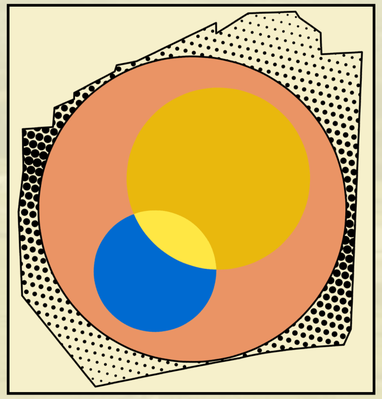
Ideas for ~~neutrino~~ physics at a muon collider detector

~~forward~~

tangential?



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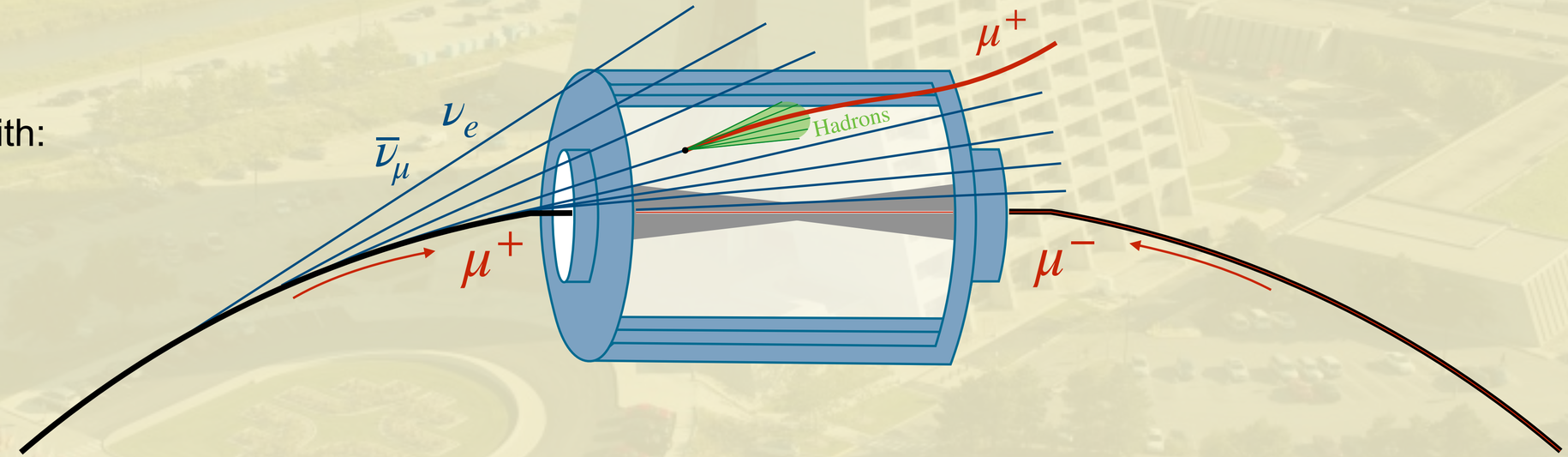

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Inaugural US Muon Collider Meeting

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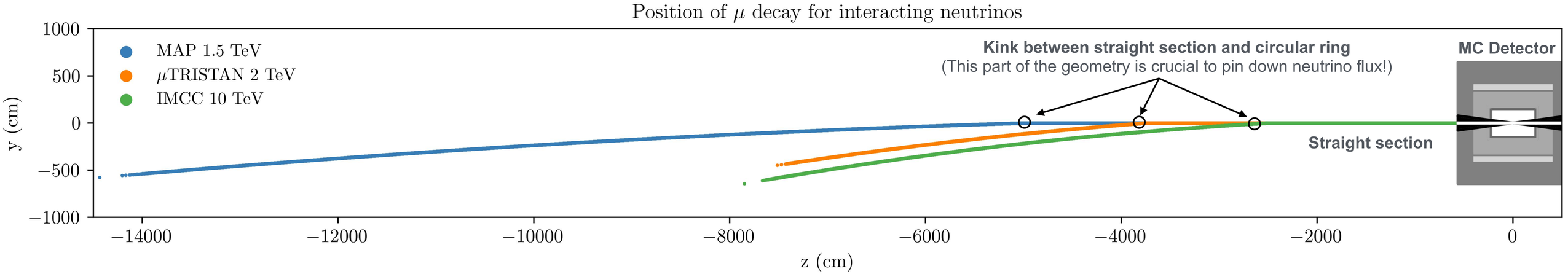
Event rate: leap in intensity

Detector components following IMCC studies



Preliminary

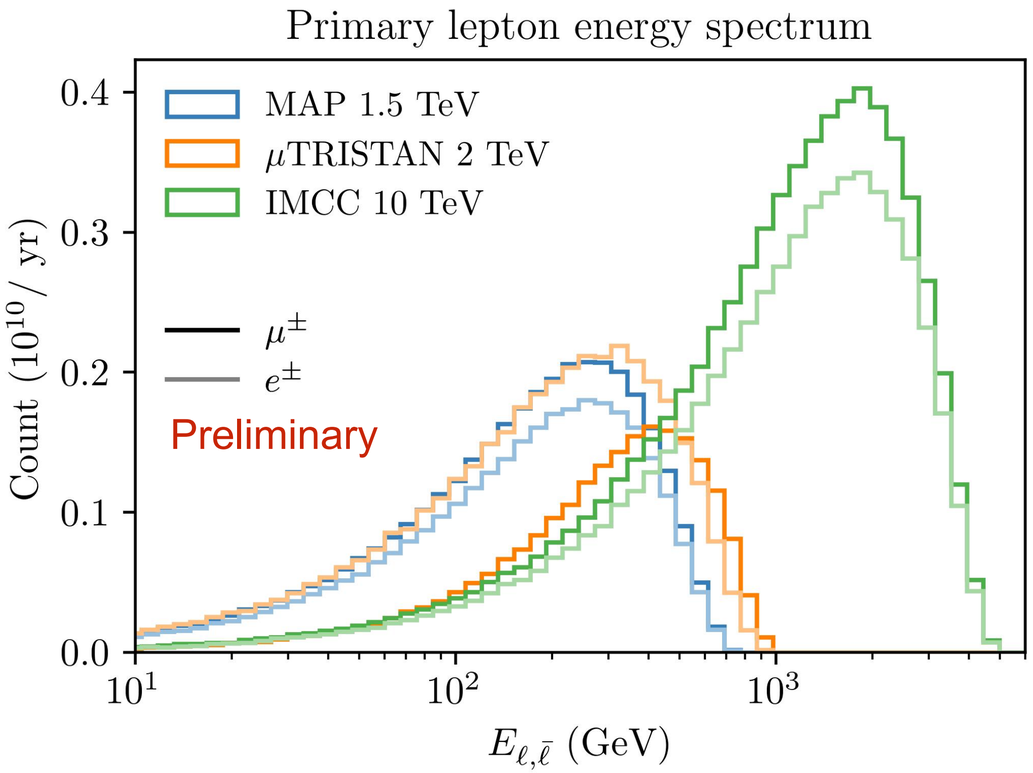
Detector components	MAP $\mu^+\mu^-$ $\sqrt{s} = 1.5$ TeV $C_{\text{ring}} = 2.7$ km $L_{\text{straight}} = 50$ m	μTRISTAN μ^+e^- $\sqrt{s} = 2$ TeV $C_{\text{ring}} = 3$ km $L_{\text{straight}} = 75$ m	IMCC $\mu^+\mu^-$ $\sqrt{s} = 10$ TeV $C_{\text{ring}} = 10$ km $L_{\text{straight}} = 100$ m
Muon Sys (7.5 kt)	49%	84%	48%
HCal (1.4 kt)	24%	9.7%	23%
ECal (0.15 kt)	4.4%	$< 0.1\%$	2.9%
Nozzles (0.14 kt)	19%	0.20%	23%
Total event rate (yr^{-1})	8.9×10^{10}	8.3×10^{10}	1.7×10^{11}

$\mathcal{O}(1-10)$ **neutrino interactions per bunch crossing!**

Very sensitive to the exact geometry of the accelerator.

More neutrinos than we have ever detected by >3 orders of magnitude.

Characterizing neutrino events



GENIE v3.04 charged-current neutrino interactions

The wrong L/E for oscillations, but other ideas:

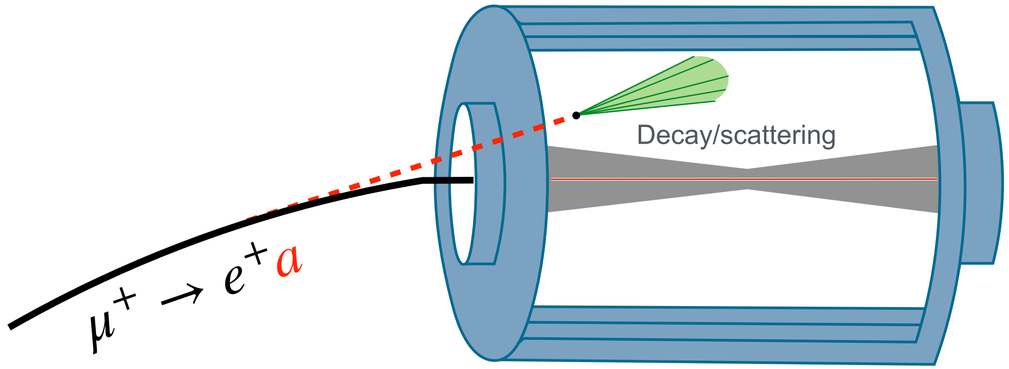
1) **Measure properties of the muon beam far from the collision point?**

2) **High-energy "beam-induced-background". Not an issue** for main collider program (small pT, large transverse position, and timing), but what are the **implications for the forward muons if nozzle is instrumented?** (e.g., for $\mu\mu \rightarrow \mu\mu H$).

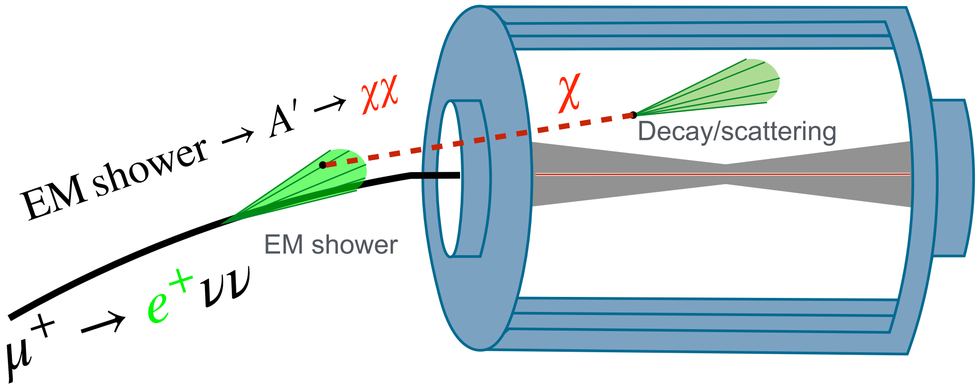
3) **Precision measurement** of cross sections, including **rare processes** and **new physics.**

Not just neutrinos?

Primary particle production from muon decay
(Neutrinos beam, heavy neutrinos, ALPs)

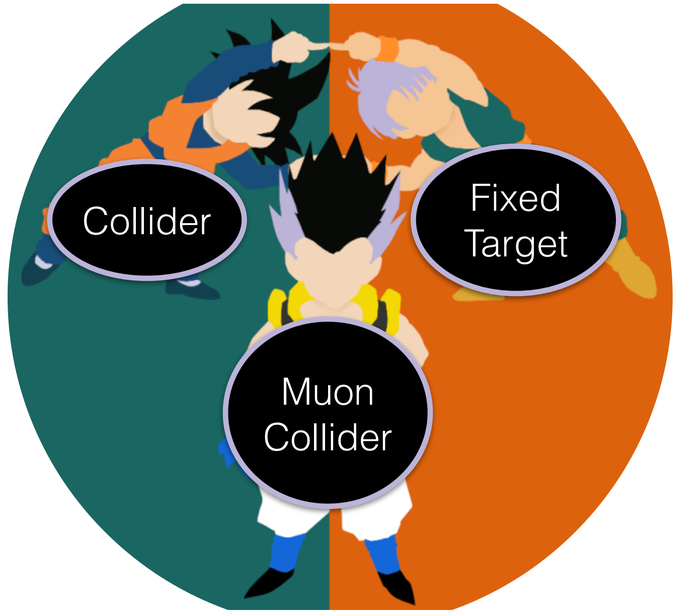


Secondary particle production from $e^{\pm}/\gamma/n/\mu^{\pm}$ interactions
(Circular TeV-scale "fixed target" facility)



Lots of possibilities to be explored.

Fusion!



This is an unavoidable physics program for a muon collider.