A case for more small-scale experiments

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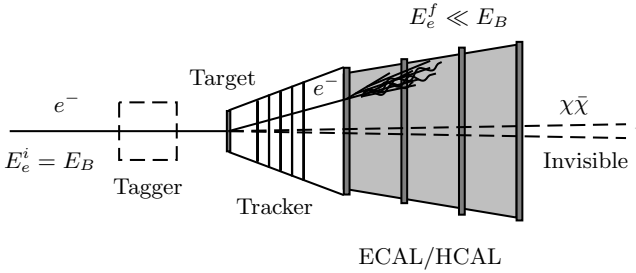
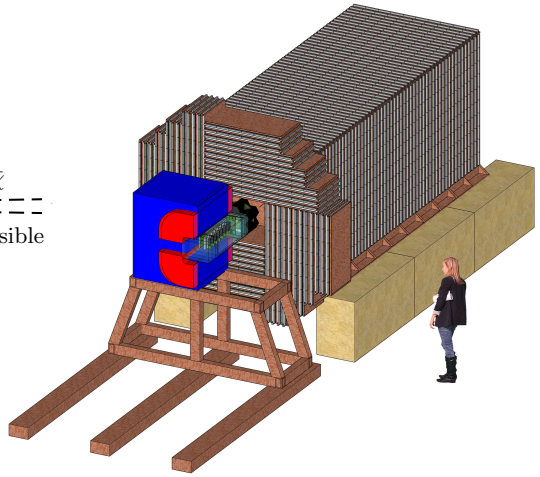
Accelerating science from Theory to Reality

Scientists can generate ideas for experiments at a far higher rate (and far lower cost) than they can build them!

- Small projects are key to demonstrating **new technologies and measurement strategies**.
- Pathfinder experiments can *establish the key methodologies at low cost*, while building domestic expertise in tomorrow's state-of-the-art.



Izaguirre, Krnjaic, Schuster, Toro
Phys. Rev. D 91, 094026 (2015)



"Testing GeV DM with fixed-target missing momentum"

Light Dark Matter Experiment whitepaper

Prototype beam test

LDMX discovers Dark Matter ??

Natural connection between large- and small-scales

Large projects can propel the development of cutting-edge technologies, which can often emerge as powerful, general-purpose devices.

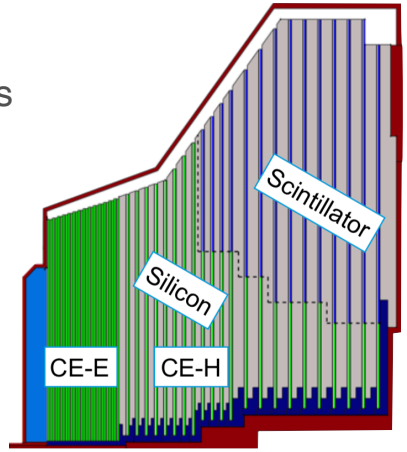
- E.g. Silicon sensors: fine pitch, precise timing, high-rate and rad-hard readout electronics.
  - Sophisticated technologies, developed & validated by large teams of experts!

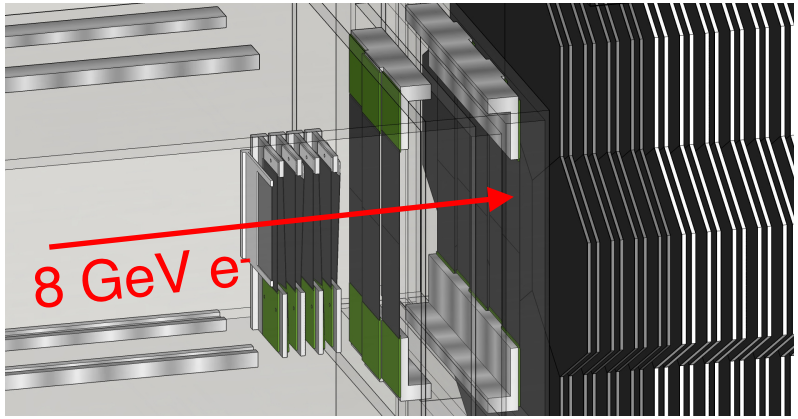
Once developed, *these technologies can enable entirely new experimental concepts*.

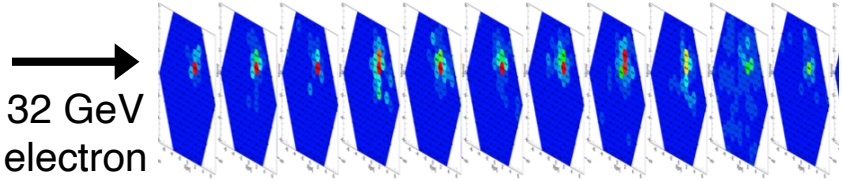
- One-time costs of technical innovation can power concepts across scientific domains.

CMS Experiment develops **High-Granularity Endcap Calorimeter** (Si/CuW) for **High-Luminosity LHC**

- Radiation tolerant
- Excellent e^- ID







HGCal fulfills central requirements for LDMX

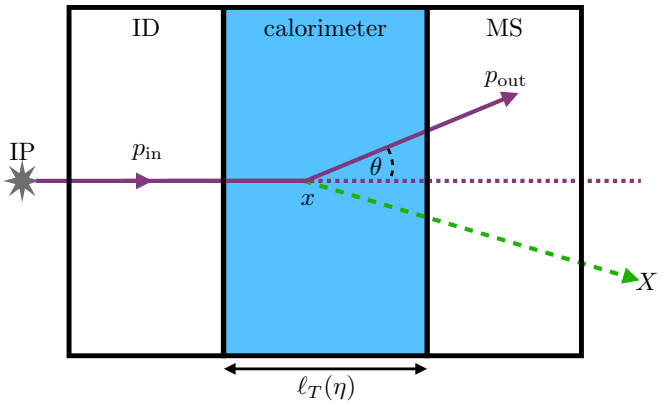
- Radiation hardness (10^{16} electrons on target)
- Fine segmentation for background rejection

Natural connection between large- and small-scales (II)

Small projects trickle up to benefit large ones too.

- Directly establishing new measurement techniques, science goals e.g.
  - Fixed target, missing-momentum at collider experiments.
  - Explosion in the number of Dark Sector papers at ATLAS/CMS, interest in this science.

Golan+, Phys. Rev. D 101, 011701 (2020)



- Training a next-generation of detector experts, who can immediately contribute elsewhere.
  - Experienced detector optimization, prototyping, testing, production, and data-taking!
  - Significant benefits from having local hardware, and a US-based experiment.
  - E.g. LDMX students have made an huge impacts on CMS detector operations.
- **A balance of small & large experiments encourages wide collaboration, breaks silos!**