Accelerator Science and Technology

Friday, 13.09.2024, Room ETZ E 6

Time	ID	ACCELERATOR SCIENCE AND TECHNOLOGY *Chair: Mike Seidel, PSI Villigen*
13:30	281	**High Field Magnet Roadmap at PSI/CHART** *Douglas Martins Araujo [1], Bernhard Auchmann [1], André Brem [1], Michal Duda [1], Henrique Garcia Rodrigues [1], Ariel Haziot [2], Jaap Kosse [1], Thomas Uli Michlmayr [1], Colin Mueller [1], Dmitry Sotnikov [1], Anna Stampfli [1]* *[1] Paul Scherrer Institut, [2] CERN* In the framework of the European High Field Magnet (HFM) program, hosted at CERN, and the CHART program hosted at Paul Scherrer Institute, the MagDev Laboratory at PSI pursues multiple projects for the advancement of high-field magnet technology for accelerators like the Future Circular Collider (FCC) require a substantial increase in magnetic field strength while maintaining high field quality. The PSI HFM R&D roadmap includes stress-managed low-temperature superconducting (LTS) magnet designs, the development of computational models for high-temperature superconducting (HTS) magnets, as well as the design and production of subscale hybrid (LTS-HTS) magnets. The outcomes of each program step shape the future direction of high-field magnet R&D at PSI.
13:45	282	**NI magnet projects at PSI** *Jaap Kosse [1], Bernhard Auchmann [1,2], André Brem [1], Michal Duda [1], Henrique Garcia Rodrigues [1], Thomas Uli Michlmayr [1], Stephane Sanfilippo [1]* *[1] Paul Scherrer Institut, [2] CERN* We present the work on non-insulation (NI) high-temperature superconductor (HTS) magnets at PSI as part of the CHART framework. Supported by modeling and small-scale experiments, we are building several NI solenoids which are to be installed in PSI's experimental facilities. These include a 72 mm warm bore 15 T solenoid for proof-of-principle positron production, a 18 T split coil for neutron scattering, and a very compact 6 T solenoid for X-ray scattering experiments. The high current density, high stability, and relatively straightforward cooling at 10-15 K make NI HTS magnets ideally suited for these DC applications.
14:00	283	**Optimization and Shimming of a High Temperature Superconducting Bulk Undulator** *Carlos Gafa [1], Alexandre Arsenault [1], Marco Calvi [1], Anthony Dennis [2], John Durrell [2], Andrew Sammut [3], Nicholas Sammut [3]* *[1] Paul Scherrer Institut, [2] University of Cambridge, [3] UoM* A novel short period, high-temperature superconducting bulk undulator is being developed at the Paul Scherrer Institute. It has been shown that a staggered array bulk configuration may be magnetized, via a field-cooling procedure, to generate more than a factor of two increase of the peak on-axis field when compared to permanent magnet undulators. However, to be useful at high harmonics it must also be shimmed to an acceptable level of phase error. This presents with some challenges as the differences between the bulks are more significant than those between permanent magnets. In this work we present our progress to reduce these field errors.

14:15 | **284**

Energy-efficient FCC-ee operation via HTS nested magnets

Jaap Kosse [1], Bernhard Auchmann [1,2], M. Koratzinos [1], Jürgen Schmidt [1], Adrien Thabuis [2]
[1] Paul Scherrer Institut, [2] CERN

We present our work on energy-efficient nested high-temperature superconducting (HTS) magnets for FCC-ee. By replacing the normal-conducting sextupole and quadrupole magnets in the 2900 short-straight-sections by HTS nested variants, and by including dipole coils, significant energy can be saved, estimated at 20 - 30 % of the total FCC-ee energy consumption. The optimum operating temperature, 4 K, of such an HTS magnet system is found by balancing the operational costs (dominated by electricity use for cooling) with capital costs (dominated by HTS conductor). The end goal of the project, a 1 m prototype, is supported by demonstrators manufactured at CERN and PSI.

This work is part of the CHART framework and the FCC Feasibility Study.

14:30 | **285**

Lattice correction and polarization estimation for the Future Circular Collider e^+e^-

Yi Wu [1], Felix Simon Carlier [2], Werner Herr [1], Tatiana Pieloni [1], Mike Seidel [3], Leon van Riesen-Haupt [1]
[1] EPFL, [2] CERN, [3] PSI

Precise determination of the center-of-mass energy in the Future Circular Collider e^+e^- (FCC-ee) at Z and W energies can be achieved by employing resonant spin depolarization techniques, for which a sufficient level of transverse beam polarization is demanded under the presence of machine imperfections. In this study, the FCC-ee lattice has been modeled and simulated with a variety of realistic lattice imperfections, including misalignments, angular deviations, BPM errors, long-range errors, etc., along with refined orbit correction and tune matching procedures. The equilibrium polarization is calculated within the context of realistic machine models, aiming to understand the underlying reason for polarization loss and potentially improve polarization by lattice manipulation.

14:45 | **286**

Controlling the electron beam energy at SwissFEL

Evan Ericson [1,2], Paolo Craievich [2], Rasmus Ischebeck [2], Eduard Prat Costa [2], Sven Reiche [2], Mike Seidel [2], Fabio Marcellini [2]
[1] EPFL, [2] Paul Scherrer Institut

SwissFEL at the Paul Scherrer Institute provides femtosecond X-ray pulses for experiments by accelerating electron beams up to 6 GeV before they are sent to undulators where they produce coherent, narrow bandwidth X-rays. The correlated energy spread of the beam is finely controlled using passive dielectric structures or structures with corrugated surfaces separated by an adjustable gap. These structures are routinely used to perform beam manipulations that optimize the FEL bandwidth or control the X-ray pulse duration down to 1 femtosecond. We compare experimental and simulation results for our dielectric structure to show short-range wakefields are responsible for tuning the central energy and energy spread of the SwissFEL beam.

15:00 | **287**

High Gradient Photoguns for a Potential Upgrade to the SwissFEL

Thomas Geoffrey Lucas, Paolo Craievich, Paul Scherrer Institut

In the aim of boosting the performance of the Swiss Free-Electron Laser (SwissFEL), two new high gradient radiofrequency photo-emission electron sources are under development as part of an international collaboration between Paul Scherrer Institut (PSI) and INFN Frascati. These electron sources aim to increase the cathode electric field through the use of higher frequencies and shorter filling times, achieved through novel RF designs. In this work, we present the design and first high power tests of these new electron sources at PSI and illustrate how they could enhance the performance of SwissFEL.

15:15	**288**	**Development and Optimization of a Field-Emission based Electron Gun for Low Energy Electron Cooling at ELENA** *Elisabeth-Sena Welker, Technische Universität Wien, Gerard Alain Tranquille, CERN* This study explores Carbon Nanotubes (CNTs) as a colder electron source for electron cooling in the ELENA decelerator. Currently, a thermionic tungsten-doped BaO cathode limits the cooling efficiency due to a high transverse energy spread. Investigating field emission (FE) aims to achieve a colder antiproton beam, enhancing trapping efficiency for antimatter experiments. Although CNT-based FE feasibility is studied, full characterization for this application is missing. Multi-walled, vertically aligned (VA) CNT arrays with a honeycombed pattern show promising current densities. A Cold Cathode Test Bench (CCTB) was built to fully characterize different samples and to measure the properties of an electron gun using a larger (4 x 4 cm) VACNT array as its source.
15:30	**289**	**Beam dynamics studies of performance reach of future ion species in the CERN accelerator complex** *Elias Walter Waagaard, EPFL, Mike Seidel, PSI* The current ion physics programme at CERN is mainly based on lead (Pb) ion beams. Untested lighter ion species have been requested as a possible way to reach higher nucleon-nucleon luminosities. In order to identify the ion species with the highest luminosity performance in the Large Hadron Collider (LHC), a series of beam dynamics studies have been performed to characterize beam loss mechanisms caused by space charge and intra-beam scattering. Here we present benchmarking studies for the Super Proton Synchrotron (SPS), which will be used to develop an accurate model of the beam degradation mechanisms for future ion species.
15:45	**290**	**Muon Collider Feasibility Studies: Collective effects and muon cooling** *Joséphine Marie Bénédicte Potdevin [1], Xavier Buffat [2], Tatiana Pieloni [1]* *[1] EPFL, [2] CERN* Muon colliders have a great potential for high-energy physics. They can offer collisions of point-like particles at very high energies, since muons can be accelerated in a ring without limitation from synchrotron radiation. However, the need for high luminosity faces challenges, which arise from the short muon lifetime at rest, and the difficulty of producing large numbers of muons in bunches with small emittance. Addressing these challenges requires the development of innovative concepts and demanding technologies. In this study we will present the challenges linked to the transverse collective effects in the muon collider cooling system.
16:00		***END***