COMET status and plan and demonstrator at J-PARC

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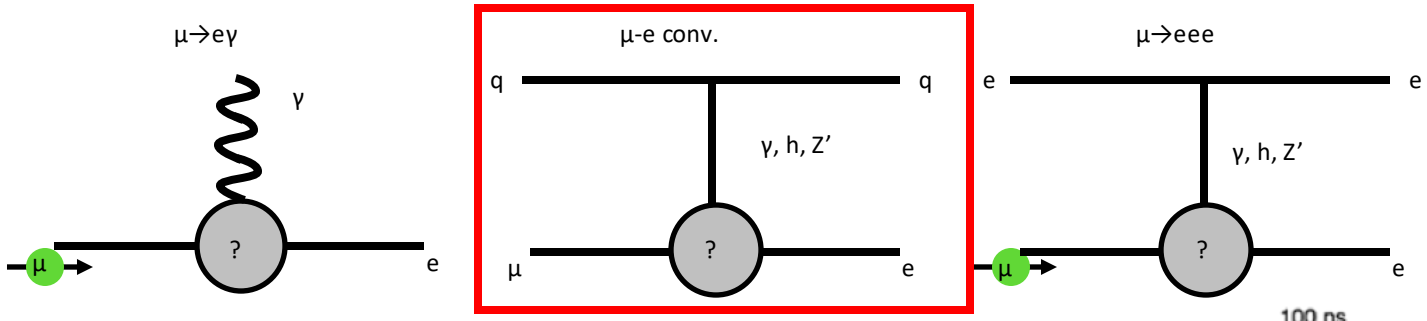
Contents

- COMET Introduction
- COMET schedule and plan
- Demonstrator in COMET ?
- Summary

μ-e conversion search at J-PARC (COMET)

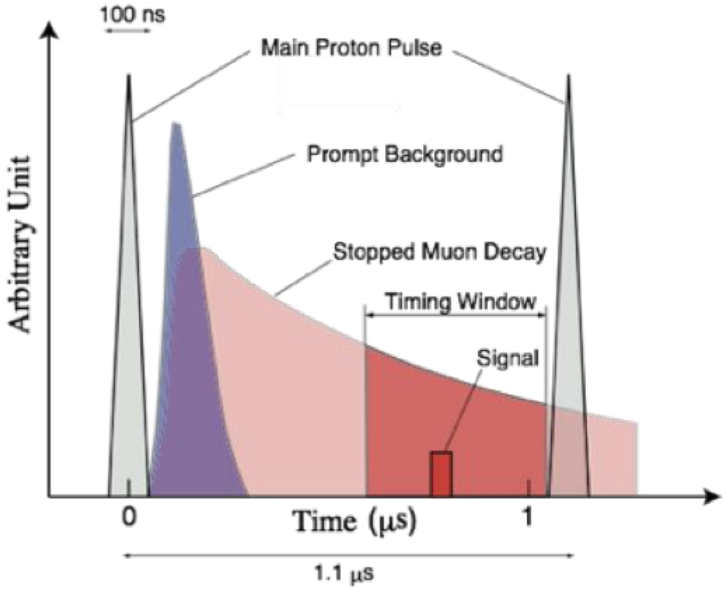
- Forbidden in SM or very small O(10^{-54}) even if ν oscillation is taken into account due to tiny neutrino mass
  - → **NO SM physics BG!**
- Many new physics models predict the existence of μ-e conversion **just below the current limit of SINDRUM II at 7x10^{-13} (PSI)**
  - Induced by new particle(s) with flavor mixing caused by right-handed neutrino introduction



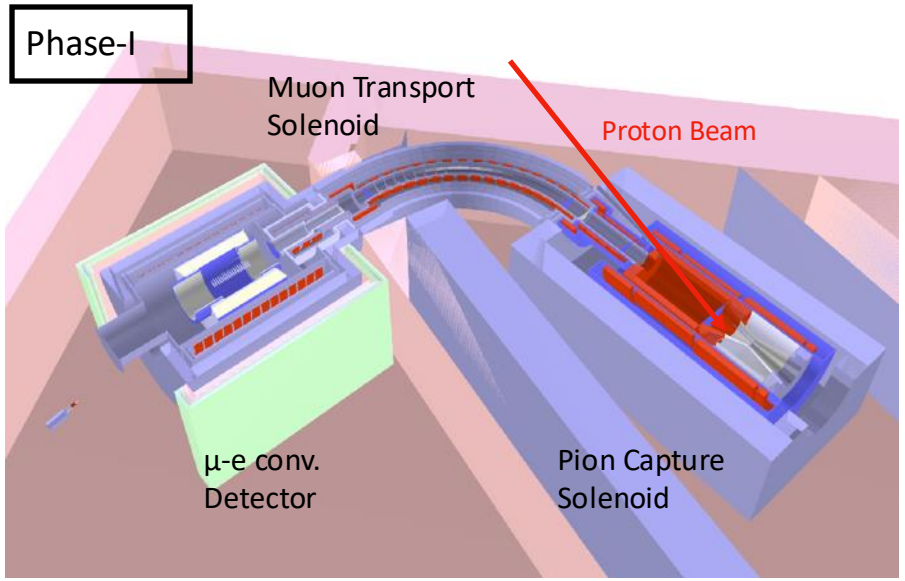
Muon cLFV Trio

COMET at J-PARC

- Search for the μ-e conversion in muonic alminium
- Bunched SX proton beam at 8 GeV
  - Extremely purely pulsed beam (R_{ext} < O(10^{-11}))
- Two-staged approach
  - < 10^{-14} in Phase I, 3.2 kW beam
  - < 10^{-16} in Phase II, 56 kW beam



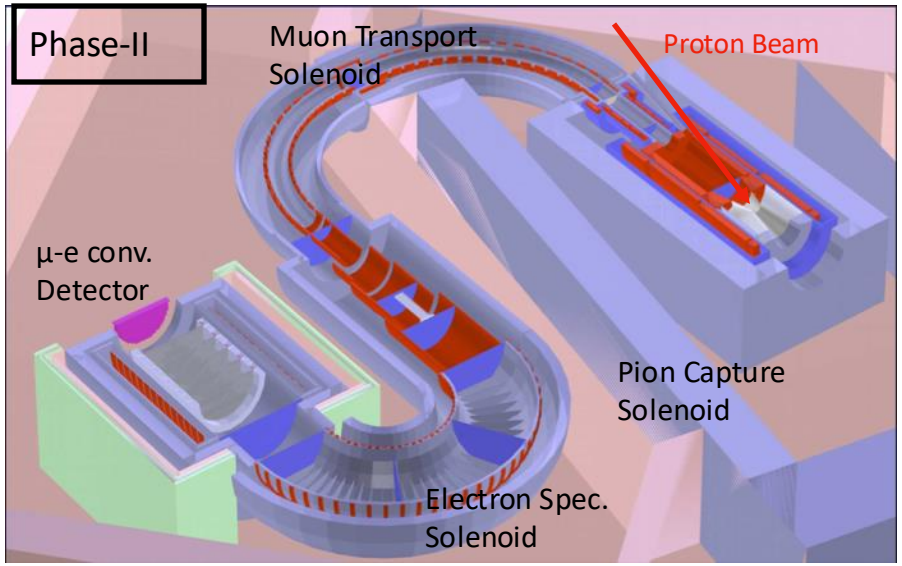
COMET staging approach to the final goal



Target Sensitivity $<10^{-14}$ with 3.2kW beam

- **Proton beam line** construction completed in **FY2021**
- **Graphite** as a pion production target
- Pion Capture Solenoid construction is in the 2nd year of multi-year construction contract (FY2020-2023)
- Physics Detector
  - CDC and hodoscope in a solenoid
  - Muon stopping target (Al) at the center of the solenoid

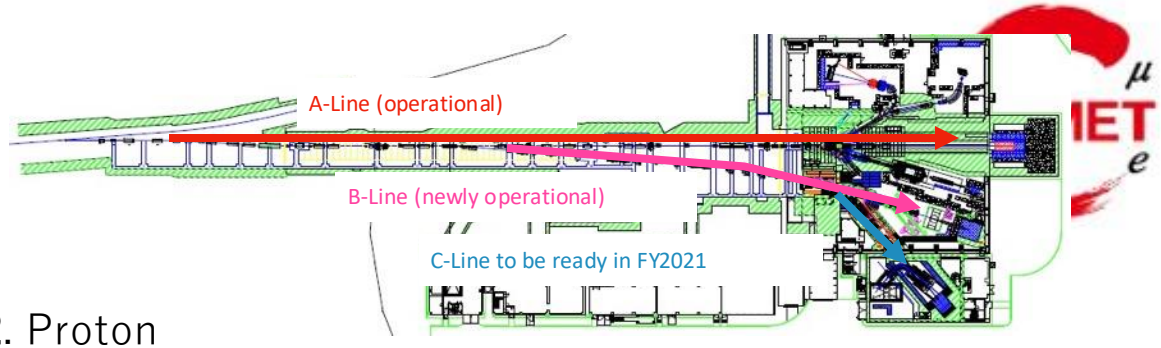
Beam engineering run in FY2022 and physics in FY2026-.



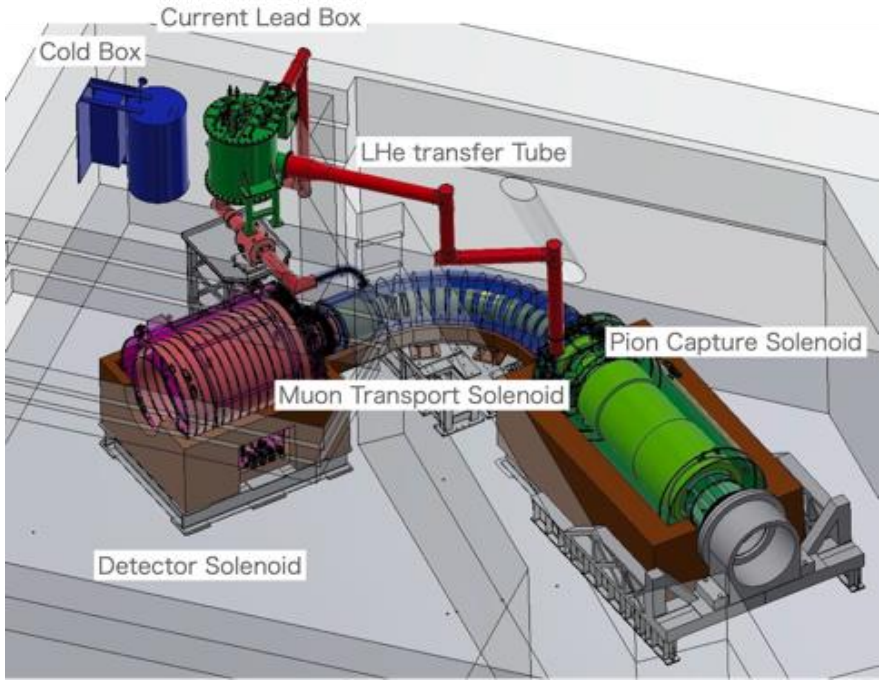
Target Sensitivity $<10^{-16}$ with 56 kW beam

- **Extension of muon transport solenoid** to **cope with higher proton beam power**
  - More efficient beam background suppression
  - Pions decay to muons in longer transport
- **Tungsten alloy** as a pion production target
- **Electron spectrometer solenoid** to suppress the detector counting rate
- Physics detector
  - Straw-tube tracker and LYSO calorimeter
  - Muon stopping target (Al + others) in a gradient magnetic field for the purpose of signal electron collection with a magnetic lens

COMET Phase-I

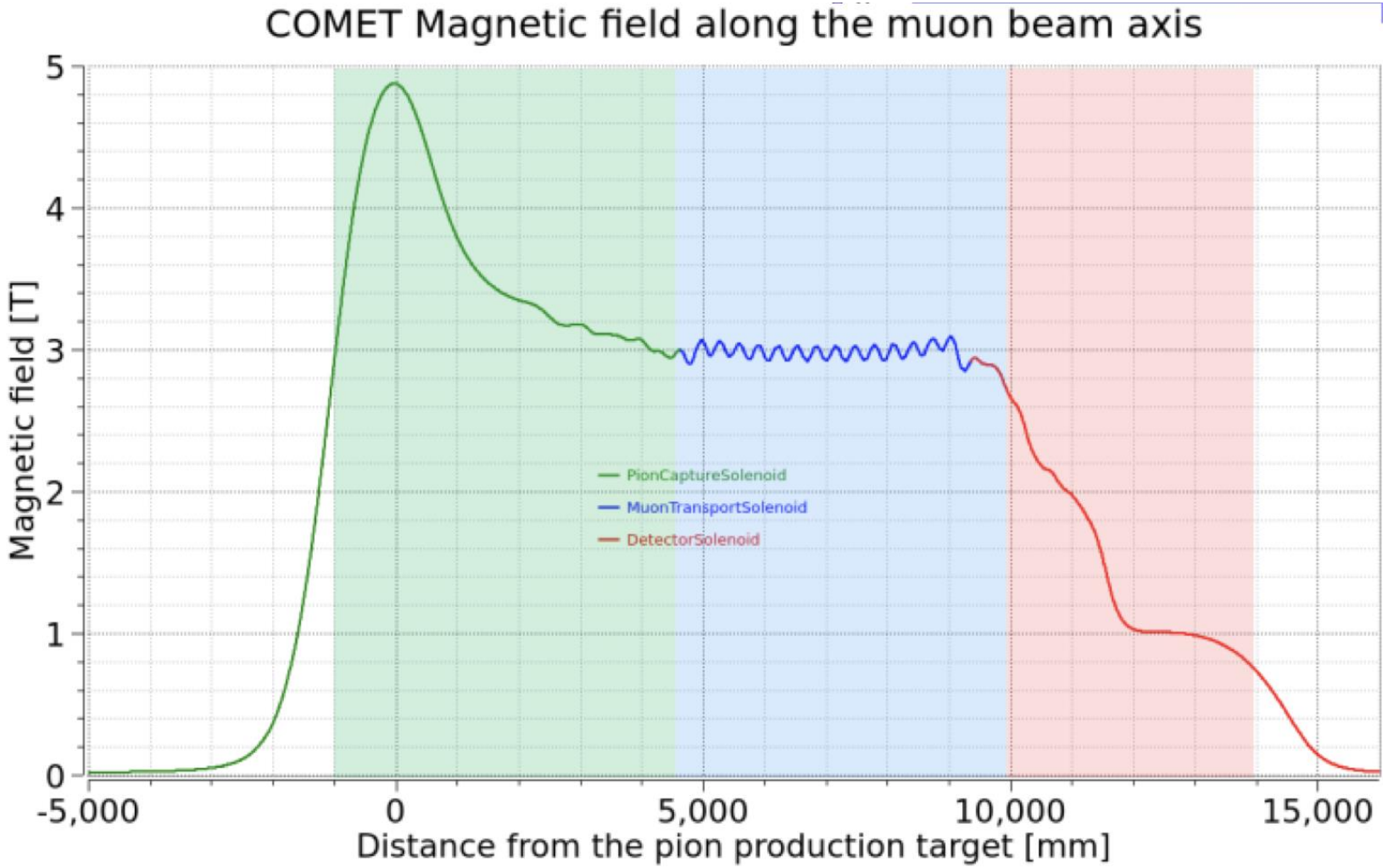


- **Proton transport beamline**
  - **Ready in FY2021**
  - **Beam engineering run** with a thin graphite target **in FY2022**. Proton beam diagnostics & backward pion production (@8GeV) as well as background survey like anti-protons.
- **Solenoid magnet system**
  - **Pion capture solenoid (PCS) has been delivered in Oct. 2024**
    - Cold mass assembly (FY2020), Cryostat construction (FY2021), and final assembly (FY2022)
  - Cryogenics system to be ready in FY2022 for the engineering run
- Physics detector in preparation by the COMET collaboration toward **Physics run in FY2026-2028**



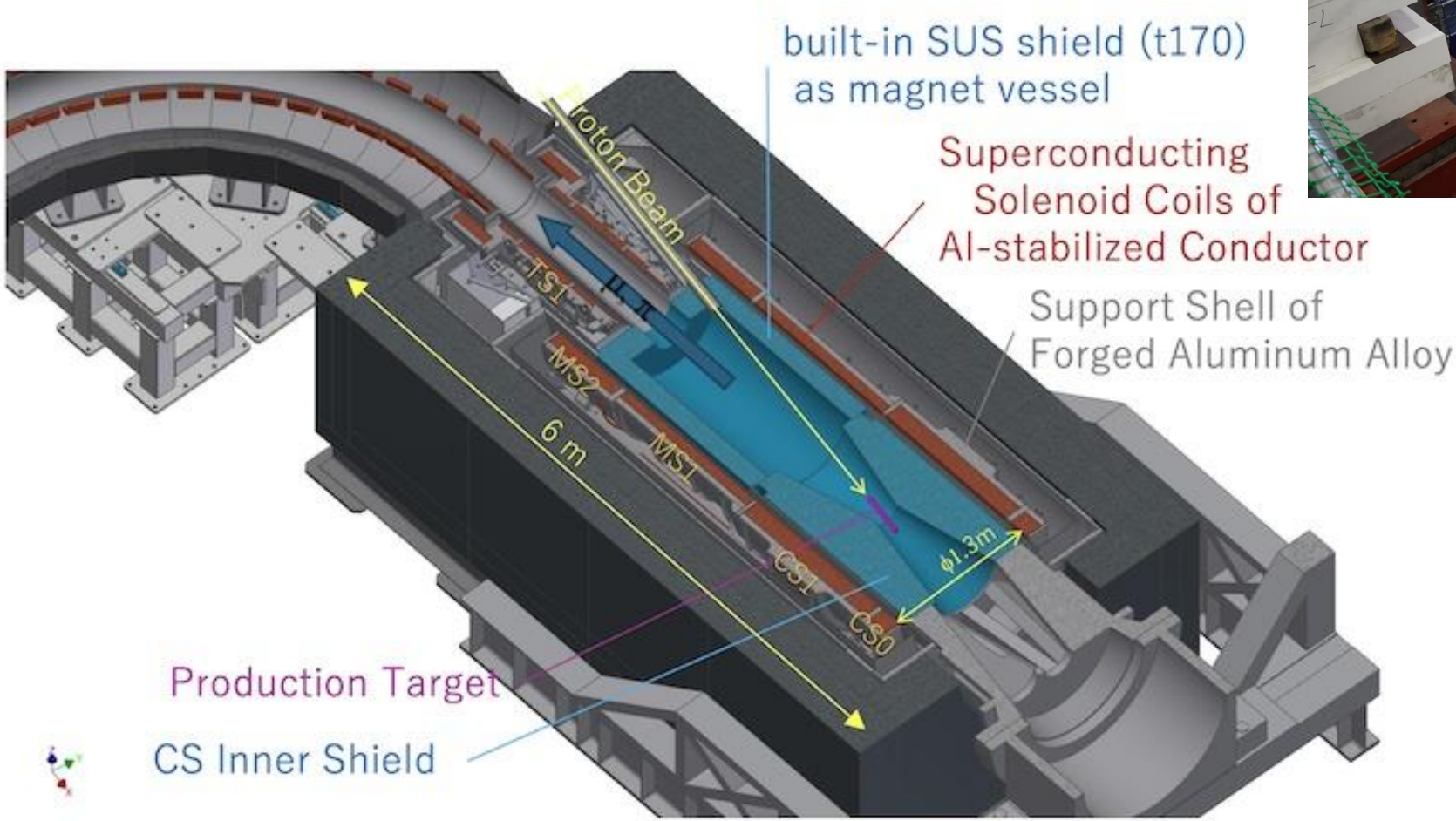
Magnet System in COMET Phase I

- Capture Solenoid
  - Cooled with LHe
  - 5T-3T
- Transport Solenoid
  - Cooled with LHe
  - Curved solenoid (3T) + dipole (0.07T)
- Detector Solenoid
  - Cooled with Cryocoolers
  - 1T

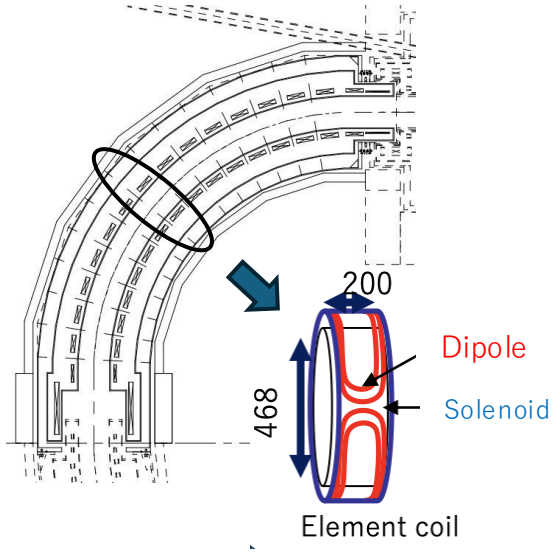


COMET Capture Solenoid

Delivered 30 Oct.2024



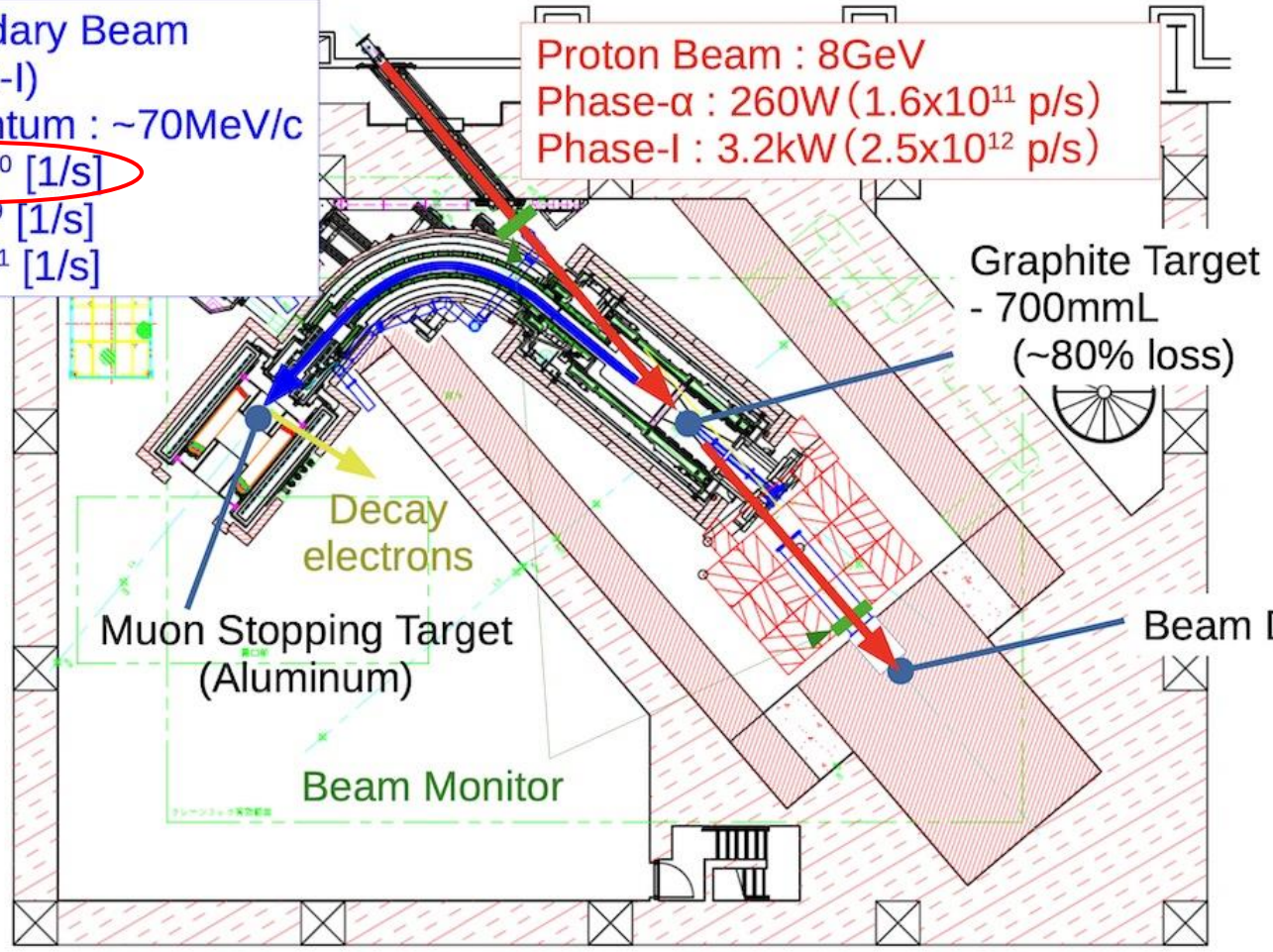
COMET Transport and Detector Solenoids

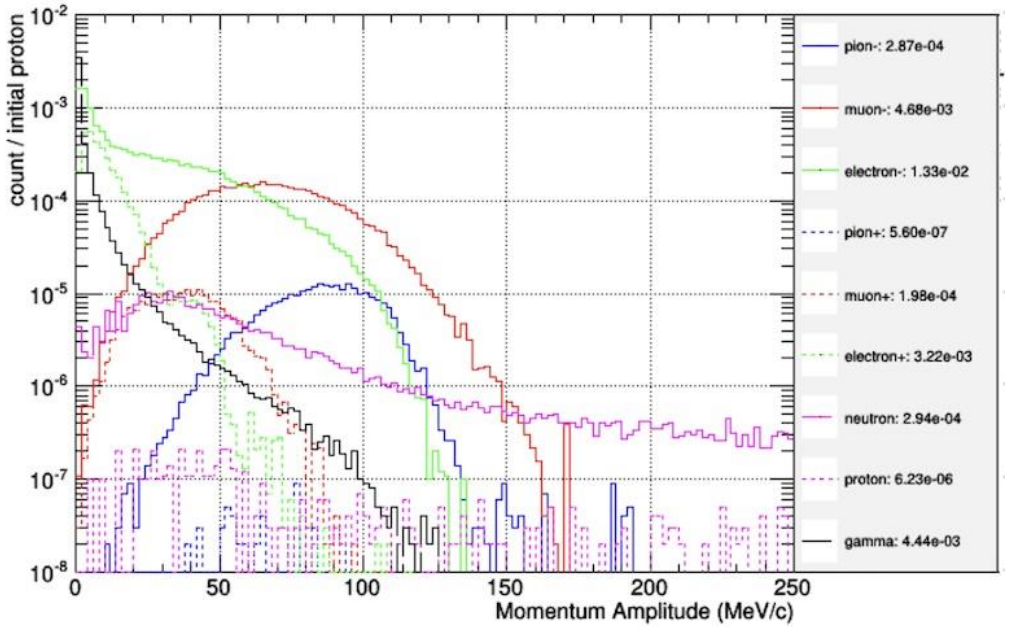


Muon Beam in COMET Phase I

Secondary Beam
(Phase-I)
Momentum : ~70MeV/c
μ^- : 10^{10} [1/s]
π^- : 10^{9} [1/s]
e^- : 10^{11} [1/s]

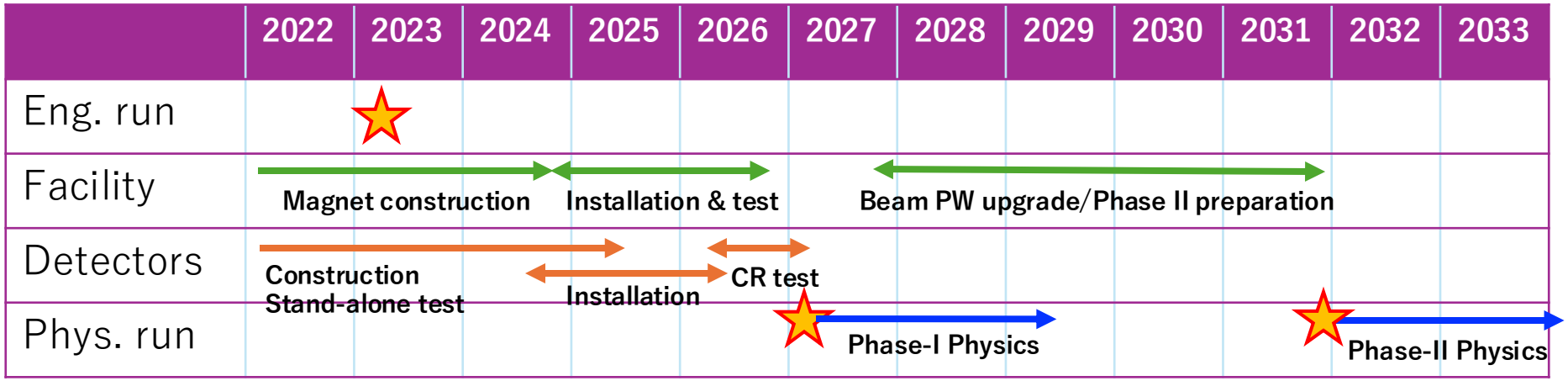
Proton Beam : 8GeV
Phase-α : 260W (1.6x10^{11} p/s)
Phase-I : 3.2kW (2.5x10^{12} p/s)





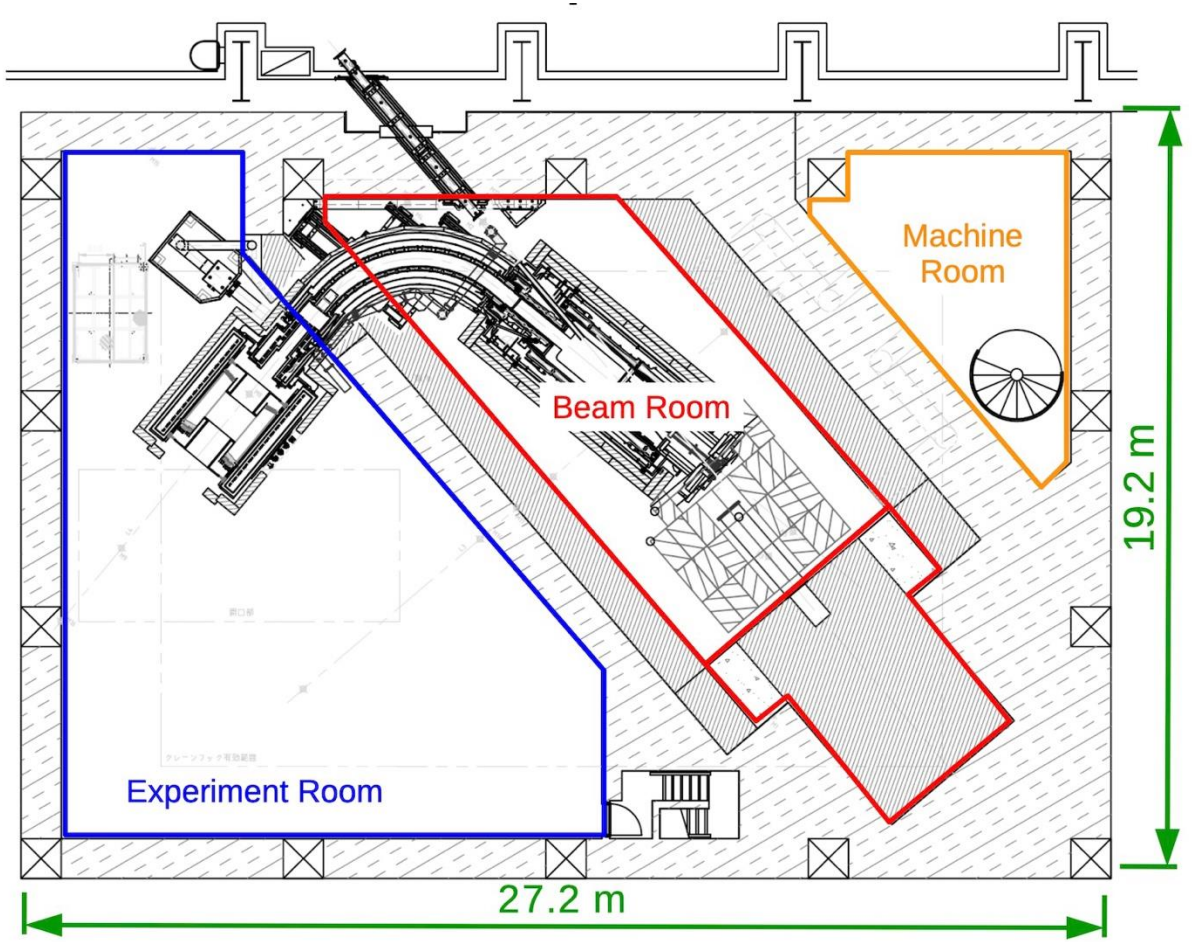
COMET Schedule

- Engineering run in FY2022. Confirmation of muon transport.
- CS magnet installation Oct. 2024, followed by cryogenics installation
- Phase I physics in FY 2026. 2-3 years DAQ
- “Shutdown” for Phase II upgrade (budget is not secured yet).
- Phase II physics in FY 2031 (technically driven)



Demonstrator in COMET ?

- Phase I in 2026-2028
- Phase II 2-3 years after Phase I
  - Magnet construction for 2 years
  - (Budget is not secured yet)
- During magnet construction for Phase II
  - DS (1T, 3.2m long owned by Osaka Univ.)
  - Muon beam 10^{10} $\mu^{-(+)}$/sec
- Additional 90 degree bend to keep a longer straight section?



Summary

- High-intensity muon beam facility at J-PARC for COMET
  - 5T capture solenoid and 90 degree curved solenoid
  - 1T detector solenoid for the spectrometer in Phase I
  - Graphite target as the primary option for pion production. Tungsten target R&D in progress
  - Phase I physics DAQ in FY2026-2028 (9?), followed by Phase II magnet construction for 2-3 years.
  - Phase II physics DAQ in FY 2031 (earliest)

- Any possibility of conducting test or R&D for the demonstrator in the COMET facility?