LDMX as a Geant4 Use Case

Geant4 Hadronics Meeting

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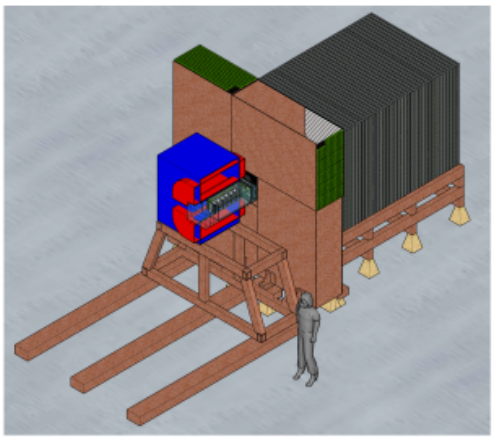
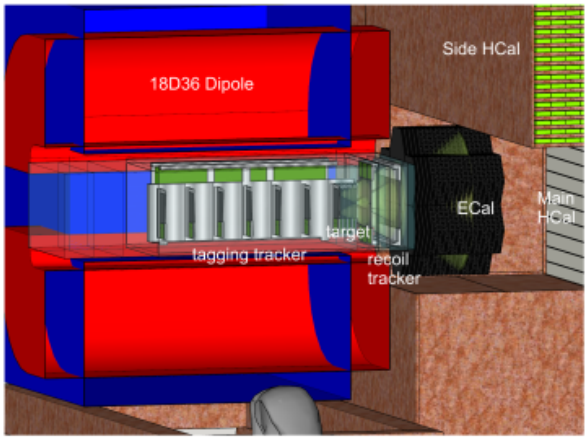
About

- Recently started PhD student
- Working in Lund with:
  - Pico (Nuclear physics)
  - Ruth Pöttgen (High energy physics)
  - Stefan Pretsel (Theoretical physics)

What is LDMX?

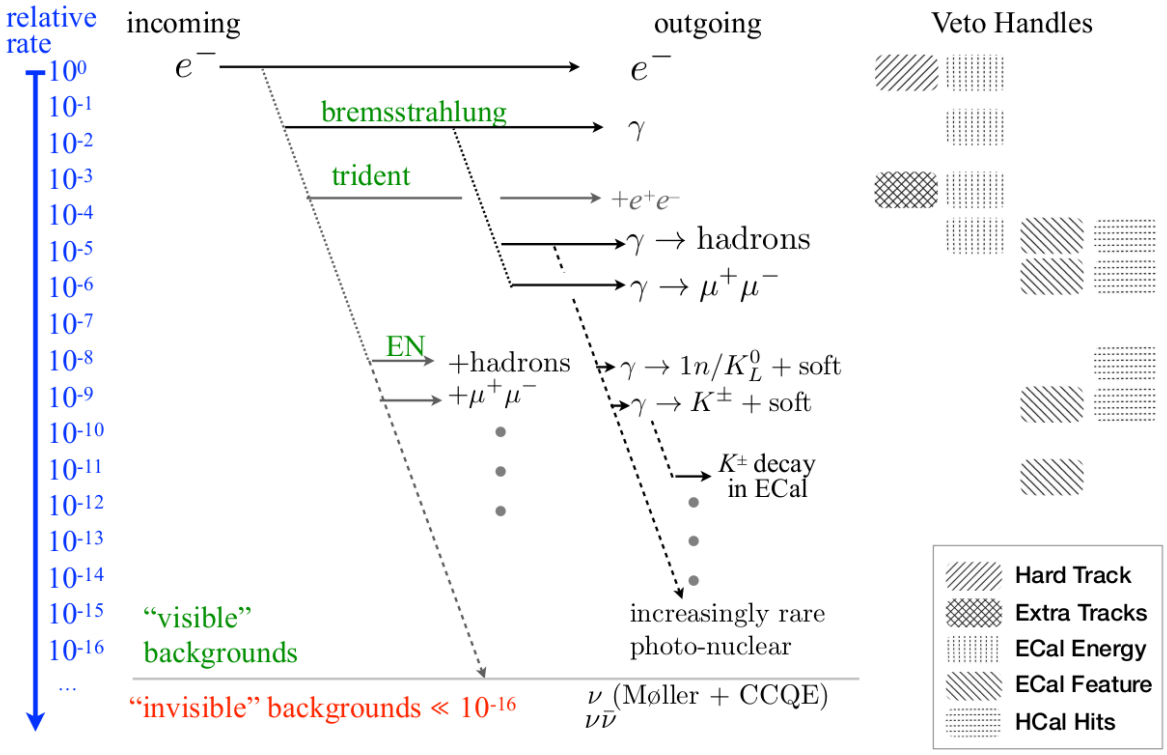
- An experiment searching for low mass Dark matter
- Fixed target
  - Electron beam, initially with $4\,\mathrm{GeV}$ at SLAC
  - Later: Up to $\sim 8 - 16\,\mathrm{GeV}$
- Signal: Missing momentum
- Using Geant4 for propagation + background generation
  - Geant4 modelling drives detector design





Detector overview from 19Veto

Background



Veto design driving background processes 19Veto

	Photo-nuclear		Muon conversion	
	Target-area	**ECal**	**Target-area**	**ECal**
EoT equivalent	4×10^{14}	2.1×10^{14}	8.2×10^{14}	2.4×10^{15}
Total events simulated	8.8×10^{11}	4.65×10^{11}	6.27×10^{8}	8×10^{10}
Trigger, ECal total energy < 1.5 GeV	1×10^{8}	2.63×10^{8}	1.6×10^{7}	1.6×10^{8}
Single track with $p < 1.2$ GeV	2×10^{7}	2.34×10^{8}	3.1×10^{4}	1.5×10^{8}
ECal BDT (> 0.99)	9.4×10^{5}	1.32×10^{5}	< 1	< 1
HCal max PE < 5	< 1	10	< 1	< 1
ECal MIP tracks = 0	< 1	< 1	< 1	< 1

Estimated levels of backgrounds after successive cuts, 19Veto

Challenges and goals

- Rare signal -> “Zero background”
  - We care about modelling rare background events
  - Veto efficiency
- Different energy scale for typical HEP applications of Geant
- For higher energies, how do we best model Photonuclear background?
- Currently using a rather old “patched” version of Geant (`10.02.p03`)
- Physics list level changes for different volumes
  - In our case, Pythia8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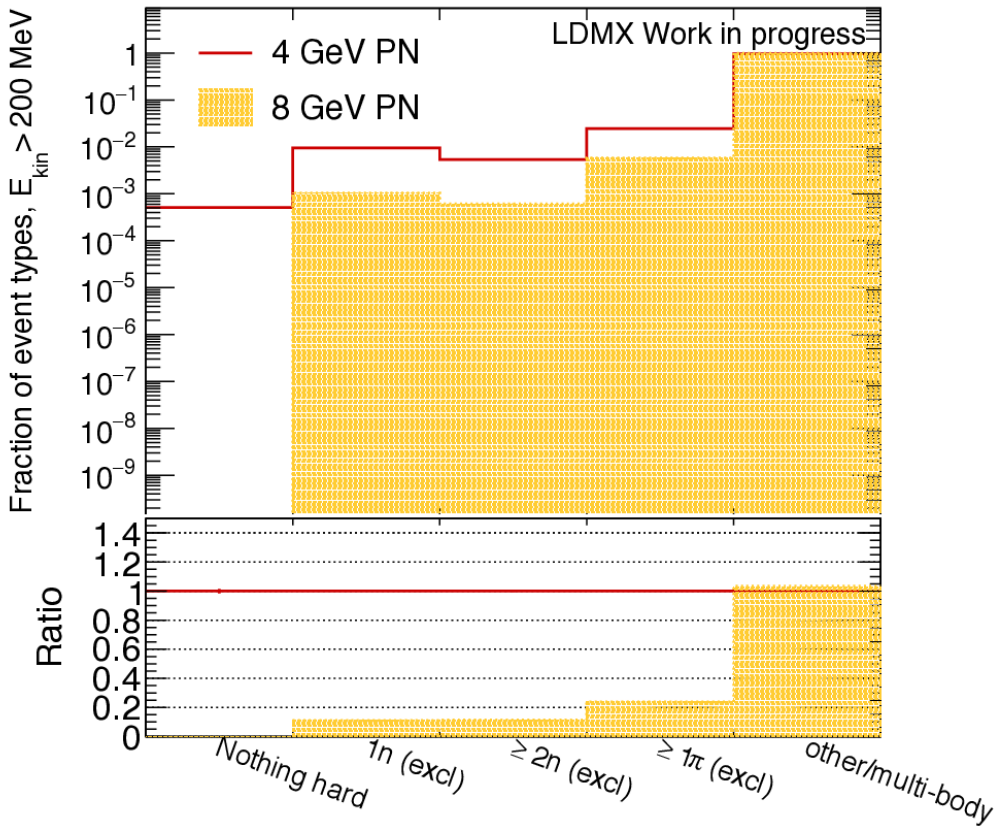
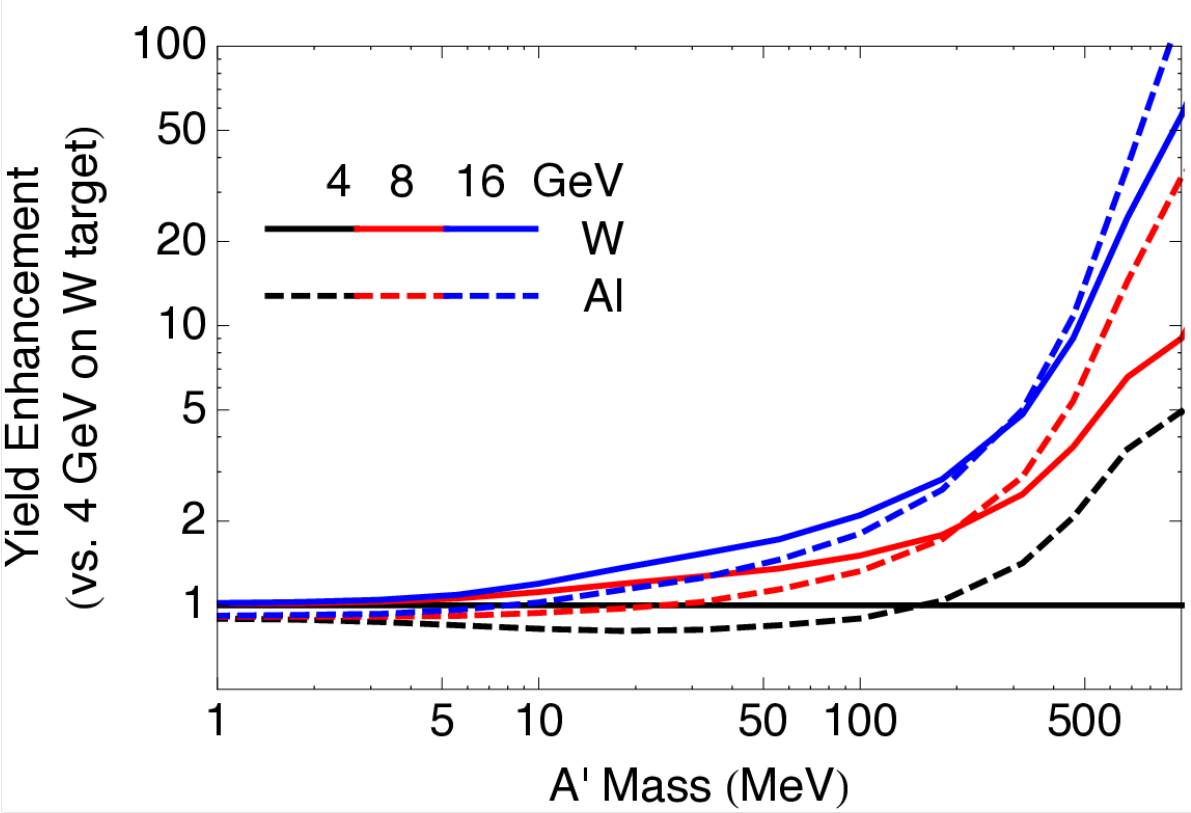
Backup

Background categories



Signal Yield Enhancement



Bibliography

[19Veto] Åkesson, Blinov, Bryngemark, Colegrove, Collura, Dutta, Echenard, Eichlersmith, Group, Hiltbrand, Hitlin, Incandela, Krnjaic, Lazaro, Li, Mans, Masterson, McCormick, Moreno, Mullier, Nagar, Nelson, Niendorf, Oyang, Petersen, Pöttgen, Schuster, Siegel, Toro, Tran & Whitbeck, A High Efficiency Photon Veto for the Light Dark Matter Experiment, *CoRR*, (2019). link .