SPD toroidal magnetic field: first view

SPD meeting

11.12.2017

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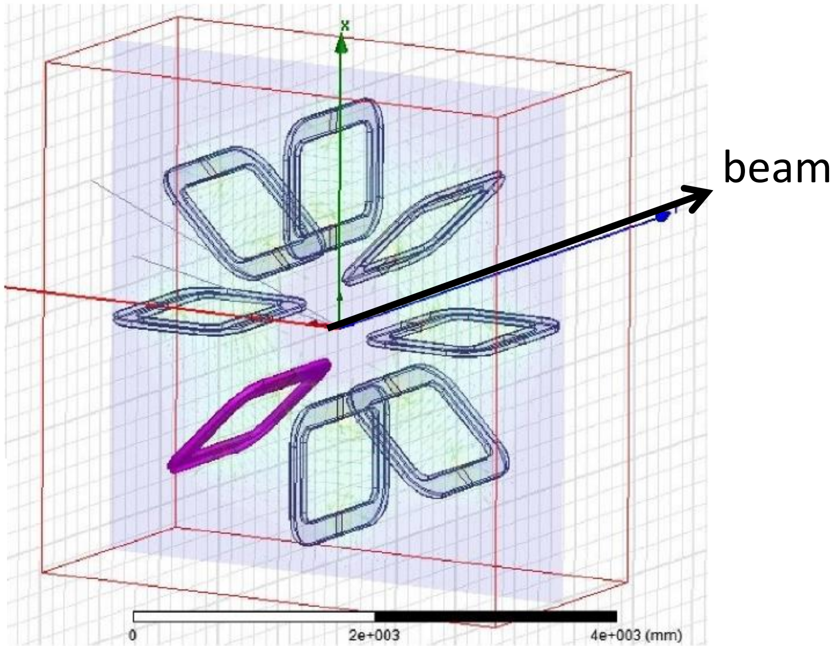
Simulation of toroidal magnetic field

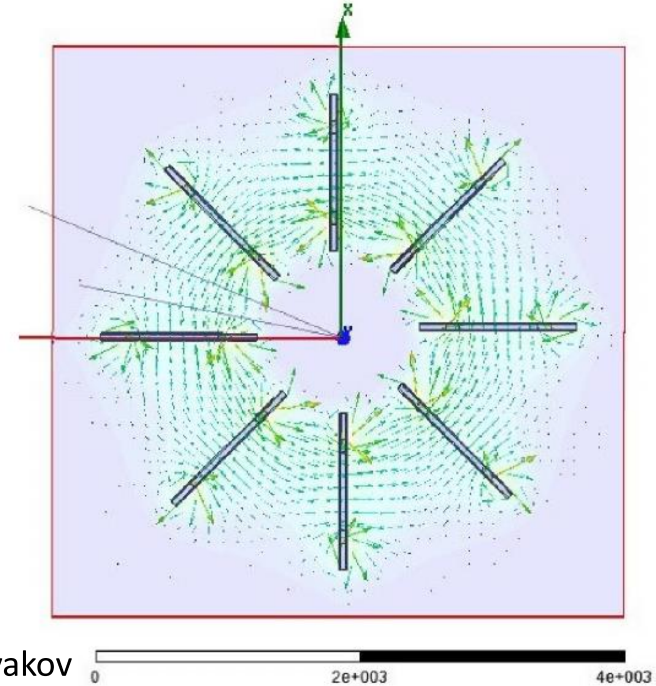
To simulate toroidal magnetic field, the software package ***Ansoft Maxwell 15*** *was used*

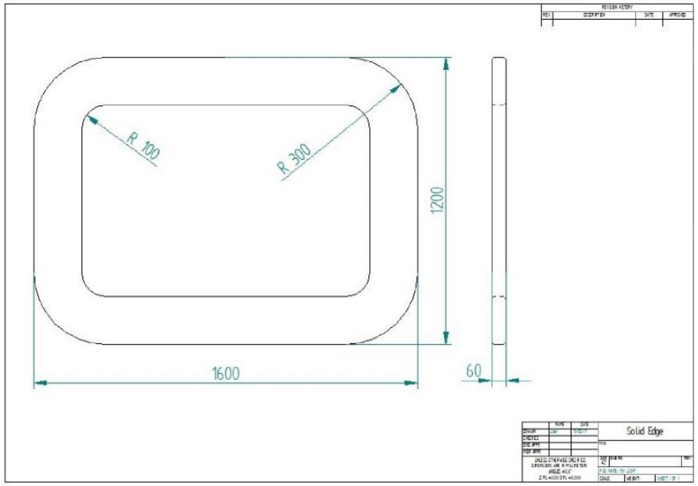
The parameters of toroidal magnet:

- Max current: 240 kA
- Length: 1.6 m
- Radial size: 1.2 m
- Max field: up to 1 T in mid region



Direction of force lines

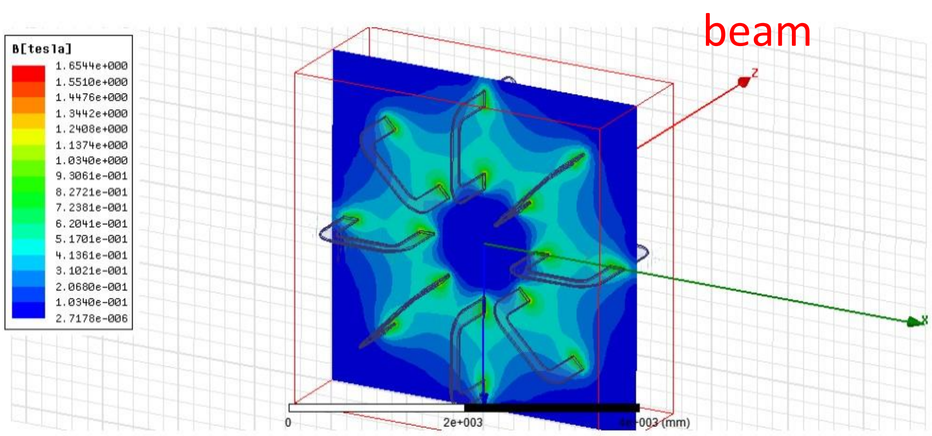




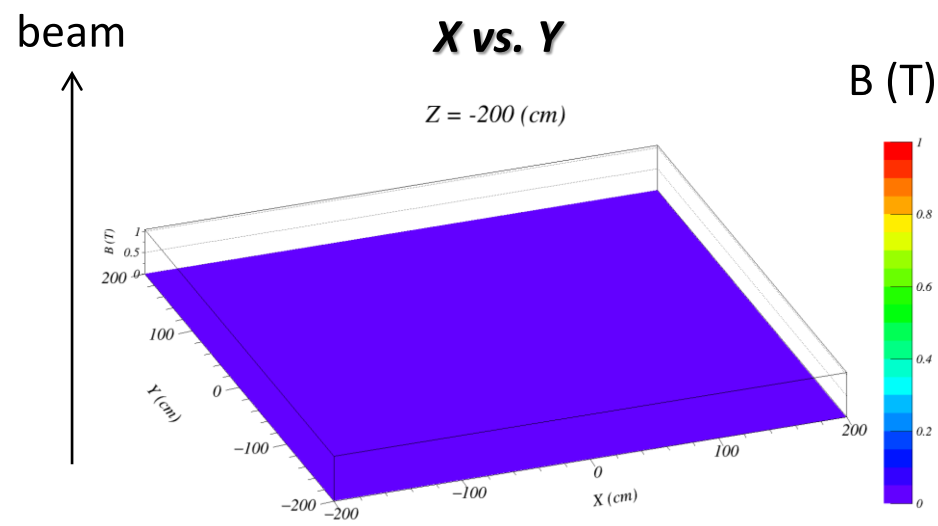
Produced by G. Meshcheryakov

Magnetic field in SpdRoot

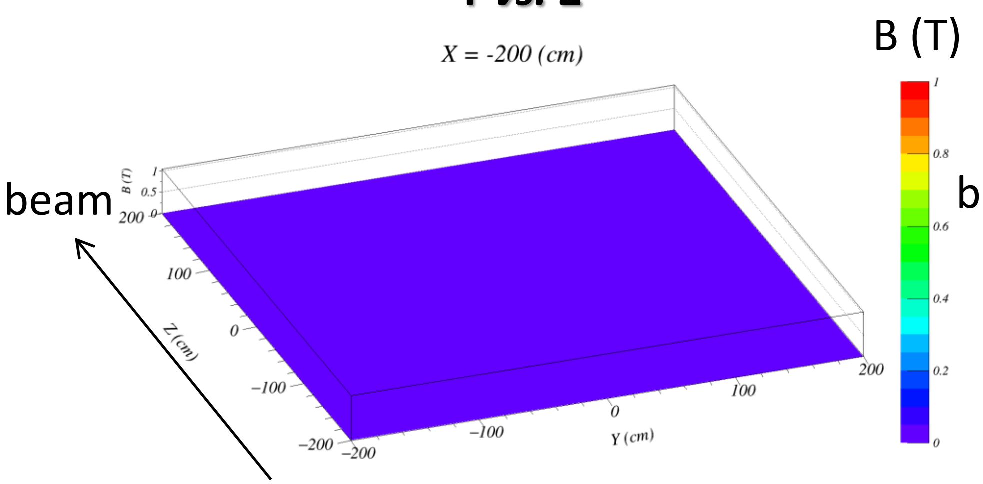
From simulation program



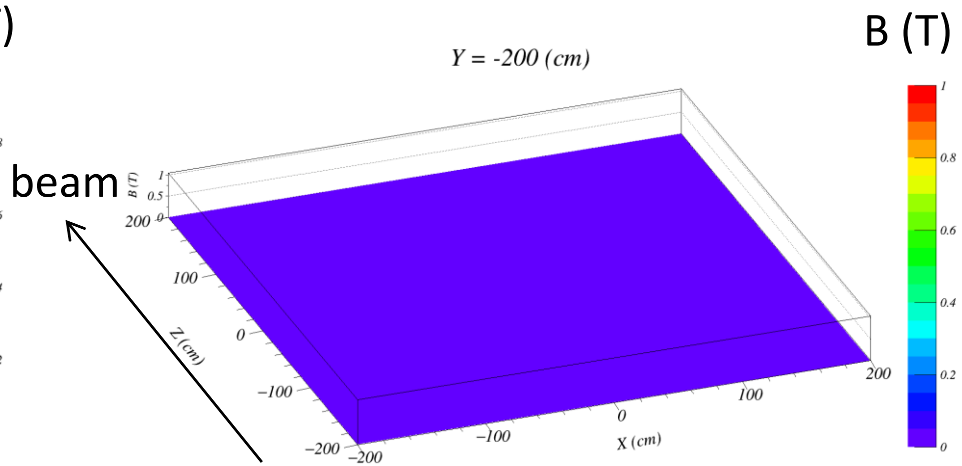
X vs. Y



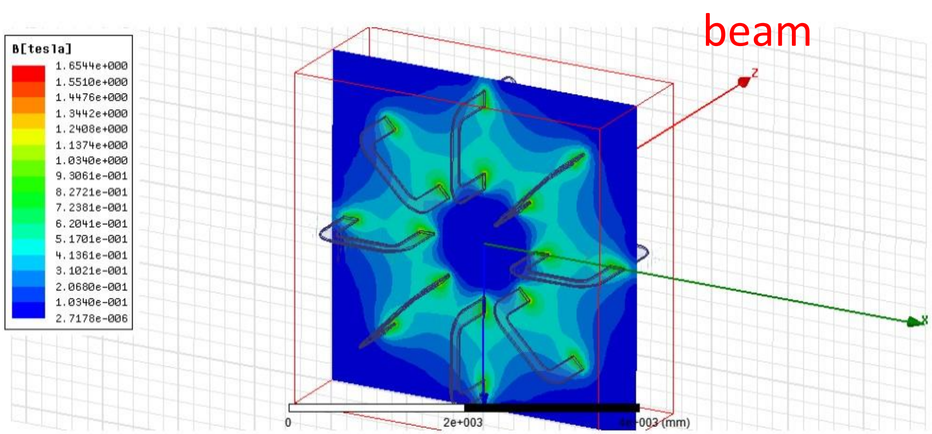
Y vs. Z



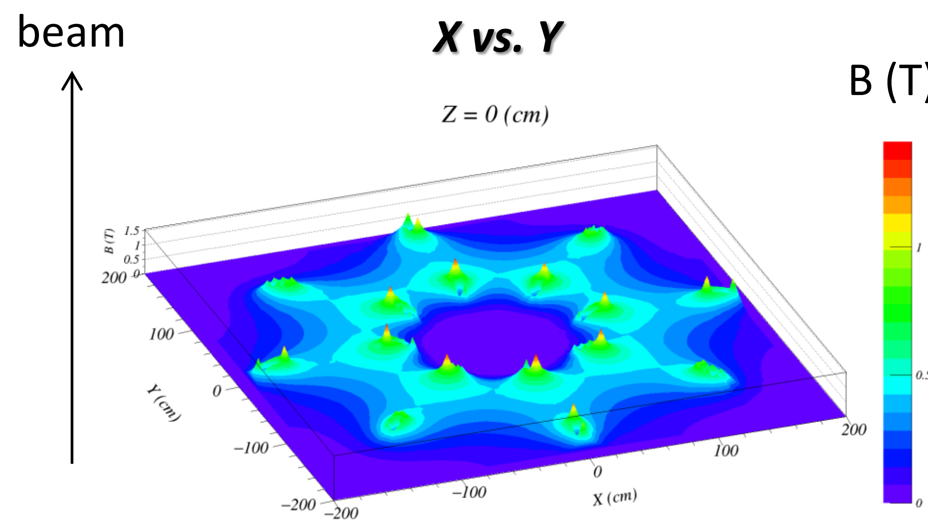
X vs. Z



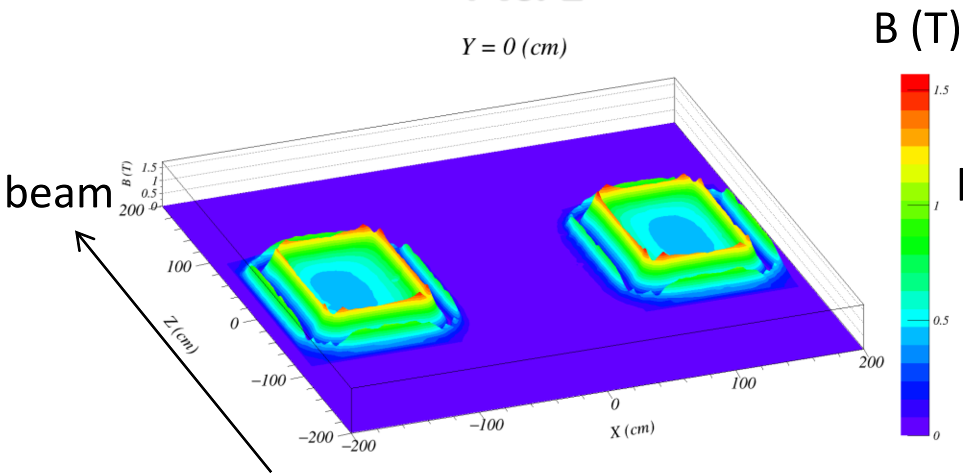
From simulation program



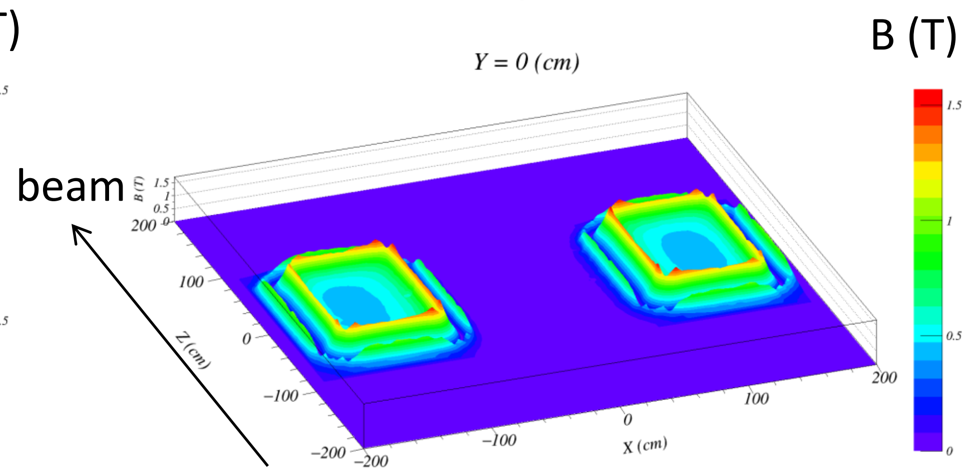
X vs. Y



Y vs. Z

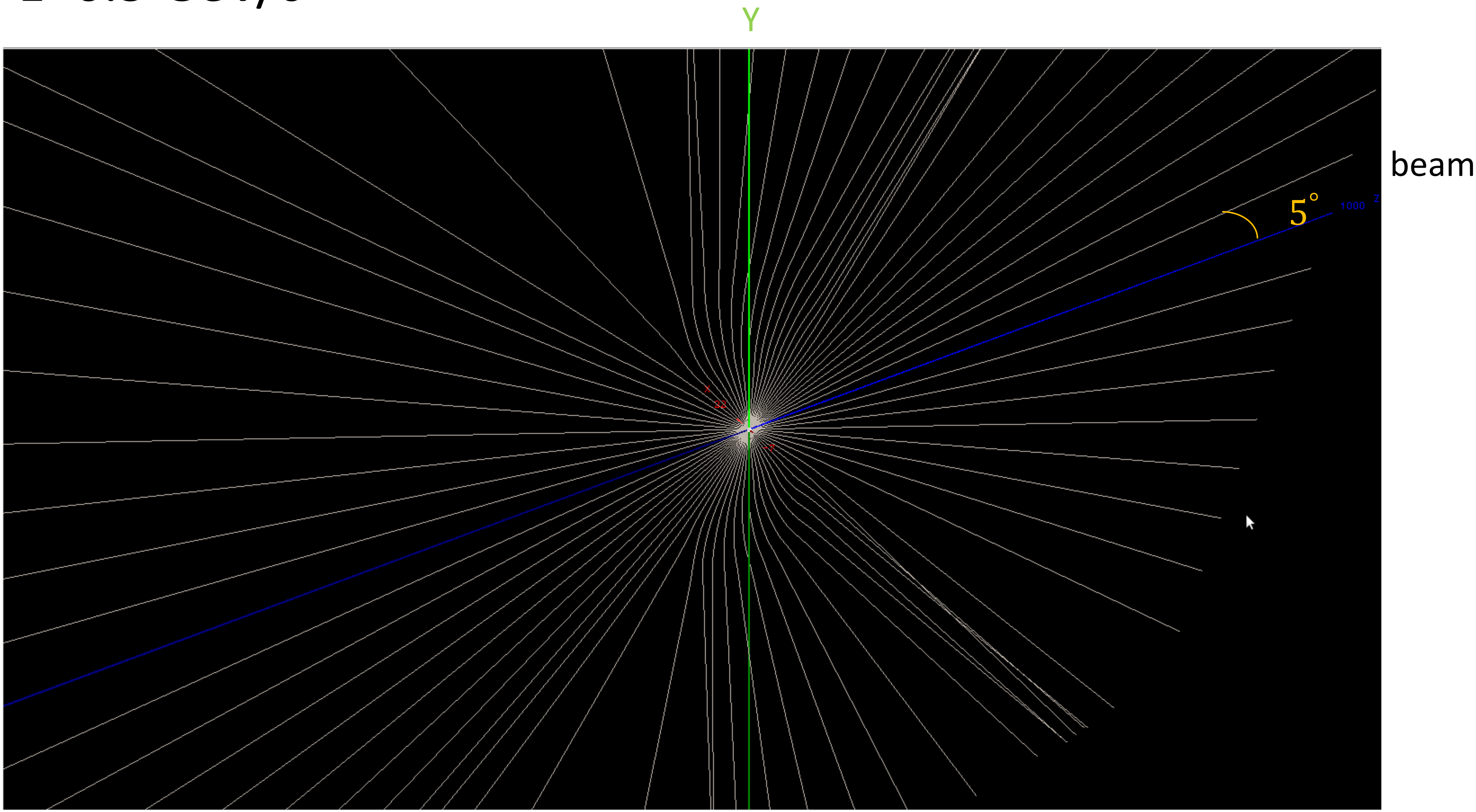


X vs. Z



Behavior of μ^- in magnetic field ?

E=0.5 GeV/c



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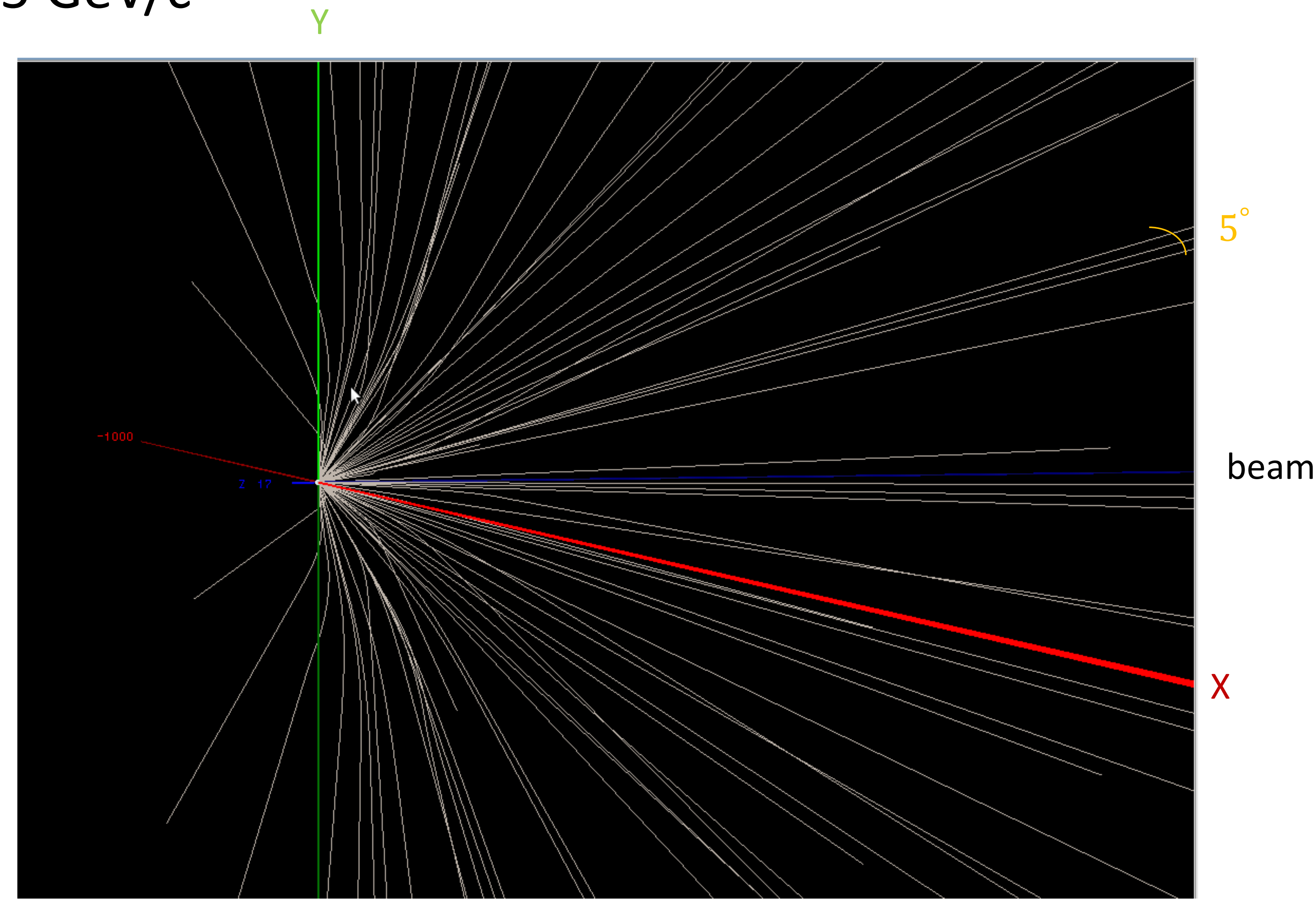
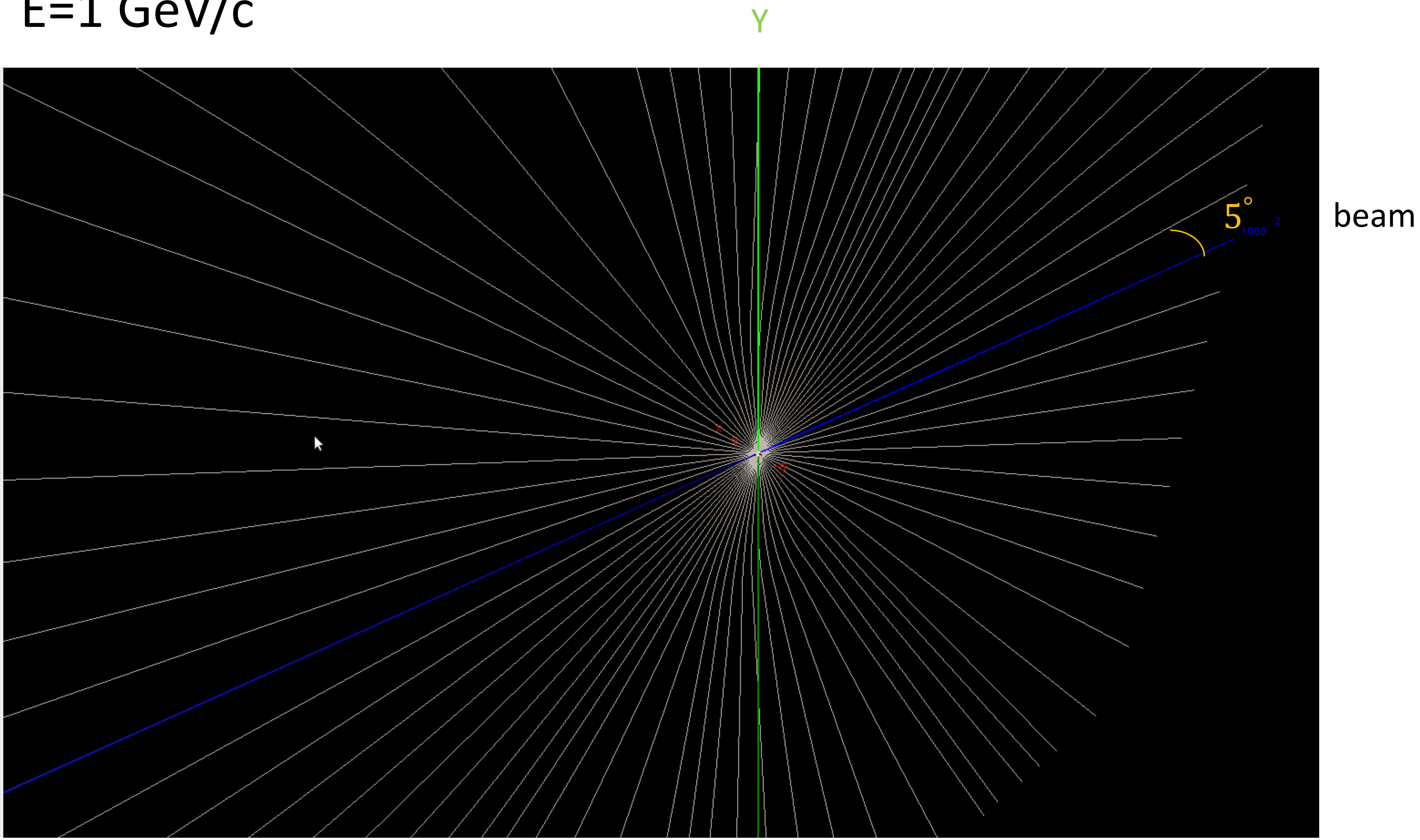


Behavior of μ^- in magnetic field ?

E=1 GeV/c



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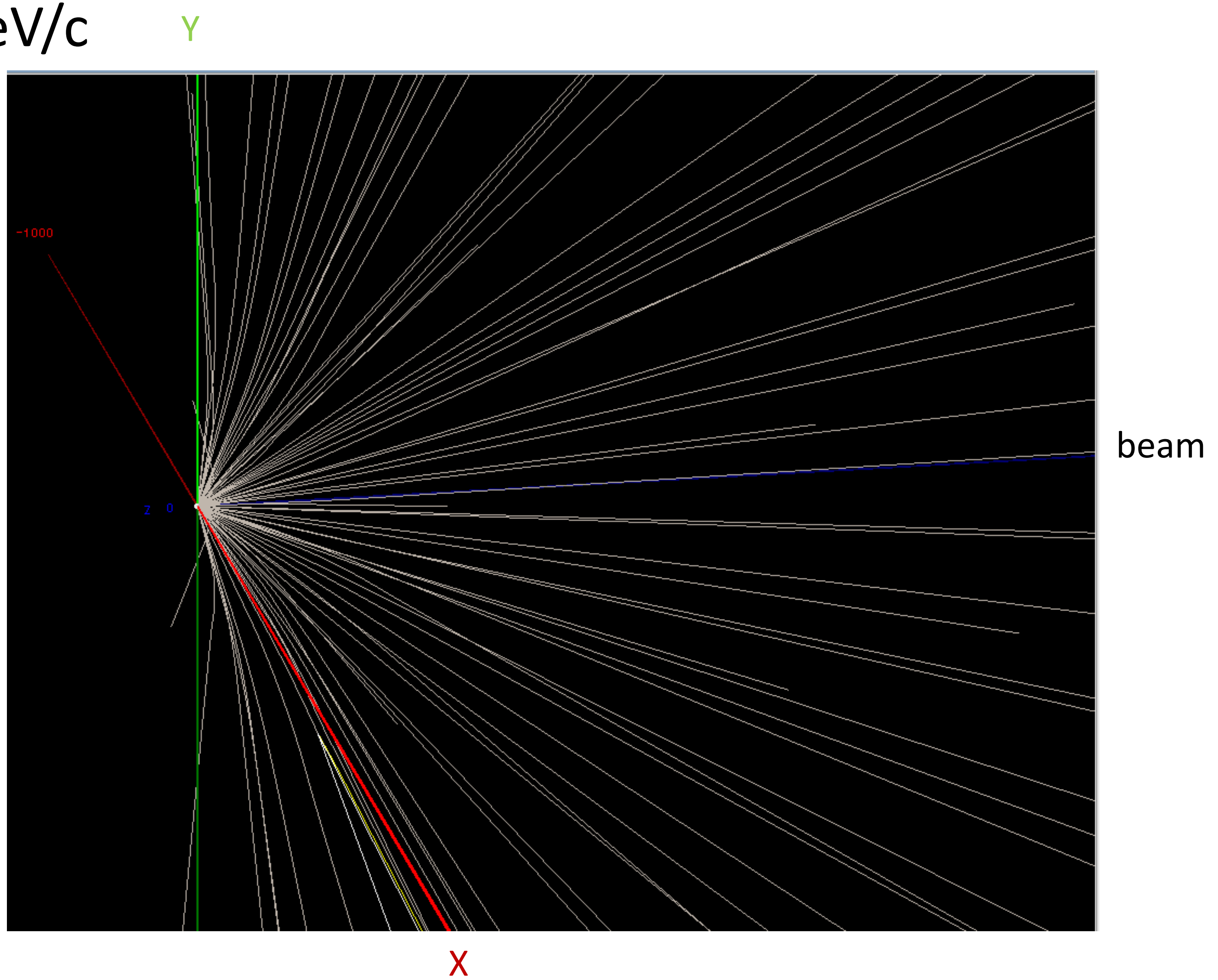
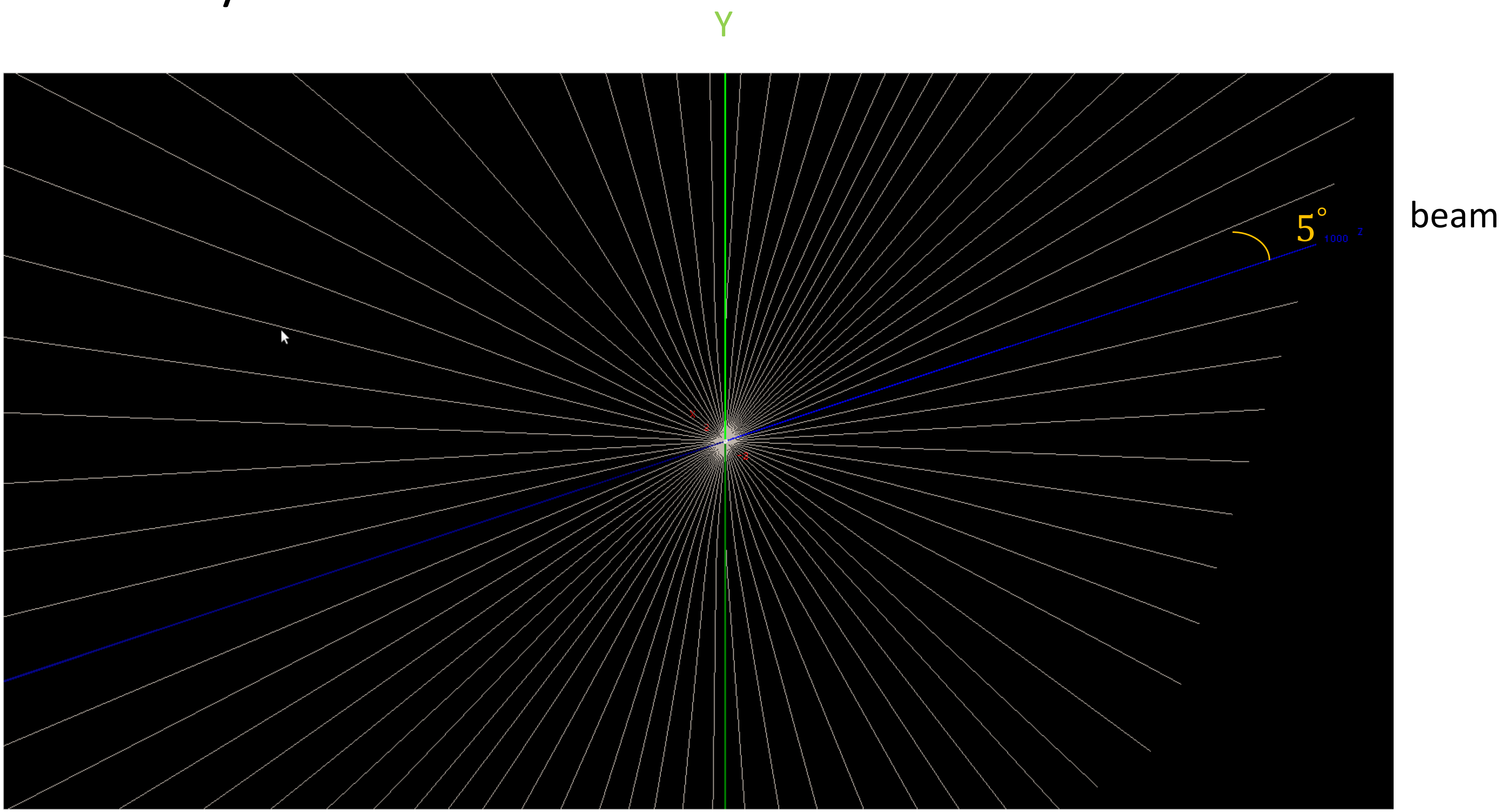


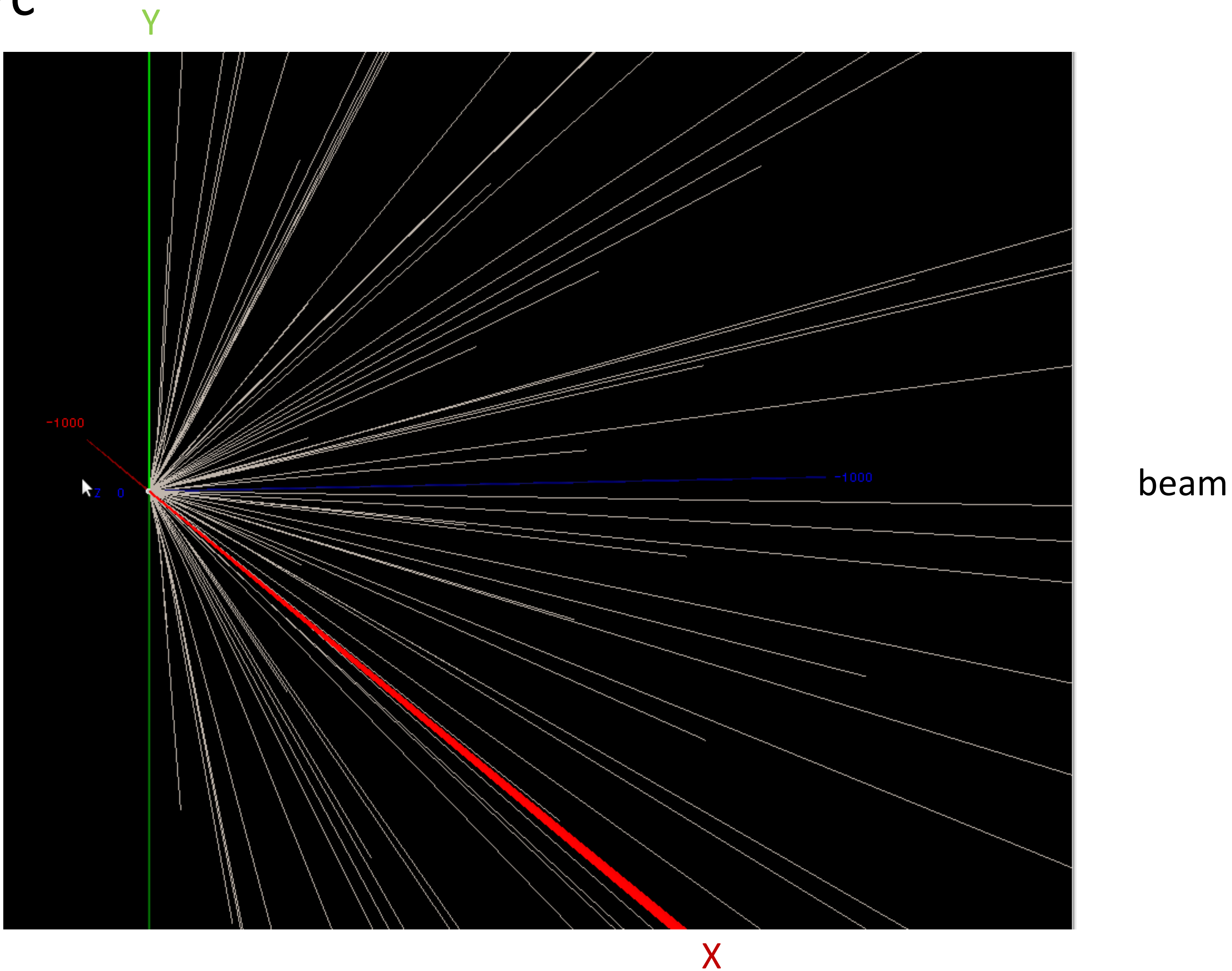
Behavior of μ^- in magnetic field ?

E=2 GeV/c

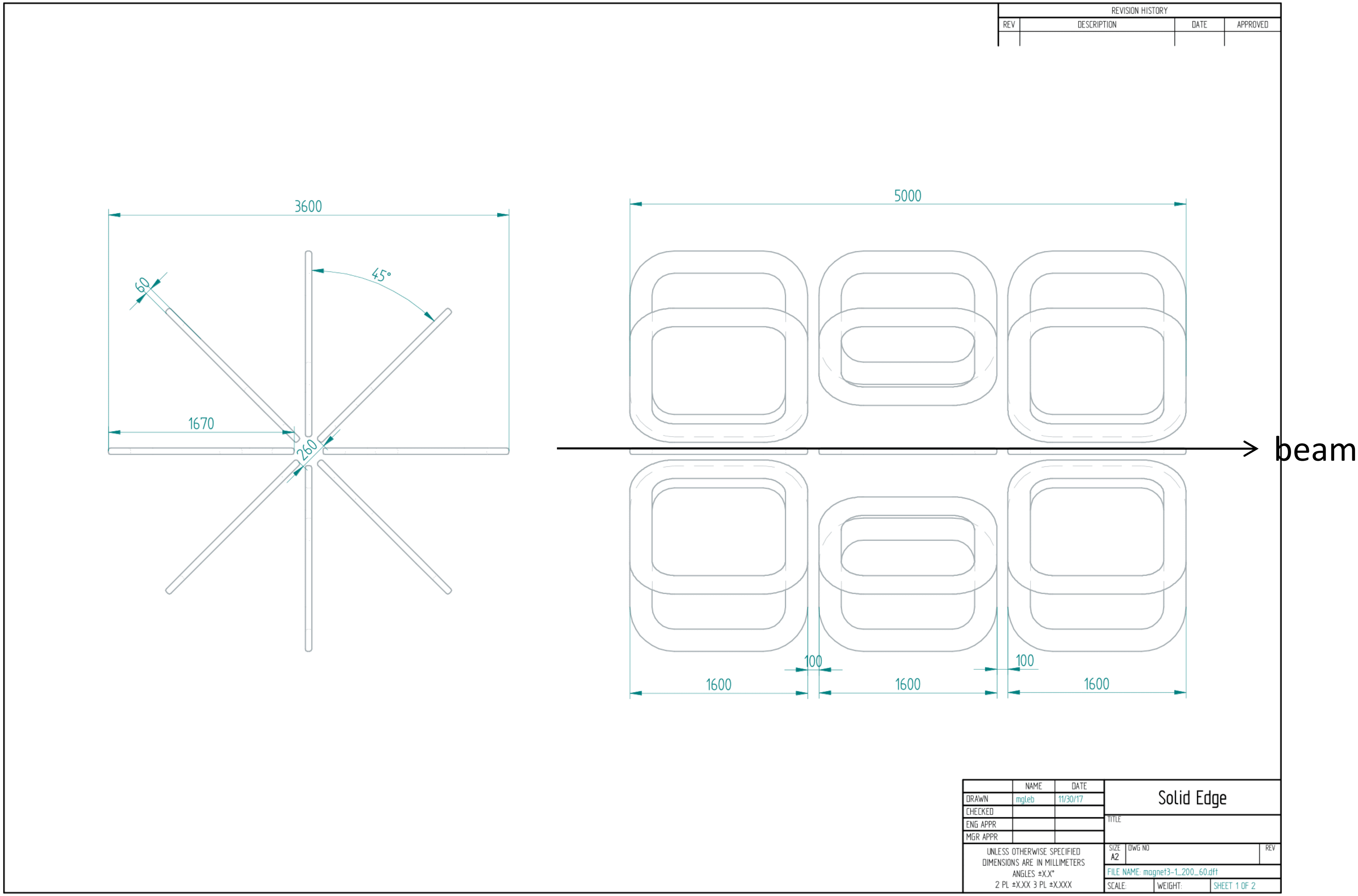


Behavior of μ^- in magnetic field ?

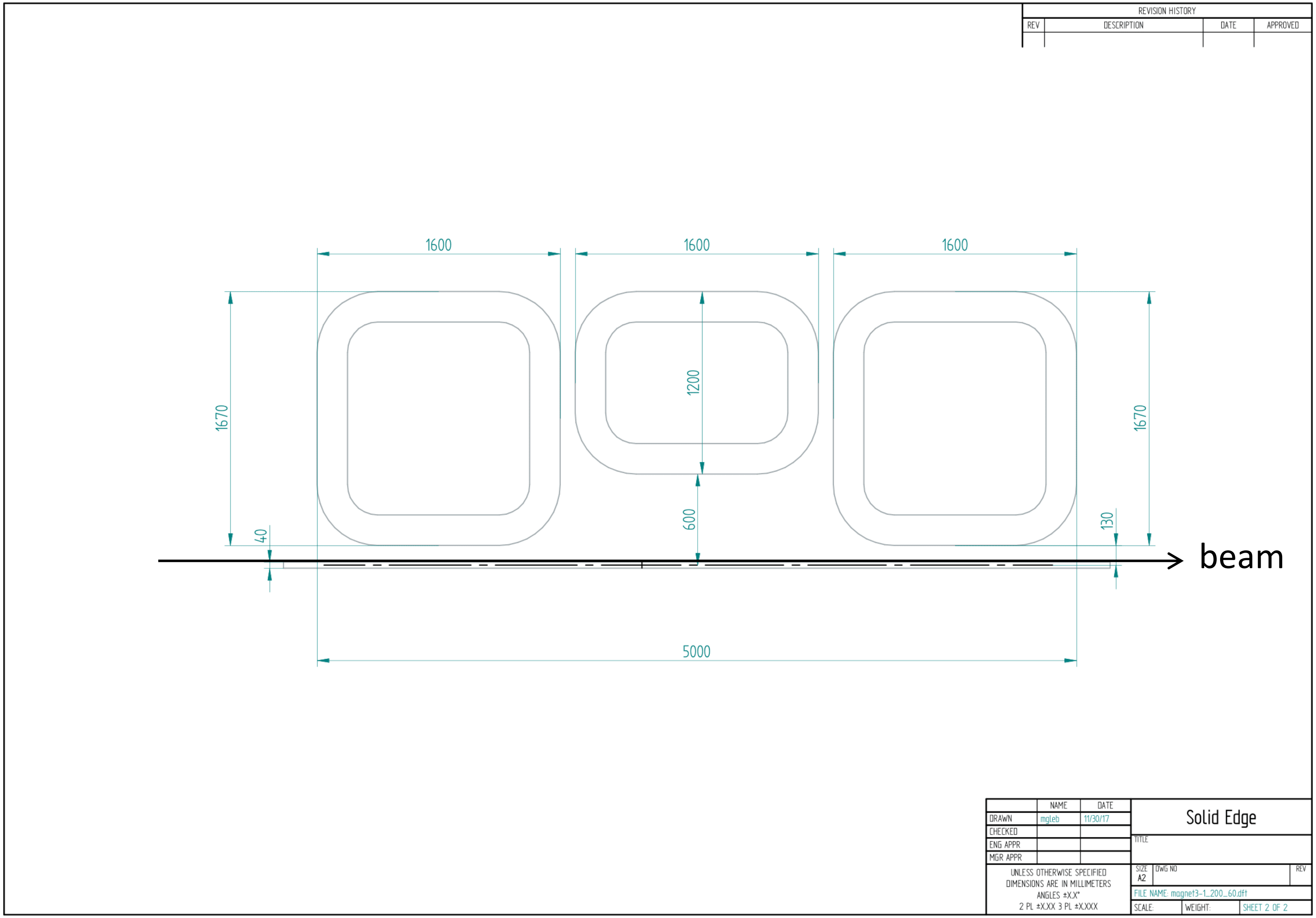
E=2 GeV/c



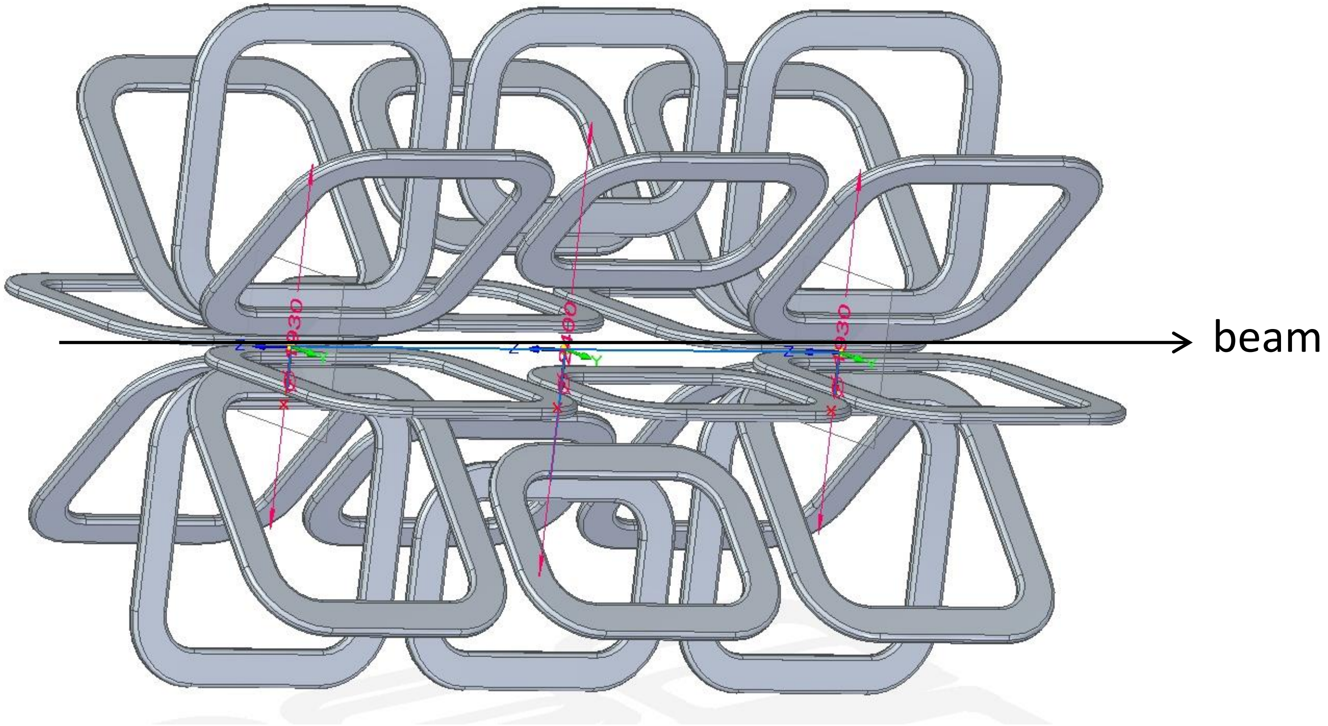
Future plans: sketch of toroidal magnets



Future plans: sketch of toroidal magnets



Future plans: sketch of toroidal magnets



Conclusion and future plans

1. The first view on SPD toroidal field is done.
2. The field structure is tested with various energy muons.
3. The magnetic field strength have to be increased.

1. The field with 3 *toroidal magnets* will be considered.

BackUp

CLAS12 Toroidal magnet

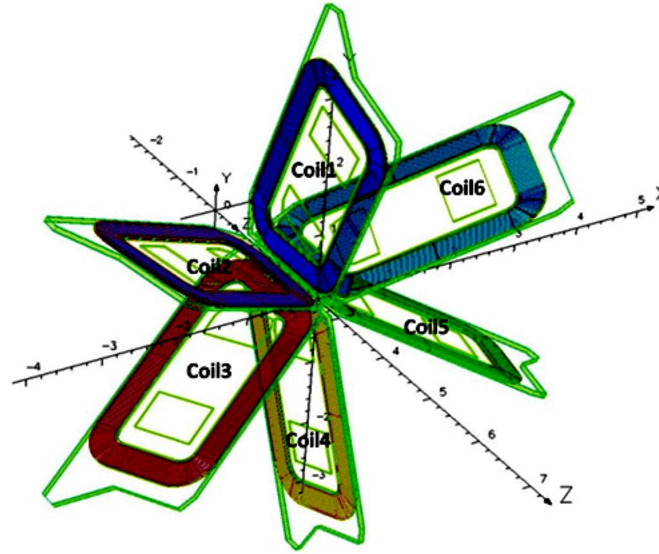
CLAS12 - TORUS Magnet

The CLAS12 Toroid is based on six superconducting coils around the beam line to produce a field primary in the azimuthal (ϕ) direction. The choice of this configuration leads to an approximate toroidal field distribution around the beam axis. The Torus design was driven by the following physics requirements:

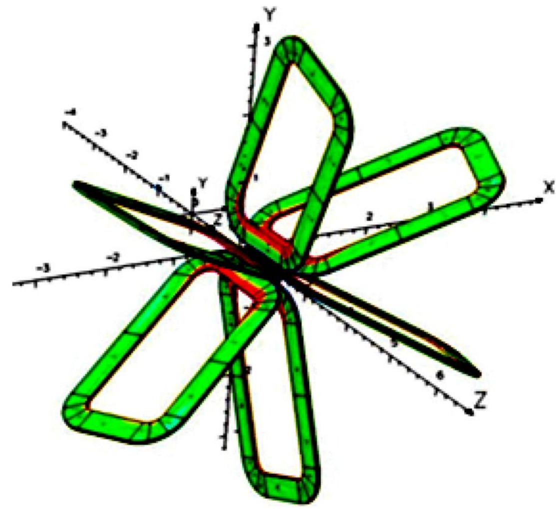
- Large acceptance for forward going particles (50% particle acceptance in detectors at 5 degrees from beam axis)
- Good momentum resolution
- 6 fold symmetry around the beam axis
- Large bore to allow passage of scattered primary beam

TECHNICAL PARAMETERS

PARAMETER	DESIGN VALUE
Magnet Type	Toroidal Field Geometry
Number of Coils	6
Coil structure	Double pancake potted in Aluminum Case
Warm bore ∅ (mm)	124
Total weight (Kg)	25,500
Number of turns per pancake	117
Number of turns per coil	234
Conductor	SSC outer dipole cable soldered in 20 mm x 2.5 mm Cu channel
Turn to Turn Insulation	0.003” E-Glass Tape ½ Lap
Nominal current (A)	3770
Ampere turns (-)	882,000
Peak Field (T)	3.58
Peak Field Location	Inner turn near warm bore adjacent to cooling tube
B-Symmetry	Yes
∫Bdl @ nominal current (Tm)	2.78 @ 5 degree , 0.54 @ 40 degree
Inductance (H)	2.00
Stored Energy (MJ)	14.2
Quench Protection/Dump Resistor	Hard wired quench detector / 0.124 Ω dump resistor
Coil Cooling	Conduction Cooled by Supercritical Helium
Supply temperature (K)	4.6
Temperature margin (K)	Min 1.52 (@5.3 K) to Generation temperature 6.82
Heat Shield Cooling	LN2 Thermo-Siphon



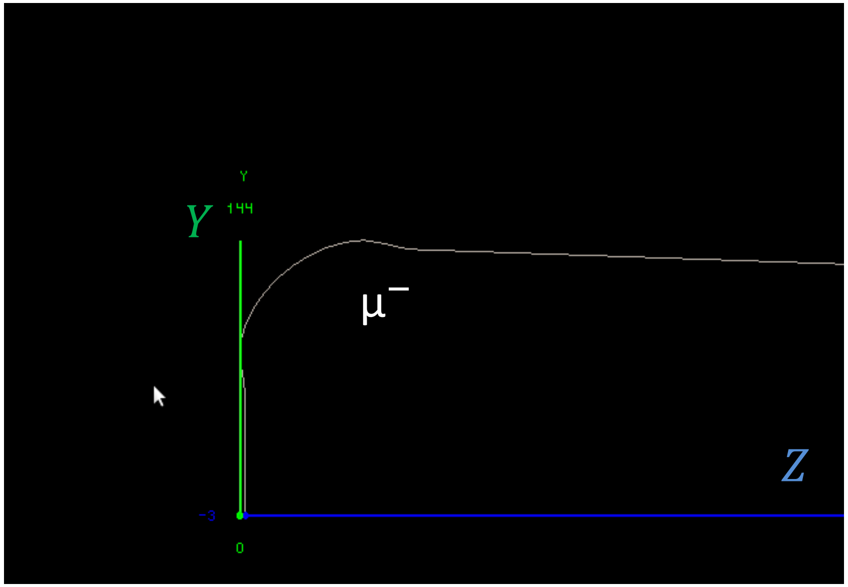
Superconducting magnet system (dimensions in m).



Magnetic flux density map (Bmax=3.6 T) at 3770 A (nominal).

$P_{\mu^-} = 0.1\ GeV$

90^0



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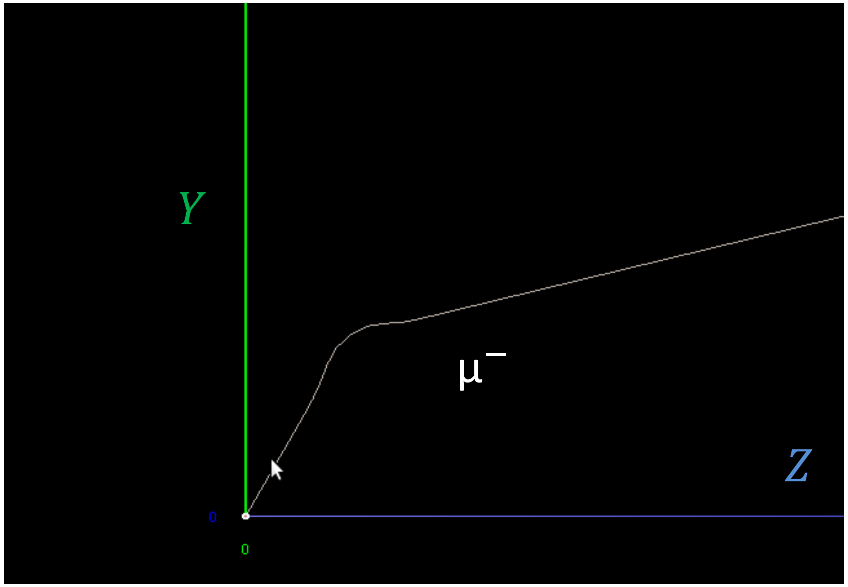

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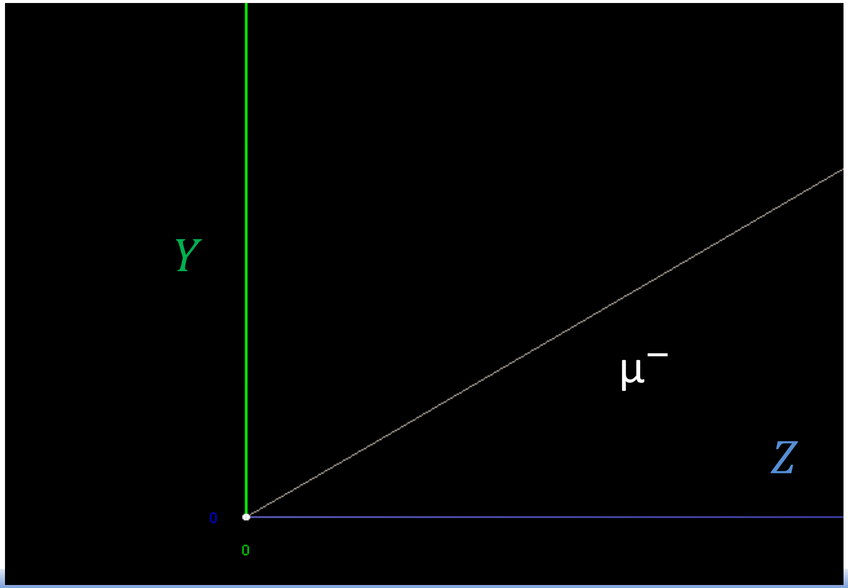
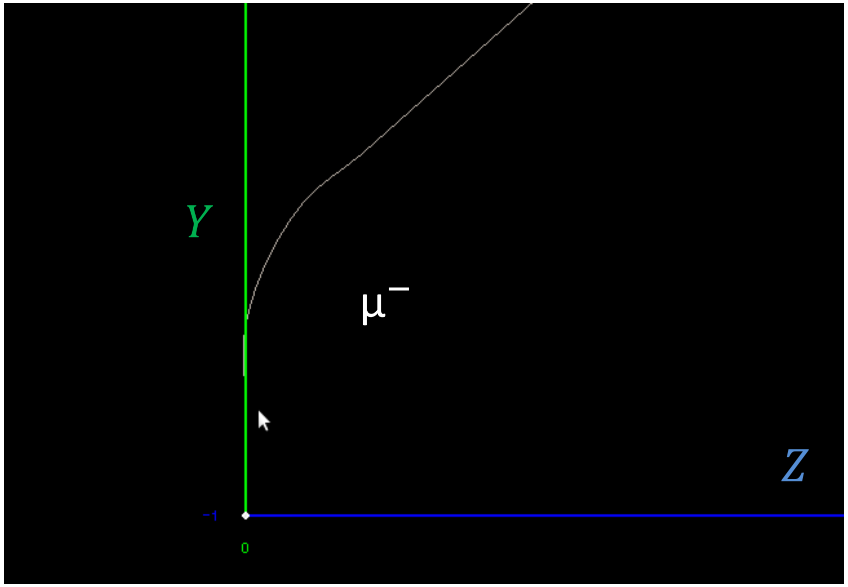


$P_{\mu^-} = 0.2\ GeV$

90^0



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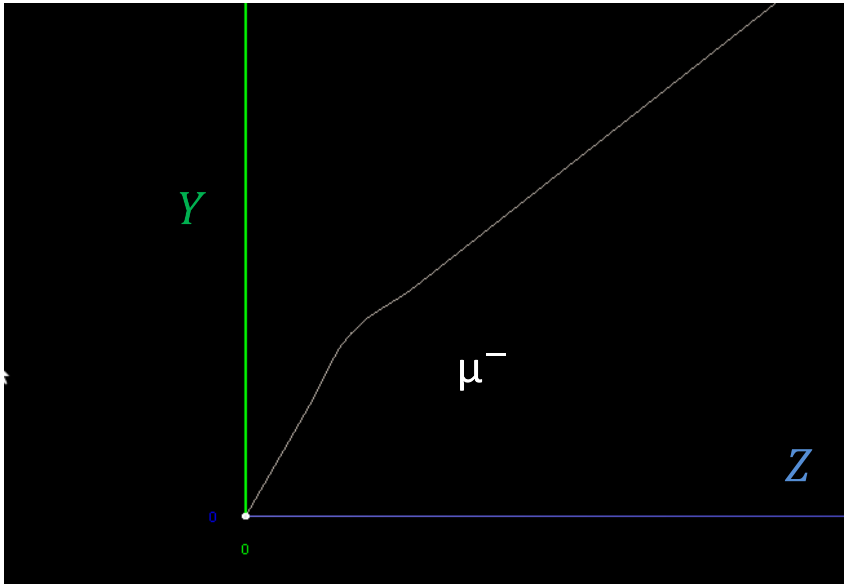

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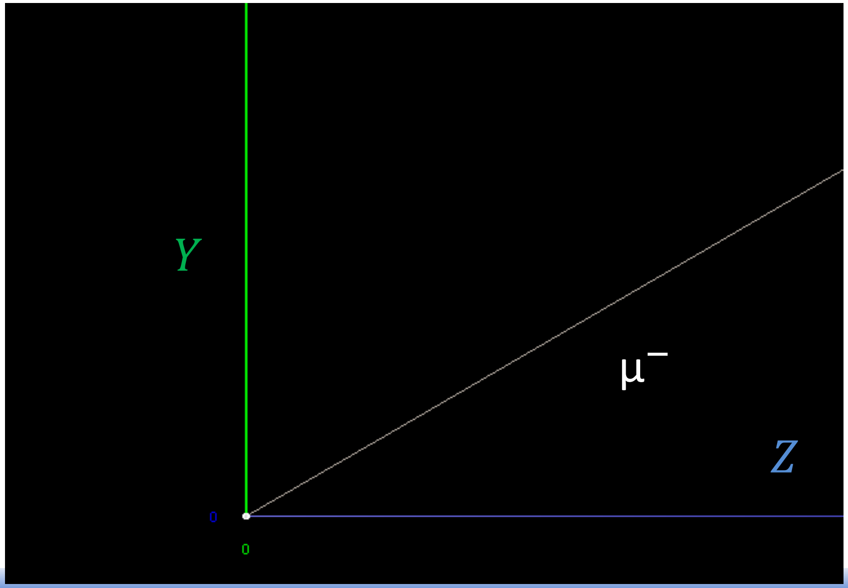

$P_{\mu^-} = 0.4\ GeV$

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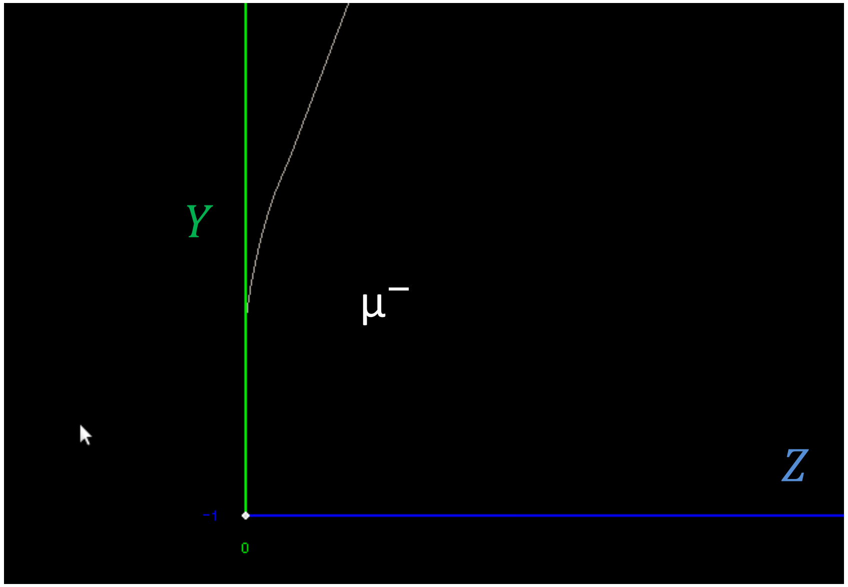

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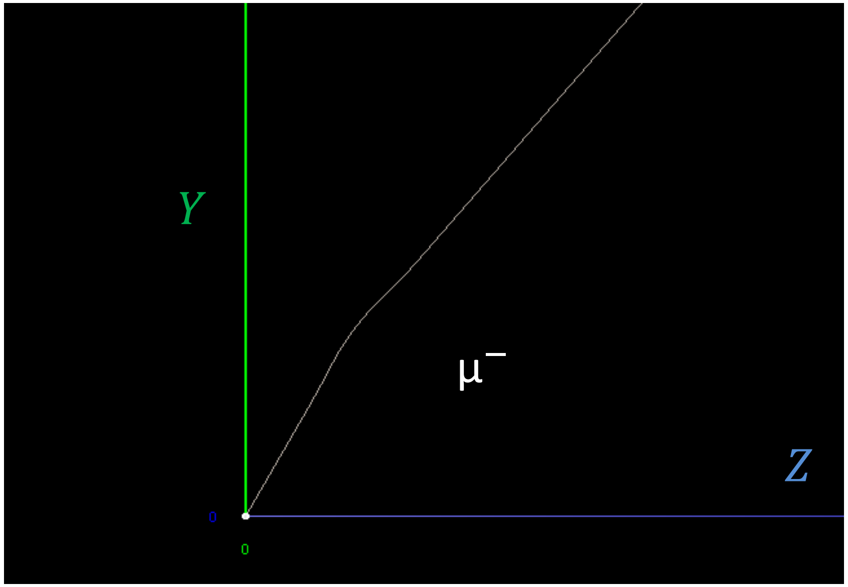

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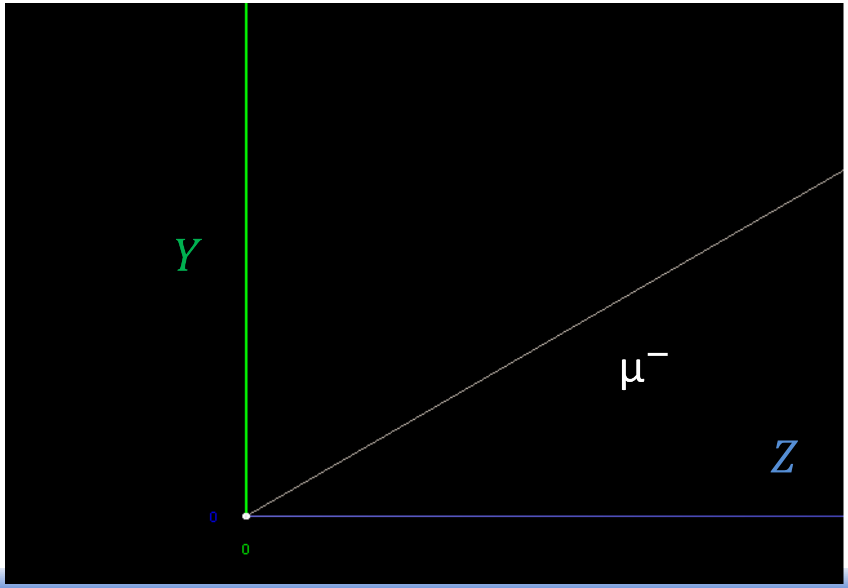

$P_{\mu^-} = 0.6\ GeV$

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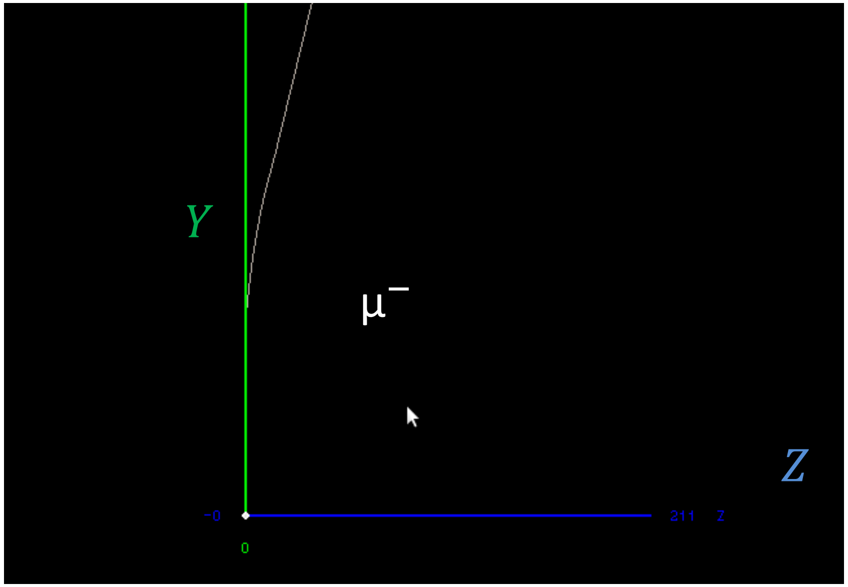

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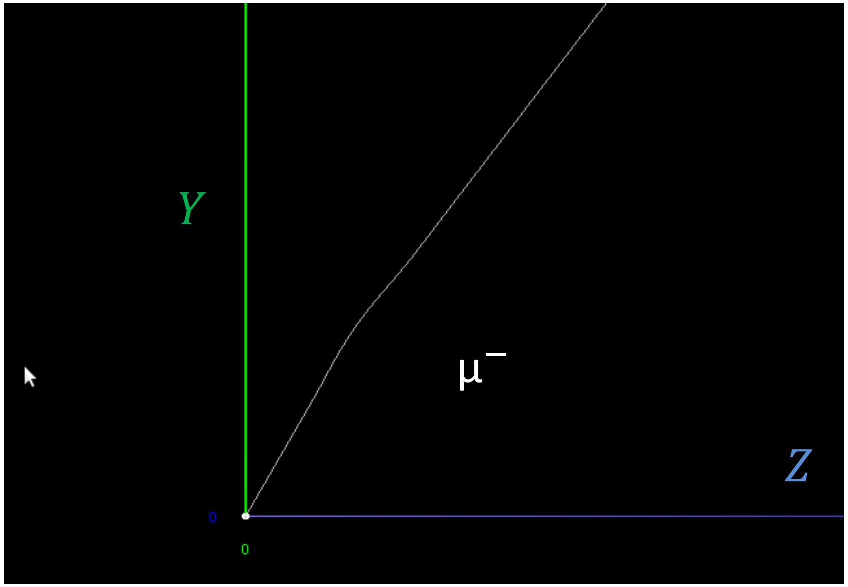

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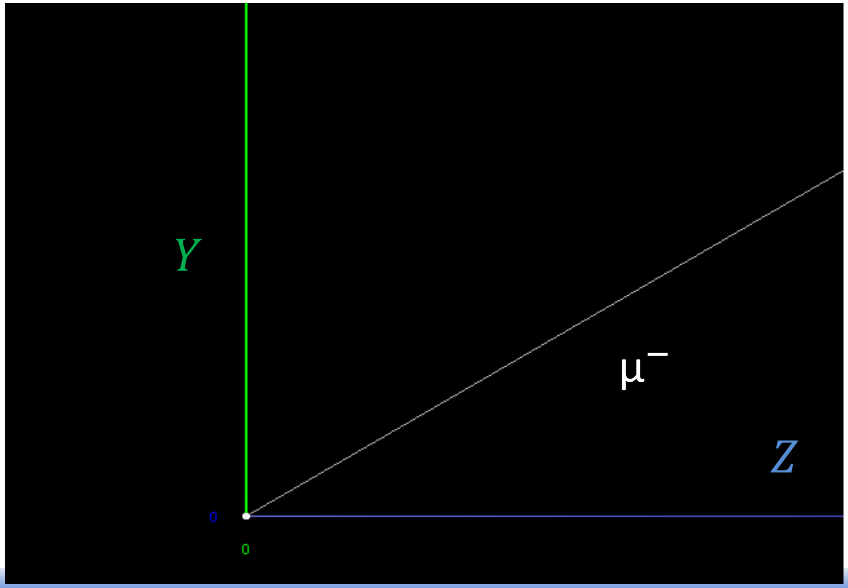
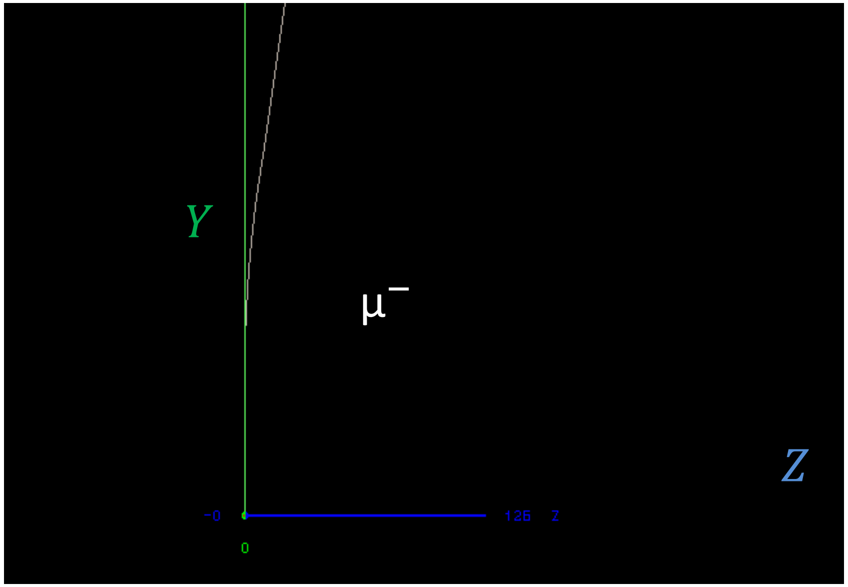


$P_{\mu^-} = 1.0\ GeV$

90^0



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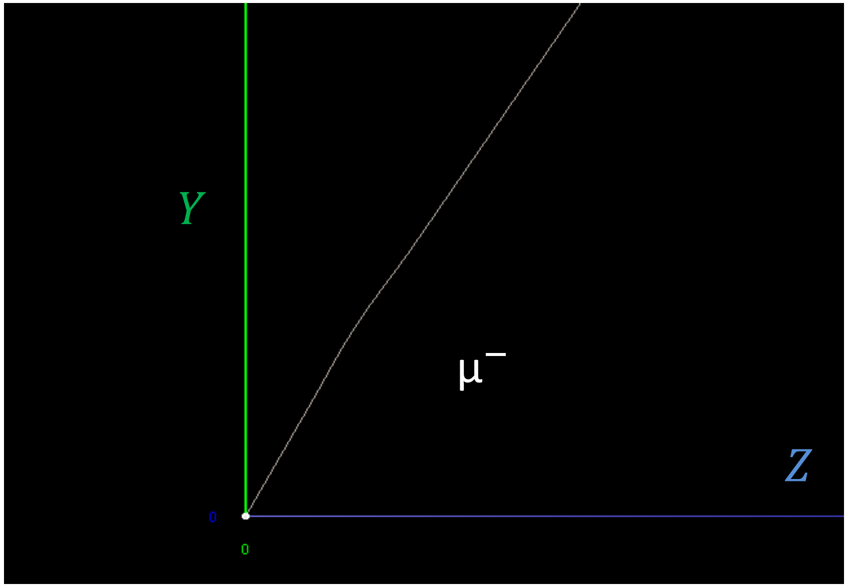

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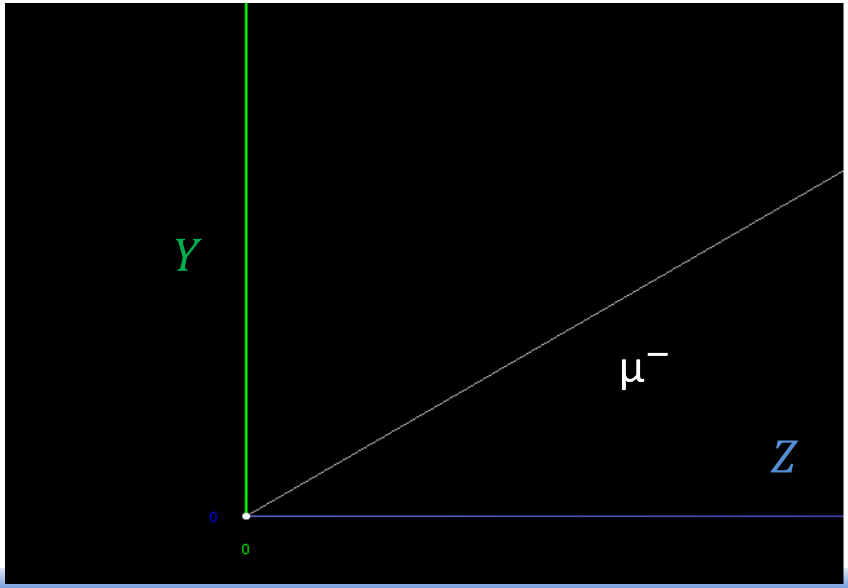
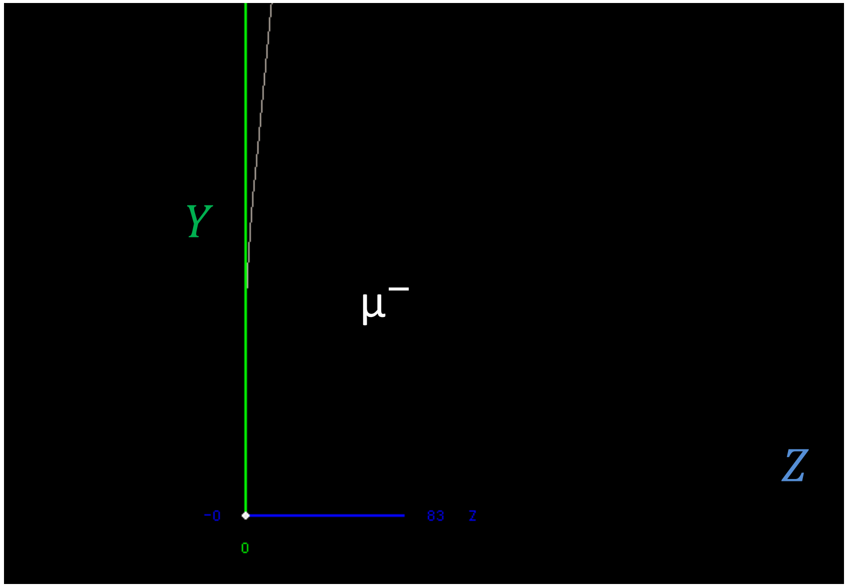


$P_{\mu^-} = 1.5\ GeV$

90^0



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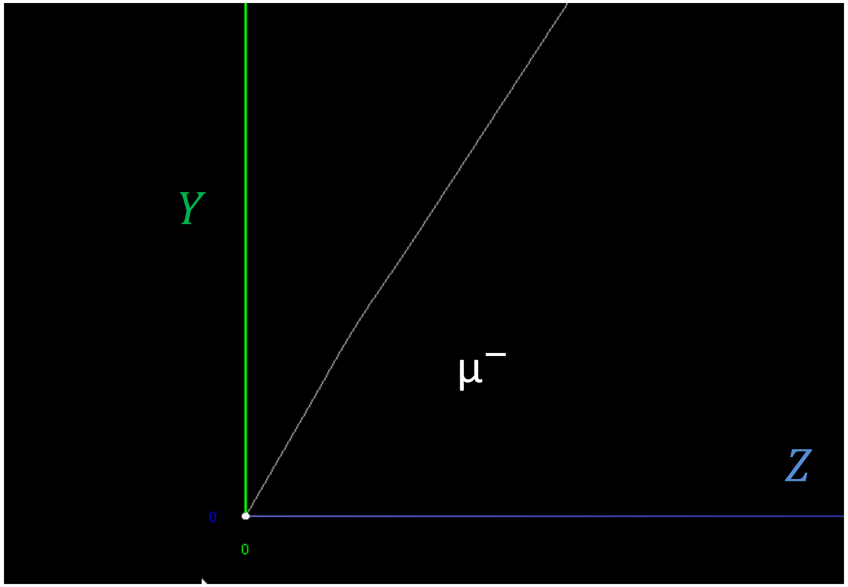

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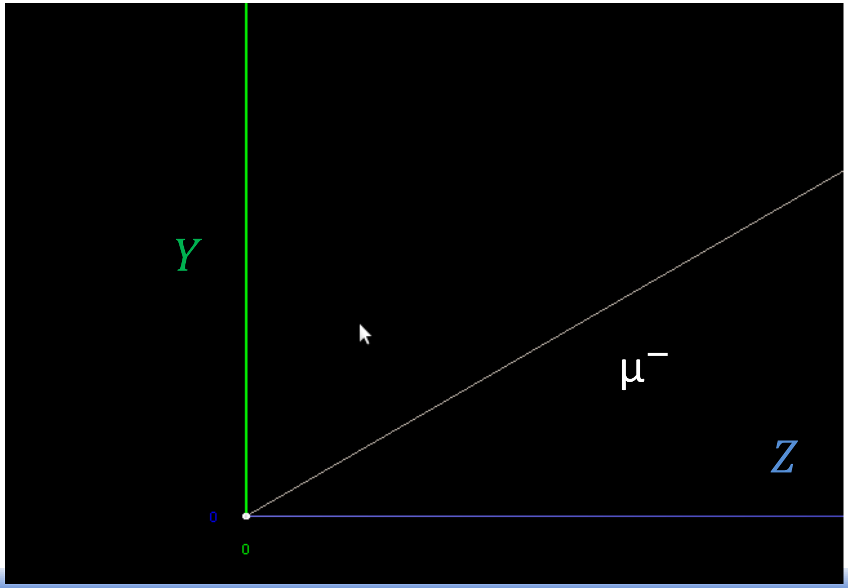
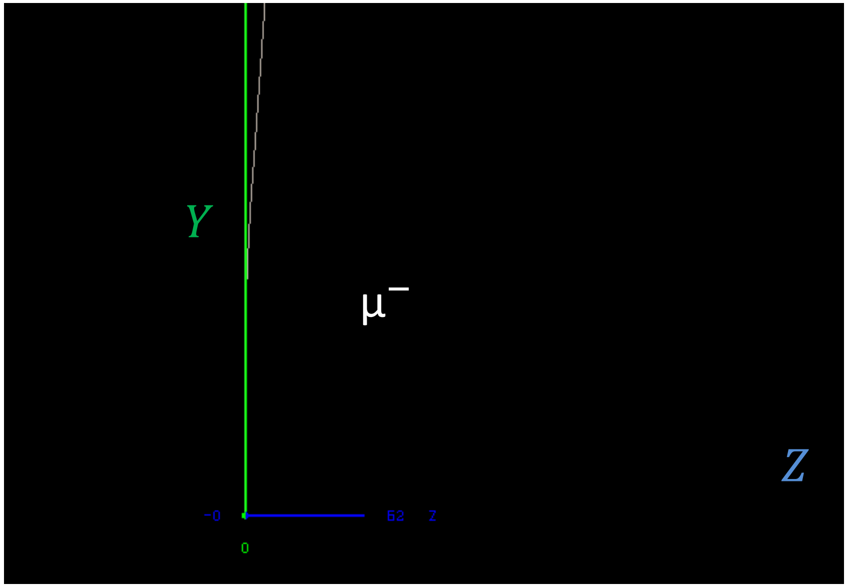


$P_{\mu^-} = 2.0\ GeV$

90^0



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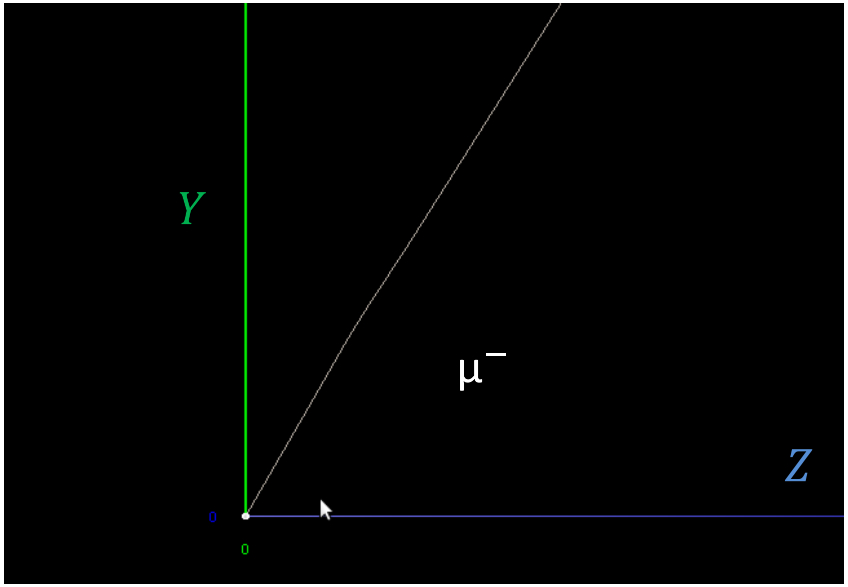

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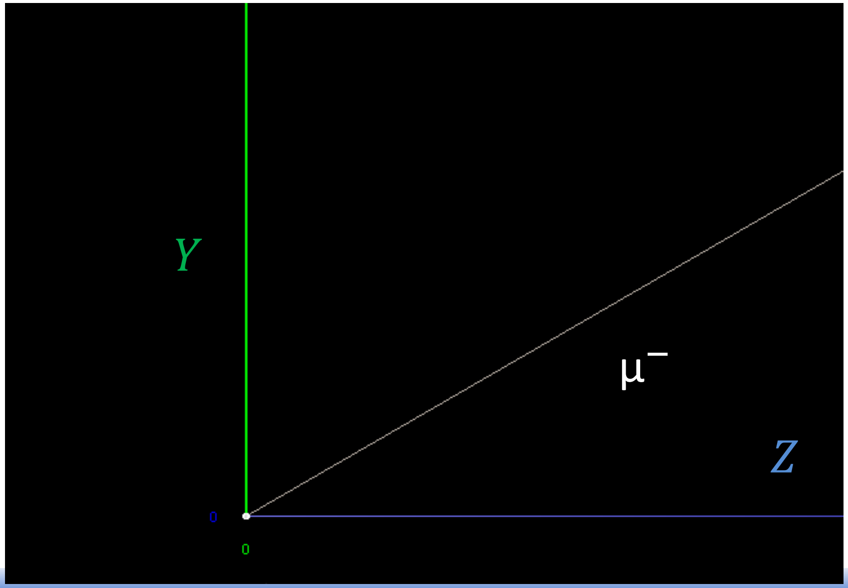

$P_{\mu^-} = 2.5\ GeV$

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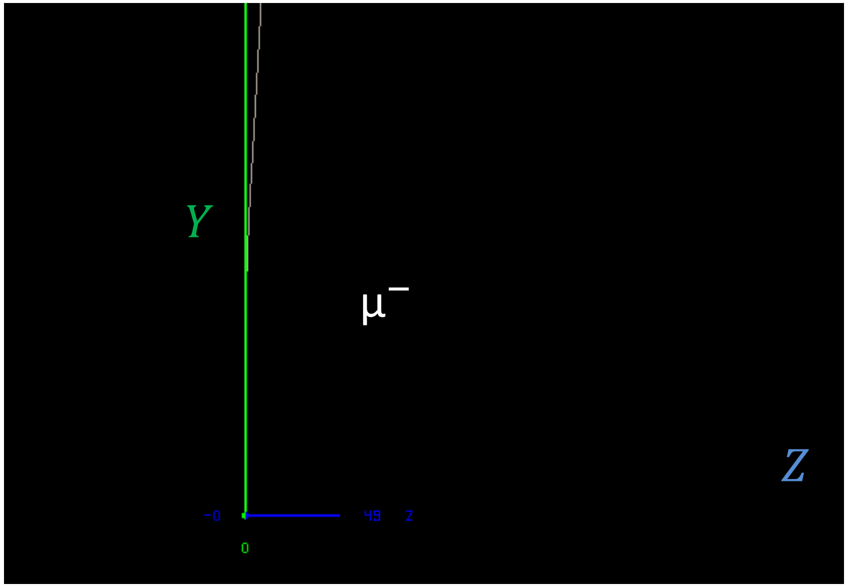

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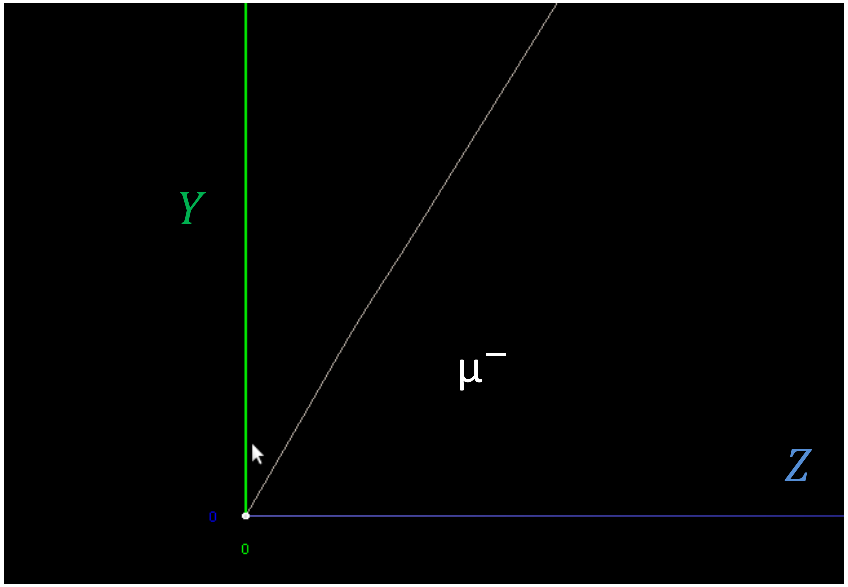

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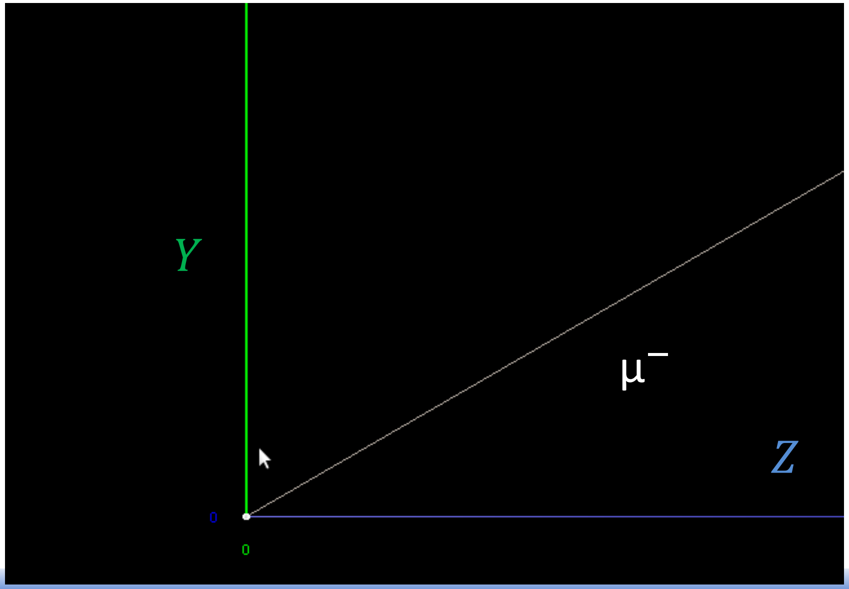

$P_{\mu^-} = 3.0\ GeV$

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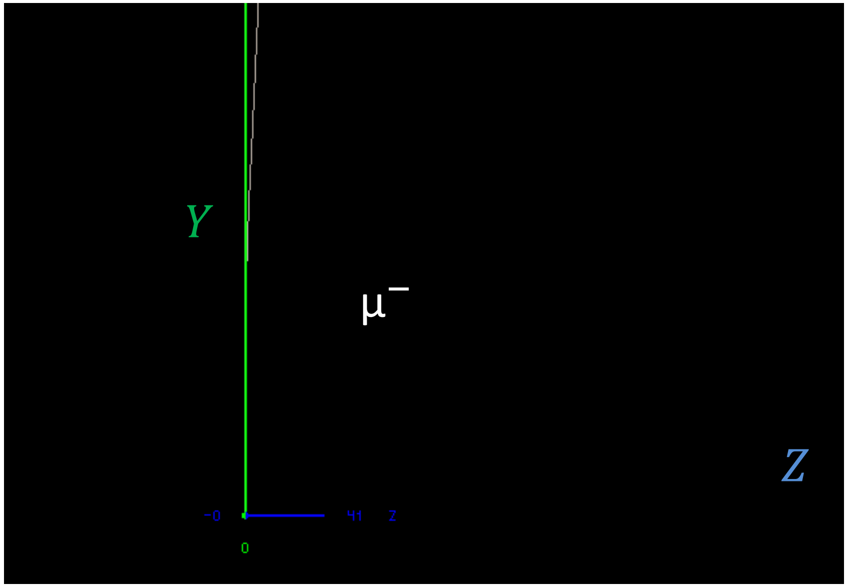

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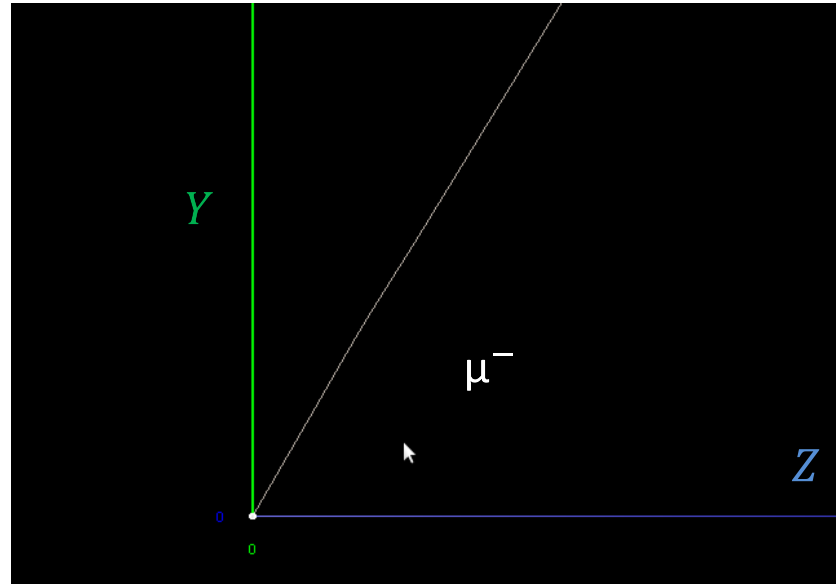

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