



Dual Readout crystal calorimetry for precision measurements at future colliders

Grace Cummings

BNL P5 Town hall, 12-14 April, 2023

Demands of Future Colliders

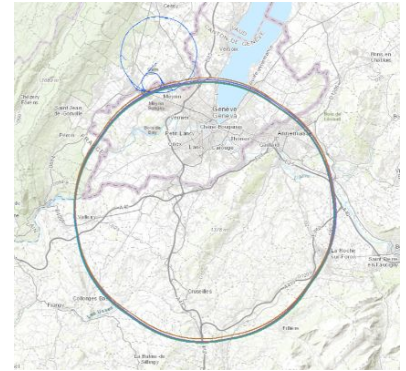
- Precision Machines!
- We need the detectors to match them
 - And we do not have them (in most cases)
- We need the research supported
 - [Jinlong's Talk](#)
 - [Marina's Talk](#)

Priority Research Direction (PRD)

PRD 1: Enhance calorimetry energy resolution for precision electroweak mass and missing-energy measurements

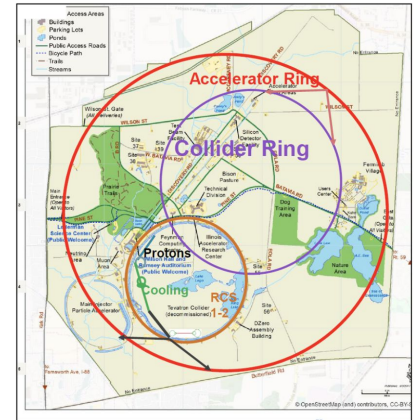
PRD 2: Advance calorimetry with spatial and timing resolution and radiation hardness to master high-rate environments

PRD 3: Develop ultrafast media to improve background rejection in calorimeters and improve particle identification



[arXiv:2203.08310](#)

These slides touch on two points, but **support is needed across all of the proposed detector R&D collaborations**



[2209.01318](#)

[arXiv:2208.12861v2](#), <https://doi.org/10.2172/1659761>

Electromagnetic Calorimetry in Crystals

- Full shower capture
 - good energy resolution
- Scintillation light a proxy for energy
- Poor e/h response
 - 2.4 e/h for CMS ECAL
 - degrades hadronic energy resolution

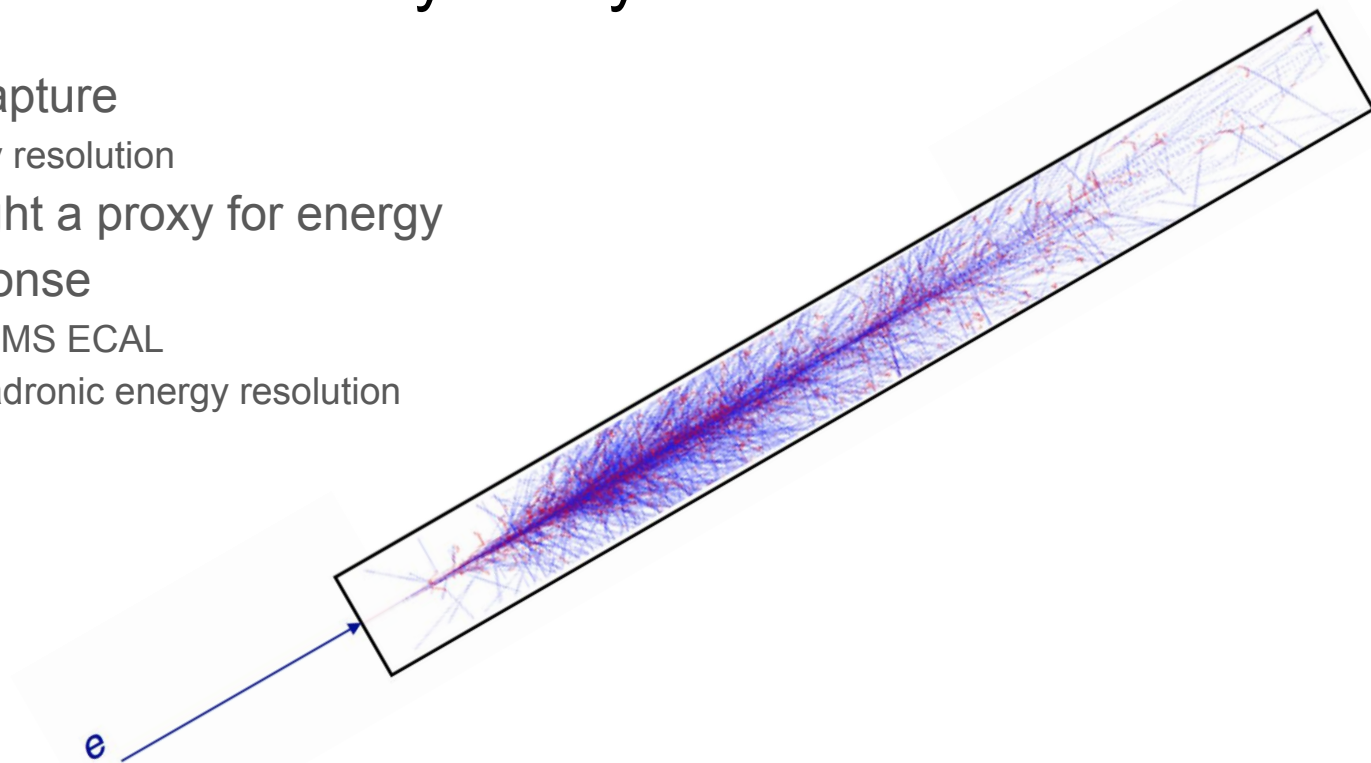
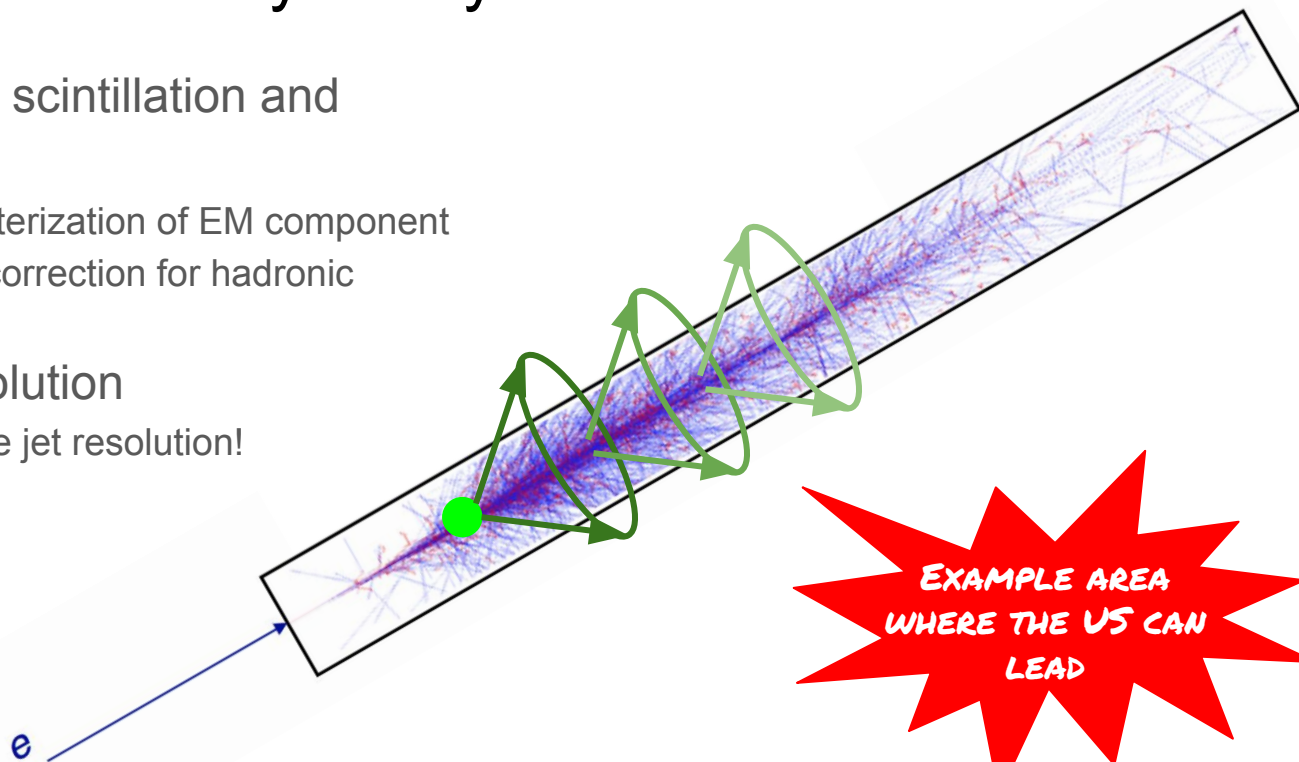


image credit:

https://www.physi.uni-heidelberg.de/~sma/teaching/ParticleDetectors2/sma_ElectromagneticCalorimeters.pdf

Dual Readout Calorimetry in Crystals

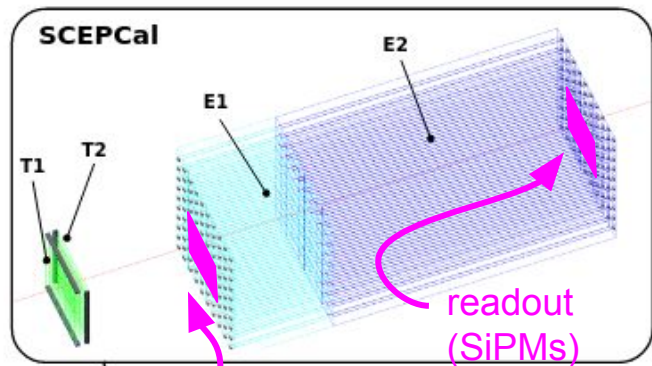
- Measure both the scintillation and Cerenkov light
 - complete characterization of EM component
 - Event-by-event correction for hadronic component
- Preserve EM resolution
 - does not degrade jet resolution!



DREAM Paper
[arXiv:1712.05494](https://arxiv.org/abs/1712.05494)

image credit:
https://www.physi.uni-heidelberg.de/~sma/teaching/ParticleDetectors2/sma_ElectromagneticCalorimeters.pdf

Other potential features



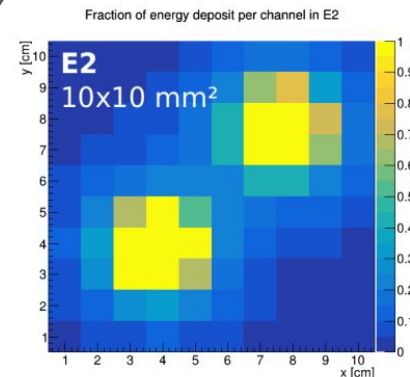
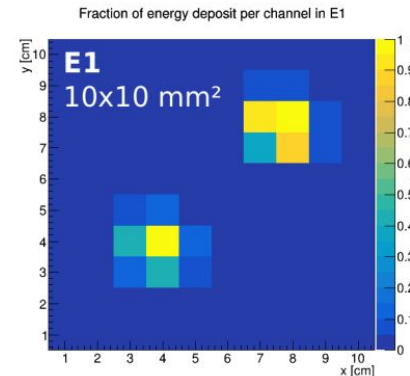
readout (SiPMs)

SiPMs open new space!

Moderately high granularity

Particle ID w/
minimal segmentation

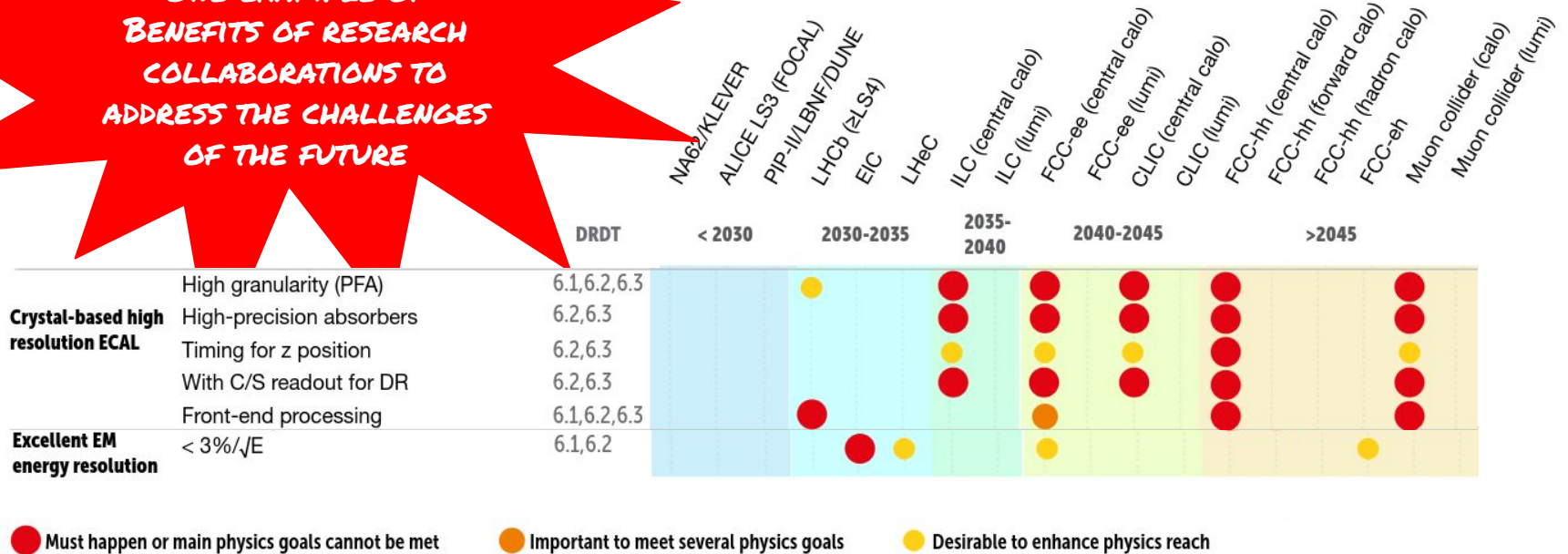
incorporating timing



More research is needed!

WE HAVE INITIATIVES LIKE **CALVISION** THAT CAN FUNDAMENTALLY CHANGE CALORIMETRY, BUT THIS CAN ONLY HAPPEN BY FUNDING THIS R+D

ONE EXAMPLE OF BENEFITS OF RESEARCH COLLABORATIONS TO ADDRESS THE CHALLENGES OF THE FUTURE



10.17181/CERN.XDPL.W2EX - 2021 ECFA Roadmap