



New Idea for Producing an Intense, Cool Muon Beam

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Synopsis:

- A recent clever proposal could lead to a neutrino factory without cooling or muon acceleration!
- I can think of 3 ways to implement it:
 - 2 of them fail by many orders of magnitude
 - the 3rd, as of yet, I understand too poorly to rule out...

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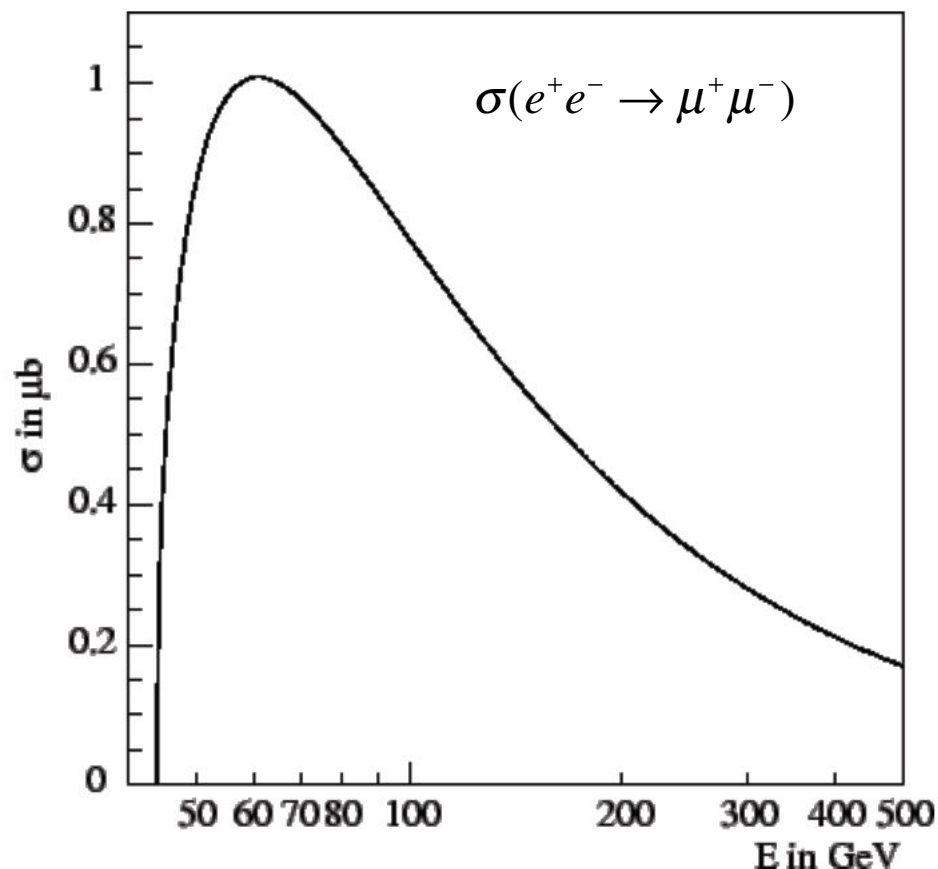
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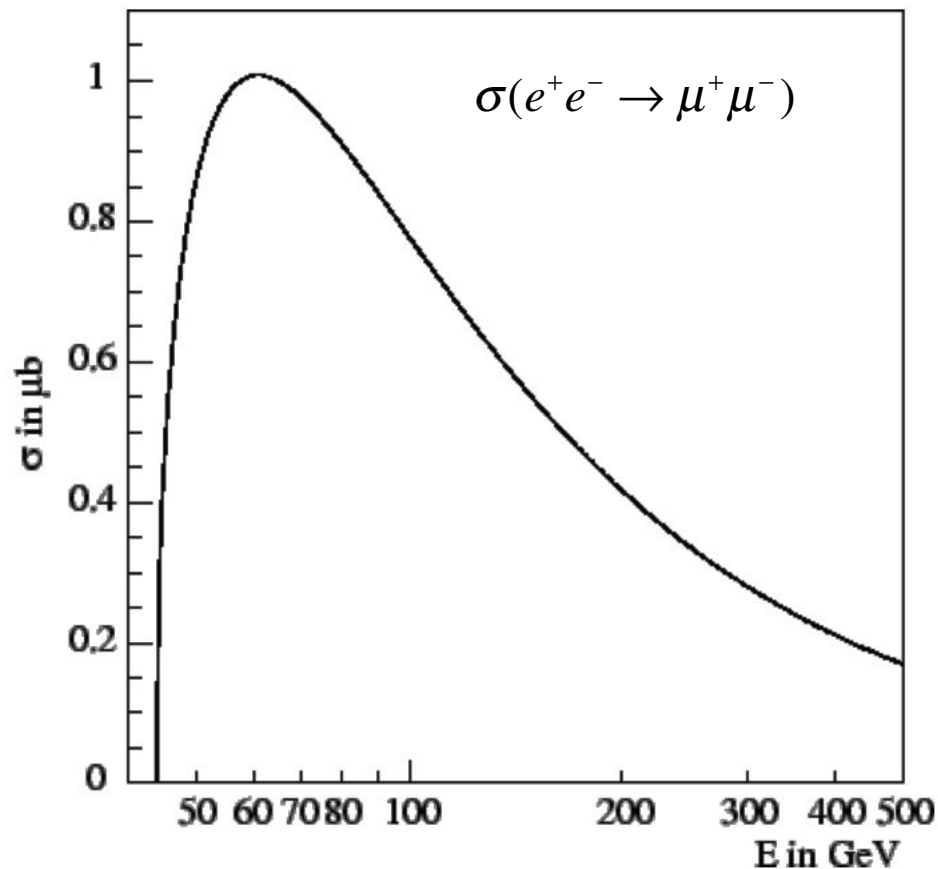
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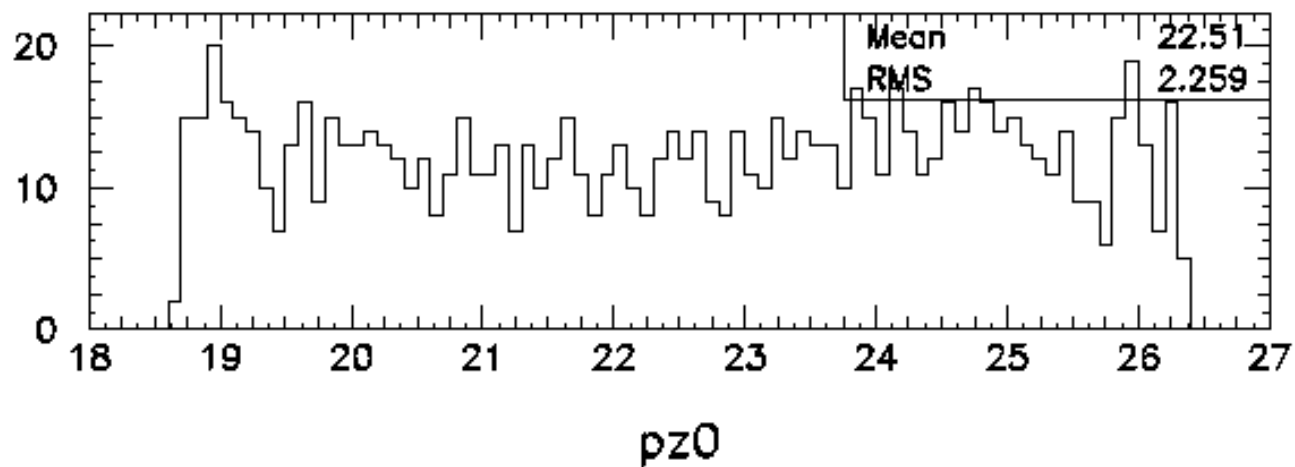
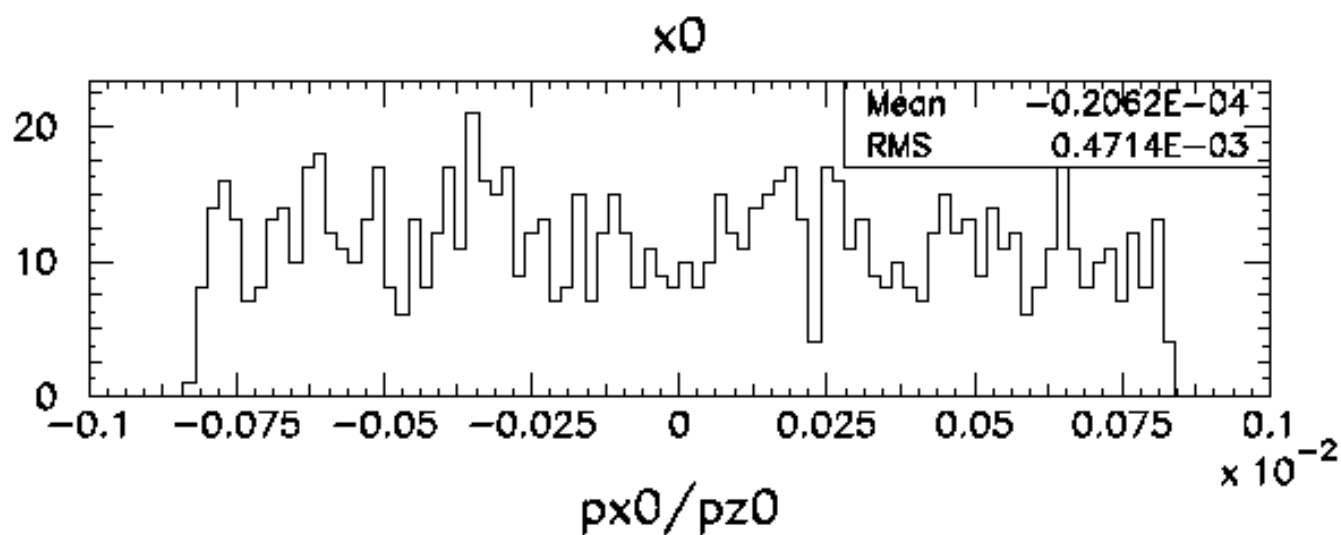
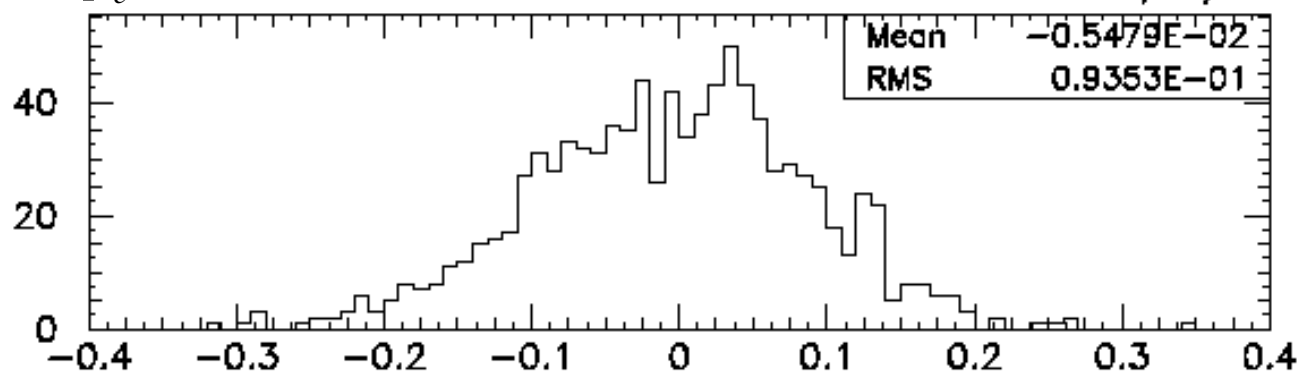
Note:

- Fixed-target threshold is 43.7 GeV
- Cross section peaks at 1 μB at 60 GeV
 - o this is $\sqrt{s} \approx 250$ MeV

Muon Beam Properties

$p_{e^+} = 45 \text{ GeV}/c$

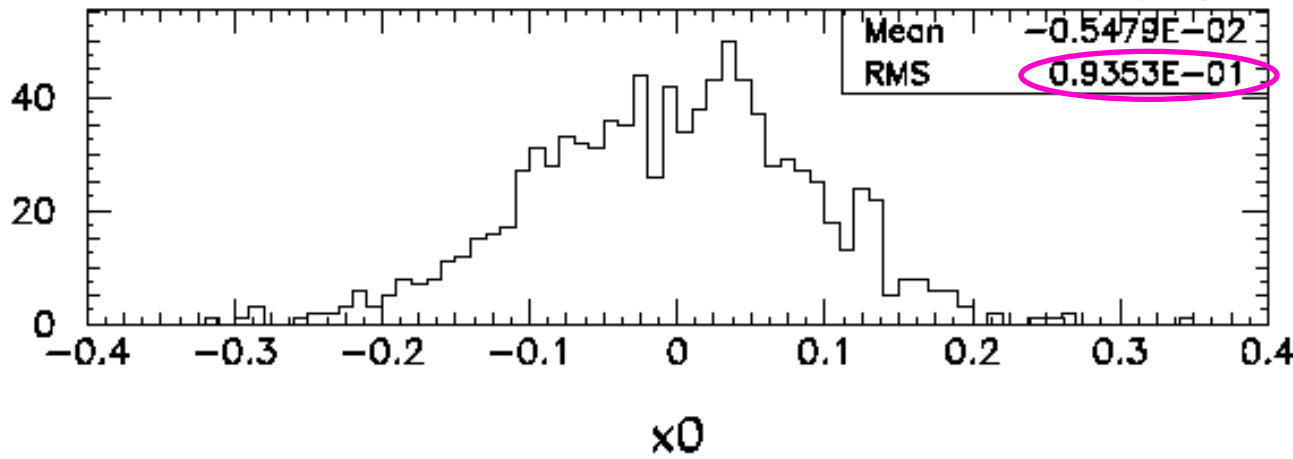
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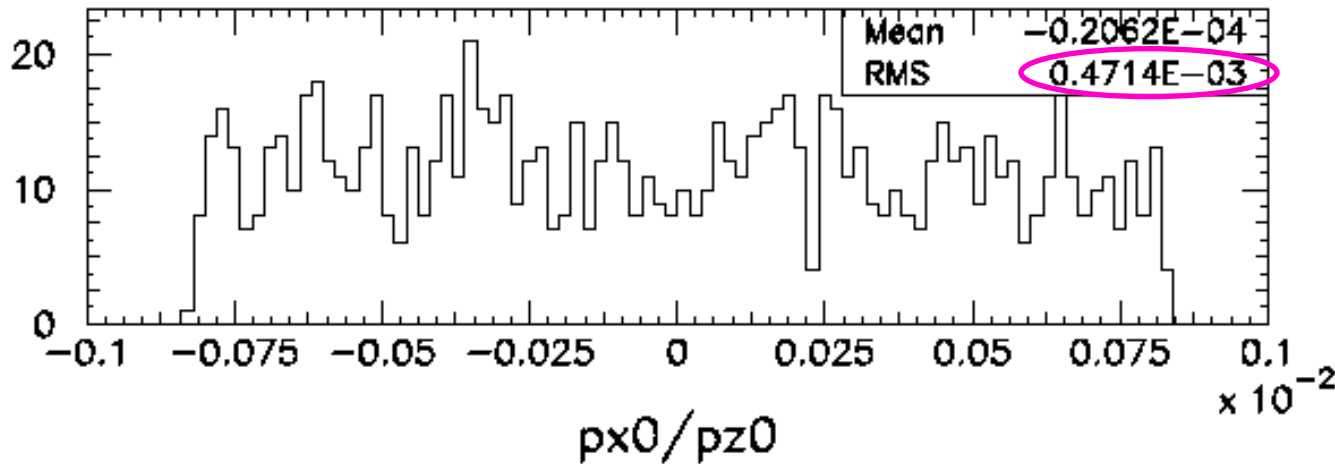
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$$\epsilon_n = \gamma \beta \sigma_x \sigma_{x'}$$

$$= 212 \times 0.1 \text{ mm} \times 0.47 \text{ mrad}$$

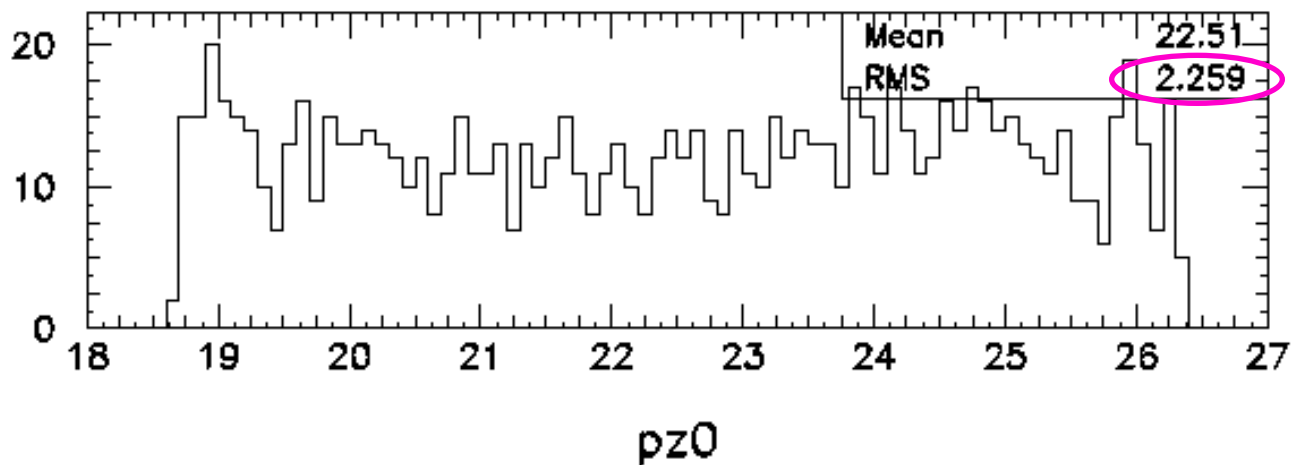
$$= 10 \text{ mm}\cdot\text{mrad}$$



but $\Delta p/p = 10\%$

\Rightarrow can only use fraction of beam – say, 10%?

$$\rightarrow \epsilon_n = 1 \text{ mm}\cdot\text{mrad}$$



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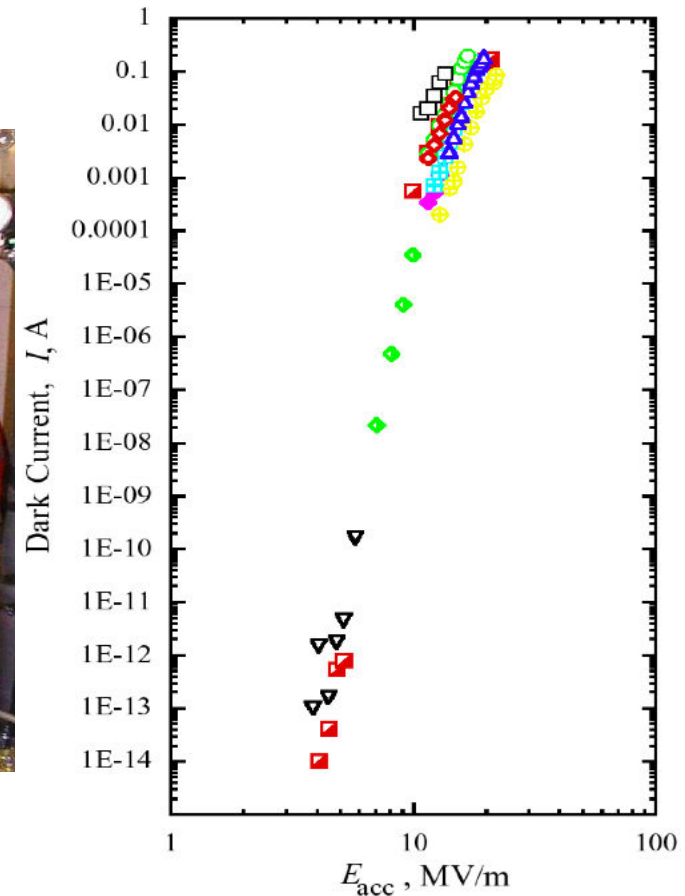
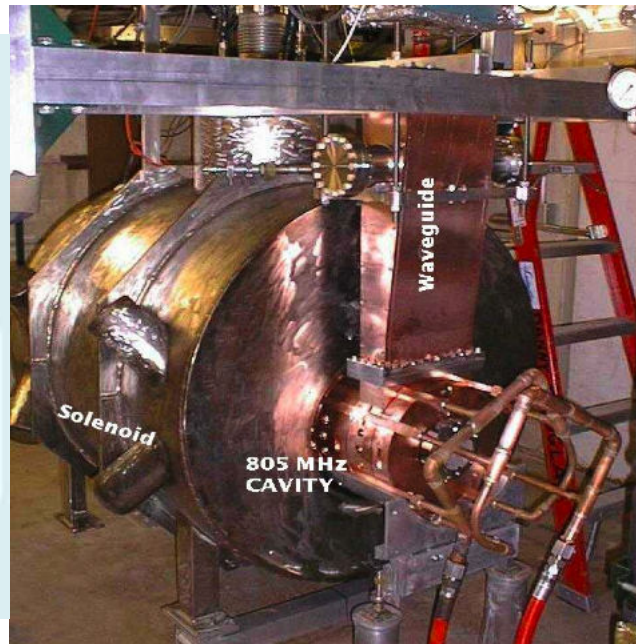
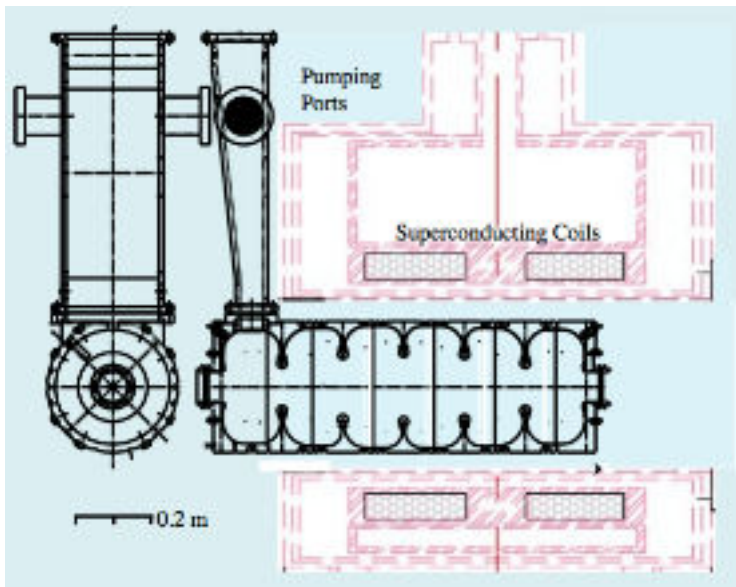
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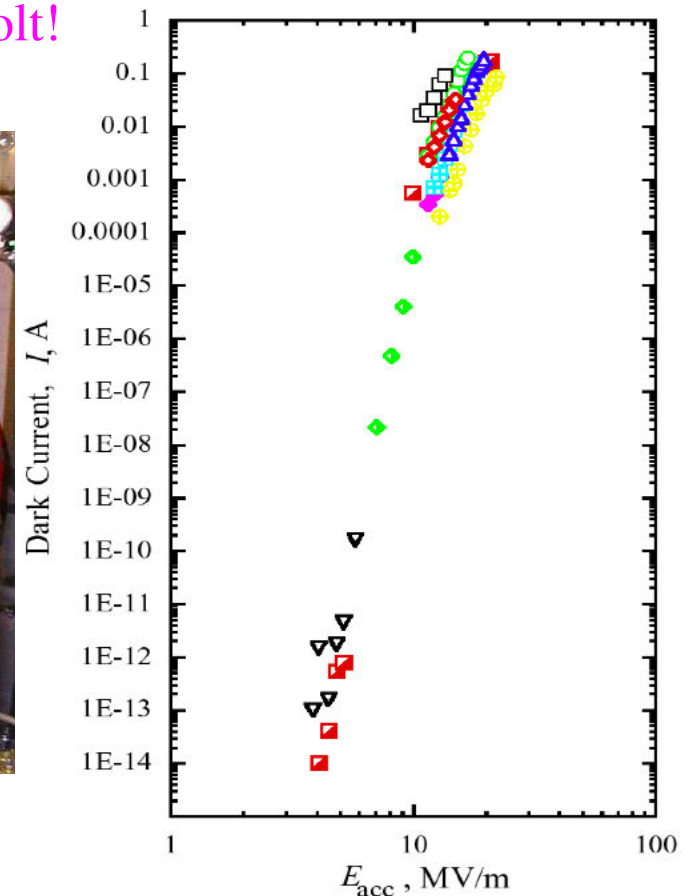
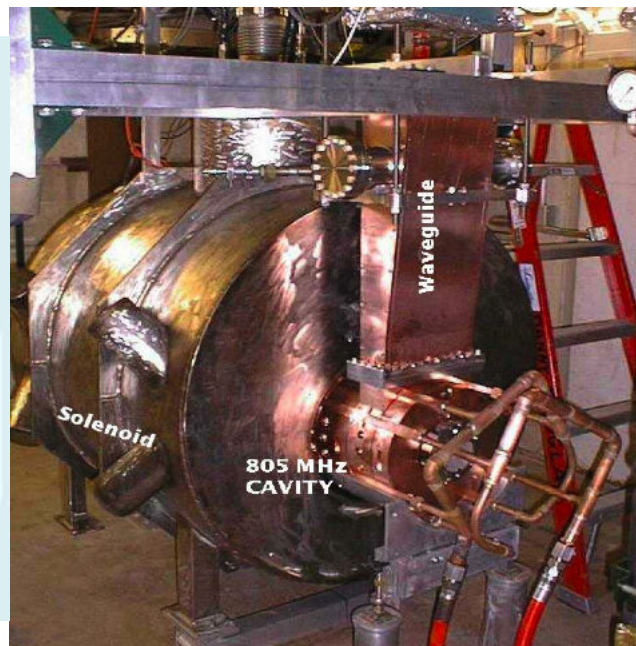
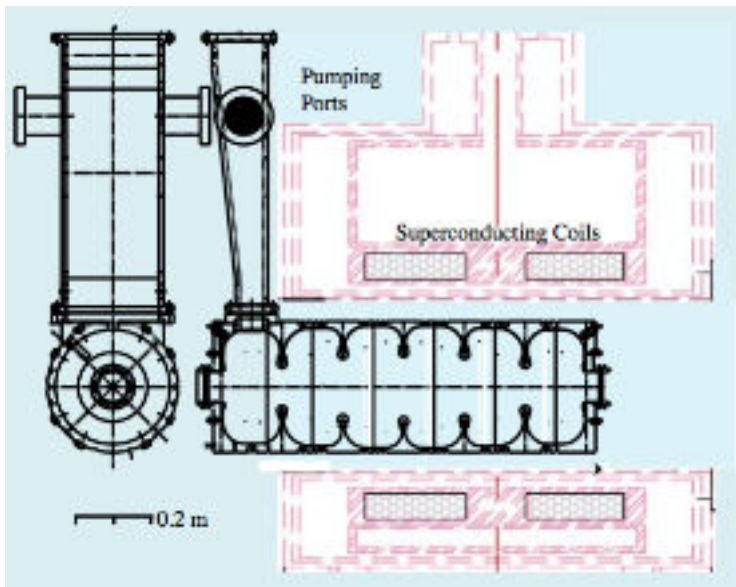
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→ need only a tiny fraction of a ($\sim 10^{6-8}$ A/cm²) lightning bolt!



Summary

- e^+e^- annihilation to muon pairs at threshold can produce cool muons ($\mathcal{E}_n \sim \text{mm}\cdot\text{mrad}$, $\Delta p/p \sim 1\%$)
- In principle these could be fed directly into decay rings \rightarrow neutrino factory without muon cooling or acceleration!
- But fixed-target and asymmetric-collider implementations miss νF intensity goal by many orders of magnitude
- Could high-current positron storage ring with internal high-intensity electron-discharge target meet the goal???

(– or – less ambitious? – that of muon collider?)

not a cheap solution – but at least one with new & different set of challenges!

\rightarrow Thanks to Phil Allport, Terry Hart, Tom Roberts, Don Summers