UK Accelerator Institutes Seminar Series Autumn 2022 (Session 5)

Report of Contributions

https://indico.cern.ch/e/1198656

Contribution ID: **1** Type: **not specified**

No Seminar Scheduled

Thursday, 20 October 2022 16:15 (1 hour)

Contribution ID: **2** Type: **not specified**

Societal impact of CERN Accelerator Technologies: From Cancer Therapy to Artwork Analysis

Thursday, 27 October 2022 15:45 (1 hour)

This seminar will take place in the Fisher Room, Denys Wilkinson Building, University of Oxford, and will also be available via Zoom.

After introducing the different CERN programmes aiming at maximising the impact of CERN technologies on society, the seminar will present some recent examples of applications of CERN accelerator technologies, mainly related to the medical field, but extending towards environmental issues and the analysis of artworks. In the field of medicine, some new collaborative initiatives for cancer therapy with particle beams will be described, giving, in particular, an overview of two new proposed facilities making use of CERN technologies, the South East European International Institute for Sustainable Technologies and the Baltic Advanced Particle Therapy Centre.

Presenter: Dr VRETENAR, Maurizio (CERN)

Contribution ID: **3** Type: **not specified**

Machine Learning Project Development in Particle Accelerators: A Business Perspective

Thursday, 3 November 2022 16:15 (1 hour)

This seminar will take place in the Fisher Room, Denys Wilkinson Building, University of Oxford, and will also be available via Zoom.

Machine Learning, Artificial Intelligence and Data Science are finding applications in particle accelerators. Although most of these applications are being developed in a research environment, they can translate to medical and industrial particle accelerators. In this presentation, we will firstly discuss how the lessons learned in the research environment and scientific mindset can be taken to the entrepreneurial world. Secondly, we will discuss the differences between Machine Learning project development in academia and business. Finally, we will also explore in detail the main uses of Machine Learning in particle accelerators and we will explore how these can be applied to medical and industrial accelerators.

Presenter: Dr GARCIA MORALES, Hector (Co-founder and Co-CEO of PickleTech)

Contribution ID: **4** Type: **not specified**

Trip the light fantastic: Using Artificial Materials to Mediate Novel Wave-Particle Interactions

Thursday, 10 November 2022 16:15 (1 hour)

This seminar will take place at Daresbury Laboratory and will also be available via Zoom.

In this presentation we explore the ability of artificial electromagnetic materials to manipulate light. These materials are man-made composites, homogenised to act as effective media, whose dispersion relations can be engineered to give rise to novel particle wave interactions, and offer a path to reduce the size/weight of conventional technologies.

We examine the ability of artificial electromagnetic materials to generate EM waves and how they can be used to accelerate particle beams. Using a modified form of Madey's theory we show how the engineered dispersion gives rise to particle–wave interactions, and mediates energy transfer between wave and particle beam. We present our results of using this interaction to generate an electromagnetic wave. Utilising a low-loss, dispersion engineered, artificial material to form an oscillator for the generation of EM waves.

In addition, we examine the use of biological systems as foundries for the mass manufacture of artificial electromagnetic materials, and examine the use of artificial electromagnetic materials as analogs for quantum mechanical processes, such as electron emission from cathodes.

Presenter: SEVIOUR, Rebecca (University of Huddersfield)

Contribution ID: **5** Type: **not specified**

The LCLS-II and the CW X-ray Free Electron Laser: Advancing Operational SRF Technology

Thursday, 17 November 2022 16:15 (1 hour)

The LCLS-II X-ray Free Electron Laser (FEL) is CW X-ray FEL that will cover the spectral range from 250 eV through 20 keV with MHz rates. The FEL is being constructed in two parts: the first portion (LCLS-II) will use with a 4 GeV SRF linac to cover the soft and tender X-ray regimes from 250 eV to 5 keV and then an upgrade (LCLS-II-HE) will expand the linac energy to 8 GeV and increase the X-ray spectral range to 20 keV using a novel SRF gun to further increase the beam brightness. The LCLS-II SRF linac will be able to accelerate 30 microamps and generate up to 250 kW of electron beam which will have the potential to generate kW-scale X-ray powers. The SRF linac is based on 1.3 GHz 9-cell SRF cavities similar to those for the EuXFEL in Hamburg or the International Linear Collider however the LCLS-II cavities will operate CW at gradients between 16 and 21 MV/m and have Q0s of roughly 3x10^10. The very high Q0 is achieved using tuned N2 doping techniques, careful magnetic field control, and a 'fast' cool-down technique that reduces the remnant magnetic field. The linac will be cooled to cryogenic temperatures with two new 4kW 2K liquid helium cryoplants. Finally, to have flexible control over the spectral range, the facility will use two variable gap undulator systems, one optimised for hard X-rays and one for soft X-rays. The talk will describe the basics of a Free Electron Laser and the LCLS-II and LCLS-II-HE designs as well as the technological innovations pioneered by the facility. It will also describe recent commissioning results from the two new undulator systems and the LCLS-II SRF linac.

Presenter: Dr RAUBENHEIMER, Tor (SLAC)

Contribution ID: **6** Type: **not specified**

Towards Nuclear Physics Driven by Extreme Light at ELI-NP

Thursday, 24 November 2022 16:15 (1 hour)

Extreme Light Infrastructure - Nuclear Physics (ELI-NP) is the pillar of the pan-European ELI project dedicated to nuclear physics driven by extreme electromagnetic fields. ELI-NP will host two systems that generate extreme light beams with unique features: (1) a system of two high-power ultra-short-pulse lasers with the highest proven power in the world (10 PW each) and (2) a variable energy gamma (VEGA) system to deliver quasi-monochromatic gamma beams with energy up to 20 MeV.

ELI-NP is currently in a transition phase from implementation to operation. The 2 x 10 PW high-power laser system is fully operational and the experimental set-ups are gradually made operational. As a first step, commissioning experiments, designed to demonstrate the technical performance of the experimental set-ups and the quality of the laser beams, are being performed for all the experimental set-ups and they are made gradually available to users during 2022 and 2023. The first call for users was launched this year in collaboration with ELI ERIC.

The high-power laser system will provide pulses on target with irradiances as high as 10ˆ23 W/cmˆ2. This opens unprecedented possibilities in nuclear physics, high-energy radiation beam science, non-linear field theory, and ultra-high-pressure physics. First experiments with the high-power lasers at ELI-NP aim at: measuring the magnitude and scaling of the achievable laser intensity via laser-gamma conversion efficiency, investigation of new ion acceleration schemes, nuclear reactions in plasma.

A broad research programme on applications of extreme light is currently being developed at ELI-NP and addresses topics such as: production of radiotherapy relevant nuclear beams; radiobiological effects of short-duration particle pulses; high-contrast medical imaging with laser-driven X-ray sources; use of intense, short-duration, and mixed radiation pulses to study the behaviour of materials under extreme radiation conditions.

Presenter: Dr UR, Calin Alexandru (ELI-NP / IFIN-HH)

Contribution ID: **7** Type: **not specified**

Synchrotron Light Illuminates the Origin of the Solar System

Thursday, 1 December 2022 10:00 (1 hour)

Samples of the carbonaceous asteroid Ryugu were brought to Earth by the Hayabusa2 spacecraft. Mineralogical, petrological, and physical properties of seventeen Ryugu particles measuring 1 –8 mm indicate that they are most similar to CI chondrites. The presence of CO2-bearing water in pyrrhotite indicates that the original parent asteroid formed beyond the H2O and CO2 snow lines in the solar nebula, where, based on Ryugu mineralogy, very limited amounts of high-temperature objects including small chondrules and Ca, Al-rich inclusions were present. Fluid-rock reactions occurred at low-temperature, high pH, and reducing conditions at water/rock mass ratios smaller than 1 and changed an olivine-pyroxene rich lithology, remaining as the least-altered fragments in Ryugu samples, into phyllosilicate-carbonate rich lithologies, the predominant material of Ryugu samples. The solar nebula might have been still present when magnetite crystallized from the fluid in Ryugu's parent body.

Presenter: Prof. NAKAMURA, Tomoki (Tohoku University)

Contribution ID: **8** Type: **not specified**

Accelerator Physics at Fermilab's IOTA ring

The Integrable Optics Test Accelerator (IOTA) at the Fermilab Accelerator Science and Technology (FAST) facility has been operating since 2018. The IOTA ring was first commissioned with 100-MeV electrons and, to date, performed three experimental runs. The IOTA research program aims at attaining maximum beam intensities and brightness in future ring accelerators while minimizing the accelerator scale and cost. Along this direction, the key research areas are i) suppression of coherent beam instabilities by Landau damping; ii) mitigation of space-charge effects, and iii) beam cooling. The flexibility of the IOTA ring allows it to cover a wide range of complementary studies, such as experiments with a single electron, studies of undulator radiation and to test IOTA with low emittance beams. The most-recent IOTA Run-3 physics program was focused on the world's first demonstration of Optical Stochastic Cooling. In the near future, a proton injector will be constructed and commissioned, which would complete a premier accelerator physics test facility with lasers, linacs, a ring, and with photons, electrons, and protons. This talk will describe the accelerator science program at IOTA and will highlight the emerging collaboration opportunities.

Presenter: NAGAITSEV, Sergei

Contribution ID: **9** Type: **not specified**

20 Years of Photo Electrons at the Photo Injector Test facility at DESY in Zeuthen (PITZ): High Brightness Electron Sources and their Applications

Thursday, 13 October 2022 16:15 (1 hour)

This seminar will take place at Daresbury Laboratory and will also be available via Zoom.

The Photo Injector Test facility at DESY in Zeuthen (PITZ) has produced high brightness beams for more than 20 years now. After an introduction on the motivation to build this R&D facility to develop and optimise high-brightness electron sources for free electron laser applications and a summary of the state-of-the-art at the end of last century, the talk will summarise the major findings and development steps for generating high-brightness electron beams, including the continuous improvement of the beam emittance, the RF gun cavities, the photo cathode laser systems and the photo cathodes. In the second part of the talk, further applications of high-brightness electron beams are discussed , such as two different beam driven plasma wakefield acceleration experiments, the generation of tunable, high peak and average power THz radiation, as well as the capabilities to study the most modern form of radiation therapy against cancer, the so-called FLASH radiation therapy.

Presenter: Dr STEPHAN, Frank (DESY, Zeuthen)