Noble Liquid Calorimetry for a Higgs Factory

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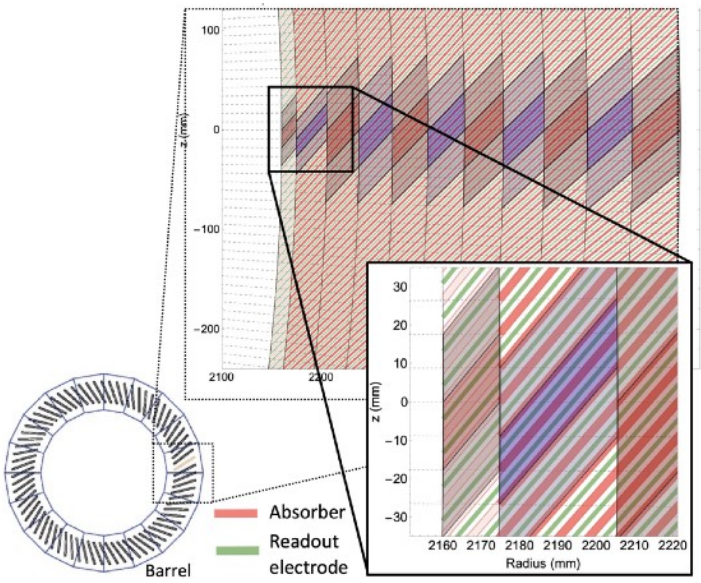
Motivations for NL Calorimetry

- Well-established technology with features that are desirable for any calorimeter, including one at a Higgs Factory:
  - exceptional linearity and stability
  - flexible readout granularity
    - determined by absorber/NL gap thicknesses and readout electrode segmentation
  - also exceptional radiation hardness, which is not important for a Higgs factory but will be critical for a future *pp* machine

NL Calorimetry for the FCCee

- One of the proto-detector concepts for the FCCee (ALLEGRO) is built around a NL EM calorimeter

Barrel design features inclined planes of absorbers/ electrodes/NL gaps



US Interests and Plans

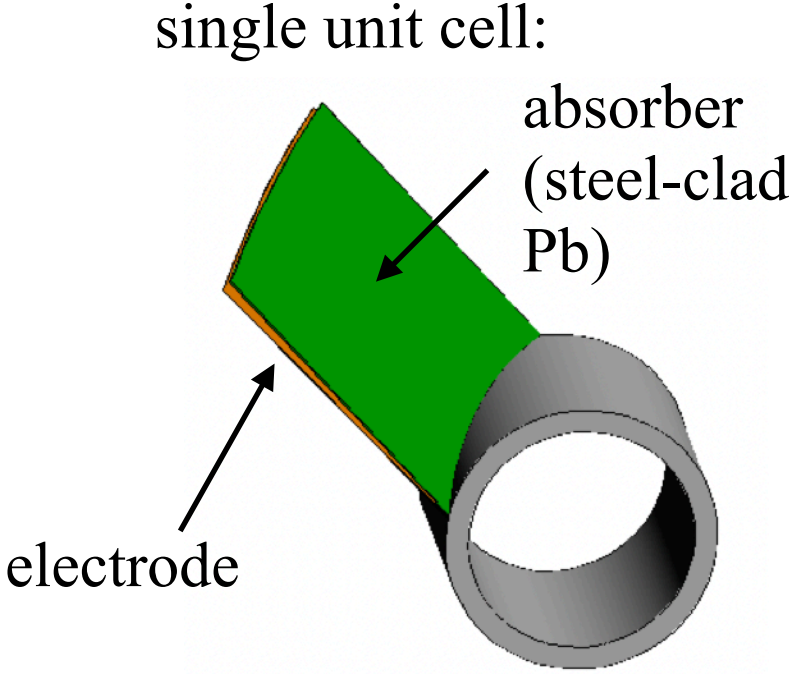
- US groups who have expressed interest:
  - Arizona
    - Endcap EM calorimeter geometry and readout electrode design
    - Testbeam organization and equipment donation (e.g. cryostat)
  - Brookhaven
    - Integral system design of high granularity noble liquid calorimetry with focus on cold electronics readout of PCB-based electrode
  - UC Irvine
    - General interest but no specific project yet
  - Columbia
    - Readout electronics

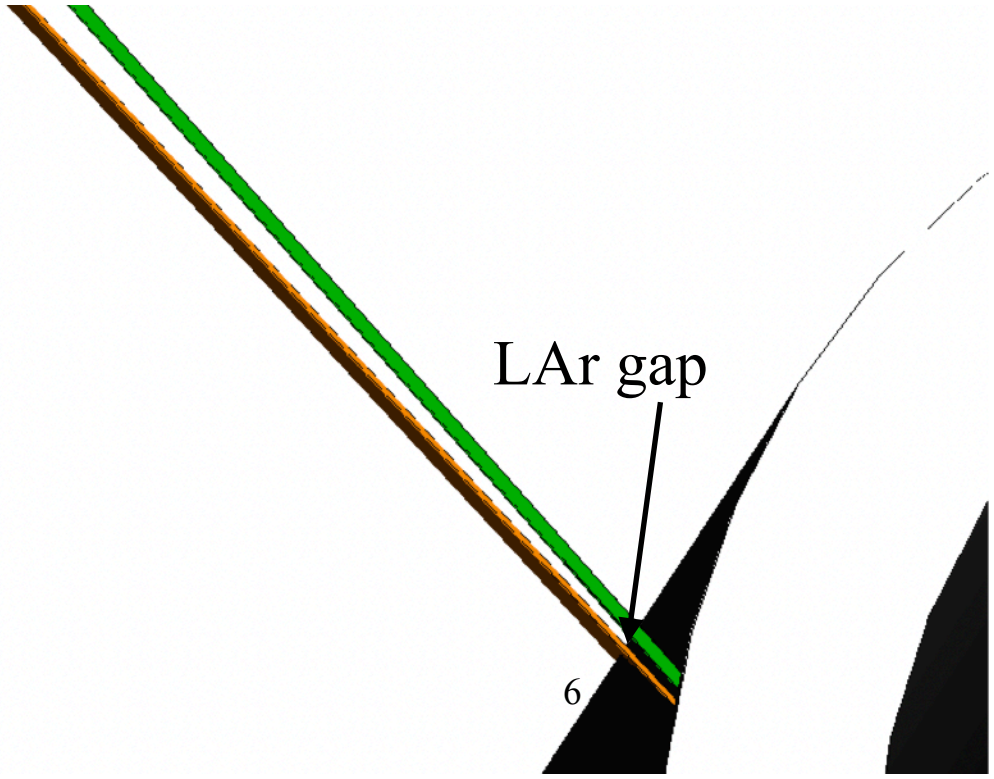
- SMU
  - high-speed data transmission
- StonyBrook
  - detector simulation
  - joint work on module development and testing
- UT Austin
  - readout electronics design, including feasibility of including AI/ML algorithms on the readout ASICS

Current Status

- Endcap ECal design concept: "turbine" geometry
- One absorber/electrode/gap unit cell:

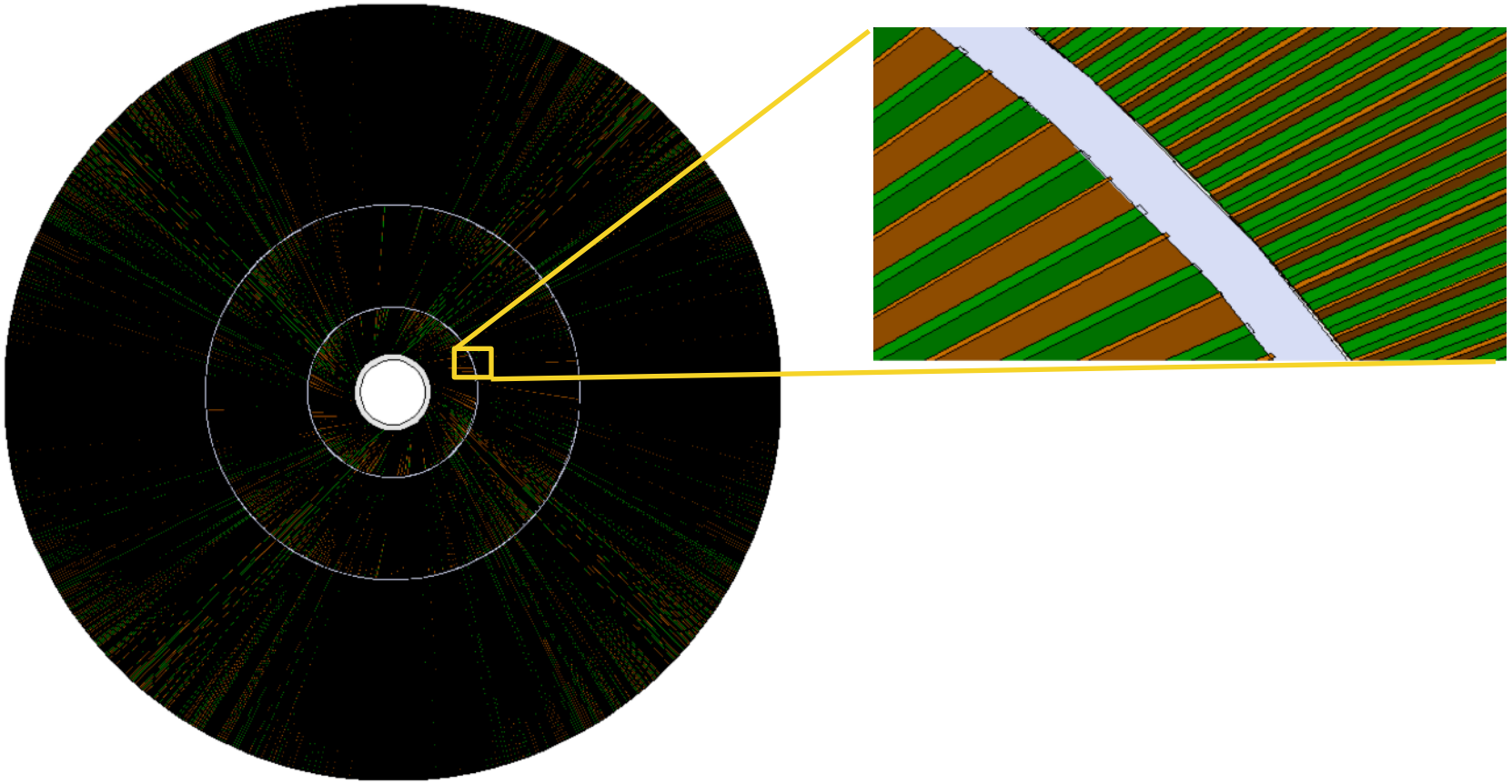
single unit cell:



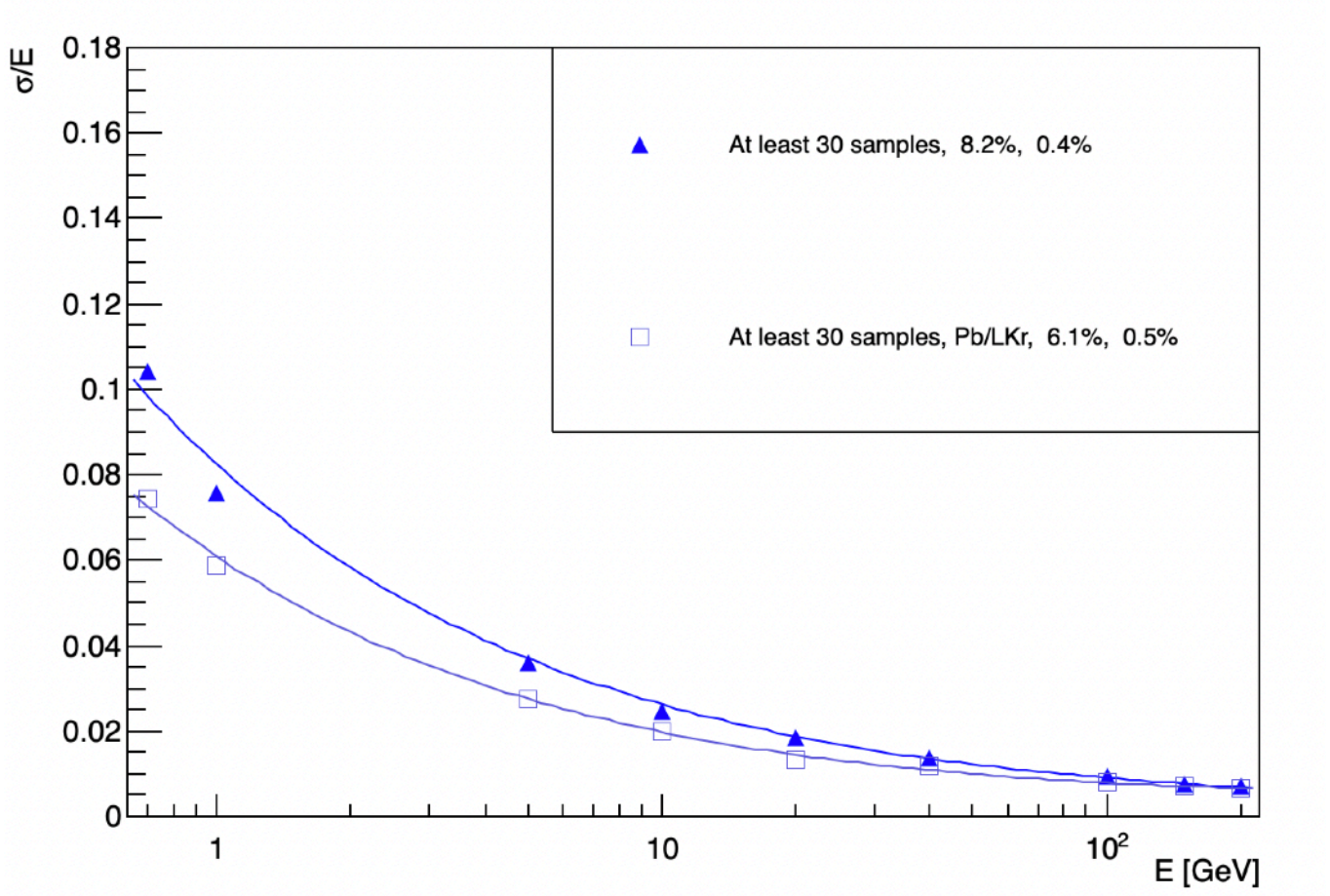


- We refer to both the absorber and electrodes as "blades"

- Full detector (divided into three “wheels”):

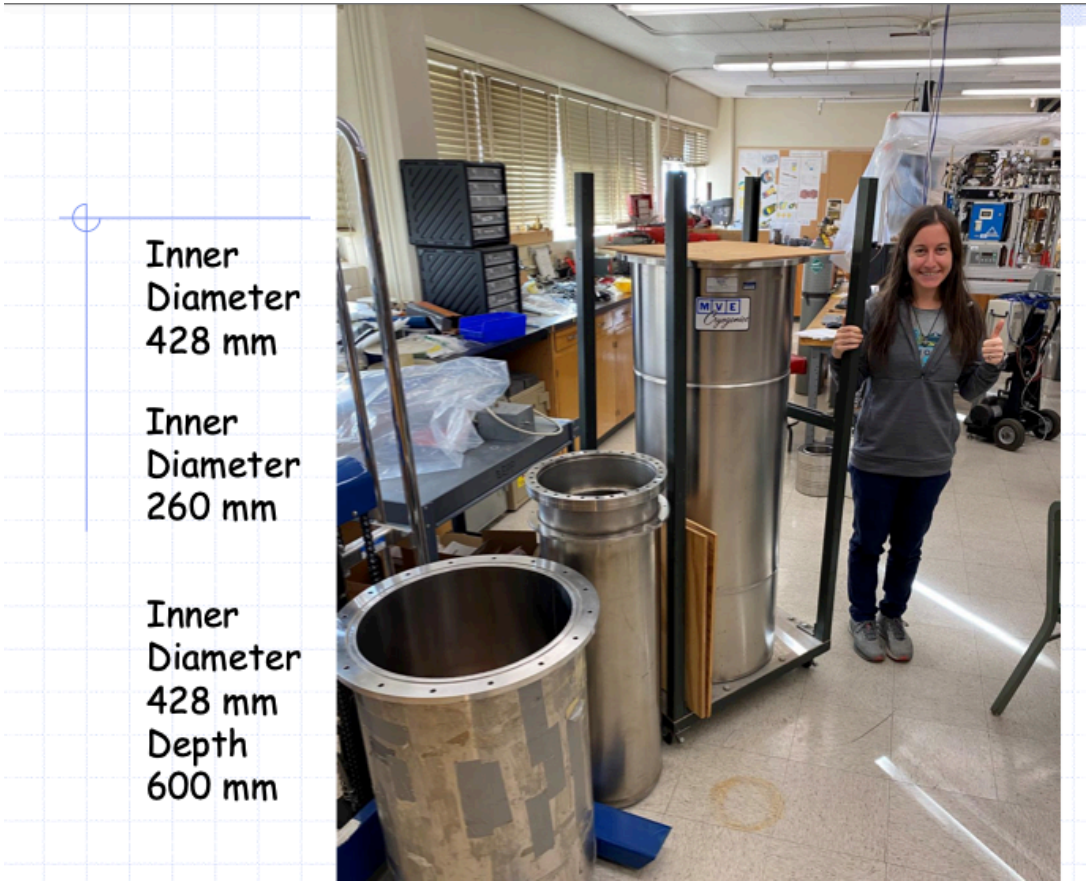


Results from full simulation

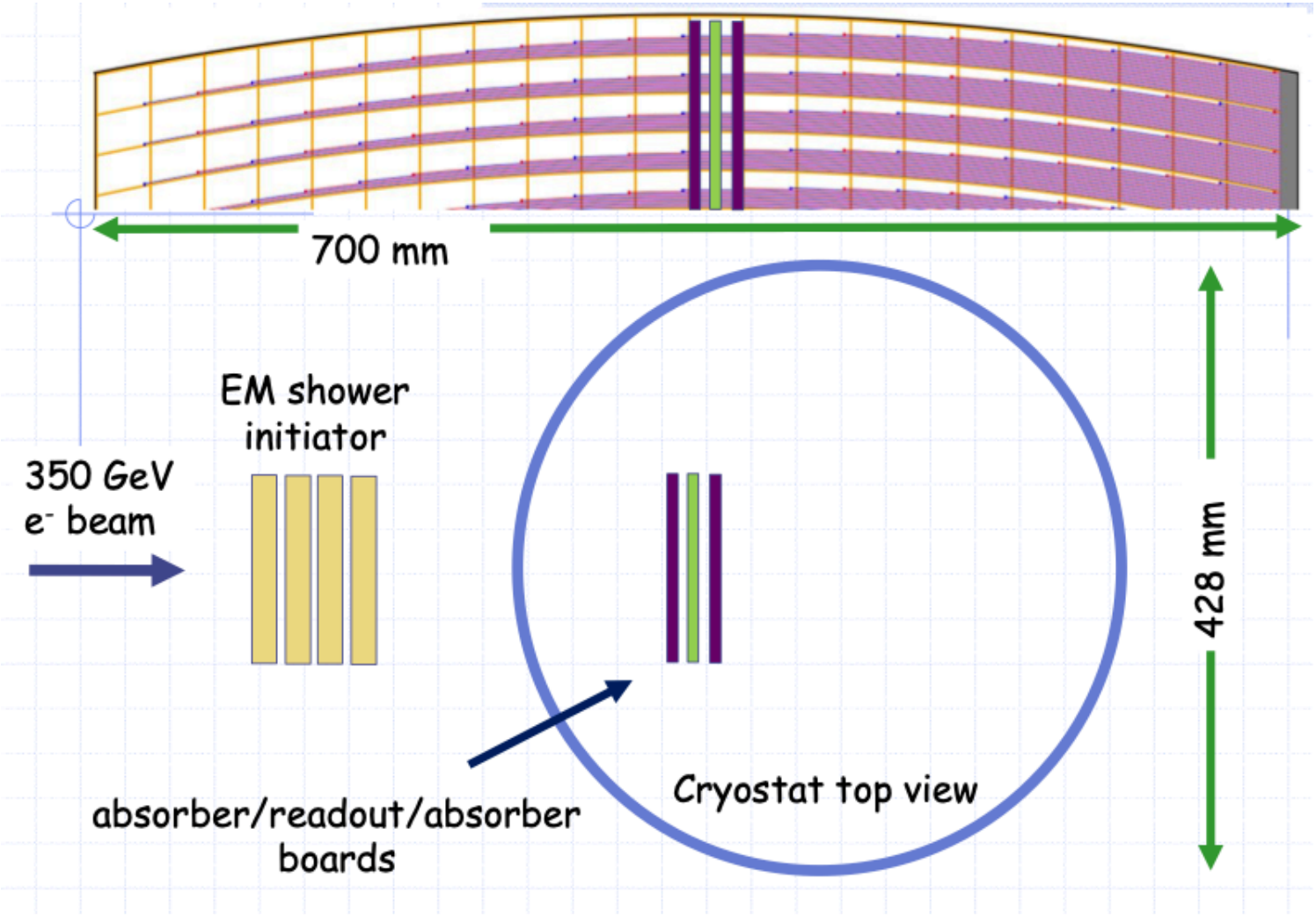


Testbeam equipment (Arizona)

- AZ group has several cryostats and extensive experience with organizing/running testbeam campaigns at CERN North Area



Possible testbeam configuration



Testbeam Plans

- Unfortunately the CERN schedule is not optimal for FCCee testbeam
  - a run in 27/28 would be ideal, but that's during LS3
- Options:
  - wait until 2029
  - run in 2026
    - likely on a smaller scale given the development possible by then
    - what do we hope/need to learn from this early run?

Readout considerations (SMU)

- See R. Stroynowski's talk in the TDAQ session: https://indico.slac.stanford.edu/event/9297/contributions/11197/attachments/4926/13214/RS SLAC Workshop Dec.2024.pptx