UK Accelerator Institutes Seminar Series Spring 2024 (Session 10)

Report of Contributions

https://indico.cern.ch/e/1410360

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

The CERN Fixed-target Programme - Beyond Collider

Thursday 30 May 2024 16:15 (1 hour)

The CERN accelerator complex provides beams for a highly diverse, world class fixed-target research programme, which complements its flag-ship collider physics programme. At the same time, it enables an extensive and highly versatile test beam and irradiation programme, which is essential for the design, prototyping and construction of future physics experiments and new accelerator generations.

This seminar builds on and complements the "Physics at the CERN Secondary Beamlines"seminar from 15 February 2024, and covers all beam based non-collider facilities. The emphasis will be on recent highlights and developments in the CERN fixed-target programme.

This talk will be hosted at Daresbury Laboratory.

Presenter: HOLZER, Eva Barbara (CERN)

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

R&D of CW Normal Conductivity VHF Gun at Tsinghua University (SHINE Injector)

A 217 MHz very-high-frequency gun operating in CW mode is being developed at Tsinghua University, which will be served as the beam source of the high repetition XFEL facilities and high repetition MeV UED. The cavity profile has been optimized to minimize input power, peak surface electric field, and peak wall power density. The profile optimization also takes into account the suppression of multipacting effect. Additionally, thermal analysis has been performed to guide the design of water cooling channels in coordination with gun mechanical design. The fabrication of the gun has been completed, and the frequency and quality factor measured in cold test are in good agreement with simulation expectations. During high power conditioning, 75 kW cw radio frequency power was successfully fed into the gun, corresponding to a cathode gradient of 27 MV/m and a gun voltage of 780 keV. Under this condition, the maximum dark current collected by the Faraday cup at the gun exit was 376 nA when the strength of the gun solenoid was scanned. To measure and optimize the beam quality, a test beamline was constructed. After preliminary optimization, the 95% projected transverse emittance was 0.161 mm mrad for 10 pC bunches with a bunch length of 0.49 mm rms, 0.429 mm mrad for 50 pC bunches with a bunch length of 1.15 mm rms, and 0.853 mm mrad for 100 pC bunches with a bunch length of 1.44 mm rms. Now one of the guns has been delivered to Shanghai and installed in the SHINE tunnel. Recently, it was operated in CW mode with ˜75 kW input power and generated the first beam successfully.

Primary author: Dr DU, Yingchao (Tsinghua University)

Presenter: Dr DU, Yingchao (Tsinghua University)

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

AWAKE: beam-plasma interaction studies, and plasma wakefield acceleration for application to particle physics

Thursday 16 May 2024 16:15 (1 hour)

AWAKE studies and develops a plasma wakefield accelerator driven by a long proton bunch to produce high-energy electrons for application to particle physics at CERN. It relies on the self-modulation of a cm-long, 400GeV proton bunch to reach ˜1GV/m accelerating fields. It is also a platform to study beam-plasma interactions. I will introduce the project and experiment. I will show experimental results on: Seeding of self-modulation; Observation of the growth of self-modulation; Observation of the effect of motion of plasma ions; Acceleration of externally-injected test electrons; Observation and seeding of the hose instability; And observation of the transverse filamentation instability. I will outline plans for upcoming experiments aimed at transitioning from acceleration experiments to an accelerator for applications. These open new opportunities, for example in terms of development of long plasma sources (50-100m), diagnostics and other key components of the accelerator.

Latest publications:
Filamentation of a Relativistic Proton Bunch in Plasma, L. Verra, C. Amoedo, N. Torrado, A. Clairembaud, J. Mezger, F. Pannell, J. Pucek, N. van Gils, M. Bergamaschi, G. Zevi Della Porta, N. Lopes, A. Sublet, M. Turner, E. Gschwendtner, P. Muggli (AWAKE Collaboration), accepted in Phys. Rev. E (2024):
https://journals.aps.org/pre/accepted/2d071Rf7Z4d1fa26d28909335c088dd09af665447

Hosing of a long relativistic particle bunch in plasma, T. Nechaeva, L. Verra, J. Pucek, L. Ranc, M. Bergamaschi, G. Zevi Della Porta, and P. Muggli (AWAKE Collaboration),Phys. Rev. Lett. 132, 075001 (2024):
https://doi.org/10.1103/PhysRevLett.132.075001

Development of the self-modulation instability of a proton bunch in plasma L. Verra, S. Wyler, T. Nechaeva, J. Pucek, V. Bencini, M. Bergamaschi, L. Ranc, G. Zevi Della Porta, E. Gschwendtner, P. Muggli (AWAKE Collaboration), Physics of Plasmas 30, 083104 (2023):
https://doi.org/10.1063/5.0157391

Mitigation of the onset of hosing in the linear regime through plasma frequency detuning, Mariana Moreira, Patric Muggli, Jorge Vieira, Phys. Rev. Lett. 130, 115001 (2023):
https://doi.org/10.1103/PhysRevLett.130.115001

Controlled Growth of the Self-Modulation of a Relativistic Proton Bunch in Plasma, L. Verra, G. Zevi Della Porta, J. Pucek, T. Nechaeva, S. Wyler, M. Bergamaschi, E. Senes, E. Guran, J.T. Moody, M.A. Kedves, E. Gschwendtner, and P. Muggli (AWAKE Collaboration), Phys. Rev. Lett. 129, 024802 (2022): https://doi.org/10.1103/PhysRevLett.129.024802

This talk will be hosted at Daresbury Laboratory.

Presenter: MUGGLI, Patric (Max Planck Institute for Physics)

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

Progress on Optical Stochastic Cooling in IOTA

Tuesday 14 May 2024 16:15 (1 hour)

The world's first experimental observation and achievement of 'optical stochastic cooling'(i.e., relativistic charged particles cooled via feedback from their own optical radiation) in the IOTA storage ring at Fermilab, USA was reported in Nature, August 11, 2022. Recapturing that achievement, I will report on further progress in optical stochastic cooling in IOTA to date. The method has direct applications towards cooling of exotic unstable particles like muons and towards fundamental studies of "quantum optics and entanglement"of 'electric charge'and 'virtual quanta'in an otherwise benign electron-photon Feynman vertex.

Historical Prelude: The technique of "Stochastic Cooling"of phase space of a particle beam, using microwave techniques in the GHz frequency range, has been employed historically in particle colliders, leading to ground-breaking discoveries. 'Cooling'increases the probability of interactions in colliding beams, thus enhancing the likelihood of observing rare physics events. The first important advance in this area was stochastic cooling of anti-matter (e. g. 'antiprotons'), invented by Simon van der Meer (Nobel Prize, 1984), which was instrumental in the discovery of the W and Z Bosons at CERN in 1983 and the 'top'quark at Fermilab years later. Stochastic Cooling reduces the random motion of the beam particles through repeated granular sampling and correction of the beam's phase-space structure, thus resembling a 'Maxwells demon'. The extension of Stochastic Cooling from the microwave regime up to optical frequencies and bandwidths, samples and exploits a charged particle's radiation to affect its own phase space with a resolution of 'microns', leading to increases in the achievable cooling rates by three to four orders of magnitude.

Presenter: Prof. CHATTOPADHYAY, Swapan (UC Berkeley and Fermilab)

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

Small Modular Reactors and Advanced Nuclear Technologies

Thursday 6 June 2024 16:15 (1 hour)

With Net Zero targets and climate change on the minds of policy makers, technology vendors, utility providers and the general public, challenges have never been greater in the energy sector. It is clear from the direction of travel over the last decade that nuclear will play a part in this energy mix, to what degree is largely undecided. What is apparent is the need for new solutions to ensure confidence in three markers that have historically posed challenges within the industry; price, time and delivery certainty.

In this talk I will give an overview of the SMR technologies on offer with a focus on the six designs through to the next stage of the UKs nuclear technology competition. Giving some insight into; key design choices that are made when developing a nuclear technology, how nuclear safety is managed throughout the CADMID cycle, the regulatory process and challenges faced by the regulator in this new era of nuclear technology and what the near term for nuclear deployment looks like (national grid supply, hydrogen generation, data centre supply etc.). A number of advanced nuclear technologies are in development to meet more niche demands, additionally I will discuss some of the more forward thinking and innovative ideas regarding deployment and improvements to nuclear safety.

Presenter: BEECH, Ryan (Jacobs)

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

Physics at the CERN Secondary Beamlines

The talk will provide a description of the secondary beamlines at CERN. More specifically, it will address the operational principles and the available beam parameters, as well as highlights of the exciting physics that takes place at these unique facilities at CERN. The talk will also cover HiRadMat - the high-energy, single-pulse facility for material tests at CERN.

Presenter: CHARITONIDIS, Nikolaos (CERN)

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

Modern alchemy, the production and application of radioactive ion beams at thick target ISOL facilities

Thursday 13 June 2024 16:15 (1 hour)

Radioactive ion beam facilities employ accelerated particles to produce exotic isotopes for experiments in fields ranging from nuclear, atomic and solid-state physics, to biophysics and medicine. A key subset of these facilities is the thick target Isotope Separator Online or ISOL type, where the irradiated material is thick enough to stop and thermalise the nuclear reaction products prior to their ionisation and reacceleration into radioactive ion beams. The first part of this seminar will discuss the techniques and technologies involved in producing exotic ion beams at such facilities, with a particular focus on the CERN-ISOLDE facility and the upcoming TRIUMF-ARIEL facility. The second part will explore the application of these approaches for fundamental physics and medicine.

Presenters: DAY GOODACRE, Thomas (TRIUMF (CA)); DAY GOODACRE, Thomas

Contribution ID: **10** Type: **not specified**

Development of CW SRF L-band photoinjector for future High-Duty-Cycle EuXFEL

The future high repetition rate upgrade of the EuXFEL assumes the implementation of a continuous wave (CW) electron source. A CW photoinjector based on the 1.3 GHz SRF gun cavity is the preferred option for EuXFEL. Recently, we demonstrated the possibility of achieving a peak axial electric field of 55 MV/m with a copper photocathode installed. Further steps include advanced metal photocathode R&D and constructing a test stand facility (ts4i) that will enable 6D phase space characterization. In this talk, we introduce the history of the development of the SRF gun cavity and report on the present status of our R&D efforts.

Presenters: Dr BAZYL, Dmitry (DESY); Dr VOGEL, Elmar (DESY)