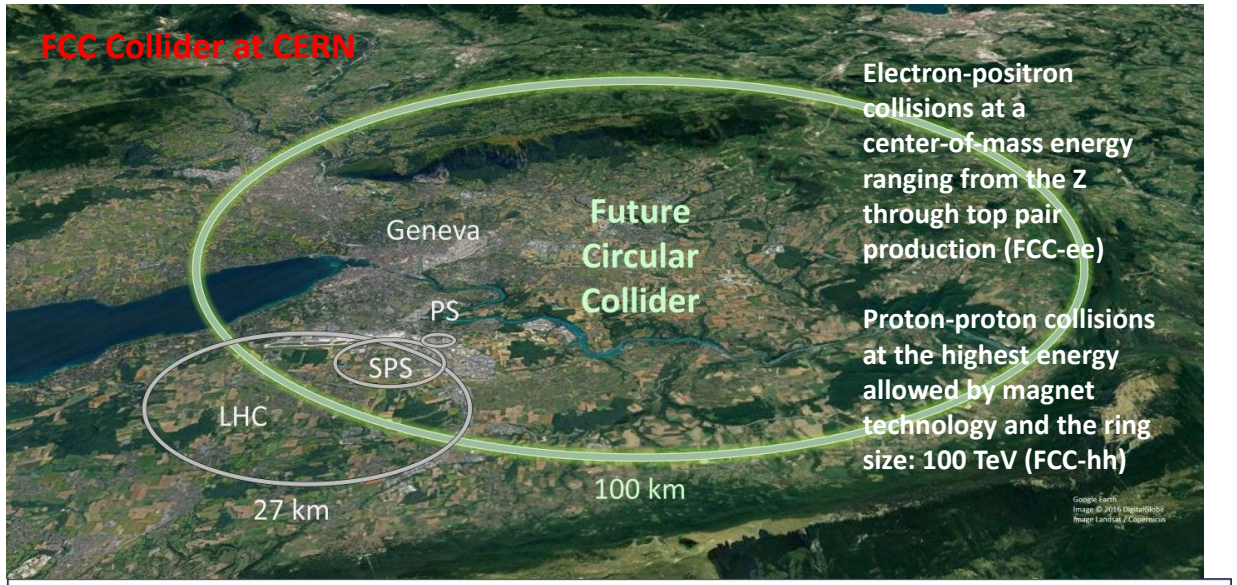
National Labs and University Synergy for the next generation (FCCee test case)

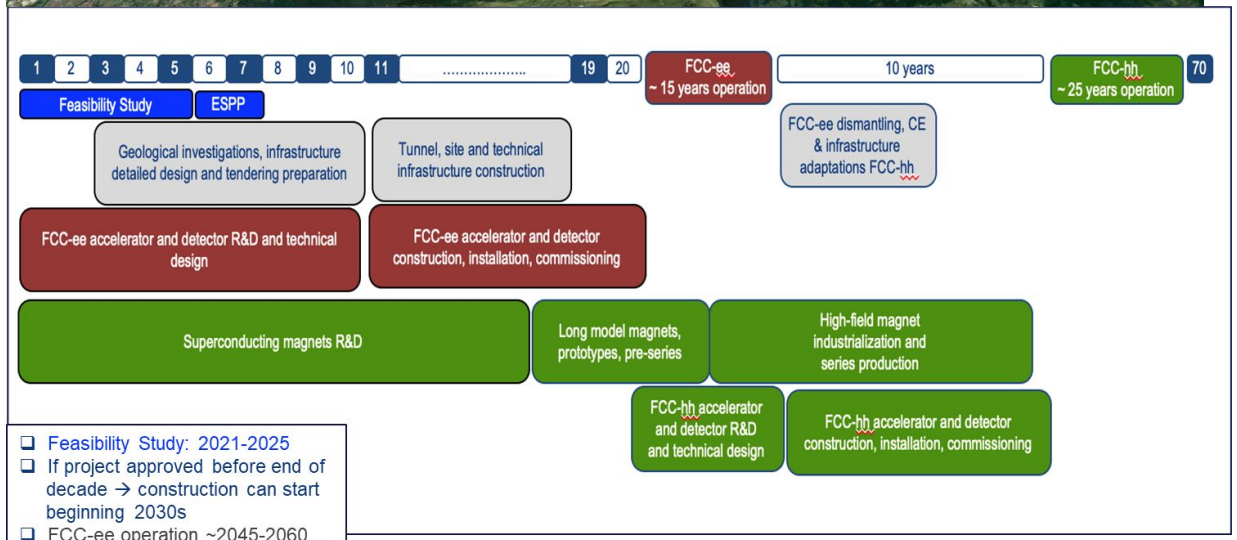
Assistant Professor Chris Palmer (University of Maryland)

While any future collider will bring challenges and collaborations to overcome them, the FCCee offers the US a special opportunity to take advantage of unique and specialized synergy between US universities, US national laboratories, and CERN.

Between now and the construction of FCCee, there will be continued R&D and, ultimately, FOUR large scale detector construction projects.

Giving a couple of examples of CMS detector construction for LHC and on-going HL-LHC upgrades, I will highlight the importance of integrated partnerships with universities and national labs.



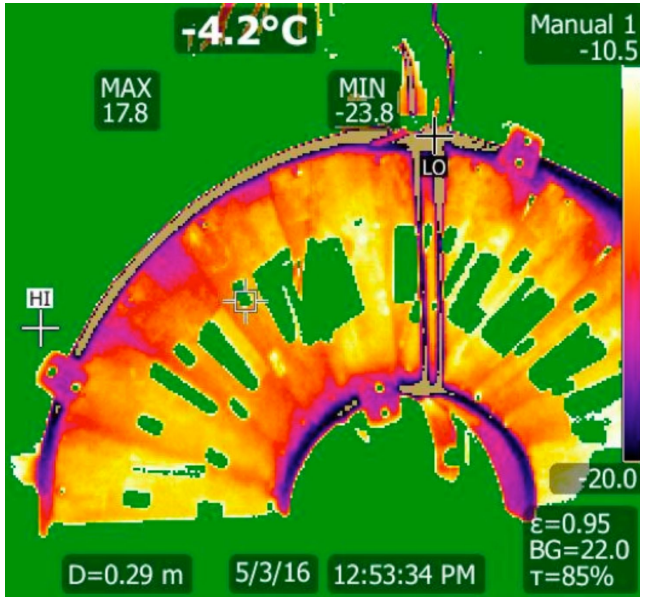


CMS Phase 1 Pixel Detector (in operation now)

The two primary components of the pixel detector were built separately:

- Barrel Pixels (BPIX)
  - Mostly European responsibility - DESY/University of Hamburg
- Forward Pixels (FPIX)
  - US responsibility
  - Fermilab was responsible for assembly
  - Supported by many US universities
- FNAL has infrastructure that universities don't have.
  - E.g. thermal properties with CO_2 cooling

https://cds.cern.ch/record/2748381



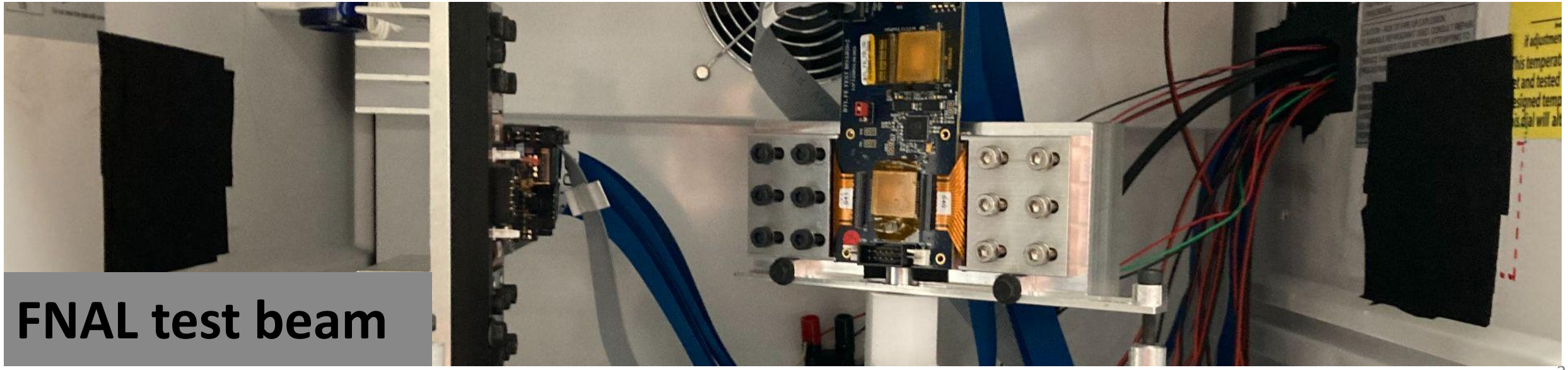
CMS MTD Barrel Timing Layer for HL-LHC (transitioning to production now)

The process of designing, prototyping, and testing components of the Barrel Timing Layer (BTL) of CMS's upgrade MIP Timing Detector (MTD) is a case study in effective coordination of national laboratory, US universities, and CERN's collective resources.

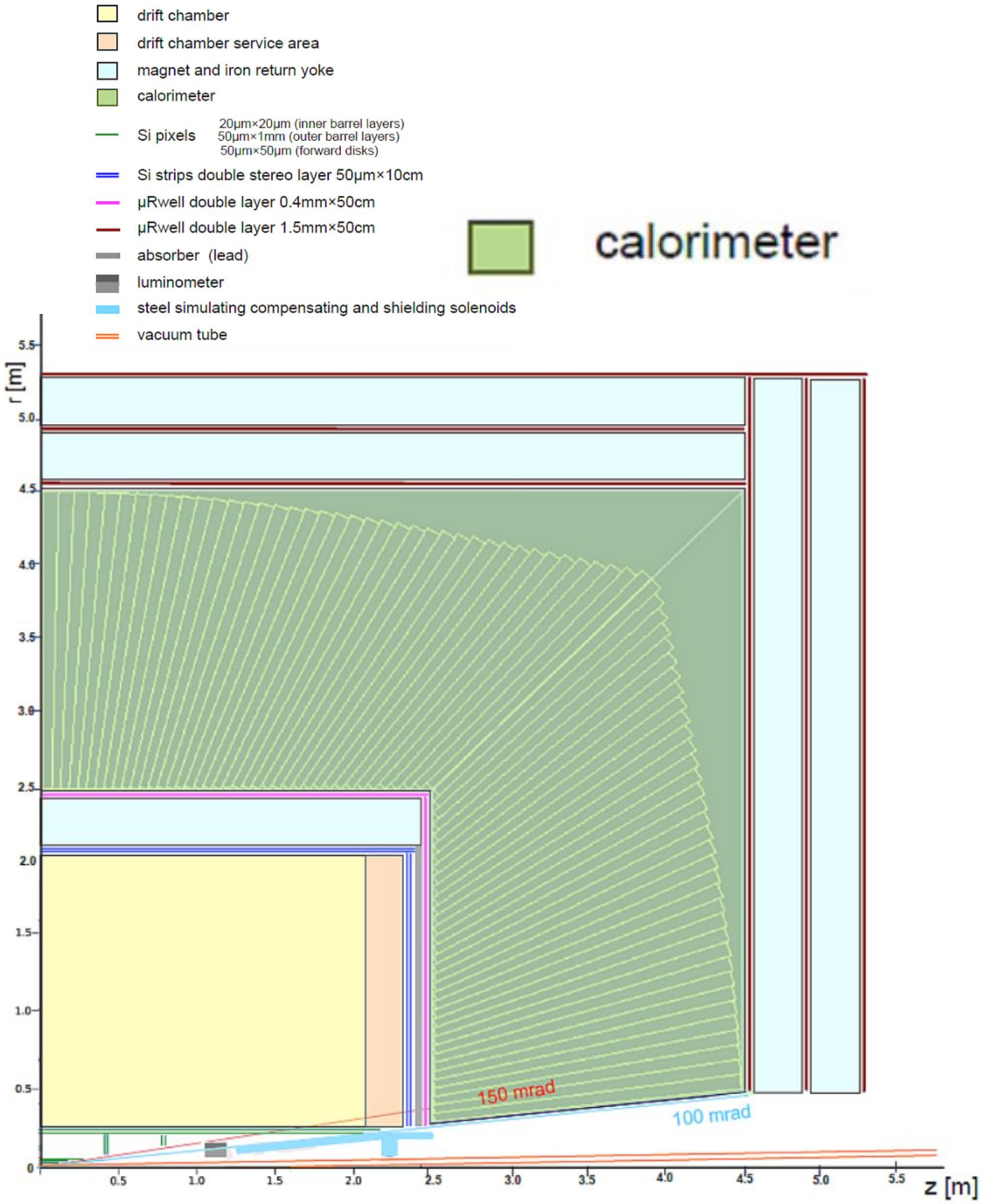
UVa and CalTech (as part of the USCMS Collaboration) will produce 50% of BTL modules for fast, precise timing measurements at HL-LHC in CMS.

Fermilab is critical for test beam, and CERN is of course the site of final integration before installation.

BTL Module



FNAL test beam



IDEA Detector with Dual Readout Calorimetry

Dual readout calorimetry aims to measure scintillating and cerenkov light to maintain precise electromagnetic resolution while improving hadronic precision in a homogeneous calorimeter.

The US effort has been spearheaded by CalVision, which is a consortium of PIs from several universities (e.g. UMD, Princeton, UVa, MIT) and FNAL staff scientists.

One can easily envision one (or more) of the four FCCee detectors use this technology, and a heavy US footprint on at least one of the experimental collaborations that grow out of CalVision.

In summary, the US particle physics community has had substantive and substantial contributions to LHC experiments which has pushed forward an entire generation of US physicists. Retaining that position in the next generation of colliders will keep future generations of US particle physicists at the forefront of the field.

https://detectors.fnal.gov/projects/calvision/