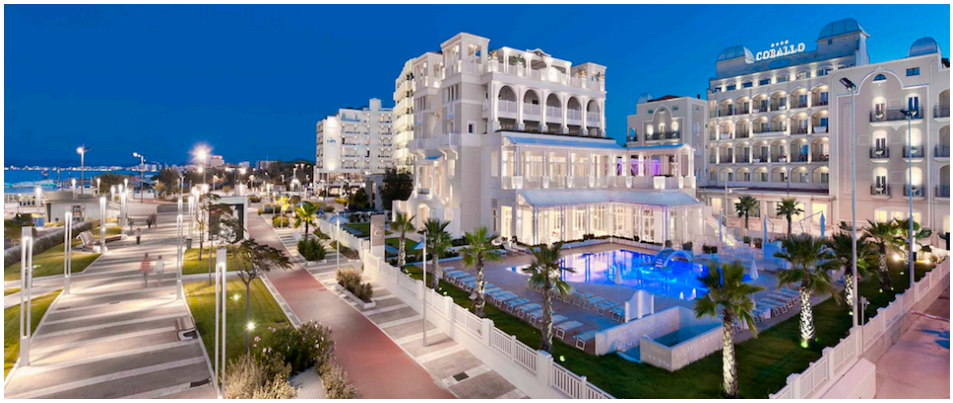
Channeling 2023



Report of Contributions

https://agenda.infn.it/e/21811

Contribution ID: **8** Type: **poster**

The phenomenon of monoenergetic electron generation in the pyroelectric accelerator

Tuesday, 6 June 2023 18:13 (1 minute)

The change in temperature of single crystals in vacuum conditions, such as lithium tantalate (LiTaO3), gives an attractive possibility to generate and accelerate electron and positive ions fluxes up to 100 keV and more. Also, the generation of X-ray and neutron fluxes in this way is very productive. The conception of a pyroelectric accelerator implies a compact device, which does not require an external high-voltage circuit and the use of hazardous materials.
One of the interesting features of the pyroelectric accelerator is the generation of monoenergetic electron flux with a stable value of peak energy for a long time. The reason for such long-term stabilization of flux energy is not clear yet. Here we present studies of features of electron flux in pyroelectric accelerator depending on the pressure of residual gas, the distance between the crystal and the target-collimator. The correlation between monoenergetic electron production and avalanche discharge in the pyroelectric accelerator is discussed. Besides of that, the simulation of electron motion in a pyroelectric accelerator is presented and discussed.
The work was supported by the grant from the Russian Science Foundation (project №21-72-00006). The work of A.K and P.S. was financially supported by a Program of the Ministry of Education and Science of the Russian Federation for higher education establishments, project No. FZWG-2020-0032 (2019-1569).

Primary authors: OLEINIK, Andrey; KARATAEV, Pavel; KUBANKIN, Alexander; Mr GILTS, Mark; Mr SHAPOVALOV, Pavel; Mr KLENIN, Artemy

Presenters: OLEINIK, Andrey; KARATAEV, Pavel

Session Classification: PS: Poster Session

Contribution ID: **9** Type: **oral**

Efficient space-selective and space-scanning nuclear fusion based on channeling low-energy particles in crystals

Thursday, 8 June 2023 09:30 (20 minutes)

The report discusses the possibility of effective spatially selective and spatially scanning nuclear fusion based on the interaction of low-energy (several keV) channeling particles with the nuclei of crystall planes or axes.
The physical basis for such a fusion is the formation of a coherent correlated state of these particles at a given location into crystal with the optimal ratio of the particle velocity (after partial deceleration), the grating period, and the frequency of transverse oscillations in the channel. For LiH crystal, the optimal local longitudinal energy of a moving particle is 500 eV. In this state, giant fluctuations of the transverse kinetic energy (50–150 keV) are generated and efficient Li+p fusion occurs.

Primary author: VYSOTSKII, Vladimir

Co-authors: Dr VYSOTSKYY, Mykhaylo; BARTALUCCI, Sergio

Presenter: VYSOTSKII, Vladimir

Session Classification: S5: Applications & X-Rays

Contribution ID: **10** Type: **oral**

Reduction of multiple scattering of positively charged ultrarelativistic particles channeling in planar fields of single crystals

Tuesday, 6 June 2023 09:50 (20 minutes)

Recently the effect of reduction of multiple scattering of positively charged particles was observed at channeling in bent (111) and (110) planes of silicon. The effect is observed in the plane orthogonal to the bending plane. The degree of reduction of rms scattering angle channeling particles (in comparing with equivalent amorphous media) reached up to 8 times. The analytical theory of observed phenomenon was proposed in the article.In this report we present the improved variant of the theory and give the results of calculation of reduction of multiple scattering angles for particles channeling in (111) and (110) planar electric fields of silicon and germanium single crystals.The increase in the angle of multiple scattering (in comparison with an equivalent amorphous medium) during planar channeling of negatively charged particles is also discussed.

Primary authors: Mr KRUTOV, Anton; MAISHEEV, Vladimir

Presenter: MAISHEEV, Vladimir

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **11** Type: **oral**

Radiation of Surface Polaritons in Cylindrical Channels

Tuesday, 6 June 2023 12:20 (20 minutes)

We investigate the radiation of surface polaritons by a charged particle moving parallel to the axis of a dielectric cylinder immersed in homogeneous medium. Both the cases of the charge motion inside and outside the cylinder are discussed. The electromagnetic fields in the exterior and interior media are evaluated by using the Green tensor. The parts in the fields corresponding to surface polaritons localized near the cylindrical interface are extracted explicitly. By using those fields the energy fluxes inside and outside the cylinder are studied for general case of the dispersion of the active medium with negative dielectric permittivity. The general results are specified for the Drude model of dispersion. The total energy losses of the charged particle are investigated as well. The corresponding results are compared with the energy losses on guiding modes of the dielectric cylinder.

The work was partially supported by the Science Committee of RA, in the frames of the research project 21AG-1C069 and the PhD support program 22AA-1C002.

Primary authors: KOTANJYAN, Anna (Yerevan State University); SAHARIAN, Aram (Yerevan State University, Yerevan, Armenia); KOTANJYAN, Vardazar; KHACHATRYAN, Hrant (Institute of Applied Problems in Physics); GRIGORYAN, Levon (Institute of Applied Problems in Physics)

Presenter: KOTANJYAN, Vardazar

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **12** Type: **invited**

Accelerator based Neutron Source VITA

The report describes the accelerator based neutron source VITA that provides beams of protons, deuterons, neutrons, photons, alpha particles and positrons for a wide range of studies, present and discuss the results obtained, and declare plans.

Primary author: TASKAEV, Sergey

Presenter: TASKAEV, Sergey

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **13** Type: **oral**

Observation of Coherent Cherenkov Radiation of Electron Bunches from a Partially Dielectric Loaded Waveguide

Tuesday, 6 June 2023 17:10 (20 minutes)

The results of experimental observation of coherent Cherenkov radiation from picosecond electron bunches traveling along the axis of a hollow cylindrical dielectric loaded waveguide are presented. Experiments are provided on the linear accelerator AREAL of CANDLE laboratory in Yerevan. The angular distribution of radiation from 3.7 MeV electron bunches passing through cylindrical quartz sample is investigated. The obtained results are compared with theoretical estimates.

The work was partially supported by the Science Committee of RA, in the frames of the research project № 21AG-1C069.

Primary authors: GRIGORYAN, Levon; POTYLITSYN, Alexander; SHEVELEV, Mikhail; Dr VUKOLOV, Artem; KARATAEV, Pavel; DABAGOV, Sultan; Dr VARDANYAN, Ashot; Dr YEREMYAN, Arsham; Dr SUKIASYAN, Minas; SAHARIAN, Aram; KOCHARYAN, Vahan; KHACHATRYAN, Hrant; ARAMYAN, Artur; Dr MURADYAN, Tigran; Mr BAGHDASARYAN, Davit; Dr GRIGORYAN, Mher; KOTANJYAN, Vardazar; SARGSYAN, Anush; Mr HARUTYUNYAN, Hayk; MKRTCHYAN, Artak

Presenter: GRIGORYAN, Levon

Session Classification: S2 & S4: Radiation: Generation & Interaction. & New Concepts

Contribution ID: **14** Type: **poster**

Peculiarities of Cherenkov Radiation by a Train of Bunches Moving Inside a Partially Dielectric Loaded Waveguide

Tuesday, 6 June 2023 18:12 (1 minute)

The Cherenkov radiation from train of electron bunches traveling along the axis of a partially dielectric loaded cylindrical waveguide is investigated theoretically. It is shown, that by special choice of the values of problem parameters, it is possible to generate quasi-coherent radiation from bunches in a train, on several waveguides modes simultaneously. A visual explanation of the obtained results is given.

The work was partially supported by the Science Committee of RA, in the frames of the research project № 21AG-1C069.

Primary authors: GRIGORYAN, Levon; MKRTCHYAN, Artak; DABAGOV, Sultan; SAHARIAN, Aram; KOTANJYAN, Vardazar; HARUTYUNYAN, Hayk; Mrs MNATSAKANYAN, Armine; KHACHATRYAN, Hrant

Presenter: KHACHATRYAN, Hrant

Session Classification: PS: Poster Session

Contribution ID: **15** Type: **oral**

Spectral-Angular Distribution of Radiation Generated by Train of Electron Bunches Passing Through the Centre of a Ball

Tuesday, 6 June 2023 17:30 (20 minutes)

The results of theoretical studies of the spectral and angular distribution of radiation generated by a train of electron bunches crossing a dielectric ball are presented. The numerical results are given for a dielectric ball made of Quartz, Teflon, or Strontium titanate. It is shown, that strong peaks can appear in the spectral distribution of the radiation intensity for certain values of the problem parameters. A visual explanation for this phenomenon is given.
The work was partially supported by the Science Committee of RA, in the frames of the research project № 21AG-1C069.

Primary authors: Prof. GRIGORYAN, Levon; MKRTCHYAN, Artak; Prof. ALEKSANDROV, Petr; Prof. SAHARIAN, Aram; WAGNER, Wolfgang; GRIGORYAN, Mher; SARGSYAN, Anush; Ms MARKOSYAN, Jemma; KHACHATRYAN, Hrant

Presenter: SARGSYAN, Anush

Session Classification: S2 & S4: Radiation: Generation & Interaction. & New Concepts

Contribution ID: **16** Type: **oral**

Capillary Channel Formation in PMMA and Electrons Acceleration by a Long-Pulse KrF Laser

Thursday, 8 June 2023 12:40 (20 minutes)

A narrow (30–40 μm in diameter) capillary-like rippled channel finished by a post-channel crown was observed in 2D hydrodynamic interaction regime of 100J@100 ns KrF laser pulses with a translucent PMMA targets at intensities up to 5×1012 W/cm^2. Channel formation mechanism includes self-consistent laser beam filamentation along UV light penetration depth. The modelling experiments with a preliminary drilled capillary channel and Monte Carlo simulations proved that the crown origin might be caused by an electron beam acceleration up to ~100 keV energies, which is much higher than the electron temperature of the plasma corona ~100 eV.

Primary author: ZVORYKIN, Vladimir

Co-authors: Mr VELIEV, Polad; Dr USTINOVSKII, Nikolai; Dr SHUTOV, Alexei

Presenter: ZVORYKIN, Vladimir

Session Classification: S3 & S4: Acceleration Techniques & New Concepts

Contribution ID: **17** Type: **oral**

Application of short-distance adaptive channeling of low energy particles in above-target graphene to optimize nuclear fusion in unstructured target

Thursday, 8 June 2023 09:50 (20 minutes)

The report discusses a method for optimizing controlled nuclear fusion in an unstructured target using low-energy particles. The essence of the method is the use of quasi-channeling of such particles in a thin single-crystal film of the graphene type located on the polished surface of this target. Such a motion at an optimum particle energy of 500 eV leads to the formation in this film and in the adjacent part of the target of a coherent correlated state of these particles with very large fluctuations of the transverse energy up to 50–150 keV. This effect lead to nuclear fusion in the main unstructured target.

Primary author: VYSOTSKII, Vladimir

Co-authors: Dr VYSOTSKYY, Mykhaylo; BARTALUCCI, Sergio

Presenter: VYSOTSKII, Vladimir

Session Classification: S5: Applications & X-Rays

Contribution ID: **18** Type: **oral**

Investigation of Ultrashort Electron Beam Interaction with the DNA Molecule

Thursday, 8 June 2023 10:10 (20 minutes)

Electron linear accelerators are the primary equipment of a modern radiotherapy department. Current research aimed at investigating the possibility of using ultrashort low emittance electron beam pulses for radiation therapy produced by linear electron accelerator at CANDLE, Armenia. High-energy radiation damages genetic material - DNA of cells and thus killing the cancer cells. The study and understanding of the mechanisms of radiation causing damage to DNA is one of the actuality problems for the development of new cancer therapies and effective radiosensitizers.

Primary author: ALOYAN, Lusine

Co-authors: Dr AVETISYAN, Ani (Yerevan State University); Mr MARGARYAN, Hrayr; Prof. ARAKELYAN, Valeri

Presenter: ALOYAN, Lusine

Session Classification: S5: Applications & X-Rays

Contribution ID: **19** Type: **oral**

Diffraction Image of a narrow X-rays beam in Crystals with Weak Deformation

Thursday, 8 June 2023 16:30 (20 minutes)

The problem of dynamic diffraction of X-rays from a point source on the spatial lattice of a crystal with a weak deformation field is considered. Theoretical study is based on the asymptotic representation of the Green-Riemann function for a pair of Takagi-Taupin equations of the hyperbolic type. Experimental studies were carried out on quartz crystals in the presence of a temperature gradient perpendicular to the reflecting planes. The conditions and characteristics of focusing depending on the distances source-crystal-detector and parameter of the deformation field are considered.

Primary authors: Mrs SHAHVERDYAN, Arus; Mr BAGDASARYAN, David; Prof. TROUNI, Karapet; Dr NOREYAN, Serob; KOCHARYAN, Vahan

Presenter: KOCHARYAN, Vahan

Session Classification: S5: Applications & X-Rays

Contribution ID: **20** Type: **oral**

On the Possibility of Accelerating Charged Particles in the Atmosphere

Wednesday, 7 June 2023 09:30 (20 minutes)

This work is devoted to the problem of acceleration of charged elementary particles and ions in air. This work is a continuation of a cycle of research in a new field of acoustoplasma physics, created by the founder of the Institute of Applied Problems of Physics of the NAS of the RA, Academician A.R. Mkrtchyan.
For experimental research, in the IAPP NAS RA developed and created unique experimental equipment, on the basis of which the experimental setup was designed.
During experimental studies, the obtaining and acceleration of various plasma formations in the real atmosphere were observed.
Thus, the previously obtained results of theoretical calculations on the acoustoplasmic acceleration of charged particles were confirmed experimentally.

Primary authors: Dr ABRAHAMYAN, Alexan; MKRTCHYAN, Artak; Mrs MARGARYAN, Artur; Dr CHILINGARYAN, Ruben; MKHITARYAN, Samvel; KOCHARYAN, Vahan

Presenter: MKHITARYAN, Samvel

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **21** Type: **oral**

Emission on prohibited transitions in acoustoplasma enviroment

Monday, 5 June 2023 16:50 (20 minutes)

In laboratory nitrogen acoustoplasma at pressures from several hundred to several thousand Pa, strong emission lines of molecular nitrogen were obtained at forbidden transitions at 654.81 and 658.36 nm. Strong emission lines were observed both in pure nitrogen acoustoplasma and in a CO2 :N2:He = 1:1:8 laser mixture. In the laser mixture, the emission at the forbidden transition was up to 17 times greater than the adjacent spectral lines of the nitrogen FPS band. The obtained result is explained by the acoustoplasma medium and the analogue of Raman scattering, which remove the prohibition. The obtained intense lines correspond to the mechanism of stimulated emission.

Primary authors: Dr ABRAHAMYAN, Aleksan; Prof. MELIKYAN, Armen; MKRTCHYAN, Artak; Dr CHILINGARYAN, Ruben

Presenter: MKRTCHYAN, Artak

Session Classification: S4: New Concepts

Contribution ID: **23** Type: **poster**

Ion accelerations in a liquid medium

Tuesday, 6 June 2023 18:14 (1 minute)

This work is devoted to the problem of acceleration of ions of various atoms in a liquid medium. This work is a continuation of the series of experimental studies carried out at the Institute of Applied Problems of Physics (IAPP) of the National Academy of Sciences (NAS) of the Republic of Armenia since the beginning of the 90s of the last century.
In order to conduct experimental studies, a unique experimental setup was developed and created with the appropriate nodes, ensuring high-precision performance of the entire system. In the course of experimental studies, hydrogen, oxygen, sodium, potassium and iron ions were used, the sources of which were developed and created at the IAPP NAS RA.
During experimental studies, the acceleration of ions up to several orders of magnitude was recorded, and the corresponding emission spectra were also recorded during the passage of ions in a liquid medium.

Primary authors: Dr ABRAHAMYAN, Alexan; MKRTCHYAN, Artak; Dr NALBANDYAN, Vache; Mr KOTANJYAN, Vardazar; Dr KOTANJYAN, Khoren; Mr YEGHIAZARYAN, Karen

Presenter: Mr YEGHIAZARYAN, Karen

Session Classification: PS: Poster Session

Contribution ID: **24** Type: **oral**

Bent crystal extraction from DAΦNE storage rings: the SHERPA experiment

Friday, 9 June 2023 10:50 (20 minutes)

The SHERPA ("Slow High-efficiency Extraction from Ring Positron Accelerator") project aim is to develop an efficient technique to extract a positron beam from one of the accelerator rings composing the DAΦNE accelerator complex at the Frascati National Laboratory of INFN, setting up a new beam line able to deliver positron spills of O(ms) length, excellent beam energy spread and emittance.
The most common approach to slowly extract from a ring is to increase betatron oscillations approaching a tune resonance in order to gradually eject particles from the circulating beam.
SHERPA proposes a paradigm change using coherent processes in bent crystals to kick out positrons from the ring, a cheaper and less complex alternative [1]. This non-resonant technique, already successfully used and still developed mainly in hadron accelerators, will provide a continuous multi-turn extraction of a high quality beam [2, 3, 4, 5].
Realizing this for sub-GeV leptons is challenging, however would provide the world's first primary positron beam obtained with crystal extraction. An immediate application of this new extracted beam line would be the PADME ("Positron Annihilation into Dark Matter Experiment") experiment [6], currently strongly limited by the duty cycle. Using the proposed extraction, PADME could increase the statistics by a factor 104 and its sensitivity by a factor 102.
This technology can be applied in general for both negative and positive leptons, including muons, providing a know how that can be applied for several accelerating machine aspects in the next future, as collimation, extraction and beam splitting, contributing to a general improvement in the particle accelerator field.
In the talk will be given an overview of the whole experiment, describing in particular the crystal extraction principle, the accelerator optics studies [7], the crystal prototype and the characterization apparatus. Simulation and experimental results will be reported, together with new future applications.

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Primary author: GARATTINI, Marco

Presenter: GARATTINI, Marco

Session Classification: S1 & S4: Beams Interactions & New Concepts

Contribution ID: **26** Type: **invited**

A 500 MeV positron beam for channeling experiments at the Mainz Microtron MAMI

Wednesday, 7 June 2023 09:50 (20 minutes)

A beam line for 500 MeV positrons is under construction at the applied physics area of the Mainz Microtron MAMI. Positrons will be created by pair conversion of bremsstrahlung, produced by the 855 MeV electron beam of MAMI in a 10 ☒m thick tungsten converter target, and energy selected by an outside open electron beam-line bending magnet. - Results of channeling calculations of 500 MeV positrons in a silicon single crystal at (110) planes will be presented.

Primary authors: BACKE, Hartmut; LAUTH, Werner

Co-authors: F. STIELER; I. BELTSCHIKOW; P. DREXLER; P. KLAG

Presenters: BACKE, Hartmut; LAUTH, Werner

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **27** Type: **poster**

Orbital Angular Momentum of Axial Channeling Radiation from Relativistic Electrons in Thin Si Crystal

Monday, 5 June 2023 18:19 (1 minute)

The twisted photon is the electromagnetic wave carrying the orbital angular momentum (OAM). Various schemes of production of the twisted photons have been proposed recently. The undulators and free electron lasers are used in these schemes. High energy twisted photons can also be generated by parti-cles channeled in aligned crystals.
In our previous work We described planar channeling radiation from electrons in terms of twisted photons. We calculated the energy spectrum of twisted photons and the dependence of the projection of total angular momentum on the radiation angle.
The calculations were performed for electrons channelled in (220) Si crystal. The crystal thickness was L = 20 μm. The energy of electrons was 255 MeV (the Lorenz factor ɣ=500). The calculations reveal that the pro-jection of total angular momentum oscillates and the distance between the maxima is of the order 25-30 keV. At present time, we do not have a precise explanation of this fact. This effect may be a manifestation of periodicity in m of the undulator radiation probability in the case when the detector axis does not coincide with the undulator axis.
In this work, we plan to perform the same calcu-lation for the case of axial channelling and check whether the periodical dependence remains intact or dis-appears.

Primary authors: Dr BOGDANOV, Oleg; Prof. KAZINSKI, Petr; TUKHFATULLIN, Timur

Presenter: Dr BOGDANOV, Oleg

Session Classification: PS: Poster Session

Contribution ID: **28** Type: **poster**

Desktop devices for alignment of X-ray double interferometer and generation of dislocations in its block-crystal

Tuesday, 6 June 2023 18:15 (1 minute)

A desktop universal device for X-ray interferometric diagnostics of structural imperfections in single crystals was developed, created and tested. The proposed device can serve both for scratching the surface of the interferometer crystalline blocks and for bending them in order to generate dislocations in the interferometer blocks using our proposed technology.
It has been proved that the moiré topograms obtained from a double X-ray interferometer depend on orientations of reflecting planes relative to the defect. It is shown that multiple interferometers make it possible to simultaneously observe images of various structural imperfections. The experiments make it possible to judge the spatial orientation of defects and the distribution of the stress field caused by defects.

Primary authors: Prof. DRMEYAN, Henrik; Dr MKHITARYAN, Samvel; NOREYAN, Serob

Presenter: Dr MKHITARYAN, Samvel

Session Classification: PS: Poster Session

Contribution ID: **29** Type: **oral**

Generation of microwave self-channeling undamped temperature waves and their use for stimulation of nuclear fusion in remote and behind-screen targets

Tuesday, 6 June 2023 16:50 (20 minutes)

The traditional interpretation of the channeling phenomenon is associated with the possibility of transporting particle or radiation beams over long distances without dissipation in specially ordered or focusing systems. It is shown that a similar process of quasi-channel motion with complete self-suppression of absorption and scattering can be realized for a weak (small in amplitude) temperature wave in any homogeneous material medium (including air) at very high selective wave frequencies . The interaction of these undamped waves with remote optimal targets leads to the stimulation of effective nuclear reactions (eg, d+d fusion) in these targets. It is shown that such effects occur even when such targets are placed at a great distance from the wave source behind a thick metal screen. All these phenomena are confirmed in experiments.

Primary author: VYSOTSKII, Vladimir

Co-author: Dr KORNILOVA, Alla

Presenter: VYSOTSKII, Vladimir

Session Classification: S2 & S4: Radiation: Generation & Interaction. & New Concepts

Contribution ID: **30** Type: **poster**

Study of Spontaneous Radiation during Axial Channeling of Relativistic Positrons in Hexagonal Crystals

Monday, 5 June 2023 18:20 (1 minute)

Using the energy levels and corresponding wave functions found for hexagonal crystals of Be, Sc, Ti, Co, Zn, Y, Zr, Ts, Ru, Cd, and La, the spectra of channeled spontaneous radiation are calculated in the dipole approximation for nondispersive relativistic positron beams moving at zero angles with respect to the c-axes. Analysis of the dependencies shows that the intensity maxima of spectral lines correlate with the depths of potential wells. Based on the fact that in wide hexagonal channels it is possible to achieve channeled motion of relativistic positron beams with high density, and taking into account that their dechanneling lengths significantly exceed the channeling lengths for electrons, it is possible to obtain intense short-wavelength spontaneous radiation.

Primary author: MAKSYUTA, Mykola

Co-authors: Ms YEFIMENKO, Svitlana; VYSOTSKII, Vladimir

Presenter: MAKSYUTA, Mykola

Session Classification: PS: Poster Session

Contribution ID: **31** Type: **invited**

The major upgrade projects EPAC and Vulcan 20-20

Thursday, 8 June 2023 11:40 (20 minutes)

To stay up to date with the user requirements, two major upgrade project are ongoing at the Central Laser Facility.
The first project EPAC is aiming to provide a 1PW laser system, 30J in 30fs at 10Hz. A new building has been recently completed and the installation phase is now starting.
The second project Vulcan 20-20 is at the final stage of the approval. The aim is to deliver a 20PW laser pulse, 400J 20fs, within long laser pulses of around 10ns and up to 10kJ of energy.

Primary author: GALIMBERTI, Marco

Presenter: GALIMBERTI, Marco

Session Classification: S3 & S4: Acceleration Techniques & New Concepts

Contribution ID: **32** Type: **poster**

Feasibility of using the crystal channeling to reduce the beam losses in Slow Extraction at 8GeV

Friday, 9 June 2023 10:30 (20 minutes)

The mitigation of the beam losses in slow extraction is becoming more and more demanding in accelerator applications for HEP as the beam power is gradually increasing. The successful demonstration of using the proton beam channeling at 450GeV to deflect the beam away from the extraction septa opens the new levels of improving the slow extraction efficiency.
It is yet to be demonstrated that this method is still effective at low and medium proton beam energies. Here we present the results of the recent computer simulation studies of the septum shadowing at 8GeV for the Mu2e
project slow extraction at Fermilab. Depending on the beam parameters the beam loss reduction is shown to be achievable in the range of 1/3 to factor of 3.

Primary author: NAGASLAEV, Vladimir

Presenter: NAGASLAEV, Vladimir

Session Classification: S1 & S4: Beams Interactions & New Concepts

Contribution ID: **33** Type: **poster**

Concept of a New Method for Determining the Transverse Profile of Wide-Aperture Beams

Tuesday, 6 June 2023 18:11 (1 minute)

This study describes the concept of a method for the measurement of flux density distribution in the transverse plane of wide-aperture beams such as radiotherapeutic medical beams. Currently, various approaches are used to modulate a radiation field of photons, electrons, protons and ions. However, all of these methods require continuous monitoring of the dose and spatial parameters of the beams. Therefore, the development of new methods for determining the beam's spatial parameters during the creation and modernization of linacs and hadron installations is a vital task.
One of the main requirements of detectors intended to determine parameters of therapeutic beams is the possibility of real-time measurement without disturbing the beam and with high resolution. This study proposes a new method for lateral beam profile determination by multiangle scanning to meet these requirements.
The proposed approach is based on integral transformations by inverse Radon reconstruction of data that could be obtained by multiple scanning of the therapeutic beam at different angles with a fixed angle step. This idea was to evaluate by numerical experiment.
For this purpose, we chose a distribution that is characteristic of the radiotherapeutic field. The test distribution has one maximum and one minimum in the lateral beam profile.
The two-dimensional projections are obtained from the original image of the beam test distribution using the MatLab software package. The dataset is obtained in such a way that the value at each point is the sum of the intensities in the column perpendicular to the scanning line, and the displacement angle is set in accordance with the required number of projections. The total displacement angle should not be less than 180°. These data are used to restore the original image with a different number of projections.
The images of the test distribution were reconstructed by the inverse Radon transformation for a different number of projections from 2 to 180. The results obtained show that 12 or more projections allow the initial distribution to be visually determined.
The proposed approach will enable the determination of the full beam density distribution in the transverse plane and ensure the continuous monitoring of therapeutic beam parameters in both plan verification and treatment. It is shown that 12 projections are enough to obtain reliable results. The multiangle beam scanning method could be applied for different types of radiation including beams of photons, electrons, protons and ions.

This work is supported by the project No. 21-79-00252.

Primary author: BULAVSKAYA, Angelina

Co-authors: Ms GRIGORIEVA, Anna; MILOICHIKOVA, Irina; STUCHEBROV, Sergei

Presenter: BULAVSKAYA, Angelina

Session Classification: PS: Poster Session

Contribution ID: **34** Type: **poster**

Electron beam modulation by 3D printed plastic samples

Tuesday, 6 June 2023 18:10 (1 minute)

Nowadays, modulation of the electron beam depth dose distributions in radiation therapy sessions is provided by sets of tissue equivalent plates or individually shaped thermoplastic boluses.
In this study we propose to use 3D printed samples for depth dose distribution modulation in electron radiotherapy. This approach allows producing patient-specific boluses and compensators. The aim of this study is to prove possibility of electron beam dose modulation by plastic samples produced with 3D printed approach.
The 3D printed test samples with 10x10 cm2 transverse size made of ABS plastic is used for experimental study. This sample has three different functional areas: for partial beam absorption (2 cm thicknesses) with two collimation holes of 0.5 cm and 1 cm diameters; the wedge filter with thickness varied linearly from 5 cm to 0 cm, and semicircle shaped non-linear absorber of 5 cm radius.
The experimental study is performed using Elekta Synergy accelerator as a source of electron beams of 6 and 12 MeV energies. The modulated beam shape is obtained by Gafchromic EBT3 dosimetry film and universal detector array MatriXX. Experimental study is performed for two geometries: with test sample set in accelerator applicator and on the surface of tissue equivalent. The first geometry means sample application as compensator, while second one as a bolus.
In this study we prove the possibility of electron beam modulation by plastic sample produced by fused deposition modeling. The 1 cm collimation hole allows circular beam shaping. It is revealed that collimator positioning in applicator causes broadening of the shaped radiation field because of influence of electrons scattered in air. Propagation of electron beam through 0.5 cm collimation hole leads to dose increasing in its area by less than 5%. The latter is caused by electron scattering at the edge of two media. Wedge-shaped filter allows radiation field modification. The semicircle shaped absorber provide total absorption for 6 MeV and 12 MeV electrons and dose increasing on its edges is obtained only for bolus geometry and both considered beam energies.
Performed investigation shows applicability of 3D printed samples to modulate clinical electron beam. The efficiency of beam modulation is compared for two geometries, simulating bolus and compensator application.

This work is supported by the project No. RSF 19-79-10014-П.

Primary author: STUCHEBROV, Sergei

Co-authors: BULAVSKAYA, Angelina; Ms GRIGORIEVA, Anna; MILOICHIKOVA, Irina

Presenter: STUCHEBROV, Sergei

Session Classification: PS: Poster Session

Contribution ID: **35** Type: **poster**

Excitation of a giant dipole resonance by radiation of channeled electrons in a Si (110) crystal

Monday, 5 June 2023 18:10 (1 minute)

The study of giant dipole resonance (GDR) as a collective nuclear excitation [1] is a relevant area of theoretical and experimental research. GDR was first observed in the experiments on the braking ɣ-beam (bremsstrahlung - BS) [2]. Interest in this fundamental phenomenon does not weaken in our days [3].
Channeling radiation (CR) of electrons in crystals has been studied in detail [4] and till now is of interest in terms of generation of high-energy photons.
As known, the spectrum of CR electrons of sub-GeV and GeV energies is characterized by an optimal width maximum and photon energies up to several tens of MeV, which is sufficient to overcome the threshold in photonuclear reactions of light nuclei [5]. On the other hand, at an equal thickness of the primary target, the CR yield is more than an order of magnitude higher than the braking yield that suggest the use of the orientation dependence of the CR spectrum in studying the giant dipole resonance of heavy nuclei.
This work aims in investigating the total yield of GDR (for heavy nuclei Au, Pb, and U) by electron channeling radiation in a Si crystal target at various electron energies and angles of incidence respect to the channeling planes.
The efficiency of the proposed method in comparison to the use of the braking gamma photons is growing up to 3 GeV and higher. For example, increasing the electron beam energy from 2 to 3 GeV with zero angle of incidence leads to approximately 6-fold (Au target) and 9-fold (Au target) increase in GDR yield in the case of CR compared to that of BS.
There is also an additional effect for fine-tuning: the possibility of slightly changing the GDR yield at a fixed electron energy combined with an orientation effect to tune the CR spectrum.
Since the number of CR photons could be more than an order of magnitude greater than the number of BS photons for equal radiator thickness, the use of CR instead of traditional BS in studying photonuclear reactions might be preferrable.

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Primary authors: ASHURKO, Nikita; BOGDANOV, Oleg; DABAGOV, Sultan

Presenter: ASHURKO, Nikita

Session Classification: PS: Poster Session

Contribution ID: **36** Type: **oral**

First ab-initio channeling and Baier-Katkov Geant4 FastSim model

Monday, 5 June 2023 10:10 (20 minutes)

The design of innovative applications of electromagnetic interactions of charged particles interactions with oriented crystals in accelerator physics, detector physics, astrophysics, nuclear physics and radiation therapy requires extensive and reliable simulation tool to simulate in details all the experimental setup. Therefore, the implementation of the physics of channeling and radiation in oriented crystals into Geant4 simulation toolkit is in high demand.

In this work we present the first ab-initio Geant4 ChannelingFastSimModel including simulations of charged particles trajectories in a crystalline averaged atomic potential as well as their radiation spectra and secondary photons production using the Baier-Katkov method.

Primary authors: SYTOV, Alexei; Dr BANDIERA, LAURA; Prof. CHO, Kihyeon; Prof. CIRRONE, Giuseppe Antonio Pablo; Prof. GUATELLI, Susanna; HAURYLAVETS, Viktar; Prof. HWANG, Soonwook; Prof. IVANCHENKO, Vladimir; PANDOLA, Luciano; ROSENFELD, Anatoly; Dr PATERNÒ, Gianfranco; Prof. TIKHOMIROV, Victor

Presenter: SYTOV, Alexei

Session Classification: S1: Beams Interactions

Contribution ID: **37** Type: **oral**

Status and prospects of E336 Experiment at SLAC FACET-II on channeling plasma wakefield acceleration in structured solids

Tuesday, 6 June 2023 09:30 (20 minutes)

Plasma wakefield acceleration in oriented structured solids (nanotubes and crystals) has a potential of extremely high acceleration gradients exceeding 1 TeV/m. One can exploit the nuclei-free space in nanotubes and crystals both to produce plasma waves and to accelerate channeling particles being contained within their channel and moving almost without collisions with ions.

In this work we present the progress, the challenges and the prospects of the E336 Experiment at SLAC FACET-II on plasma acceleration in structured solids. In addition, we present the new results on simulations of channeling of multi-GeV beam in carbon nanotubes manifesting their ordered structure.

Primary authors: ARINIELLO, Robert; BANDIERA, LAURA; CORDE, Sebastien; DAVOINE, Xavier; EKERFELT, Henrik; FIUZA, Frederico; GILLJOHANN, Max; GREMILLET, Laurent; KNETSCH, Alexander; MANKOVSKA, Yuliia; MARTINEZ, Bertrand; MATHERON, Aimé; PIEKARZ, Henryk; SAN MIGUEL CLAVERIA, Pablo; SHILTSEV, Vladimir; STOREY, Doug; SYTOV, Alexei; TABOREK, Peter; TAJIMA, Toshiki

Presenter: SYTOV, Alexei

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **38** Type: **poster**

Spin dynamics in nonuniform electromagnetic wave fields

Monday, 5 June 2023 18:11 (1 minute)

Based on solution of Dirac equation, the dynamics of a quantum particle with a half-integer spin in the field of an arbitrary inhomogeneous electromagnetic wave has been analyzed. It is shown that, in the first order of expansion in longitudinal energy, the effective interaction potential of a fermion coincides with that of a scalar particle, while the spin features of interaction in this field appear only in the next expansion term. Analyzing the semiclassical approximation of dynamics of an arbitrary spin for a charged particle in an optical lattice field, we have shown that under the condition that the both field and energy of an individual photon are small compared to the longitudinal energy of a charged particle, the dynamics of the polarization vector reveals a smooth precession, over which fast small oscillations are superimposed. The rate of smooth precession is proportional to the difference between the magnetic moment of the particle and its anomalous part $\Omega \sim \mu - \mu'$. An estimate of the angular velocity of the spin vector precession is also found, which can reach rather large values Ω 10^9 s^{-1}.

Primary author: DIK, Alexey

Co-author: DABAGOV, Sultan

Presenter: DIK, Alexey

Session Classification: PS: Poster Session

Contribution ID: **39** Type: **poster**

On charged particle dynamics near flat solid surface

Monday, 5 June 2023 18:12 (1 minute)

We have considered the motion of a nonrelativistic charged particle near flat solid surface at sliding angles based on the result of work [S.B. Dabagov and A.V. Dik, “Surface channeling of charged and neutral beams in capillary guides.”, Quantum Beam Science, 6(1), 2022.] devoted to the analysis of a nonrelativistic charged particle motion in a cylindrical single capillary. The interaction potential is examined within the formalism of the effective potential composed by the interaction of a particle with surface atoms and excitations. It is shown that the elastic part of effective potential has a not deep potential well capable of capturing a particle. Neglecting the inelastic part of the effective potential, an approximate analytical expression for the transverse energy levels was found. Comparison of the transverse energy values obtained by analytical expression with those calculated numerically showed good agreement.

Primary author: DIK, Alexey

Co-author: DABAGOV, Sultan

Presenter: DIK, Alexey

Session Classification: PS: Poster Session

Contribution ID: **40** Type: **poster**

Coherent channeling radiation of electron beam in optical lattice

Monday, 5 June 2023 18:13 (1 minute)

The interaction of particles in the channeling regime with crystal lattices has a number of features that allow controlling charged particle beams [Edouard N. Tsyganov, "Some aspects of the mechanism of a charge particle penetration through a monocrystal.", FERMILAB preprint, 1976.], as well as obtaining high-energy electromagnetic radiation [M.A. Kumakhov, "On the theory of electromagnetic radiation of charged particles in a crystal.", Physics Letters A, 57(1):17 –18, 1976.]. The principles of particles beams control have found their application in practice (project UA9), but the creation of powerful radiation sources is not so promising due to the destruction of crystals during the passage of intense beams of charged particles. Optical lattices are devoid of such a disadvantage. Moreover, the larger size of the channels of the optical lattice will allow use of larger electron beams. And here the coherent part of the spectrum plays an important role. In this work the spectral-angular distribution of electron beam coherent radiation is found, taking into account the dependence of the electron channeled oscillations frequency on the oscillation amplitude.

Primary author: DIK, Alexey

Co-author: DABAGOV, Sultan

Presenter: DIK, Alexey

Session Classification: PS: Poster Session

Contribution ID: **41** Type: **oral**

Stability of electrons and X-rays generated in a pyroelectric accelerator

Thursday, 8 June 2023 12:20 (20 minutes)

Changing the temperature of single crystal lithium tantalate (LiTaO3) at moderate vacuum conditions gives an attractive possibility to generate and accelerate electron up to 100 keV. The electrons are ejected either from the crystal or from the target (depending on polarity). The electrons than generate X-Rays via bremsstrahlung and characteristic X-ray emission processes.

Amptek, Inc (USA) has developed a miniature pyroelectric X-ray source (Amptek COOL-X). However, unstable X-ray emission, lack of reproducibility of the X-ray spectra limits the use of pyroelectric sources for practical applications. The aim of this experimental investigation is the interesting feature of the pyroelectric accelerator to generate a monoenergetic electron flux with a stable value of peak energy for a long time. The reason for such long-term stabilization of flux energy is not clear yet. Here we present studies of features of electron flux in pyroelectric accelerator depending on the pressure of residual gas, the distance between the crystal and the target-collimator. The correlation between monoenergetic electron production and avalanche discharge is discussed. Moreover, a pyroelectric accelerator consisting of a pair of crystals is proposed. The temperature of the crystals was changed simultaneously in opposite polarity to create higher electric field between the crystals and the target to generate high-energy x-rays than could be produced with a conventional single-crystal source.

The pyroelectric x-ray generator technology is currently being developed in a reliable compact, stable, and reproducible x-ray source with controllable parameters, which does not require a high-power DC voltage or the use of hazardous (radioactive) materials.

Primary author: ALI, Majid

Co-authors: KUBANKIN, Alexander; SHCHAGIN, Alexander; OLEINIK, Andrey; KARATAEV, Pavel

Presenter: ALI, Majid

Session Classification: S3 & S4: Acceleration Techniques & New Concepts

Contribution ID: **42** Type: **oral**

Searching for Dark Matter with Vertically-Aligned Carbon Nanotubes: the ANDROMeDa Project

Monday, 5 June 2023 16:30 (20 minutes)

We present the latest results from the ANDROMeDa (Aligned Nanotube Detector for Research On MeV Darkmatter) project, which was funded with 1MEur PRIN grant by the italian Ministry of Research (MUR). The main objective of ANDROMeDa is the development of the Dark-PMT, a novel light Dark Matter (DM) detector based on vertically-aligned carbon nanotubes. The detection scheme is based on DM-electron scattering inside a target made of vertically-aligned carbon nanotubes. Carbon nanotubes are made of wrapped sheets of graphene, which is a 2-dimensional meterial: therefore, if enough energy is transferred to overcome the carbon work function, the electrons are emitted directly in the infra-tube vacuum. If the ejected electrons are capable of leaving the target without being re-absorbed, they can then be detected by an external electron detector. Vertically-aligned carbon nanotubes have reduced density in the direction of the tube axes, and have been shown to channel Ar+ ions along the whole length (200 μm) of the tubes. Transmission properties of electrons traveling parallel to the nanotubes still hasn't been observed experimentally, and is one of the main aims of the R&D of this project.

Primary authors: RUOCCO, Alessandro; APPONI, Alice; APPONI, Alice; MARIANI, Carlo; MARIANI, Carlo; PANDOLFI, Francesco; CAVOTO, Gianluca; Dr RAGO, Ilaria Carmela; YADAV, Ravi Prakash

Presenters: POFI, Francesca; CAVOTO, Gianluca

Session Classification: S4: New Concepts

Contribution ID: **43** Type: **poster**

Crab crossing in inverse Compton scattering of diverging beams

Monday, 5 June 2023 18:15 (1 minute)

Generalized theory of Compton backscattering in terms of luminosity, suitable for both classical and quantum regimes obtained. Optimal parameters, which require a certain mutual orientation and inclination of the fronts of the laser and electron beams described by 3D Gaussians, correspond to the crab scheme. The scattering of diverging beams was also considered. The constructed theory not only predicts the optimal geometry for laser and electron beams but also describes the luminosity. Our results reveal the opportunity to sharply increase the luminosity of compact x-ray sources based on Compton/Thomson backscattering.

Primary authors: POTYLITSYN, Alexander; TISHCHENKO, Alexey; GAVRILENKO, Dmitrii

Presenter: GAVRILENKO, Dmitrii

Session Classification: PS: Poster Session

Contribution ID: **44** Type: **oral**

The basic model of crystalline medium simulation in GEANT4

Monday, 5 June 2023 09:50 (20 minutes)

In this work we propose a relatively simple model for taking into account the medium crystallinity in GEANT4. The model includes a simplified method for crystallinity description by changing cross-sections of the physical processes without microscopic motion simulation of the charged particles in channeling mode. The cross-sections for processes of Bremsstrahlung and the electron-positron pair production in GEANT4 are modified depending on the particles energy according to the coefficients obtained from the simulation of the channeling process using a microscopic model for various crystalline axes or planes and materials.

Primary authors: Dr LOBKO, Alexander; Dr SYTOV, Alexei; Dr BANDIERA, Laura; Prof. TIKHOMIROV, Victor; HAURYLAVETS, Viktar

Co-authors: SOLDANI, Mattia; Mr SACHYUKA, Mikita

Presenter: HAURYLAVETS, Viktar

Session Classification: S1: Beams Interactions

Contribution ID: **45** Type: **oral**

Electron Emission Channeling for lattice location of radioactive isotopes in single crystals: Improvements from a Timepix3 quad detector and new PyFDD data analysis software

Tuesday, 6 June 2023 10:30 (20 minutes)

Electron Emission Channeling is a technique used for the measurement of the lattice location of radioactive isotopes implanted into single crystals. This work reports on how a Timepix3 detector was installed in the experimental setup and the resulting advantages of doing so. It also reports on the data analysis and software updates that were necessary to accompany the increase in data, and number of pixels, which resulted in the development of the PyFDD software.

Primary authors: BERGMANN, Benedikt; DAVID BOSNE, Eric; Dr CORREIA, João; Dr DA SILVA, Manuel; Dr BURIAN, Petr; Dr WAHL, Ulrich; Dr COSTA, Ângelo

Presenter: DAVID BOSNE, Eric

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **46** Type: **poster**

Use of focusing crystals in magnetic fields

Monday, 5 June 2023 18:16 (1 minute)

A series of experiments demonstrated the possibility of focusing positively charged particles using focusing crystals. In these experiments, between a crystalline focusing crystal and the position of the focus was a space free from magnetic fields. In this work, we consider an important case from the point of view of practical aither dipole or quadrupole.se when between the focusing crystal and the focal plane there is a magneic field either dipole or quadrupole. The obtained relations allow us to take into account the influence magnetic fields on the focusing properties of crystals.

Primary author: MAISHEEV, Vladimir

Presenter: MAISHEEV, Vladimir

Session Classification: PS: Poster Session

Contribution ID: **47** Type: **oral**

Channeling of low-energy ions in carbon nanotubes taking into account many-body effects

Wednesday, 7 June 2023 10:30 (20 minutes)

Channeling of low-energy ions in carbon nanotubes taking into account many-body effects

A.V. Stepanov, A. S. Sabirov, A. A. Shemukhin

The use of carbon nanotube (CNT) bundles instead of masks has the advantage of allowing the ion beam to be controlled in three dimensions by manipulating the nanotubes. Due to this, it becomes possible to direct the ion beam to hard-to-reach places, for example, in the manufacture of microelectromechanical systems (MEMS) or nanoelectromechanical systems (NEMS), as well as in the creation of semiconductor devices with a complex spatial architecture. The aim of this study was to study the passage of low-energy ions through carbon nanotubes in the channeling mode. Problems that were solved: 1. The study of elastic perturbations of the CNT wall when low-energy particles are channeled into them. 2. Accounting for the effect of wall perturbations on the motion of particles in CNTs.

The method of molecular dynamics was used to solve the set problems. the LAMMPS package [1] was used, the interaction between carbon atoms in a carbon nanotube was described using the AIREBO potential [2, 3], and between an ion and carbon atoms using the Ziegler-Biersack-Littmark (ZBL) potential [4]. The deceleration on the electron gas was taken into account according to the method [5]. Calculations were made using the Lomonosov supercomputer center of Lomonosov Moscow State University. M.V. Lomonosov [6].

Using the example of Ar+ ions with an energy of 100 eV, it is shown that when an ion moves with angles close to critical, after its collision with a CNT wall (10, 10), wall perturbations arise - deformation waves that affect the motion of the channeled particle. The motion of the channeled particle after the first collision leads to the exchange of energy between the elastic perturbation of the wall and the channeled particle. In the case when the velocities of their longitudinal motion are close, this leads to a twofold decrease in the energy loss of the moving particle in each collision with the wall as compared to the case of motion without taking into account perturbations of the nanotube wall.

This work is supported by the Russian Science Foundation grant № 20-72-10118.

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Presenter: STEPANOV, Anton

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **48** Type: **invited**

Horizon Europe EIC-Pathfinder Project TECHNO-CLS: ”Emerging technologies for crystal-based gamma-ray light sources”

Monday, 5 June 2023 11:10 (30 minutes)

Andrey V. Solov’yov
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TECHNO-CLS project aims at the breakthrough in technologies needed for designing and practical realisation of novel gamma-ray Light Sources (LS) operating at photon energies from ~100 keV up to GeV range that can be constructed through exposure of oriented crystals (linear, bent and periodically bent) to the beams of ultra-relativistic charged particles [1]. The TECHNO-CLS high-risk/high-gain science-towards-technology breakthrough research programme will address the physics of the processes accompanying the oriented crystal exposure to irradiation by the high-energy electron and positron beams at the atomistic level of detail needed for the realisation of the TECHNO-CLS goals [2-4].

A broad interdisciplinary, international collaboration has been created previously in the frame of FP7 and H2020 projects, which performed initial experimental tests to demonstrate the crystalline undulator (CU) idea, production and characterisation of periodically bent crystals and the related theory (see [2-4] and references therein). TECHNO-CLS aims to build the high-risk/high-gain science-towards-technology breakthrough research programme on these successful studies aiming at a practical realisation of the novel gamma-ray LSs such as crystalline channeling radiation emitters, crystalline synchrotron radiation emitters, crystalline undulators and others. Additionally, by means of a pre-bunched beam a CU LS has a potential to generate coherent superrradiant radiation with wavelengths orders of magnitudes less than 1 Angstrom, i.e. within the range that cannot be reached in existing LSs based on magnetic undulators. Such LSs will have many applications in the basic sciences including nuclear and solid-state physics and the life sciences. Theoretical, computational, experimental and technological results obtained in the course of this project will pave a way for key technological developments of the LSs and their wide exploitation. The TECHNO-CLS international collaboration possesses all the necessary expertise to conduct successfully the outlined programme.

There will be presented the main goals and the current developments within the TECHNO-CLS project. Particular emphasis will be made on the recent theoretical advances in atomistic simulations of channeling and radiation processes in oriented crystals [2-6] which was achieved by means of the advanced software packages MBN Explorer [7] and MBN Studio [8] during the last years.

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Primary author: SOLOV'YOV, Andrey

Presenter: SOLOV'YOV, Andrey

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **49** Type: **oral**

Vertically-Aligned Carbon Nanotubes as effective platforms to kill bacteria

Thursday, 8 June 2023 10:30 (20 minutes)

We propose and demonstrate a strategy for the design of highly antimicrobial surfaces with vertically aligned carbon nanotubes (VA-CNTs), also known as CNT forests, synthesized by means of an easy, low-cost and fast (~15 min) chemical vapor deposition process (CVD). The resulting VA-CNTs, uniformly covering the underlying growth substrate, are characterized by a high packing density forcing their vertical orientation. However, the great parallelism between CNTs terminates with a not-aligned top crust layer composed by entangled CNTs extending over the surface of the forest [1]. We show, via a combination of microscopic and spectroscopic techniques, the ability to finely shape this crust of CNTs in a controlled and time-efficient manner, by means of plasma etching processes, thus enhancing VA-CNTs antibacterial properties [2].
In particular, we investigate the antimicrobial power of three different varieties of VA-CNTs against *Pseudomonas aeruginosa* and *Staphylococcus aureus*: as-grown, and after two different etching treatments. The highest reduction of cell viability (100% and 97% for *P. aeruginosa* and *S. aureus*, respectively) was observed for VA-CNTs modified through Ar and O_2 as etching gas, thus identifying the best configuration for a VA-CNTs-based surface to inactivate both planktonic and biofilm infections. Additionally, this work sheds light on the mechanism responsible of this exceptional antimicrobial activity of CNT forests, pointing out that it occurs due to the mechanical interaction between the bacterial cell walls and the nanotube structures, which are capable of 'skewering' or 'smothering' the bacteria and, simultaneously, producing high levels of ROS, thus preventing the formation of microbial colonies. We firmly believe that the here proposed synthesis process, involving the CVD growth of CNT forests followed by the subsequent tuning of their nanomorphology through plasma etching, is an effective, rapid and low-cost route for engineering antibacterial coatings for a wide range of applications, such as biomedical devices, filtering systems for hospital, solid–air/liquid interfaces in healthcare units where biofilms usually appear.

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Presenter: YADAV, Ravi Prakash

Session Classification: S5: Applications & X-Rays

Contribution ID: **50** Type: **invited**

X-rays from laser produced plasmas

Thursday, 8 June 2023 09:00 (30 minutes)

Since the early 60s, with the advent of LASERs, it was understood how they could be used to create pulsed X-ray sources of extraordinary brightness. The peculiar characteristics of these sources have progressively been implemented hand in hand with the evolution of laser technologies. In fact, as the duration of the laser pulses became shorter and consequently higher intensities were reached, denser and hotter plasmas were produced, with a consequent increase in the source brightness and energy of the emitted photons. With the further advent of the amplification techniques of ultrashort laser pulses (fs) and the overwhelming development of the acceleration of high energy electrons (GeV) in laser produced plasmas, new possibilities of generating X-rays have become possible. Among these certainly the most important are (a) the bremsstrahlung radiation (1), produced by directing the high energy electrons on high atomic number targets (b) the betatron radiation (2) produced by the accelerated electrons in the plasma, during their transverse oscillation motion as they propagate at relativistic speeds in the low-density channel induced by the laser pulse via the ponderomotive forces. We certainly cannot ignore the most important sources of X-ray radiation available at LINACs or synchrotrons, nor the quality of that radiation in terms of tunability, monochromaticity and directionality. However, the sources of X-ray radiation from laser produced plasmas undoubtedly remain favorable by their relatively small dimensions and maintenance costs.

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Primary authors: CURCIO, Alessandro; GIULIETTI, Danilo

Presenter: GIULIETTI, Danilo

Session Classification: S5: Applications & X-Rays

Contribution ID: **51** Type: **oral**

ADVANTAGES OF HYBRID POSITRON SOURCES WITH GRANULAR CONVERTERS

Tuesday, 6 June 2023 11:40 (20 minutes)

Hybrid positron sources using a crystal axially oriented as a photon radiator followed by an amorphous converter are promising for the yields as for the behaviour with thermal stresses. Emphasis is put on the advantages of using a granular converter made of small spheres instead of a bulk material for the photon conversion into e+e- pairs.

Primary author: CHEHAB, Robert

Co-authors: Mr ALHARTHI, Fahad; Dr CHAIKOVSKA, Iryna; Dr SIEVERS, Peter; Dr MYTROCHENKO, Victor

Presenter: CHEHAB, Robert

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **52** Type: **oral**

Some considerations on the development of "new" FEL Architecture

Tuesday, 6 June 2023 16:00 (30 minutes)

Sources of free electrons coherent radiation, be they FEL or CBS devices, are undergoing a continuous demand of improvement of the relevant output performances.
These laser-like tools are widely used all over the world and are the highest performing in terms of brilliance, mono-chromaticity, coherence, directionality and polarization control. However in spite of their undoubted success and reliability, their wider use is still hampered by their size and cost, which require large laboratories and significant financial efforts.
It would be therefore desirable to develop more compact and cheaper systems operating at higher repetition rates and with larger average brightness. Accordingly, the strategy, pursued by many worldwide research institutions, is the design of FEL facilities in the VUV-X region, using compact accelerators and shorter undulator sections.
Within this context, the most natural solutions are those of designing high gradient accelerating devices, capable of providing high-quality electron beams and non-standard undulator lines.
Both solutions might concur with the reduction in either the size or the cost, but although these are the most obvious, they are not the only.
"Alternative"undulator are being studied to prevent the use of hundred meter long magnetic structures, necessary to provide the saturation length, in standard FEL architecture. Within this context the suggested solutions include a combination of non-linear harmonic generation, seeding, hybrid devices, coupled oscillators amplifier systems, etc.
In this talk we review the conclusion achieved in two Special Issues [1,2] devoted to "non-conventional" architectures and describing different strategies and sinergies, which have been proposed in the past. We focus on both the underlying physics and the different aspects of the relevant design, with particular reference to feasibility and relevant performance. Some proposals, like those foreseeing high-repetition-rate X-ray FELs [3,4], developed within the context of oscillator/amplifier architectures have achieved a good deal of maturation and will be "viable"solutions in the next future. Other, based on e. g. recirculated wave [5] or on undulators realized with an electromagnetic field provided by a CARM-type microwave source are worth to be pursued.
Analogous considerations are developed for CBS based X ray sources along with specific design strategies for high performing high brightness X-ray beams [7,8].

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Primary authors: CURCIO, A.; GIULIETTI, D.; DI PALMA, E.; DATTOLI, Giuseppe; SPASSOVSKY, I.

Presenter: DATTOLI, Giuseppe

Session Classification: S2 & S4: Radiation: Generation & Interaction. & New Concepts

Contribution ID: **53** Type: **oral**

The structure of quantum carpets in a carbon nanotube

Thursday, 8 June 2023 12:00 (20 minutes)

We have investigated long-time dynamics of the quantum carpets occurring in positron transmission through a chiral single-wall carbon nanotube in the channeling mode. We found that the carpet structure depends strongly on the width of the initial wave packet. In the case of the narrow wave packet obtained carpet is periodic and very regular, woven by full and fractional wave packet revivals. Additional inverted revived patterns were observed close to fractional revival, which does not exist in carpets for a particle in a sealed box. In the case of the wide wave packet, we were able to recognize motifs that repeat approximately and conclude that dynamics, in this case, is quasi-periodic.

Primary authors: COSIC, Marko; Mr HADZIJOJIC, Milivoje

Presenter: COSIC, Marko

Session Classification: S3 & S4: Acceleration Techniques & New Concepts

Contribution ID: **54** Type: **oral**

X-ray channeling for imaging and spectroscopic applications at XLab Frascati

Thursday, 8 June 2023 17:30 (20 minutes)

X-ray applications are widely used in the world. By the way, due to the high interaction between radiation and matter, the possibility to have optical devices suitable for X-ray radiation is not trivial. In the last 30 years, the studies concerning novel advanced material have fostered the development of several solutions for more efficient X-ray lens, necessary to perform high spatial resolution in spectroscopy as well as for imaging techniques applied in Medicine/Pharmacology, Cultural Heritage, Geology and Environment, Electronics, Aerospace, etc...

The main accent will be highlighted to advance tools for X-ray both Imaging and Spectroscopy based on combination of modern polycapillary optics and developed reconstruction software together with commercially available systems.

Recent results (principally in three main fields, such as high resolution X ray Imaging, micro X Spectroscopy and micro Tomography) obtained at XLab-Frascati will be discussed. In particular, we will show the last results concerning our XRF facility and the new experimental setup dedicated for Tomography:
1) "Rainbow X-Ray" (RXR) is an experimental station dedicated to 2D/3D XRF μXRF spectroscopy, opened for users at LNF XLab-Frascati, optimized for most of X-ray analytical research fields. The basic principle of the station is in the use of various geometrical combinations of polycapillary optics for X-ray beam shaping (focusing/collimation) at specially designed laboratory unit. The flexible RXR layout allows investigating specimens of the dimensions ranging from several millimeters up to half meter and weighting up to several tens of kilograms.
2) "Computed Tomography Station" (CTS) is a measuring station for high precision tomography. Developed as part of a Premiale project, the station, equipped with a micro-focusing source (5 μm on the anode), high precision mechanics and high-resolution CCD detector (10.4 μm per pixel), through the phase retrival technique CTS resolution is estimated in 600-700 nm per voxel. The CTS experimental setup is commissioned ad the end of 2022 and will be ready and opened for users in the beginning of the 2023.

Primary author: HAMPAI, Dariush

Co-authors: CAPITOLO, Emilio; CAPPUCCIO, Giorgio; PAPALINO, Giuseppe; DABAGOV, Sultan; GUGLIELMOTTI, Valeria

Presenter: HAMPAI, Dariush

Session Classification: S5: Applications & X-Rays

Contribution ID: **55** Type: **invited**

From Bremsstrahlung to Channeling Radiation. A Promising Way for Positron Generation

Tuesday, 6 June 2023 11:10 (30 minutes)

Crystal effects and especially channeling radiation are interesting, instead of bremsstrahlung, to provide a large number of photons,for positron generation in converters This work is describing the choice , more and more, spread , of axially oriented crystals in channeling conditions to provide such amount of photons . Emphasis is put on a particular scheme, the hybrid source, associating a crystal-radiator to an amorphous converter. The development of this scheme since the first proposal is described.

Primary author: CHEHAB, Robert

Presenter: CHEHAB, Robert

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **56** Type: **oral**

Half-Wavelength-Crystal Channeling of Relativistic Ions and its Possible Application for Beam Deflection and Focusing

Friday, 9 June 2023 11:10 (20 minutes)

The phenomenon of Half-Wavelength Crystal (HWC) channeling, where a particle experiences "mirroring" due to a single collision with a crystallographic plane, has been observed for protons and electrons. While the HWC channeling phenomenon has been observed for 400 GeV protons at CERN-SPS [1] and for 255-MeV electrons at the SAGA-LS Facility [2, 3], there are additional parameters that arise in the case of Relativistic Heavy Ions (RHI), namely the ion charge Ze and mass number A. The critical channeling angle is influenced by (Z/A)1/2. The computer simulations of HWC channeling of low-Z isotopes [4] revealed the significant iso-topic effect. The results of computer simulations of HWC channeling of high-Z RHI (129Xe, 208Pb, 238U) with almost the same values of (Z/A)1/2 in Si, Ge and W crystals, using the computer code BCM-2.0 was obtained in [5]. The assembly of sequentially placed and rotated HWC crystals can increase the deflection angle. Re-cently, calculations were performed for two HWC crystals rotated to the critical channeling angle, and they showed that such a system could be used as secondary beam deflectors or splitters similar to the applications of bent crystals in high-energy particle physics.
In this work, we present results of computer simulation of HWC crystals channeling in an assembly of N sequentially placed and rotated HWCs. Our simulation demonstrated that such system could achieve a de-flection angle up to N times the critical channeling angle. A similar system of several bent and straight (but not HWC) crystals for deflection of a 1.3 GeV proton beam was recently studied in [6]. We also discuss the potential applications of HWC channeling for RHI beam deflection and focusing on the downstream target, in view of atomic physics experiments with RHI beams planned for the Super-FRS Experiment Collaboration [7].
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Primary author: TUKHFATULLIN, Timur

Co-author: BOGDANOV, Oleg

Presenter: TUKHFATULLIN, Timur

Session Classification: S1 & S4: Beams Interactions & New Concepts

Contribution ID: **57** Type: **oral**

Anti-shielding of the Coulomb field of relativistic charge in a matter

Monday, 5 June 2023 17:30 (20 minutes)

The Coulomb field of the charged particle in the medium is known to be shielded, due to the response of the material. In this research, we show that, unexpectedly, for the relativistic charge moving inside the medium it is possible that at certain conditions the Coulomb field will be enhanced rather than weakened! This phenomenon is predicted theoretically; we also simulated this process in CST, and the results have confirmed our conclusions. This effect can play a vital part for qualitative understanding of the processes of dynamic polarization of the medium by relativistic charged particle beams, especially when they generate radiation.

Primary authors: SAVCHENKO, Aleksandr; TISHCHENKO, Alexey; GAVRILENKO, Dmitrii

Presenter: GAVRILENKO, Dmitrii

Session Classification: S4: New Concepts

Contribution ID: **58** Type: **oral**

BEAM DYNAMICS IN THE STORAGE RING OF A COMPACT MONOCHROMATIC RADIATION SOURCE IN THE X-RAY RANGE BASED ON COMPTON BACKSCATTERING

Monday, 5 June 2023 12:40 (20 minutes)

The study aimed to conduct dynamics calculations, considering collective effects in a storage ring for a compact monochromatic radiation source in the X-ray range based on Compton backscattering. The calculation focused on various instabilities and collective effects, including microwave instability, coherent synchrotron radiation (CSR), instability of transverse coupled modes, space charge, and Beam-Ion instability. The analysis provided a comprehensive understanding of the factors limiting the machine's performance and instabilities thresholds.

Primary author: SAGAN, Kirill

Co-author: DYUBKOV, Vyacheslav

Presenter: SAGAN, Kirill

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **59** Type: **invited**

Open issues in astroparticle experimental physics

The Lambda Cold Dark Matter model (LCDM), the General Relativity (GR) and the Standard Model (SM) are today our best interoperation of the universe surrounding us, that since long time have many open questions. Moreover, recent observations in astronomy and astrophysics are strongly changing the theoretical and experimental scenario.
An overview of today open issues in the astroparticle physics and in the technique of the main experiments in the world is presented.

Primary author: MAZZITELLI, Giovanni

Presenter: MAZZITELLI, Giovanni

Session Classification: Channeling Primer

Contribution ID: **60** Type: **oral**

New solutions for acceleration and radiation in a new Compton source at MEPhI

Tuesday, 6 June 2023 16:30 (20 minutes)

Today, a compact monochromatic radiation source in the X-ray range based on inverse Compton scattering is being constructed in MEPhI. The source will be based on linear standing wave accelerator of electrons and compact o-shape magnetic channel (accumulator ring). The features of collective effects in the ring are studied. The thresholds of longitudinal microwave instability and transverse mode-coupling instability (TMCI) are calculated and discussed.

Primary author: DYUBKOV, Vyacheslav

Co-authors: Mr TISHCHENKO, Alexey; SAGAN, Kirill; Prof. POLOZOV, Sergey; Mr RASHCHIKOV, Vladimir

Presenter: DYUBKOV, Vyacheslav

Session Classification: S2 & S4: Radiation: Generation & Interaction. & New Concepts

Contribution ID: **61** Type: **oral**

Experimental Demonstration of Super-radiant Emission of Coherent Cherenkov Diffraction Radiation

Tuesday, 6 June 2023 12:00 (20 minutes)

Recent years have witnessed an intense development of accelerator-based sources generating radiation from radiowaves to hard X-rays. Intense electromagnetic radiation in the far-infrared spectral range is an advanced tool for scientific research in biology, chemistry, and material science because many materials leave signatures in the radiation spectrum. Monochromatic lines in the spectrum with variable frequency enables researchers to investigate the matter response in greater detail. The development of variable frequency far-infrared radiation sources has therefore become a broad area of research. High energy electron beams consisting of a long train of dense bunches of particles provide a super-radiant regime and can generate intense highly monochromatic radiation due to coherent emission in the spectral range from a few GHz to potentially a few THz. At Tomsk microtron we have employed a novel coherent Cherenkov diffraction radiation mechanism in super-radiant regime. This effect occurs when a fast charged particle moves in the vicinity of and parallel to a dielectric interface. Two key features of the ChDR phenomenon are its non-invasive nature and its photon yield being proportional to the length of the radiator. The bunched structure of the very long electron beam produced several spectral lines that were observed to have frequencies from 7 upto 21 GHz with a relative bandwidth of 0.001 –0.01 % defined by the shape and the length of the bunch train. A compact linear accelerator can be utilized to control the resonant wavelength by adjusting the bunch sequence frequency. These mechanism can potentially be integrated in X-ray free electron lasers. After the undulator the still powerful electron beam is terminated in a beam dump. By integrating a compact radiator (or even a series of radiators) one may extract a fraction of the residua beam power and convert it into a THz radiation source to be used for fundamental and applied research.

Primary author: KARATAEV, Pavel

Co-authors: POTYLITSYN, Alexander; VUKOLOV, Artem; NAUMENKO, Gennady

Presenter: KARATAEV, Pavel

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **62** Type: **invited**

Present status and future perspectives of high precision X-ray measurements at LNF for nuclear physics and agrifood applications

Thursday, 8 June 2023 16:00 (30 minutes)

The INFN Laboratories of Frascati host a sparkling community working on X-ray detection and its possible applications. Among this community, the SIDDHARTA-2 and the VOXES collaborations developed and implied, in the last years, a series of spectroscopic detectors for several purposes, ranging from a few keV to almost 300 keV.
The SIDDHARTA-2 experiment at LNF exploits the large area of Silicon Drift Detectors (SDD) to measure for the first time the strong interaction induced shift and width of the 1s level in kaonic deuterium; in parallel, CdZnTe and HPGe detectors are also installed within the main experimental apparatus to measure transitions from other kaonic atoms having potential breakthrough impacts like, for example, a new precise measurement of the charged kaon mass, still an unsolved puzzle.
The VOXES collaboration started, in 2016, to develop a Bragg spectrometer based on HAPG mosaic crystal aiming at future measurements of kaonic atoms with sub-eV precision and a few eV resolution; while working in this direction, the developed spectrometer proved itself to be suitable for a series of other interesting applications involving isotropic sources of millimetric and centimetric dimensions, like for instance the possible determination of metals'oxidation states in wine.
In this talk, we present the recent advancements, both in terms of detector development and obtained results, for all the above-mentioned activities.

Primary author: SCORDO, Alessandro

Presenter: SCORDO, Alessandro

Session Classification: S5: Applications & X-Rays

Contribution ID: **63** Type: **oral**

Experimental studies towards the development of an ultra-compact electromagnetic calorimeter composed of oriented crystals

Monday, 5 June 2023 12:20 (20 minutes)

In the last few years, the STORM collaboration has studied the Strong Field regime in a variety of crystals of interest for the development of innovative electromagnetic calorimeters (such as 0.5 - 4.6 X0 PbWO4). In all the tested samples, a large reduction of the effective radiation length has been observed. This contribution will describe the results, obtained by the STORM collaboration, which led to the new INFN project OREO (ORiEnted calorimeter), dedicated to the construction and test of the first calorimeter composed of oriented crystals.

Primary authors: MONTI-GUARNIERI, Pietro; SELMI, Alessia; LOBKO, Alexander; SYTOV, Alexei; MAZZOLARI, Andrea; DE SALVADOR, Davide; VALLAZZA, Erik Silvio; RONCHETTI, Federico; Dr SGARBOSSA, Francesco; LEZZANI, Giulia; BANDIERA, LAURA; PERNA, Leonardo; BOMBEN, Luca (Istituto Nazionale di Fisica Nucleare); MOULSON, Matthew David; SOLDANI, Mattia; PREST, Michela; KORJIK, Mikhail; Dr CARSI, Stefano; MASCAGNA, Valerio; TIKHOMIROV, Victor; HAURYLAVETS, Viktar; GUIDI, Vincenzo; ROMAGNONI, Marco

Presenters: MONTI-GUARNIERI, Pietro; MOULSON, Matthew David

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **64** Type: **poster**

Impact of Dopant Concentration on the Crystalline Structure of Si-Ge Crystals for the Construction of Crystal-based Light Sources using Molecular Dynamics Simulations

Monday, 5 June 2023 18:14 (1 minute)

Crystal-based Light Sources (CLS) offer a novel method to produce sources of gamma-rays. Making use of the channelling phenomena, ultra-relativistic charged particles are directed through bent crystals to produce synchrotron-like radiation. These bent crystals are produced by doping a base crystal, thus changing the crystalline inter-planar distances.

In this preliminary study we conduct molecular dynamics simulations of fixed-sized $Si_{1-x}Ge_x$ crystals doped at Germanium concentrations of $0.00 \leq x \leq 0.30$ and temperatures of 10K and 300K to elucidate the impact of these parameters on the distances between channelling planes.

We observe a linear relationship between Germanium concentration and inter-planar distance, with minimal dependence on temperature at low Germanium concentrations. We observe less formation of crystalline defects than expected from literature. This work will be complemented with experimental characterisations of $Si_{1-x}Ge_x$ crystals.

Primary author: Mr DICKERS, Matthew

Co-authors: KOROL, Andrei; SOLOV'YOV, Andrey; Prof. MASON, Nigel

Presenter: Mr DICKERS, Matthew

Session Classification: PS: Poster Session

Contribution ID: **65** Type: **oral**

PYROELECTRIC ELECTRON BEAM DEFLECTOR AND UNDULATOR

Tuesday, 6 June 2023 12:40 (20 minutes)

A.V. Shchagin

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Deflection of a relativistic electron beam by means of the pyroelectric deflector is demonstrated experimentally for the first time [1]. The operating principle of the pyroelectric deflector is based on the generation of a strong transverse electric field in a vacuum in the gap between a pair of pyroelectric crystals due to the pyroelectric effect. The experiments on observation of deflection of 7 MeV electron beam for 26 mrad in the transverse electric field with a strength of about 100 kV/cm arising at a variation of the temperature of a pair of pyroelectric crystals in vacuum are described. The possibility for application of the installed sequentially pyroelectric deflectors in pyroelectric undulator for production of undulator radiation by relativistic electron beam without any external high voltage power supply is discussed. This project has received funding through the MSCA4Ukraine project, which is funded by the European Union.

1. V.I. Alekseev, A.N. Eliseev, O.O. Ivashchuk, I.A. Kishin, A.S. Kubankin, A.N. Oleinik, V.S. Sotnikova, A.S. Chepurnov, Y.V. Grigoriev, A.V. Shchagin. Pyroelectric deflector of relativistic electron beam. Chinese Journal of Physics 77 (2022) 2298-2306.

Primary author: SHCHAGIN, Alexander

Presenter: SHCHAGIN, Alexander

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **66** Type: **oral**

IONIZATION LOSS FOR MEASUREMENTS OF THE DECHANNELING LENGTH OF ELECTRONS

Monday, 5 June 2023 17:10 (20 minutes)

A new method for the experimental study of ionization loss of relativistic negatively charged particles moving in a crystal in the channeling regime using a semiconductor surface-barrier detector with smoothly tunable thickness of the depleted layer is proposed. The ionization loss can only be measured in the depleted layer of the detector. The thickness of the depleted layer in a flat semiconductor detector can be smoothly regulated by the value of the bias voltage of the detector. Therefore, the energy distribution of the ionization loss of relativistic particles which cross the detector and move in the channeling regime in the detector crystal can be measured along the path of the particles at variation of the bias voltage of the detector. Thus, the dechanneling length of electrons in a crystalline detector can be measured [1,2]. This project has received funding through the MSCA4Ukraine project, which is funded by the European Union.

1. A.V. Shchagin, G. Kube, S.A. Strokov, W. Lauth. Surface-barrier detector with smoothly tunable thickness of depleted layer for study of ionization loss and dechanneling length of negatively charged particles channeling in a crystal. Preprint, 2022. http://arxiv.org/abs/2211.01913
2. S.V. Trofymenko, I.V. Kyryllin. On the ionization loss spectra of high-energy channeled negatively charged particles. Eur. Phys. J. C 80 (2020) 689.

Primary authors: SHCHAGIN, Alexander; Dr STROKOV, Sergey; Dr LAUTH, Werner; Dr KUBE, gero

Presenter: SHCHAGIN, Alexander

Session Classification: S4: New Concepts

Contribution ID: **67** Type: **oral**

Study of the influence of the curvature radius and the beam energy on beam steering and radiation by sub-GeV electrons

Monday, 5 June 2023 11:40 (20 minutes)

In this work we report the observation of sub-GeV electrons deflection and radiation emission in ultrathin silicon crystals, bent along (111) planes, at the MAinzer Mikrotron (MAMI). The crystal length of $15\mu m$ was chosen to be comparable with the dechanneling length of electrons. Firstly, at the fixed energy of 855 MeV, the channeling efficiency, the dechanneling length, the volume reflection angle as well as the radiation spectra were measured in dependence on the crystal curvature and its orientation. All the results were critically compared with our Monte Carlo simulation. The trade-off between radiation intensity and angular acceptance at different values of the crystal curvature was studied, and it was concluded that, using volume reflection, intense gamma radiation can be produced –with intensity comparable to that obtained in channeling but with a higher angular acceptance[1].
Secondly, with a second crystal with a fixed radius of curvature, the modification of radiation spectra and channeling/VR efficiency was studied at different values of beam energy, i.e., at 300, 600, and 855 MeV.
All these results are relevant for crystal-based beam steering/extraction from electron synchrotron as well as for the realization of an innovative intense X-ray source via channeling in a periodically bent crystal[2].

Primary authors: SYTOV, Alexei; MAZZOLARI, Andrea; DE SALVADOR, Davide; BAGLI, Enrico; VALLAZZA, Erik Silvio; Dr SGARBOSSA, Francesco; Dr PATERNÒ, Gianfranco; BANDIERA, LAURA; Mr MALAGUTTI, Lorenzo; ROMAGNONI, Marco; SOLDANI, Mattia; CANALE, Nicola; P. KLAG; CAMATTARI, Riccardo; NEGRELLO, Riccardo; TIKHOMIROV, Victor; HAURYLAVETS, Viktar; GUIDI, Vincenzo; LAUTH, Werner

Presenter: NEGRELLO, Riccardo

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **68** Type: **invited**

Radiation and pair production in oriented crystals: innovative application to future particle accelerators and detectors

Wednesday, 7 June 2023 09:00 (30 minutes)

It has been known since decades that the alignment of a beam of high-energy e- or photons with particular crystal direction involves a huge increase of radiation emission or pair production probability, respectively. While crossing an oriented crystal, such penetrating particles experience an electromagnetic field so strong that it leads to a huge enhancement of the e.m. shower development with consequent reduction of the radiation length. Here we present recent results in this topic, with a focus on materials and configurations suitable for applications in future accelerators/detectors.
The presented results open up several application scenarios in accelerators, e.g. in intense e+ source for the Future Circular Collider, and particle detectors, e.g. in the development of compact forward calorimeters and photo-absorber in fixed-target experiments, as well as in satellite-borne gamma-telescopes.

Primary author: BANDIERA, LAURA

Presenter: BANDIERA, LAURA

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **69** Type: **poster**

Formation of Hydrogen Atom Beams during Capture of Electrons by Non-relativistic Protons Channeled in Carbon Nanotubes

Monday, 5 June 2023 18:17 (1 minute)

The paper shows that when beams of non-relativistic protons are channeled along the axes of carbon nanotubes (non-chiral nanotubes of the type are chosen, in which the chains of carbon atoms are located in the corners of a regular 2n-gon), the formation of fast directed beams of neutral hydrogen atoms is possible. Consideration of such a mechanism is carried out using the non-stationary perturbed theory under the conditions of resonant interaction of carbon atoms with beams of non-relativistic protons moving at optimal speeds. With the use of calculated wave functions and energy levels of channeled protons, as well as modeled wave functions of electrons moving in the electrostatic fields of carbon nuclei, the probabilities of their capture by channeled protons with the possibility of forming directed beams of hydrogen atoms are calculated.
It should be noted that such beams of neutral atoms can be used, for example, in the implementation of an inertial thermonuclear device or atmospheric probing to exclude the influence of a magnetic field.

Primary author: MAKSYUTA, Mykola

Co-authors: Mr MAKSYUTA, Dmytro; DABAGOV, Sultan; VYSOTSKII, Vladimir

Presenter: MAKSYUTA, Mykola

Session Classification: PS: Poster Session

Contribution ID: **70** Type: **poster**

Ion Irradiated Aligned Multiwall Carbon Nanotubes Physical Properties

Monday, 5 June 2023 18:18 (1 minute)

The combination of chemical and physical processes is the main mechanism of the CNTs' bactericidal action. The mechanism of the antibacterial effect of nanomaterials has not been sufficiently studied to date. Changing the structure of carbon nanomaterials by ion beams allows one to adjust their electrical and magnetic properties, vary the thermal conductivity of individual carbon nanofibers, change the wettability of various liquids on the surface, increase the sensitivity to certain gases by surface defect engineering, etc.

We have recently reported that 80 keV He+ ion irradiation helps to obtain MWNT-based surfaces with tunable wettability, [1],which can be significantly varied from hydrophilic to superhydrophobic behavior, such properties have prospects in biomedical applications.

All abstracts must be written in English and occupy a maximum of 1 page A4 written in Times New Roman 12, alignment in mode "justify". Please make sure to respect the following margins: top, bottom, right: 25 mm; left: 30 mm.

Modeling the interaction of irradiated carbon nanomaterials, especially carbon nanotubes, with environmental gas molecules is often not taken into account when calculating the ionic modification of such materials.The present study is aimed at modeling the interaction of carbon nanotubes irradiated with an ion beam with environmental gas models. For the calculation under consideration, the interaction of four types of atoms in the simulated system was taken into account according to the PeahFF potential, the total number of atoms of the simulated system was about 300 thousand.The network of bonds was analyzed in order to search for defects in its structure.Simulation was done with help of Lomonosov-2 supercomputer [2] on gprahical processor unit (GPU) nodes with up to 10 times acceleration..

As a result of simulation the ion irradiation of multi-walled carbon nanotubes (MWNTs) with inert gas ions, it was shown that complex defects can form in the inner layers, including those caused by recoil atoms, dusting of inner shells, thermal annealing, and other processes caused by ion irradiation. Such defects changed the conductivity type of the nanotube, and upon functionalization, they were able to become a detecting element of a sensor built on the basis of ion-modified CNTs.

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2. Sadovnichy V., Tikhonravov A., Voevodin Vl., et al., Contemporary High Performance Computing: From Petascale toward Exascale. –Boca Raton: CRC Press, 2013. –283 p

Primary authors: Dr GABDULKHAKOVA, Aida; Mr EVSEEV, Alexander; Mr POPOV, Alexander; Ms KOVALENKO, Alyona; Dr DIMITRIEVA, Anastasia; Dr SHEMUKHIN, Andrew; STEPANOV, Anton; Mr YUMANOV, Dmitriy; Dr VOROBYEVA, Ekaterina; Dr ELSEHLY, Emad; Dr MIFTAKHOVA, Regina

Presenters: Mr POPOV, Alexander; Dr DIMITRIEVA, Anastasia; Dr SHEMUKHIN, Andrew; STEPANOV, Anton

Session Classification: PS: Poster Session

Contribution ID: **71** Type: **oral**

Future proof-of-principle experiment on crystal-based extraction of electrons from the DESY II Booster Synchrotron

Monday, 5 June 2023 09:30 (20 minutes)

Crystal-based extraction using a bent crystal has been already applied at several high-energy hadron accelerators, but has never been applied for electrons. However, this technique can be very promising for synchrotron light sources and for existing and future lepton collider projects as well for nuclear and particle physics detectors and generic detector R&D and in many projects in high-energy physics.

We propose and simulate the first detailed design of a proof-of-principle experiment on the crystal-based extraction of 6 GeV electrons from the DESY II Booster Synchrotron using a bent crystal.

Primary authors: MAZZOLARI, Andrea; SYTOV, Alexei; Dr KUBE, Gero; BANDIERA, LAURA; CIRRONE, Giuseppe; EHRLICHMANN, Heiko; GUIDI, Vincenzo; HAURYLAVETS, Viktar; ROMAGNONI, Marco; SOLDANI, Mattia; STANITZKI, Marcel; TAMISARI, Melissa; TIKHOMIROV, Victor; WITTENBURG, Kay

Presenters: MAZZOLARI, Andrea; SYTOV, Alexei

Session Classification: S1: Beams Interactions

Contribution ID: **72** Type: **invited**

Diamond-based detection systems for tomorrow's precision dosimetry

Thursday, 8 June 2023 11:10 (30 minutes)

Radiation dosimetry for Radiotherapy (RT) is a key element in ensuring treatments efficacy as well as both the safety and the proper management of patients. Accurate dosimeters able to perform precise dose measurements is of pivotal importance for the calibration of the radiation beams, aimed at evaluating their characteristics and validating the treatment plan performed during the therapy.
Over the years, the evolution and spread of modern dynamic and conformal techniques in RT has imposed a number of challenges from the dosimetric point of view. The radiation beams typically used in RT are either high-energy (6-18 MeV) or low-energy (50 keV) photon beams, for external or intraoperative treatments, respectively. Very recently, the emerging FLASH RT technique is posing additional and new challenges in the field of dosimetry. The FLASH technique is a modern solution for the cancer treatments of the future, which employs high-energy pulsed electron beams with ultra-high dose-per-pulse values allowing for a differentiated response between healthy and diseased tissue, thus sparing radiation damage to healthy tissue.
A unique multi-purpose dosimeter able to offer a good performance with radiations of different nature and energy range would be highly desirable, especially in the RT field. Diamond detectors, which represent an established and mature technology for conventional RT, may also be the optimal solution for the FLASH RT. Due to the unique physico-chemical characteristics of the material, diamond detectors exhibits an excellent linearity of the response with both the dose and the dose-rate, a high sensitivity, a high spatial resolution, and a response time in the nanosecond range, regardless of the nature and/or energy of the radiation. For these reasons, diamond is a highly versatile and particularly appealing material for applications in ionising radiation dosimetry. In addition, diamond dosimeters coupled to a tailored signal readout system easily enables pulse-by-pulse monitoring of the radiation beam in terms of: dose and dose-rate delivery, pulse duration, and pulse repetition rate. Therefore, diamond-based dosimeters allow performing a real-time full-diagnostics of the beam, thus assuring accurate single-pulse measurements fundamental in improving the quality of the treatments in the RT field.

Primary author: PETTINATO, Sara

Presenter: PETTINATO, Sara

Session Classification: S3 & S4: Acceleration Techniques & New Concepts

Contribution ID: **73** Type: **invited**

Symmetric Compton Scattering - a possible way to compact monochromatic gamma-ray sources

Monday, 5 June 2023 16:00 (30 minutes)

We report our recent study on the transition between Compton Scattering and Inverse Compton Scattering (ICS), which is characterized by an equal exchange of energy and momentum between the colliding particles (electrons and photons). This regime has been called Symmetric Compton Scattering (SCS) and has the unique property of cancelling the energy-angle correlation of scattered photons, and, when the electron recoil is large, transferring mono-chromaticity from one colliding beam to the
other, resulting in back-scattered photon beams that are intrinsically monochromatic. The study suggests that large-recoil SCS or quasi-SCS can be used to design compact intrinsic monochromatic gamma-ray sources based on compact Linacs, thus avoiding the use of GeV-class electron beams together with powerful laser/optical systems as those typically required for ICS sources.

Primary author: SERAFINI, Luca

Presenter: SERAFINI, Luca

Session Classification: S4: New Concepts

Contribution ID: **74** Type: **oral**

ABOUT FREQUENCIES OF RADIATION OF RELATIVISTIC PARTICLES IN PERIODICAL CRYSTALLINE STRUCTURE

Monday, 5 June 2023 12:00 (20 minutes)

The frequencies of radiation of relativistic particles in periodical crystalline structure are considered. The threshold character of the radiation is discussed. This project has received funding through the MSCA4Ukraine project, which is funded by the European Union.

Primary author: SHCHAGIN, Alexander

Co-authors: Dr KUBE, Gero; Dr STROKOV, Sergey

Presenter: SHCHAGIN, Alexander

Session Classification: S2: Radiation: Generation & Interaction

Contribution ID: **75** Type: **poster**

Optical properties of corundum crystals after electron beam exposure

Tuesday, 6 June 2023 18:16 (1 minute)

Cherenkov effect is well-known phenomenon and finds a broad application in physics including beam diagnostics [1]. Corundum crystals irradiated by charged particles are often used as Cherenkov light source. Corundum radiators may significantly change their optical properties during extensive exploitation with particle beams that would influence Cherenkov light intensity. In this report we investigated optical properties of corundum crystals before and after irradiation by electron beams. Obtained results shows that crystals'transmittance decreases for low frequencies, and increases for high frequencies.

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Primary author: CHEREPENNIKOV, Yury

Co-authors: POTYLITSYN, Alexander; VUKOLOV, Artem; Dr KONUSOV, Fedor; SHEVELEV, Mikhail; Mr PAVLOV, Sergey; KOCHARYAN, Vahan

Presenters: POTYLITSYN, Alexander; SHEVELEV, Mikhail; KOCHARYAN, Vahan; CHEREPENNIKOV, Yury

Session Classification: PS: Poster Session

Contribution ID: **76** Type: **poster**

Estimation of radiation exposure of human body in neutron-capture radiation therapy

Tuesday, 6 June 2023 18:17 (1 minute)

Particle and radiation beams are widely used for cancer therapy. In last decades neutron sources are becoming more and more popular for medical applications. One of the most advanced technique for cancer treatment is neutron-capture therapy (NCT). The main feature of this technique is using epithermal and thermal neutrons to create a powerful source of radiation in the human body and particularly in the tumour. For this purpose, a particular element with high cross-section of neutron initiated nuclear reaction is accumulated in the tumour and emits radiation under neutron beam. The most popular element used for this kind of radiation therapy is 10B emitted after nuclear reaction alpha particle, which further absorb in very short range [1]. The latter provides good localization of radiation dose in the tumour volume. Other elements which potentially may be used for NCT are 156Gd and 158Gd. These elements have a much larger nuclear reaction cross section, which is attractive for practical use. Another potential advantage of Gd using is the easier control of element distribution in the human body since Gd based drugs are widely used for Magnetic resonance imaging. However, unlike 10B, isotopes of Gd emits after neutron initiated nuclear reaction electrons and high energy gamma quanta that can cause high radiation exposure of healthy organs and tissues [2]. In this study relative level of dose exposure of tumor and healthy tissues are estimated using Monte Carlo based numerical simulation. This work is supported by the Russian Science Foundation, project No. 23-19-00614.

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2. Issa F., Loppolo J. A., Boron and Gadolinium neutron capture therapy. –Sydney: Elsevier, 2013. –24 p.

Primary author: CHEREPENNIKOV, Yury

Co-authors: Dr REMNEV, Gennady; Dr ZHURAVLEV, Mikhail; Dr BESPALOV, Valery

Presenter: CHEREPENNIKOV, Yury

Session Classification: PS: Poster Session

Contribution ID: **77** Type: **oral**

A new way to develop ”LOW COST” instrumentation: the PICO RX diffratometer/XRf spectrometer enhanced with polycapillary lenses

Thursday, 8 June 2023 16:50 (20 minutes)

Here we present a new line of transportable and portable X-ray instruments. They have been manufactured based on a number of specifications:
- high sensitivity, low cost, cheap and easily programmable electronics, AI-based software and “open source” platforms
High sensitivity is achieved by adopting INFN polycapillary lenses, in particular a semi-lens for diffraction and a cylindrical lens for fluorescence. The low cost goal was achieved by adopting a construction based on 3D printing in carbon fiber and PLA. The electronics are based on programmable PSOC platforms, which manage the instruments together with ARDUINO MEGA boards. PSOC boards completely replace a complete “mother boards” full of components of the past. The software is built in “open source” and some of the most delicate routines have been created thanks to the use of the artificial intelligence of Chat Gpt4.0. Finally, commands and management are entrusted to a new class of “intelligent” LCD touch screens and Apps that can be easily managed with any type of device (PC, Tablet, Smartphone). Both instruments have a maximum power of the X-ray tube of only 4 W. For outdoor transport, given the Italian national legislation, the fluorescence system has a W tube with self-limited power supply at 30 kV. The same instrument, once reinserted in the chassis, becomes a bench system with a maximum acceleration voltage of 40 kV and an 8-position sample holder. The use of lenses increases the sensitivity of the aforementioned instruments by two orders of magnitude.
Using the technologies described, the prices of these instruments are placed in a market range accessible to small and medium-sized laboratories, including gemmological and cultural heritage restoration laboratories.

Primary authors: Dr HAMPAI, Dariush; Dr VOLAKAKIS, Manuel; PLESCIA, Paolo; Dr ITALIANO, Pietro; Prof. DABAGOV, Sultan

Presenter: PLESCIA, Paolo

Session Classification: S5: Applications & X-Rays

Contribution ID: **78** Type: **oral**

Recent developments of the FLUKA Channeling model and benchmarking of SPS and LHC crystal-related activities

Monday, 5 June 2023 10:30 (20 minutes)

In recent years, bent crystals have become a mature technology now exploited in several applications at CERN, such as shadowing techniques to reduce particle losses during slow extraction from the SPS as well as crystal-assisted collimation for LHC ion runs. Looking forward, they are also a key component of future plans to measure the electric and magnetic dipole moments of short-lived particles, in a double-crystal experiment in the LHC.

This increasing prevalence of bent crystals use in accelerators has driven the development of the FLUKA model of crystal channeling, presented in 2014[1]. The model is now fully incorporated in the main software and allows users to perform multiturn transport simulations in complex crystal-based geometries, with the help of independently developed tools (FLUKA-Sixtrack coupling, LineBuilder)[2,3]. This integration effort has been complemented by the refinement of several of the model components. In particular we will explore the novel analytical microscopic tracking in quasi-channeling enabling a more precise reproduction of the interaction suppression in that regime.

Finally, we give a detailed overview of experimental results obtained in the LHC and SPS, and their comparison with results of performed simulations.

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[3]: A. Mereghetti, V. Boccone, F. Cerutti, R. Versaci, V. Vlachoudis,
"The FLUKA LineBuilder and Element DataBase: Tools for Building Complex Models of Accelerator Beam Lines", Proc. IPAC 2012, New Orleans, 2687-2689

Primary author: SCHOOFS, Philippe

Co-authors: Dr SALVAT PUJOL, Francesc; Dr VELOTTI, Francesco; ESPOSITO, Luigi Salvatore

Presenter: SCHOOFS, Philippe

Session Classification: S1: Beams Interactions

Contribution ID: **79** Type: **invited**

Considerations toward a Compact Coherent Light Source based \\ on a Two-Beam Acceleration Technique

Friday, 9 June 2023 09:00 (30 minutes)

The demonstration of the reliable operation of an X-band radio-frequency (RF) photoinjector with fields ~ 0.4~GV/m [1] on a photocathode provides a pathway to bright electron bunches. This success was enabled by powering the RF gun with short RF pulses thereby mitigating breakdowns and dark-current generation. The ~300-MW RF pulses were generated by decelerating a high-charge relativistic bunch train. This contribution summarizes ongoing activities focused on further deploying this two-Beam acceleration technique concept toward a free-electron laser demonstration at the Argonne Wakefield Accelerator with a focus on the beam dynamics and photon-generation aspects.

Primary author: PIOT, Philippe

Presenter: PIOT, Philippe

Session Classification: S1 & S4: Beams Interactions & New Concepts

Contribution ID: **80** Type: **poster**

Particle-in-Cell Modeling of Coherent Inverse Compton Scattering

Tuesday, 6 June 2023 18:18 (1 minute)

A pathway to a compact accelerator-based short-wavelength light source consists of scattering a high-power laser pulse off relativistic bright electron beams thereby producing frequency up-shifted photons. This inverse Compton scattering (ICS) process has formed the backbone of gamma- and X-ray-generation at several facilities. In the present paper, we investigate the onset of coherent ICS (CICS) where the electron coherently participates through the interaction resulting in a significant enhancement of the photon flux. We specifically explore via particle-in-cell simulation the generation of coherent X-rays from pre-bunched electron beams as recently proposed and explore possible beam shaping to enhance the interactions.

Primary author: PHILIPPE, piot

Presenter: PHILIPPE, piot

Session Classification: PS: Poster Session

Contribution ID: **81** Type: **oral**

SPHINX: Structure Probing by Holographic Imaging at Nanometer scale with X-ray lasers

Friday, 9 June 2023 09:30 (20 minutes)

The SPHINX project aims building an ultrafast X-ray holographic camera able to record images of microscopic samples and of their internal parts with nanometer resolution. The application is based on a new implementation of the phase-contrast holography that overcomes the main limitations encountered in the current systems (mostly based on absorption-contrast), namely the low energy range, the limited detector granularity and the weak illumination. As a practical solution, a combination of polycapillary lenses, large X-Ray CCD arrays with small pixel size and XFEL sources will allow splitting the beam, focusing, magnification and phase-contrast imaging in the keV energy range. Unlike the absorption-based methods, where angles increase with the energy, the refractive diffraction reduces the diffraction limit together with the characteristic angles, both essential for the resolving power (given the limited X-ray detector pitch), while also eliminating the shadow effect and giving access to full structure probing. The key parameters are defined by the focusing optics, which could be, according to the beam and sample sizes, a polycapillary micro semi-lens or a combination of the former with a parabolic monocapillary. The main advantage of "imperfect"optics (not providing a point-like focus) is their divergence, driven mostly by the single fiber. This allows sending on the same detector area both the object and the reference beams, condition unreachable with a Fresnel lens or a crystal mirror. Moreover, the femtosecond exposure time permits holographic reconstruction of in-vivo cell elements, viruses and nanorobotic devices during ultrafast molecular processes, yet unexplored by imaging techniques.

Primary author: ILIESCU, Mihail Antoniu

Presenter: ILIESCU, Mihail Antoniu

Session Classification: S1 & S4: Beams Interactions & New Concepts

Contribution ID: **82** Type: **oral**

X-ray Based Techniques for Transportation Applications

Thursday, 8 June 2023 17:10 (20 minutes)

Transportation sector is facing a watershed moment: the need of reducing emission of greenhouse gases imposes radical changes in propulsion systems. Despite the run to powertrain electrification, this goal is far to be realized before 2050. Therefore, more and more attention will be paid worldwide to rich close-to-zero pollutant emissions from future road transportation vehicles.
Next future emission regulations will limit both exhaust and non-exhaust emissions (brake wear particles and Tire Road Wear Particles, etc.). This scenario imposes new challenges for development of advanced research methods capable to provide an insight on the inner structure pollutant species.

X-ray based techniques have been widely used in the recent past for the characterization of local phenomena occurring inside the fuel dense sprays emerging from high pressure injection systems for modern engine applications. Due to of the weak interaction
with the fluids, x-rays can penetrate fuel jets structures and provide spatially-resolved information along the propagation direction. Besides this frontier application x-ray based techniques are well recognized as the most effective solution to investigate the interaction of engine exhaust catalysts with single pollutant species and for detection of soot and its precursors in internal combustion engines. This work aims at providing an insight on the state of art and perspective of x-rays techniques for transportation sector. First, a brief description of the different measurement techniques will be provided. Then, a detail on the measurement methods and examples will be provided, with particular care to soft-x-rays application. Finally, the more appropriate solutions for future vehicle application such tyre and road wear particles analysis will be proposed.

Primary authors: MARCHITTO, Luca; HAMPAI, Dariush; DABAGOV, Sultan

Presenter: MARCHITTO, Luca

Session Classification: S5: Applications & X-Rays

Contribution ID: **83** Type: **poster**

The Synchronous Detection Technique for Accurate Monitoring of High-Energy Pulsed X-rays

Tuesday, 6 June 2023 18:19 (1 minute)

At high energy, the smaller inelastic nucleon-Carbon cross-section implies that diamond has a radiation hardness an order of magnitude higher than that of silicon. The production of high-quality diamond samples grown using the chemical vapor deposition technique paved the way for the use of synthetic diamonds in the fabrication of detectors for both charged particles and photons. Importantly, laser processing technology for the fabrication of three-dimensional (3D) contacts in diamond has been proposed to produce highly efficient detectors, even with ultra-low active volumes. However, 3D contact structures made with laser treatments unavoidably induce structural defects in the bulk of the material, thus affecting detector response due to trap-related charge transport mechanisms. Remarkably, low-quality diamond-based detectors show a strong sub-linear response with the radiation dose-rate, as usually observed for synthetic diamonds grown with the high-pressure and high-temperature technique. When pulsed radiation is concerned, the experimental results illustrated in this work demonstrate that adequate synchronous signal conditioning can strongly mitigate the trap-mediated contribution, thereby improving the performance of the overall detection system. Very significantly, the results open the way of using low-quality diamond samples for the fabrication of accurate detectors also in the field of microdosimetry.

Primary author: SALVATORI, Stefano

Co-authors: Dr PETTINATO, Sara; Prof. ROSSI, Maria Cristina

Presenter: SALVATORI, Stefano

Session Classification: PS: Poster Session

Contribution ID: **84** Type: **oral**

On (110) planar channeling experiments with 500 MeV positrons in silicon single crystals

Wednesday, 7 June 2023 10:10 (20 minutes)

Experiments with the 500 MeV positron beam under construction at the Mainz Microtron MAMI will be proposed to study the (110) channeling process in silicon single crystals. Simulation calculations were performed which are based on the double differential cross-section as function of the momentum transfer q and the energy transfer W to a bound electron. In this framework, also the energy deposition of positrons, channeling in a silicon semiconductor detector, can be estimated. The role of strong low energy plasmon excitations will be discussed.

Primary author: BACKE, Hartmut

Presenter: BACKE, Hartmut

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **85** Type: **oral**

Operational experience, recent developments and plans for crystal collimation at the LHC

Tuesday, 6 June 2023 10:10 (20 minutes)

The concept of crystal collimation exploits the peculiar properties of crystalline materials to deflect high-energy beam halo particles at angles orders of magnitude larger than what can be achieved with scattering by conventional materials used as primary collimators. This innovative technique is planned to be used to improve the collimation efficiency with heavy-ion beams at the Large Hadron Collider (LHC) and its High-Luminosity upgrade (HL-LHC). The unprecedented proton-equivalent energy range up to 7 TeV makes this technique particularly challenging, so a dedicated experimental program was put in place at the LHC to demonstrate the feasibility of this concept. This paper reviews the extensive operational experience gathered with a test stand during LHC Run 2 (2015-2018) with beams of record energy and intensity. An overview of the current plans and hardware upgrades carried out in preparation for deployment during operation with heavy-ion beams in Run 3 is also given.

Primary author: D'ANDREA, Marco

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Presenter: D'ANDREA, Marco

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques

Contribution ID: **86** Type: **oral**

Adiabatic Invariants at Channeling in a Curved Crystal

Friday, 9 June 2023 09:50 (20 minutes)

The channeling effect in a curved single crystal is considered. In an accompanying reference frame moving along a plane or channeling axis at a speed equal to the longitudinal component of the electron velocity, such motion is essentially an implementation of the model of a one-dimensional 1D atom or a two-dimensional 2D atom, and with controllable parameters. The depth and shape of the potential of the channeling plane or the ion axis of channeling depend both on the chemical composition, crystal structure and orientation of the crystal, and on the energy of the electron moving in the planar or axial channel. It is important that the mode of movement in the channel remains stable even when moving in a curved single crystal. Using expressions for adiabatic motion invariants, the article estimates the maximum bending angle of a single crystal at which motion in the planar or axial channeling mode still retains stability. It is demonstrated that the maximum bending angle of a single crystal should not exceed the Lindhard's critical channeling angle, which limits the hypothetical possibility of using curved single crystals to deflect the beams of accelerated particles to only small deflection angles.

Primary authors: OLCHAK, Andrey; KALASHNIKOV, Nikolay

Presenter: KALASHNIKOV, Nikolay

Session Classification: S1 & S4: Beams Interactions & New Concepts

Contribution ID: **87** Type: **oral**

Simulations of crystal collimation processes for 6.8 Z TeV lead ion beams at the LHC

Friday, 9 June 2023 10:10 (20 minutes)

In future heavy-ion runs of the Large Hadron Collider (LHC), the stored beam energy is planned to increase and reach values above 20 MJ. This requires improving the performance of the betatron collimation system. The solution found is to use crystal channeling to reduce nuclear fragmentation and guide halo particles safely to an absorber. Crystal collimation is part of the HL-LHC baseline and is being deployed already for LHC Run 3 (2022-2025). For a successful implementation of this novel scheme, it is very important to develop simulation tools to model accurately the complex non-linear halo dynamics in the ring, as well as the interactions with the crystal and the conventional collimators along the ring. The development of a well-tested simulation setup is also instrumental to study in detail optimal crystal configurations. This paper presents the latest progress and improvements regarding circulating-beam simulations, addressing the benchmark tests performed and the expected future performance of operational configurations at the LHC.

Primary author: CAI, Rongrong

Co-authors: LECHNER, Anton; MIRARCHI, Daniele; SALVAT PUJOL, Francesc; POTOINE, Jean-Baptiste; ESPOSITO, Luigi Salvatore; D'ANDREA, Marco; SEIDEL, Mike; HERMES, Pascal; SCHOOFS, Philippe; BRUCE, Roderik; REDAELLI, Stefano

Presenter: CAI, Rongrong

Session Classification: S1 & S4: Beams Interactions & New Concepts

Contribution ID: **88** Type: **poster**

Commissioning the STAR Inverse Thomson Scattering X-ray source: progress report

Tuesday, 6 June 2023 18:20 (1 minute)

RUIJTER, Marcel (Istituto Nazionale di Fisica Nucleare)

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PRELZ, Francesco (Universita'degli Studi di Milano & INFN);
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SAMSAM, Sanae (Istituto Nazionale di Fisica Nucleare);
VESCOVI, Sandro (Istituto Nazionale di Fisica Nucleare);
BINI, Simone (Istituto Nazionale di Fisica Nucleare);
TOCCI, Simone (Istituto Nazionale di Fisica Nucleare);
PETRILLO, Vittoria (Universita'degli Studi di Milano)

The Southern European Thomson back-scattering source for Applied Research (STAR) is a high energy photon
facility located on the campus of the University of Calabria (UniCal). The facility was designed for its
first phase to operate with an electron and photon energy up to 85MeV and 140keV respectively. For the
second phase of the project the energy of the electrons, and thereby the photons, would be increased up
to 150MeV and 350keV respectively. The Italian Institute for Nuclear

Physics (INFN) was awarded the project
for installing, testing and commissioning the energy upgrade of the electron beamline. Here we will outline
the progress made regarding the RF system and the Control System Software (CSS). The former consists out of
two C-band linacs connected to their individual RF power stations for which the site acceptence test has
recently been performed. For the latter the network of the STAR site has been extended to allow

the EPICS
based CSS to be further developed, including top level GUIs and IT security infrastructure.

Primary author: RUIJTER, Marcel

Presenter: RUIJTER, Marcel

Session Classification: PS: Poster Session

Contribution ID: **89** Type: **invited**

Advanced Channeling Technologies to Guide Charged and Neutral Beams

Monday, 5 June 2023 09:00 (30 minutes)

Channeling is the phenomenon well-known in the physics world mostly related to the motion of the beams of charged particles in aligned crystals. Since the beginning of 1970s channeling of high-energy leptons (electrons/positrons of several MeV up to hundred GeV energies) and hadrons (protons/ions of tens GeV up to several TeV energies) has been applied at various famous world research centres within different national/international projects related to the phenomenon utilisation to handle the beams as well as to produce high power X-ray and gamma radiation sources.

However, recent studies have shown the feasibility of channeling phenomenology application for description of other various mechanisms of interaction of charged as well as neutral particles beams in solids, plasmas and electromagnetic fields covering the research fields from crystal/laser/plasma based beam guides and collimators to capillary guides for charged beams and X-rays/neutrons.

This review talk is devoted to actual channeling-based projects that have been realizing since so-called renaissance of channeling studies started in the end of last century. The future possible developments in channeling physics for accelerator physics will be analysed within the presentation.

Primary authors: DIK, Alexey; DABAGOV, Sultan

Presenter: DABAGOV, Sultan

Session Classification: S1: Beams Interactions

Contribution ID: **90** Type: **invited**

Riccione, La Perla Verde dell'Adriatico: una Storia per Immagini

Sunday, 4 June 2023 17:20 (25 minutes)

Presenter: Prof. COSTA, Francesco

Session Classification: Channeling Primer

Contribution ID: **91** Type: **invited**

Open Issues in Astroparticle Experimental Physics

Sunday, 4 June 2023 17:45 (25 minutes)

Presenter: Dr MAZZITELLI, Giovanni (Istituto Nazionale di Fisica Nucleare)

Session Classification: Channeling Primer

Contribution ID: **92** Type: **not specified**

Channeling 2023 Closing

Friday, 9 June 2023 11:30 (30 minutes)

Presenter: DABAGOV, Sultan (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **93** Type: **not specified**

Channeling 2023 - Opening

Presenter: DABAGOV, Sultan (Istituto Nazionale di Fisica Nucleare)

Session Classification: Channeling Primer

Contribution ID: **94** Type: **not specified**

Channeling 2023 - Opening

Sunday, 4 June 2023 17:00 (10 minutes)

Presenter: DABAGOV, Sultan (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **95** Type: **invited**

Advanced photon beams from a seeded FEL

Tuesday, 6 June 2023 09:00 (30 minutes)

The injection of a seed to initiate the FEL amplification in a free electron laser is a concept initially introduced to improve the source spectral brightness. This concept was first demonstrated at BNL (USA). A few experiments carried out later have shown the possibility to extend the method to reach VUV wavelengths and FERMI was built as a facility exploiting these methods to provide to users coherent light down to the soft X-ray range of the spectrum from a seeded FEL.

`After about thirteen years of operation of FERMI, a number of other possibilities which go beyo`

An overview of FERMI will be provided.

Primary author: Dr GIANNESI, Luca

Presenter: Dr GIANNESI, Luca

Session Classification: S1 & S3: Beams Interactions & Acceleration Techniques