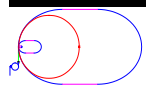


# MACHINE INDUCED BACKGROUND:\*

- Muon Halo
- Muon Decay
- Beam-Beam Interaction

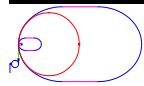
\*



$\mu^+ \mu^-$  COLLIDER

Calculations are done with  
GEANT and MARS  
Study is just beginning†

†



$\mu^+ \mu^-$  COLLIDER

BACKGROUND FROM  $\mu$

HALO : Muon halo refers to  $\mu$ 's lost from main bunches but manage to appear at the detector( full energy)

Passing through the calorimeter undergo Deep Inelastic Scattering and deposit clumps of energy (constraints on calorimeter)

SOLUTION: careful injection and collimation

# BACKGROUND FROM $\mu$ DECAY ‡

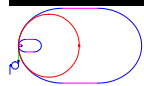
$$\mu^- \rightarrow e^- + \nu_\mu + \bar{\nu}_e$$

$2 \times 10^{12} \times 2$  decays in  $10^3$  turns

$2 \times 10^9 \times 2$  decays per turn

$5 \times 10^5$  decays per m

‡

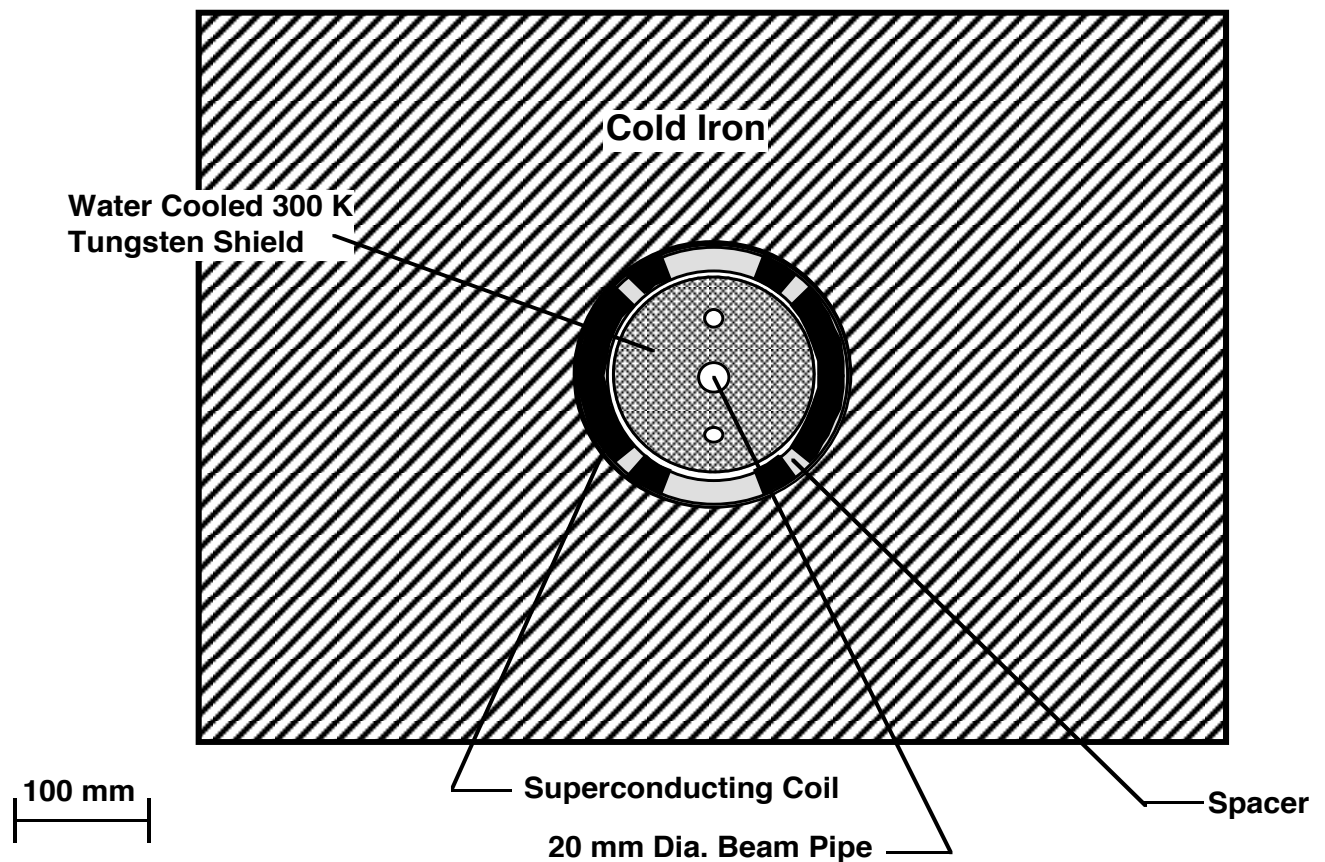


$\mu^+ \mu^-$  COLLIDER

electron synchrotron radiation

High energy electromagnetic  
showers ( $e, \gamma$ , neutrons and  
charged hadrons)

- Heating of beam pipe  $\rightarrow$  6 cm of Tungsten liner
- background at detector  $\rightarrow$  design of W nose cone



Beam Power 38 MW 6 kW/m

Power → pipe 12 MW 2 kW/m

Power → Cold Fe 30 kW 6 W/m

Radiation (after 1 day) on outside of W 100  
mR/hr

Radiation (after 1 day) on outside of Fe 1  
mR/hr

- Incoherent pair creation  $e^+e^-$  due to beam beam interaction ( $\sigma \approx 10 \text{ mb} \rightarrow 3 \cdot 10^4 e^+e^-$  per crossing). 90% trapped in tungsten nose cone; only pairs with  $30 < E < 100 \text{ MeV}$  will enter detector ( $20^\circ$  shielding cone angle).

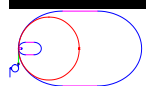
Solution: Design of nose cone; Skrinsky and P. Chen has suggested plasma (Li jet) at IP ( $\sigma \approx 90 \text{ mb}$  but most pairs move along beam pipe)

- Electrons generate Bethe-Heitler muon pairs, Deep Inelastic Scattering cause spikes of energy distribution
- hadron background (neutrons) due to photo-production

# STRAWMAN DETECTOR:§

Present state-of-the-art  
technologies seems to be  
sufficient to build a detector  
which will meet the  
requirements (background:  
large number of soft particles)

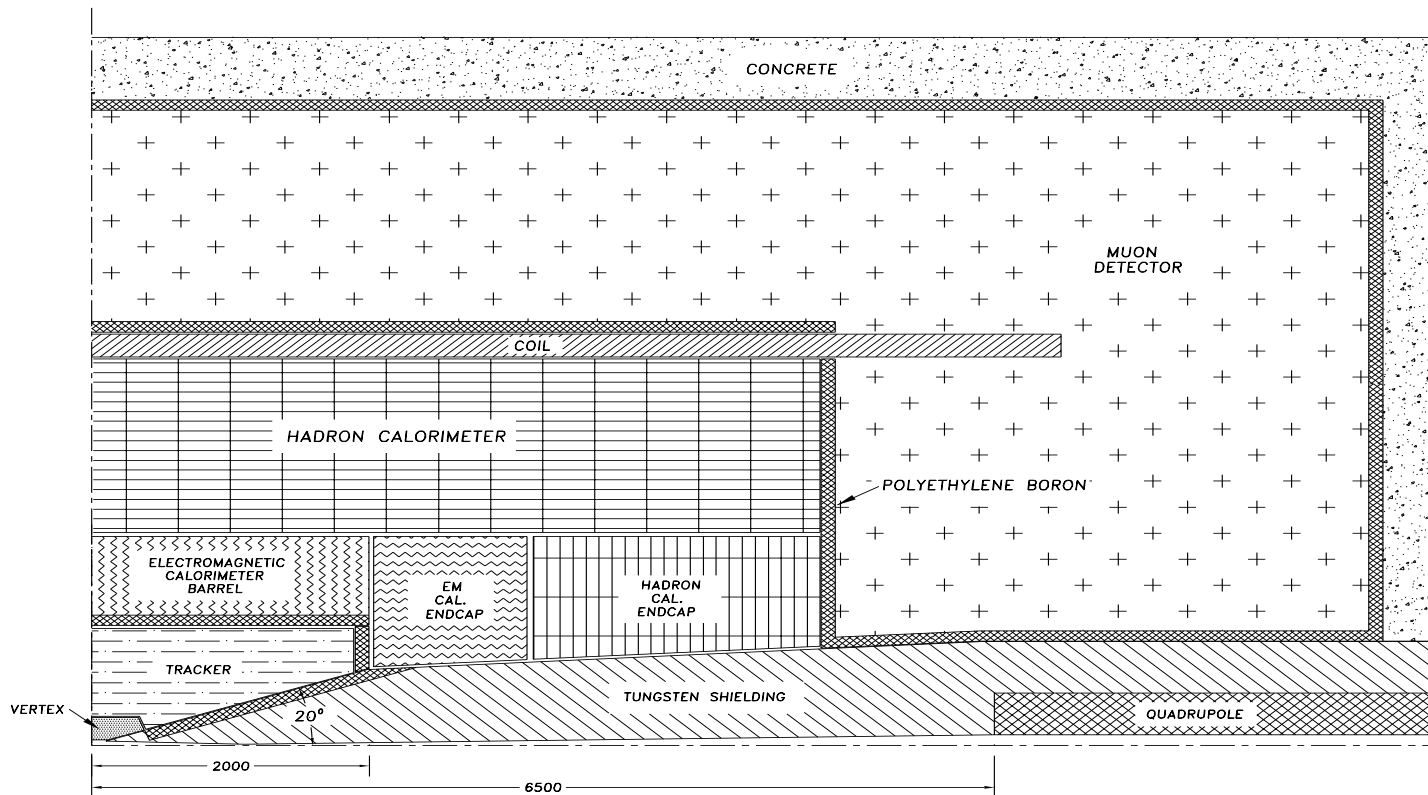
§



$\mu^+ \mu^-$

COLLIDER





Detector Component	Minimum Resolution/Characteristics
Magnetic Field	Solenoid; $B \geq 2T$
Vertex Detector	b – tagging, small pixels
Tracking	$\Delta p/p^2 \sim 1 \times 10^{-3} (GeV)^{-1}$ at large p High granularity
EM Calorimeter	$\Delta E/E \sim 10\%/\sqrt{E} \oplus 0.7\%$ Granularity : longitudinal and transverse Active depth : $24X_0$
Hadron Calorimeter	$\Delta E/E \sim 50\%/\sqrt{E} \oplus 2\%$ Granularity : longitudinal and transverse Total depth (EM + HAD) $\sim 7\lambda$
Muon Spectrometer	$\Delta p/p \sim 20\%$ at $1 TeV$

## Detector Performance Requirements

