50 Tesla Solenoid: confine the decay electrons

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Ways to protect a detector:

- 1. Shield the detector with high-Z materials to absorb the shower debris from interacting electrons from muon decays in the lattice. This implies a lot of tungsten, specifically, 20⁰ cones about the interaction point. This solution is workable.
- Keep the decay electrons inside the beam pipe; do not let them interact and shower. This implies a high-field solenoid to reduce the gyro radius. Dump the electrons far from the detector.

3. a linear combination of 1 & 2 ?4. ???

The idea is simple, and maybe naive: in the final 200 meter approach to the detector region, impose a 50T solenoidal field on the beam pipe, in a straight section, no dipoles, only quads and other multipole magnets. This solenoid stops at about 6 meters from the IP.

The maximum p_T of a decay electron is 52 MeV/c with respect to the muon, and at B=50T the gyro radius is

 $r = p_T / 0.3 B \sim 3.3 mm$

The electrons form a thin disc surrounding the muon bunch, extending out to 6.6 mm.

Problems

• 50T is hard

but is being worked on already for the MuX

- requires 150m to 200m straight sections this increases the circumference of the machine and lowers the luminosity
- the quads and sextupoles for muon final focus will over-focus the lower momentum electrons

but the electrons need not be focused, only confined

• final focus elements should be integrated into the solenoid, all in a single cryostat

Benefits to experiments (if it works)

• Can use the full solid angle

important for forward asymmetry measurements

• Design intelligent (not "defensive") detectors

design the best experiment, without (excessive) concern for radiation damage, occupancy reduction, background hit rejection, etc.

• Decouples detector and machine

each can optimize with relative freedom

• A few μ^+e^- and μ^-e^+ events ... just for fun

Benefits to the machine

• Decoupls bending and final focus lattices?

This is a true machine+detector problem:

and it will require the talents of many people,

from Fermilab ... Nikolai Mokhov, Vadim Alexakhin (MARS), Steve Geer, Ryuji Yamada (50T),

from Lecce ... Vito Di Benedetto, Anna Mazzacane, Corrado Gatto, "MuXroot",

from Muons, Inc. (Steve Kahn, etc.)

from anyone else who would like to think through new problems