Construction of the Super Omega Muon Beamline at J-PARC

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μCF2007

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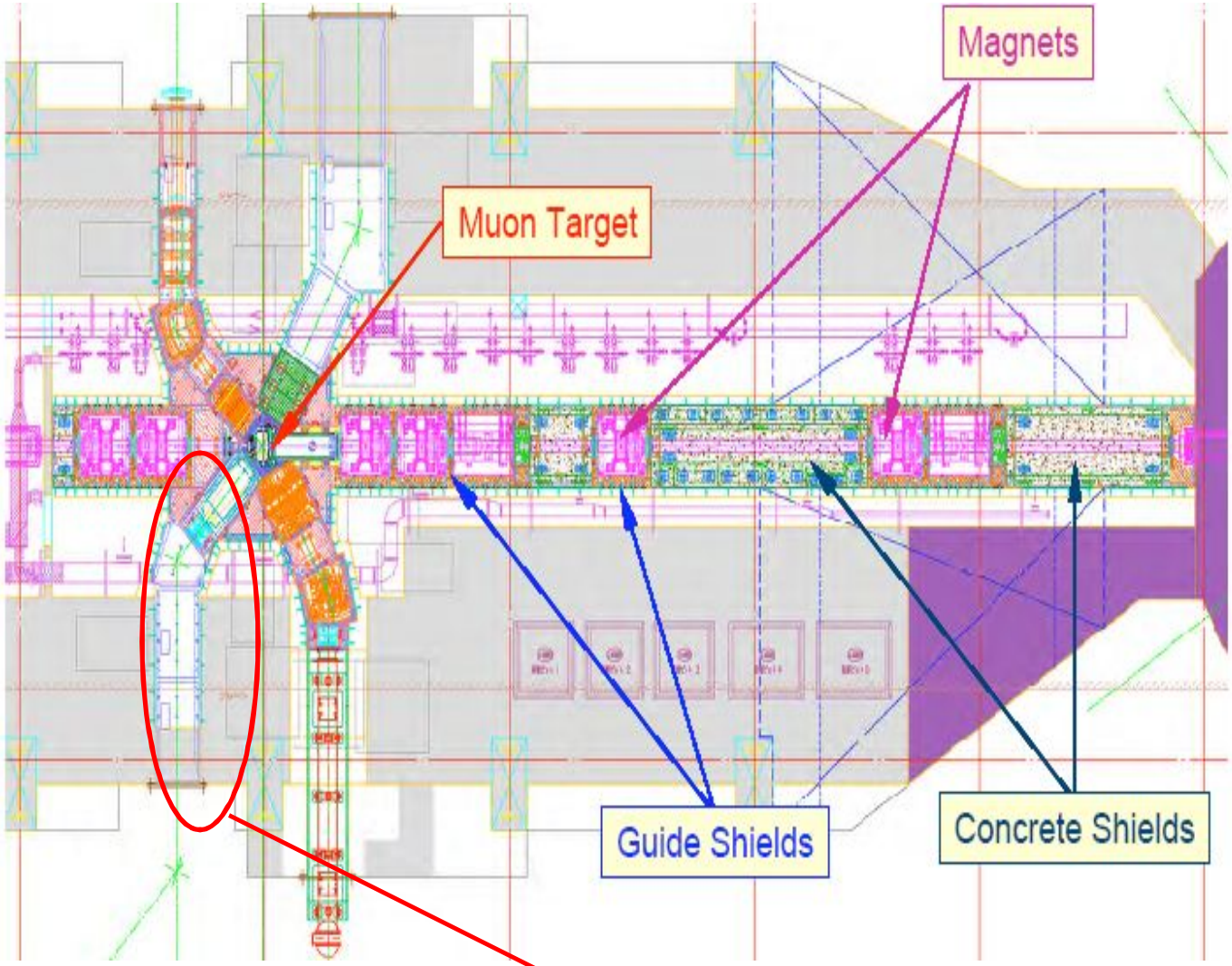
- The Super Omega Beamline
- Potential for μCF
- Current Status

J-PARC/MSL



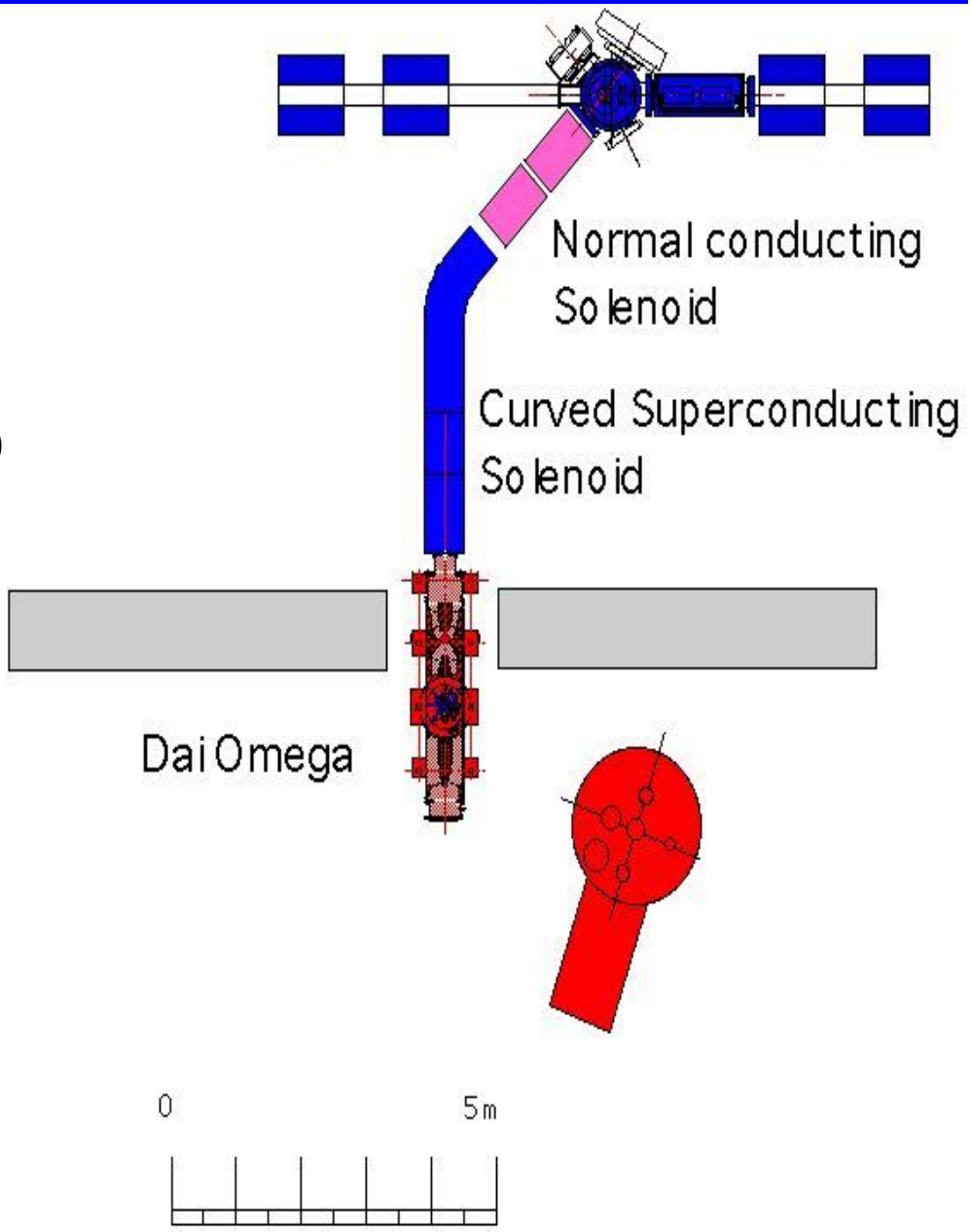
Super Omega Beamline

The Super Omega Muon Beamline

Objective: Build the highest intensity pulsed muon beamline in the world (30~60 MeV/c)

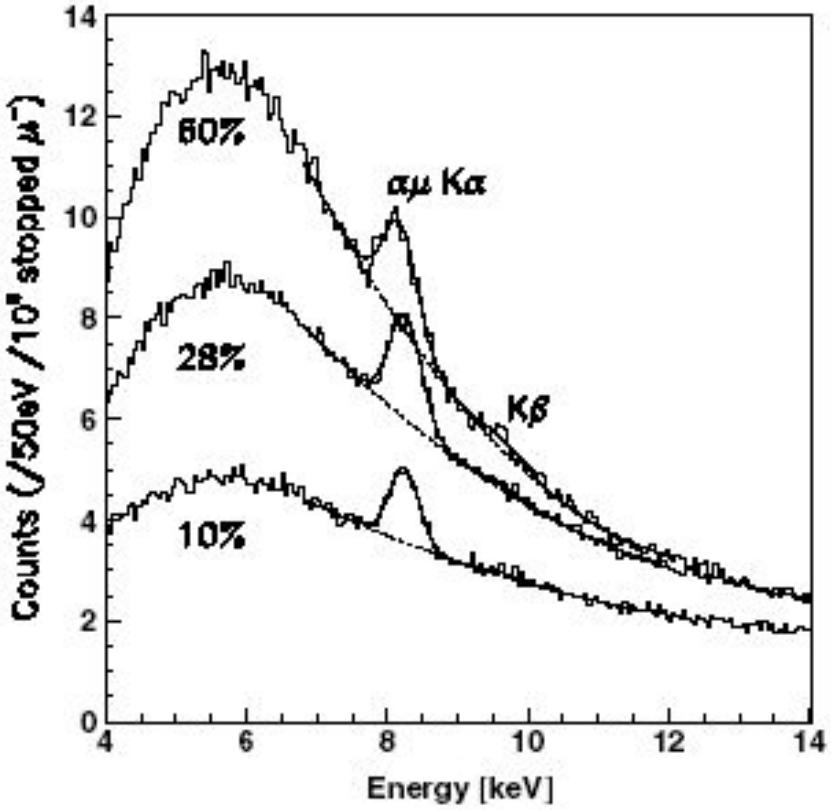
- Capture both cloud μ^- and surface μ^+
- 400mSr (RIKEN/RAL: 40 mSr)

- Consists of three sections:
  - Normal conducting capture solenoid
  - Superconducting transport solenoid
  - Super Omega axial focusing magnet



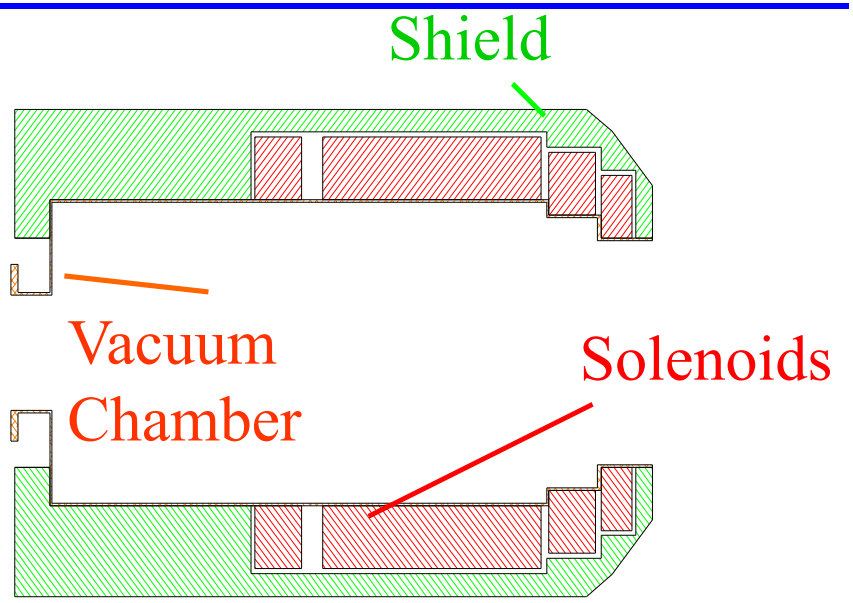
Cloud Muons for μCF

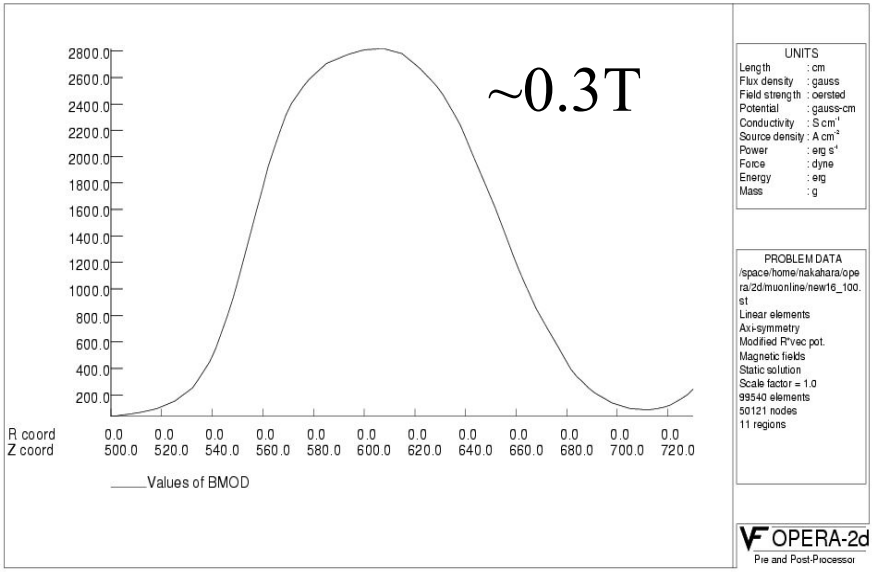
- RIKEN/RAL: ~10^5 /s
- Higher intensity negative muons ➔ better S/N (especially for K_β)

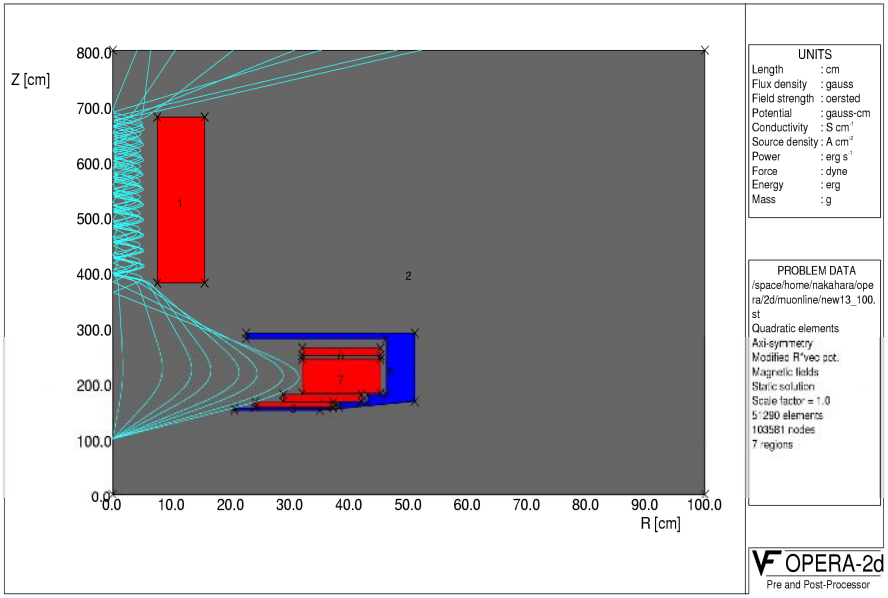


Capture Solenoid

- 400mSr
- Four solenoids designed through TOSCA
- Tunable for different momenta

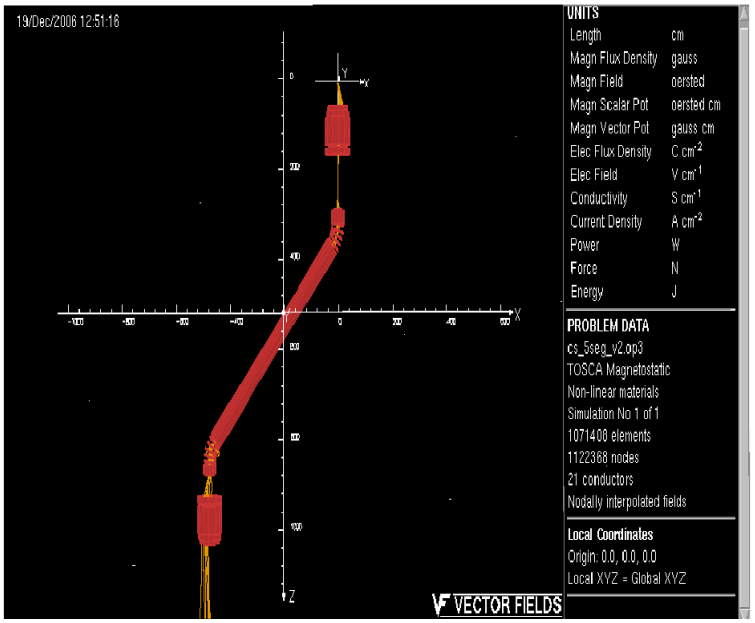


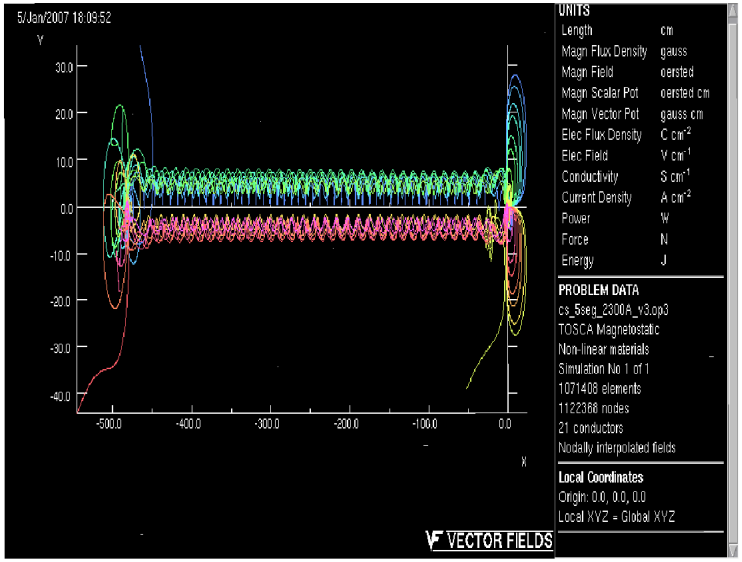


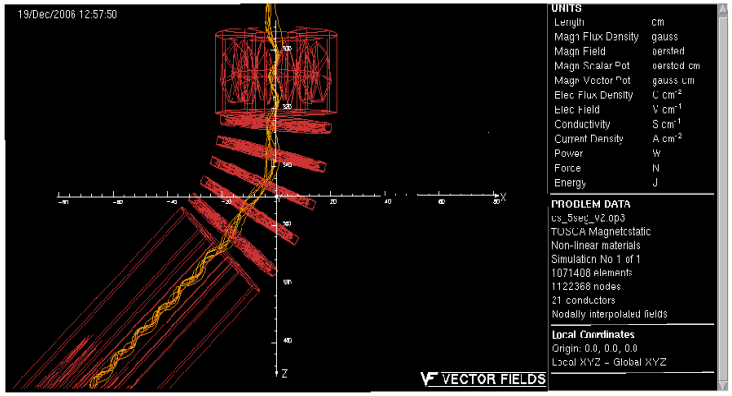


Transport Solenoids

- Superconducting curved solenoid
- Two 45º bends
  - Separates μ^+ and μ^-
  - Background rejection
- 2T field
- Currently under design:
  - Cryogenics
  - Transport Efficiency



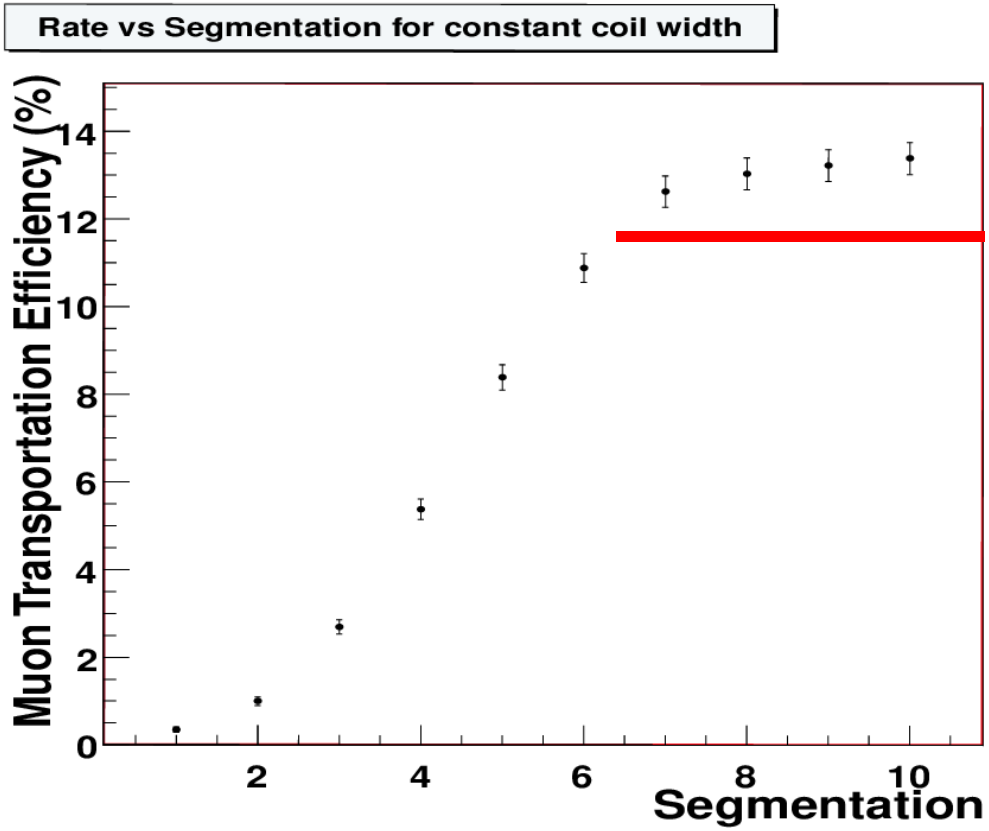


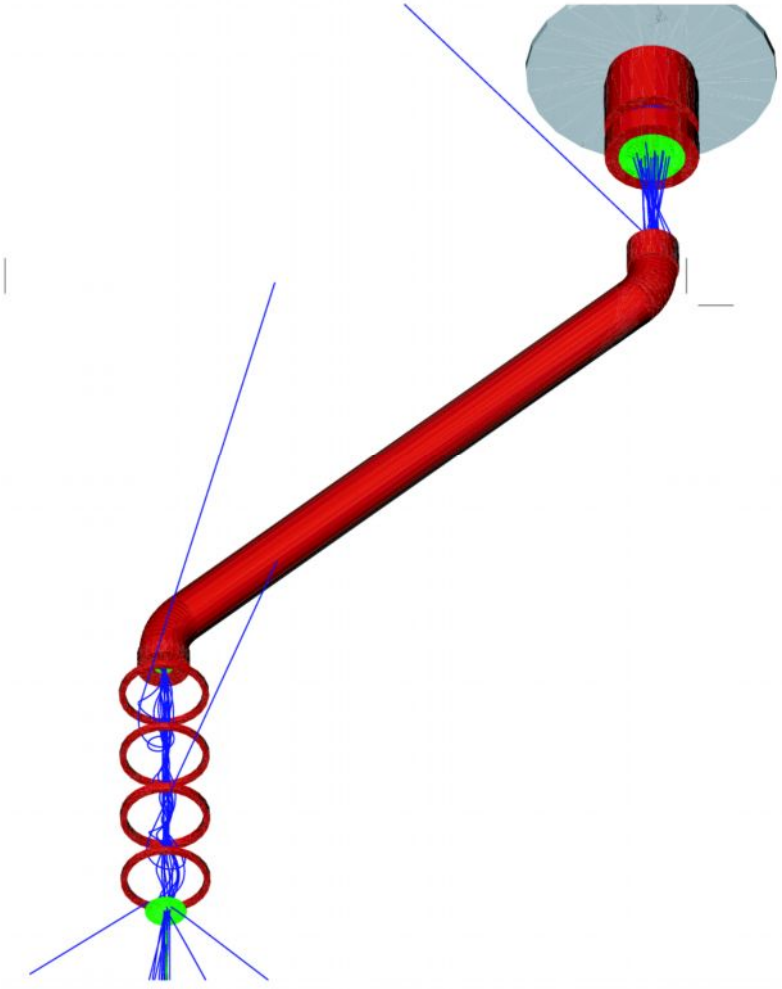


Trajectory/Transport Efficiency

- Transport efficiency calculated through GEANT4 (30 MeV/c)
- Most beamloss occurs at bend – dependent on segmentation

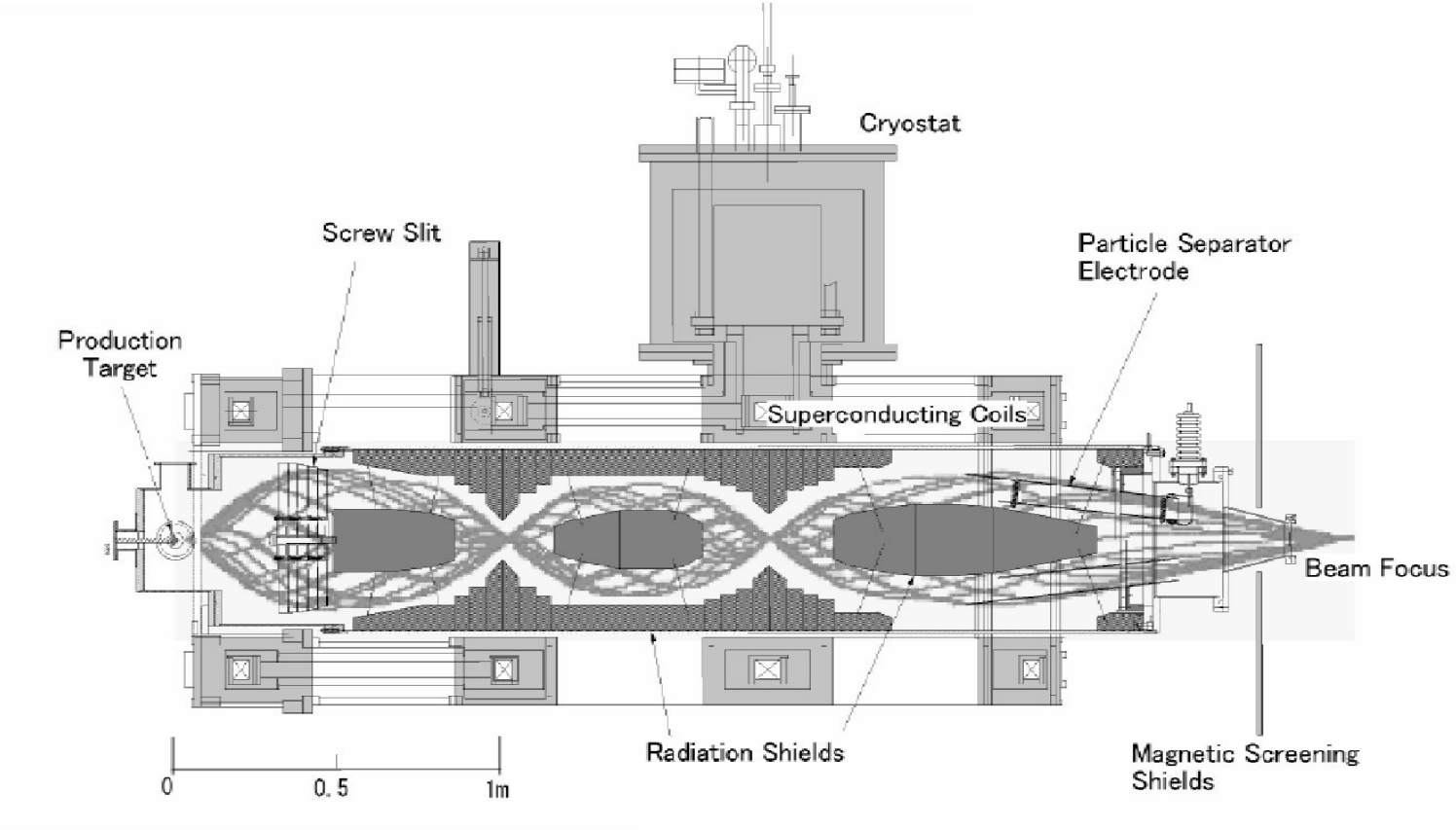
Efficiency stabilizes ~7 segments





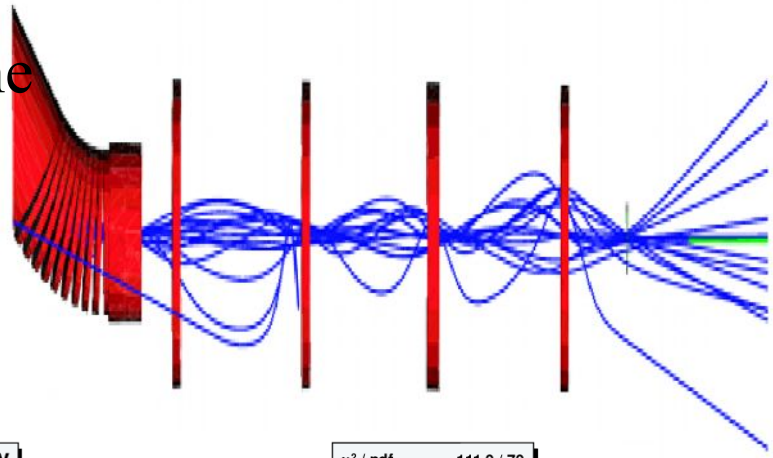
Super Omega Axial Focusing Magnet

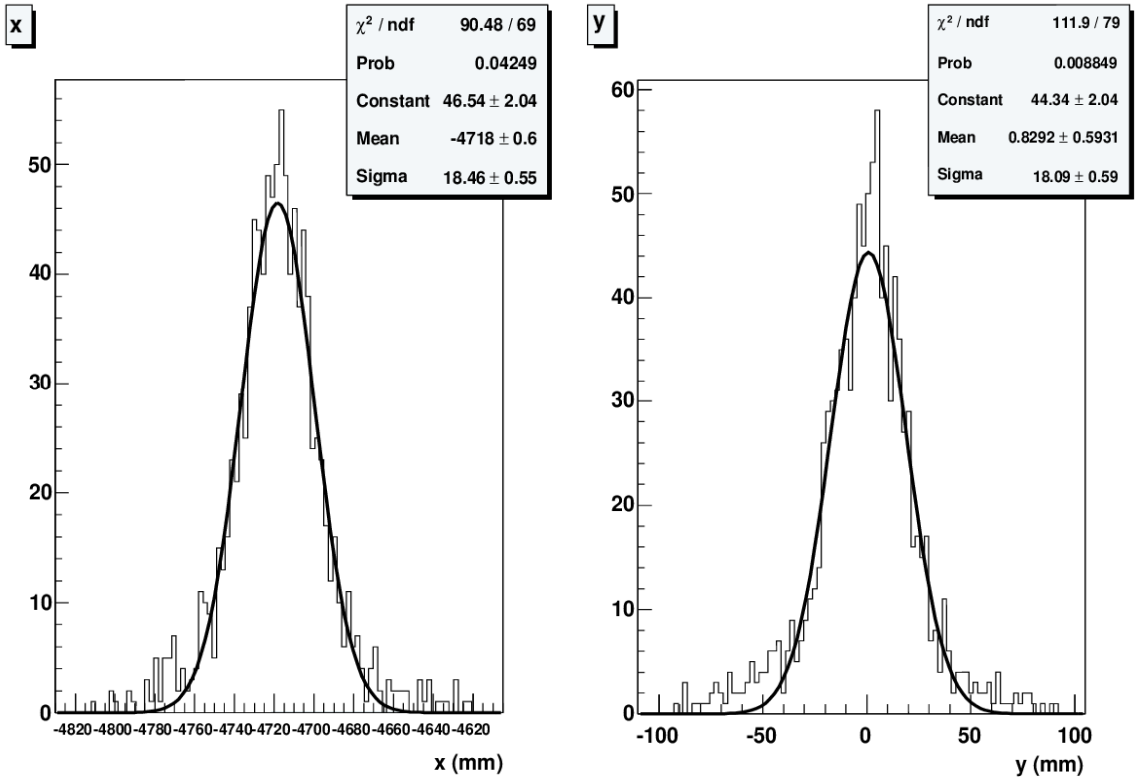
- Originally developed for the KEK muon beamline
- Designed for point to point focusing
- Can this be used at J-PARC? Compatibility with the capture and transport solenoids currently being considered



Super Omega Axial Focusing Magnet

- Four solenoids designed for axial focusing; compatibility with beamline calculated through GEANT4
- Goal: focus to $1\times1\text{cm}^2$
- Current configuration allows for $\sim1.8\times1.8\text{cm}^2$





Estimating μ^- Intensity

- How many cloud muons can we capture?
  - Capture solenoid efficiency
  - Transport efficiency
  - Momentum dependence
- Measurements made at RIKEN/RAL ➔ valuable in estimating cloud muon rates at J-PARC

◆ **Negative Muon Beam at RIKEN-RAL Port 4**

➔ Muon Source:	Decay Muon	Cloud Muon
➔ Momentum:	27 MeV/c	27 MeV/c
➔ Width ($\Delta p/p$):	~ 10 %	~ 7%
➔ Intensity:	~ 5000 s^{-1}	~ 15000 s^{-1}
➔ Beam size:	~ Ø40 mm	

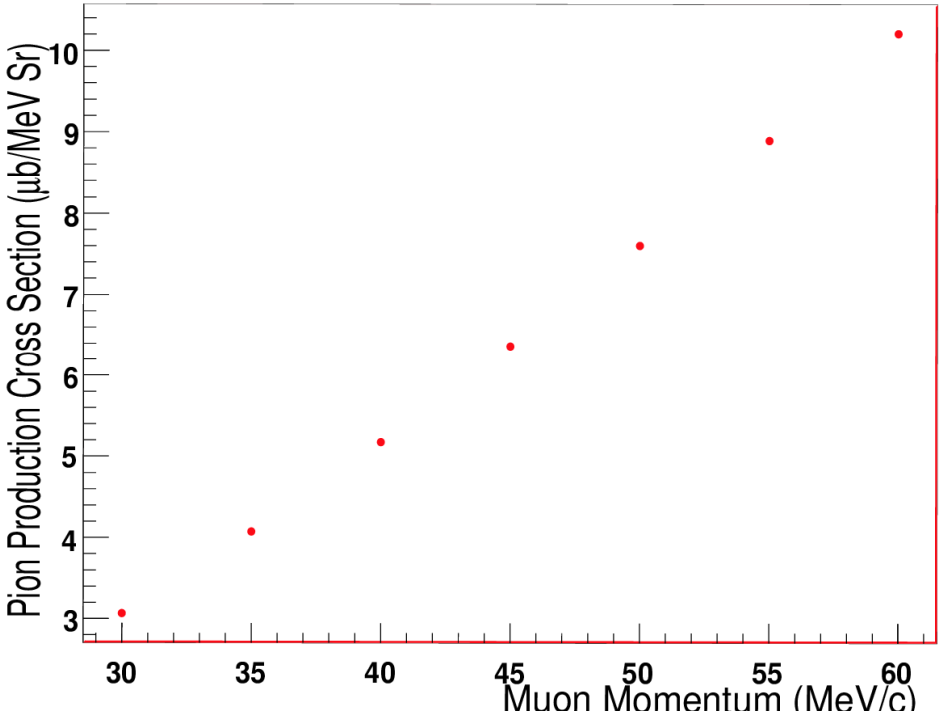
Cloud muons: ~4% of μ^+ production

Estimating μ^- Intensity

- Cross Section - parameterized 2.9GeV proton on Be

(P.A. Pirone and A.J.S. Smith, Phys.Rev.148, 1315 (1966))

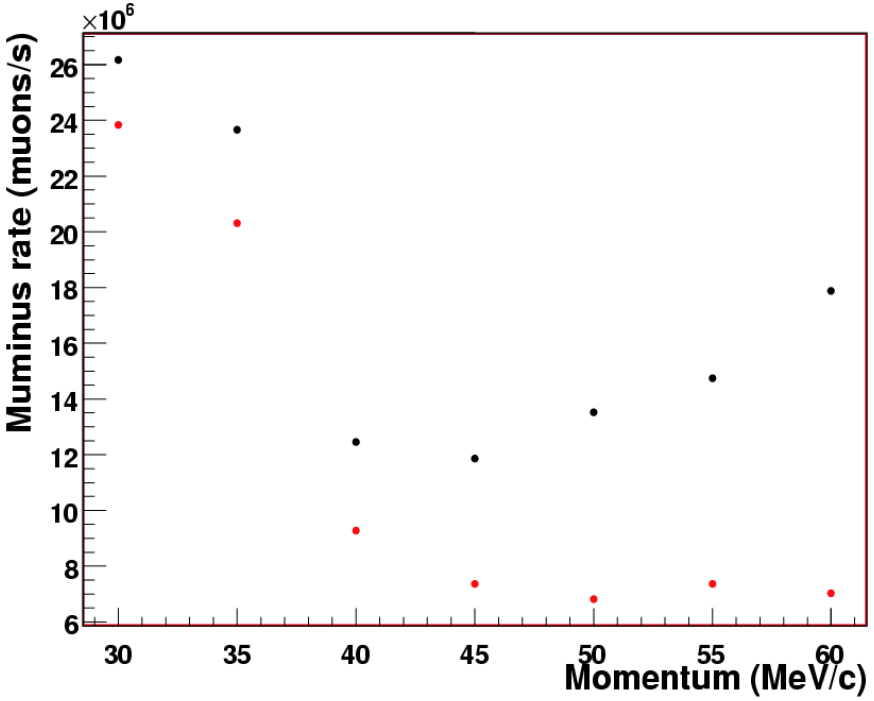
- Pion to surface μ^+ production efficiency ➔ 8.4×10^{-5}
- Scaling from surface μ^+ production to cloud μ^- production➔ ~4%

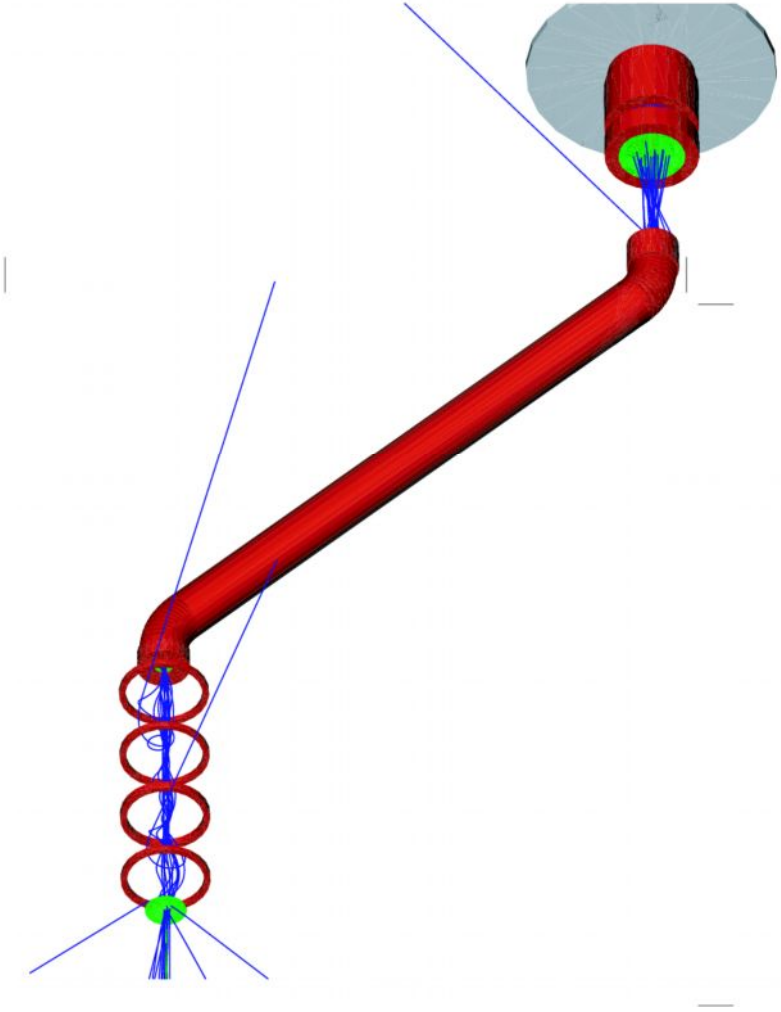


Target Thickness	2cm
Beam Current	333 μA
Energy Spread	5%

Estimating μ^- Intensity

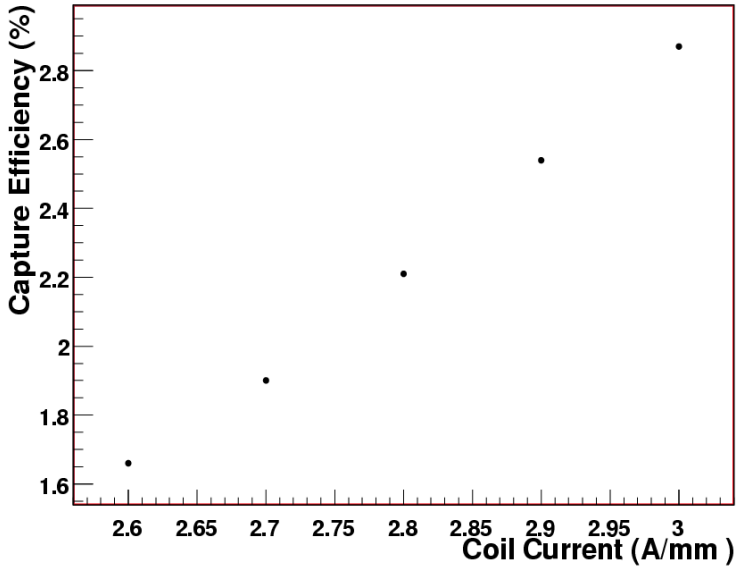
- Momentum dependence of capture efficiency through GEANT4 (solenoids optimized for 30MeV/c)



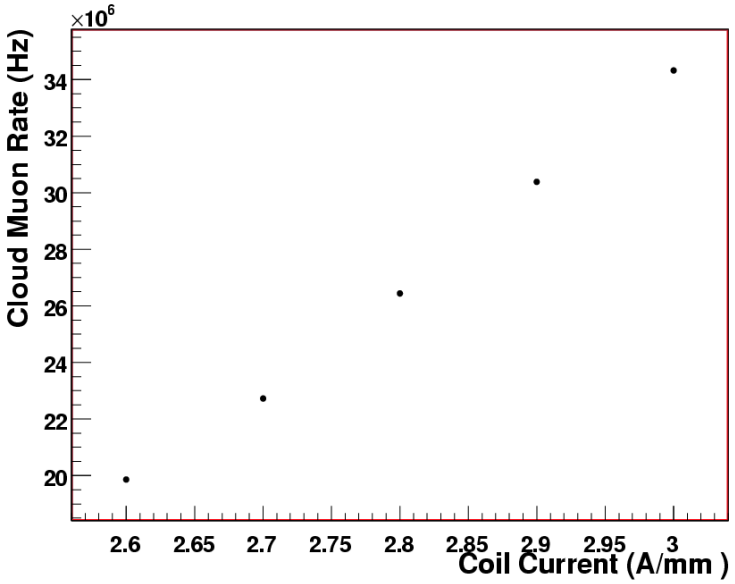


Estimating μ^- Intensity

- Optimize capture solenoids for 50 MeV/c ➔ Proof of principle
- 4 coils (3 in series) ➔ 2 current settings
- Rates $1\sim2\times10^7$ should be possible



- Technical limitations are coolant to reduce heating of coils



Summary

- Super Omega beamline at J-PARC can expect ×10~ ×100 μ^- compared to RIKEN/RAL.
- Capture solenoids under construction
- Transport solenoids and Super Omega magnet under design
- Come use our facility for some μCF!!