

Accelerator Science and Technology

Thursday, 07.09.2023, Room 118

Time	ID	ACCELERATOR SCIENCE AND TECHNOLOGY Chair: Mike Seidel, PSI Villigen
14:00	381	<p style="text-align: center;">The P³ Experiment: A Positron Source Demonstrator at PSI in 2025</p> <p style="text-align: center;"><i>Nicolas Vallis ^{1,2}, Paolo Craievich ¹, Mattia Schaer ¹, Riccardo Zennaro ¹</i> <i>¹ PSI Villigen, ² EPFL</i></p> <p>The long-standing difficulty to handle the extreme e⁺ emittance and energy spread generated at converter targets has been a major limiting factor for future large e⁺ machine designs such as high-luminosity lepton colliders. The PSI Positron Production (P-cubed or P³) experiment, framed in the FCC-ee study, is a demonstrator for a e⁺ capture system with potential to improve the state-of-the-art e⁺ yield by an order of magnitude. The experiment will be hosted at the SwissFEL facility at PSI as of 2025, where installation works are ongoing. This presentation is an overview of P³, with a particular focus on the novel capture system, e⁺ beam dynamics and experiment diagnostics.</p>
14:15	382	<p style="text-align: center;">PSI CHART Superconducting Magnets Roadmap: from Powered Samples to Hybrid Magnets</p> <p style="text-align: center;"><i>Douglas Martins Araujo ¹, Bernhard Auchmann ^{1,2}, André Brem ¹, Michael Daly ¹, Thomas Michlmayr ¹, Dmitry Sotnikov ¹, Attilio Milanese ²</i> <i>¹ PSI Villigen, ² CERN</i></p> <p>In the context of accelerator-magnet technology to enable a next generation of HEP colliders, many superconducting magnet solutions are being considered. These solutions include Low-temperature, High-temperature and hybrid magnets. At the Paul Scherrer Institute (PSI), we have been working on the design of stress-managed magnets, for example the successfully tested CCT magnet CD1, as a means to decrease Nb₃Sn coil stress and prevent its degradation. In order to bring meaningful innovation to our developments, the High-Field-Magnet Roadmap aims to allow a fast-turnaround and consistent development of LTS, HTS and Hybrid magnets. All elements composing this roadmap will be presented and in particular the status of each of its programs.</p>
14:30	383	<p style="text-align: center;">ReBCO High-Temperature Superconductors for Application in High Field Accelerator Magnets.</p> <p style="text-align: center;"><i>Bernhard Auchmann ^{1,2}, Michal Duda ¹, Henrique Garcia Rodrigues ¹, Jaap Kosse ¹, Douglas Martins Araujo ¹, Attilio Milanese ², Stephane Sanfilippo ¹, Dmitry Sotnikov ¹</i> <i>¹ PSI Villigen, ² CERN</i></p> <p>High-temperature superconductors (HTS) promise a significant increase in performance of accelerator magnets. This presentation examines challenges related to today's ReBCO tape conductor and lays out an R&D roadmap towards a consistent magnet technology for the FCC-hh's main dipole system in terms of cable- and coil configurations, cryogenic, mechanical, and protection concepts. Numerical modeling is accompanied by sample testing and the construction of sub-scale demonstrator coils and magnets. A first program goal is the identification of ramp-losses and adequate cooling concepts for a magnet based on optimized ReBCO-based cable.</p>

14:45	384	<p style="text-align: center;">High temperature superconducting magnets for FCC-ee</p> <p style="text-align: center;"><i>Henrique Garcia Rodrigues¹, Jaap Kosse¹, Bernhard Auchmann^{1,2}, M. Koratzinos¹, Michal Duda¹</i> <i>¹ Paul Scherrer Institut, ² CERN</i></p> <p>High temperature superconductor (HTS) technology has attractive features for use in accelerator magnets. Two distinct benefits compared to low-temperature superconductors are the ability to operate at higher magnetic fields and/or at higher temperatures. We illustrate the advantages of HTS magnets by means of two potential use-cases for FCC-ee.</p> <p>The first concerns a compact defect-tolerant 15 T capture solenoid for FCC-ee's positron source. The second use-case investigates the possibility of replacing the normal conducting magnets in FCC-ee's short straight sections by HTS variants, allowing a reduction in energy consumption from ~ 50 MW to below 10 MW. Additional benefits are an increase in dipole filling-factor, and flexibility in the optics.</p>
15:00	385	<p style="text-align: center;">HTS FCC-ee energy efficient beam optics</p> <p style="text-align: center;"><i>Cristobal Garcia, EPFL</i></p> <p>The FCC-ee project takes a step forward towards the discovery of new physical phenomena beyond the frontier of the standard model, by aiming at unprecedented center of mass energies and luminosities in a double-ring lepton collider. In order to explore potential improvements to the current beam optics design, this work looks at the use of combined function magnets for the main dipoles and quadrupoles within the short straight sections of the arc cells to increase the bending radius, decreasing the synchrotron radiation (SR). The use of High Temperature Superconductors (HTS) and normal conducting technology for the combined function magnets is explored with comparisons to the current baseline aiming for potential savings above 10 % of the SR power.</p>
15:15	386	<p style="text-align: center;">Simulation Tools for Future Colliders</p> <p style="text-align: center;"><i>Leon van Riesen-Haupt¹, Tatiana Pieloni¹, Xavier Buffat², Riccardo De Maria², Giovanni Iadarola², Peter Kicsiny¹</i> <i>¹ EPF Lausanne, ² CERN</i></p> <p>As colliders become more complex, it is crucial to consider physical phenomena in simulations including complex effects such as radiation, beam-beam, and impedance. However, existing simulation tools are often outdated or focus on single aspects. To address this, the CHART collaboration is developing a software framework integrating existing tools and actively contributing to new simulation tools in collaboration with external colleagues. The project's main focus is the Future Circular Collider, for which the tools enable studies of beam stability, luminosity, and lifetime, incorporating multiple effects simultaneously. We will provide an overview of the collaboration's work on simulation tools and present beam dynamics studies for the FCC obtained using these tools.</p>
15:30	387	<p style="text-align: center;">Investigating LHC Electron Cloud Instabilities through Linearized Vlasov Method</p> <p style="text-align: center;"><i>Sofia Carolina Johannesson¹, Giovanni Iadarola², Mike Seidel³, Tatiana Pieloni¹</i> <i>¹ EPFL, ² CERN, ³ PSI Villigen</i></p> <p>The Vlasov approach models e-cloud driven instabilities on time scales beyond conventional Particle-In-Cell simulations. It uses a linear description of electron cloud forces that accounts for both the betatron tune modulation along the bunch and the dipolar kicks. Chromaticity effects can also be included. Benchmarked against macroparticle simulations using the same e-cloud force formalism, both methods agreed for strong electron clouds and experience a stabilizing effect from positive chromaticity. This stabilizing effect is consistent with observations from the LHC. For positive chromaticity the Vlasov approach predicts weak instabilities not observed in the macroparticle simulations, suggesting the existence of damping mechanisms not captured by the Vlasov approach.</p>

15:45	388	<p style="text-align: center;">LHC Schottky Spectrum from Macro-particle Simulations</p> <p style="text-align: center;"><i>Christophe Lannoy</i>^{1,2}, <i>Kacper Lasocha</i>², <i>Diogo Miguel Louro Alves</i>², <i>Nicolas Mounet</i>², <i>Tatiana Pieloni</i>¹ ¹ EPFL, ² CERN</p> <p>We introduce a method for computing Schottky spectra, which can be used for non-invasive beam diagnostics, from time-domain, macro-particle simulations. For LHC beam conditions the use of a standard Fast Fourier Transform (FFT) algorithm is computationally intractable memory-wise, hence a semi-analytical method was developed to efficiently handle the Fourier transform. Since Schottky spectra can be strongly affected by collective effects, thereby preventing the extraction of machine and beam parameters from the spectra, the use of macro-particle simulations where such effects can be included is well suited to study their impacts on the spectrum. Using this approach first results on the effect of a broad-band resonator as longitudinal impedance are obtained.</p>
16:00	389	<p style="text-align: center;">A muon beam of small phase space</p> <p style="text-align: center;"><i>Giuseppe Lospalluto</i>¹, <i>Aldo Antognini</i>², <i>Malte Hildebrandt</i>², <i>Ryota Iwai</i>¹, <i>Klaus Kirch</i>^{1,2}, <i>Andreas Knecht</i>², <i>Patrick Mullan</i>¹, <i>Jonas Nuber</i>¹, <i>Angela Papa</i>², <i>Joanna Peszka</i>¹, <i>Claude Petitjean</i>², <i>Mikio Sakurai</i>¹, <i>David Taqqu</i>, <i>Bastiano Vitali</i>, <i>Taylor Yan</i>¹ ¹ ETH Zürich, ² Paul Scherrer Institut</p> <p>High precision experiments including the measurement of the muon g–2, muonium spectroscopy and muonium gravity would benefit from intense high-quality and low-energy muon beams. At the Paul Scherrer Institute, the muCool device is being developed to compress the phase space of a standard μ^+ beam by a factor of 10^9 with 10^{-4} efficiency. This is achieved with a cryogenic helium gas cell and complex E and B-fields. Once compressed, the beam is extracted from a small orifice into a vacuum and into a magnetic field free region. This talk will outline the present status and future prospects of the experiment with a special focus on the extraction stage.</p>
16:15	390	<p style="text-align: center;">Compact Synchrotrons for Hadron Therapy: Development and Synergies with HEP Projects.</p> <p style="text-align: center;"><i>Elena Benedetto</i>, <i>SEEIIST Association (CH)</i></p> <p>Carbon-ion therapy has advantages over X-rays, because of the Bragg peak, and proton therapy, because of radio-biology properties that allow treating radio-resistant tumours. Accelerator development aims at size reduction: within EU-funded projects and CERN, we study a super-conducting synchrotron and a gantry, based on a concept of TERA Foundation. The super-conducting magnets, of CCT type, are strongly curved and require extensive R&D and new tools for beam-optics. Another development, with several beam-dynamics challenges, is accumulating 20-times larger intensity for FLASH irradiation, i.e. delivering high dose rates to spare healthy tissues. SEEIIST, federating SE-European countries, will implement these developments and build a medical facility, to foster collaboration and scientific excellence.</p>
16:30		END; Coffee Break
19:30		Conference Dinner