FCC Week 2025

Monday, 19 May 2025 - Friday, 23 May 2025

Hofburg Vienna

Book of Abstracts

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Physics, Experiments and Detectors / 2

Transfer learning for FCC detector optimization

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We demonstrate transfer learning capabilities in a machine-learned algorithm trained for particle-flow reconstruction in high energy particle colliders. This paper presents a cross-detector fine-tuning study, where we initially pre-train the model on a large full simulation dataset from one detector design, and subsequently fine-tune the model on a sample with a different collider and detector design. Specifically, we use the Compact Linear Collider detector (CLICdet) model for the initial training set, and demonstrate successful knowledge transfer to the CLIC-like detector (CLD) proposed for the Future Circular Collider in electron-positron mode (FCC-ee). We show that with an order of magnitude less samples from the second dataset, we can achieve the same performance as a costly training from scratch, across particle-level and event-level performance metrics, including jet and missing transverse momentum resolution. Furthermore, we find that the fine-tuned model achieves comparable performance to the traditional rule-based particle-flow approach on event-level metrics after training on 100,000 CLD events, whereas a model trained from scratch requires at least 1 million CLD events to achieve similar reconstruction performance. To our knowledge, this represents the first full-simulation cross-detector transfer learning study for particle-flow reconstruction. These findings offer valuable insights towards building large foundation models that can be fine-tuned across different detector designs and geometries, helping to accelerate the development cycle for new detectors and opening the door to rapid detector design and optimization using machine learning.

Poster session / 3

Time-Dependent Precision Measurement of $B_s^0 \to \phi\mu^+\mu^-$ Decay at FCC-ee

Authors: Tsz Hong Kwok[1]; Zach Polonsky[None]; Valeriia Lukashenko[1]; Jason Aebischer[2]; Ben Kilminster[1]

[1] *University of Zurich (CH)*

[2] *CERN*

We study the potential of the FCC-ee to perform time-dependent CP violation measurements in rare decays $B_s^0 \to \phi(\to K^+K^-)\mu^+\mu^-$ at the Z-pole, where large statistics can be achieved. These decays serve as sensitive probes for physics beyond the Standard Model (SM). In the SM, CP violation enters only through loop processes and is therefore highly suppressed, so any significant CP-violating effect could be a clear indication of New Physics (NP). By examining these rare decay modes, we aim to uncover signatures of complex NP contributions that are not accessible with current facilities. The FCC-ee, operating at the Z-pole, benefits from high luminosity, an exceptionally clean experimental environment, and advanced detector capabilities for particle identification and precise vertexing. Our studies, based on the IDEA detector concept, PYTHIA Monte Carlo simulations, and DELPHES reconstruction, demonstrate that a relative precision better than 1% on the branching ratio and an accuracy of $\mathcal{O}(10^{-2})$ on the time-integrated CP asymmetry are achievable. Furthermore, the analysis exhibits promising sensitivity of $\mathcal{O}(10^{-2} - 10^{-1})$ in observables D_f, C_f and S_f, which characterize the time-dependent CP violation. These results underscore the critical role of the FCC-ee, especially at the Z-pole, which stands as perhaps the only facility capable of making such precise measurements in this sector, thereby opening a new window into the study of CP violation and the potential for discovering NP.

Poster session / **5**

Top quark mass measurement at $t\bar{t}$ threshold with the IDEA detector

Author: Giulia Carramusa[1]

Co-authors: Giancarlo Panizzo [2]; Michele Pinamonti [3]

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The top quark mass plays a fundamental role in verifying the stability of the Higgs vacuum. A more precise measurement allows us to determine whether the Universe is in a stable state or if it is destined, in the distant future, to decay. For this reason, high-precision measurements of the top quark mass are central to the scientific programs of present and future colliders. One of the primary goals of the CERN Future Circular Collider project, in its e+ e- phase (FCC-ee), is to achieve a highly precise determination of this parameter. This contribution presents some of the most recent feasibility studies for measuring the top quark mass through a threshold scan in collisions, which represent the starting point for my Master's thesis work.

Poster session / **6**

KKMCee: Precision multiphoton MC for lepton and quark pair production at lepton colliders

Authors: Andrzej Konrad Siodmok[1]; Bennie Ward[2]; Zbigniew Was[3]; Scott Yost[4]

[1] *Jagiellonian University (PL)*

[2] *Baylor University (US)*

[3] *Institute of Nuclear Physics, Krakow, Poland*

[4] *The Citadel*

We present an overview and update for the {\tt KKMCee 5.00.2} Monte Carlo event generator for lepton and quark pair production in high-energy electron-positron annihilation processes. We note that it is still the most sophisticated event generator for such processes. Its entire source code is rewritten in the modern C++ language and it reproduces all features of the older KKMC code in Fortran 77. We discuss a number of improvements both in the MC algorithm and in its various interfaces, such as those to parton showers and detector simulation.

Technical Infrastructure / **7**

Review of the safety concept - pre-TDR roadmap

Author: Andre Henriques[1]

Co-author: Oriol Rios [1]

[1] *CERN*

In view of the FCC feasibility study, the Safety WP was tasked with the editorial of a full Safety Concept, which was recently published in Volume 2 of the Feasibility Study report. The outcome of

the safety concept leans on the results from several safety studies and the implementation of safety-relevant systems which are designed and proposed by other WPs in the Technical Infrastructure Pillar.
The review bodies of the study requested an external review of the safety concept, which was performed in the begging of 2025.
This presentation will focus on the outcome of the external review and identify / prioritise the tasks and milestones for the pre-TDR phase, in view of consolidating the concept.

Technical Infrastructure / 8

Radiation protection studies for the FCCee

Authors: Giacomo Lavezzari[1]; Markus Widorski[1]; Pavol Vojtyla[1]

[1] *CERN*

Radiation protection studies ensure that the proposed FCC-ee design meets radiological safety objectives for personnel and the environment. FLUKA Monte Carlo simulations help to analyse critical radiation protection aspects, here focusing on three topics for the pre-TDR phase that may significantly impact system integration and civil engineering.

The first aspect concerns the activation of the beamstrahlung dump, assessing its impact on integration, maintenance, and radioactive waste production, along with an overview of key radiation protection aspects to be developed in the upcoming phases. The second focus is set on the expected residual radiation levels around the betatron collimation system, with its implications for access and maintenance to be addressed in design, integration and civil engineering during the pre-TDR phase. Lastly, radiation protection considerations for the FCC-ee injector complex are reviewed, highlighting areas that require further development as the injector complex will become the first installation to be built and operated.

Technical Infrastructure / 9

Reviewed fire safety concept and future studies

Authors: Andre Henriques[1]; Oriol Rios[1]

[1] *CERN*

The external Safety Concept review conducted by the HSE Executive UK concluded that the current fire safety concept presents no major showstoppers. However, several areas require further development to ensure comprehensive risk mitigation. Key aspects identified include the need for complete hazard inventories, in-depth analysis of degraded modes, and assessment of fire and ventilation interactions. This presentation will outline the roadmap for the upcoming study phase, highlight the progress made so far, and discuss critical challenges that will demand particular attention and dedicated effort moving forward.

Environment / 10

From Static Markup to Dynamic Interfaces

Author: Francesco Pinzauti[1]

[1] *CERN*

Civil Engineering / **11**

Update on FCC Civil Engineering Strategy and Schedule

Author: Timothy Paul Watson[1]

[1] *CERN*

In order to commence the civil engineering for the FCC in early 2033,contracts for construction of the necessary civil engineering will need to be put in place in mid-2032. To achieve this challenging milestone, a series of sequential activities needs to take place in order that a robust and largely frozen set of requirements and associated civil engineering designs are available to take forward into the procurement and construction phases. This presentation outlines the current plan of work and associated schedule of activities for the period between the end of the Feasibility Study and the start of civil engineering construction activities. The presentation will identify those activities that need to take place prior to the "project approval" milestone and those activities that will take place after a future "project approval". The presentation will also identify the key inputs that will be needed from other stakeholders in order to maintain the planned schedule for the civil engineering activities.

Poster session / **12**

Strategies for optimizing the usage of greenhouse gases in particle detectors

Author: Pieter Vanslambrouck[None]

Co-authors: Gianluca Rigoletti [1]; Stefania Juks [2]; Mattia Verzeroli [3]; Damiano Galassi ; Maria Cristina Arena [1]; Amin Bouzaiene [4]; Mattia Busato [1]; Beatrice Mandelli [1]; Roberto Guida [1]

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[4] *Politecnico di Torino (IT)*

At the LHC experiments, a variety of gas mixtures are used to operate different gaseous detectors. Some of these gases (C2H2F4, C4F10, CF4, SF6) are powerful Greenhouse Gases (GHGs) with a high Global Warming Potential (GWP). This raises the need for optimizing the GHG consumption, for which the gas team (EP-DT-FS) identified three key strategies. First, gas consumption is reduced through gas recirculation and the operation of the gas systems is optimized. This involves continuous tuning of the Gas Control Systems to ensure proper detector performance and decrease fresh gas consumption. The second strategy consists of recovering the gas that cannot be recirculated and would otherwise be lost. Gas recuperation plants were developed to allow specific gases to be recovered from the gas mixture for future reuse. A third strategy involves the study of detectors operated with low-GWP, alternative gases. Gases in the family of hydrofluoroolefins (HFOs) are being investigated as possible long-term alternative solutions to C2H2F4 in Resistive Plate Chamber detectors, while a short-to-medium term solution was identified in the addition of CO2 to the C2H2F4-based gas mixture without compromising on detector performance. In conclusion, there are several successful strategies to use gaseous detectors efficiently and sustainably for the next generation of particle detectors.

Technical Infrastructure / **13**

Optimizing Magnet Production Plan: Insights from simulations

Author: Milosz Artur Zielinski[1]

[1] *CERN*

The Future Circular Collider (FCC) demands an unprecedented scale of magnet production, with nearly 25,000 components for both the collider and booster requiring tightly coordinated manufacturing and installation. This presentation outlines the production and logistics strategy.

Civil Engineering / **14**

Strategy for the management of excavated materials

Author: Luisa Ulrici[1]

[1] *CERN*

In the framework of the FCC feasibility study a strategy for the management of the excavated material was established in collaboration with the French tunnel design centre, (CETU), the Centre for studies and expertise on risks, environment, mobility and urban planning, (CEREMA), the Montanuniversität Leoben (Austria) and with the technical support of the Swiss cantonal 'Service de géologie, sols et déchets' (GESDEC).
This strategy is a first step towards the definition of an excavated material management plan, that needs to be established before the start of the civil engineering works.
This presentation will provide an overview of the approach taken to define the strategy, based on the current practices in France and Switzerland, and on the analysis of the legal context in the two host States.

Joint effort PED & accelerators / **15**

The FCCee Inverse Compton polarimeter design

Author: Robert Kieffer[1]

Co-authors: Aurelien Martens [2]; Juba TAMAZIRT ; Stefano Mazzoni [1]; Thibaut Lefevre [1]

[1] *CERN*

[2] *Université Paris-Saclay (FR)*

For the FCC week 2025, we aim to present the most recent advances in the design of the inverse Compton polarimeters for the energy calibration at the Z and WW modes of the FCC-ee machine. The polarimeter will track the polarization state of a set of non-colliding polarized bunches dedicated to energy calibration. The same instrument will also be used to insure there is no polarization buildup in the colliding bunches.

Poster session / **18**

Probing HZZ Interactions through HZ Production in e+e- Collisions at FCC-ee

Author: Orhan Cakir[1]

Co-author: Isinsu Kahraman [2]

[1] *Ankara University (TR)*

[2] *Ankara University*

The associated production of a Higgs boson with a Z boson decaying into leptons and the Higgs boson mostly decays to b b˜ pair can be measured in the high transverse momentum regime of dileptons, ranging 50 - 70 GeV, with the IDEA detector. The recoil mass distributions from the signal (HZ, Z-> l+ l-) and the backgrounds (mainly ZZ, WW and other backgrounds) have been analyzed using the analysis code, the parameters have been optimized by appropriate fitting to obtain more precise results. This method plays an important role in probing the HZZ interactions. The analyzed MC simulation data, corresponding to an integrated luminosity of 1/ab, have been used as reference to compare the sensitivities at 240 GeV and 365 GeV center of mass energy of the collider.

Poster session / 19

Studying the electromagnetic properties of the neutrinos at FCC-ee

Author: Ilkay Turk Cakir[1]

Co-authors: Haluk Denizli ; Abdulkadir Senol ; Murat Koksal

[1] *Ankara University (TR)*

We investigate the non-standard ν¯ν γγ couplings parameterized by dimension-seven operators through the process e^+ e^-⟶ν¯ν γ at the FCC-ee. A comprehensive Monte Carlo simulation is performed, where signal and relevant background events are generated within the MadGraph framework, incorporating the non-standard ν¯ν γγ interactions. Subsequent parton showering and hadronization are performed using Pythia, while detector effects are simulated using the IDEA detector card in Delphes. The projected sensitivity to ν¯ν γγ couplings is determined at a 5σ confidence level, both with and without a 5% systematic uncertainty at the FCC-ee. Notably, even when accounting for a 5% systematic uncertainty, the most stringent limit on anomalous ν¯ν γγ couplings obtained for a muon collider with √s=365 GeV and an integrated luminosity of L_int=1.5 ab-1 surpasses the upper bound derived from the analysis of the rare decay Z⟶γγν¯ν using LEP data by six orders of magnitude.

Poster session / 20

Single Higgs Boson Production via Vector-Boson Fusion at FCC-ee

Authors: İnci Çakır[None]; Ilkay Turk Cakir[None]; Hilal Kucuk[None]

Abstract

The FCC-ee at √s = 365 GeV provides a better environment to study Higgs boson production with high precision. This study focuses on single Higgs production via vector-boson fusion (VBF) and associated production (ZH), followed by its H ⟶ WW ⟶ 2 l + MET decay. Using MadGraph5, event generation was performed for $e^+ e^- \to \nu_l \bar{\nu}_l \mathbf{H}$ and $e^+ e^- \to \mathbf{Z H}$. Parton-level events were hadronized with Pythia8, detector effects were simulated using Delphes, and final-state observables were analyzed via ExRootAnalysis. Histograms for missing transverse energy (MET), invariant mass (m(*ll*)), and transverse momentum (pT(*l*)) were constructed. Background contributions from ***ZZ, WW, l+ l-*** *(l:e,μ)*, and τ+ τ- were systematically studied, and optimized kinematic cuts were applied to enhance signal extraction. The results indicate that FCC-ee provides a highly controlled environment to probe Higgs boson couplings with electroweak gauge bosons. This study contributes to the precise determination of the Higgs coupling constants *gHWW* and *gHZZ*, which play a critical role in

testing the Standard Model (SM) predictions and exploring possible deviations that could hint at new physics.

Keywords: Higgs boson, Vector boson, Couplings, FCC, Lepton collider

Civil Engineering / **21**

Preliminary Results from Phase 1 Site Investigations

Author: Roddy Cunningham[1]

[1] *CERN*

This presentation will provide an overview of the objectives of Subsurface Site Investigations (SSI) Phase 1 and summarise the work carried out to date. It will outline the remaining investigation programme, scheduled for completion in early-2026, and highlight the key adjustments made to the original strategy. It will then review the results obtained so far and discuss how this emerging data may influence potential modifications to the FCC's subsurface civil engineering infrastructure.

The presentation will also introduce the provisional scope, objectives, and timeline for SSI Phase 2, and explain how upcoming investigation campaigns, along with other parallel stand-alone studies, aim to further reduce uncertainty and provide the necessary information to allow for the detailed design of the FCC underground infrastructure.

Civil Engineering / **22**

Update on FCC underground civil engineering

Author: Liam Bromiley[1]

[1] *CERN*

This presentation will provide an overview of the civil engineering design associated with the feasibility study submission of the FCC project. Key updates will include the revised construction schedule, and the latest design developments from the feasibility study. The session will also cover the developments to be made during the pre-TDR phase and discuss some of the studies required for the detailed design of the FCC. Furthermore, a summary of lessons learned from industry will be discussed to better understand the TBM (Tunnel Boring Machine) requirements and tunnelling within similar geological conditions, providing valuable insights into the practical considerations of the project.

Technical Infrastructure / **23**

FCC-hh cryogenics update for 1.9 K and 4.5 K options

Author: Laurent Delprat[1]

Co-authors: Anita Petrovic ; Benjamin Bradu [1]; Patricia Tavares Coutinho Borges De Sousa [1]; Ximo Gallud Cidoncha [1]

[1] *CERN*

The cryogenic system design of FCC-hh has matured during the Feasibility Study with the evolution of the magnets operation parameters, from a Nb3Sn @ 16 T version, updated from the CDR, towards a 14 T version of the same magnet technology in the so-called "F14 scenario", while even envisaging a 4.5 K option.
This presentation will focus on the FCC-hh machine, emphasizing on the latest cryogenic layouts foreseen at this stage of the study for the 1.9 K and the 4.5 K options operating in the F14 scenario. It will address the impacts of the optimization of the main FCC-hh machine parameters, starting from the cryogenic infrastructure with the new implementation of the cryoplants, down to the related cryogenic distribution system sizing, based on the refinement of the cryogenic heat loads updated from the CDR to the F14 scenario in both 1.9 and 4.5 K options. Associated helium inventory management and resulting electrical power consumption will be discussed. New magnets cooling scheme proposal for the 4.5 K option will only be mentioned and is not part of this talk.

Environment / **24**

A platform for developing quality-managed processes for constructing soil from geological excavation materials

Authors: Christiana Staudinger[1]; Corentin Lucas Pueyo[None]

[1] *University of Natural Resources and Life Sciences (BOKU) (AT)*

OpenSkyLab was established in 2024 on a 1 hectare field near LHC P5 to develop the potential for valorizing molasse-based excavation materials as functional soils. This initiative involves a multidisciplinary team of soil scientists, agronomists, geologists, biologists, and civil engineers.
The objective is to develop, under controlled conditions, the transformation of representative quantities of molasse into engineered soils suitable for applications such as urban and industrial land restoration, erosion control, green infrastructure development, as well as agriculture, horticulture, and forestry.
This presentation will provide a technical overview of the platform, as well as the soil construction approach developed by the OpenSkyLab collaboration, including the selection and preparation of materials, plant species and the hypotheses to be tested in the coming years following the installation.

Technical Infrastructure / **25**

FCC-ee cryogenics status update from FSR

Authors: Anita Petrovic[None]; Benjamin Bradu[1]; Boyan-Kaloyanov Naydenov Popov[1]; Laurent Delprat[1]

[1] *CERN*

With a focus on the work published in the feasibility study report, this presentation will explore the cryogenic system design and changes made since the feasibility study mid-term review for the FCC-ee machine. Included in this talk will be the status of the heat loads, cryogenic cooling capacities, electrical power consumption, and helium inventory.

The presentation will also address the impacts of the updated Reverse Phase Operation (RPO) RF layout. In this configuration, all cryomodules for the Z, W, and ZH modes will be installed during the initial installation window. Due to RPO, the Z and W stages of the machines will induce cryogenic loads at the level of ZH energy. This revised layout has led to significant changes in the cryogenic system's staging, installation strategy, and power consumption, which will be discussed in detail.

Finally, the next stage of the cryogenic system design will be discussed along with the objectives to be achieved during the Pre-TDR (Preliminary Technical Design Report) phase.

Environment / **26**

Environment aspect report

Author: Sophie Valette[1]

[1] *HSE Unit*

The FCC feasibility study includes the creation of an inventory of environmental aspects of the project as a preparation for the environmental authorisation process. This systematic work includes the compilation of characteristics of all project elements that may have environmental effects, e.g. energy and water consumption, wastes,
wastewater, noise, visibility in the landscape, ionizing and non-ionizing radiations, resources needs and others. This effort permits creating a hierarchisation of the noteworthy environmental effects. This presentation will provide an overview of the approach taken to create this inventory, report on challenges encountered and information about the current status of the work.

FCC accelerator technical design / **27**

Availability, Efficiency and Integrated Luminosity: Rising to the challenge in the FCC-ee

Author: Jack Heron[1]

Co-authors: Daniel Wollmann [1]; Hannah Alida Dostmann [2]; Jan Uythoven [1]; Lukas Felsberger [1]

[1] *CERN*

[2] *Universitaet Stuttgart (DE)*

To reach integrated luminosity goals, the FCC-ee aims to be operational for minimum 80 % over the scheduled 185 physics days each year. For comparison, the Large Hadron Collider (LHC) averaged 72 % in 2015-2024. Characteristics of the FCC-ee relating to size, complexity and ambitious technical objectives make availability one of the main challenges to its physics deliverables. This presentation showcases results from an enhanced Monte Carlo simulation environment that extrapolates reliability and availability performance of all major systems and subsystems in the FCC-ee from current working accelerators. Shortfalls in integrated luminosity are identified in all energy modes in the current baseline design, which are compounded in the electroweak sector by low operational efficiency. The primary contributors to unavailability and lost luminosity are highlighted, and compelling R&D opportunities are discussed.

Technical Infrastructure / **28**

Technical Infrastructure Availability: Challenges and Opportunities from LHC to FCC-ee

Author: Hannah Alida Dostmann[1]

Co-authors: Daniel Wollmann [2]; Jack Heron [2]; Jan Uythoven [2]; Lukas Felsberger [2]

[1] *Universitaet Stuttgart (DE)*

[2] *CERN*

Cryogenics, electrical network and cooling & ventilation faults accounted for nearly 30% of LHC down time in 2015-2025. Extrapolation to equivalent systems in the FCC-ee suggests a similarly high contribution, posing a substantial challenge to achieving the ambitious availability targets for

this large and complex machine. This presentation illustrates key statistics from infrastructure faults in the LHC significant to the FCC-ee availability challenge. Conclusions are drawn from an enhanced Monte Carlo simulation of these FCC-ee systems, highlighting core areas of concern. Finally, various proposals for mitigation are discussed.

FCC-ee injector / 29

RF-Track development for FCC-ee injector studies

Author: Andrea Latina[1]

[1] *CERN*

The FCC-ee injector complex requires high-charge, high-brightness, low-energy-spread electron and positron beams, posing stringent demands on beam dynamics modeling and accelerator design tools. RF-Track is a parallelized particle tracking code that has been developed at CERN and applied to support the design of the FCC-ee injector linacs and positron source. In this talk, I will present recent advances in RF-Track that enable realistic start-to-end simulations of the linacs, including the implementation of beam loading with trains of arbitrary bunch charge profiles and a particle-based model for intra-beam scattering (IBS). These new features have been critical for evaluating beam quality preservation under intense collective effects, and for optimizing the positron production and capture system. I will showcase simulation results and design studies carried out for the FCC-ee injector, highlighting how RF-Track has contributed to shaping the accelerator layout and establishing the RF parameters that meet the collider's challenging requirements.

Technical Infrastructure / 30

Powering RF for FCC-ee

Author: Davide Aguglia[1]

Co-author: Manuel Colmenero Moratalla [1]

[1] *CERN*

This presentation addresses the electrical powering of RF tubes, specifically tristrons and solid-state amplifiers, for both the FCC-ee collider and booster. The baseline solution currently under consideration is a centralized system delivering 130 MW through a high-power converter. We present the architecture and characteristics of the proposed converters and share insights gained from a technical visit to a comparable infrastructure in Spain. The different powering stages of the RF system are outlined, with particular emphasis on the challenges and constraints introduced by the unique power modulation requirements of tristron operation in the collider.

Technical Infrastructure / 31

Integrating Renewable Energy and Hydrogen Storage into the FCC

Authors: Christophe Turpin[1]; Corentin Boennec[1]; Santiago Hernán SUAREZ[1]

Co-authors: Bruno Sareni [1]; Xavier Roboam [1]

[1] *ENSEEIHT*

The contribution proposes an integration study of a hydrogen infrastructure distributed in the 8 connection points of the FCC. It considers the main constraints linked to the sizing of the system as well as the use of renewable electrical production placed locally and remotely to ensure partial energetic autonomy. It includes technical and economic indicators such as the actualized total cost, maintenance and operation costs, as well as macro environmental indicators.

FCC-ee accelerator / **32**

Optics tuning simulations for FCC-ee lattices

Author: Elaf Musa[1]

Co-author: Ilya Agapov [2]

[1] *DESY*

[2] *Deutsches Elektronen-Synchrotron (DE)*

The proposed electron-positron Future Circular Collider (FCC-ee) is planned to achieve unprecedented high luminosity, enabling answers to fundamental questions in high-energy physics. Magnets field imperfections and misalignments significantly impact beam dynamics and can strongly affect the collider's performance. In this contribution, we present the current status of a developed correction procedure, as well as the alignment and field tolerances for the FCC-ee baseline nominal lattice and a dedicated ballistic optics that will be used during the initial commissioning phase. proper sequence of the initial commission phase has been defined.

FCC-ee injector / **33**

FCC-ee top-up operation: photocathodes and laser systems

Author: Eduardo Granados[1]

Co-authors: Alexandre TRISORIO ; Anahita Omoumi ; Carlo Vicario [2]; Eva Roikova [3]; Giulia Tenasini ; Ralf Erik Rossel [1]

[1] *CERN*

[2] *INFN-LNF*

[3] *Uppsala University (SE)*

The FCC-ee injector requires a flexible and reliable high-brightness photoinjector capable of delivering on-demand electron bunch charge. This contribution presents several concepts currently under study for both the laser and the photocathode material —ranging from high-QE semiconductors to robust metallic options—suitable for reliably producing 7 nC electron bunches. We also explore flexible electro-optic Yb-based solid-state laser systems optimized for generating tailored bunch train structures in the time domain. These are paired with advanced pulse shaping and conditioning systems that allow rapid spatio-temporal manipulation of UV pulses to ensure optimal interaction with the photocathode surface. Together, these technologies enable the FCC-ee injector to meet the demanding requirements of continuous top-up operation and sustained high-luminosity performance.

Environment / **34**

Public participation in France and Switzerland in the FCC study

Author: Mattis Kennouche[1]

[1] *CERN*

This presentation offers a feedback on the public participation approaches implemented as part of the feasibility study for the Future Circular Collider (FCC) in France and Switzerland. It will present the tools and methods used on both sides of the border to inform and engage citizens and local stakeholders. The presentation will highlight the differences in institutional and cultural frameworks between the two countries, as well as the broader European context of participation around a large-scale international scientific project. It will also provide the timeline for upcoming citizen participation initiatives and outline their role in contributing to and enriching the FCC studies.

FCC-hh HFM / **35**

HTS magnet R&D for next-generation accelerators at IHEP

Author: Qingjin Xu[None]

To realize the dipole field beyond 15 T at 4.2 K, which is required by the proposed high energy accelerators for the next 20~30 years like SPPC or FCC-hh, High Temperature Superconducting (HTS) technology is the only choice due to its highest critical field over 100 T. IHEP has started the R&D of the HTS coils applied in the high field region with IBS and ReBCO from 2018. Significant progress has been achieved in the last years: IBS short sample cable reached 7 kA at 4.2 K, solenoid coils reached 49 A at 35 T background field, racetrack coils operated properly at 10 T dipole field with a compressive stress over 100 MPa; ReBCO racetrack coils reached 7 T dipole field standalone at 4.2 K in March 2025, and will be tested in a Nb3Sn background magnet in May 2025. This talk will present the latest progress of the HTS technology at IHEP and discuss with worldwide colleagues about the plan for next steps.

FCC accelerator technical design / **36**

A new type of gamma-source

Author: Krzysztof Piotrzkowski[1]

[1] *AGH University (Kraków, PL)*

The combination of high energies, high intensities, and very low emittances of electron and positron beams at the FCC-ee offers an extraordinary possibility of making a unique γ-source. This involves using a novel technique, which in addition allows one to operate such a source concurrently with the nominal e^+e^- collisions.

Using a low-energy ERL beam with short bunches, the proposed facility would produce the polarised gamma beams of very high brilliance and flat energy spectra for photon energies from 0.1 to 500 MeV.

Poster session / **37**

Quasi-Strong-Strong Beam-Beam Simulation with Full Lattice for Bootstrapping Injection into FCC-ee Collider

Authors: Frank Zimmermann[1]; Katsunobu Oide[2]; Takashi Mori[3]

[1] *CERN*

[2] *Universite de Geneve (CH)*

[3] *High Energy Accelerator Research Organization (KEK)*

Because of the strong beam-beam force at the interaction points in FCC-ee, the charge balance of two beams opposing each other is vitally important.
The injection of a high charge beam derives the imbalance of two beams, which causes the instability of the beams.
To avoid this imbalance, the bootstrapping injection has been adopted for the FCC-ee collider.
The conditioning of the bootstrapping injection is being performed as a part of the design study of FCC-ee.
For simulating the top-up injection, the quasi-strong-strong beam-beam calculation is implemented in the full lattice simulation code SAD.
In this report, the current status of the quasi-strong-strong simulation status are presented.

Joint effort PED & accelerators / **38**

Injecting polarized beams

Author: Jorg Wenninger[1]

[1] *CERN*

The FCCee physics program relies on an accurate knowledge of the centre-of-mass energy of the collisions. A key input to the centre-of-mass energy is the accurate measurement of the single beam energy which can be obtained from resonant depolarization of the e+ and e- beams as demonstrated at LEP. Resonant depolarization requires however beams with a minimum of transverse polarization. The FCCee baseline scenario to obtain transversely polarized beams relies on non-colliding low intensity bunches. Those bunches are polarized using powerful wigglers during around two hours before injection of the main beam. This scheme complicates the machine cycle an recovery from beam aborts and has an important impact on machine availability for physics data taking, in particular in the event of frequent beam aborts. An alternative scenario relies on the injection of polarized beams into the collider ring. This option requires a polarized source followed by transport of the polarized beam through the transfer line into the booster and by preservation of the polarization during acceleration in the booster until injection into the collider. This presentation will outline the current status of the FCCee studies concerning injection of polarized beams.

Physics, Experiments and Detectors / **39**

Summary of Silicon detectors from recent BNL workshop on Tracking Detectors

Author: Artur Apresyan[1]

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FCC-ee injector / **40**

Swap-out injection with beam recycling in the booster: design and commissioning at the High Energy Photon Source

Author: Duan,Zhe duanz[None]

The High Energy Photon Source (HEPS) is a fourth-generation synchrotron light source with a beam energy of 6 GeV and a circumference of 1.3km, currently under commissioning near Beijing, China. To achieve an ultra-low emittance of 35pm, the HEPS storage ring employs swap-out injection, significantly reducing the dynamic aperture requirements. However, the implementation of this scheme faces numerous physics and technical challenges. In particular, to meet the demands of time-resolved experiments, the injector need to prepare full-charge bunches of exceeding 15 nC, imposing stringent requirements on beam generation and acceleration.

To address these challenges, the HEPS team proposed a swap-out injection scheme based on high-energy accumulation in the booster ring, innovatively utilizing the booster also as a high-energy accumulation ring for recycling extracted bunches from the storage ring. This approach effectively alleviates technical bottlenecks in generating, capturing, and accelerating high-charge bunches at the low-energy end of the injector.

Since the proposal of this scheme in 2017, the team has spent seven years completing the physics design, development of key hardware components, and joint commissioning. On July 23, 2024, beam commissioning of the HEPS storage ring commenced, achieving first-turn injection within three hours. Through phased commissioning and optimization, the whole injection scheme was successfully demonstrated on January 2, 2025 and used in routine operation since then, supporting the commissioning of the HEPS storage ring, and laying the foundation for realizing the high-charge filling pattern.

This presentation summarizes the design philosophy, technical challenges, and beam commissioning experiences of this novel injection scheme, offering relevant insights for designs of future synchrotron radiation facilities and circular colliders.

Joint effort PED & accelerators / **41**

Update on IR HOM evaluations

Author: Alexander Novokhatski[1]

[1] *SLAC National Accelerator Laboratory*

We present current results of electromagnetic calculations of the interaction of a high-intensity beam field with the metallic walls of the FCC-ee vacuum chamber of the Interaction Region. This interaction creates a thermal load on the beam pipe walls, which leads to the destruction of vacuum conditions and a possible increase in background. We calculated the thermal load for the proposed materials used in the mechanical design and analyzed how coating the beam tube with other materials can reduce the thermal load or improve vacuum conditions. We performed calculations using FCC-ee beam parameters for different energies Z, WW, H(ZH) and ttbar.

Poster session / **42**

The model of composite dark matter at FCC

Author: Hiroaki Wada[1]

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The FCC holds a great opportunity for the discovery of dark matter. By achieving energy scales and collision frequencies surpassing the LHC, the FCC is expected to open new avenues for exploring

candidate dark matter particles. The composite dark matter models are possible candidates for dark matter in the FCC. We focus our research on the composite dark matter models based on QCD-like theories. This model is interesting for exploring new physics beyond the Standard Model. Now, we study the possibility of detecting the composite dark matter at the FCC.

FCC-hh accelerator / 43

Cryogenic baseline and advancements on the 4.5 K option for FCC-hh using Nb3Sn magnets

Authors: Patricia Tavares Coutinho Borges De Sousa[1]; Ximo Gallud Cidoncha[1]

Co-authors: Anita Petrovic ; Benjamin Bradu [1]; Dimitri Delikaris [1]; Laurent Delprat [1]; Rob Van Weelderen

[1] *CERN*

In the framework of the Future Circular Collider (FCC) study at CERN, a conceptual design of a cooling scheme for Nb_3Sn-based accelerator magnets operating at 4.5 K is proposed for the FCC-hh configuration. This alternative, at a higher operating temperature than the baseline at 1.9 K using Helium II, is driven by the efforts towards a more energetically sustainable machine, while ensuring compatibility with the tunnel structure envisaged for the FCC-ee configuration, and providing a technically viable solution for the required superconducting magnets.

The study is carried out for the latest configuration of the FCC-hh machine (F14 scenario), considering Nb_3Sn superconducting magnets with an operational magnetic field of 14 T, for a centre-of-mass energy of 84 TeV with a magnetic filling scheme of 83%. The updated heat loads are presented, and the system parameters, along with longitudinal and expected radial temperature gradients in the magnet structure, are evaluated. The move from 1.9 K, operation making extensive use of Helium II, towards 4.5 K using single-phase helium significantly reduces the overall cryogenic power consumption by at least 30%, and the machine's helium inventory by 50% with respect to the baseline scenario at 1.9 K. Other advantages, such as a simplification of the cold mass structure and the relaxation of access exclusion zones due do the more manageable helium content in case of release are analyzed and compiled. The challenges associated with this cryogenic cooling scheme, which has so far not been implemented in such a large-scale accelerator, are addressed.

FCC-ee accelerator / 44

Overview on collective effects for the main rings

Author: Mauro Migliorati[1]

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The FCC-ee low-energy machine, operating at 45.6 GeV, is the most affected by the collective effects because of the lowest beam energy combined with the highest beam current, the lowest emittances and the longest damping times. The design of this machine is still in progress, and the coupling impedance budget is continuously evolving in parallel with the updates of the vacuum chamber components. Correspondingly, the collective effects and instability thresholds need constant revision. In this contribution, several scenarios related to the single-beam impedance-induced collective effects are presented together with an analysis of the interplay between different tools used to mitigate possible instabilities.

FCC accelerator technical design / 45

Recent advances and future plans for the HNFS project

Author: Mirko Siano[1]

Co-authors: Andriy Nosych [2]; Bruno Paroli [1]; Daniele Butti ; Eduardo Solano [3]; Georges Trad [4]; Laura Torino ; Marco Potenza [1]; Stefano Mazzoni [4]; Thibaut Lefevre [4]; Ubaldo Iriso Ariz

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[4] *CERN*

In this contribution we report on recent advancements of the HNFS project for the transverse beam diagnostics of FCC-ee. The project aims at developing novel nanostructured targets to monitor the full 2D beam profile with the Heterodyne Speckle technique. We will present preliminary numerical and experimental results concerning the target design, prototyping and testing, as well as the current status of a dedicated speckle beamline at the ALBA Synchrotron Light Source. We will conlcude by outlining the plan for future R&D activities.

FCC accelerator technical design / **46**

Synchrotron radiation management and pressure profiles

Author: Marton Ady[1]

[1] *CERN*

In the current FCC-ee design, the synchrotron radiation (SR) power in the collider ring reaches 100MW for all operation modes. This magnitude presents thermal, mechanical, vacuum and beam lifetime issues that need to be carefully predicted and managed.

Using the ray-tracing codes MolFlow and SynRad, an estimation of the the pressure profiles, static and dynamic, is presented for the booster ring. In addition, a representative period of the collider ring's optics and vacuum chamber are modeled to trace the generated SR, and the optimal placement of copper absorbers is presented that allows to stay below safe thermal limits.

Superconducting Radio Frequency / **47**

SRF material R&D for FCCee: high-Q niobium and high-delta ceramic

Author: Akira Miyazaki[1]

[1] *Université Paris-Saclay (FR)*

The goal of FCCee, high energy and luminosity collisions, imposes technical challenges to the SRF cryomodules. To cope with high current e+/e- beams with relatively high accelerating gradients, one needs to achieve an extremely high-quality factor in accelerating mode while efficiently damping other modes. The former can be achieved by niobium cavities with dedicated heat treatment and the latter can be achieved by employing special ceramic materials. In this presentation, we show the progress of studies on cavities and ceramics for FCCee and emphasize strong technical synergy with a local project PERLE at IJCLab.

Environment / **48**

Environmental Initial State Analyses Report

Author: Patrycja Laidouni[1]

[1] *CERN*

To establish a baseline of environmental conditions for surface sites, comprehensive initial state analyses have been conducted since 2022. These studies are essential for subsequent environmental impact assessments and support the eco-design approach of the Future Circular Collider.
The analyses encompass environmental topics laid out in the regulatory frameworks of France and Switzerland.
The report incorporates the legal bases followed throughout the studies, including a project description accessible to laypersons, evaluations of alternatives and variants, the organizational context, a description of the methodologies used, environmental conditions, and the likely development of the environment without the project.
The results were compiled in a detailed, multimedia report integrating text, images, audio recordings, videos, and interactive maps.
This presentation will outline the methodology used for the analyses, address challenges encountered during the process, present key findings, and provide an outlook for future work should the study advance to the preparatory project phase and authorization processes in the two host states.

FCC-ee injector / **49**

Overview of the booster status

Author: Antoine Chance[1]

[1] *CEA Irfu*

During this presentation, we will give an overview of the main features of the FCC-ee booster This presentation will also resume the main changes in the parameter tables, optics, tuning, and booster operation.

FCC-ee accelerator / **50**

Correction and tuning strategies for FCC-ee

Authors: Jacqueline Keintzel[1]; Rogelio Tomas Garcia[1]

[1] *CERN*

The Future electron-positron Circular Collider, FCC-ee, is a proposed next collider aiming, to provide unprecedented luminosities at beam energies ranging from 45.6 up to 182.5 GeV. One of the major challenges is delivering the ambitious design performance in the presence of realistic misalignment and field errors. A commissioning strategy has been developed including dedicated optics designs, efficient beam-based alignment and optics corrections based on refined optics measurements. First specifications on main magnets, corrector circuits, and instrumentation have also been investigated. A summary of all these aspects is presented here.

Superconducting Radio Frequency / 51

Semi-dry Cooling R&D of Superconducting Radiofrequency Cavities at CERN

Author: Torsten Koettig[1]

Co-authors: Alan Saillet [1]; Guillaume Jonathan Rosaz [1]; Marco Garlasche [1]; Maria Chioteli [1]; Pierre Maurin [1]; Vittorio Parma [1]

[1] *CERN*

Novel cooling schemes for SRF cavities are under study in the Cryolab at CERN aiming to improve cooling performance of the cavities in terms of heat transfer, lowering cooling source influences and improve cooldown behavior esp. at the transition temperature of the superconducting material. The studied options of integrated channel cooling are currently applied to 1.3 GHz coated copper cavities. Especially Nb3Sn coatings enable cooling temperatures of up to 6 K, which allows the use supercritical helium flow in the cooling channels. An experimental test station has validated the cryogenic concept with cooling capillaries on a copper cavity or a mock-up copper plate with integrated grooves. The results of the cryogenic performance tests will be presented and conclusions for further testing be drawn.

FCC-hh HFM / 52

Status of HFM development at PSI

Authors: Douglas Martins Araujo[None]; Bernhard Auchmann[1]; André Brem[None]; Christian Lindner[None]; Thomas Uli Michlmayr[2]; Colin Mueller[3]; Dmitry Sotnikov[None]; Anna Stampfli[None]

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In this contribution we present recent results from high-field magnet development for FCC-hh at PSI in the context of the CHART program. R&D activities at PSI include both, LTS (Nb3Sn) and HTS (REBCO) technologies. For LTS, we show test results of two subscale assemblies of stress-managed common-coil magnets, as well as the technical design of a full-scale stress-managed asymmetric common coil magnet SMACC1, to be tested in 2026. For HTS, we present numerical studies, cable-sample test results, as well as our progress towards a subscale stress-managed common coil with REBCO tape-stack cable, to be tested later this year. We also briefly mention synergetic activities, enabled by the investment in HEP R&D at PSI, which demonstrate the immediate societal impact of HFM R&D for FCC-hh.

FCC-ee accelerator / 53

Integrated simulations for calculation of tolerances

Author: Kyriacos Skoufaris[1]

Co-authors: Abid Hussain [2]; Cristobal Garcia [3]; Peter Kicsiny [1]; Rogelio Tomas Garcia [1]

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This presentation provides a concise overview of recent integrated simulation studies conducted for the FCC-ee accelerator. It covers key performance aspects, including the impact of varying sextupole strengths during commissioning on particle dynamics, degradation effects due to imperfections in the -I transform, and sensitivity to different ground motion scenarios. Additional topics include injection efficiency and the evolution of injected emittance, field error tolerances at both injection and collision stages, and the cumulative performance degradation resulting from the interplay of these effects.

Superconducting Radio Frequency / **54**

Electropolishing of large copper substrates for FCC_ee SRF cavities

Author: Leonel Marques Antunes Ferreira[1]

[1] *CERN*

CERN now possesses both the tools and expertise required to electropolish 400 MHz copper elliptical cavities. This contribution provides a brief overview of the electropolishing setup, the associated interfaces, and the simulation efforts undertaken to design the system and optimize the process. A comparison between simulation data and results from actual processing will be presented and explained. The achievements to date, along with the measures implemented to improve surface stability, will be highlighted. Furthermore, in preparation for processing the 2-cells 400 MHz FCC-ee cavities, the main anticipated challenges will be outlined, along with the proposed strategies to address them.

FCC accelerator technical design / **55**

Beam loss monitoring system for FCCee

Author: Belen Maria Salvachua Ferrando[1]

[1] *CERN*

Stored energies in the FCC-ee colliding ring are expected to be just below 20 MJ for the Z-pole configuration - still one order of magnitude below that of the LHC. However, due to the extremely small vertical beam size, the beam energy density remains high enough to pose a risk of damaging the accelerator. A beam loss system must therefore be capable of detecting losses quickly enough to protect the accelerator components by triggering a beam extraction before any damage occurs.
In addition, the system must provide continuous measurements of the magnitude and location of beam losses throughout the accelerator to optimize the machine operation. While final specifications for the minimum and maximum detectable beam losses are still under study, the proposed beam loss system for the FCC-ee will cover monitoring in both the arcs and at the collimators.
For the arc, the required granularity of the system is being discussed. For the collimators, a fast read-out beam loss monitor is proposed downstream each unit. R&D is necessary to determine the final technology to be used for both the arc and the collimation systems. However, based on the current information, the required infrastructure and number of devices can already be estimated.

Joint effort PED & accelerators / **56**

Development of Spin Tracking in XSuite

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[3] *BNL*

The Future Circular Collider of electrons and positrons (FCC-ee) requires high precision measurements of beam energy. This is foreseen to be facilitated by measuring the depolarization of non-colliding electron bunches. Spin tracking is being developed for the XSuite accelerator code package for polarization studies in the FCC-ee. Installation in XSuite will make spin tracking more accessible to the accelerator community. An overview of the spin tracking algorithm, benchmarking progress, and implementation into XSuite are given.

Joint effort PED & accelerators / **57**

Polarization status at the Electron Ion Collider

Authors: Eiad Hamwi[1]; Erdong Wang[2]; Georg Hoffstaetter[None]; Haixin Huang[3]; Kiel Hock[None]; Matthew Signorelli[1]; Sergei Nagaitsev[3]; Vadim Ptitsyn[None]; Vahid Ranjbar[None]; Vincent Schoefer[4]

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The Electron-Ion Collider (EIC) is a future facility to be constructed at Brookhaven National Laboratory. This collider will probe the spin structure of nuclei, and the quarks and gluons they contain. This will be facilitated by collisions of polarized electrons on polarized protons and other polarized light ions. For electron and hadron beams, the required polarization is 70%. An overview of polarization loss mechanisms and their mitigation in the electron injectors, the Electron Storage Ring, the hadron injectors, and the Hadron Storage Ring is given.

FCC-hh accelerator / **58**

Feasibility Study Baseline Layout and Prospects for FCC-hh

Author: Gustavo Perez Segurana[1]

[1] *University of Malta (MT)*

Following the completion of the FCC feasibility study, we present the baseline design of the FCC-hh collider as established in the final report. Key developments include updated arc cell configurations with reviewed corrector systems, increased dipole filling factor, and revised layouts for technical and experimental insertions within the shared tunnel infrastructure. We also highlight additional exploratory studies in the FCC-hh design, aiming to guide future development efforts.

Joint effort PED & accelerators / **59**

Status report on the MDI alignment monitoring study

Author: Leonard Watrelot[None]

The FCC-ee Machine Detector Interface (MDI) represents a uniquely challenging and compact region, integrating state-of-the-art final focusing technology as close as possible to the interaction point (IP) within the detector. Within this highly constrained environment, a dedicated alignment monitoring system has been developed to track the position of the final focusing quadrupoles and other critical components. The proposed solution combines a deformation monitoring sensor based on in-fiber frequency scanning interferometry (FSI) with conventional in-air metrology. To enhance system coverage, an additional subsystem has been implemented to monitor alignment across the full MDI, linking the final focusing quadrupoles on either side of the detector. This contribution will present the latest developments of the measurement system, including prototype implementations, simulation results, preliminary measurements, and future integration plans. Initial studies on the feasibility of monitoring the vertex detector geometry using this approach will also be discussed.

FCC-hh HFM / 60

Status of HFM development at INFN

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To explore physics beyond the capabilities of the LHC and its High-Luminosity Upgrade (HL-LHC), particle physicists are aiming for higher-performance accelerators that allow more precise measurements or operate at higher energies and intensities. The last update of the European Strategy for Particle Physics highlighted the urgent need for enhanced research and development on advanced accelerator technologies, particularly high-field superconducting magnets, including High Temperature Superconductors (HTS). In response, CERN launched the High Field Magnets (HFM) R&D Programme in collaboration with national laboratories. The programme aims to explore the performance limits of Low Temperature Superconductor (LTS) accelerator magnets, investigate the new HTS magnet technologies beyond the capabilities of Nb3Sn, and develop the next generation of accelerator magnets for future colliders. This presentation will be focused on the progress of the FalconD project, developed by INFN in collaboration with CERN (12 T cos-theta single aperture dipole magnet). Following this work, a new agreement is in process of being signed between CERN and INFN to carry on the activities, in particular we will be engaged in the design, manufacture, and cold tests of a single aperture, 4-layer short model magnet (less than 2 meters), featuring a cos-theta configuration and generating a bore field of 14 T. Within the HFM program, different configurations of HTS dipole magnets designed for accelerator applications will be studied and assessed as well. HTS technology is making significant progress, with reductions in conductor cost, improved quality, and better availability. However, it remains uncertain if HTS can be developed into conductors suitable for accelerator-quality magnets. The focus of the collaboration agreement between CERN and INFN is also to explore a range of HTS dipole designs, assessing their potential to become high-quality accelerator magnets. Among the various designs, the most promising one will be selected for engineering, manufacturing, and testing at various temperatures to thoroughly assess their suitability as candidates for accelerator magnets. The main characteristics of this dipole subscale model will be determined by the collaboration parties, with the broad goal of achieving 10 T at 20 K and a coil aperture of approximately 50 mm.

Joint effort PED & accelerators / 61

Integration of vertex detector services and cooling

Authors: Andrea Ciarma[1]; Andrea Moggi[2]; Daniele Benvenuti[2]; Fabrizio Palla[2]; Filippo Bosi[2]; Francesco Fransesini[1]; Gherardo Ammirabile[2]; Manuela Boscolo[1]; Maurizio Massa[2]; Stefano Lauciani[1]

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The FCC-ee IR general layout has a compact architecture, designed to respect multiple constraints given by the physics and mechanics of the experiment. To do this, a specific integration study of the vertex detector and central beam pipe services has been launched: it involves 3D printed support with internal air channels and others lightweight structures used both to support the inner vertex detector staves and to allow the routing of the cables and their integration with the ducts of the liquid paraffin for the cooling of the central beam pipe. In addition, to achieve adequate air cooling of the three internal layers, the inlet and outlet ducts have been specifically designed and directly integrated into the supports of the staves, always with the aim of respecting the constraint of low mass material budget and the need to take out the connection buses of the silicon detectors from the inner part.
The presentation will show the layout of the interaction region with a focus on the structure design and problems still being studied in the integration of the various systems.

Superconducting Radio Frequency / 62

FCC RF power sources and powering schemes

Author: Igor Syratchev[1]

[1] *CERN*

The recent evolution of the FCC operational regime towards Reverse Phase Operation (RPO) for Z-pole has reduced by factor 2 RF power level required to feed individual cavities and put stringent requirements on the temporal RF power modulation of the two sets of accelerating SRF cavities in the collider. In this new environment, High Efficiency TS MBK Klystron, developed for FCC in the past few years, could not provide efficient operation anymore, as it loose almost 20% in efficiency due to operation, on average, well below the saturated RF power level. The new gridded tube approach called Triston (hybrid of triode and klystron) was suggested to replace MB TS klystrons. Tristron was studied and optimized at CERN as a candidate for FCC RF power source. The final multi-beam (10 beams) Tristron design at 400MHz showed an excellent performance in RF power range from 300kW to 600kW with efficiency exceeding 90%. MB Tristron also supports RPO regime preserving operational RF efficiency at 90% level, thanks to the inherent properties of the electrons bunching mechanism in the gridded tubes. The FCC MB Tristron design and performance will be presented together with the corresponding RF powering schemes of the booster and collider.

FCC-ee injector / 63

FCC-ee injector linacs: the design and the RF frequency choices for the TDR

Author: Alexej Grudiev[1]

[1] *CERN*

The design of the FCC-ee injector linacs for the FCC feasibility study will be briefly summarized including electron and HE-linacs at 2.8 GHz and positron linac at 2 GHz. Then possible design choices and the RF frequency choices in the linacs for the TDR phase will be discussed towards using the standard European S-band RF frequency of 3 GHz.

FCC accelerator technical design / **64**

Alignment system based on a Structured Laser Beam

Author: Witold Grzegorz Niewiem[None]

Co-author: Dirk Mergelkuhl [1]

[1] *CERN*

Structured Laser Beams (SLBs) are pseudo-non-diffractive optical beams characterized by a low-divergence Inner Core (IC), down to 10 μrad. The dimensions of the IC vary depending on the SLB generator setup. Due to their small IC diameter and theoretically infinite propagation distance, experimentally confirmed over 900 m, SLBs offer strong potential as reference lines in long-distance alignment systems. However, beam straightness can be compromised by atmospheric refraction. To counter this, high-precision alignment systems often use vacuum enclosures, which eliminate refraction but introduce constraints on space, access, and system operation. When propagating through a vacuum pipe, SLBs may experience alterations in intensity distribution and apparent IC displacement, disrupting the reference line. These alterations include changes in the IC shape due to the symmetry breaking of an SLB. Furthermore, reflections from the pipe walls generate stray light, introducing noise that complicates accurate IC position detection. This presentation outlines the development of an SLB-based measurement system prototype and presents a comparative performance assessment against other methods within a 140 m experimental setup.

FCC-hh HFM / **65**

Overview of LTS HFM magnet and conductor activities

Author: Ezio Todesco[1]

[1] *CERN*

After recalling the updated baseline for LTS option in FCC-hh, with 14 T dipole field and 85 TeV c.o.m. energy, we will outline the main alternative options that are being considered, namely (i) operation at 4.5 K, (ii) hybrid Nb-Ti Nb3Sn magnets, (iii) 20 m long dipoles and (iv) reduced field in the 12 T to 14 T range. We will then outline the advancement in Nb3Sn conductor, magnets designs, demonstrator tests, protection schemes and cooling studies.

FCC-ee injector / **66**

FCC-ee injector: linacs design for single- and multi-bunch effects

Author: Simona Bettoni[1]

Co-authors: Adnan Kurtulus ; Alexej Grudiev [2]; Andrea Latina [2]; Jean-Yves Raguin ; Paolo Craievich ; Riccardo Zennaro ; Steffen Doebert [2]

[1] *Paul Scherrer Institut*

[2] *CERN*

The FCC-ee injector complex aims to deliver tunable, high-charge electrons and positron bunches for injection into the booster ring first and the final collider ring. The injector complex includes multiple linacs that sequentially boost the energy of the bunches to the booster injection energy of 20 GeV. This work addresses the significant challenges posed by the required beam parameters. We investigated the transverse and longitudinal dynamics considering static and dynamics effects as well for single- and multi-bunch. The design underwent several iterations in the past 3 years. This paper summarizes the design and optimization studies which brought to the present layout, which meets all current requirements for efficient injection into the booster ring, paving the way for the ambitious operational goals of the FCC-ee accelerator complex.

Technical Infrastructure / **67**

Geodesy update

Author: Benjamin Weyer[1]

[1] *CERN*

Constructing the FCC tunnel, installing and aligning each component of the machine and the experiments at the designed location will be a challenging task relying notably on the accuracy and reliability of the geodetic infrastructure.

Over the past year, in collaboration with ETHZ, HEIG-VD, IGN and Swisstopo, progress has been made developing the new geodetic infrastructure for the FCC. Efforts were centred on the validation of the local geoid model and investigations on potential future improvement. In this context, the development of a gravity field close loop simulator has been initiated.

In the meantime, the construction of the primary surface geodetic network has been continued and geo-monitoring studies are underway to evaluate the long-term stability of the FCC area.

The presentation reviews the achievements of the past year and outlines the remaining challenges to be addressed during the Pre-TDR phase.

Poster session / **68**

Environmentally friendly detector refrigeration solutions for the FCC, inspired by ongoing LHC detector refrigeration research

Authors: Amandla Power Mvimbi[1]; Bart Verlaat[2]; Camila Rocio Pedano Medina[3]; Daniella Ida Teixeira[2]; Derek Jan Langedijk[None]; Jerome Daguin[2]; Krzysztof Sliwa[2]; Loic Davoine[2]; Luca Contiero[4]; Lukasz Zwalinski[2]; Michal Zbigniew Zimny[2]; Paolo Petagna[2]; Szymon Jan Galuszka[5]; Viren Bhanot[2]; Yann Herpin[2]; Youri Penders[None]

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Environmentally friendly detector refrigeration solutions for the FCC, inspired by ongoing LHC detector refrigeration research

In order to guarantee the foreseen lifetime operation of the FCC and its related experiments, environmental impact and machine performance are key elements to be considered, at a technical efficiency level as well as a global political level. New governmental regulations, increased energy costs, and environmental concerns are factors that have driven CERN to innovate in this field for decades, and it is inevitable that the same strategy will be necessary during the design and construction of the FCC.

Particularly, accelerator and detector refrigeration are renowned for their impact on both machine performance and environment. For this reason, new solutions have been proposed, developed and successfully implemented by CERN's engineers and technical staff. Good examples are the LHCb, CMS and ATLAS experiments, where since 2008, two-phase Carbon Dioxide (CO2) cooling systems have been implemented as a high-performance alternative with a low environmental footprint. Solutions like these are going to be essential for the approval, acceptance and perceived success of the FCC on a global scale.

Additionally, the EP-DT-FS section has initiated research into the use of both supercritical CO2 for applications at warmer temperatures, which could prove beneficial for detector during the e+e- phase, and Krypton as a working fluid, potentially useful for detector cooling at ultra-low temperatures below -80℃ during the pp phase. These efforts may prove valuable for emerging detector designs and future detector performance requirements.

Furthermore, this introduction of natural refrigerants in detector cooling, such as the use of CO2 refrigeration, has been a game changer in the battle against greenhouse gases (GHG's), such as fluorocarbons (FC's) and hydrofluorocarbons (HFC's), while still maintaining strong and reliable cooling performance and efficiency at CERN.

This poster will display the efforts for implementation of current natural fluids made by the EP-DT-FS section as well as a highlight of the efforts made in new solutions for detector refrigeration, such as Krypton and (supercritical) CO2 cooling. Showing its potential for the FCC and related experiments.

Key words:
Refrigeration, Carbon Dioxide, Krypton, CMS, ATLAS, LHCb, 2PACL, GWP, GHG, Environment, CERN

FCC-ee accelerator / 69

Impact of Collimators' Geometric Impedance on Beam Stability in the FCC-ee: Analysis and Optimization Techniques

Author: Dora Gibellieri[1]

Co-authors: Adnan Ghribi ; Carlo Zannini [1]; Mauro Migliorati ; Mikhail Zobov

[1] *CERN*

Beam stability in the FCC-ee collider is critically influenced by both transverse and longitudinal beam coupling impedance. The development of a flexible and comprehensive impedance model is essential for accurately evaluating and mitigating instabilities as machine parameters evolve.
The collimation system has been identified as a dominant contributor to the total machine impedance. This study provides a detailed investigation into its impact on the overall impedance budget of the FCC-ee and explores potential optimization strategies to mitigate its effects and improve beam stability.
Both resistive and geometric impedance contributions are systematically analyzed, with geometric effects found to play a particularly significant role in shaping the overall impedance landscape. A simplified model was used to isolate geometric and resistive wall dependencies. Despite its simplicity, this model accurately represents the actual jaw lengths and apertures and effectively highlights critical parameters that can be optimized to reduce impedance.
Continued improvements in the modelling of collimators'geometric impedance are fundamental for

assessing beam stability. Having a flexible and accurate model enables global impedance considerations, supports and easily incorporates further optimization solutions, and informs critical design decisions by accounting for interactions among various accelerator components.

Superconducting Radio Frequency / 70

SRF 400 & 800 MHz cryomodules: design evolution and future work

Author: Karin Canderan[1]

[1] *CERN*

The technical specifications for the cryomodules have been evolving following the SRF requirements and the approval of the Reverse Phase Operation (RPO) scheme. The conceptual design for the 400MHz and 800MHz cryomodules, as described in the FCC Feasibility Study Report, have been completed accounting for the SRF needs but also for the integration of the equipment and dedicated services in the FCCee machine tunnel. This presentation describes the recent updates in the cryomodules technical specifications, heat load budgets and the design challenges linked to the latest SRF requirements. The current engineering design activities will be illustrated together with the planned work from conceptual to detailed design of the cryomodules and its internal components (helium tank, tuner, FPC, HOM, etc.) for the construction of demonstrator prototypes.

FCC-ee accelerator / 71

Beam-Beam and Wakefield-Induced Collective Instabilities and Mitigation Strategies in the FCC-ee at Z Energy

Author: Roxana Soos[1]

Co-authors: Angeles Faus-Golfe [2]; Xavier Buffat [3]

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[3] *CERN*

This presentation discusses the various collective instabilities that arise in the FCC-ee at Z energy. Intensity limitations in both the vertical and horizontal planes are influenced by the combined effects of beam-beam interactions and impedance. In the vertical plane, the transverse mode repulsion instability, driven by impedance, is a limiting factor, while in the horizontal plane, the coherent <x-z> instability, driven by beam-beam interactions, is the more significant. We will discuss the relevant parameters, optimisation strategies, and mitigation techniques, such as chromaticity and transverse feedback, for both cases. Our results suggest that the mitigation approaches differ between the two planes.

FCC accelerator technical design / 73

Preliminary technical design for the FCC-ee dipole shielding

Author: Alvaro Romero Francia[1]

Co-authors: Anton Lechner [1]; Antonio Perillo Marcone [1]; Barbara Humann [1]; Marco Calviani [1]; Marlini Simoes [1]; Regis Seidenbinder [1]; Stefano Sgobba [1]

[1] *CERN*

Managing radiation from primary synchrotron photons is a major design challenge for the FCC-ee, as prolonged exposure can degrade tunnel infrastructure and critical machine components. Effective shielding is therefore essential, not only to protect equipment and maintain operational reliability, but also to minimize the need for costly radiation-hardened materials.

The current shielding approach under consideration involves enclosing photon stoppers with inserts and plates. With 2840 dipoles, each housing 10 photon stoppers, the FCC-ee requires shielding for a total of 28400 units. Preliminary simulations using lead-antimony alloys have shown encouraging dose reduction performance. The initial concept estimates around 400 kg of shielding per photon stopper, leading to a total mass exceeding 11000 tons. Ongoing R&D is focused on optimizing the geometry, in view of simplifying manufacturing and assembly processes to support large-scale production. These efforts also involve detailed cost evaluations, assessments of mechanical stresses, thermal behaviour, and integration constraints in and around the dipoles . Advancing this work is essential to confirm the FCCee's overall feasibility.

FCC accelerator technical design / 74

Status of the Beamstrahlung Dump Design

Author: Silvio Candido[1]

[1] *CERN*

At the FCC-ee, Beamstrahlung radiation generated at the interaction points produces intense photon beams, with power reaching up to 370 kW per interaction point at Z-pole operation. To absorb this energy, a dedicated beam dump based on liquid lead (Pb) is under development. Liquid lead is selected due to its high density, high atomic number, and favorable thermal properties, making it a suitable material for high-power photon absorption.
Due to space constrains for the hydraulic system of liquid lead, the design is constrained by a maximum mass flow rate of 300 kg/s. This poses a challenge in reaching an effective interaction thickness between 10 and 20 cm for a transverse size of 70cm x 70cm, required to fully absorb the beam at 500m from the interaction point.
This presentation outlines the conceptual and numerical optimization of a free-surface flow of liquid lead over a sloped wall within an argon-filled vessel. A range of geometries are investigated to enhance energy absorption and thermal performance. FLUKA Monte Carlo simulations are employed to model the photon energy deposition, while multiphase CFD simulations in ANSYS Fluent are used to analyse free-surface flow dynamics and heat transfer.

FCC accelerator technical design / 75

Magnet's circuits and system optimisation update

Author: Byamba Wicki[1]

Co-authors: Davide Aguglia [1]; Manuel Colmenero Moratalla [1]; Serge Pittet [1]

[1] *CERN*

This talk presents updated results on optimal powering solutions for the FCC-ee, based on the latest data from the Feasibility Study.
It includes new magnet parameters, CO2-equivalent material mass estimation for environmental assessment and updated power losses with the top-up scheme of the booster.

A global optimisation tool, developed in collaboration with CERN expert groups, is employed to evaluate CAPEX and OPEX trade-offs across beam optics, power converters, cabling, magnets, and infrastructure. With the aim of minimising the global total expenditure.

The study illustrates how system-level choices, influence overall expenditure and performance.

Superconducting Radio Frequency / **76**

Roadmap for a 400 MHz cryomodule demonstrator (400 MHz DEMO) at CERN

Author: Vittorio Parma[1]

[1] *CERN*

As part of a recently approved Accelerator R&D programme at CERN, we aim at building a new cryomodule demonstrator at 400 MHz: DEMO.
DEMO will be a full scale FCCee cryomodule housing four two-cell cavities of a novel design and operating at the RF parameters for the Reverse Phase Operation (RPO), the new RF baseline for FCCee to accelerate ee- beams at currents and energies spanning from the Z point to the ttbar. In this presentation we illustrate the roadmap of this new project, covering organizational aspects and highlighting technical challenges and learning objectives.

Monday plenaries / **77**

Welcome Remarks

Authors: Jens Schneider[1]; Jochen Schieck[2]

[1] *Technische Universität Wien*

[2] *Austrian Academy of Sciences (AT)*

Monday plenaries / **78**

Welcome and Introduction

Author: Fabiola Gianotti[1]

[1] *CERN*

Monday plenaries / **79**

The Future Circular Collider - A View from CERN Council

Author: Costas Fountas[1]

[1] *University of Ioannina (GR)*

Monday plenaries / **80**

Opening Remarks and Perspectives from the Austrian Academy of Sciences

Author: Heinz Faßmann[1]

[1] *Austrian Academy of Sciences*

Monday plenaries / **81**

Practical Information About the Conference

Author: Christoph Schwanda[1]

[1] *Austrian Academy of Sciences (AT)*

FCC-ee accelerator / **82**

Update on the GHC optics

Author: Katsunobu Oide[1]

[1] *Universite de Geneve (CH)*

The collider beam optics (GHC) has been updated since FCC Week 2024 including several changes: longer L^*, smaller β_x^* (Z), higher horizontal chromaticity (Z), longer space for the RF (Zh/$t\bar{t}$), wider beam separation in the technical straight, installation of vertical depolarization bump (Z/W), etc. The resulting luminosity and beam lifetime basically kept unchanged.

FCC-ee injector / **83**

Approach for low impedance design of the FCC DR vacuum chamber

Author: Shalva Bilanishvili[None]

Co-author: Mikhail Zobov

The beam dynamics in the FCC-ee Damping ring can be affected by the vacuum chamber wakefields (impedances) resulting in potentially harmful effects and beam instabilities. In order to diminish their impact, measures for the impedance reduction should be considered already at the design stage. In this talk we discuss possible design solutions of the key vacuum chamber components and hardware aimed at the impedance minimization, both broad-band and narrow band.

Physics, Experiments and Detectors / **84**

How large can the light Yukawa couplings be?

Authors: Barbara Anna Erdelyi[1]; Nudžeim Selimović[2]; Ramona Groeber[3]

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So far, measurements of the Higgs boson's coupling to the electroweak gauge bosons, the third-generation massive fermions and the muon have confirmed the predictions of the Standard Model. However, the Yukawa couplings of the electron and the first and second generation quarks remain experimentally elusive due to their smallness and, in the case of the quark couplings, the difficulty of tagging the particles in detectors.
We identify and study simplified UV models with the ability to enhance the Yukawa couplings of the light quarks and the electron. Adopting the Standard Model Effective Field Theory framework, we consider the effective operators generated by the UV models and constrain them via flavour physics, direct searches, electroweak precision observables and Higgs Physics data. In the case of the light quarks, considering both current experimental results and projections for the FCC-ee, we show that the latter have the potential to significantly improve our ability to constrain possible enhancements of the light fermion Yukawa couplings. For the electron Yukawa coupling, we show how constraints from a dedicated FCC-ee run at the Higgs pole mass can compete with those from the electron anomalous moment.

Poster session / **85**

New Physics contamination in precision luminosity measurements at FCC-ee

Authors: Clara Lavinia Del Pio[1]; Francesco Pio Ucci[2]; Fulvio Piccinini[3]; Guido Montagna[4]; Mauro Chiesa[None]; Oreste Nicrosini[5]

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[3] *Pavia University and INFN (IT)*

[4] *University of Pavia e INFN, Pavia (IT)*

[5] *Dipartimento di Fisica Nucleare e Teorica*

Several key observables of the high-precision physics program at FCC-ee will critically depend on the knowledge of the absolute machine luminosity. The determination of the luminosity relies on the precise knowledge of some reference process, which is in principle not affected by unknown physics, so that its cross section can be computed within a well-established theory, like the Standard Model. Quantifying the uncertainties induced by possible New Physics effects on such processes is therefore crucial. We present an exploratory investigation of light and heavy New Physics contributions to the small-angle Bhabha process at FCC-ee and we discuss possible strategies to remove potential uncertainties originating from such contaminations by relying on observables that are independent of the absolute luminosity.

FCC-ee injector / **86**

FCC-ee Injector overview and outlook

Author: Paolo Craievich[None]

The FCC-ee project aims to achieve unprecedented luminosities over a broad energy range, requiring a highly efficient and robust injector complex. This talk will provide an overview of the FCC-ee

injector system, highlighting recent updates from the newly published Feasibility Study Report and key challenges in delivering high-charge, high-quality electron and positron beams. I will summarize the main components under development —including the electron source, positron production system, linacs, damping ring, high-energy linac, and transfer lines —as well as ongoing efforts to enhance performance, reliability, and cost-effectiveness. The presentation will conclude with an outlook on the next steps and R&D priorities toward the technical design.

FCC accelerator technical design / **87**

R&D on longitudinal diagnostic for FCC main ring and booster

Author: Kacper Lasocha[1]

[1] *CERN*

Longitudinal profile monitoring is crucial for assessing beamstrahlung effects in the FCC-ee, as well as for energy calibration—both fundamental from the physics point of view. From an operational perspective, bunch-by-bunch longitudinal profiles will be needed during machine commissioning and to assess the quality of bunches freshly injected from the booster. To overcome the limitations associated with the synchrotron light extraction, new techniques of longitudinal beam monitoring are being investigated, including electro-optical spectral decoding (EOSD) and the measurement of Cherenkov diffraction radiation (ChDR). This presentation will discuss the principles of these techniques and describe ongoing studies on their applicability to FCC-ee diagnostics.

Joint effort PED & accelerators / **88**

MDI efforts at Magnet Division, BNL: Corrector Magnets and Screening Solenoid design for Interaction region of FCC-ee

Author: Vikas Teotia[1]

Co-authors: Andrew Marone, [1]; Brett Parker [2]; John Theodore Seeman [3]; Michael Anerella, [1]

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[2] *Brookhaven National Laboratory (US)*

[3] *SLAC National Accelerator Laboratory*

The Interaction Regions (IR) for the FCC-ee collider as envisioned by the CERN FCC Feasibility Study requires a variety of superconducting correction coils that must be integrated with the main IR focusing quadrupoles. The design of corrector magnets takes advantage of BNL's Direct Wind coil technology to essentially print multiple nested corrector layers, with small diameter superconductor wire, on a common support tube. As with the main quadrupole coils, because there is no magnetic yoke material between the side-by-side coils, these corrector coils must include a deliberate, longitudinally varying, admixture of field harmonics to self-consistently compensate for field crosstalk between neighboring coils. This talk will cover the design of correctors for FCC-ee IR using multi-functional canted cosine theta direct wind magnets with longitudinal varying harmonics. Electromagnetic design for corrector assembly for final focusing quadrupoles will be discussed. BNL is working on developing a demonstrator multi-functional canted cosine theta direct wind magnet with longitudinal varying harmonics for annulling cross talk in vicinity of an existing direct wind quadrupole magnet. Design status of this magnet along with preliminary electromagnetic design of screening solenoid magnet will also be discussed in the talk. Talk will also touch base on recent nano-meter level magnetic field vibration measurements carried out jointly by BNL and KEK. Such measurements will be crucial for nano-meter beam colliders.

FCC accelerator technical design / **89**

Fast readout system for beam signal digitalisation in the FCC era

Authors: Andreas Schloegelhofer[None]; Stefano Mazzoni[1]; Thibaut Lefevre[1]; Tom Levens[1]

[1] *CERN*

Beam signal digitisation during FCC operation presents significant challenges for existing acquisition technologies, including the demand for high analog bandwidth, the capability to manage high repetition rates, and robustness in radiation-intense environments. In this work, we propose an electro-optical readout system based on photonic time-stretch techniques to address these limitations. In addition to enhancing acquisition performance, the use of fibre-optic technology facilitates seamless integration into large-scale accelerator facilities, where space constraints are critical. We present experimental results from a prototype currently under development, targeting future deployment during HL-LHC operation.

FCC accelerator technical design / **90**

Effects and criticality of powering failure in the FCC-ee main dipole circuits

Author: Delphine Domange[1]

[1] *CERN & Universite Libre de Bruxelles (BE)*

The stored beam energy of FCC-ee will reach 17.5 MJ per beam during the Z-mode operation at 45.6 GeV. Due to the very small beam emittances, the resulting extremely high energy densities pose a significant risk of damage to collider components in case of failures leading to beam impact. This study investigates the criticality of powering failures in the main dipole circuits. The time-dependent effects on the beams are simulated with the Xsuite tracking code. The results expressed in terms of orbit shifts, optics changes, and particle losses show that this failure is highly critical. The beam may experience a horizontal orbit excursion of 10 σ within three turns. Interlocking and mitigation strategies have been evaluated and are discussed.

Joint effort PED & accelerators / **91**

Beam Polarization studies: status and challenges

Author: Yi Wu[1]

Co-authors: Leon Van Riesen-Haupt [1]; Mike Seidel ; Tatiana Pieloni [2]

[1] *EPFL - Ecole Polytechnique Federale Lausanne (CH)*

[2] *EPFL*

High-precision center-of-mass energy calibration at the Future Circular Collider e^+e^- (FCC-ee) relies on sufficient transverse beam polarization for resonant depolarization measurements. Simulations have been performed to assess the achievable polarization levels in the presence of machine imperfections. Harmonic spin matching techniques have been explored to enhance polarization. The impact of imperfections on closed orbit spin tune shifts has been analyzed, revealing the contribution to systematic uncertainties that affect the precision of energy measurements. Preliminary studies on resonant depolarization have also been carried out.

Superconducting Radio Frequency / **92**

FCC-ee Power Coupler Design Overview

Author: Shahnam Gorgi Zadeh[1]

[1] *CERN*

The FCC-ee accelerating cavities need reliable power couplers to deliver high RF power across different operation modes. This presentation will cover the design of a 400 MHz coupler for the collider cavities, capable of delivering around 400 kW with a Qext adjustable between 9×10^5 and 5×10^6, for Z, W, H, and top-quark ($t\bar{t}$) operation. It will also present the design of an 800 MHz coupler for the accelerating cavities in the $t\bar{t}$ collider and booster, providing up to 200 kW with a variable Qext. The talk will discuss the RF power requirements for each mode, ceramic window options, and Qext tuning methods.

Joint effort PED & accelerators / **93**

First look at injection backgrounds

Author: Giulia Nigrelli[1]

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The electron-positron Future Circular Collider (FCC-ee) is a proposed high-energy lepton collider that aims to reach unprecedented luminosity and precision in the measurement of fundamental particles. To fully exploit this potential, it is crucial to keep machine-induced detector backgrounds under control to ensure safe operation and optimal detector performance. Due to the high stored beam energy and complex operational requirements (e.g. the top-up injection scheme), controlling these backgrounds to the physics experiments becomes more challenging. We present the studies of background produced during the injection process. The top-up injection scheme generates unavoidable losses at every cycle, originating from both the injected and circulating beams.

Superconducting Radio Frequency / **94**

Accelerating cavities with HOM damping for FCC-ee

Author: Shahnam Gorgi Zadeh[1]

[1] *CERN*

This presentation will cover the latest status of the accelerating cavity designs for the FCC-ee main collider and booster, taking into account reverse phase operation. It will include the 2-cell 400 MHz cavities developed for the Z, W, H modes and part of the voltage needed for the $t\bar{t}$ collider, as well as the 6-cell 800 MHz cavities designed for the $t\bar{t}$ collider and booster. Each working point requires a dedicated higher-order mode (HOM) damping scheme, which will also be presented and discussed.

FCC-ee accelerator / **95**

Main rings impedance budget

Author: Carlo Zannini[1]

Co-authors: Adnan GHRIBI ; Dora Gibellieri [2]; Elena Macchia [3]; Mauro Migliorati

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A comprehensive impedance model is essential to ensure beam stability and optimize performance in the FCC-ee main rings. In this talk, we present the current status of the impedance budget, developed as part of the ongoing FCC-ee design studies. The model includes contributions from a wide range of components —including beam pipe, collimators, bellows, tapers, RF cavities and beam position monitors —and accounts for both resistive wall and geometric effects. We also address the specific challenges posed by the unique characteristics of FCC-ee, together with recent advancements in simulation tools and methodologies. Finally, we discuss the criteria adopted to define and structure the impedance budget.

FCC accelerator technical design / **96**

Collider magnet design status

Author: Jeremie Bauche[1]

[1] *CERN*

We will summarize the arc magnet designs proposed for the GHC optics baseline in the Feasibility Study Report, and compare it with alternative designs for the LCC optics. We will conclude with an overview of the collider magnet work plan for the Pre-TDR phase.

FCC-ee accelerator / **97**

IR alignment and Xsuite migration

Author: Satya Sai Jagabathuni[1]

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[2] *CERN*

[3] *ESRF*

The performance of the Future Circular Collider - electron-positron (FCC-ee) relies critically on the precise alignment of its Interaction Region (IR) components. Small misalignments can significantly degrade the dynamic aperture and luminosity, demanding stringent control of mechanical tolerances. This study uses detailed tuning simulations developed in pyAT, to determine the acceptable misalignment ranges for key IR elements. To enhance simulation capability and flexibility, the tolerance studies are being migrated to the Xsuite framework. This migration will allow to perform modeling of machine imperfections and correction procedures in the same framework as beam-beam and collective effects, which is a critical step for the FCC-ee. The present work contributes to the ongoing development for deploying Xsuite as a next-generation tool in accelerator physics research and operations at CERN.

Superconducting Radio Frequency / **98**

Beam dynamics and RF requirements for the high-energy booster

Author: Lina Valle[None]

Co-authors: Antoine Chance [1]; Franck Peauger [2]; Heiko Damerau [2]; Ivan Karpov [2]; Rama Calaga [2]; Wolfgang Hofle [2]

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The accelerating ramps of the high-energy booster are optimised to comply with the transverse beam size requirements at extraction energy while maintaining longitudinal beam stability. Specifically, the Z mode ramp includes an energy overshoot to boost the synchrotron radiation damping effect. Beam stability challenges are foreseen at low energy, which are mitigated with damping wigglers at the cost of a higher energy spread at extraction. The expected RF requirements and dynamic power losses for all operation modes are also presented.

Poster session / **99**

Design Aspects of the Arc Beam Position Monitors of the FCC-ee

Author: Emily Rose Howling[1]

Co-authors: Diogo Alves [2]; Marek Gasior [2]; Philip Nicholas Burrows [3]; Robert Kieffer [2]; Stefano Mazzoni [2]; Thibaut Lefevre [2]

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The electron-positron Future Circular Collider (FCC-ee) has challenging requirements for beam instrumentation, including the need for thousands of high-resolution beam position monitors (BPMs) presenting low impedance to the circulating beam. This poster details the requirements for the FCC-ee arc BPMs and presents the simulation results of BPM button pickups with various geometries, modelled with FCC-ee beam parameters. Applying results from benchmarking tests of already available button electrodes at AWAKE, a suggested geometry and expected performance are presented.

FCC accelerator technical design / **100**

Layer by Layer: Additive Manufacturing Strategies for the FCC-ee with focus on the Bake-Out System

Author: Martin Bammer[1]

Co-authors: Cedric Garion [2]; Fabrice Santangelo [2]; Marco Morrone [2]; Stefania Grozavu

[1] *Technische Universitaet Wien (AT)*

[2] *CERN*

The Future Circular Collider –electron-positron (FCC-ee) demands an ultra-high vacuum environment to reach its ambitious performance targets. At the heart of this vacuum system lies a deceptively simple yet critically important component: the bake-out system. Its role? To activate and regenerate the Non-Evaporable Getter (NEG) coating inside the vacuum chamber through a high temperature thermal cycle.
This presentation explores the bake-out system not merely as a heating mechanism, but as a complex, large-scale, multilayered coating architecture composed of metals and ceramics applied via thermal spray technologies—namely Atmospheric Plasma Spray (APS) and Cold Spray (CS). We will unpack the fundamental criteria for material selection in this highly demanding environment, emphasizing radiation hardness, mechanical resilience under thermal cycling, cost-efficiency and morphological influences on coating performance.
A key theme of the talk is materials selection—how do you find the right material to not only produce laboratory prototypes but also transition to kilometres of reliable, high-performance and affordable bake-out systems? Challenges such as thermal stress management between layers, adhesion durability, manufacturing sequence optimization, and system integration will be addressed through the lens of materials selection and optimisation. Finally, we'll delve into how these materials and coatings are tested for real-world suitability in the FCC-ee context.
In addition to the bake-out system, the presentation will briefly highlight other additive manufacturing opportunities within the FCC-ee vacuum system. These include the development of the Synchrotron Radiation Absorber (SRA) using Laser Powder Bed Fusion (L-PBF), as well as the production of mounting sockets for Beam Position Monitors (BPM) via Cold Spray Additive Manufacturing.
These emerging techniques further illustrate how advanced manufacturing is shaping the future of accelerator infrastructure.

Superconducting Radio Frequency / **101**

Nb3Sn coatings for RF cavities

Author: Valentin Giglia[None]

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To address the challenges of helium and energy consumption in next-generation particle accelerators such as the Future Circular Collider (FCC), it is essential to reduce the demands placed on cryogenic infrastructure. This has spurred a growing interest within the scientific community in advancing technologies that support operation at temperatures above 2 K. Within this framework, alternatives to conventional bulk niobium and niobium-on-copper superconducting radio frequency (SRF) cavities are under active investigation. Among these, the A15 phase of Nb_3Sn has emerged as a highly promising material, offering a significantly higher critical temperature (18.2 K versus 9.2 K for niobium) and reduced BCS surface resistance, making it a strong candidate for thin-film applications on copper substrates.

In this work, we present our recent advances in the development of thin Nb_3Sn films using High-Power Impulse Magnetron Sputtering (HiPIMS). We report the successful fabrication of QPR samples exhibiting RF performance up to three times higher than current state-of-the-art niobium-on-copper coatings, as measured at 4.5 K and 800 MHz. These promising results represent a significant step toward meeting the FCC requirements and have driven the launch of two major developments: (1) a custom deposition system optimized for 800 MHz cavities, and (2) a novel cylindrical Nb_3Sn cathode designed to minimize target cracking during sputtering.

FCC-ee accelerator / **102**

BBA for FCC-ee and Beam Test at KARA

Author: Christian Goffing[1]

Co-authors: Anke-Susanne Mueller [2]; Frank Zimmermann [3]; Jacqueline Keintzel [3]; Micha Reißig

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[3] *CERN*

The ambitious design goals of the Future electron-positron Circular Collider (FCC-ee) demand excellent orbit and optics control and, therefore, set strict limits on alignment tolerances. One approach to relax the mechanical alignment tolerances is Beam-Based Alignment (BBA), where corrector magnets steer the beam towards the magnetic centre. One of the key challenges of FCC-ee is developing an accurate and fast BBA strategy for quadrupoles and sextupoles. A parallel BBA technique is evaluated and compared in simulations for the GHC and LCC lattice using Xsuite and different BBA techniques are testet at the KArlsruhe Research Accelerator (KARA). In this talk, the first simulation results and beam test results at KARA are presented.

Technical Infrastructure / **103**

FCC electrical grid and infrastructure update

Author: Charline Marcel[1]

[1] *CERN*

This presentation provides an updated overview of the FCC electrical grid and infrastructure as established for the Feasibility Study Report, with a particular focus on developments since the FCC Week 2024.

The feasibility study of the HV line running through the tunnel has been completed, delivering key outcomes, notably regarding integration requirements. Electrical equipment needs have been estimated across the various facilities, enabling the initial detailing of integration requirements.

The secured electrical network concept has been further developed and discussed with the safety team, leading to a preliminary agreement, contingent upon specific conditions being fulfilled.

The electrical grid is now defined from the connections to external grids, through the HV transmission network to the MV distribution network, reflecting the latest users'requirements and study outcomes. Distribution networks concepts are well defined with several optimization approaches identified.

Finally, the next steps required to reach the necessary level of detail for the pre-TDR phase are outlined.

Poster session / **104**

RF Design and Optimization of the High-Energy Linac for the FCC-ee Injector Complex

Author: Adnan Kurtulus[None]

Co-authors: Alexej Grudiev [1]; Andrea Latina [1]; Jean-Yves Raguin ; Paolo Craievich ; Simona Bettoni [2]

[1] *CERN*

[2] *Paul Scherrer Institut*

The high-energy linac of the Future Circular Collider electron-positron (FCC-ee) injector complex requires high-performance RF accelerating structures to efficiently accelerate beams up to 20 GeV while ensuring operational stability. This study presents an analytical approach to the RF design of traveling-wave structures, incorporating a pulse compression system to enhance power efficiency and meet the demanding FCC-ee specifications. By utilizing lookup tables and analytical models, we systematically explored a broad parameter space to determine the fundamental mode at 2.8 GHz and analyze Higher Order Mode (HOM) characteristics. The structure's geometry, particularly the iris parameters, was optimized to maximize effective shunt impedance, minimize peak surface fields, and implement HOM detuning for wakefield suppression. Additionally, we investigated the bunch-to-bunch energy spread minimization including the impact of transient beam loading, with a focus on top-up operation, where bunch charges vary dynamically among four bunches. To accommodate these variations, we introduce the concept of the "golden"RF pulse, an optimized input RF waveform that averages the solutions for fully loaded and unloaded conditions. While this method does not eliminate energy deviations entirely, it provides a practical compromise, reducing energy spread across all possible charge distributions. Finally, comprehensive thermal and mechanical simulations were performed to evaluate the structural integrity and operational performance of the HE linac under 100 Hz repetition frequency, ensuring long-term reliability.

FCC-hh HFM / **105**

Status of HFM development at CEA

Author: Etienne Rochepault[1]

[1] *Université Paris-Saclay (FR)*

CERN and CEA Paris-Saclay are collaborating in the framework of the HFM (High Field Magnet) project.
One part of the program is to develop Nb_3Sn magnets generating a 14 T operational field, as a baseline for a future high-energy collider. Following some experience acquired in the previous collaborations, CEA has proposed a development plan for block-coil magnets. The goal is to design, build and test short models, representative of accelerator magnets. The first demonstrator, R2D2, is currently in fabrication.
In parallel, HTS magnet technologies are explored to generate dipole fields above 14 T using REBCO based HTS materials. In particular, CEA is studying the MI (Metal Insulated) technology. Various mock-up coils have been already manufactured and tested to explore the design limits.

Poster session / **106**

FCC-ee injector experiments at FACET-II

Authors: Andrea Latina[1]; Brendan O'Shea[2]; Paolo Craievich[None]; Simona Bettoni[3]

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The accelerator at the FACET-II National User Facility at SLAC National Accelerator Laboratory can test several elements of the design of the FCC-ee injector. To support the design of the injector we propose three experiments: measurement of emittance growth as a function of compression at high charge, characterization of jitter amplification of high-charge beams in s-band linacs at 25 ns separation, and photoinjector performance when varying charge from 0 to 5 nC. Historically, high-charge beams have been challenging to operate [1,2] and experience at light sources has motivated

a move to lower charge beams [3]; CSR effects at high charge are not well studied. For the first experiment, we propose a study of the operation of compression systems at high charge that looks at 2D coherent synchrotron radiation effects on beam parameters to benchmark models used to design the FCC-ee injector. The second experiment examines how jitter is amplified by optics and wakefields along linacs operating at high charge with 25 ns bunch separation. The study includes potential optics testing of a method to damp jitter growth along a linac. To meet the charge variation requirements for top-up injection, the injector performance when varying the charge from 0 charge to 5 nC should be characterized. We propose to study methods to generate charge and laser size variation at 100 Hz that will produce the beam parameters required for the FCC-ee injector.

[1] Phinney, Nan. "SLC final performance and lessons." arXiv preprint physics/0010008 (2000).
[2] Funakoshi, Y., et al. Journal of Instrumentation 19.02 (2024): T02003.
[3] P. Emma, SLAC-TN-05-042

FCC accelerator technical design / **107**

Challenges for the EM-Separator and its alternatives

Authors: Bruno Balhan[1]; Giorgia Favia[1]; Jan Borburgh[1]; Johannes Ruf[1]; Lucien Porta[1]; Sen Yue[1]; Yann Dutheil[1]

[1] *CERN*

The use of a common RF section in the Higgs and ttbar modes of the FCC-ee collider requires the separation of the beam outgoing from RF at point H. An electromagnetic separator (EMS) taking advantage of a combination of DC electric and magnetic fields has been first considered. The main challenges such has minimising the impact on the incident beam, high-voltage breakdown and device topology are currently being addressed, while certain aspects such as beam impedance preservation have still to be studied.
Recently, an alternative solution based on kickers has been proposed and the main requirements and feasibility are being assessed in parallel of the EMS project.
This presentation will give an overview of the current concepts and challenges regarding beam separation for the two alternatives using EMS or kickers.

FCC accelerator technical design / **108**

Update on the FCC-ee vacuum system development

Author: Marco Morrone[1]

Co-author: Cedric Garion [1]

[1] *CERN*

The vacuum system requirements for the FCC-ee arcs will be presented, highlighting key challenges and expected performance. An update of the design of the vacuum chambers and overall vacuum layout for both the collider and the booster will be described. Innovative approaches under consideration include additive manufacturing techniques (such as 3D printing and thermal spray), friction stir welding, advanced bake-out systems, and the use of shape memory alloy connectors.

Poster session / **109**

Septa developments for FCC-ee Booster and Collider

Authors: Bruno Balhan[1]; Jan Borburgh[1]; Lucien Porta[1]

[1] *CERN*

Various magnetic septa devices and topologies are foreseen in the FCC-ee complex, from the injector to the collider. While some of the proposed topologies, such as direct-drive septa, are well known and mastered, others require in-depth consideration of their design. The Lambertson half-vacuum topology, designed to reduce the area exposed to vacuum, or the low-power topology, which significantly reduces energy consumption, are new concepts that require further research and development work.
In addition, an effort has been made since last year to harmonise the septa magnet family across the complex.
This poster will therefore present an overview of the septa devices, highlighting the improvements and harmonisation of the topologies as well as the remaining development and prototyping needs.

FCC-ee injector / **110**

Injection/extraction systems across the FCCee complex

Authors: Bruno Balhan[1]; Giorgia Favia[1]; Jan Borburgh[1]; Pablo Arrutia[1]; Sen Yue[1]; Thomas Kramer[1]; Wolfgang Bartmann[1]; Yann Dutheil[1]

[1] *CERN*

The FCCee complex will produce and transport the lepton beams to the collider ring via a serious of beam transfer systems. From the damping ring to the top-up injection in the collider ring, beam injection and extraction systems are required to ensure efficient beam transfer. Each system has specific requirements, determined by the beam energy, required deflection, available space and so on. This contribution presents the concepts for injection and extraction systems across all those machines, as well as the beam transfer line from the HE linac. Special focus is given to the collider technical straight section at Point B, where the integration of booster and collider systems presents unique challenges.

FCC accelerator technical design / **111**

Overview of and Challenges for the FCC-ee Fast Pulsed Beam Transfer Systems

Authors: Dylan Standen[1]; Giorgia Favia[1]; Jan Borburgh[1]; Johannes Ruf[1]; Pavlina Trubacova[1]; Sen Yue[1]; Thomas Kramer[1]; Wolfgang Bartmann[1]; Yann Dutheil[1]

[1] *CERN*

This presentation summarises the feasibility studies conducted for the various kicker systems needed to transfer the beam between the different FCC-ee machines. The selected kicker design is presented, reflecting the most recent updates in system requirements. The feasibility and technology options for both the beamline elements and pulse generators are discussed, with emphasis on the key challenges. Among these are integration aspects and the impact on subsystems, such as pulse transmission cables. Significant effort has been made to harmonise hardware parameters across machines, aiming to minimise the variety of beamline and generator element types. This contribution also outlines the prototyping requirements in preparation for the upcoming detailed technical design phase.

FCC-ee accelerator / 112

Collimation studies for FCC-ee

Author: Giacomo Broggi[1]

Co-authors: Andrey Abramov ; Anton Lechner [2]; Frederik Van Der Veken [2]; Giulia Nigrelli [3]; Manuela Boscolo [4]; Roderik Bruce [2]; Stefano Marin ; Stefano Redaelli [2]

[1] *CERN, Sapienza Università di Roma e INFN Laboratori Nazionali di Frascati*

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[3] *Sapienza Universita, INFN-LNF, CERN*

[4] *INFN e Laboratori Nazionali di Frascati (IT)*

The Future Circular electron-positron Collider (FCC-ee) is being designed to explore physics beyond the present energy and luminosity frontiers for leptons. To achieve this goal, the FCC-ee must be capable of storing and colliding very high-intensity lepton beams. Handling such intensities poses unique challenges, including the need to safely manage stored beam energies of up to 17.5 MJ. A beam collimation system is therefore indispensable to protect sensitive machine components from damage due to beam losses and to minimize backgrounds in the experimental detectors. This contribution presents the current status of the collimation studies for the FCC-ee baseline optics, including collimation performance evaluations under different beam loss scenarios.

Joint effort PED & accelerators / 113

IR beam losses and MDI collimators

Author: Giacomo Broggi[1]

Co-authors: Andrey Abramov ; Giulia Nigrelli [2]; Manuela Boscolo [3]; Roderik Bruce [4]; Stefano Redaelli [4]

[1] *CERN, Sapienza Università di Roma e INFN Laboratori Nazionali di Frascati*

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[3] *INFN e Laboratori Nazionali di Frascati (IT)*

[4] *CERN*

The Future Circular electron-positron Collider (FCC-ee) is being designed to explore physics beyond the present energy and luminosity frontiers for leptons. To achieve this goal, the FCC-ee must be capable of storing and colliding very high-intensity lepton beams. Handling such intensities poses unique challenges, including the need to safely manage stored beam energies of up to 17.5 MJ. A beam collimation system is therefore indispensable to protect sensitive machine components from damage due to beam losses and to minimize backgrounds in the experimental detectors. This contribution focuses on beam losses that can reach the interaction region (IR) and discusses collimation solutions under study to mitigate their impact. The current status of the studies is presented, including simulation-based evaluations of collimator performance in various beam loss scenarios affecting the IR and machine-detector interface (MDI).

FCC accelerator technical design / 114

A flat racetrak HTS design option for the lattice combined function MQ/MS of the FCCee collider ring

Authors: Lucio Rossi[1]; Samuele Mariotto[None]; Simone Busatto[None]

[1] *Università degli Studi e INFN Milano (IT)*

Energy consumption represents an increasing critical challenge for particle physics research laboratories like CERN. This issue is particularly significant in large accelerator facilities, where normal conducting magnet technology plays a fundamental role in beamline design. In this context, R&D on high-temperature superconducting (HTS) magnets offer promising solutions to improve energy efficiency. HTS materials can substantially reduce energy consumption and operational costs enabling higher operating temperatures compared to conventional superconductors. When combined to superferric magnets designed, this technology can offer simpler, cost-effective designs, reducing the influence of the high temperature superconductor large magnetization effect. In this paper, a combined superferric (sextupole and quadrupole) HTS magnet for the FCC-ee's main ring is described. With the main goal to produce the same performances of the current resistive magnet configuration while increasing dipole filling factor. This approach offers two key advantages: a slight decrease in overall energy consumption through reduced RF cavity power requirements or, more significantly for high-energy physics, improved beam luminosity at constant RF power consumption. The currently electromagnetic optimization of the HTS superferric design is described addressing also , a preliminary thermal and energy consumption model of the proposed configuration.

FCC accelerator technical design / **115**

Thermo-mechanical and CFD simulations for the Synchrotron Radiation Absorber of the FCC-ee

Author: Stefania Grozavu[None]

Co-authors: Cedric Garion [1]; Fabrice Santangelo [1]; Jerome Gilles Chaure [1]; Marco Morrone [1]; Martin Bammer [2]; Marton Ady [1]

[1] *CERN*

[2] *Technische Universitaet Wien (AT)*

In the FCC-ee study, it is proposed that electron and positron beams circulate at high current and high energy in a 91-km circumference twin ring. The present operational scenario foresees a first running step at an energy of 45.6 GeV and around 1.4 A current, which would generate copious amounts of synchrotron radiation power and flux. To guarantee a quick decrease of the photon desorption yields and so a fast vacuum conditioning, it has been proposed to use localized Synchrotron Radiation Absorbers (SRA) along the vacuum chamber, spaced about 5-6 m apart. This would also help contain the high-energy Compton-scattered secondaries once the beam energy is increased up to 182.5 GeV. Each absorber features a tapered interception surface, where a total power ranging from 2.8 to 4.5 kW is deposited and subsequently dissipated via a dedicated water-cooling circuit integrated into the absorber.

The current absorber design is intended to be manufactured using 3D printing technology. This technology enables to manufacture of the complex SRA geometry and include, at the same time, heat transfer enhancement mechanisms within the cooling channels and the sawtooth profile to lower the reflected photons towards the vacuum chamber. To accurately assess the heat transfer performance of the cooling system, CFD simulations are employed, supporting a more precise thermo-mechanical analysis of the component while also facilitating the exploration and optimization of alternative cooling circuit designs.

All simulation data will be experimentally validated using a thermo-hydraulic test setup equipped with pressure and temperature sensors, enabling the measurement of pressure drops and the calculation of the heat transfer coefficient.

FCC-ee injector / **116**

FCC-ee Injector: New DR at 2.86 GeV

Authors: Antonio De Santis[None]; Catia Milardi[1]; Ozgur Etisken[2]

[1] *INFN e Laboratori Nazionali di Frascati (IT)*

[2] *Ankara University (TR)*

The new optimised FCC-ee injector layout imposed a review of the intrinsic structure of damping ring (DR) Transfer Lines (TLs). The presence of two independent linacs for electron and positron beams, and the elimination of the common linac, naturally led to increased DR energy which, to avoid spin resonances, was set at the value of 2.86 GeV.

The main concept driving the DR and TLs design consists of achieving an overall efficiency of the order of 80% in transporting electron and positron beams from the respective LINACs, through the DR for emittance cooling, to the end of the TLs conveying extracted beams toward the collider booster. Electron and positron LINACs produce beam pulses at 100 Hz, each pulse consists of 4 bunches spaced by 25 nsec, each bunch stores a variable charge intensity up to 5 nC. The DR is mainly needed to reduce the emittance of the incoming positron beam by more than three orders of magnitude, from 2.4×10^{−6} m·rad to about 1.8×10^{−9} m·rad

The new DR lattice features a six-fold symmetry. It consists of six arc cells connected by six straight sessions. Each straight session is used to host three wiggler magnet insertions, one RF cavity module, and two independent injection/extraction sections. Injection and extraction will be implemented in the same branch for the two-particle species in order to avoid changing the polarities of the DR magnets, thus ensuring fast and reliable operation modes for both electron and positron. The injection will be performed using an on-axis scheme.

FCC accelerator technical design / **117**

FCC-ee IP Feedback Tolerances & new modelling of SuperKEKB in Xsuite

Author: John Patrick Salvesen[1]

[1] *University of Oxford, CERN*

To achieve physics performance at the Future Circular electron-positron Collider (FCC-ee), luminosity and beam lifetime must be maintained at close to design specifications.
Alongside global feedbacks, a fast feedback system is proposed to mitigate beam offset errors at the interaction points (IP), caused by magnet vibrations or other time-varying errors.
To identify the performance requirements for the FCC-ee IP feedback system beam-beam simulations are performed, and input is taken from other groups.
As part of the development of FCC-ee Feedback simulation, analysis and simulation of IP feedback at SuperKEKB is underway.
The tolerances for the FCC-ee IP feedback system are presented alongside progress on optics modelling of SuperKEKB in Xsuite.

Superconducting Radio Frequency / **118**

FCC RF operation scenarios - new baseline

Author: Ivan Karpov[1]

[1] *CERN*

The FCC-ee must accommodate very different RF system requirements at different energy points driven by a fixed synchrotron radiation power budget of 100 MW. This talk presents the new baseline for the RF system implementation. The key update to the baseline scenario is a unification of the cavity designs for three beam energies (45.6, 80, and 120 GeV) due to the inclusion of the reverse phase operation (RPO) scheme. The main features of this new scenario and the remaining challenges are also discussed.

Superconducting Radio Frequency / 119

WOW and SWELL cavity test results

Author: Franck Peauger[1]

Co-authors: Alban Sublet [1]; Alexej Grudiev [1]; Carlota Pereira Carlos [2]; Fabian Manke ; Fabio Avino [3]; Guillaume Jonathan Rosaz [1]; Igor Syratchev [1]; Leonel Marques Antunes Ferreira [1]; Marco Garlasche [1]; Mathieu Therasse [1]; Olivier Brunner [1]; Shahnam Gorgi Zadeh [1]; Stewart Leith [1]; Valentin Giglia ; Walter Venturini Delsolaro [1]

[1] *CERN*

[2] *Universite de Geneve (CH)*

[3] *École polytechnique fédérale de Lausanne (EPFL) - Switzerland*

The SWELL and WOW cavities are novel superconducting RF (SRF) concepts developed within the framework of the FCC study, specifically designed for high beam current acceleration and deflection. Exploiting niobium thin film technology on copper substrates, these cavities offer significant advantages in terms of cost efficiency and performance robustness. This presentation summarizes preliminary RF test results conducted at 4.5 K and 2 K in a vertical cryostat on two prototypes fabricated and niobium-coated at CERN. The achieved performance in terms of Q0 and RF voltage, current limitations, and future prospects are discussed.

FCC-ee accelerator / 120

Nested magnets and balistic optics for the FCC-ee

Author: Cristobal Garcia[1]

Co-authors: Kyriacos Skoufaris [2]; Leon Van Riesen-Haupt [1]; Mike Seidel ; Rogelio Tomas Garcia [2]; Tatiana Pieloni [3]

[1] *EPFL - Ecole Polytechnique Federale Lausanne (CH)*

[2] *CERN*

[3] *EPFL*

A major project such as the FCC-ee, with a circumference of 91.17 km, presents numerous challenges to guarantee the stability and performance of the machine. As part of the efforts to optimize energy consumption during its operation, the use of Nested Magnets has been explored as a potential method to reduce synchrotron radiation. This talk will address the challenges and solutions associated with the implementation of these magnets. Additionally, a review of the ballistic optics proposal will be presented.

Superconducting Radio Frequency / 121

Progress of the EIC superconducting RF system

Authors: Alex Zaltsman[None]; Binping Xiao[None]; David Savransky[1]; Geetha Nayaran[2]; Graeme Campbell Burt[3]; Guangjiang Li[2]; Holmes Douglas[2]; Jean Delayen[4]; Jesse Fite[2]; Jiquan Guo[None]; Joseph Matalevich[1]; Katherine Wilson[1]; Kevin S. Smith[None]; Lin Guo[2]; Naeem Huque[None]; Niklas Templeton[None]; Paolo Berrutti[5]; Pashupati Dhakal[6]; Qiong Wu[None]; Robert Rimmer[None]; Silvia Verdú Andrés[7]; Subashini De Silva[8]; Zachary Conway[1]; wencan xu[None]

[1] *JLab*

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[6] *Jefferson Lab*

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[8] *Old Dominion University (US)*

The Electron-Ion Collider (EIC) under construction at Brookhaven National Laboratory is being developed in partnership with the U.S. Department of Energy's Thomas Jefferson National Accelerator Facility. The EIC will deliver high-luminosity, variable center-of-mass energy collisions of highly polarized electron beams with highly polarized proton beams and ion beams. Superconducting radio-frequency (SRF) cavities will be used to provide fast acceleration of the electron beam in the rapid cycling synchrotron (RCS), store the Ampere-class beams in the electron storage ring (ESR) and the hadron storage ring (HSR), and crab the colliding bunches to restore head-on collisions. All these SRF cavities will operate at 2 K. This presentation will describe the challenges and proposed solutions for the EIC SRF systems, review the progress, and overview our plans for the first article 591 MHz ESR cryomodule.

FCC-hh accelerator / 122

Hybrid REBCO-Cu coating for the FCC beam screen to achieve low surface impedance and high magnetic field homogeneity

Authors: Joffre Gutierrez Royo[1]; Guilherme Telles[None]; Neil Lamas[2]; IRFAN ahmed[2]; Luca Benedetti[None]; Xavier Granados[2]; Sergio Calatroni[3]; TERESA Puig Molina[None]

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[3] *CERN*

CERN's next generation hadron collider, the Future Circular Collider (FCC-hh) will achieve an increase in center-of-mass collision energies of a factor seven when compared to the Large Hadron Collider (LHC), reaching 100 TeV. To handle the higher energy levels of the orbiting particle beam and shield the magnet cold bore from the synchrotron radiation produced by the accelerated charged particles, a new beam screen design is necessary. Due to its proximity to the beam, the beam screen must present a low surface impedance to ensure beam stability and minimize the heat produced by the image currents induced by the beam in the beam screen.
Delaminated Rare Earth-Ba2Cu3Ox (REBCO) High Temperature Superconductors (HTS) Coated Conductors (CC) are proposed as a coating solution for the FCC beam screen, as a means to achieve the necessary low surface impedance. However, due to the trapped fields in HTS exposed to external magnetic fields, a full REBCO coating would decrease the field quality in the beam surroundings, once again threatening beam stability. To avoid this, a hybrid coating composed of alternated longitudinal segments of REBCO and Cu is proposed.
In this talk, we present our research achievements over these years, where we have worked towards understanding the high-field microwave response of REBCO CCs and we have demonstrated its better-than Cu surface resistance up to fields of 16T. We analyze the behavior of the Beam Screen with the hybrid coating when exposed to the bending and focusing magnets of the FCC by the means of Finite Elements Method numerical computation, focusing on the effect of different coating topologies in the field homogeneity inside the vacuum chamber. We will also present our developments

on a coating technique using CCs to cover flat and curved surfaces (such as those needed for the beam-screen chamber of the FCC-hh).

Technical Infrastructure / **123**

Cooling update for FCC

Author: Inigo Martin Melero[1]

[1] *CERN*

The water-cooling systems of the FCC are designed to remove the heat generated by critical components such as magnets, cryogenic systems, absorbers, and electronics. This presentation will provide an overview of the current design status of these systems, highlighting updates on the thermal loads managed by the cooling systems, comparisons of various cooling tower technologies, strategies for water supply from different sources and an examination of the available options for the disposal of effluent water from the filters and cooling towers.

Technical Infrastructure / **124**

Ventilation update for FCC

Author: Inigo Martin Melero[1]

[1] *CERN*

The ventilation system for the FCC is designed to supply, condition, and extract air throughout the entire accelerator complex. This includes the Technical Areas, Experimental Areas, RF Areas, the Tunnel, and surface buildings. The supplied air must comply with safety, humidity, and temperature standards. This presentation will provide an overview of this system, with a focus on the updated thermal loads to air, the integration of ventilation within the various facilities and the alternative longitudinal ventilation concept proposed of the Tunnel.

Poster session / **125**

Enhanced Nb/Cu Film Morphology via HiPIMS for Superconducting Accelerators

Author: Milad Ghaemikermani[1]

Co-authors: Alvaro Lopez Cazalilla ; Carlota Pereira Carlos [2]; Flyura Djurabekova [1]; Guillaume Jonathan Rosaz [3]; Kostas Sarakinos [1]; Marcel Himmerlich [3]; Sergio Calatroni [3]; Stewart Leith [3]

[1] *University of Helsinki*

[2] *Universite de Geneve (CH)*

[3] *CERN*

The efficacy of superconducting radio-frequency cavities in particle accelerators is predicated upon the quality of thin niobium films deposited onto complex copper substrates. Conventional direct-current magnetron sputtering (DCMS) often yields sub-optimal, porous columnar morphologies on intricate 3D geometries due to line-of-sight limitations. High-power impulse magnetron sputtering

(HiPIMS, generating highly-ionized fluxes steerable by electric fields) presents a compelling alternative for achieving conformal coatings. We employed a synergistic approach, combining classical molecular dynamics simulations with experimental validation, to scrutinize Nb film growth dynamics on Cu under both DCMS and HiPIMS conditions. Our findings definitively demonstrate that HiPIMS facilitates the deposition of markedly denser and more uniform films. This enhancement is primarily attributable to a confluence of factors: the preferential arrival of ions closer to the substrate normal, energetic particle bombardment disrupting non-ideal crystalline growth, and dynamic atomic rearrangement coupled with thermal annealing effects. Furthermore, we elucidate the profound influence of these processes on nascent epitaxial alignment at the film-substrate interface, offering valuable insights for optimizing deposition strategies on convoluted cavity structures.

Superconducting Radio Frequency / 126

Strategy for SRF R&D at CERN

Author: Walter Venturini Delsolaro[1]

Co-authors: Alick Macpherson [1]; Franck Peauger [1]; Guillaume Jonathan Rosaz [1]; Marco Garlasche [1]; Torsten Koettig [1]

[1] *CERN*

The SRF R&D project was launched in 2023, with the purpose to introduce a more detailed structure, coordination and progress reporting of the SRF R&D activity which is taking place since several years at CERN. More recently, the project was renamed as SRF R&D-R, to distinguish it from the twin SRF R&D-D, which is focused on producing demonstrators for the FCC. The overarching purpose of the SRF R&D-R program is to advance the knowledge, strengthen the know-how, the facilities and in general the capabilities in the field of superconducting RF at CERN, to secure the necessary support to the present accelerators, and to enable design, prototyping and eventually building future machines. This general SRF R&D activity underpins and complements the focussed developments and prototyping work done in the context of the FCC study. In the context of the general SRF R&D, performance targets for SRF cavities are in line with but not limited to the specific needs of the FCC ee machines. The project is structured in 5 work packages, covering SRF methods and studies, cavity fabrication methods, SRF thin films, non-mechanical tuning, and novel cooling methods. In this presentation I will give an overview on these activities, highlight the underlying strategy, discuss the present results, and the next steps

Poster session / 127

Geological Challenges and Investigations in the FCC Study Area

Authors: Guihlem Gabriel[None]; Roddy Cunningham[1]

[1] *CERN*

The Geneva Basin consists of a variety of geological formations, including Mesozoic limestone, Cenozoic Molasse, and Quaternary moraines. A 3D ground model has been developed using existing geological data; however, significant uncertainties remain in several areas along the proposed FCC tunnel alignment due to the limited extent of previous site investigations.

This poster summarises ongoing research aimed at evaluating the current geological understanding along the FCC trace and identifying the zones of greatest uncertainty. It also outlines the scope and objectives of the first subsurface site investigation campaign, currently underway, which is essential for informing both the exact elevation and tilt of the alignment as well as the detailed design of the tunnel.

FCC-hh HFM / **128**

Progress towards HTS HFM magnet and conductor strategy

Author: Amalia Ballarino[1]

[1] *CERN*

Properties of High Temperature Superconductors (HTS) make them unique for both high field and higher temperature (> 4.2 K) applications. While their potential for future accelerators is undeniable, the route to high field magnets requires development and innovation via a targeted and focused research and development programme. Synergy with other on-going HTS projects is important and highly beneficial, but specificities driven by accelerator requirements must be addressed at the early stage of the development. After a brief overview of recent progress on HTS, the program and goal of the activities launched in laboratories and universities in the context of the HTS High Field Magnet Programme are presented and discussed.

Superconducting Radio Frequency / **129**

Cavity substrate development

Author: Marco Garlasche[1]

Co-authors: Franck Peauger [1]; Guillaume Jonathan Rosaz [1]; Vittorio Parma [1]; Walter Venturini Delsolaro [1]

[1] *CERN*

The development of cavity substrate for FCC involves a combination of activities aiming at both providing optimal substrates for superconducting coating studies and establishing a strategy for an industry-ready production of the full cavity series required by the FCC SRF scheme. The presentation will provide an overview of the status of these activities, which are ongoing at CERN, Collaborations and Industry.

Technical Infrastructure / **130**

Arc-cell mock-up status

Authors: Audrey Piccini[1]; Federico Carra[1]

[1] *CERN*

The FCC-ee arc half-cell mock-up project is about to enter the installation phase, as the first elements of the mock-up structure have been received and most of the components to be installed have been ordered. The mock-up is designed to be modular, enabling it to accommodate systems from other teams: robots, magnets, vacuum systems, etc. Extensive collaboration with other teams has taken place to ensure the successful integration of the mock-up into its designated covering: safety studies, transport studies and preparation work. Meanwhile, design and optimisation studies are continuing on the supporting structures of the booster and collider, as well as on the interfaces between main systems.

Poster session / **131**

Vibrational study of the booster and collider supporting system

Authors: Audrey Piccini[1]; Federico Carra[1]

[1] *CERN*

The FCC-ee arc half-cell mock-up project team is currently developing a Short Straight Section demonstrator, combining experimental measurements and simulations to evaluate the vibrational budget of various elements including the feet, the support, the magnets, etc. The results of this study have shown that vibrations will have a non-negligible effect on the stability of the magnet's magnetic center, and consequently on the stability of the particle beam.

Technical Infrastructure / 132

Installation schedule

Author: Sarah Agathe Fleury[1]

Co-authors: Jean-Paul Burnet [1]; Marzia Bernardini [1]

[1] *CERN*

As part of the FCC feasibility study, the installation schedule for the FCC-ee has been aligned with the updated Civil Engineering strategy for the tunnel construction. Fine tuning between the two schedules was carried out to optimize the overall installation duration, allowing machine installation activities to safely begin while the final phases of Civil Engineering works are still being completed. The sequence of technical infrastructure installation was analyzed and quantified, drawing on lessons learnt from the HL-LHC project, to refine the estimated installation for some critical items such as high-voltage cables between access points. Particular attention was also given to the sequencing of multiple systems installation at the dedicated points to the Radiofrequency (RF) system. The presentation provides an overview of the integrated FCC-ee schedule, summarizing the Civil Engineering works installation blocks and detailing the installation of beamlines and associated general services up to the commissioning phase, incorporating analysis performed in collaboration with the equipment groups.
Looking further ahead, a preliminary schedule for the dismantling of FCC-ee and the subsequent FCC-hh installation will be presented, offering a broader perspective on the overall project timeline.

Poster session / 133

Higgs self-coupling measurements and resonant HH searches in the $bb\gamma\gamma$ final state at the FCC-hh

Authors: Angela Taliercio[1]; Birgit Stapf[2]; Paola Mastrapasqua[3]

[1] *Northwestern University (US)*

[2] *CERN*

[3] *Universite Catholique de Louvain (UCL) (BE)*

The hadron collider phase of the Future Circular Collider (FCC-hh) is a proton-proton collider operating at a center-of-mass energy of 80-100 TeV. It is one of the most ambitious projects planned for the rest of this century and offers ample opportunities in the hunt for new physics, both through its direct detection reach as well as through indirect evidence from precision measurements.

This contribution presents recent studies of the di-Higgs measurement in the $bb\gamma\gamma$ final state, carried out as part of the input to the European Strategy Update. The same final state is exploited both for a precise measurement of the Higgs trilinear coupling and for testing BSM models that include a new scalar resonance decaying into a Higgs boson pair. Both interpretations are key to establish the shape of the Higgs potential and to constrain how New Physics may deform it.

Poster session / **136**

Exploiting polarised Λ_b^0 baryons

Authors: Anja Beck[1]; Eluned Anne Smith[1]

[1] *Massachusetts Inst. of Technology (US)*

The LHC constitutes the first and currently only opportunity to perform precision measurements of Λ_b^0 baryons. These measurements provide useful information on flavour physics which complements the meson sector. Baryons stemming from the strong production mechanism at the LHC are unpolarized. At the FCC-ee however, the baryons are produced in the decay of Z^0-bosons which can lead to polarization allowing access to a much larger number of interesting observables for searches beyond the SM as well as QCD studies. This poster discusses the measurement of angular observables in decays of polarised Λ_b^0 baryons, produced at the FCC-ee, to a Lambda and two oppositely charged muons.

FCC-hh HFM / **137**

Status of US MDP

Author: Paolo Ferracin[1]

[1] *LBNL*

The US Magnet Development Program is a collaboration among 4 US laboratories (BNL, FNAL, LBNL, NHMFL) established in 2016, whose general goal is to perform basic R&D towards next generation high-field accelerator magnets. More specifically the strategic priorities are to explore the performance limits of Nb3Sn accelerator magnets, to perform R&D on HTS accelerator magnets, to develop LTS/HTS hybrid magnets, and to investigate fundamental aspects of magnet design and technology. In this presentation, we will update on the progress regarding the development of large aperture Nb3Sn dipole magnets currently ongoing at Fermilab and LBNL, the fabrication of both REBCO and Bi2212 insert coils, and the assembly and test of the first LTS-HTS hybrid magnet HM1. Also, a description of the effort dedicated to the implementation of new modeling techniques and new diagnostics tools for quench protection and detection will be given.

Physics, Experiments and Detectors / **138**

A 3 T High Temperature Solenoid Design for the IDEA detector project

Authors: Lucio Rossi[1]; Marco Statera[2]; Massimo Sorbi[1]; Samuele Mariotto[None]; Simone Busatto[None]

[1] *Università degli Studi e INFN Milano (IT)*

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Different particle detector design concepts are currently being explored for the Future Circular Collider in the electron-positron option (FCC-ee). Different proposals (CLD and IDEA detectors) for the main experiments have been already selected to be further developed in the FCC international collaboration study, including compact superconducting solenoids up to 2 T of nominal magnetic field based on aluminum-stabilized NbTi Rutherford cables technology. To further optimize the energy resolution of the detector, allocating a new concept of dual readout crystal and fiber calorimeter, a new solenoid design, developed at INFN LASA, featuring a 3 T high temperature superconductor (HTS) winding, is proposed. By using this type of emerging technology and operating at cryogenic temperatures above 20 K, the cryogenic power consumption of modern superconducting solenoids for particle detectors can be drastically reduced, enhancing the accelerator facility's sustainability. The new design based on aluminum-stabilized HTS conductors is presented here and discussed, showing how high-temperature superconductors could become a viable option for particle detectors at collider experiments.

FCC-ee accelerator / **139**

Top-up injection status and studies

Author: Yann Dutheil[1]

[1] *CERN*

To maintain high circulating bunch charge despite the short beam lifetime and to maximize integrated luminosity, the FCC-ee requires top-up injection at all operation modes. The feasibility and efficiency of this scheme are therefore critical to the success of the FCC-ee program. Accurate simulation of the top-up injection process is essential and must account for collective effects and particle-matter interactions. This presentation provides an update on the latest simulations of the baseline top-up injection scheme with the tools and methods used. It further outlines the requirements, timeline, and expected deliverables needed to support the comparison of the two optics options currently under consideration.

Joint effort PED & accelerators / **140**

FCC-ee Inverse compton polarimetry simulations

Author: Juba Tamazirt[None]

Co-authors: aurelien martens ; robert kieffer

This work focuses on the energy calibration of the FCC-ee and aims to develop precise techniques for ensuring accurate beam energy measurements, essential for improving the precision of electroweak parameter determinations. To do so, the resonant depolarisation technique will be employed, requiring the continuous operation of a depolariser and Compton polarimeters for both electron and positron beams. Extraction of pilot bunches polarization is realized from the spatial distribution of scattered electrons and photons. Preliminary, conceptual investigations of the fitting procedure for this extraction are shown here. The study explores the extraction of Compton scattering parameters under different configurations, corresponding to different realistic integration scenarii. In addition to these preliminary investigations, the work focuses on more realistic studies involving the implementation of a possible detector, aiming to evaluate the polarimeter performance in integrated conditions closer to the final experimental setup.

FCC-ee accelerator / **141**

Xsuite evolution for FCC studies

Author: Giovanni Iadarola[1]

[1] *CERN*

Xsuite is a Python-based simulation framework for beam dynamics studies in circular accelerators, and is progressively becoming a core tool for several FCC design studies. Recent developments include the implementation of a Particle-in-Cell (PIC) beam-beam interaction model, a module for Intra Beam Scattering (IBS), and native support for wakefield effects. The optics toolkit has also been extended with improved matching capabilities, orbit correction algorithms, and support for modeling lattice imperfections. An interface to MAD-NG has been introduced, enabling, for example, the computation of Non-Linear Resonance Driving Terms. Additionally, spin tracking and polarization estimation are being integrated to support studies related to precision energy calibration.

Poster session / 142

AI techniques to improve optics measurements based on the Turn-by-turn Beam Position Monitors

Authors: Barbara Dalena[1]; Francesca Bugiotti[None]; Hugo Le Corre[2]; Jonathan Piscart[2]; Leonardo Vitileia[2]; Quentin Bruant[3]; Yasmina Nasr[2]

Co-authors: Adnan Ghribi ; Jacqueline Keintzel [4]; Valerie GAUTARD [5]; Yukiyoshi Ohnishi

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Collider rings all around the world need to have several sensors all around the ring to operate. One kind of these sensors is the Beam Position Monitors (BPMs), that allows operators to measure if the beam travelling in their apparatus is well centered in the different magnets.

One specific category of BPMs, standing out by its very high aquisition rate, is called the Turn-by-turn BPMs (TbTBPMs). Several methods exist in order to recontruct the magnetic lattice and the associated optical functions based on these sensors, but each of these methods needs to have several functional TbTBPMs all along the ring. In the context of the FCC, it involves several thousand of these sensors scattered along a 91-km ring operating in very adverse environment specially due to the effect of radiations on the electronics.

Therefore, in order to maximise the duty cycle in this very large scale accelerator, operation may occur even when some of its sensors are down.

It is consequently important to quickly detect and take into account the detection of faulty TbTBPMs in the study for the reconstruction of the optical functions as well as to have sufficient confidence in the actual measurement which needs to be sensitive and precise enough (i.e having a high Signal-over-Noise Ratio (SNR)) to make decision for the correction of the behavior of the multi-GeV beam. Indeed, the ability to function with very high precision in a very noisy environment is also a challenge that SuperKEKB, but also future colliders and even future lightsources, need to achieve in order to measure rapidly and with high precision the optics functions

We present several methods imported from data science and studied in the context of accelerators, to either detect faulty TbTBPMs and to denoise the TbTBPMs tracks of SuperKEKB, the largest e+/e- collider currently in operation; hoping that an efficient enough method could be scalable to the scale of the FCC accelerator.
We also show the main effect on the harmonic analysis of the different denoising methods tested.

FCC accelerator technical design / **144**

FCCee Machine Protection Considerations

Author: Jan Uythoven[1]

Co-authors: Anton Lechner [1]; Christoph Wiesner [1]

[1] *CERN*

Due to the high brightness of the FCCee beams, the damage potential of these beams is comparable to those of the LHC. Fast failure modes of the FCCee have been identified, requiring a fast reacting and ultra reliable machine protection system.
This presentation gives an overview of the present state of identified failure modes of the FCCee and resulting requirements for a coherent machine protection system. Outstanding study topics related to machine protection are mentioned together with the final deliverable of the Machine Protection Task Force for the pre-TDR study.

FCC-ee injector / **145**

Status and perspectives of the emittance tuning of the FCC-ee High Energy Booster ring

Authors: Barbara Dalena[1]; Quentin Bruant[2]

Co-authors: Adnan Ghribi ; Antoine Chance [3]

[1] *CEA-Irfu & Université Paris-Saclay (FR)*

[2] *CEA/IRFU*

[3] *CEA Irfu*

Previous studies for the FCCee have highlighted the need to define tolerances on magnet imperfections and develop correction strategies. This is also crucial for ensuring the performance of one of the main elements in the acceleration chain: the High Energy Booster (HEB) ring.

The efficiency and overall performance of the correction strategy, as well as the magnet field quality and

We present the status of the emittance tuning for the HEB ring of the FCCee, following a method ramping the

Technical Infrastructure / **146**

Integration Update

Author: Fani Valchkova-Georgieva[1]

[1] *Bulgarian Academy of Sciences (BG)*

This presentation summarizes the results of the 3D integration studies carried out in the frame of the FCC feasibility study. The 3D integration have been carried out with careful consideration of spatial constraints with respect to the updated requirements provided by the different stakeholders, such as civil engineering, cooling circuits, HVAC systems, electrical supply, transport, safety systems, and machine systems. An update of the 3D integration models is presented for the machine tunnels, alcoves, experiment and service caverns for the points PA, PB, PD, PF PG, and PJ. The update on the RF areas are presented in the RF session.

Poster session / 147

Exploration of Non-Linear FCC-ee Optics

Author: Patrick James Hunchak[1]

Co-authors: Jacqueline Keintzel [2]; Mark James Boland [1]

[1] *University of Saskatchewan (CA)*

[2] *CERN*

To achieve the desired experimental outcomes at the FCC-ee, precise control of linear and non-linear optics is essential. Amplitude dependent tune shifts, higher order chromaticity and resonant driving terms (RDTs) are examples of non-linear optics parameters which must be understood and controlled. Two key figures of merit for the collider ring are the dynamic aperture (DA) and momentum acceptance (MA). They are strongly linked to these non-linear optics parameters which are in turn dependent on lattice and field errors.

Currently, two optics designs are under evaluation for the FCC-ee: the Global Hybrid Correction (GHC) optics and the Local Chromatic Correction (LCC) optics. In this work, we aim to characterize non-linear optics parameters for both the GHC and LCC designs. In future steps, correction techniques for non-linear optics control will be investigated.

FCC-ee injector / 148

Updates on FCC-ee High Energy Booster collective effects studies

Author: Adnan Ghribi[None]

Co-authors: Ali Rajabi ; Aliasghar Rajabi [1]; Antoine Chance [2]; Barbara Dalena [3]; Carlo Zannini [4]; Mauro Migliorati [5]; Mauro Migliorati ; Quentin Bruant [6]; Rainer Wanzenberg [7]; Rainer Wanzenberg [8]

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[8] *DESY*

Collective effects are key to defining the design constraints and performance limits of the FCC-ee High-Energy Booster, particularly at injection energy and in Z-pole operation. Building on previous studies, this contribution presents updated results incorporating the latest lattice design and operational parameters. It includes an improved analysis of transverse jitter at injection and examines the interplay between intrabeam scattering, wakefields, and synchrotron radiation. These studies are critical for establishing operational margins and ensuring beam stability across the booster cycle.

Superconducting Radio Frequency / 149

The INFN LNL SRF R&D projects towards FCC-ee

Author: Cristian Pira[None]

Co-authors: Alessandro Salmaso ; Davide Ford ; Dorothea Fonnesu [1]; Eduard Chyhyrynets

[1] *INFN*

SRF R&D activities at INFN LNL cover all the cavity production chain with the main goal of producing the first prototype of a Nb3Sn on Cu 1.3 GHz elliptical cavity by the end of 2025. In particular INFN is focusing on Cu surface preparation by Plasma Electrolytic Polishing (PEP) and Nb3Sn coatings by DC Magnetron Sputtering.
Cu surface preparation by PEP presents several advantages over traditional EP, including a superior removal rate up to 30 μm/min and a final surface roughness (Ra) lower than tens of nm. The process scaling to 1.3 GHz Cu elliptical cavity has been done successfully in 2024 and a collaboration with CERN and KEK is ongoing to validate the RF performances of PEP on a hydroformed seamless cavity produced by KEK and coated with a Nb thin film at CERN. First results are presented in this talk.
An optimized recipe for Nb3Sn on Cu films deposited via DCMS was first established on small flat samples and then validated on bulk Nb by measuring the RF properties on a QPR sample. A Tc>17 K and a surface resistance of 25 nΩ at 4.5 K, 20 mT, 417 MHz, was measured, which is about 5 times larger than the baseline specifications for the LHC Nb/Cu cavities, and already fulfills the requirements for the FCC-ee. Finally, the scalability of the coating recipe from small flat samples to an elliptical cavity prototype is also discussed.

FCC accelerator technical design / 150

TL magnet design status

Authors: Alexey Vorozhtsov[1]; Pierre Alexandre Thonet[1]

[1] *CERN*

Permanent magnets and conventional electromagnets were studies as candidates for the FCC-ee transfer lines. The preliminary 2D design was performed to evaluate the engineering parameters and cost for both options. The results were discussed and the electromagnets have been approved as a base line due to their capability of the magnetic field adjustment in a wide range, that is an important feature for the FCC-ee transfer lines.

Technical Infrastructure / 151

Transport concepts (personal and material)

Author: Damien Lafarge[1]

[1] *CERN*

Following the release of the Feasibility Study, this presentation will provide an overview of the concepts related to the transport of personnel and materials, as well as the roadmap for the objectives of the Pre-TdR phase.
Personnel transport includes vertical access through shafts and horizontal access to the workplace via personnel transport vehicles.
Material transport primarily addresses surface logistics on one hand, and on the other, the transport and installation processes, including examples of specific equipment currently foreseen, such as custom-made convoys for magnets and large and heavy pieces of equipment to assemble the beamstrahlung dumps.

Poster session / **152**

Beam Loss Monitoring simulations for the FCC-ee

Author: Fabian Titz[1]

Co-authors: Belen Maria Salvachua Ferrando [2]; Christos Zamantzas [2]; Anton Lechner [2]; Barbara Humann [2]; Sara Morales Vigo [2]

[1] *Vienna University of Technology (AT)*

[2] *CERN*

Although the stored beam energy in the FCC-ee will be lower than in the LHC, the extremely small vertical beam size leads to a high energy density. This poses a risk of damaging accelerator components, making machine protection essential. A Beam Loss Monitoring (BLM) system capable of quickly detecting and localizing beam losses is therefore needed to protect the machine by triggering the beam abort sequence when power deposition exceeds safe limits.
This work presents preliminary simulation results of energy deposition in ionisation chambers based on the LHC design, placed along a section of an FCC-ee arc half-cell. The expected detector responses are presented for losses from a 45.6 GeV electron beam in different scenarios. Those include impacts onto the beam pipe in both shielded and exposed parts of a dipole magnet.

Joint effort PED & accelerators / **153**

Polarized electron sources in LINACS

Author: Kurt Aulenbacher[None]

Highly spin-polarized electron bunches with polarization degrees of nearly 90% may be generated by photo-emission from semiconductor superlattice structures. I will discuss the cathode lifetime phenomena which limit the integrated electron fluence from the photocathode and hence the operational lifetime of a source. Fluences of 1000 Coulomb per square centimeter are possible. Whereas this can be sufficient for some of the applications presently discussed, another limitation of polarized electron generation is the fact that charge accumulation on the surface (”surface photovoltage”) may limit the fluence within a single bunch at nanosecond timescales. This may cause challenges for machines which need highly charged bunches of Nanocoulombs with a low emittance.

Poster session / **154**

Updated monochromatization Interaction Region optics design for FCC-ee GHC lattice

Author: Anna Korsun[1]

Co-authors: Angeles Faus-Golfe [2]; ZHANDONG ZHANG [3]

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[3] *IJCLab*

Measuring the Yukawa couplings of the Higgs boson remains one of the most critical and unresolved tasks since its discovery. The FCC-ee, with its extremely high integrated luminosity, provides a rare chance to probe the electron Yukawa coupling via s-channel Higgs production at a centre-of-mass energy of 125 GeV—on the condition that the energy spread can be reduced from 50 MeV to match the Higgs boson’s natural width of 4.1 MeV. To achieve this precision, a monochromatization mode has

been proposed, involving a special interaction region (IR) optics configuration with opposing-sign nonzero dispersion at the interaction point (IP). An initial optics layout and early beam dynamics studies have been conducted using version 22 of the FCC-ee GHC lattice. This paper introduces a refined and optimized monochromatization IR optics design, adapted to the updated 2023 version of the FCC-ee GHC optics.

Monday plenaries / **155**

Keynote - From HL-LHC to FCC

Author: Marumi Kado[1]

[1] *Max Planck Society (DE)*

Monday plenaries / **156**

FCC Feasibility Study Results

Author: Michael Benedikt[1]

[1] *CERN*

Monday plenaries / **157**

FCC Collaboration Status

Authors: Emmanuel Tsesmelis[1]; Gregorio Bernardi[2]; Philippe Pierre Chomaz[3]

[1] *CERN*

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[3] *Commissariat à l'énergie atomique et aux énergies alternatives (CEA)*

Monday plenaries / **158**

Implementation Scenario: Status and next Steps

Author: Johannes Gutleber[1]

[1] *CERN*

Monday plenaries / **159**

Civil Engineering

Author: Timothy Paul Watson[1]

[1] *CERN*

Monday plenaries / 160

Accelerator Design Status

Author: Frank Zimmermann[1]

[1] *CERN*

Monday plenaries / 161

Technologies and Technical Infrastructures

Author: Jean-Paul Burnet[1]

[1] *CERN*

Monday plenaries / 162

Theory challenges in precision calculations

Authors: Federico Buccioni[1]; Federico Buccioni[2]

[1] *Technische Universität München (TUM)*

[2] *University of Zurich*

Monday plenaries / 163

Flavour and BSM through measurements at 90 GeV and beyond

Author: Admir Greljo[1]

[1] *Universitaet Basel (CH)*

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Detector Concepts Overview: current ideas and challenges ahead

Author: Mogens Dam[1]

[1] *University of Copenhagen (DK)*

FCC-hh HFM / **165**

Protection of LTS and HTS magnets and circuits for FCC-hh

Authors: Arjan Verweij[1]; Jan Uythoven[1]

Co-authors: Emmanuele Ravaioli [1]; Mariusz Wozniak [1]

[1] *CERN*

This presentation introduces the concepts of magnet and circuit protection of the FCC-hh, focusing on the main dipole magnets. For the baseline case of 14 T Nb3Sn magnets, magnet protection is preferably provided by ESC, and eventually quench heaters to cover the low current regime, combined with cold by-pass diodes.
For the case of 14-20 T HTS magnets, a similar protection strategy is feasible, although more challenging. An alternative approach based on a 'no-quench'concept is also proposed. The advantages, disadvantages and limitations of the latter are presented.
Irrespective of the type of magnets, circuit protection is provided by energy extraction. Multiple circuits per arc are envisaged, with power converters and energy extraction systems located at the 8 access points, and an additional cryogenic distribution line to house the superconducting links feeding these circuits.

Poster session / **166**

Pion rejection studies for ALLEGRO's high-granularity noble liquid ECAL

Author: Martina Maria Koppitz[1]

[1] *Technische Universitaet Dresden (DE)*

Calorimeters based on liquified noble gases have demonstrated excellent performance over the past decades in various particle physics experiments, offering good energy resolution, linearity, uniformity, and stability. To achieve the goals of FCC's ambitious physics programme, future detector technologies must meet stringent performance requirements.

As part of an extensive R&D programme, the ALLEGRO (A Lepton-Lepton Collider Experiment with Granular Read-Out) detector concept is being developed as a general-purpose detector for the FCC-ee, designed to deliver high jet energy resolution, excellent particle identification and low systematic uncertainties.
Its electromagnetic sampling calorimeter combines noble liquid technology with multilayer printed circuit boards for signal readout, enabling a highly granular design. It features 11 longitudinal layers with cell sizes of about 2×1.8 cm^2 in the $\theta \times \varphi$ plane. The use of a strip layer with four times finer segmentation is under investigation to support particle flow reconstruction methods and to improve the pi0 rejection. Since π^0s decay into two photons that often produce overlapping showers, they can mimic single photon signatures in the detector. To address this, shower shape variables such as lateral width and energy distribution profiles, are being studied to characterize these subtle differences and improve discrimination.
Simulation studies are ongoing to evaluate the impact of various strip layer configurations on π^0 rejection performance. Preliminary results indicate that different shower shape variables are optimal at different energy ranges. Additionally, it was observed that showers tend to develop deeper in the detector than initially expected, suggesting that pushing the strip layer further back than originally planned could enhance performance.

This poster will present the current status of the calorimeter design and simulation studies, with a particular focus on photon/π^0 separation, and will outline future strategies for optimizing the design and preparations for the prototyping phase.

FCC-ee accelerator / 167

Electron-cloud effects and possible mitigations strategies

Author: Luca Sabato[1]

Co-authors: Lotta Mether [2]; Tatiana Pieloni [3]

[1] *EPFL - Ecole Polytechnique Federale Lausanne (CH)*

[2] *CERN*

[3] *EPFL*

The FCC-ee may face significant challenges related to electron cloud effects. These effects are expected to be most pronounced in the Z configuration, due to the highest number of bunches, which leads to the smallest bunch spacing, which is a key parameter in the e-cloud formation process. A high electron density within the beam pipe can limit accelerator performance through several mechanisms, including transverse instabilities, emittance growth, particle losses, vacuum degradation, and increased heat loads on the vacuum chamber walls. During the design phase, the goal is to suppress these unwanted effects. Consequently, various effective mitigation techniques have been investigated to prevent e-cloud avalanche build-up and its detrimental consequences.

Technical Infrastructure / 168

Heat recovery perspectives with CO2

Author: Armin HAFNER[1]

Co-author: Sarun Kochunni [1]

[1] *NTNU*

A novel CO_2-based architecture to recover, transport, and utilise surplus thermal energy across eight distributed sites is proposed as The Waste Heat Supply System (WHSS) for the Future Circular Collider (FCC).

The WHSS applies CO_2 in pressurised pipelines to transfer heat to decentralised heat pump - chiller units, where heat is delivered to end users and the CO_2 is liquefied.
Key optimisation strategies include: a) shifting FCC operational schedules to align with seasonal heat demand, b) transfer of surplus heat between surface sites via the tunnel, c) providing direct expansion AC with CO2 inside the entire tunnel, and d) buffering heat through Borehole Thermal Energy Storage (BTES) for weekly-to-seasonal load balancing.

Case studies show these strategies significantly reduce cooling tower demand and eliminate entirely cooling water transport and consumption. Compared to conventional water-based systems, the CO_2-based approach enables more compact infrastructure, higher delivery temperatures, and efficient heat recovery at multiple decentralised locations.

Technical Infrastructure / 169

New technologies for electrical transmission and distribution in FCC

Authors: Manuel Colmenero Moratalla[1]; Mario Parodi[1]

[1] *CERN*

The development of the power transmission and distribution network for the Future Circular Collider (FCC) involves the integration of advanced technologies aimed at improving efficiency, reliability, and resilience. Smart systems for real-time control of power flows and voltage regulation enable optimized energy management, reduce losses and ensure grid stability under varying conditions, including enhanced immunity against disturbances from the external transmission network.
The presentation will describe the principles that will guide the studies for the control of the electrical grid, including an overview of the activities currently ongoing with the project Research Infrastructure 2.0 (RF 2.0) to monitor and analyze the behavior of the existing network of LHC, with the aim of establishing the frame for an optimized and sustainable grid for FCC.

Poster session / **170**

Impact of powder granulometry on the transport properties of Ba122 superconducting tapes

Authors: Alessandro Leveratto[1]; Amalia Ballarino[2]; Andrea Malagoli[1]; Cristina Bernini[1]; Emilio Bellingeri[1]; Federico Loria[1]; Hafiz Mansoor Ul Hassam[1]; Matteo Bordonaro[1]; Valeria Braccini[1]

[1] *CNR-SPIN*

[2] *CERN*

The iron-based superconductor $\mathrm{Ba_{1-x}K_xFe_2As_2}$ (Ba122), with a critical temperature around 38 K and a very high upper critical field (Hc2), is a promising candidate for high-field magnet applications, including those envisioned in future particle accelerator technologies. In this context, CNR-SPIN and CERN have initiated a joint collaboration—within the framework of the High Field Magnets (HFM) program—to investigate the potential of Ba122 for use in accelerator magnet systems.
Among iron-based superconductors, Ba122 stands out for its relatively low anisotropy, good grain connectivity, and compatibility with the Powder-In-Tube (PIT) wire fabrication method. However, the performance of PIT-processed conductors is strongly influenced by the properties of the precursor powders. Key parameters such as phase purity, grain boundary quality, and particle size distribution must be carefully controlled to ensure good mechanical workability and high critical current density.
This work presents an overview of the strategies adopted to tailor powder characteristics, with particular focus on particle size control via potassium excess in the starting mixture or by adjusting the granulometry of the metallic precursors (e.g., iron)[1]. These parameters significantly affect the final microstructure and, consequently, the transport properties of the wires. Our findings provide insights into process optimization toward the development of next-generation superconducting conductors for high-field applications.

FCC-hh accelerator / **171**

Tl-1223 Superconducting Films for Beam Screen Coatings in FCC: Synthesis and Performance Validation

Author: Emilio Bellingeri[1]

[1] *CNR-SPIN*

Thallium-based cuprates, particularly Tl-1223, are of significant interest due to their high critical temperature (˜120 K) and their potential for applications in extreme environments. In this study, nearly pure Tl-1223 superconducting films were successfully synthesized by laser ablation or electrochemical deposition to deposit precursors onto single-crystal or texturing templates, followed by high-temperature treatments (up to 950℃) under moderate high-pressure conditions (up to 50 bar) to minimize thallium loss. Tl-1223's ability to maintain superconducting properties over a wide temperature range confirms its suitability for applications requiring low surface resistance in high magnetic fields. The produced films, approximately 1 μm thick and deposited on lanthanum aluminate

single crystals, exhibit biaxial texture. Growth mechanisms and crystallographic orientation were investigated using Electron Backscatter Diffraction (EBSD) and High-Resolution X-ray Diffraction (HRXRD), as a function of different deposition parameters and thicknesses. Transport measurements under magnetic fields up to 16 T, along with RF surface resistance measurements up to 12 T, allowed the estimation of key material parameters such as the irreversibility line and depinning frequencies, validating the material's robustness and its potential for next-generation particle accelerators and high-field RF applications.
The targeted material specifications have been successfully achieved; the study now advances towards the evaluation of scalability and applicability.

Poster session / **172**

Beam dump transfer line design in FCC-ee

Author: Sen Yue[1]

[1] *CERN*

The Future Circular lepton Collider (FCC-ee) is a proposed e+e– collider covering a beam energy range from 45.6 GeV to 182.5 GeV. In Z-mode operation, it will achieve the highest luminosity ever reached by any lepton collider, with a stored beam energy of up to 18 MJ. Due to synchrotron radiation damping, the vertical beam size will shrink to a few tens of micrometers, resulting in a maximum energy density of approximately 11 GJ/mm2 in the collider ring.
To safely dispose of this intense beam, a dedicated beam dumping system is essential. A transfer line is designed to increase the beam transverse size and thus lower the energy density at the dump. This contribution presents the design of the FCC-ee collider dump transfer line, excluding the absorber block, and highlights key aspects of machine protection and operational safety.

Technical Infrastructure / **173**

RF General Layout and Integration

Authors: Fani Valchkova-Georgieva[1]; Marc Timmins[2]

[1] *Bulgarian Academy of Sciences (BG)*

[2] *CERN*

This presentation outlines the ongoing developments in the RF straight sections located around points H and L, with a particular focus on the new designs of the 400 MHz and 800 MHz cryomodules, including the rationale for their specified dimensions. Integration studies are being carried out with careful consideration of spatial constraints, all within the 5.5 meters internal diameter of the tunnel. These constraints include underground infrastructure elements (such as access shafts and connection tunnels), the available straight section length, the dimensions of the cryomodules, and the provision of general services, such as electrical supply, cooling, and ventilation. Transport clearance volumes are also considered. The presentation will highlight current challenges encountered in the integration process as identified during the feasibility study and will explore potential solutions currently being considered for the pre-TDR phase.

Technical Infrastructure / **174**

ODH simulations: benchmark and access conditions to RF sector

Author: Guven Nergiz[1]

[1] *CERN*

The SRF cryomodules of the FCC-ee rely on liquid helium to reach their superconducting state. The 400 MHz cavity cryomodule will be cooled using 115 kg of helium at 4.5 K (He-I), whereas the 800 MHz cryomodule will use 55 kg of superfluid helium (He-II) at 2 K. Following a risk assessment, a few accident scenarios were identified as potential sources of helium release in the FCC tunnel. Such a release poses considerable risks for people working underground. A performance-based design approach, using numerical simulations in the form of computational fluid dynamics (CFD), provided an analysis of the ODH in the RF section of the FCC-ee accelerators.

Envelope studies were made for the feasibility study showing that with the cryomodules at nominal conditions (i.e., maximum inventory), the access to the RF section of the tunnel is restricted when the risk of such accident events is present. During the pre-TDR phase more precise studies are carried out to optimize the risk assessment and scenarios for the simulations, in view of revisiting the access conditions in the RF sectors. It is intended to extend these studies, for the further design of the FCC study to include the use of the emergency (smoke) extraction duct and measure the impact on the extent of the helium plug and cloud propagation, in view of iterating on the access conditions to the RF sector. This study will present the results of new studies as well as a benchmark validation case study with the controlled helium spill test data performed in the LHC.

FCC accelerator technical design / **175**

Preliminary design of FCCee collimators

Authors: Anton Lechner[1]; Antonio Perillo Marcone[1]; Regis Seidenbinder[1]; Richard Cowan[1]; Stefano Marin[None]

[1] *CERN*

FCC-ee requires a collimation system to isolate unavoidable beam losses and reduce particle backgrounds in the detectors, and to protect the machine in case of excessive beam losses from unstable or mis-steered beams at stored energies of 17.5MJ. The system is composed of primary and secondary collimators for betatron and momentum collimation, which will be located in one of the technical insertions of the 91 km ring, along with additional collimators and masks upstream of IPs to absorb syncrotron radiation, and additional injection and extraction protection devices, totalling over 100 individual devices for the final machine.
This presentation will provide an overview of current and upcoming work on the design for the FCCee collimators. Preliminary designs for primary and secondary collimators are underway. To maintain resilience against fast beam losses, replaceable collimator jaws and/or absorber blocks are considered for certain devices to reduce both machine downtime and cost. Moreover, tiltable jaws are considered, as this function could potentially improve the collimation efficiency. Studies on heating and deformation from energy deposited by the beam halo, endurance to beam impact and impedance optimisation are planned in the near future.

Civil Engineering / **177**

Online characterization of the excavated materials on the conveyor belt

Author: Robert Galler[None]

Environment / 178

Use of wastewater for FCC and society

Author: Leslie Alix[1]

[1] *CERN / CNRS (FR)*

Environment / 179

OpenSkyView field monitoring system

Author: Markus Marchhart[None]

Environment / 180

Environmental information system

Author: Sylvain Girod[1]

[1] *CERN*

The Environmental Information System (EIS) developed for the FCC feasibility study is intended to collect, manage, analyze, and visualize a wide range of environmental data related to the FCC area. This presentation will revisit the main requirements and challenges, provide an overview of the system's conceptual architecture and implemented solutions, and briefly outline ongoing work and planned improvements.

Environment / 181

Quantified environmental aspects

Author: Chiara Pancotti[None]

Environment / 182

Status of the waste heat supply concept

Author: Leslie Alix[1]

[1] *CERN / CNRS (FR)*

Technical Infrastructure / 185

Prepare now for the future: Robotics and CFRS interventions in FCC safety scenarios

Authors: Hannes Gamper[None]; Marc Nas[1]

[1] *CERN*

Ensuring a credible, feasible and sustainable safety response for the FCC requires planning for complex emergency situations. This presentation outlines a layered response concept involving self-sufficient workers, robotic support, AI-assisted monitoring, and human emergency responders. It reflects ongoing collaboration between the Safety WP, CFRS and robotics experts. The focus will be on current developments, integration challenges, and next steps to ensure safe operations and effective intervention strategies tailored to the FCC and its personnel.

Technical Infrastructure / **186**

Robotics update

Author: Hannes Gamper[None]

This presentation provides an overview of the Robotics Work Package launched in 2022, with key deliverables completed between 2023 and 2025. The results have been consolidated in the Feasibility Study Report, which serves as the foundation for the subsequent Robotic Automation for Maintenance and Safety Platform (RAMP) Work Package. RAMP outlines the critical tasks to be undertaken from 2025 onwards, aimed at enabling machine automation through advanced robotics. The presentation will detail the essential steps required to perform a comprehensive cost-benefit analysis, which will inform the appropriate level of automation for the Future Circular Collider (FCC). Furthermore, a preliminary assessment of the interdependencies between RAMP and other FCC Work Packages will be presented. The current status of prototype development for the optimal robotic system intended for deployment in the FCC main tunnel will also be showcased, including its planned integration within the FCC mock-up environment.

FCC-hh HFM / **188**

Status of HFM development at CIEMAT

Author: Fernando Toral[1]

[1] *CIEMAT - Centro de Investigaciones Energéticas Medioambientales y Tec. (ES)*

CIEMAT is contributing to HFM Programme by means of common coil magnets. ISAAC is the first step, a model magnet made using existing RMC coils produced by CERN. Mechanics is based on a low preload concept. As a second step, we have explored the space design of common coil magnets providing 14 T in a 50 mm aperture at 1.9 K. We have found very promising results for hybrid magnets using Nb3Sn and NbTi coils. DAISY will be our first common coil magnet demonstrator. We propose not featuring accelerator field quality, but addressing the mechanics of a hybrid magnet. In the future, we would target a hybrid common coil magnet performing accelerator field quality. CIEMAT is finishing the commissioning of SMART-Lab, a new facility for the development of high field magnet prototypes up to 2.5 m long and 10 tons.

Joint effort PED & accelerators / **190**

FCC-ee HTS CCT magnet design proposal for the final focus quadrupole and its cooled beam pipe

Author: Laurent BRUNETTI[1]

[1] *LAPP*

Superconducting Radio Frequency / **191**

800 MHz SRF cavity and cryomodule developments at FNAL towards FCC

Authors: Donato Passarelli[None]; Kellen McGee[1]; Mattia Parise[None]; Sergey Belomestnykh[None]; Vincent Roger[None]

[1] *Fermi National Accelerator Laboratory*

800 MHz SRF cavity and cryomodule developments at FNAL towards FCC have been progressing through active and fruitful collaboration with CERN colleagues. With the recently published FCC Feasibility Study Report, the 800 MHz systems have changed from 5-cell to 6-cell bulk Nb cavities, and employ 112 cavities in 28 cryomodules for the booster up through the ZH operating point. At the ttb operating point, the booster will require a total of 448 800 MHz cavities in 112 cryomodules, and the collider will have an additional 408 cavities in 102 cryomodules. The performance requirements of 20 MV/m at Q0 = 3e10 are challenging but feasible given optimization of current RF surface processing techniques. With support from CERN colleagues, FNAL is exploring medium-temperature baking in 5-cell and 1-cell cavity formats. In addition FNAL is collaborating on the mechanical design of the 6-cell cavities and cryomodules, based on experience with PIP-II designs and production. We present updates and future plans for 800 MHz SRF R&D for FCC in this talk.

FCC accelerator technical design / **192**

HTS4 development

Author: m Koratzinos[1]

[1] *Paul Scherrer Institute (CH)*

Superconducting Radio Frequency / **193**

Operation / reliability

Author: Andy Butterworth[1]

[1] *CERN*

Superconducting Radio Frequency / **195**

The transverse feedback system for FCC_ee

Author: Wolfgang Hofle[1]

[1] *CERN*

Superconducting Radio Frequency / **196**

Superconducting thin films devlepments for RF cavities at CEA

Author: Yasmine Kalboussi[None]

Superconducting Radio Frequency / **198**

HOM coupler sensitivity

Author: Sosoho-Abasi Udongwo[None]

Superconducting Radio Frequency / **200**

TEM analysis of coatings for RF cavities

Author: Johannes Bernardi[None]

Nb3Sn thin films are a promising candidate for use in superconducting radio frequency (SRF) cavities in order to achieve higher operating temperatures and reduced surface resistances.
Thin film with A15 phase can be manufactured e.g. by chemical vapor diffusion or DC magnetron sputtering.
In this work within the FCC Study, we present TEM, SEM and FIB investigations performed on thin Nb3Sn films produced by HIPIMS (High-Power Impulse Magnetron Sputtering) on copper substrates. We show that very good films can already be produced with this technique and how manufacturing conditions influence the quality of the films.

Civil Engineering / **201**

Advances in Derisking the FCC Tunnel Design: Update from the Geological Investigation Campaign

Author: Andrea Moscariello[1]

Co-authors: Guihlem Gabriel ; Roddy Cunningham [2]; Timothy Paul Watson [2]

[1] *University of Geneva*

[2] *CERN*

The Future Circular Collider (FCC) is envisioned as the next-generation particle accelerator, requiring an underground tunnel approximately 90 km in length. Given the significant scale of this infrastructure, a detailed understanding of the subsurface is critical for reducing geological and geotechnical uncertainties. This abstract provides an update on the recent progress made through the geological investigation campaign aimed at de-risking the FCC tunnel design.
The campaign integrates an extensive range of methods including high resolution 2D seismic surveys, deep drilling, laboratory testing, in situ stress measurements, and hydrogeological analysis. The multidisciplinary effort has focused on characterizing key geological domains along the proposed tunnel alignment, with emphasis on understanding lithological heterogeneity, fault architecture, and fluid flow behavior.
Particular attention has been paid to three structurally and geologically critical zones. In the Vuache region, new geophysical and stratigraphic data have revealed unexpected complexity in the Molasse

formations. This has provided a clearer understanding of the peculiar topography and surface deformation patterns in the area, which are now linked to previously unrecognized structural variations within the Molasse sequence. In the Bornes Plateau, the Bornes-1 deep well successfully penetrated a large aseismic thrust sheet, offering valuable geomechanical and lithostratigraphic information about the overthrusted sedimentary pile. The data acquired here has significantly improved modeling of stress redistribution and tunnel stability within this zone.
The Mandallaz anticline remains the most geologically sensitive sector along the FCC alignment. Composed of highly fractured Mesozoic carbonates, this zone posed a potential risk for intersecting karstic voids and unpredictable groundwater behavior. However, results from the campaign have confirmed the absence of large karst cavities, a key finding that reduces immediate concerns for tunnel construction. Nevertheless, due to the complex fault geometry and fracturing patterns, further detailed investigations will be required to constrain the hydrogeological regime, predict groundwater pathways, and assess potential fluid inflow during excavation.
Overall, the geological campaign has led to the delineation of risk zones along the tunnel path, enhancing the reliability of engineering models for tunnel alignment, excavation, and support design. This proactive approach has not only reduced uncertainty but also set a new benchmark for integrating geological science into large-scale infrastructure planning. Continued work in these critical areas will be essential for ensuring the safe and cost-effective realization of the FCC project.

FCC accelerator technical design / **202**

Overview of the BI developments for the pre-TDR phase

Authors: Robert Kieffer[1]; Thibaut Lefevre[1]

[1] *CERN*

FCC accelerator technical design / **203**

R&D of autonomous production line for CEPC magnets

Author: Wen Kang[None]

Poster session / **205**

Understanding Strange Tagging and its Uncertainties

Authors: Florencia Canelli[1]; Kyle Cormier[1]

[1] *University of Zurich (CH)*

The identification of jets initiated by a strange quark and discriminating them against jets initiated by other flavours of partons is a crucial piece of measuring the Higgs Yukawa coupling to strange quarks. While ML-based taggers have been trained on simulation to provide such simulation, its unclear which features of the simulation they are using in their discrimination and how this might be impacted by theoretical uncertainties on the modelling of jet production and the fragmentation process. We investigate some of the physics of strange jets, as produced in simulation, provide a first assessment of theoretical uncertainties on strange tagging and provide some thoughts on future directions.

FCC-ee injector / **206**

Positron Production for FCC-ee

Author: Iryna Chaikovska[1]

[1] *CNRS/IJCLab*

The high-luminosity circular collider FCC-ee will need a low-emittance positron beam with high enough intensity to shorten the injection time. In particular, operation at the Z-pole demands a positron bunch intensity of $2.14 \cdot 10^{10}$ particles at injection into the collider rings. The baseline design for positron production relies on a conventional source, where a 2.86 GeV electron beam impinges on a 15 mm thick tungsten target. The positrons are captured using an Adiabatic Matching Device (AMD), followed by a capture linac embedded in a DC solenoidal magnetic field, accelerating the positron beam to approximately 170 MeV. A chicane is employed to separate positrons from electrons after the capture linac, while solenoidal focusing continues up to positron energy of 930 MeV. Subsequently, the positron beam is transported through a matching section into a quadrupole-focused section and accelerated to the Damping Ring (DR) injection energy of 2.86 GeV. An energy compression system (ECS) is used upstream of the DR to maximize the number of positrons captured within the DR longitudinal acceptance. This contribution will present the current status of the FCC-ee positron source design, including the main challenges and a roadmap for future developments.

FCC accelerator technical design / 207

Booster magnets

Authors: Halil Deveci[None]; Luke Von Freeden[1]

[1] *CERN*

This presentation reviews recent progress in the design of the high energy booster magnets. We will summarize the proposed designs of the main arc magnets —dipoles, quadrupoles, and sextupoles — from the feasibility study report. Results from magnetic measurements of a short prototype dipole will be presented, highlighting implications for low-field performance. Finally, we will outline future directions for magnet system development as the project moves toward the pre-TDR phase.

FCC-ee accelerator / 208

Numerical tools for FCC-ee beam-beam studies

Author: Peter Kicsiny[1]

[1] *CERN*

This talk gives an overview on the FCC-ee studies enabled by the development of the Xsuite beam-beam model. A summary of ongoing projects and a review of the computational needs and challenges are presented.

Poster session / 209

Radiation damage study of the FCC-ee crystal-based positron source

Author: Fahad Alharthi[None]

Co-author: Iryna Chaikovska [1]

[1] *CNRS/IJCLab*

The design of the FCC-ee positron source based on the conversion of bremsstrahlung photons into e-/e+ pairs in the tungsten target has been carried out and integrated into the FCC Feasibility Study report. An alternative scheme exploiting lattice coherent effects in oriented crystals has been proposed. This contribution presents the conceptual design of this approach and preliminary results from a crystal irradiation study performed at the MAinz MIcrotron (MAMI) facility. The test aimed to identify the fluence threshold for degradation of the crystalline structure. The irradiated crystal showed no signs of structural damage after about 33 hours of irradiation, corresponding to a fluence of $1.13 \times 10^{19}\ \mathrm{e}^{-}/\mathrm{mm}^{2}$

Technical Infrastructure / **210**

Radiation environment in the FCC-ee arcs

Author: Barbara Humann[1]

Co-authors: Alvaro Romero Francia [1]; Anton Lechner [1]; Cedric Garion [1]; Fani Valchkova-Georgieva [2]; Jeremie Bauche [1]; Luke Von Freeden [1]; Marco Calviani [1]; Marco Morrone [1]; Marton Ady [1]

[1] *CERN*

[2] *Bulgarian Academy of Sciences (BG)*

The intense radiation environment in the FCC-ee tunnel, primarily driven by Synchrotron Radiation (SR) from high-energy electrons and positrons, presents significant challenges for accelerator components and nearby equipment. To mitigate these effects, localized photon stoppers and dedicated shielding have been implemented, reducing annual ionising dose levels in the tunnel to below 10 kGy. For radiation-sensitive electronics that must be installed close to the accelerator, a dedicated shielded bunker is foreseen to further reduce radiation exposure.
This presentation outlines both the baseline shielding design described in the Feasibility Report and an improved conceptual solution, highlighting the resulting radiation levels in the tunnel and within the electronics bunker as obtained from FLUKA simulations. Additionally, particle spectra inside the bunker will be presented to support a deeper understanding of the shielding approach and assess its effectiveness.

FCC accelerator technical design / **211**

Strategy for mitigating radiation to equipment in FCC-ee

Author: Anton Lechner[1]

[1] *CERN*

The radiation fields generated by synchrotron photons and beam losses pose a significant challenge for FCC-ee equipment. The annual ionizing dose can reach MGy-levels in the collider tunnel and requires dedicated shielding configurations in order to reduce the need of expensive radiation-hard equipment. A first shielding concept for the collider arc dipoles has been conceived in the Feasibility Study phase, demonstrating that a substantial reduction of the radiation levels is achievable. In addition, the option of housing accelerator electronics in a dedicated bunker near lattice quadrupoles has been explored, which can possibly allow for custom-off-the-shelf-based radiation tolerant electronics systems. This presentation summarizes the next steps and the goals for the pre-TDR phase. Key objectives are to review and consolidate the target radiation levels for the tunnel and the electronics

bunker, to derive radiation level specifications for equipment and infrastructure, and to progress on the mechanical design and integration of the dipole shielding and the bunker. The presentation highlights the present study directions, including a simplification of the dipole shielding topology and a larger photon stopper volume. Furthermore, the space requirements for the electronic racks and the integration options for the bunker are discussed. While most of the shielding studies in the Feasiblity Study phase focussed on the arcs, the presentation also outlines the study plans for the technical and experimental insertions.

FCC-ee accelerator / 212

Beam-beam effects in presence of errors: results and strategies for optics tuning

Author: Leon Van Riesen-Haupt[1]

Co-authors: Peter Kicsiny [2]; Tatiana Pieloni [3]; Xavier Buffat [2]; Yi Wu [1]

[1] *EPFL - Ecole Polytechnique Federale Lausanne (CH)*

[2] *CERN*

[3] *EPFL*

Xsuite enables detailed beam dynamics simulations including full lattice descriptions, synchrotron radiation, lattice errors, corrections and beam-beam effects. In this work we explore the interplay by these effects by systematically combining individual effects to produce and understand comprehensive simulations and complex behaviour. We also explore different dynamic indicators including emittance, luminosity, dynamic aperture, momentum acceptance and life times under these conditions and their correlations.

Physics, Experiments and Detectors / 213

ALPs

Author: Patricia Rebello Teles[1]

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Physics, Experiments and Detectors / 214

SMEFT@NLO for e+e-

Author: Anders Eller Thomsen[1]

[1] *University of Bern*

Physics, Experiments and Detectors / 215

Indirect BSM at FCC-ee

Author: Lukas Allwicher[None]

Physics, Experiments and Detectors / **216**

Higgs and new physics

Author: Roberto Franceschini[1]

[1] *Rome 3 U.*

Physics, Experiments and Detectors / **217**

Review FCC-hh

Author: Birgit Stapf[1]

[1] *CERN*

Physics, Experiments and Detectors / **218**

Improvement of EWPTs with $Z \to b\bar{b}$ measurements at FCC-ee

Author: Leonardo Toffolin[1]

[1] *Universita e INFN Trieste (IT)*

Physics, Experiments and Detectors / **219**

FCC-ee bounds on SMEFT

Author: Frank F Deppisch[None]

Physics, Experiments and Detectors / **220**

QCD at FCCee

Author: Stefan Kluth[1]

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Physics, Experiments and Detectors / **221**

Overall summary of recent workshop on Tracking Detectors at BNL

Author: Christoph Paus[1]

[1] *Massachusetts Inst. of Technology (US)*

Physics, Experiments and Detectors / 223

Summary of Gaseous and SciFi trackers from recent BNL workshop on Tracking Detectors

Author: Fabrizio Palla[1]

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Physics, Experiments and Detectors / 224

Muons Systems (technologies and performance studies)

Author: Bing Zhou[1]

[1] *University of Michigan (US)*

Physics, Experiments and Detectors / 226

Silicon and SiPM-Scintillator Calorimeters

Author: Vincent Boudry[1]

[1] *LLR, CNRS, École polytechnique, Institut Polytechnique de Paris*

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Noble-Liquid Calorimetry

Author: Zhibo Wu[1]

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Optical Readout Calorimetry

Author: Bob Hirosky[1]

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Physics, Experiments and Detectors / **229**

Status of the ARC

Author: Serena Pezzulo[1]

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Physics, Experiments and Detectors / **230**

Review Higgs 1

Author: Xunwu Zuo[1]

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Physics, Experiments and Detectors / **231**

Review Higgs 2

Author: Alexis Maloizel[1]

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Physics, Experiments and Detectors / **232**

Review Top

Author: Matteo Defranchis[1]

[1] *CERN*

Physics, Experiments and Detectors / **233**

Review Flavor and Future Prospects

Author: Stephane Monteil[1]

[1] *Université Clermont Auvergne (FR)*

Physics, Experiments and Detectors / **234**

General Status of the Software

Author: Brieuc Francois[1]

[1] *CERN*

Physics, Experiments and Detectors / 235

FCC Detector Models

Author: Alvaro Tolosa-Delgado[1]

[1] *CERN*

Physics, Experiments and Detectors / 236

Reconstruction status and plans

Author: Sang Hyun Ko[1]

[1] *Seoul National University (KR)*

Physics, Experiments and Detectors / 238

Analysis and visualization

Author: Juraj Smiesko[1]

[1] *CERN*

Physics, Experiments and Detectors / 239

Detector Requirements Summary from FSR

Author: Andrea Sciandra[1]

[1] *Brookhaven National Laboratory (US)*

Physics, Experiments and Detectors / 240

Review BSM

Author: Rebeca Gonzalez Suarez[1]

[1] *Uppsala University (SE)*

Physics, Experiments and Detectors / **241**

EWK needs & priorities

Author: Josh Bendavid[1]

[1] *CERN*

Physics, Experiments and Detectors / **242**

Tracking with ML

Author: Andrea De Vita[1]

[1] *Universita e INFN, Padova (IT)*

Physics, Experiments and Detectors / **243**

ParticleFlow with ML

Author: Lena Maria Herrmann[None]

Physics, Experiments and Detectors / **244**

Tagging with ML

Author: Sara Aumiller[1]

[1] *Technische Universitat Munchen (DE)*

Joint effort PED & accelerators / **245**

TID and Fluence in the detector and IR

Author: Alessandro Frasca[1]

[1] *University of Liverpool (GB)*

The high beam energies and intensities foreseen at FCC-ee pose significant challenges in terms of radiation environment. To support the design of the machine-detectore interface and ensure the long-term reliability of sensitive systems, a detailed FLUKA model of the interaction region has been developed to predict both component radiation load and tunnel radiation levels. This talk presents first results on total ionising dose and particle fluence in the IDEA detector, along with updated radiation maps for Z-pole operation. The study includes key source terms such as incoherent pair creation, radiative Bhabha scattering, and beam-gas interactions.

Joint effort PED & accelerators / 246

Studies towards a depolariser design

Author: Wolfgang Hofle[1]

[1] *CERN*

Physics, Experiments and Detectors / 247

CLD plans

Author: Andre Sailer[1]

[1] *CERN*

Physics, Experiments and Detectors / 248

IDEA plans

Author: Paolo Giacomelli[1]

[1] *Universita e INFN, Bologna (IT)*

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ALLEGRO plans

Author: Martin Aleksa[1]

[1] *CERN*

Physics, Experiments and Detectors / 250

ILD plans

Author: Victor Schwan[1]

[1] *Deutsches Elektronen-Synchrotron (DE)*

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TDAQ plans

Author: Juraj Bracinik[1]

[1] *University of Birmingham (GB)*

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FCC-hh & HFM

Author: Vladimir Shiltsev[1]

[1] *NIU*

Friday summaries / 253

Civil Engineering

Author: Timothy Paul Watson[1]

[1] *CERN*

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Technical Infrastructure

Author: Klaus Hanke[1]

[1] *CERN*

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Injector & Booster

Author: Paolo Craievich[1]

[1] *PSI*

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Accelerator

Author: Kevin Daniel Joel Andre[1]

[1] *ESRF*

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Accelerator R&D including RF

Author: Tor Raubenheimer[1]

[1] *SLAC National Accelerator Laboratory - On Leave (US)*

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EPOL

Author: Jacqueline Keintzel[1]

[1] *CERN*

Friday summaries / **259**

MDI

Author: Manuela Boscolo[1]

[1] *INFN e Laboratori Nazionali di Frascati (IT)*

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Physics

Author: Jan Eysermans[1]

[1] *Massachusetts Inst. of Technology (US)*

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Early Career Researchers

Author: Armin Ilg[1]

[1] *University of Zurich*

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Concluding Remarks

Poster session / **263**

Synchrotron Radiation Diagnostics for Transverse Profile Measurements at FCC-ee

Author: Daniele Butti[1]

Co-author: Stefano Mazzoni [1]

[1] *CERN*

Beam profile diagnostics will play a crucial role in the commissioning and efficient operation of the electron–positron Future Circular Collider (FCC-ee). Non-invasive techniques are essential to avoid beam perturbations during regular physics operations. As is customary in high-energy lepton colliders, transverse diagnostics at FCC-ee will primarily rely on synchrotron radiation. Given the picometer-level emittances expected, diagnostics in the x-ray domain are the most suitable choice. Optimal locations for transverse beam monitoring have already been identified in the current collider lattice design.
Pinhole cameras have been selected as the baseline solution, offering robust and precise beam size monitoring from the early stages of commissioning. Additionally, more advanced techniques based on synchrotron radiation interferometry are being investigated to further enhance diagnostic accuracy. As the project moves toward the Technical Design Report stage, the main objective for the study of transverse diagnostics is the engineering design and integration of the synchrotron radiation extraction lines.

FCC-ee accelerator / **264**

GHC vs LCC design concepts and next steps for pre-TDR phase

Author: Ghislain Roy[1]

[1] *CERN*

Two families of optics, GHC and LCC, are being developed for the FCC-ee collider; they are based on different designs, involving different requirements, sensitivities to errors and tuning strategies, which have an impact on hardware specification and procurement and operation. Comparing these two designs implies a multi-criteria evaluation, beyond the pure performance reach. The steps required for this comparative evaluation and the further development of the optics from a conceptual design to a technical design will be outlined.

Poster session / **265**

FCC-ee Integration Requirements for Injection-Extraction Equipment

Authors: Bruno Balhan[1]; Dylan Standen[1]; Giorgia Favia[1]; Jan Borburgh[1]; Laurent Sylvain Ducimetiere[1]; Lucien Porta[1]; Pavlina Trubacova[1]; Peter Burkel[1]; Sen Yue[1]; Thomas Kramer[1]; Wolfgang Bartmann[1]; Yann Dutheil[1]

[1] *CERN*

This study provides an overview of integration and space requirements for fast pulsed kicker magnets, septa and their power converters and controls for the FCC-ee booster and collider injection, extraction and dump systems.

The position of the magnet, septa in the tunnel is defined by the optics, then their technology selection is based on the required pulse parameters; rise time, flat top stability and duration, deflection angle, voltage and impedance of the transmission signal.
Mainly for kicker magnets the integration of adequate power converters is crucial due to the limitation of the cable length ensuring the correct pulse form and voltage to ensure correct beam manipulation and reduce risetime degradation and flat top droop.
Thus, the required space for power converters for each individual equipment and their cable length optimisation was carried out and several iterations of proposed placements were presented in context of full FCC-ee integration model.
Additionally, an adequate position of cables installation and injection/extraction equipment accessories are studied as attention must be paid to the synchrotron radiation dose received from the beam.

Superconducting Radio Frequency / **266**

SRF R&D 1.3 GHz test results at CERN

Author: Kristof Brunner[None]

Co-authors: Carlota Pereira Carlos [1]; Guillaume Jonathan Rosaz [2]; Lorena Vega Cid ; Stewart Leith [2]; Valentin Giglia ; Walter Venturini Delsolaro [2]

[1] *Universite de Geneve (CH)*

[2] *CERN*

Niobium coated copper cavities proved their usefulness in several accelerators (e.g. LHC, HIE-ISOLDE). They allow operation at 4.5 K instead of 1.9 K leading to significant increase in the efficiency of cryogenic cooling. The main limitation of these cavities have been the significant Q-slope (the degradation of quality factor with increasing accelerating gradient). Another difficulty is caused by the thermoelectric currents induced in the bimetal junction between the niobium and the copper. Several years of research have been dedicated to produce better substrates and to optimize the coating parameters, to reach the target performance necessary for FCC-ee. In this work I present the results of the past measurements, as well as our current aim at improving the cavity performance, and achieving more reproducible cavity preparation and testing, as reproducibility will be critical to produce the number of cavities necessary for FCC-ee.

Joint effort PED & accelerators / **267**

MDI overview and IR mockup status

Author: Manuela Boscolo[1]

[1] *INFN e Laboratori Nazionali di Frascati (IT)*

The talk will give an overview of the MDI-related ongoing studies with an outlook on the prospects and goals for the next pre-TDR phase.
The status of the R&D on the IR mockup will also be reported, with first cooling tests on the Aluminium central chamber prototype.

Poster session / **268**

Coherent plane ground wave impact on the FCC-ee beam centroid

Author: Mael Le Garrec[1]

Co-authors: Agnès Dominjon [2]; Freddy Albert Poirier [3]; Gael Balik [4]; Giovanni Lamanna [3]; Isabelle De Bonis [3]; Jean-Philippe Baud [2]; Laurent BRUNETTI [4]; Matthieu Marchand [3]

[1] *Laboratoire d'Annecy de Physique des Particules (CNRS IN2P3-LAPP)*

[2] *CNRS/IN2P3 - LAPP*

[3] *Centre National de la Recherche Scientifique (FR)*

[4] *LAPP*

The FCC-ee is a collider, proposed after the LHC era, based on a ring of approximately 90 km of circumference. It will have to be able to accommodate beams running at half the z-pole and $t\bar{t}$-pole with vertical Interaction point beam size less than 40 nanometer at the z. In the present studies, coherent ground motions are being explored with particle tracking tools such as MAD-X and analytics code. The effect of parameters, such as harmonics, phase, orientation, defining global vertical sine waves like motion, are hence being detailed. At the time of writing, several lattices are subject to investigations. The differences in term of beam centroid for the main lattices and energy running will also be exposed. The impact of these motions of the machine detector interface quadrupoles is discussed.

FCC-ee accelerator / **269**

Alternate optics for the FCC-ee

Author: Kevin Daniel Joel Andre[1]

[1] *ESRF*

FCC-ee injector / **271**

Update on the filling scheme

Author: Hannes Bartosik[1]

[1] *CERN*

FCC-ee injector / **272**

Positron Target Design, Fabrication –Updates on P3 Integration

Author: Ramiro Francisco Mena Andrade[None]

FCC-ee accelerator / **273**

Spin polarization in the EIC electron storage ring

Environment / **274**

Site architecture and landscape integration concept

Author: Tue Hesselberg[1]

[1] *EFFEKT*

Presentation by Tue Hesselberg, EFFEKT.

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Detector

Author: Fabrizio Palla[1]

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Industry and Technology Day / **276**

Opening remarks

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CERN, FCC and its contribution to Europe's competitiveness

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Industrial impact potentials and opportunities of the FCC-ee

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The impact of high-tech software development with CERN: The case of ETM

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From fundamental science to society: the MedAustron co-construction with industry

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Partnership Industry-Academia-CERN for sustainability developments: The economic importance of sustainable ways for the management of excavated materials for Europe

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Q&A with audience

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Overview on CERN's present research and development directions

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Present and Upcoming Opportunities at CERN

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Exemplary case studies from CERN knowledge transfer

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Examples for supplier contracts with Austrian companies

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Final remarks

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Professional Project Management and Public Engagement for Large-Scale Infrastructure by ÖB

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Cross-Border Collaboration: Challenges and Insights from Brenner Base Tunnel¶

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Logistics and material management for large tunnel construction projects & design of underground construction site facilities – suitable contract models for the early involvement of potential contracto

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Execution of large-scale projects in regards to logistic potentials

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Closing remarks

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Bayesian Optimization for IP Aberration Correction and Luminosity Tuning in FCC-ee

FCC-ee luminosity optimization relies on measuring realistic signals from Bhabha scattering, beamstrahlung, and radiative Bhabha photons. Initial assessments of beamstrahlung signals examine the change in luminosity, beamstrahlung power and vertex detector hits in response to waist shifts, vertical dispersion and skew coupling at the collision point. These ongoing studies aim to extract IP-aberration-related signals from the energy spectrum, angular distribution, power of beamstrahlung photons, the vertex detector hits and the luminosity. Furthermore, the study integrates all these signals into a machine-learning-based approach for luminosity tuning and optimisation.

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