

M³: Muon Missing Momentum

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Snowmass 2021: EF10 meeting

September 22, 2020

Report on RF6 [LOI](#)

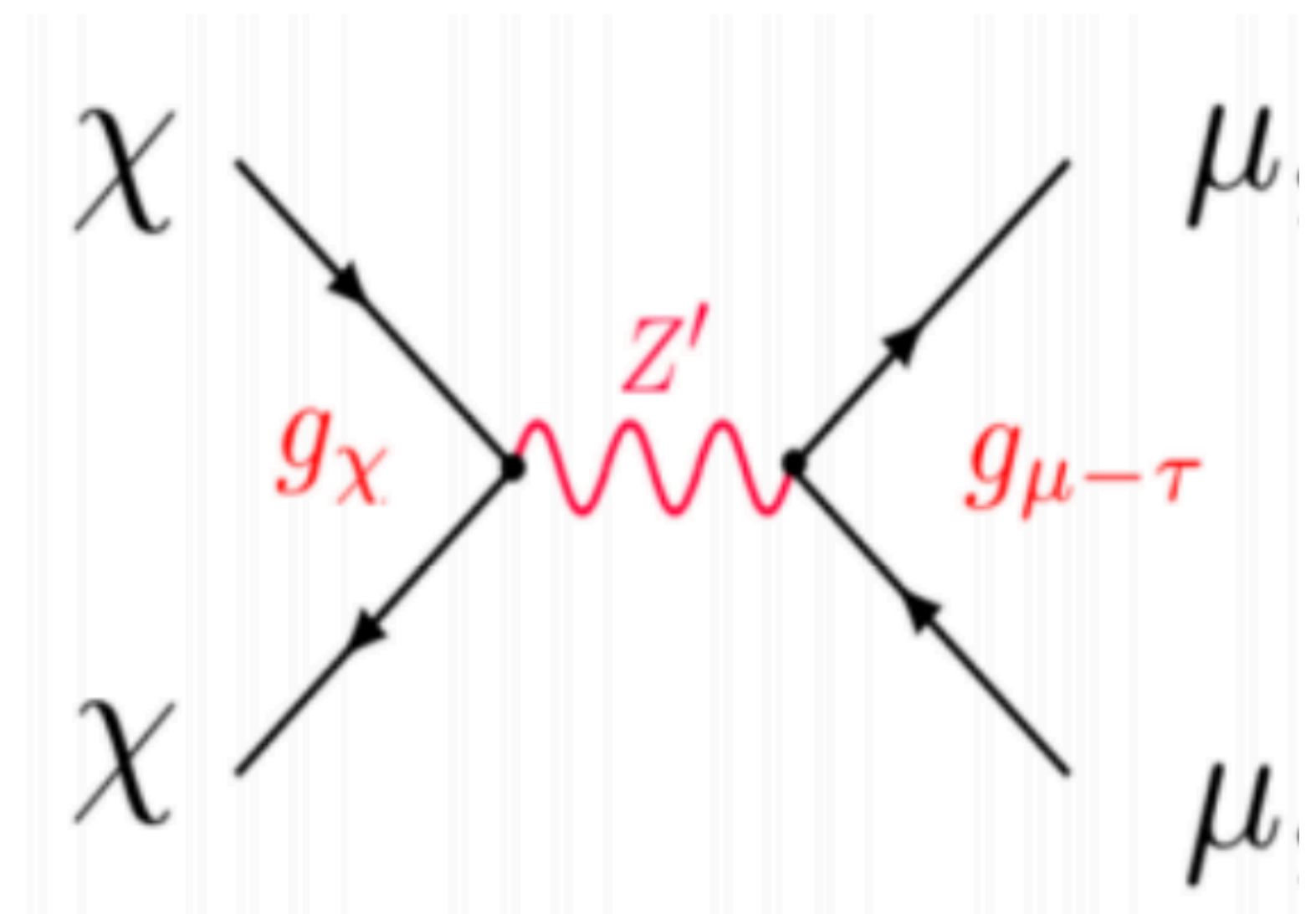
Based on work from:

Y. Kahn, G. Krnjaic, N.T., **AW**

<https://arxiv.org/abs/1804.03144>

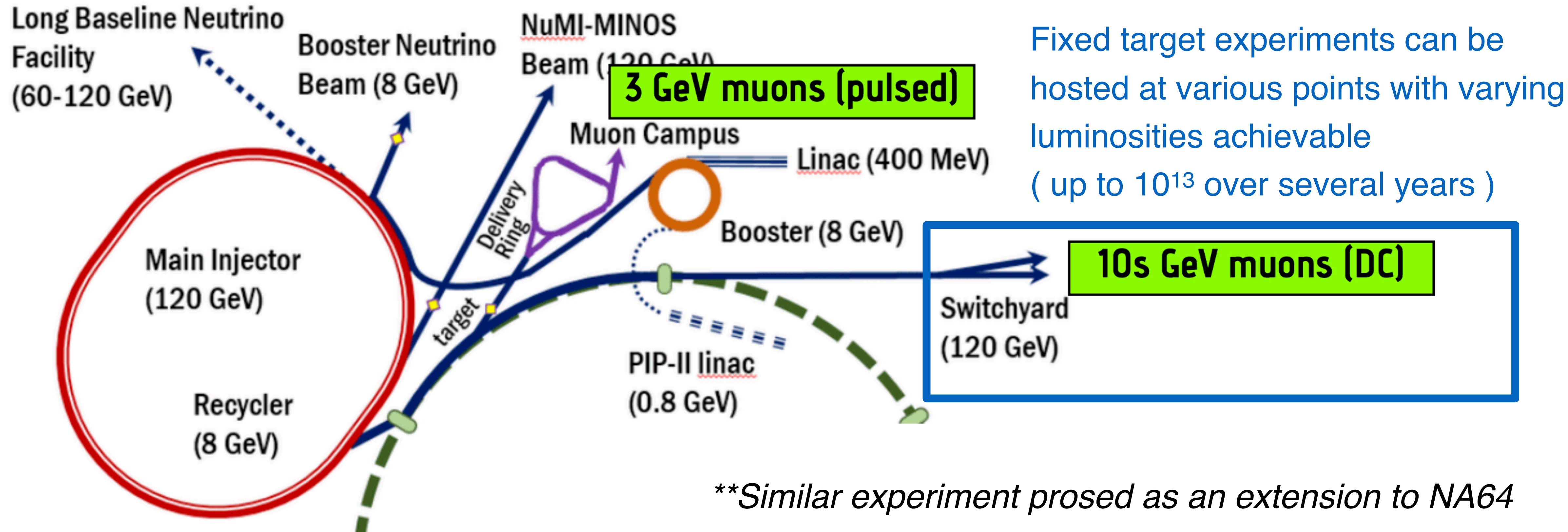
M³ in broad strokes

- M³ is a similar concept to electron fixed target missing momentum techniques (LDMX)
- Will provide a unique window into 2nd generation physics
 - Motivated by the need for model independent probes of new light physics contributing to $(g-2)_\mu$ anomaly
 - Motivated by muon-philic forces ($L_{\mu-\tau}$)
- Similar target for thermal relic DM motivate high MoT experiments: $\mathcal{O}(10^{13})$



Muon facilities at FNAL

Facilities exist that can be used immediately with minimal modifications to achieve world-leading sensitivity



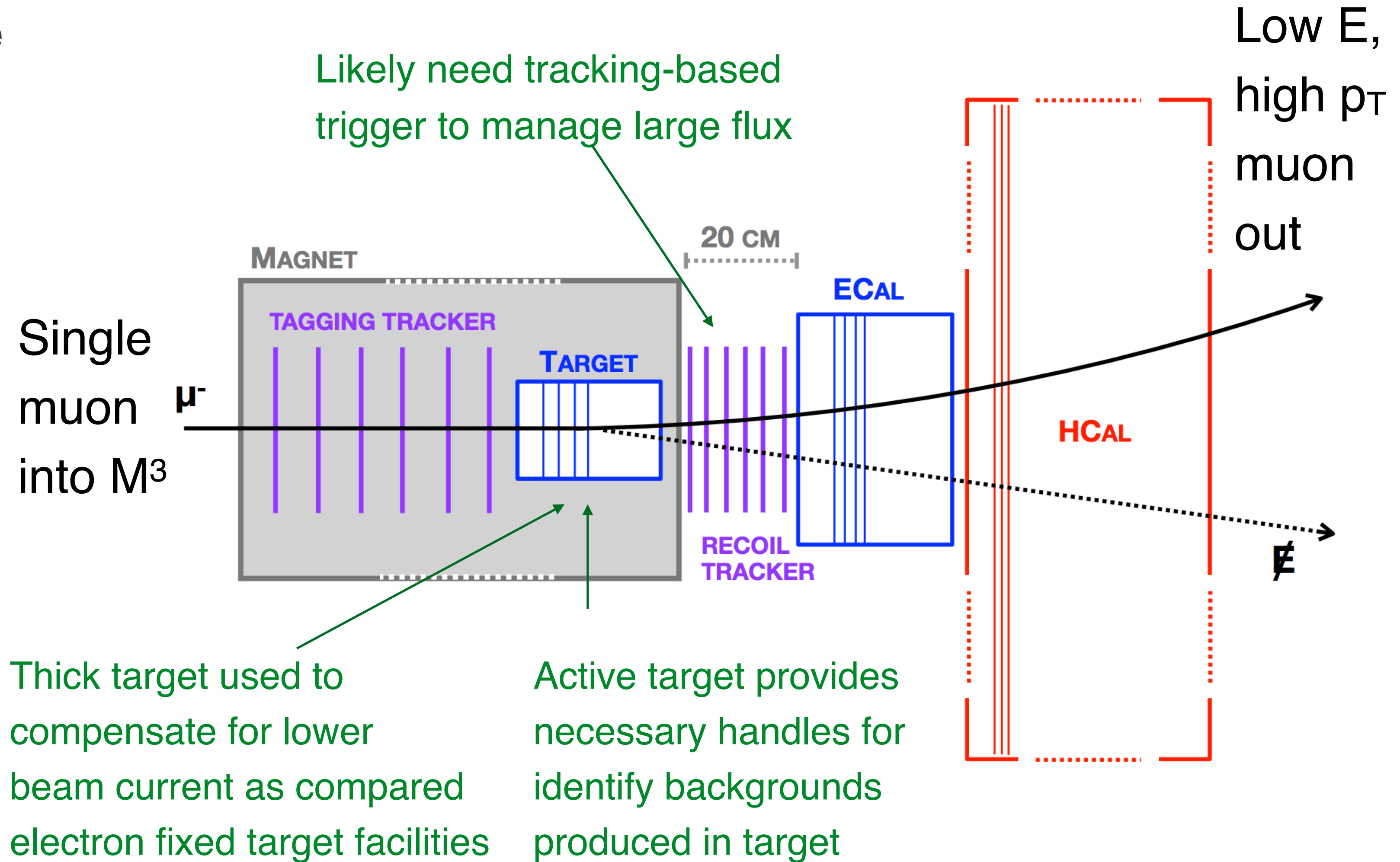
Fixed target experiments can be hosted at various points with varying luminosities achievable (up to 10^{13} over several years)

***Similar experiment proposed as an extension to NA64 using CERN's secondary muon beams with higher energy muons*

— lower energies allow for a more compact design

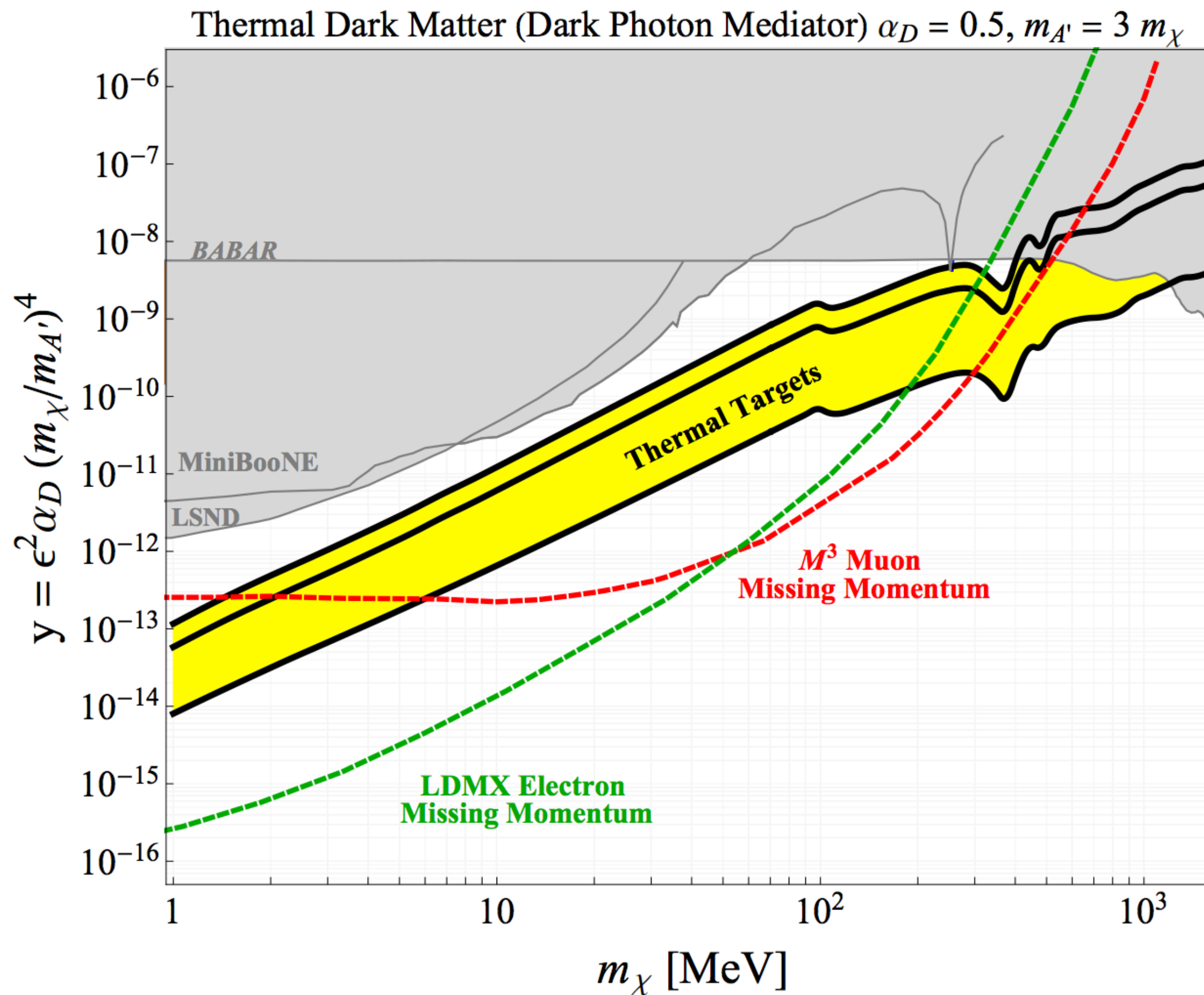
Detector concept

- Similar to LDMX, tracking will enable M^3 to look for large missing momentum signatures
- Downstream calorimeters will be used to identify by product that can otherwise fake invisible signatures

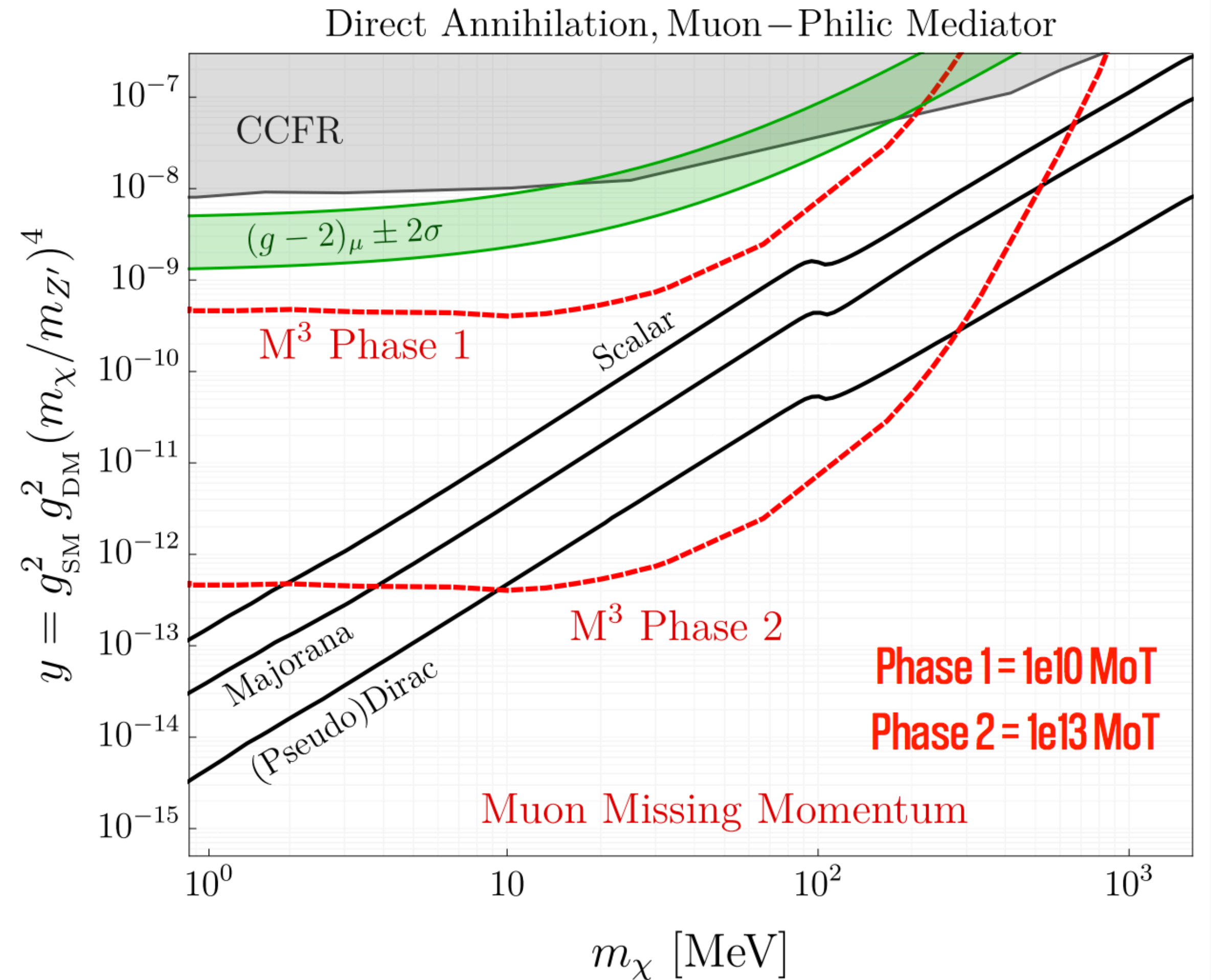


Sensitivity

Provides competitive (better at high mass) sensitivity to generic thermal relic DM scenarios & is uniquely sensitive to **muon-philic DM**



Can **test the remainder of the $(g-2)_\mu$** parameter space by covering connections to invisible signatures and by directly probing physics that couples to muons



Summary

- M^3 is a muon fixed-target missing momentum experiment proposed to utilize Fermilab's proton beam
- With modest improvement to Fermilab accelerator facilities and adapting existing detector technologies, can cover large regions of parameters space that are inaccessible to other accelerator-based experiments
 - Test remaining parameter space of the $(g-2)_\mu$ anomaly
 - Search for muon-philic DM and muon-philic mediators
 - Can perform more generic searches for both invisible and visible decays of dark photons

Backup