Beamline and detector for LDMX-μ

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Preface

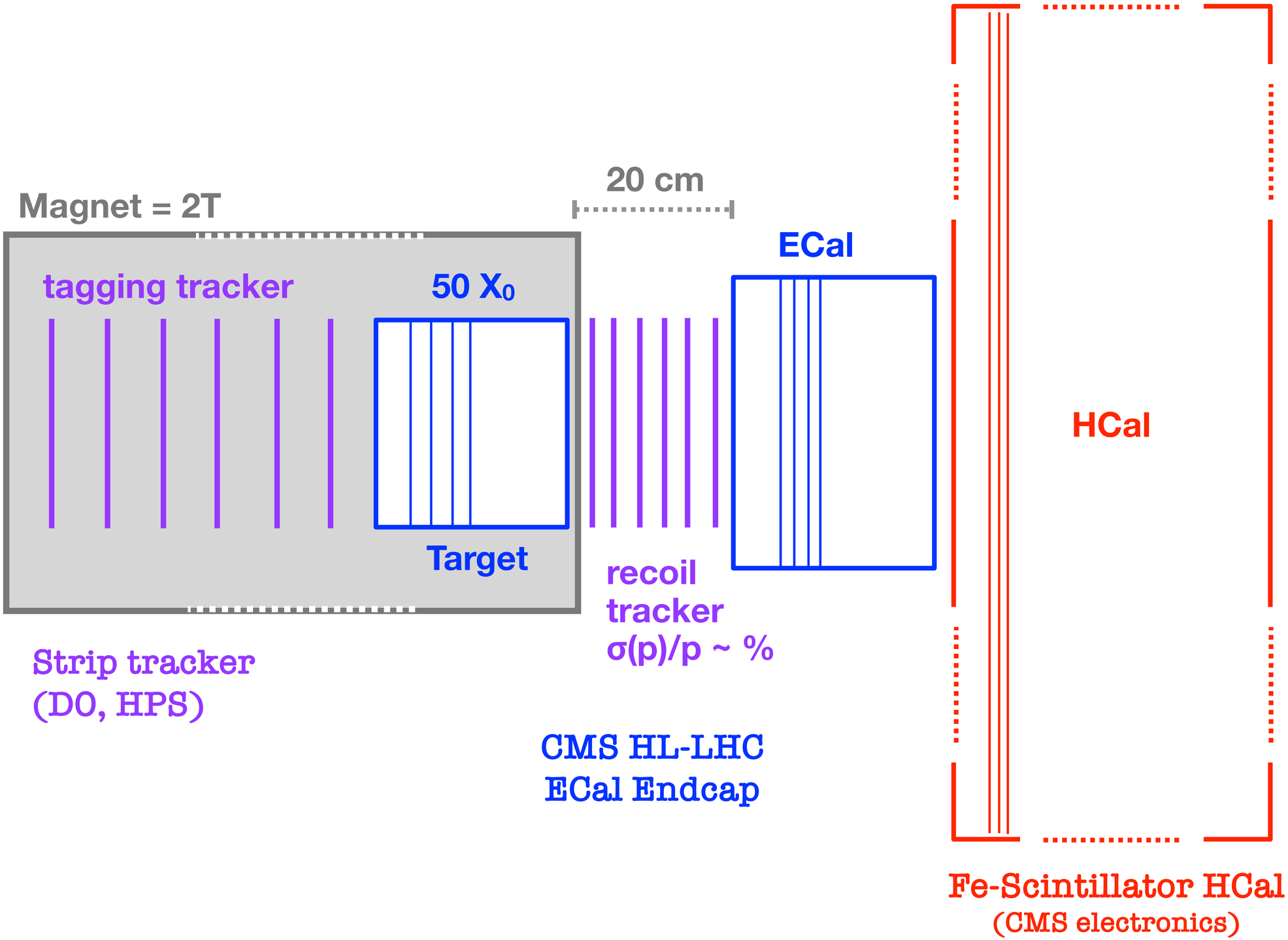
For 2017 retreat, presented work on fixed target experiments for dark matter searches

- Focus on electron beams
- https://indico.fnal.gov/event/14349/

Extend the program

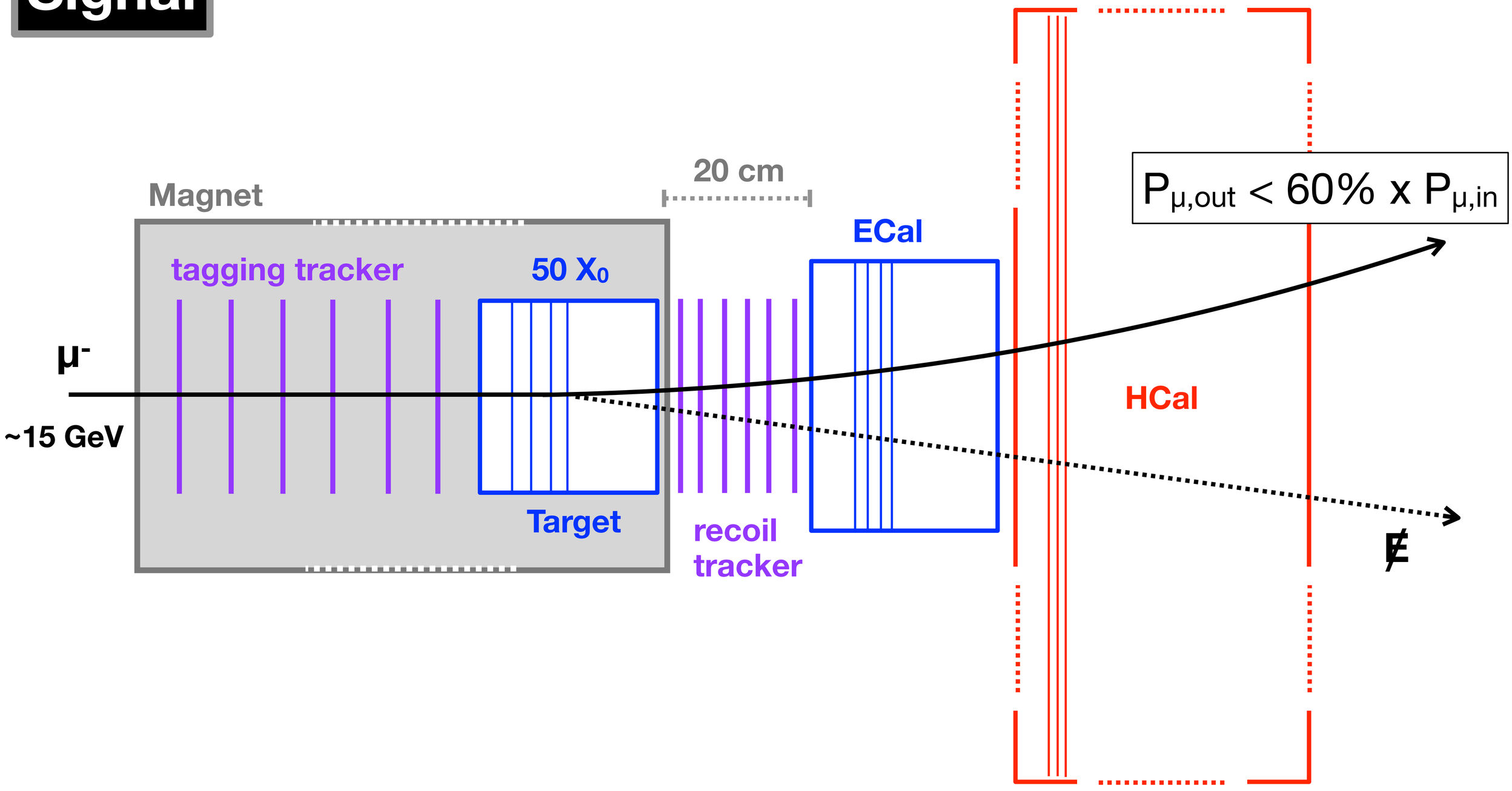
- Opportunities in muon physics (Gordan)
- Takes advantage of muon beam capabilities at FTBF and SeaQuest/ Neutrino line

LDMX-μ Detector concept



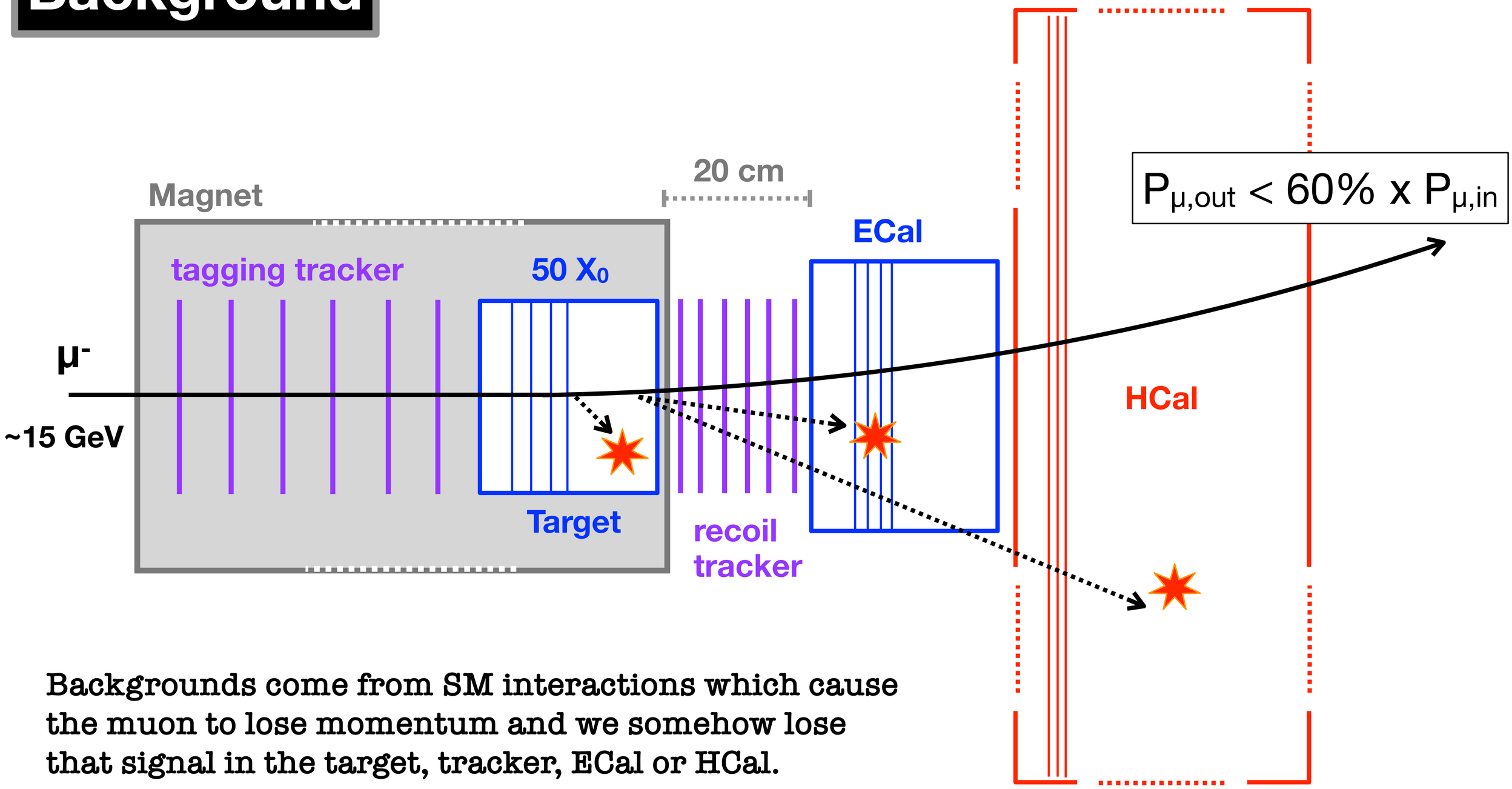
LDMX-μ Detector concept

Signal



LDMX-μ Detector concept

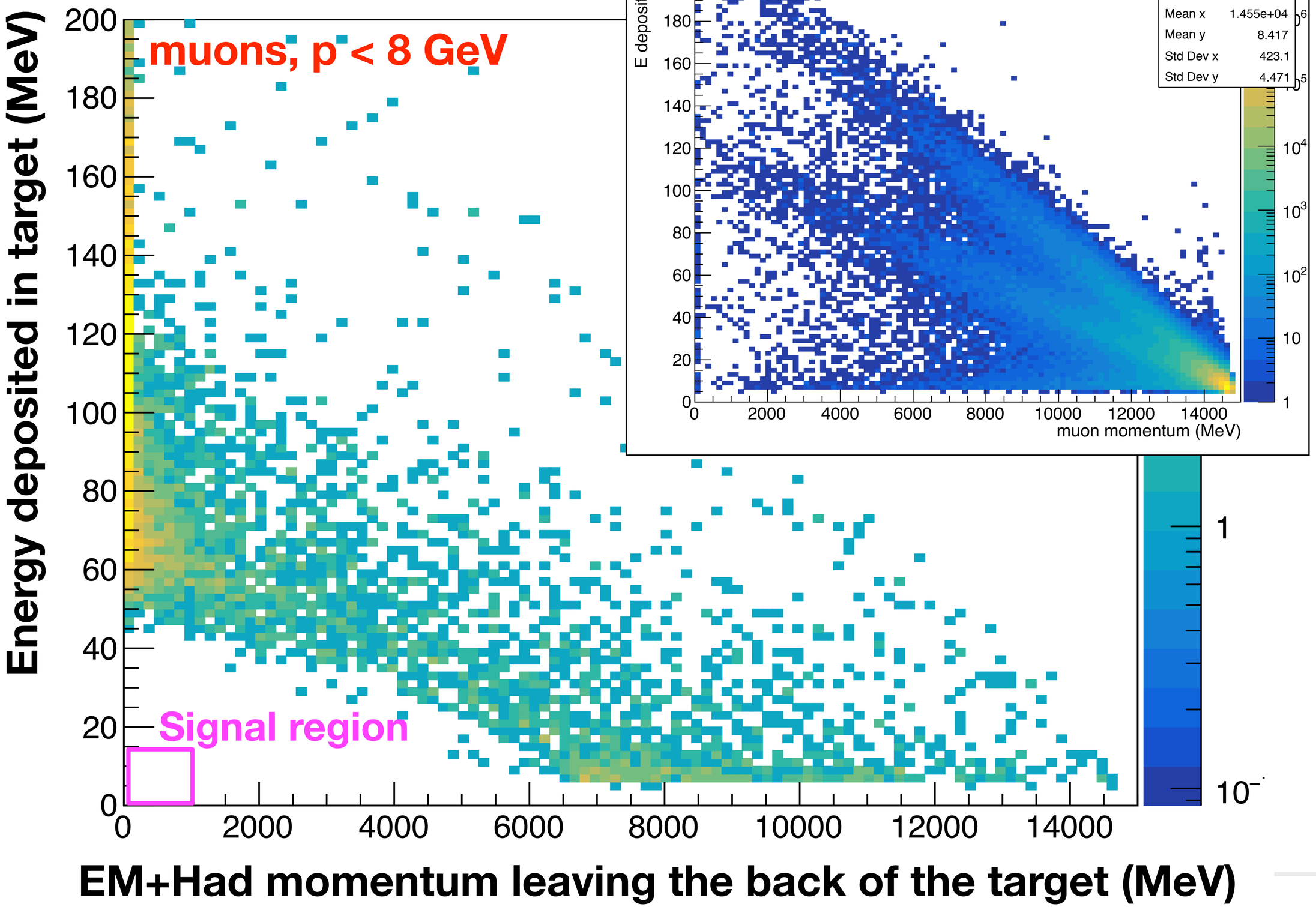
Background

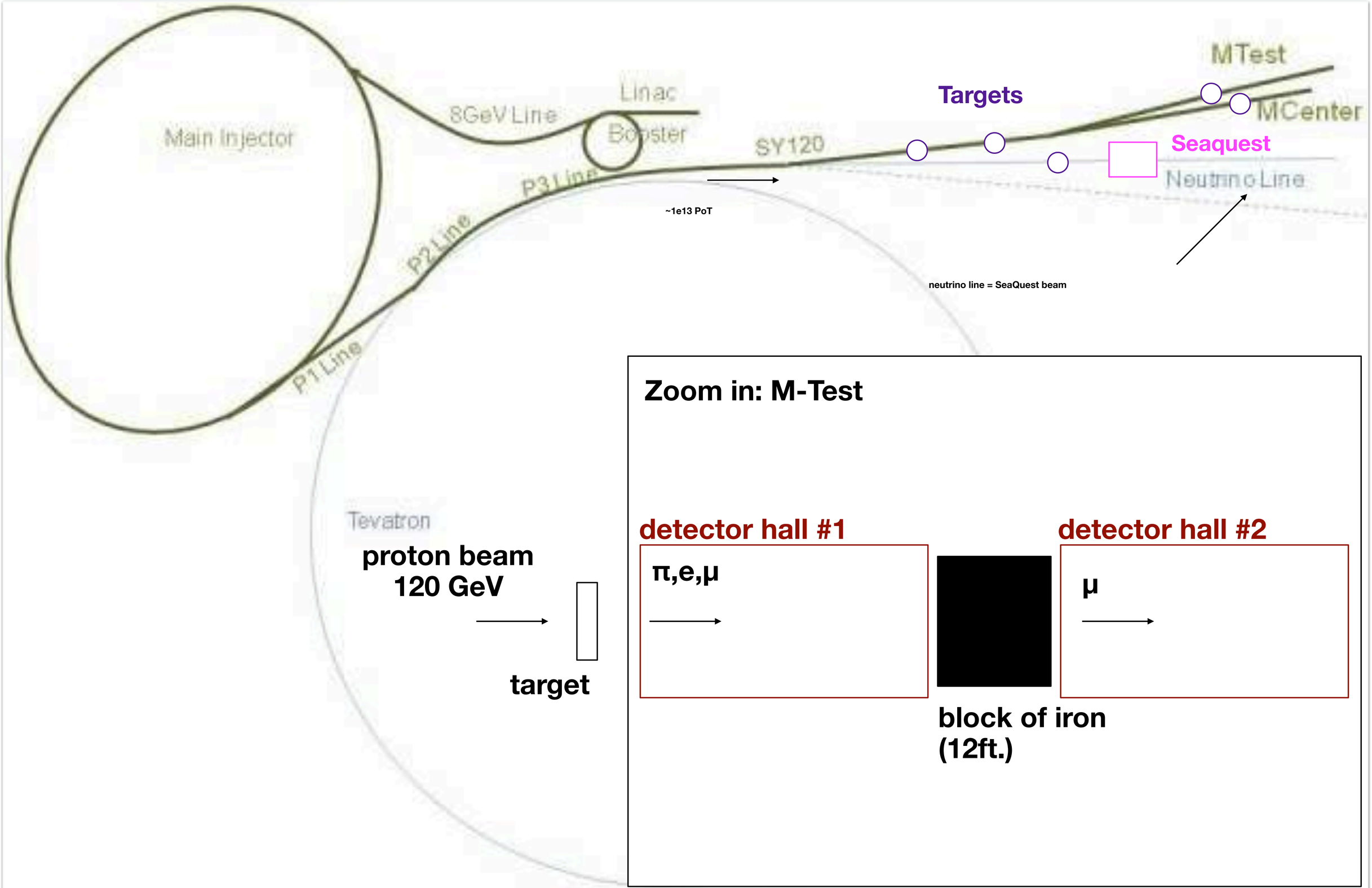


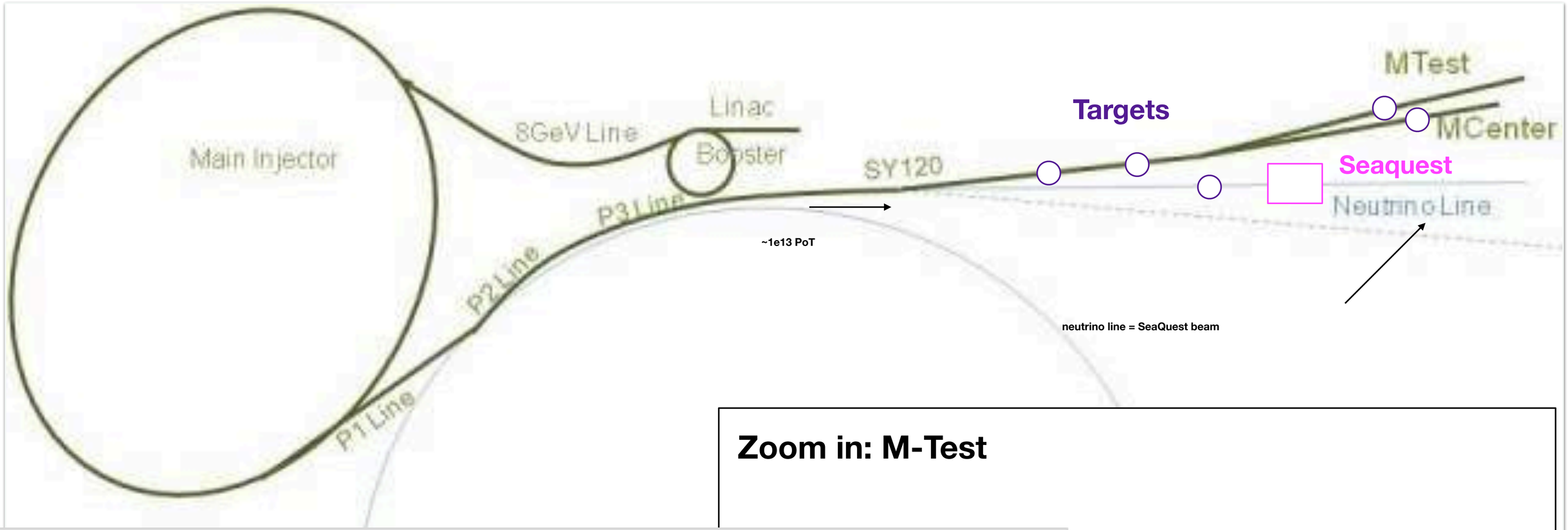
Backgrounds come from SM interactions which cause the muon to lose momentum and we somehow lose that signal in the target, tracker, ECal or HCal.

Full GEANT study of 15 GeV muons incident on 40X_0 target

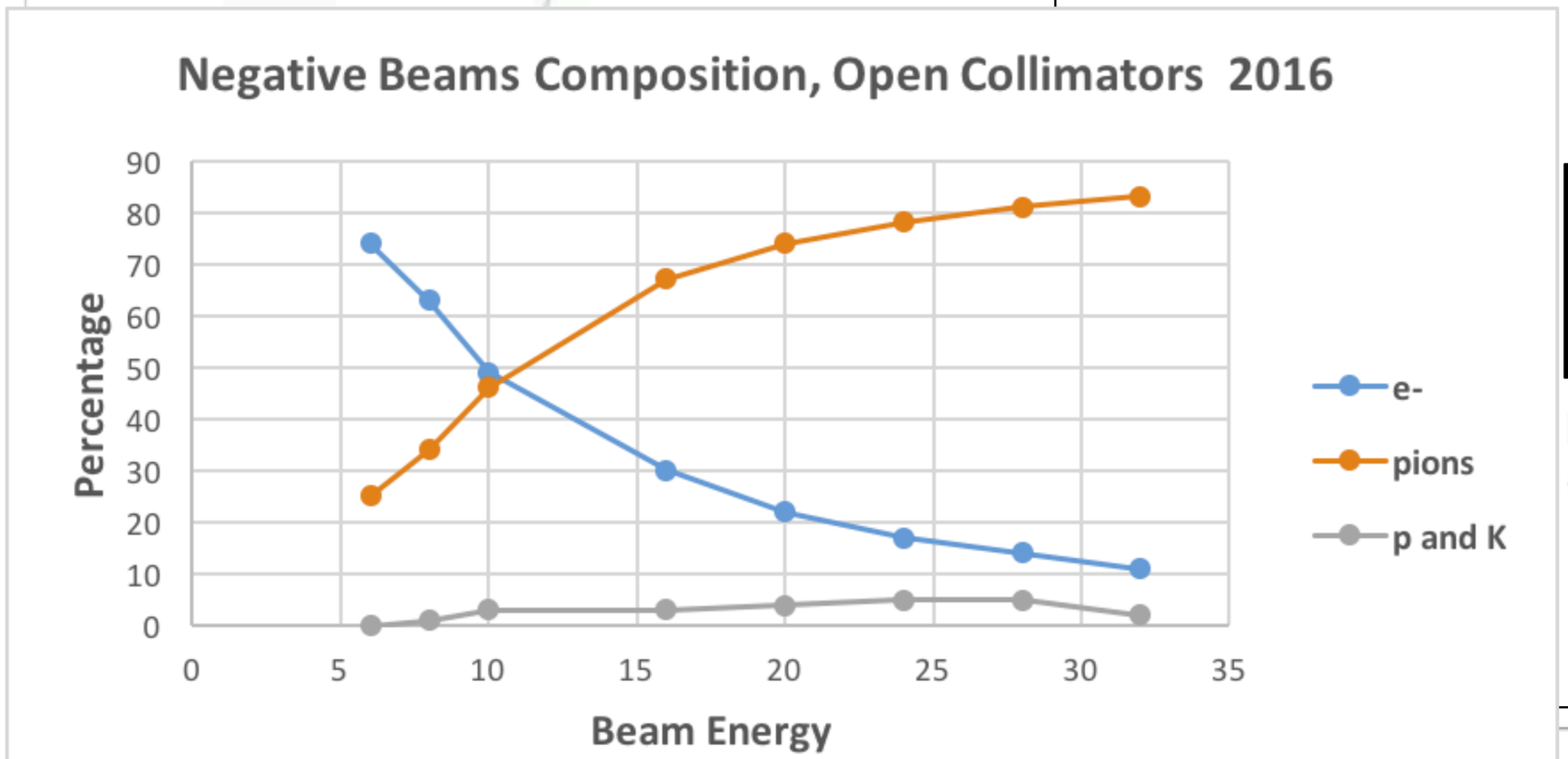
Target sim only

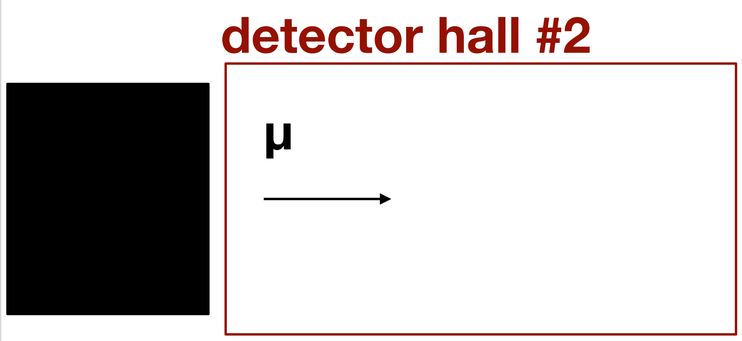



Main Injector
8GeV Line
Linac
Booster
SY120
P3 Line
P2 Line
P1 Line
Tevatron
MTest
MCenter
Targets
Seaquest
Neutrino Line
~1e13 PoT
neutrino line = SeaQuest beam
Zoom in: M-Test
proton beam
120 GeV
target
detector hall #1
π,e,μ
detector hall #2
μ
block of iron
(12ft.)



Zoom in: M-Test





SCENARIOS

Phase 1: MTest “Shovel ready”

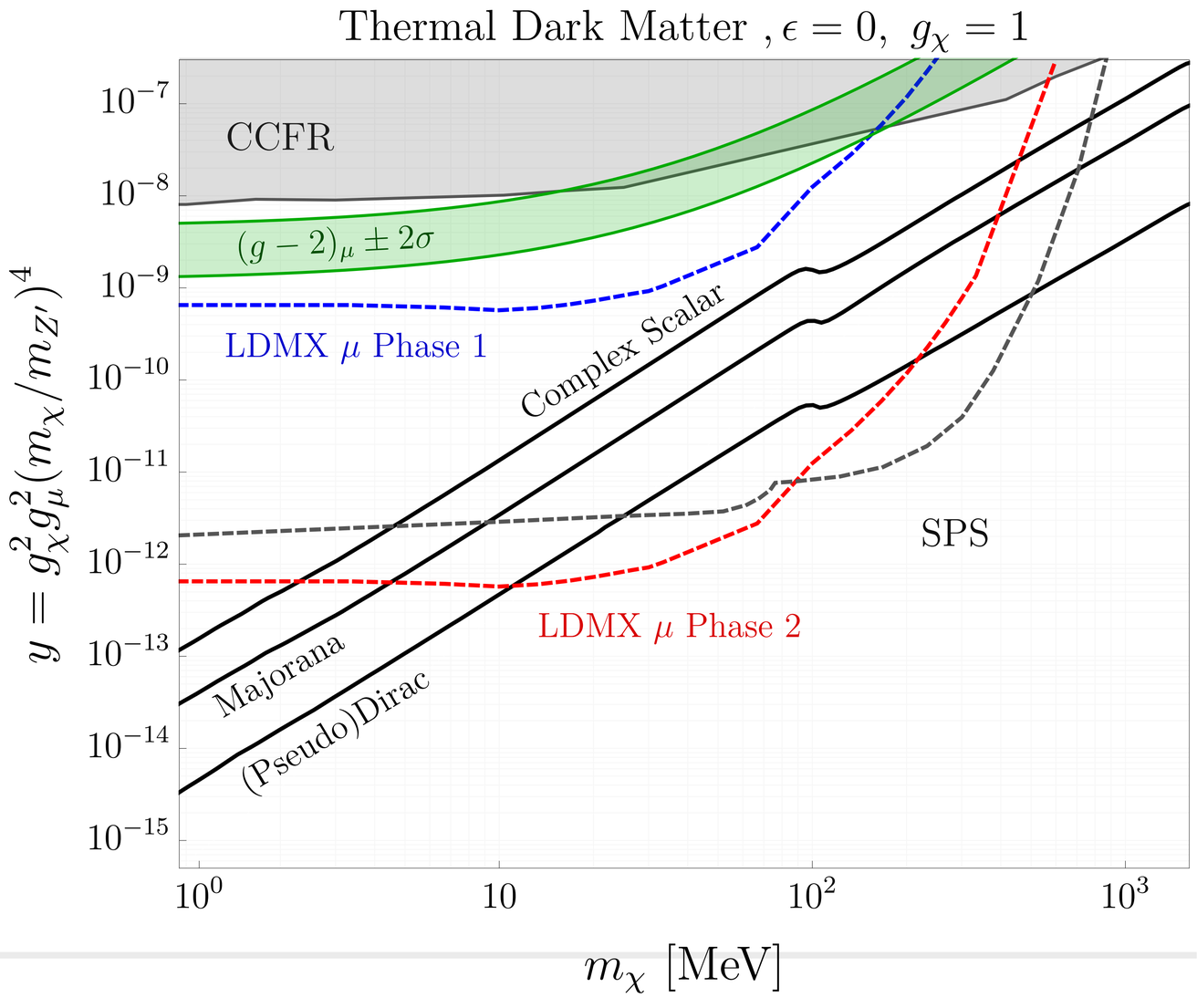
10^{10} Muons on target, 50 X_0 target

~100 days with 10^5 muons per spill

Phase 2: NM4, Seaquest

10^{13} Muons on target, 50 X_0 target

3 years with 10^7 muons per spill



THOUGHTS

LDMX-e is the most promising detector concept to search for light MeV-GeV thermal dark matter candidates

- US DOE Cosmic Visions Whitepaper: https://arxiv.org/abs/1707.04591
- Fixed target *electron beam* experiment

With small modifications to the detector target region, LDMX-μ would perform high impact muon BSM physics

- New physics could couple preferentially to muons
- Does not need full LDMX-e calorimeters
- At testbeam, could already complement g-2 phase space and be a commissioning run for LDMX-e

Longer term, could move to the SeaQuest beamline and probe thermal relic benchmarks in muon-phillic scenarios

Timelines are fluid,

- consider both LDMX-e/μ where for each could have phases 1/2