IPAC'25 - the 16th International Particle Accelerator Conferece

Sunday 1 June 2025 - Friday 6 June 2025

Taipei International Convention Center (TICC)

Book of Abstracts

Contents

FRYD: Friday Plenary Invited Oral / 10

Future circular Higgs factories: Status and prospective

Author: Yuhui Li[1]

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Corresponding Author: liyuhui@ihep.ac.cn

In this talk CEPC accelerator EDR satus will be presented, in which SRF system, magnets system, vacuum system, high power and high efficiency klystrons develpment, linac injector system, alignment and instatllation, MDI, civil engineering design and green collider technologies, etc will be covered.

Footnotes:

Funding Agency:

MOZD: Colliders and Related Accelerators (Invited) / 14

ILC accelerator status

Author: Hiroshi Sakai[1]

[1] *High Energy Accelerator Research Organization*

Corresponding Author: hiroshi.sakai@kek.jp

In this talk, ILC accelerator IDT development status will be given, where positron source, final focus system ATF3, SRF cavity and cryomodule, civil engineering design, green ILC technologies, etc. will be presented in detail.

Footnotes:

Funding Agency:

FRXD2: Colliders and Related Accelerators (Invited) / 18

EIC accelerator status

Author: Sergei Nagaitsev[1]

[1] *Brookhaven National Laboratory (BNL)*

Corresponding Author: snagaitsev@bnl.gov

In this talk EIC construction status in BNL will presented, in which electron and protron accelerator complex will be shown in detail, including polarization scheme.

Footnotes:

Funding Agency:

TUXD: Hadron Accelerators (Invited) / 22

Personnel and machine protection for FRIB commissioning, operations, and power ramp up

Author: Masanori Ikegami[1]

[1] *Facility for Rare Isotope Beams, Michigan State University*

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Safety is one of the main concerns in accelerator society. The key FRIB strategies and experience can be shared, leading to the successful FRIB operations with no safety-related incidents and meeting stringent standard in a university area.
Personnel protection and machine protection are key to high power frontier facilities like FRIB. For a facility built in the middle of university campus with heavy ion beam power being ramped up order of magnitude higher than the current record, stringent engineered and administrative controls and state-of-the-art technologies are needed to safeguard commissioning, operations, and upgrades.

Footnotes:

Funding Agency:

Plenary after coffee / 24

Liquid lithium charge stripping technology: achievement and lessons learned

Author: Takuji Kanemura[1]

[1] *Facility for Rare Isotope Beams, Michigan State University*

Corresponding Author: kanemura@frib.msu.edu

Liquid metal technology is key to the next-generation high-power hadron facilities. Following early R&D collaboration between Argonne National Laboratory and Michigan State University, FRIB pioneered on the technology of thin-film liquid lithium and is the first in the world applying such technology in accelerator operations. FRIB used liquid-lithium film for the charge stripping of high-power heavy-ion beams, enabling FRIB to achieve world's highest power uranium beam on target.
Liquid lithium technology has been successfully developed and applied for FRIB operations, offering a superior choice for charge stripping of high-power heavy ion beams including uranium. Valuable experience has been gained in the performance and maintenance. This talk focuses on operational experience, lessons learned and future improvements.

Footnotes:

Funding Agency:

FRYD: Friday Plenary Invited Oral / 27

BeamPIE –a suborbital test of an accelerator for space applications

Author: Quinn Marksteiner[1]

[1] *Los Alamos National Laboratory*

Corresponding Author: qrm@lanl.gov

Summary: An experiment to fly an accelerator in space recently concluded successfully. Discuss the objectives, differences from terrestrial accelerators, and results from the flight.

Accelerators have the potential to play a major role in space-based activities. These can range from investigation of the Earth's magnetic field, to helping mitigate the effects of increased solar activity (e.g. by helping drain the Earth's radiation belts of charged particles), to deep-space missions. There are many challenges associated with operating accelerators in a space-based environment, however, ranging from high-voltage systems, to thermal management, to spacecraft charging. The Beam-Plasma Interaction Experiment –BeamPIE –was a small electron accelerator launched on a sounding rocket in 2023, to both explore the interaction of an electron beam with the near-earth plasma environment, and to test several new approaches to accelerator design in a space environment. This talk presents an overview of the BeamPIE accelerator design, mission objectives, and results from its flight.

Footnotes:

Funding Agency:

WEXD:Accelerator Technology and Sustainability (Invited) / 34

Experimental demonstration of particle acceleration with normal conducting accelerating structure at cryogenic temperature

Author: Mamdouh Nast[1]

[1] *SLAC National Accelerator Laboratory*

Corresponding Author: mamdouh@slac.stanford.edu

This work received the PRAB 2023 DPB and PRAB Ernest Courant Outstanding Paper Recognition. https://journals.aps.org/prab/abstract/10.1103/PhysRevAccelBeams.24.093201

Paper abstract:
In this paper, we present an experimental demonstration of the high-gradient operation of an X-band, 11.424 GHz, 20-cells linear accelerator (linac) operating at a liquid nitrogen temperature of 77 K. The tested linac was previously processed and tested at room temperature. Low-temperature operation increases the yield strength of the accelerator material and reduces surface resistance, hence a great reduction in cyclic fatigue could be achieved resulting in a large reduction in breakdown rates compared to room-temperature operation. Furthermore, temperature reduction increases the intrinsic quality factor of the accelerating cavities, and consequently, the shunt impedance leading to increased rf-to-beam efficiency and beam loading capabilities. We verified the enhanced accelerating parameters of the tested accelerator at cryogenic temperature using different measurements including electron beam acceleration up to a gradient of 150 MV/m, corresponding to a peak surface electric field of 375bMV/m. We also measured the breakdown rates in the tested structure showing a reduction of 2 orders of magnitude compared to their values at room temperature for the same accelerating gradient.

Footnotes:

Funding Agency:

WEZN:Photon Sources and Electron Accelerators (Invited) / 40

Cascaded hard X-ray self-seeded free-electron laser at megahertz repetition rate

Author: Shan Liu[1]

[1] *Deutsches Elektronen-Synchrotron*

Corresponding Author: shan.liu@desy.de

High-resolution X-ray spectroscopy in the sub-nanosecond to femtosecond time range requires ultrashort X-ray pulses and a spectral X-ray flux considerably larger than that presently available. X-ray free-electron laser (XFEL) radiation from hard X-ray self-seeding (HXRSS) setups has been demonstrated in the past and offers the necessary peak flux properties. So far, these systems could not provide high repetition rates enabling a high average flux. We report the results for a cascaded HXRSS system installed at the European XFEL, currently the only operating high-repetition-rate hard X-ray XFEL facility worldwide. A high repetition rate, combined with HXRSS, allows the generation of millijoule-level pulses in the photon energy range of 6–14 keV with a bandwidth of around 1 eV (corresponding to about 1 mJ eV−1 peak spectral density) at the rate of ten trains per second, each train including hundreds of pulses arriving at a megahertz repetition rate. At 2.25 MHz repetition rate and photon energies in the 6–7 keV range, we observed and characterized the heat-load effects on the HXRSS crystals, substantially altering the spectra of subsequent X-ray pulses. We demonstrated that our cascaded self-seeding scheme reduces this detrimental effect to below the detection level. This opens up exciting new possibilities in a wide range of scientific fields employing ultrafast X-ray spectroscopy, scattering and imaging techniques.

Footnotes:

Funding Agency:

Plenary after coffee / 44

RF Acceleration with Short Pulses: Breaking the High-Gradient Barrier

Author: Xueying Lu[1]

[1] *Northern Illinois University*

Corresponding Author: xylu@niu.edu

Achieving high-gradient acceleration is critical to enabling future linear colliders, free-electron lasers, and compact accelerator applications. Pioneered by the Argonne Wakefield Accelerator (AWA) group, short-pulse SWFA (structure wakefield accelerator) technology has shown remarkable promise in surpassing the long-standing barrier of ˜100 MV/m in X-band normal conducting structures. Recent experiments have demonstrated the feasibility of this approach, with the gradient exceeding 300 MV/m in a variety of X-band accelerating structures and an X-band photogun. Experimental results indicate that the well-known empirical scaling law to estimate the RF breakdown rate (BDR ˜E^30*t^5) may be too conservative when the RF pulse durations below 10 ns. A conceptual design of ultracompact XFEL based on the short pulse acceleration will be presented.

Footnotes:

Funding Agency:

TUZD:Photon Sources and Electron Accelerators (Invited) / 46

Toward realization of few-cycle free electron lasers: basic concept and its experimental demonstration

Author: Takashi Tanaka[1]

[1] *RIKEN SPring-8 Center*

Corresponding Author: ztanaka@spring8.or.jp

The shortening of the FEL pulse length is an important subject, and especially reducing the FEL pulse length down to a few-cycle duration is a great challenge. However, there exists a theoretical limit that disturbs the realization of few-cycle FELs, which is known as the slippage effect. Recently, the author proposed a novel idea to overcome this difficulty and experimentally demonstrated it [1]. This talk will review its fundamental mechanism and report the results of the demonstration experiments, together with perspectives of few-cycle attosecond pulses that become available with this concept.

[1] T. Tanaka et al., Phys. Rev. Lett. 131, 145001 (2023)

Footnotes:

Paper preparation format:

LaTeX

Region represented:

Asia

Funding Agency:

THXN:Beam Dynamics and EM Fields (Invited) / 54

Review of beam based correction and optimisation for accelerators

Author: Xiaobiao Huang[1]

[1] *SLAC National Accelerator Laboratory*

Corresponding Author: xiahuang@slac.stanford.edu

Improving the performances of modern circular particle accelerators requires a tight and solid control of its linear optics. Decades of developments provided invaluable tools towards this end. This talk will review the historical milestones and the most recents novelties in this field.

Footnotes:

Funding Agency:

WEZN:Photon Sources and Electron Accelerators (Invited) / 58

LCLS-II commissioning and operation with high-repetition-rate CW FELs

Author: Yuantao Ding[1]

[1] *SLAC National Accelerator Laboratory*

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LCLS-II first stage commissioning will be completed in the summer of 2023, with demonstration of 1kHz FELs using the superconducting CW electron beam. Operation-based electron beam and FEL commissioning will be continued with the goal of ramping up beam rate, improving the FEL performance, and developing advanced FEL operation modes. The commissioning challenges and the latest machine performance should be reviewed, and the next step plan for achieving the objective design performance should be discussed.

Footnotes:

Funding Agency:

Plenary before coffee / **67**

High Beam Power Operations at Heavy Ion Facilities: Technical Developments, Challenges and Resolutions

Author: Osamu Kamigaito[1]

[1] *RIKEN Nishina Center*

Corresponding Author: kamigait@riken.jp

The Radioactive Isotope Beam Factory (RIBF) of RIKEN is a cyclotron-based heavy ion accelerator facility, which can accelerate heavy ions including uranium up to 345 MeV/u using an accelerator complex with a K2600-MeV Superconducting Ring Cyclotron (SRC) in the last stage to produce rare isotope beams in an in-flight technique. In the 15 years of developments the intensity and stability of the heavy-ion beams have been significantly improved. The core experimental instrumentations, such as the Rare RI Ring, are now in operation, and further results are expected in the future. This presentation will discuss the various technological developments that have been made since the start of RIBF acceleration and will provide future directions.

Footnotes:

Funding Agency:

Plenary before coffee / **75**

The operational challenges: achieving 500 mA high beam current at Taiwan Photon Source

Author: Ping Chou[1]

[1] *National Synchrotron Radiation Research Center*

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The Taiwan Photon Source (TPS) has been in routine operation at 500 mA since the last season of 2021, utilizing two superconducting cavities, bunch by bunch feedback system, and fast orbit feedback system, along with many technical efforts. The operation of TPS maintains its high reliability and availability. The mean time between failures is more than 190 hours with an availability greater than 98.9% in 2023. With newly developed cryogenic permanent magnet undulators, IVUs, and EPUs, balancing the needs of both soft X-ray and hard X-ray users. Many challenges have been encountered in the journey to achieving a beam current of 500 mA, primarily due to the short bunch length of 16 ps and impedance issues in vacuum chambers at TPS storage ring. Ongoing efforts to improve the performance and the detailed journey to achieving 500 mA top-up operation will be presented.

Footnotes:

Paper preparation format:

Word

Region represented:

Asia

Funding Agency:

National Science and Technology Council, Taiwan

TUZD:Photon Sources and Electron Accelerators (Invited) / 92

SPS-II Project: Status update

Author: Porntip Sudmuang[1]

[1] *Synchrotron Light Research Institute*

Corresponding Author: porntip@slri.or.th

SPS-II is the forth generation storage ring project in South East Asia.
Speaker should give the overview of the SPS-II.
The recent progress and update on the project will be given.
Development programs for prototypes will be covered.

Footnotes:

Funding Agency:

WEXN:Beam Instrumentation and Controls, Feedback and Operational Aspects (Invited) / 106

Upgrade of KEK electron/positron Injector Linac by using pulse magnets and machine learning

Author: Takuya Natsui[1]

[1] *High Energy Accelerator Research Organization*

Corresponding Author: takuya.natsui@kek.jp

The KEK injector linac injects high-charge electron and positron beams into the high-energy-ring and low-energy-ring of SuperKEKB respectively. The linac also injects electron beams to the two light source rings, PF ring andPF-AR. We operate simultaneous top-up injections into the four rings by using many pulsed magnets. We have been upgrading the linac to attain the higher-quality beam injections for the SuperKEKB rings. In the summer of 2023, large-aperture quadrupole pulsed magnets have been newly installed upstream of the linac and driven by large-current pulse power supplies at markedly high electric efficiency. These new magnets bring the pulse-by-pulse optics changing to provide the high-quality beams. In order to cope with the complex beam injections to the four rings, we have introduced the automatic adjustment system by using machine-learning. The system surpasses human skill in beam adjustment and has resulted in significant increases in the amount of beam charge and beam transmission.
We will report on the results of these upgrades.

Footnotes:

Funding Agency:

THYN:Hadron Accelerators (Invited) / 109

Beam commissioning of K=500 Superconducting Cyclotron at VECC

Authors: Arup Bandyopadhyay[1]; Jayanta Debnath[1]

[1] *Department of Atomic Energy*

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A program to develop K=500 superconducting cyclotron was launched in India at VECC, Kolkata during the beginning of this century. Such an accelerator was planned to be built to provide ion beams heavier compared to that provided by K=130 cyclotron in the same campus. Through this project, India ventured into the technology of superconducting cyclotron. Although the construction of this cyclotron was completed in the beginning of last decade and internal beam was observed, challenge was faced in getting the external beam. Massive R&D efforts were required to be initiated to overcome this challenge, and campaign was started to perform several magnetic field measurements at intricate locations, as a result of which it was understood that the problem was occurring due to field errors arising due to misalignment of superconducting coils. After making the required rectifications, first external beams (252 MeV N+4) were extracted in the beginning of this decade, and now efforts are ongoing to accelerate a wide variety of ion beam in this cyclotron. The proposed speaker will start by giving an introduction to the K=500 cyclotron project, briefly describing the milestones achieved in the project, and an account of the R&D efforts to diagnose the problems that were faced in extracting the beam, along with the beam commissioning results. Future plans for extending the operational regime further of the superconducting cyclotron will also be discussed by the proposed speaker.

Footnotes:

Funding Agency:

FRXD1: Beam Dynamics and EM Fields (Invited) / 116

Review of impedance effects for acclerators

Author: Takeshi Toyama[1]

[1] *High Energy Accelerator Research Organization*

Corresponding Author: takeshi.toyama@kek.jp

Starting with my first experience of the transverse feedback damper in the KEK 12 GeV PS in 2006, where we tested with analog system and in addition digital controller from SPring-8 team. Since then, digital systems have come to cover almost all the machines. In J-PARC MR bunch-by-bunch transverse feedback system had been introduced with a collaboration at the proton beam power around 150 kW in 2010. The weaknesses of this system quickly became apparent. It can damp only the center of mass motions of the whole bunches. It could not suppress intra-bunch betatron motion with different betatron phase in a different longitudinal bunch position. This happens in the case of a non-zero chromaticity. Then the intra-bunch feedback system was introduced in 2014 with a proton beam power of approximately 250 kW and has been operating successfully to date. But already this system cannot suppress collective beam instabilities in certain chromaticities over proton beam intensity of 2 - 3E+14 protons per pulse. The higher the sampling rate, the higher the damping efficiency. This system is currently under development. The above is for long bunches of 100-200 ns. Trials in case of much shorter bunches will be also reviewed.

Footnotes:

Funding Agency:

WEYN:Beam Dynamics and EM Fields (Invited) / 119

Ultrafast visualization of an electric field under the Lorentz transformation

Author: Koichi Kan[1]

[1] *National Institutes for Quantum Science and Technology*

Corresponding Author: kan.koichi@qst.go.jp

EM field around a relativistically accelerated charged particle is known to squeezed longitudinally, which is called Lorentz contraction. This behavior is well-believed and no inconsistent phenomena have been found so far. However, the Lorentz contraction of the EM field has not been directly confirmed by an experiment. The first direct observation of the Lorentz contraction of the EM field was recently performed by using an electron linac at Osaka University (*). The electric field around an electron beam with an energy of 35 MeV and a pulse width of 0.72 ps was measured by an electro-optical (EO) sampling method. A 1mm-thick ZnTe crystal was used for EO sampling, and the polarization of optical laser light was modulated by the electric field around the electron beam in the crystal. The modulated laser light was decoded into a spatiotemporal image of the electric field and the Lorentz contraction was directly confirmed. The evolution of the newly generated electric field after passing the beam through a metallic boundary was also visualized. This ultrafast measurement technique can help longitudinal diagnostics of a charged particle beam.

Footnotes:

*: M. Ota, K. Kan, et al., Nature Physics 18, 1436-1440 (2022)

Funding Agency:

TUYD:Novel Particle Sources and Acceleration Techniques (Invited) / 121

Record beam intensity productions of Highly charged heavy ions by 28-45 GHz superconducting ECR ion sources at IMP

Author: Liangting Sun[1]

[1] *Institute of Modern Physics, Chinese Academy of Sciences*

Corresponding Author: sunlt@impcas.ac.cn

Next generation heavy ion accelerators such as HIAF (High Intensity heavy ion Accelerator Facility), FRIB (Facility for Rare Isotope Beams), SPIRAL2, and so on strongly require high intensity highly charged ion beams. The production of intense highly charged heavy ion beams such as U3n+ is a worldwide challenge for the community. ECR (Electron Cyclotron Resonance) ion source is the most powerful machine to produce intense highly charged heavy ion beams. Recently, with the better understanding of ECR ion source plasma behavior and ion source technology advancement, high intensity heavy ion beams such as >0.5 emA U35+ (CW), >0.1 emA U46+ (pulsed) have been produced with state-of-the-art 24-28 GHz ECR ion sources. To further improve beam intensity for higher charge state heavy ion beams, the world First fourth generation ECR ion source (named as FECR) with microwave frequency 45 GHz is being developed at IMP. After 8 years development, the first plasma has been made in May 2024. This talk will report the recent progress of record beam intensity productions. The first beam commissioning results of FECR will be also presented.

Footnotes:

Paper preparation format:

Word

Region represented:

Asia

Funding Agency:

National Natural Science Foundation of China (12025506, 11427904)

THYD:Beam Instrumentation and Controls, Feedback and Operational Aspects (Invited) / 151

Reinforcement Learning in Particle Accelerators

Author: Andrea Santamaria Garcia[1]

Co-authors: Annika Eichler [2]; Chenran Xu [1]; Jan Kaiser [2]; Simon Hirlaender [3]

[1] *Karlsruhe Institute of Technology*

[2] *Deutsches Elektronen-Synchrotron*

[3] *University of Salzburg*

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Reinforcement learning (RL) is a unique learning paradigm inspired by the behaviour of animals and humans to learn to solve tasks autonomously. Learning occurs through interactions with an environment, exploring and evaluating strategies under various conditions. RL excels in complex environments, can handle delayed consequences and is able to learn solely from experience without access to an explicit model of the system. This makes RL particularly promising for particle accelerators, where the dynamic conditions of particle beams and accelerator systems require continuous adaptation and modelling is challenging. Although RL applications are emerging in accelerator physics and showing promising results, their widespread introduction faces critical challenges.

Among the main obstacles are the effective formulation of control problems, training, and the deployment of solutions in real systems. This work provides an overview of the potential of RL in accelerator applications and highlights current challenges and future research directions.

Footnotes:

Paper preparation format:

LaTeX

Region represented:

Europe

Funding Agency:

FRYD: Friday Plenary Invited Oral / 176

Latest Achievements in Femtosecond Synchronization of Large Scale Facilities

Author: Sebastian Schulz[1]

[1] *Deutsches Elektronen-Synchrotron*

Corresponding Author: sebastian.schulz@desy.de

The laser-based synchronisation systems for the European XFEL and FLASH provide femtosecond-stable timing references for tens of clients along the accelerator and the experiment halls over many kilometres of optical fibre. Recently, benchmarking experiments revealed a point-to-point timing stability with sub-femtosecond rms timing jitter. At the same time geophysical effects like ocean waves and earthquakes do not only affect the performance of the system, but their impact can clearly be identified. To improve the temporal resolution in X-ray/optical pump-probe experiments, additional arrival time monitors for both the electrons and the optical laser pulses are currently being installed, allowing for a posteriori data sorting and eventually active feedbacks. Further, the optical reference oscillators and advanced synchronisation schemes are being developed, resulting in timing jitter on the sub-hundred attoseconds level.

Footnotes:

Funding Agency:

WEYD:Accelerator Technology and Sustainability (Invited) / 187

Assessing and Increasing the sustainability of future accelerator based facilities

Author: Ben Shepherd[1]

[1] *Science and Technology Facilities Council*

Corresponding Author: ben.shepherd@stfc.ac.uk

The long term sustainability of future accelerators is now a crucial problem for our community. Many groups and collaborations are actively working in this area (e.g. European projects included IFAST and iSAS, RUEDI (STFC) has recently published a case study for the project lifecycle, Centre of

Excellence in Sustainable Accelerators is now being vigorously pursued in the UK with CERN backing, European LDG working group, etc). This talk will review the wider community efforts and highlight where good progress is being made and where future efforts are planned or required.

Footnotes:

Funding Agency:

THXD:Novel Particle Sources and Acceleration Techniques (Invited) / 218

Guiding of charged particle beams in curved plasma-discharge capillaries

Author: Riccardo Pompili[1]

[1] *Istituto Nazionale di Fisica Nucleare*

Corresponding Author: riccardo.pompili@lnf.infn.it

A new approach that demonstrates the guiding of relativistic electron beams over curved paths by means of a plasma-discharge capillary is presented. The magnetic field produced by the discharge current is used to deflect and focus the beam along a curved capillary, showing that the guiding can be made dispersion-less, i.e. not affected by chromatic dispersion. This proof-of-principle experiment extends the use of plasma-based devices that revolutionised the field of particle accelerators enabling the generation of GeV beams in few centimeters. Compared to state-of-the-art technology based on conventional bending magnets and quadrupole lenses, these results provide a compact and affordable solution for the development of next-generation table-top facilities.

Footnotes:

Paper preparation format:

LaTeX

Region represented:

Europe

Funding Agency:

TUYN:Colliders and Related Accelerators (Invited) / 237

Design Initiatives for a 10 TeV pCM Wakefield Collider

Author: Spencer Gessner[1]

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Corresponding Author: sgess@slac.stanford.edu

The recent P5 Report calls for a 10 TeV parton center-of-mass (pCM) collider, for which advanced wakefield accelerators are a candidate technology. Design studies are being developed including particle sources, damping rings, and linacs based on plasma and structure-based wakefield accelerators. Compact Beam Delivery Systems may be possible using plasma lenses, requiring understanding of their impact on the design of the Machine-Detector Interface, and optimization of detectors for 10 TeV e+e- and γγ collisions. The results of the design study will define the necessary technology

demonstrations to be performed. There are synergies between the design of a 10 TeV linear collider and Higgs Factory linear colliders. This study is hence developing tools and innovations that can be broadly useful to the collider community, and interaction among efforts is important.

Footnotes:

Funding Agency:

MOZD: Colliders and Related Accelerators (Invited) / 245

Status of the Baseline Design for a 10 TeV Muon Collider

Author: Daniel Schulte[1]

[1] *European Organization for Nuclear Research*

Corresponding Author: dschulte@cern.ch

A Muon Collider (MC) offers unique potential for reaching the 10 TeV center-of-mass energy regime. The most recent updates to both the European and US strategies for particle physics emphasize the importance of exploring this technology as a path to enable the next generation of energy frontier discoveries. Substantial updates to the baseline design concept have now been implemented by the International Muon Collider Collaboration. An overview of progress towards establishing the baseline design of the 10 TeV machine and delivering a full conceptual design report for this novel collider approach is presented.

Footnotes:

Funding Agency:

TUXN: Beam Dynamics and EM Fields (Invited) / 271

Elevating Beam Quality and Stability in Linear Accelerators through High Order Mode Analysis

Authors: Angelo Bosotti[1]; Daniele Sertore[1]; Luca Serafini[1]; Marcello Rossetti Conti[1]; Rocco Paparella[1]; Sanae Samsam[1]; Vittoria Petrillo[2]

[1] *Istituto Nazionale di Fisica Nucleare*

[2] *Universita' degli Studi di Milano*

Corresponding Authors: marcello.rossetti@mi.infn.it, luca.serafini@mi.infn.it, sanae.samsam@mi.infn.it, rocco.paparella@mi.infn.it, angelo.bosotti@mi.infn.it, daniele.sertore@mi.infn.it, vittoria.petrillo@mi.infn.it

The pursuit of optimal beam quality and stability in linear accelerators (Linacs) stands as a cornerstone of accelerator physics. However, the presence of High Order Modes (HOMs) within Linacs, particularly in the context of energy recovery (ERLs), presents formidable challenges to beam quality and stability. In response to this challenge, the development of the Compact HOMEN (High Order Mode Evolution based on Energy budget) model has emerged, providing precise prediction and analysis of HOM effects on beam dynamics within superconducting cavities. This model facilitates meticulous optimization strategies, guiding researchers towards unprecedented advancements in high-brightness accelerated electron beam technology. By comprehensively understanding and managing HOMs, Linacs can achieve enhanced performance and efficiency, crucial for a myriad of scientific and industrial applications.
Through this study, we underscore the constraints posed by high currents and high repetition rate

to ensure an optimal energy recuperation. Our findings not only deepen the understanding of ERL facilities but also underscore their transformative potential in shaping the forefront of accelerator technology.

Footnotes:

Funding Agency:

TUZN:Applications of Accelerators, and Engagement for Industry and Society (Invited) / 308

Carbon ion therapy facility at Taipei Veterans General Hospital

Author: Keng-Li Lan[None]

Corresponding Author: kllan@vghtpe.gov.tw

Carbon ion therapy is gaining popularity due to its unique physical and radiobiological properties, such as a lower oxygen enhancement ratio (OER) than photon and proton therapy, indicating that efficacy is not limited by hypoxic tumor microenvironments. It also has a Its superior anticancer effect on hypoxic tumor cells, which are resistant to chemotherapy, radiotherapy, and immunotherapy. It is thus used to treat a wide range of cancers and increasingly being used to treat recurrent disease. TVGH is a national medical facility committed to protecting public health and upholding the highest medical standards. Given that cancer is Taiwan's leading cause of death, accounting for one-third of our hospitalized patients, we have spent decades researching and implementing cutting-edge anticancer treatments. As well as to complete the anticancer treatment spectrum in Taiwan, TVGH has established a carbon ion therapy facility of synchrotron accelerator type. Its construction began in 2019 and was completed in a record-breaking 15 months. After twenty months of equipment installation and verification, TVGH became the world's fourteenth and Taiwan's only carbon ion therapy facility. Since the opening of this carbon ion therapy facility in May 2023, TVGH has treated nearly 200 patients, more than 90% of whom have pancreatic, prostate, liver, or lung cancer. Although TVGH has only been monitoring these patients for less than one year, numerous favorable results have been observed.

Footnotes:

Funding Agency:

TUZN:Applications of Accelerators, and Engagement for Industry and Society (Invited) / 332

Compact hadron sources and linacs for societal applications

Author: Alessandra Lombardi[1]

[1] *European Organization for Nuclear Research*

Corresponding Author: alessandra.lombardi@cern.ch

This contribution will detail how the development of accelerator sources and linacs for particle physics has found applications in medical and industrial environments. In particular for electron therapy, ion therapy and PIXE (Proton Induced X-ray Emission).

Footnotes:

Funding Agency:

MOZN:Accelerator Technology and Sustainability (Invited) / 360

Development for Various Applications at Compact ERL as a high-power CW SRF linac in KEK

Author: Masahiro Yamamoto[1]

[1] *High Energy Accelerator Research Organization*

It is about "Development for Various Application at Compact ERL as a high-current CW SRF linac in KEK". As an introduction, the author will talk about the merit of the superconducting RF (SRF) cavity and also talk about our applied research based on Compact ERL (cERL) in KEK, which uses the Nb superconducting cavity and can make energy recovery operation. The cERL's characteristic using the high-current beam has the variety of applications; industrial applications using high-intensity terahertz light and mid-infrared FEL (free-electron laser). In addition, the high current CW beam irradiation was conducted for basic research on domestic production of nuclear medicine, strengthening of asphalt, and the highly efficient production of nanocellulose from wood in cERL. After talking these applications of cERL, next we will talk about "Future plan for applied research using superconducting accelerators". One is the EUV-FEL light source development for EUV-lithography and the other is the development of compact superconducting RF accelerator based on Nb3Sn for high-power beam irradiation.

Footnotes:

Paper preparation format:

Region represented:

Funding Agency:

MOZN:Accelerator Technology and Sustainability (Invited) / 369

Overview of permanent magnet implementations for advanced light sources

Author: Ciro Calzolaio[1]

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The utilization of permanent magnets in the design of accelerator magnets has witnessed a surge in prominence, particularly within the realm of advanced light sources. Following pioneering initiatives at SIRIUS and ESRF-EBS, current projects are increasingly embracing permanent magnet technology. Notably, in the case of SLS2.0, over 30% of the magnets in the new storage ring are powered with permanent magnets. Permanent magnets offer manifold advantages, including compactness, much simpler requirements in terms of services (such as power supplies, cables, and cooling systems), and reduced operational costs. Nonetheless, they also present significant challenges that demand careful consideration. In this study, the author provides an overview of permanent magnet implementations across various projects and delves into a detailed analysis of the Swiss Light Source upgrade.

Footnotes:

Funding Agency:

FRXN1:Hadron Accelerators (Invited) / 394

Deceleration of Ion Beams - Related Callenges and Opportunities

Author: Frank Herfurth[1]

[1] *GSI Helmholtzzentrum für Schwerionenforschung GmbH*

The GSI facilities of CRYRING and HiTRAP are used for decelerating ion beams to low energies. This deceleration phase is preceded by the generation and acceleration of those ions. CRYRING and HiTRAP operate at the junction between accelerator science and atomic physics. The scientfic motivation, the operation principle, the state of the art and future outlooks are presented.

Footnotes:

Funding Agency:

FRXN2:Novel Particle Sources and Acceleration Techniques(Invited) / 410

Enhanced proton and neutron production using the ultra-short (24 fs) and high-power (2 PW) Apollon laser facility

Author: Julien Fuchs[None]

We will review interesting advances we have been able to perform in the domain of laser-driven generation of proton and neutron beams, using the new ultra-high power Apollon laser facility (France) [BUR]. Thanks to the ability to tailor the ultra-short timescales of the temporal pedestal of the laser pulse, we have notably been able to accelerate protons in a "lighthouse"fashion, whereby the highest-energy component of the beam is emitted in a narrow cone, well separated from the lower-energy components. As a result, the spectrum of the output protons can be easily adjusted by collecting them along a specific direction, therefore removing a major roadblock of these beams, which are otherwise spectrally broadband. This approach offers the advantages of leveraging a robust sheath acceleration process in standard micron-thick targets and being optically controllable. We have also demonstrated that, when enhancing the temporal contrast by using plasma mirrors, we could enhance the laser-to-target coupling and the proton energy, as well as reduce the angular divergence of the proton beams. Last, we will review the high flux neutrons that can be produced using these beams when using (p,n) reactions in Li [LEL]. The measured high fluxes that can be obtained using Apollon open perspectives for getting insight into nucleosynthesis of elements [HOR].

Footnotes:

[BUR] K. Burdonov et al., , Characterization and performance of the Apollon short-focal-area facility following its commissioning at 1 PW level, Matter and Radiation at Extremes 6, 064402 (2021)
[HOR] V. Horny et al., Quantitative feasibility study of sequential neutron captures using intense lasers,Phys. Rev. C 109, 025802 (2024).
[LEL] R. Lelièvre et al., A Comprehensive Characterization of the Neutron Fields Produced by the Apollon Petawatt Laser, http://arxiv.org/abs/2311.12653

Funding Agency:

Plenary after coffee / 416

Review of nonlinear resonances in accelerators and storage rings; including a discussion of chaos, particle diffusion and dynamic

aperture

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Review of nonlinear resonances in accelerators and storage rings; including a discussion of chaos, particle diffusion and dynamic aperture

Footnotes:

Funding Agency:

417

Cryogenic undulator at Taiwan photon source

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The first abstract for testing

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Paper preparation format:

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Asia

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FRXD1: Beam Dynamics and EM Fields (Invited) / **421**

Review of Linear and Nonlinear Optics Measurements in the CERN LHC

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Review of Linear and Nonlinear Optics Measurements in the CERN LHC

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Paper preparation format:

Region represented:

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FRXN3:Accelerator Technology and Sustainability(Invited) / 542

Neutron target for high-intensity operation at J-PARC MLF

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Neutron target for high-intensity operation at J-PARC MLF

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