PAUL SCHERRER INSTITUT

PSI


Mattia Schaer on behalf of the FCC-ee Injector Collaboration :: Paul Scherrer Institute

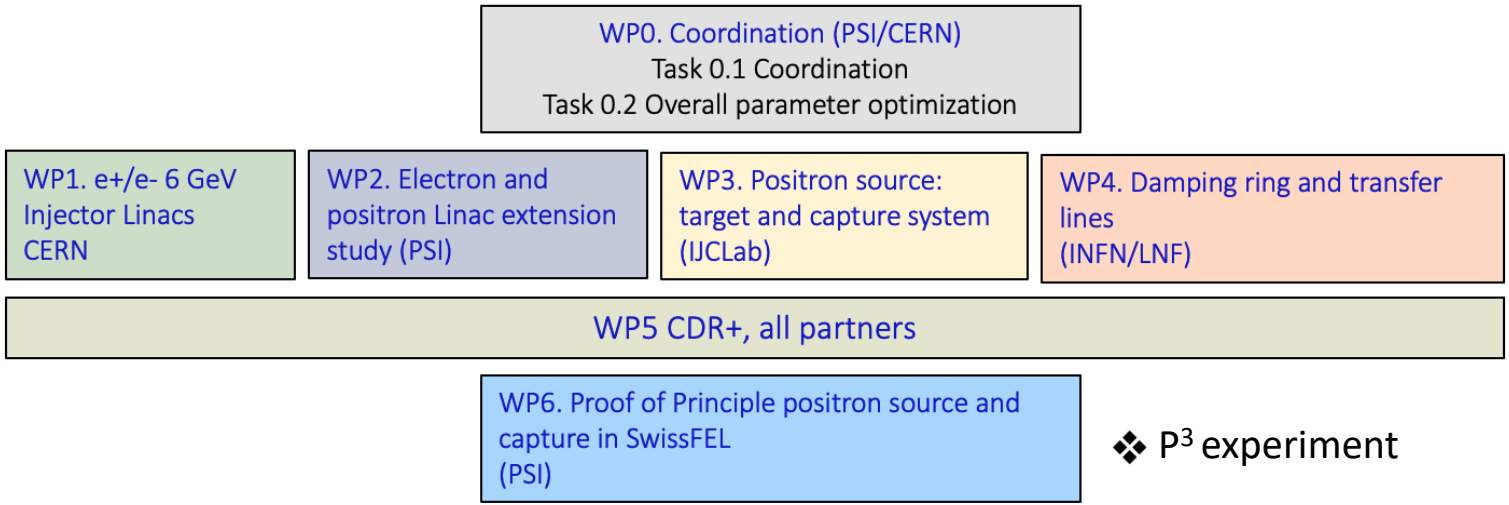
# FCC-ee Injector Baseline and P$^3$ Experiment

CHART Workshop, PSI, 11.10.2023

# FCC-ee Injector Study

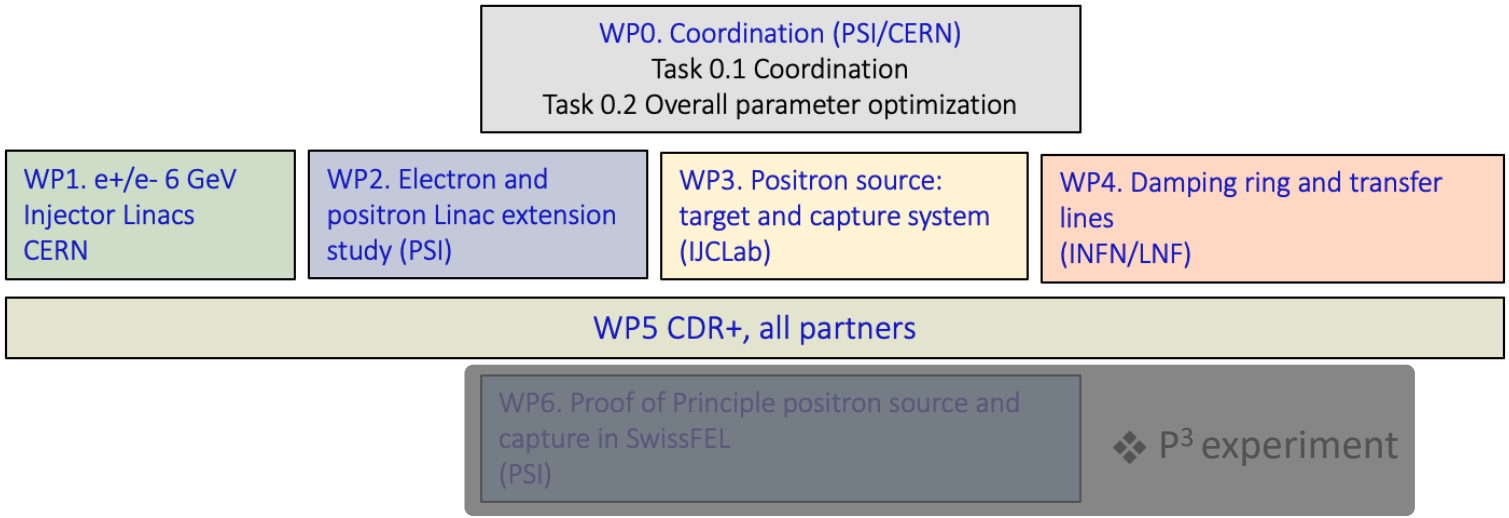
Collaboration between PSI and CERN with external partners:

CNRS-IJCLab (Orsay); INFN-LNF (Frascati); SuperKEKB – as observer, also interested in the $P^3$ experiment; INFN-Ferrara – radiation from crystal



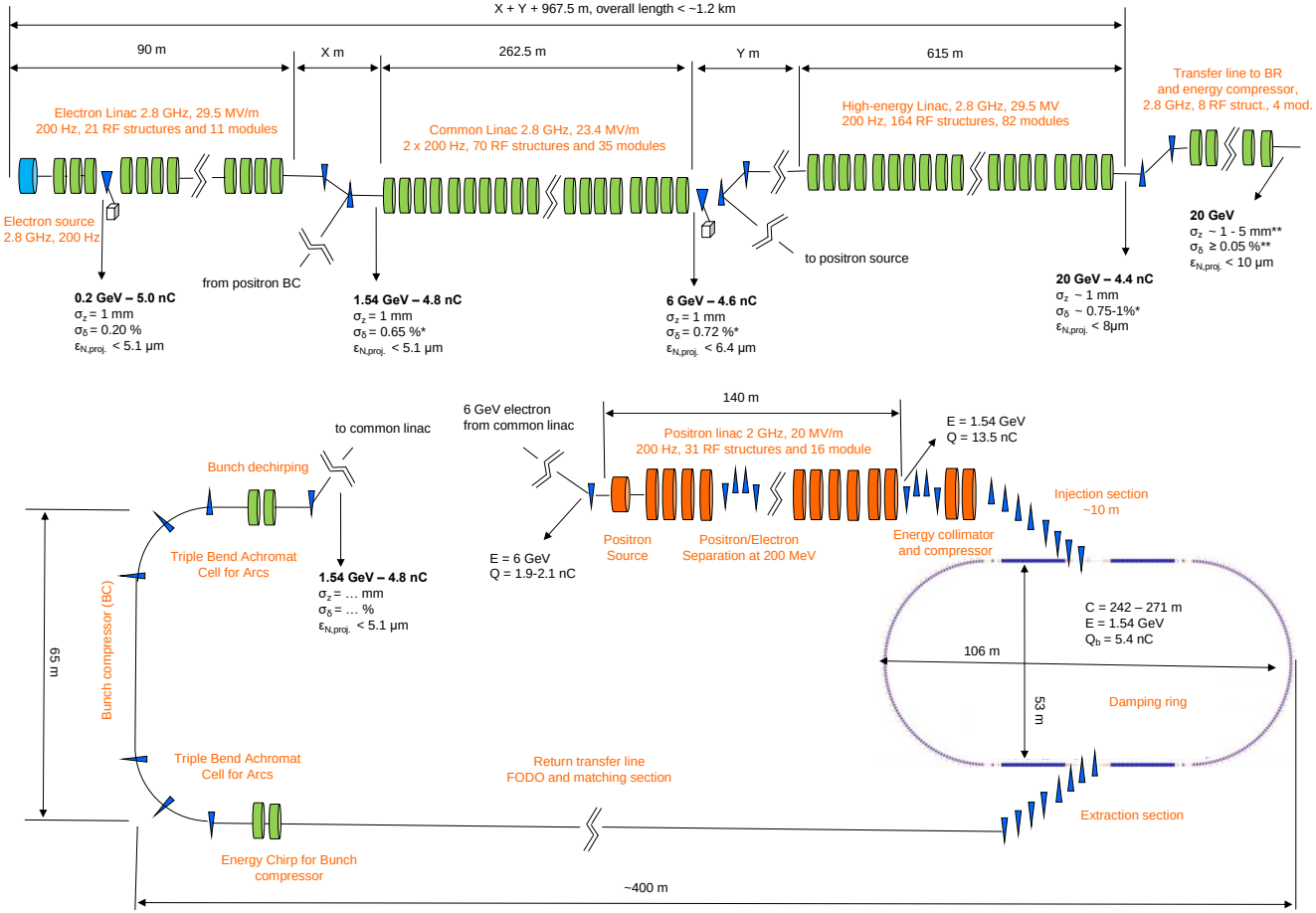

- CDR+ and cost estimate
- $P^3$ experiment

# CDR+ and Cost Estimate for FCC-ee Injector




❖ CDR+ and cost estimate

# Schematic Layout of Proposed Injector Complex




Result of:

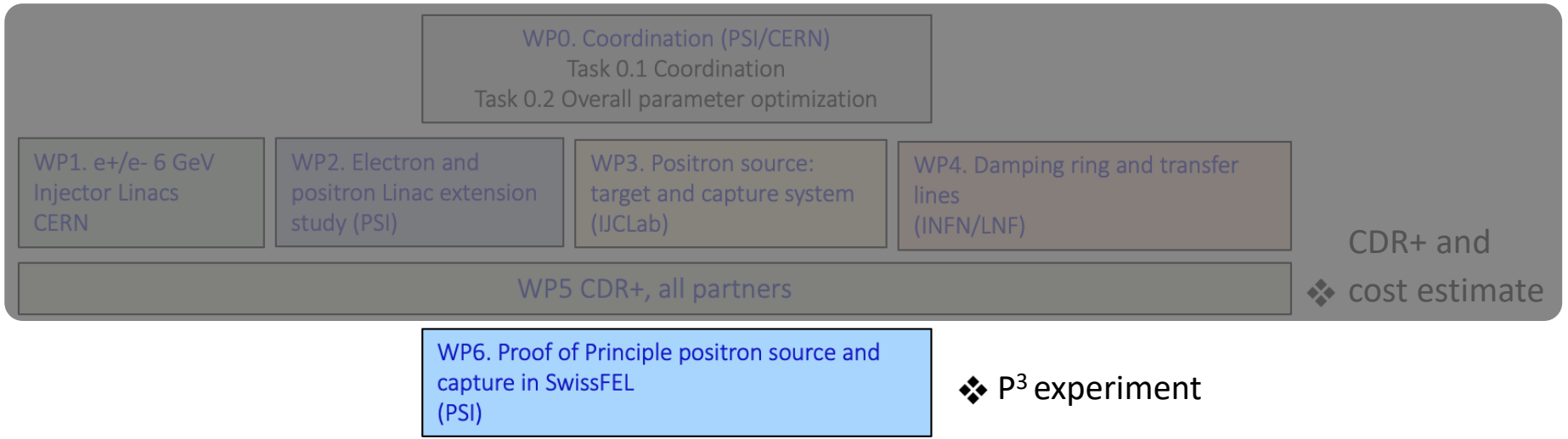
- Beam dynamics sim.
- RF design
- RF system optim.
- Magnet design
- Target design
- Radiation protection sim.
- Overall layout optim.

# FCC-ee Injector Study, Status and Outlook

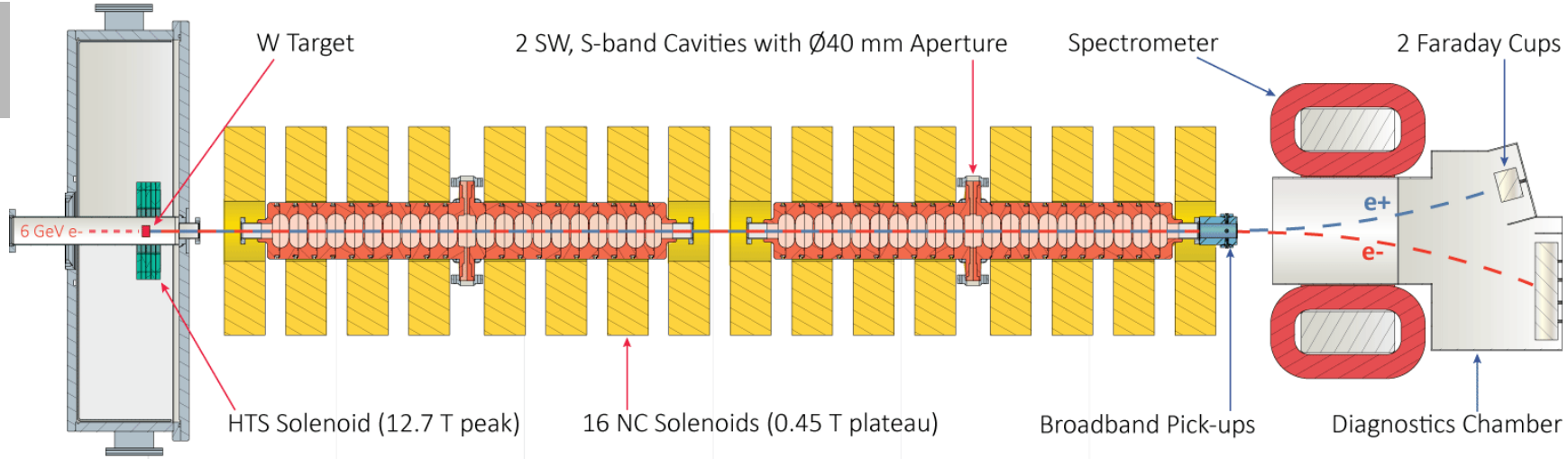
- Baseline injector layout ready
  → Fulfilling the latest requirements of the collider rings
- Corresponding cost estimate for the hardware ready

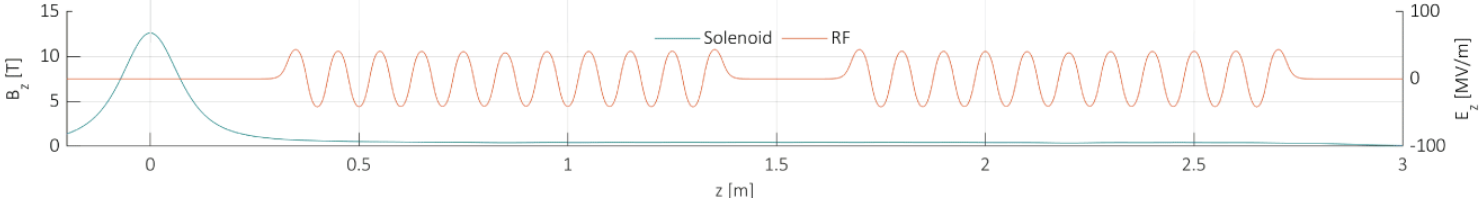
- FCC Feasibility Study: mid-term review on 16.10.2023 will provide feedback
  - Confirm/change overall machine parameters (collider)
  - Is SPS still an option as a pre-booster?
- Revise injector layout or
  write CDR+ based on presented baseline layout

# PSI Positron Production (P3) at SwissFEL (PSI)



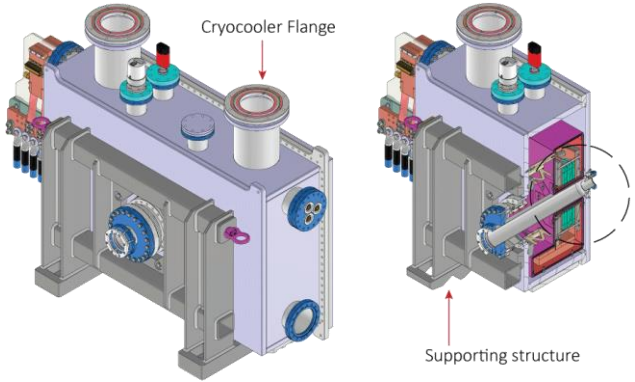
# The P3 Experiment in a Nutshell

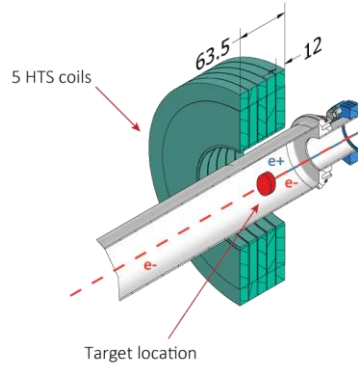


# Novel Components under Development at PSI

**HTS solenoid** ReBCO, 15 K, 2 kA, 12.7 T on-axis



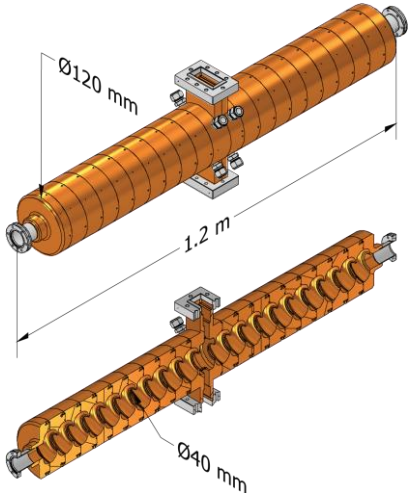




**RF S-band SW cavities**

40 mm aperture (d)

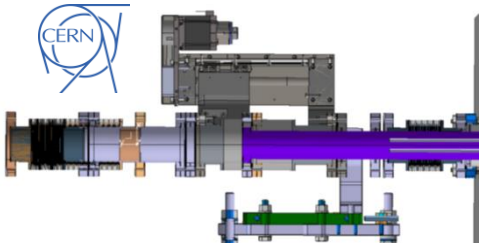
central double feeder

18 MV/m, 14 MΩ/m



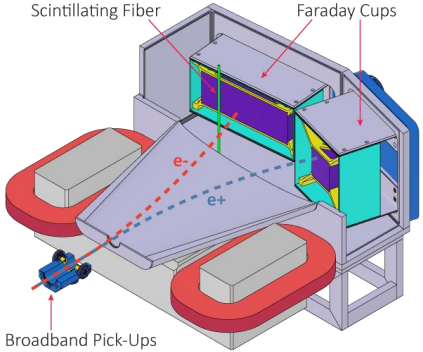

**Target device**

Δz = +/- 50 mm




27 and 65 GHz pick-ups

**Diagnostic chamber**



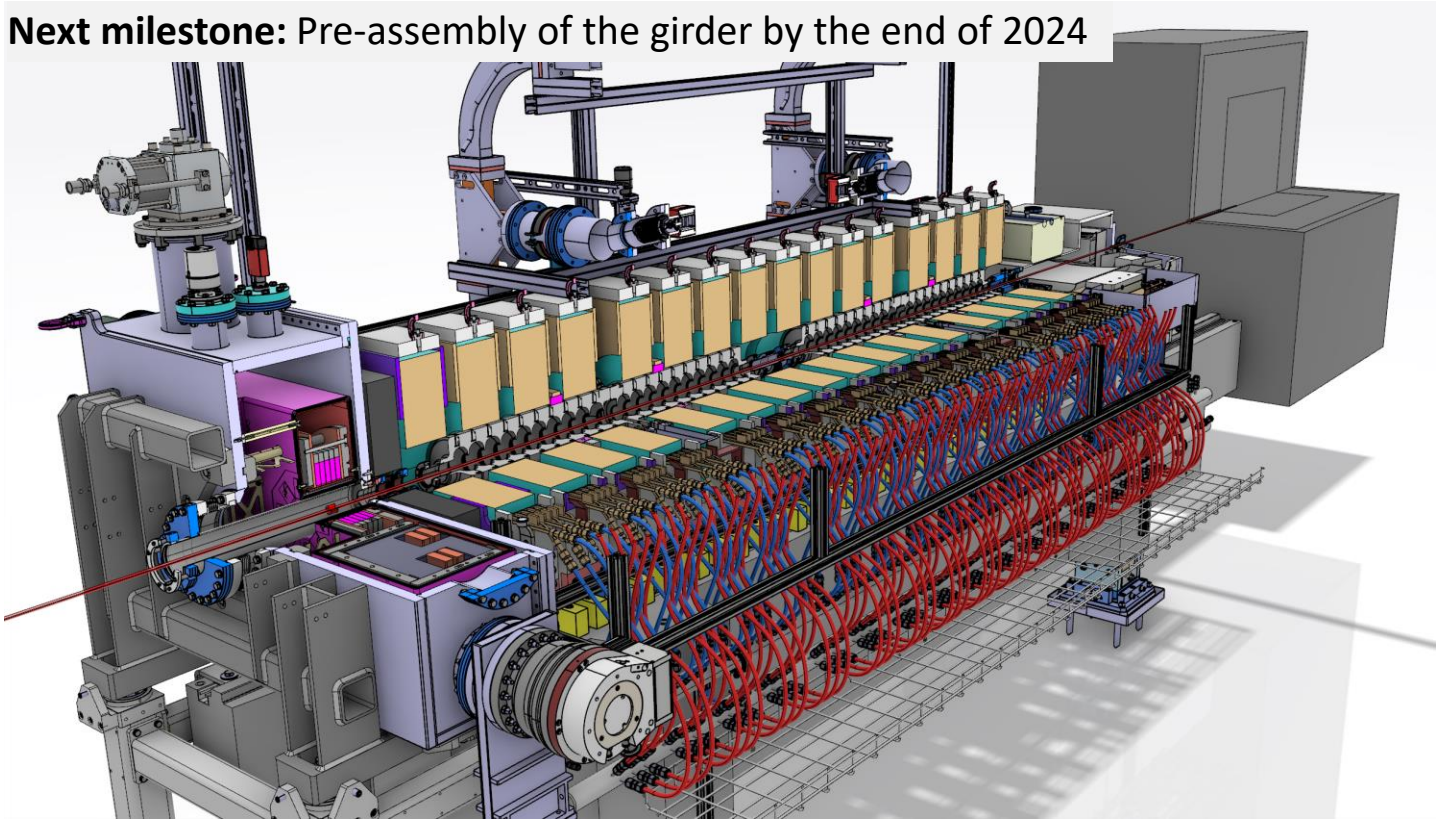
# P3 Status

Concept design
Engineering in progress
Ready for Order
Delivered

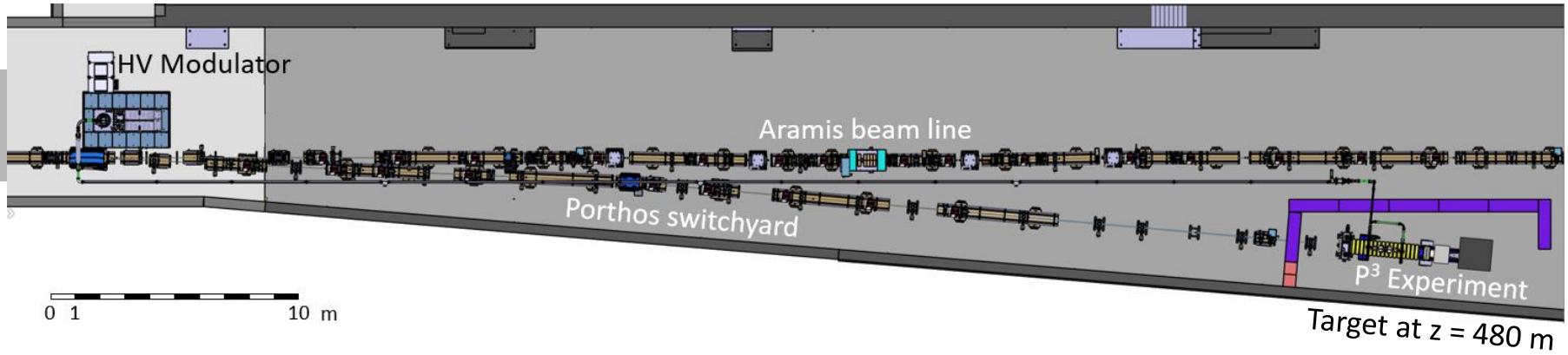
| | | |
|---|---|---|
| **Physics Studies** | Parameter Optimization | **Complete** |
| | Conical Targets Study | **In progress** |
| **Capture Section** | HTS Solenoids | **Design complete, components ordered** |
| | 2 RF Cavities | **Ordered, cups partially delivered** |
| | 16 NC Solenoids | **Design complete, waiting for offers** |
| **Diagnostics** | Broadband Pick-ups | **Assembled at PSI, tests with beam at CLEAR (CERN) Nov. 23** |
| | Faraday Cups | **Mechanical design in progress** |
| | Scintillating Fibers | **Location defined, technical design to be developed** |
| | Diagnostics Chamber | **Mechanical design in progress, to be reviewed with diagnostics team** |
| | Spectrometer | **Mechanical design for complete, ready for modification** |
| **Installation at SwissFEL** | Klystron-Modulator system | **Procurement of key components in progress** |
| | Waveguide Network | **Waveguide network layout complete, most waveguide components borrowed from CERN** |
| | Porthos Switchyard | **Design complete, most components ordered and delivered, preliminary installation works** |
| | Radiation Protection | **Study advanced, to be discussed with BAG** |

# P3 Outlook

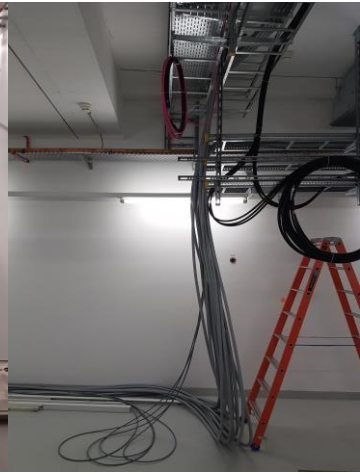
**Next milestone:** Pre-assembly of the girder by the end of 2024



# Porthos Switchyard and P³ Installation




- Status:
  - Technical design Porthos switchyard complete
  - Most beamline components delivered
  - All girder footplates installed
  - Cables for magnets and BPMs installed
- Next steps:
  - Q4 2023: Start pre-assembly of Porthos girders
  - Spring Shutdown 2024: Aramis modification complete
  - Summer Shutdown 2024: Start Porthos installation



# Credits

| | |
|---|---|
| PSI: | R. Zennaro, M. Schaer, N. Vallis, B. Auchmann, I. Besana, S. Bettoni, H. Braun, M. Duda, R. Fortunati, H. Garcia-Rodrigues, D. Hauenstein, E. Hohmann, R. Ischebeck, P. Juranic, J. Kosse, F. Marcellini, T. Michlmayr, G. L. Orlandi, M. Pedrozzi, J.-Y. Raguin, S. Reiche, R. Rotundo, M. Seidel, S. Sanfilippo, N. Strohmaier, M. Zykova and all technical groups involved in the $P^3$ exp. |
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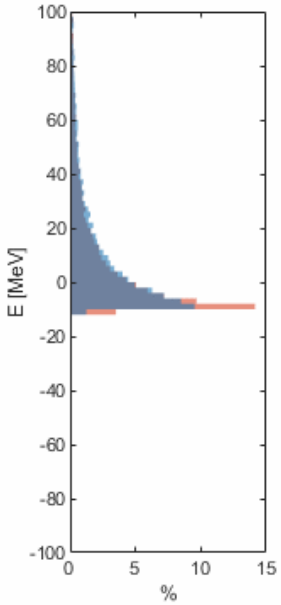
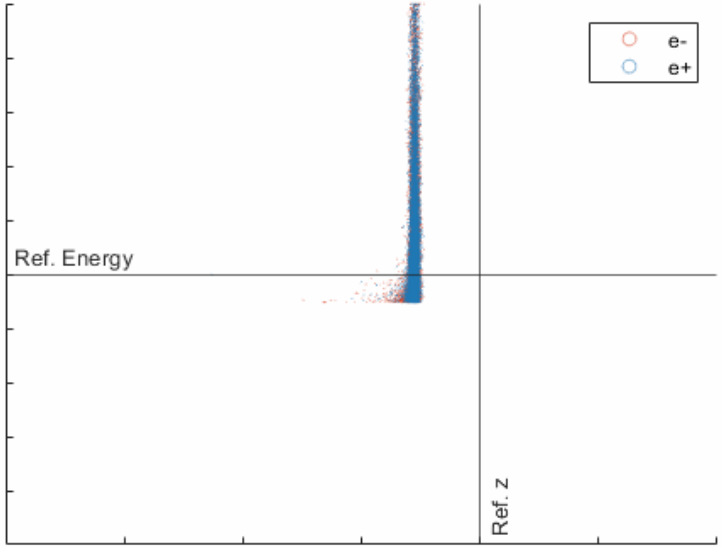
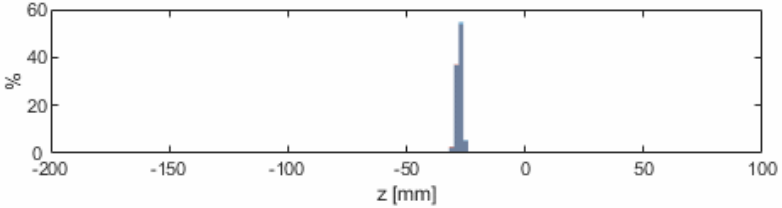
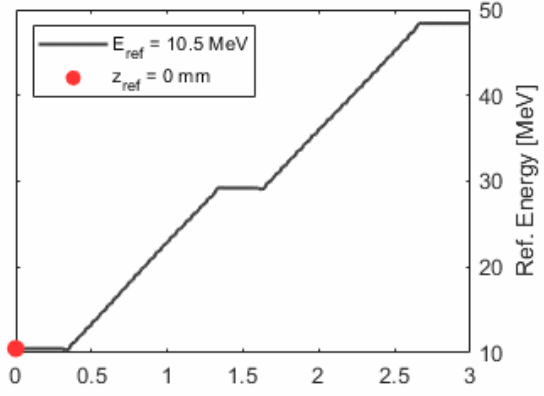

E [MeV]
%


e-
e+
Ref. Energy
Ref. z


%
z [mm]


E_ref = 10.5 MeV
z_ref = 0 mm
Ref. Energy [MeV]