelectric accelerators. In present paper, the possibility for application of polarized ferroelectric ceramics instead of pyroelectric crystals in a pyroelectric accelerator is shown experimentally. Spectra of X-ray radiation with energy up to tens keV excited by accelerated electrons has been observed at heating and cooling of the ceramics in vacuum. Application of curved layers of polarized ferroelectric ceramics as elements of miniature pyroelectric accelerator is proposed and discussed.

Primary author: Dr SHCHAGIN, Alexander (Kharkov Institute of Physics and Tecknology)

Presenter: Dr SHCHAGIN, Alexander (Kharkov Institute of Physics and Tecknology)

Session Classification: PS: Poster Session

Contribution ID: **171** Type: **Oral**

DD Fusion in Conducting Crystals

Monday, 6 October 2014 10:45 (15 minutes)

The paper presents a brief background on cold fusion leading to a discussion on some aspects of atomic physics. We are explaining the selection of the only permitted orbitals of deuterium atoms in conducting crystals when saturated with deuterium. Conduction electrons in metallic crystal are grouped in potential niches of the crystal lattice, resulting in a ban for s-states of hydrogen to occupy these same niches. At the same time, the filling of these niches with deuterium atoms is allowed for the excited atomic states of level 2p and above.

As has been shown in experiments on deuterium-deuterium (DD) fusion with low energy accelerators, if an atom of deuterium target is located within a conducting crystal, this reaction is much more probable than in the case of free atoms of deuterium.

When a single crystal niche gets two such atoms of deuterium, the distance between the nuclei of these atoms becomes equal to 1/10–1/20 of the nominal size of these atoms. Theoretical calculations show that this is equivalent to the additional energy 300–700 eV for the fusion reaction DD⟶4He*.

We believe that this process of excitation of atomic states to the 2p level and above explains the first stage of the so-called cold fusion.

References
1. E. N. Tsyganov, "DD fusion in conducting crystals", Инженерная Физика № 6. 2014, p. 6-13.

Primary author: Dr TSYGANOV, Edward (UTSWMC)

Presenter: Dr TSYGANOV, Edward (UTSWMC)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **172** Type: **Oral**

High Precision Piezo Goniometer for LHC Crystal Experiment

Friday, 10 October 2014 12:10 (15 minutes)

An innovative piezo goniometer that fully fulfils all the requirements for the channeling experiment in the LHC is presented. The piezo rotational stage is based on a specifically designed flexural structure with closed loop position control using a high accuracy interferometric angular sensor. The design guidelines as well as the experimental validation results are also presented.

Primary author: Dr MASI, Alessandro (CERN)

Presenter: Dr MASI, Alessandro (CERN)

Session Classification: S6: Crystal Simultaion Routines for Particle Accelerators : Comparison and Benchmarking with Experimental Data

Contribution ID: **173** Type: **Invited talk**

Toward TeV/m Acceleration: Current Status of CNT-Channelling Acceleration Research at Fermilab's Advanced Superconducting Test Accelerator (ASTA) Facility

Wednesday, 8 October 2014 11:30 (30 minutes)

In principle, crystals, if excited by a short pulse bunch or a high power laser, can hold acceleration gradient of 0.1 - 10 TeV/m since they have a few orders of magnitude higher ambient charge density than gas-state plasma. In the effort to prove the concept, we have been planning a feasibility test of beam-driven channeling acceleration with a carbon nanotubes (CNTs) target. This talk will discuss some preliminary simulation results and present current status of experimental setup at the Fermilab Advanced Superconducting Test Accelerator (ASTA) 50 MeV linac beamline.

Primary author: Prof. SHIN, Young-Min (Northern Illinois University)

Presenter: Prof. SHIN, Young-Min (Northern Illinois University)

Session Classification: S4: Charged Beams Shaping

Contribution ID: **174** Type: **Invited talk**

Polycapillary Optics for Advanced X-ray Instrumentations

Tuesday, 7 October 2014 09:00 (30 minutes)

X-ray optics are powerful and effective tools to focus x-rays into small spots ranging from several 100 µm to world records of a few nm. The demand to reach such dimensions is the interest to have an extreme spatial resolution and getting information about elemental distribution, chemical state, morphology of a sample. The classical x-ray optical components are Fresnel lenses, compound refractive lenses, Kirkpatrick Baez optics, single and polycapillaries. An overview of the theoretical fundamentals and the physics involved for these optical elements is given. In detail the operating principle of single and polycapillaries and the influence of total reflection occurring on the inside walls of the single fibres are discussed. This effect results in changes of the primary spectrum after the passage through the optics and also an energy dependence in the size of the focal spot is observed. The technical instrumentation of a scanning device and its optimization is discussed and moreover the results in the 2-D presentation. A combination of 2 polycapillaries one to focus the primary beam and the second in confocal geometry in front of the detector leads to a depth resolution with the possibility to create by a presentation of the scans layer by layer from the well defined depth to achieve a 3-D image of the sample. In addition corrections for absorption effects can be done which is a necessary prerequisite for quantification procedures. In various setups using these x-ray optical elements classical absorption tomography and mathematical reconstructions can be performed leading to images with high resolution. Achievable results for a setup using special detectors with 300nm polymer windows to detect light elements as well as a portable compact spectrometer for the analysis of art objects will be discussed in detail. Applications and results from various fields and many research groups are presented to show the interesting new world unveiled by the combination of x-ray optics with classical laboratory sources and the brilliant high intensive synchrotron radiation.

- Atominstitut, TU Wien, 1020 Stadionallee 2

Primary author: Prof. WOBRAUSCHEK, peter (Atominstitut TU WIEN)

Presenter: Prof. WOBRAUSCHEK, peter (Atominstitut TU WIEN)

Session Classification: S3: X-Rays/Neutrons/Atoms Channeling

Contribution ID: **175** Type: **Poster**

PS3-19 Influence of Grains Size on Interaction Processes of Fast Particles and Quanta with Mosaic Crystals

Thursday, 9 October 2014 17:00 (1h 30m)

It is well known that microstructure of the crystals essentially influence on interaction processes of fast particles and quanta. On the base of approaches developed for description of X-ray diffraction in mosaic crystals type a and b influence of crystals microstructures on emission observed characteristics such as parametric X-ray radiation and real photons of bremsstrahlung and transition radiation diffraction is analyzed. Influence of grains size and their distribution on the parameters of mosaic crystals measured is discussed. The possibility of grains size estimation and their distribution by means measurements results is analyzed. Possibility of the grains size effect manifestation in experiments on coherent pair production in mosaic crystals of pyrolytic graphite with grain size 1-5 micron is discussed.

Primary author: Prof. VNUKOV, Igor (Belgorod sate university, Belgorod, Russia)

Presenter: Prof. VNUKOV, Igor (Belgorod sate university, Belgorod, Russia)

Session Classification: Poster Session

Contribution ID: **176** Type: **Oral**

Radiation by High Energy Electrons in Ultra Thin Crystal

Tuesday, 7 October 2014 15:45 (15 minutes)

An effect analogous to TSF-effect is possible at passing of particles through thin crystals. In this case, nevertheless, not the Bremstrahlung should be suppressed, but the coherent ultrarelativistic electrons radiation. In the last years a possibility is opened to research experimentally this effect, which is connected with the development of the technology of producing ultra thin crystals (with the thickness of the order of 100 nm), which may be used for this aim. In the present work quantitative calculations of this effect are presented, which allows to define the conditions of its experimental observation.

Primary author: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Presenter: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **177** Type: **Invited talk**

Electromagnetic processes at high energies with "half-bare"particles

Monday, 6 October 2014 14:30 (30 minutes)

In the present report a short review is given of last results on electromagnetic processes at high energies with "half-bare"particles such as transition radiation, Bremsstrahlung in a structured target, coherent radiation in ultrarelativistic crystals, ionization energy losses in a thin layer of matter, process of high energy electron-positron pairs production, etc. Considered are also some possibilities of experimental study of electromagnetic processes connected with the "half-bare"particles at high energies.

Primary author: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Presenter: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **178** Type: **Poster**

PS1-24: Formation Length of Undulator Radiation Emitted by High Energy Electrons

Monday, 6 October 2014 17:00 (1h 30m)

We will report estimation of the formation (interference) length of quantum emitted by the electron passing through the undulator based on statistics of recoils undergone by the electron due to emission of quanta. As it is shown, the number of coherent quanta is inversely proportional to the energy of the electron for a fixed adulator period, and in direct proportion to the undulator for a fixed electron energy.

Primary author: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Co-author: Prof. BULYAK, Eugene (NSC KIPT Kharkov, Ukraine)

Presenter: Prof. SHUL'GA, Nikolai (Akhiezer Institute for Theoretical Physics of NSC KIPT)

Session Classification: PS: Poster Session

Contribution ID: **179** Type: **Poster**

PS3-27 Near-Field Studies of Coherent Transition and Diffraction Radiation

Thursday, 9 October 2014 17:00 (1h 30m)

Advanced accelerator technology, based on plasma structures, produce high brightness electron beams, which can be used to drive advanced radiation sources. Indeed, electron beams to be injected into the plasma and
accelerated in the plasma channel are characterized by small transverse size and ultra-short time duration,
allowing the production of coherent radiation in the THz range. In present work we examine the near field distribution of both CTR and CDR as generated by an electron beam under conditions similar to those of beams extracted from plasma, i.e around 200 pC in 100 fs rms bunch duration.

Primary author: SHPAKOV, Vladimir (LNF)

Co-authors: CIANCHI, Alessandro (ROMA2;LNF); MOSTACCI, Andrea (ROMA1;LNF); CHIADRONI, Enrica (LNF); GIORGIANNI, Flavio; FERRARIO, Massimo (LNF); PETRARCA, Massimo (LNF); CASTELLANO, Michele (LNF); POMPILI, Riccardo (LNF); LUPI, Stefano (ROMA1); DABAGOV, Sultan (LNF)

Presenter: SHPAKOV, Vladimir (LNF)

Session Classification: Poster Session

Contribution ID: **180** Type: **Poster**

PS3-28 Coherence Properties and Diagnostics of Betatron Radiation in Laser-Wakefield Acceleration

Thursday, 9 October 2014 17:00 (1h 30m)

Simulation and detection of betatron radiation in laser-wakefield acceleration are important tasks because they can reveal theoretical and practical information about beam properties in beam-plasma interaction. We present the results of a 3-dimensional simulation with particular attention to the coherence of the radiation. Furthermore we discuss about a single-shot diagnostics to map the spatio-temporal coherence of betatron radiation.

Primary author: Dr PAROLI, Bruno (Universita degli Studi di MIlano)

Co-authors: MOSTACCI, Andrea (ROMA1;LNF); ROSSI, Andrea Renato (MI); CHIADRONI, Enrica (LNF); SERAFINI, Luca (MI); Dr POTENZA, Marco (Dip. Fisica Univ. Milano - INFN Milano); FERRARIO, Massimo (LNF); Dr PETRILLO, Vittoria (Università degli Studi di Milano)

Presenter: Dr PAROLI, Bruno (Universita degli Studi di MIlano)

Session Classification: Poster Session

Contribution ID: **181** Type: **Oral**

Applications and Approaches of Advanced Gamma ray Compton Sources

Thursday, 9 October 2014 17:00 (15 minutes)

A large effort is being pursued world-wide to advance the performances of Gamma ray Sources, in order to improve the spectral density of photon beams in the 1-20 MeV range, where nuclear photonics and nuclear physics science and applications are performed. The enabling technology is Compton back-scattering of high power laser beams by high brightness GeV-class electron beams. One of the most advanced projects in this field is the EuroGammaS machine for the ELI-NP facility.

Primary author: SERAFINI, Luca (MI)

Presenter: SERAFINI, Luca (MI)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **182** Type: **Invited talk**

Laser-Plasma Acceleration of Electrons for Radiobiology and Radiation Sources

Thursday, 9 October 2014 15:00 (30 minutes)

Ultraintense lasers are now delivering high peak power beyond the PW level, with pulse duration as short as 20 fs. Laser-driven acceleration in mm-sized plasmas using multi- TW laser systems is now established for the generation of high energy electron bunches. Depending on the acceleration regime, electrons can be used directly for applications such as radiobiology and radiotherapy or for secondary radiation sources. Inverse-Compton scattering of these electrons with intense laser pulses is being considered for the generation of high energy ɣ-rays and for the investigation of fundamental electrodynamic processes. We discuss the basic mechanisms and describe the latest experimental results.

Primary author: GIZZI, Leonida Antonio (PI)

Presenter: GIZZI, Leonida Antonio (PI)

Session Classification: S5: Novel Sources: FEL/Laser/Plasma Channels

Contribution ID: **183** Type: **Poster**

PS3-02 The Influence of Attenuation Properties of Different Materials on the Results of X-Ray Fluorescence Analysis

Thursday, 9 October 2014 17:00 (1h 30m)

The availability of right reference sample with certified concentrations of all elements of interest often becomes a problem in the SRXRF analysis because of a wide range of objects with different matrices and varieties of element content to analyze. In this case, the mass attenuation coefficients of characteristic radiation in matrices to analyze can be applied to absorption correction, and thus reference samples with attenuation properties different from those of sample to analyze can be used. This expands the range of reference samples and thus increases the number of elements that can be analyzed quantitatively. Information about mass attenuation coefficients of reference samples and those to analyze extends the possibilities of SRXRF analysis and often becomes an essential requirement for obtaining reliable data. In this work the X-ray mass attenuation coefficients for energy of 7-12 keV were measured in biological (mussel and oyster tissues, blood, hair, liver, and cabbage leaves) and geological (Baikal sludge, soil, and alaskite granite) samples. The measurements were carried out at the EXAFS Station of Siberian Synchrotron Radiation Center at the VEPP-3 storage ring (Budker Institute of Nuclear Physics, Novosibirsk, Russia).Obtained experimental mass attenuation coefficients were used to estimate the influence of absorption to the analysis results. SRXRF analysis was carried at the Experimental Station of SRXRF analysis of the VEPP-3 storage ring.

The results of quantitative SRXRF analysis corrected with mass attenuation coefficients for some standard reference materials with different attenuation properties are given in this work.

Primary author: Dr TRUNOVA, Valentina (1A.V. Nikolaev Institute of Inorganic Chemistry SB RAS)

Presenter: Dr TRUNOVA, Valentina (1A.V. Nikolaev Institute of Inorganic Chemistry SB RAS)

Session Classification: Poster Session

Contribution ID: **184** Type: **Poster**

PS3-03 Activation of the Neutron Guides Designed for the European Spallation Source

Thursday, 9 October 2014 17:00 (1h 30m)

Different neutron guide materials are selected for the future European Spallation Source under construction in Lund, Sweden. Many charged particle and neutron sources around the globe have never considered the activation of beam material being exposed to the ionizing radiation. When the operation is terminated or refurbishment of beam lines becomes necessary the beam line scientists face the burden of extremely high radiation doses that hampers the "hands-on operation" and results of unnecessary increase of the radioactive waste volume. For this reason the activation of the neutron guide is an important topic because the replacement of the guides is envisaged after a few years use due to radiation damage, mechanical failure or progress in guide technology. The neutron guides are covered by multiple layers (coatings) in order to maximize neutron reflection. In the past mainly glass materials have been manufactured as a substrate of layers, the aluminium substrate is a new and fast developing solution due to its better mechanical properties. In this paper the difference between glass and aluminium guide design will be examined in terms of activation and radiation protection based on Monte Carlo modelling of particle transport and deterministic modelling of the isotopic inventories. The effect of total reflection on the activation is also examined. The results show that the aluminium substrates in terms of activation have better properties than the frequently used Zerodur (lithium aluminosilicate glass-ceramic) that has low thermal expansion.

Primary author: Dr TOROK, Szabina (HAS Centre for Energy Research, Budapest)

Presenter: Dr TOROK, Szabina (HAS Centre for Energy Research, Budapest)

Session Classification: Poster Session

Contribution ID: **185** Type: **Oral**

ICOSIM++: a Simulation Tool for Crystal Aided Collimation Experiments

Friday, 10 October 2014 11:30 (15 minutes)

UA9 is the crystal-assisted collimation experiment at CERN. In the SPS this experiment successfully demonstrated that bent crystals can work as "smart deflectors"on primary halo particles. The final goal is to use this technique for LHC collimation. A prototype of crystal aided collimation system was installed in the LHC in March 2014. To understand thoroughly the experimental data, and to prepare the future UA9 experiment in LHC, the simulation of the beam collimation process is a fundamental ingredient. Here we present the C++ based tracking code ICOSIM++ that was specifically designed to simulate the collimation of a particle beam in a circular accelerator. The interaction of the beam halo particles with the collimators is treated either by calling tabulated cross-sections or by a call to FLUKA. An interface connecting ICOSIM++ to a Fortran routine simulating the interaction of a proton with a crystal has been added recently. This makes ICOSIM++ an ideal and flexible tool to study crystal collimation. Furthermore, the energies and trajectories of the lost particles are registered for further analysis. Tracking simulation results for the SPS will be shown and compared with SixTrack simulation results.

Primary author: Ms ZHANG, jianfeng (LAL,France)

Co-authors: Dr CHANCE, Antoine (CEA IRFU); Mr MIRARCHI, Daniele (CERN); GALLUCCIO, Francesca (NA); Dr MONTESANO, Simone (CERN); DEMMA, Theo (LAL); Dr SCANDALE, Walter (ROMA1); Dr VARIOLA, alessandro (LAL IN2P3 CNRS)

Presenter: DEMMA, Theo

Session Classification: S6: Crystal Simultaion Routines for Particle Accelerators : Comparison and Benchmarking with Experimental Data

Contribution ID: **186** Type: **Oral**

Handling of Planar Channeling of Particle in Crystals Depending on Their Parameters

Tuesday, 7 October 2014 17:45 (15 minutes)

Consideration of moving of the fast charged particle in crystals within the classical theory framework is possible for protons, ions and other heavy particles of a specific range of energies, whereas for positrons and especially for electrons due to the presence of diffraction effects it is necessary the quantum description.
Redistribution of density of electrons and positrons during their moving and penetration deep into the crystal is considered in presented work in the regime of planar channeling, within the framework of quantum-mechanical theory.
Consequent quantum theory of channeling effect based on the usage of the density matrix formalism is developed in a series of works of Yu.M. Kagan and Yu.V. Kononets. This method allows to take into account the coherent nature of diffraction in the regular medium and inelastic processes accompanying the motion of fast particle in the crystal. As part of this formalism, all the observed phenomena can be explained in a unified way.
The behaviour of reflection coefficient both for rectangular potential barriers and potential holes is investigated for the nearest above-barrier and below-barrier states, as well as the influence of this behaviour on the different physical phenomena arising at planar channeling of electrons and positrons with energies in the MeV-region has been studied.
In the channeling effect of electrons we have established a special role of the above-barrier states, which are placed in close proximity to a potential barrier that, by the way, has allowed to explain the anomalous passage of the above-barrier electrons in crystals, which experimentally was observed at the Nuclear Physics SRI of Tomsk Polytechnic Institute.
Investigation of specificity of the energy spectrum and properties of the Bloch wave functions of the various states arising from the interaction of particles with a regular medium, revealed a special role in the phenomenon of channeling of negatively charged particles of the above-barrier states, manifested in the existence of a fraction of the electrons, which relatively weakly interact with the crystal atoms. As it turned out as a result of our investigations, just these states are responsible for the abnormally deep penetration of the electrons into the crystal under the channeling conditions.
So, realizing the conditions, under which the coherent phenomena have not damped (small thickness of a crystal), and, having measured the yield of inelastic processes on the crystal lattice nuclei, or interstitial impurity atoms, it is possible to find experimentally the periods of appropriate oscillations that will give the information about the energy band structure in case of particles moving in crystal.

Primary author: Dr BABAKHANYAN, Erine (National Research Laboratory after A.I. Alikhanian (Yerevan Physics Institute), Armenia)

Presenter: Dr BABAKHANYAN, Erine (National Research Laboratory after A.I. Alikhanian (Yerevan Physics Institute), Armenia)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **187** Type: **Oral**

The STAR Project

Thursday, 9 October 2014 10:15 (15 minutes)

The Southern european Thomson source for Applied Research (STAR) project ultimate goal is to install, commission and operate a dedicated user facility that produces monochromatic tunable, ps-long, polarized X-ray beams, ranging from 20 to 140 keV. These X-rays will be devoted to peer reviewed experiments dealing with material science, artifacts of archeological significance and advanced radiological imaging. STAR Phase I uses an emittance compensated 1.6 cell S-Band RF Photoinjector operating at a 100 Hz to produce a single electron bunch which is then boosted up to 60 MeV by a single SLAC Type 3 meter Travelling Wave Constant Gradient accelerating structure. For STAR Phase II, a second SLAC 3 meter section can be added to the machine without any significate impact on the user program. A dogleg will bring the beam on a parallel line, shielding the X-ray line from the background radiation due to LINAC dark current. In this talk, we shall present the overall design of the STAR Machine. In particular, we will discuss in detail the Beam Dynamics, RF System, Laser System: (Photocathode and Interaction Laser), and the electron beam diagnostics necessary to operate STAR as a dedicated user facility.

Primary author: Dr PALMER, Dennis Thomas (MI)

Presenter: Dr PALMER, Dennis Thomas (MI)

Session Classification: S2: Channeling & Radiation in Various Fields

Contribution ID: **189** Type: **Oral**

Crystal Channeling as Diagnostics for Low Emittance Beam from Plasma Injection

A method of plasma injection acceleration produces a witness bunch with extremely low emittance. We propose to use crystal channeling to distinguish the low-emittance witness bunch from the drive bunch. From the fraction of channelled particles we can measure the emittance of the witness bunch.

Primary authors: HOGAN, Mark (SLAC National Accelerator Laboratory); Dr LI, Siqi (SLAC); Dr YAKIMENKO, Vitaly (SLAC)

Contribution ID: **190** Type: **Invited talk**

CERN Strategy and Future Large Scale Projects

Sunday, 5 October 2014 14:15 (45 minutes)

The highest CERN priority for the next 20 years is the full exploitation of the Large Hadron Collider and its high-luminosity upgrade (HL-LHC). In preparation for the post-LHC era, the Future Circular Collider (FCC) study develops the design of a 100-TeV c.m. proton-proton collider (FCC-hh), based on 16-T Nb3Sn magnets, a new 100-km tunnel infrastructure, and, possibly, crystal collimators. The FCC study is also designing a high-luminosity e+e- collider in the same large tunnel (FCC-ee, formerly TLEP), serving as Z, W, Higgs and top factory, as a potential intermediate step. In addition, a proton-lepton option (FCC-he) is being explored. Other large-scale accelerator projects considered around the world include ILC in Japan, CLIC, CepC/SppC in China, and US proposals of an even larger hadron collider. Several possible scenarios and alternative evolutions of the CERN complex over the next 100 years are described.

Primary author: ZIMMERMANN, FRANK (CERN)

Co-author: Dr BENEDIKT, M. (CERN)

Presenter: ZIMMERMANN, FRANK (CERN)

Session Classification: ”CHANNELING PRIMER”

Contribution ID: **191** Type: **Round Table**

Propagation of ultra-intense laser pulses in plasma channels and related phenomena

Wednesday, 8 October 2014 18:30 (1h 30m)

The propagation of super-intense and ultra-short laser pulses in plasmas is a main concern in several applications of the laser-plasma interactions, from ICF to HEP. During the propagation in the plasma the light beam deeply changes its parameters, due to the onset of non-linear effects, among them the relativistic regime of the electron quivering motion. These extreme conditions are suitable for the electron acceleration in high field gradient, opening to the realization of compact secondary sources of X-gamma rays. Colleagues from the major laser infrastructures and research centers (CEA, RAL, Ecole Polytechnique, PALS, ...) participating to the Round Table will consider present and future links between the different applications of such physical phenomena.

Primary author: GIULIETTI, Danilo (PI)

Presenter: GIULIETTI, Danilo (PI)

Session Classification: Round Table

Contribution ID: **193** Type: **Oral**

High Energy Channeling and the Experimental Search for the Internal Clock Predicted by L.de Broglie

Wednesday, 8 October 2014 09:30 (15 minutes)

After a short review of the past and recent activities of the Lyon group on high energy particle channeling (with heavy ions, electron and positron beams) and applications, in particular a powerful positron source dedicated to linear colliders using axial channeling radiation, we will concentrate on the experimental investigation of the internal clock, predicted for any particle by Louis de Broglie in 1924, by using high energy electron channeling. A preliminary experiment was performed in France, at Saclay in 198O, by using the ALS facility and then successive tests were performed recently in Italy, at Frascati, at the LNF-BTF facility. In these experiments the resonant behaviour of channelled electron distributions at frequency m0c2/h, was explored by making small steps of the beam energy, which requires very good optical properties for the incident electron beam. Two other methods are now proposed to cross this resonant frequency by tilting the crystal at a fixed incident beam energy. The first was originally developed by S.Datz for the resonant coherent excitation of atoms, by tilting the target crystal in order to perturb the electrons by the frequency with which they pass atoms lying in ordered planes. This planar method is presently experimented by Y.Takabayashi et al at SAGA-LS. The second method could consist in varying the collision frequency by small steps in exploring a series of high index axial directions.

Primary author: Prof. REMILLIEUX, Joseph (Institut de Physique Nucléaire de Lyon)

Presenter: Prof. REMILLIEUX, Joseph (Institut de Physique Nucléaire de Lyon)

Session Classification: S4: Charged Beams Shaping

Contribution ID: **195** Type: **not specified**

Re

Contribution ID: **196** Type: **not specified**

Opening

Sunday, 5 October 2014 13:00 (10 minutes)

Presenter: DABAGOV, Sultan (LNF)

Session Classification: ”CHANNELING PRIMER”

Contribution ID: **230** Type: **not specified**

Greetings from Comune di Anacapri

Sunday, 5 October 2014 13:10 (20 minutes)

Presenter: MAZZARELLA, Pasquale (Vice-Sindaco Comune di Anacapri)

Session Classification: ”CHANNELING PRIMER”

Contribution ID: **231** Type: **not specified**

Greetings from AdSU

Sunday, 5 October 2014 17:15 (15 minutes)

Presenter: Ms TUGUZ, Fatima (Russia)

Session Classification: ”CHANNELING PRIMER”

Contribution ID: **232** Type: **not specified**

Welcome Party at Villa San Michele

Contribution ID: **233** Type: **not specified**

Discussion on ”Crystal Simulation Routines for Particles Accelerators: Comparison Benchmarking with Experimental Data”

Friday, 10 October 2014 13:30 (30 minutes)

Presenter: GALLUCCIO, Francesca (NA)

Session Classification: S6: Crystal Simultaion Routines for Particle Accelerators : Comparison and Benchmarking with Experimental Data

Contribution ID: **234** Type: **not specified**

/Discussions/

Monday, 6 October 2014 18:15 (15 minutes)

Session Classification: S2: Channeling & Radiations in Various Fields

Contribution ID: **235** Type: **not specified**

/Discussions/

Tuesday, 7 October 2014 18:15 (20 minutes)

Session Classification: S1: Channeling & Radiations in Crystals

Contribution ID: **236** Type: **not specified**

Memorial to honour of M. Kumakhov

Monday, 6 October 2014 08:45 (15 minutes)

Contribution ID: **237** Type: **not specified**

Memorial to honour of M. Ryazanov

Monday, 6 October 2014 14:15 (15 minutes)