The IDEA detector concept for FCC-ee/CepC

F. Bedeschi, INFN-Pisa
for the IDEA Study Group
International Workshop on High Energy CepC,
Shanghai, October 2026

Outline

- Layout evolution
- Performance highlights
- Ongoing R&D
- Summary & Comments



A second detector concept for CepC

F. Bedeschi

International Workshop on High Energy CepC, Beijing, November 2017

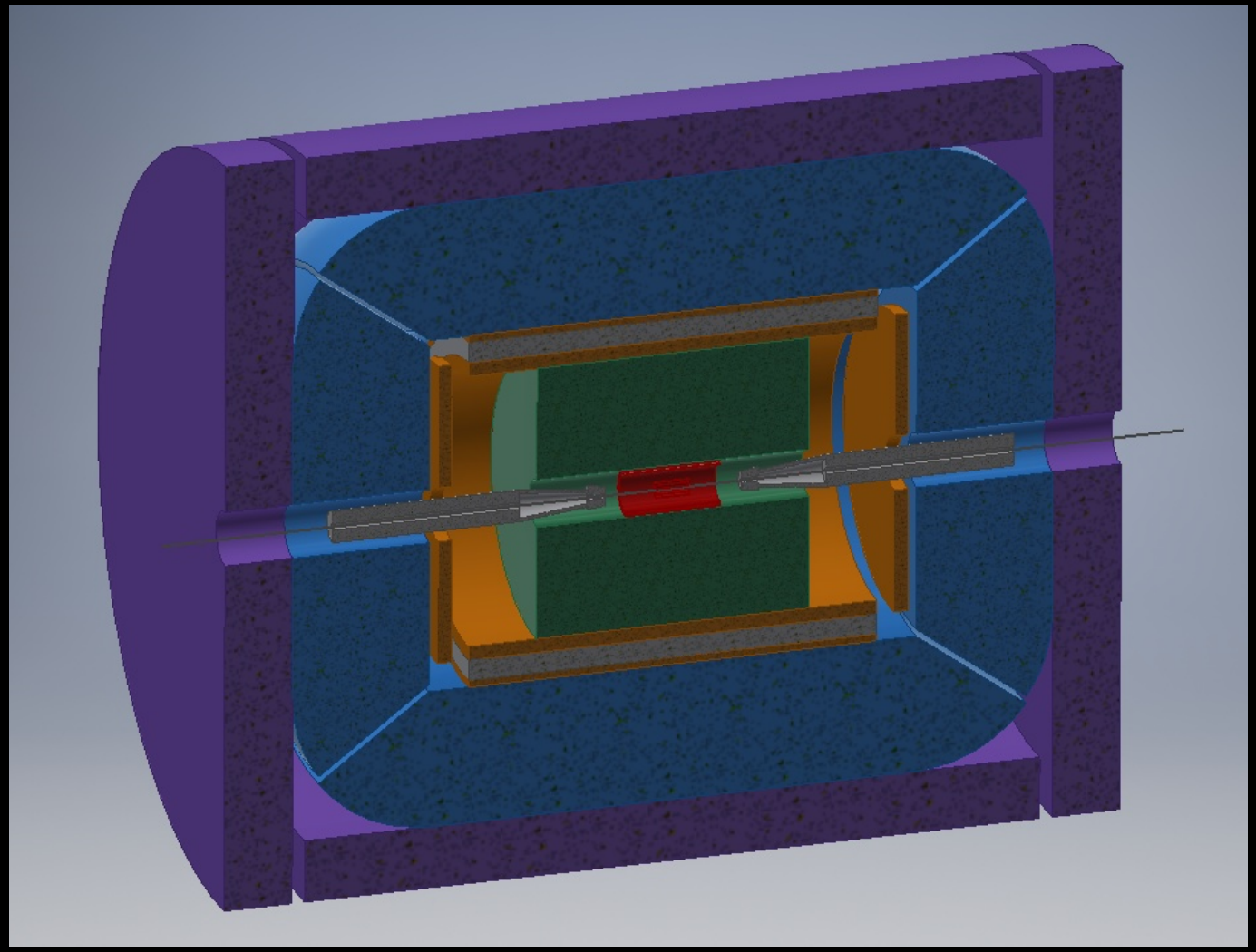
First IDEA proposal in 2017

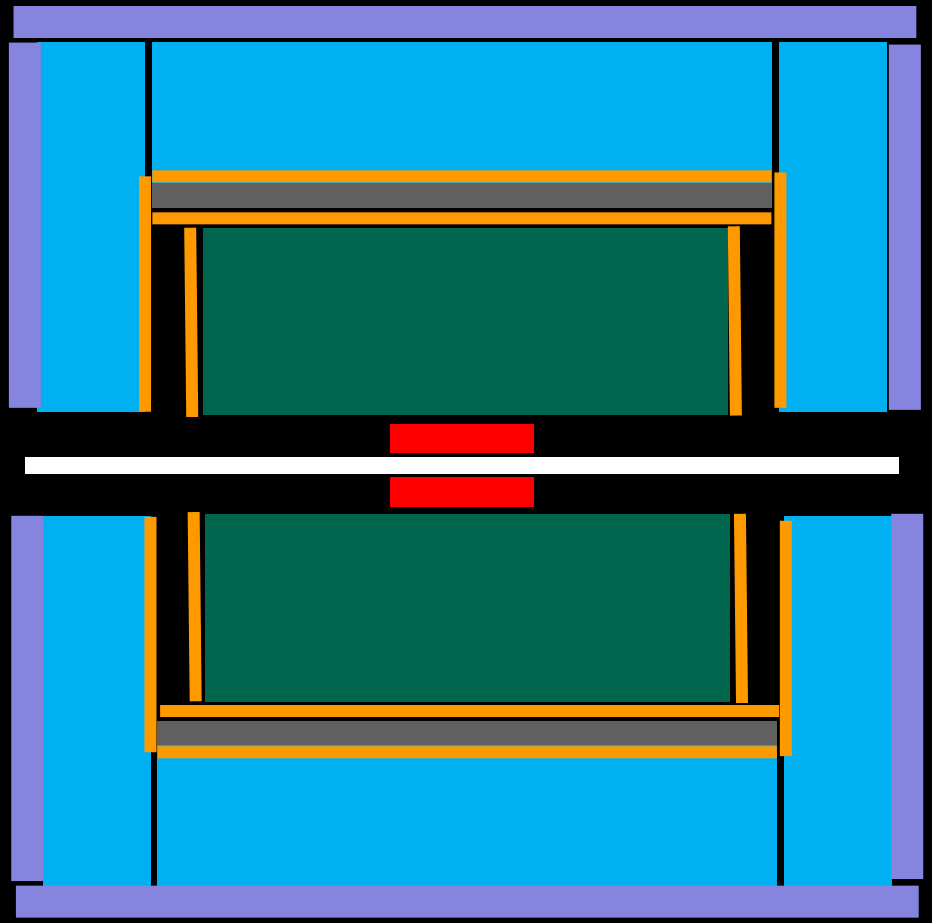
https://indico.ihep.ac.cn/event/6618/contributions/86002/attachments/45127/51886/Bedeschi_2nd-detector.pptx

Outline

- Main physics/technical drivers
- Detector layout and performance
- Cooperation opportunities
- Conclusions

Old detector layout





Baseline IDEA detector concept

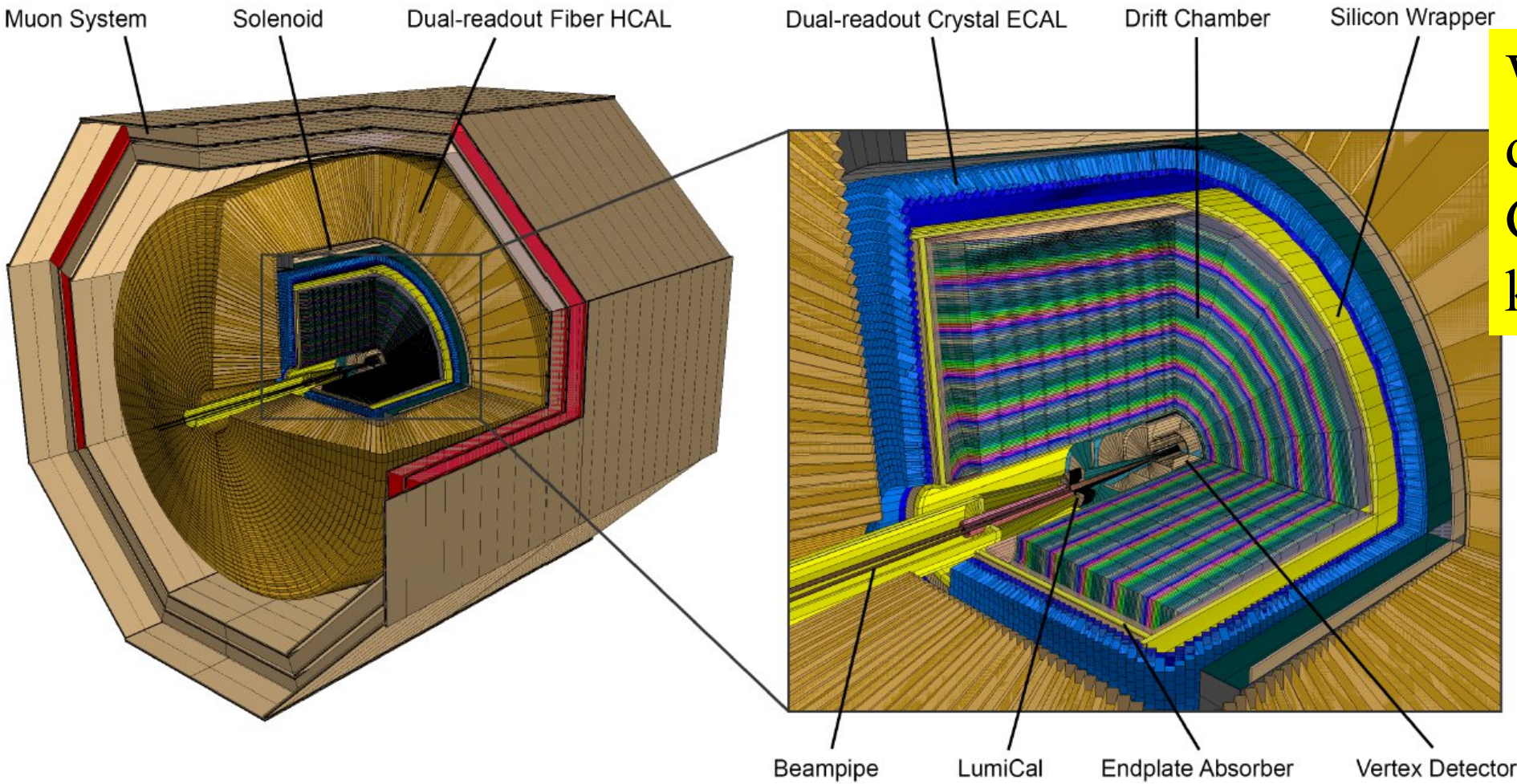
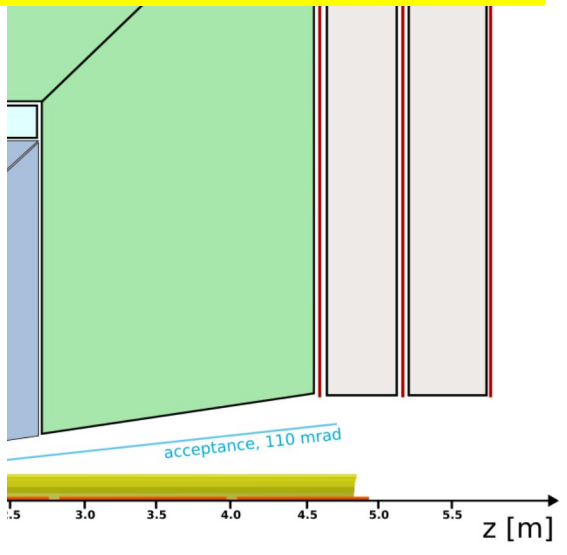


Figure 1: 3D cutout view of the IDEA baseline detector design with subdetector labels.

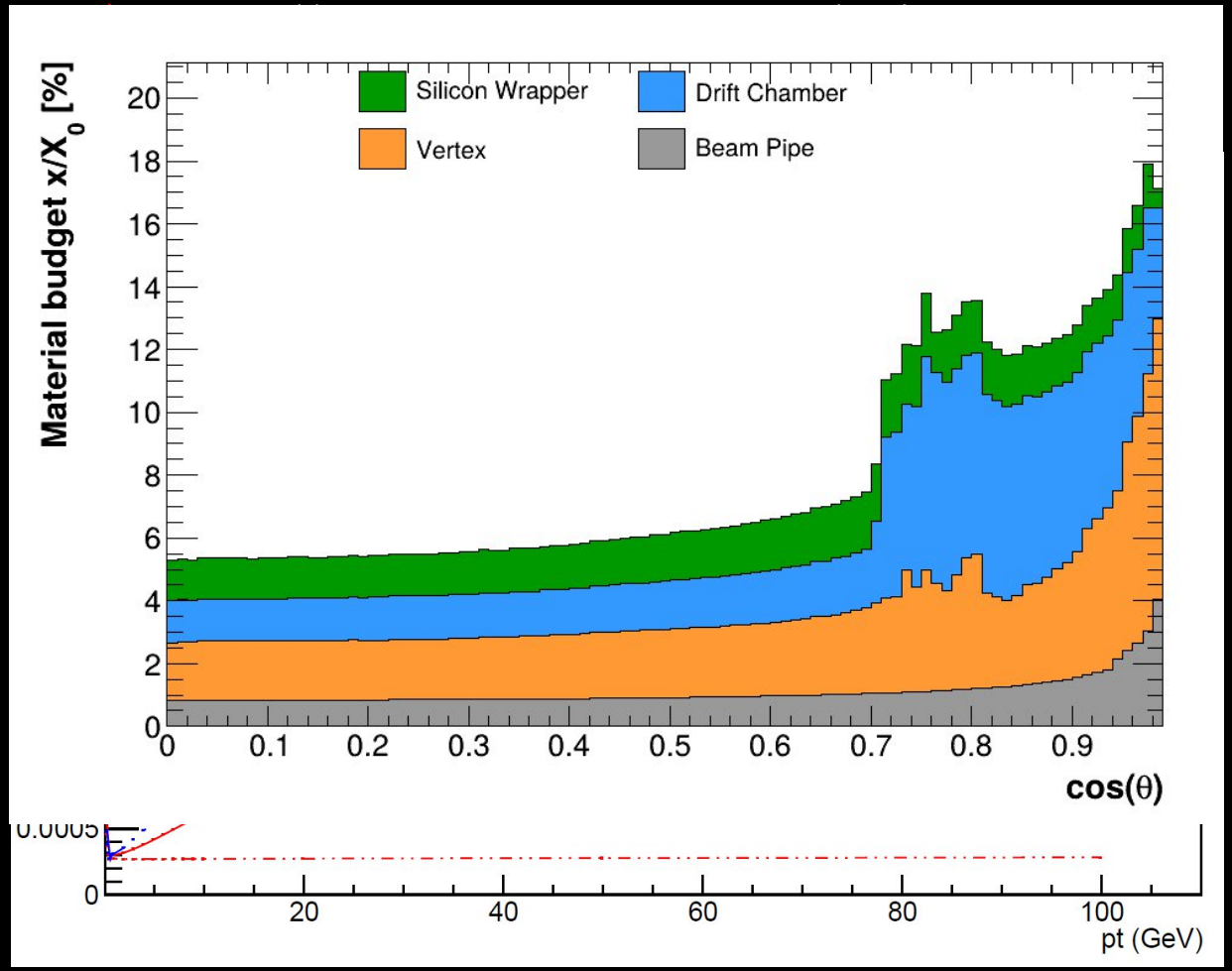
Whole baseline detector now in GEANT4 through key4hep

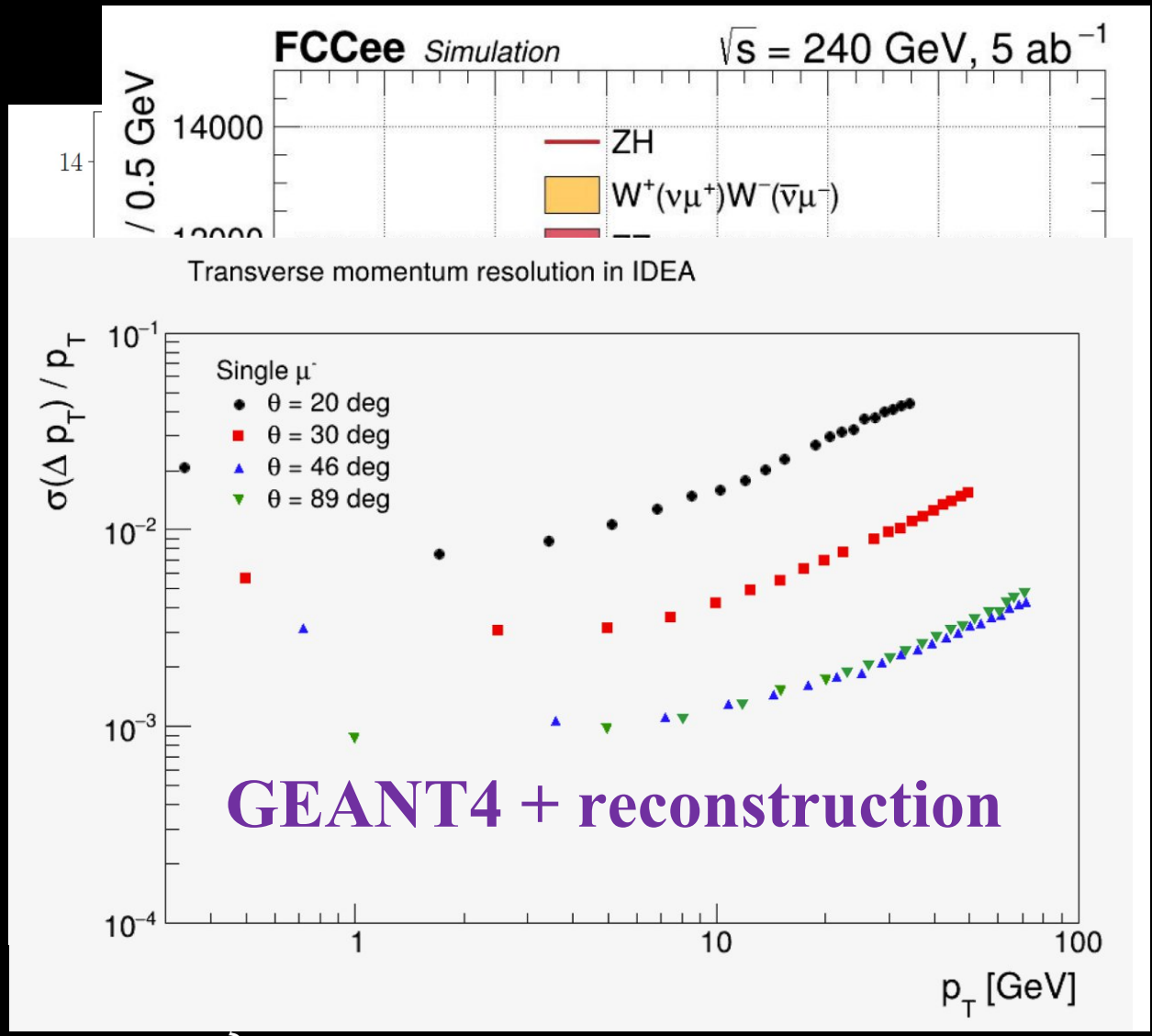


os/2502.21223

Performance highlights (1)

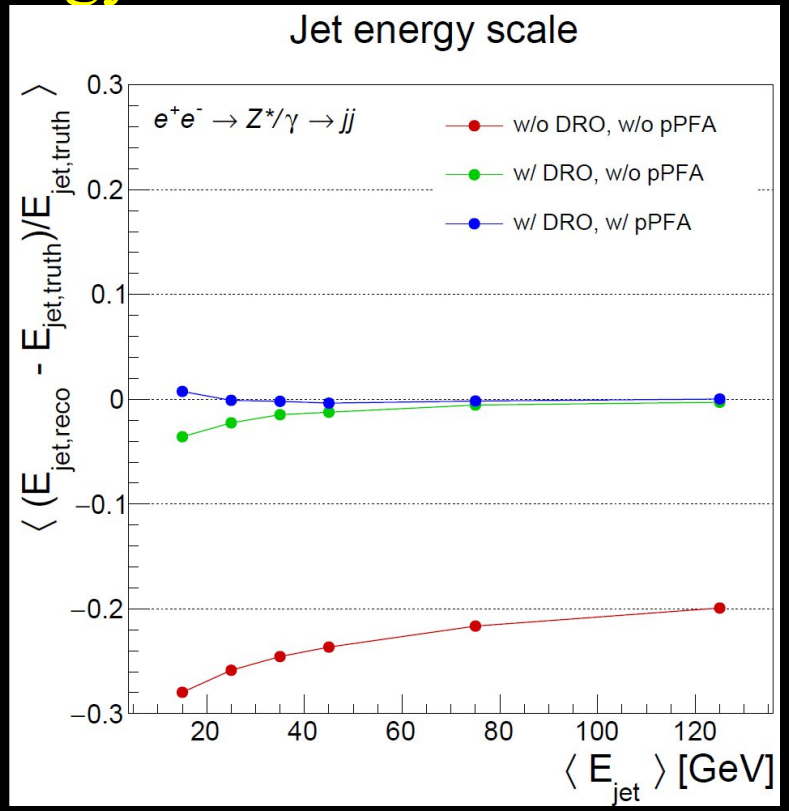
- Light tracking with good efficiency:

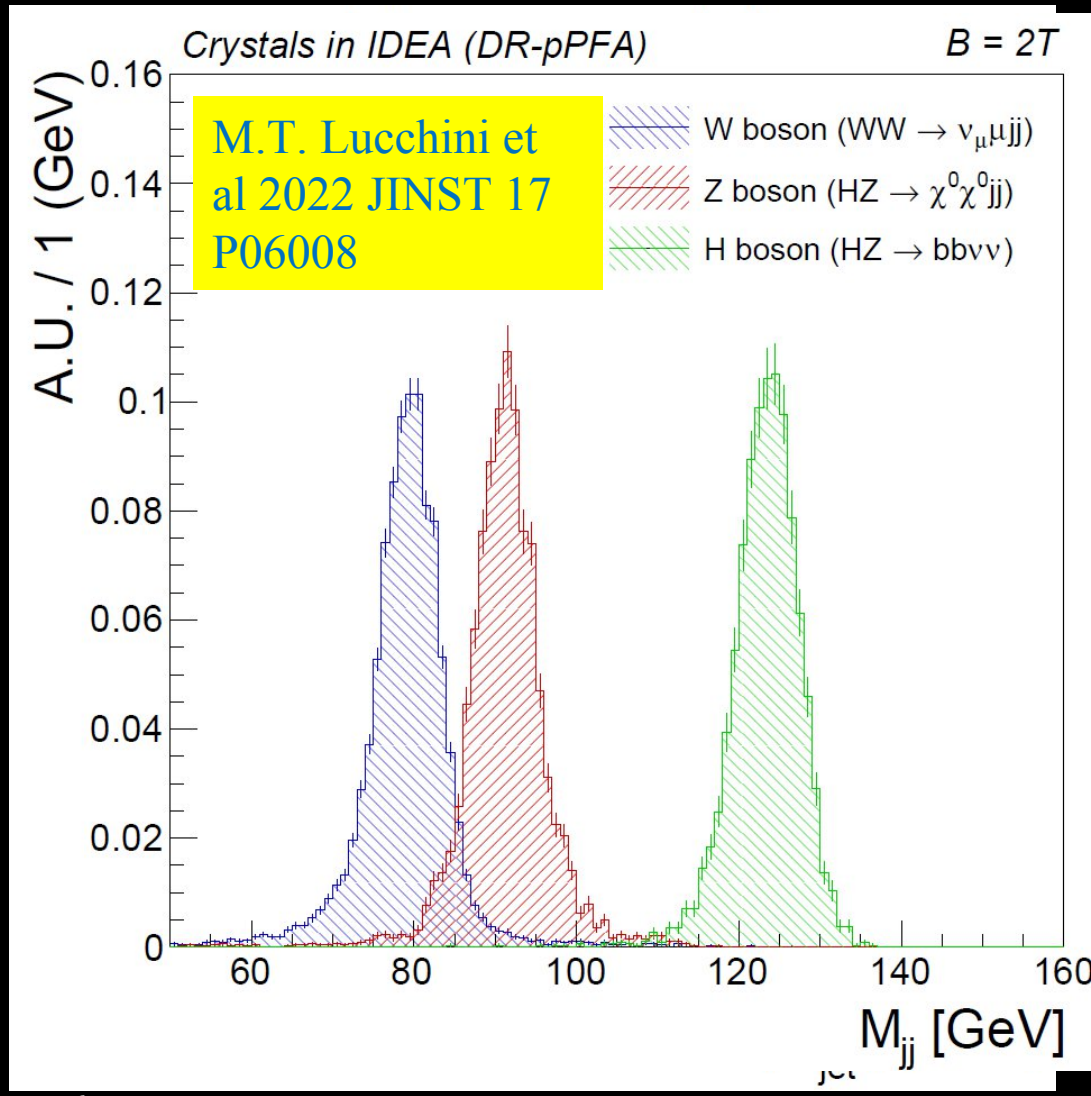




Performance highlights (2)

- EM calorimeter: very good energy resolution
- Merge with Hadron calorimeter for good linearity and jet energy resolution
- Importance of
  - Dual readout
  - Particle flow
- Boson masses



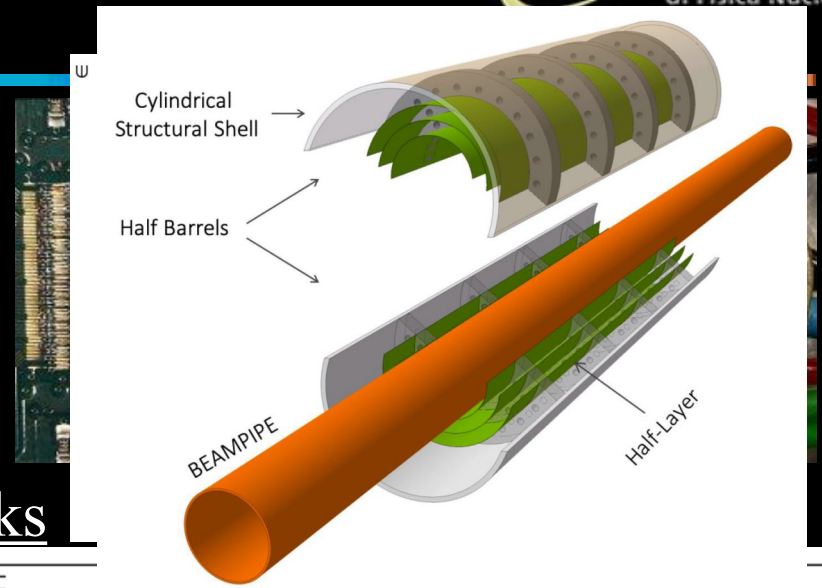


Current R&D and issues

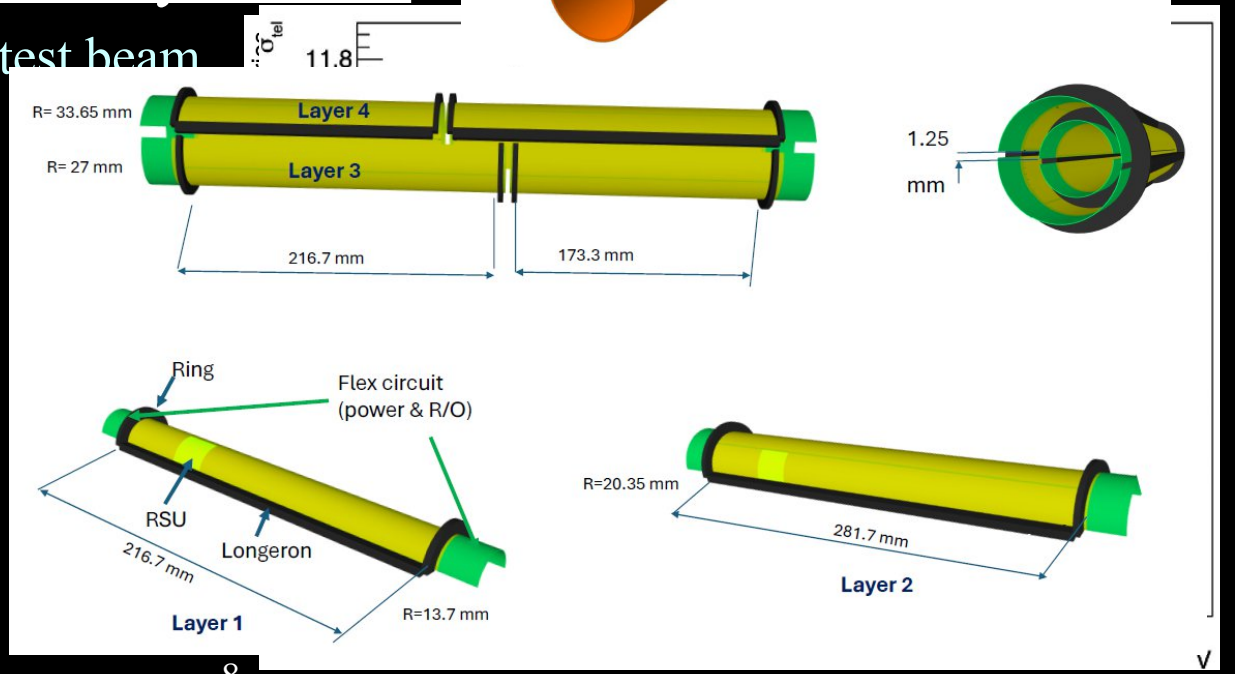
- Much R&D in progress
- No definite choices for final detectors
  - Additional options can/should be considered
- Common R&D with other experiments/concepts when synergies found

Vertex detector

- Three existing CMOS MAPS chips under study
  - ARCADIA 25 x 25 μm^2 - Baseline inner 3 layers
    - Mean detector resolution 3.8 μm from FNAL test beam
    - Low power → air cooled
  - ATLASPix3.1 150 x 50 μm^2 - Baseline outer 2 layers/disks
    - Mean detector resolution <10.6 μm from DESY test beam
    - Serial powering - High power → Water cooled



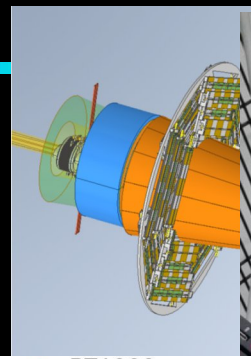


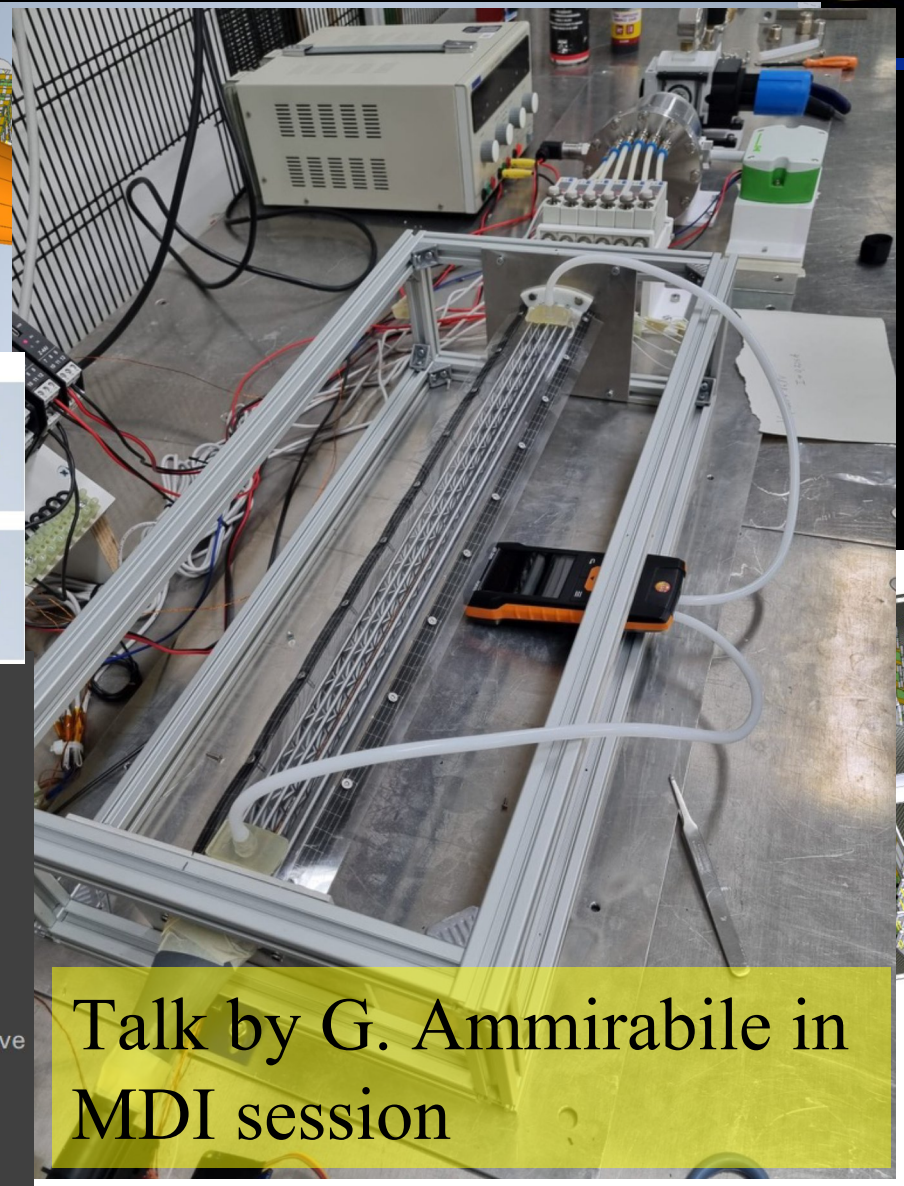


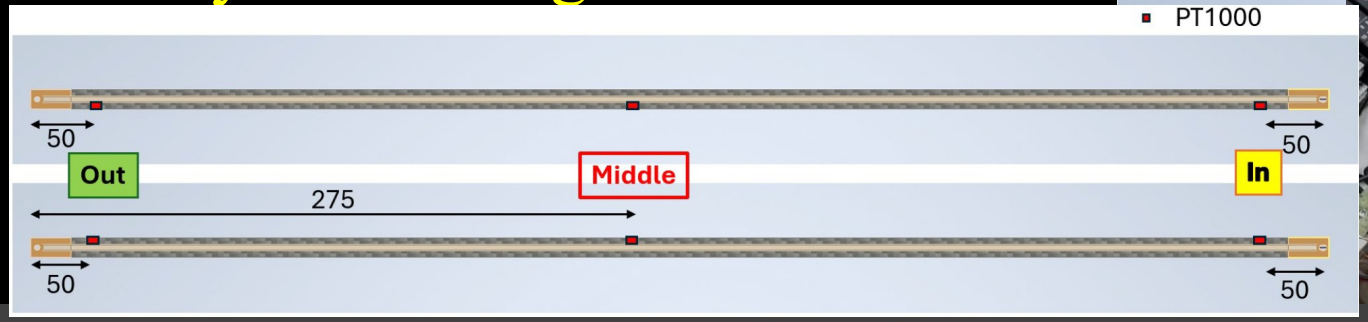
Details in A. Andreazza talk in Silicon Detector session

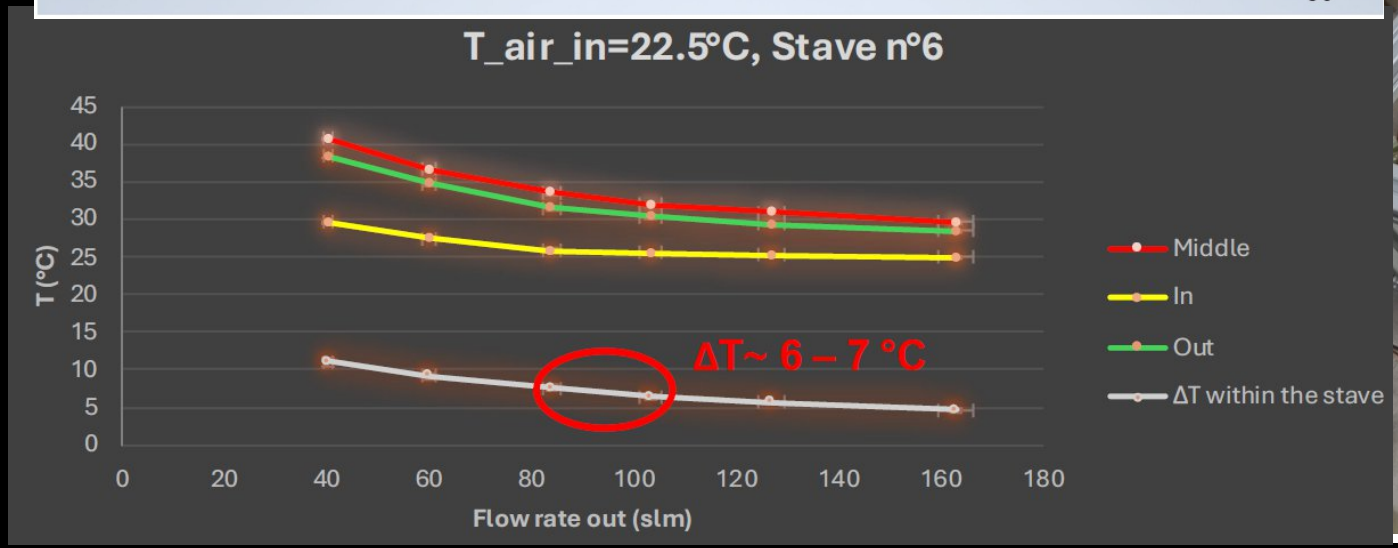
Vertex detector mechanics

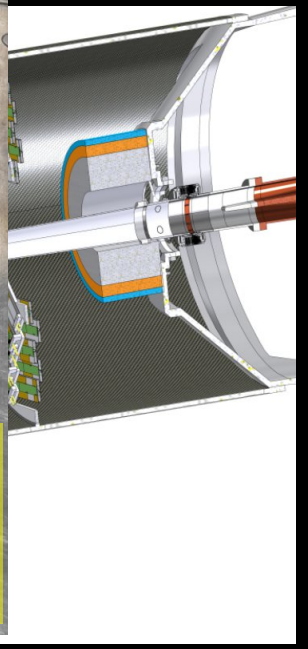
- Engineering vertex detector area
  - Mockup assembly at Frascati lab
- Study air cooling/vibrations





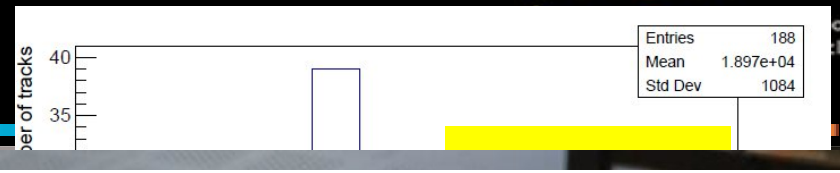




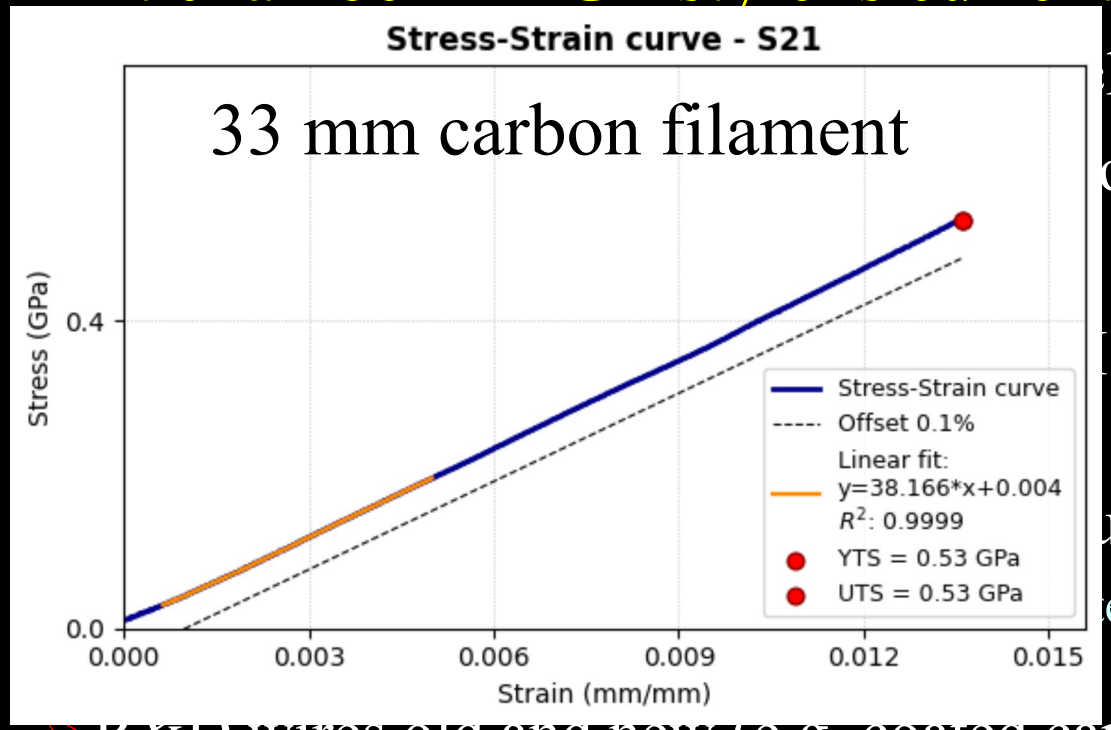


Talk by G. Ammirabile in MDI session

Main tracker



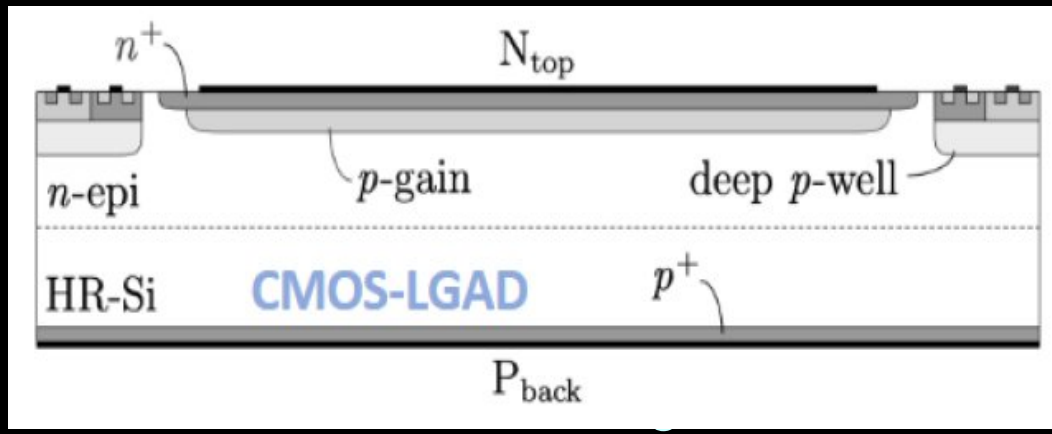
- Drift chamber MEG2-style is current baseline
  - king
  - otal
  - 10 gas
  - unting PID
  - est beam

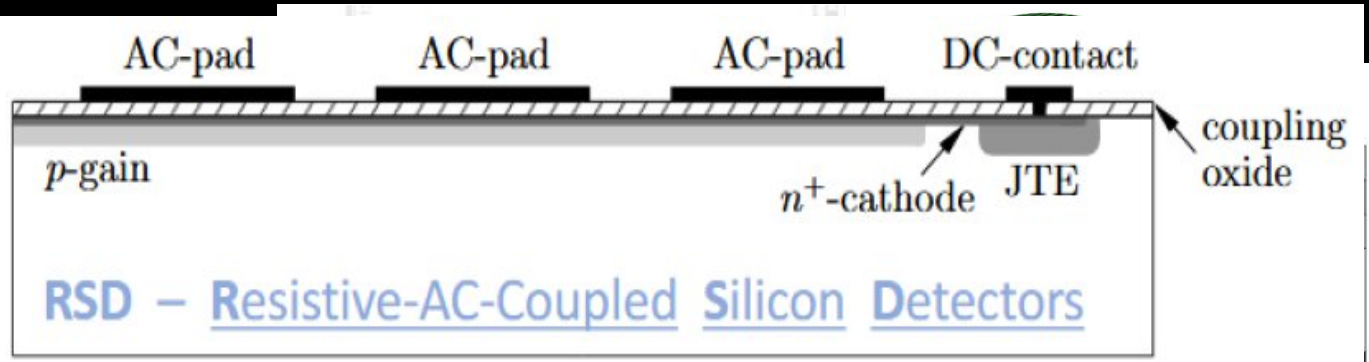




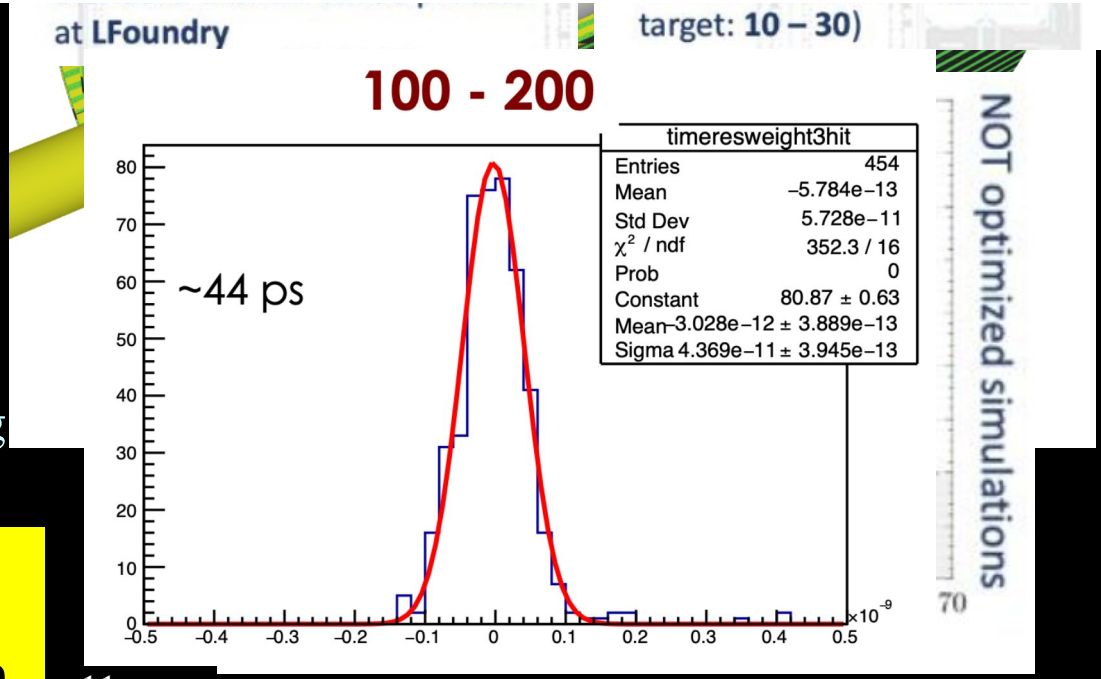
- R&D wires old and new (e.g. coated carbon filament)
- R&D engineering/prototyping mechanical structure
- R&D waveform sampling readout with PID on FPGA

Silicon wrapper





- LGAD R&D:
  - ARCADIA CMOS pixels with gain layer
    - Small demonstrators built
  - RSD
    - Work also with strips – Accuracy from charge sharing
    - Demonstrated <50 ps time resolution with <10 μm space resolution

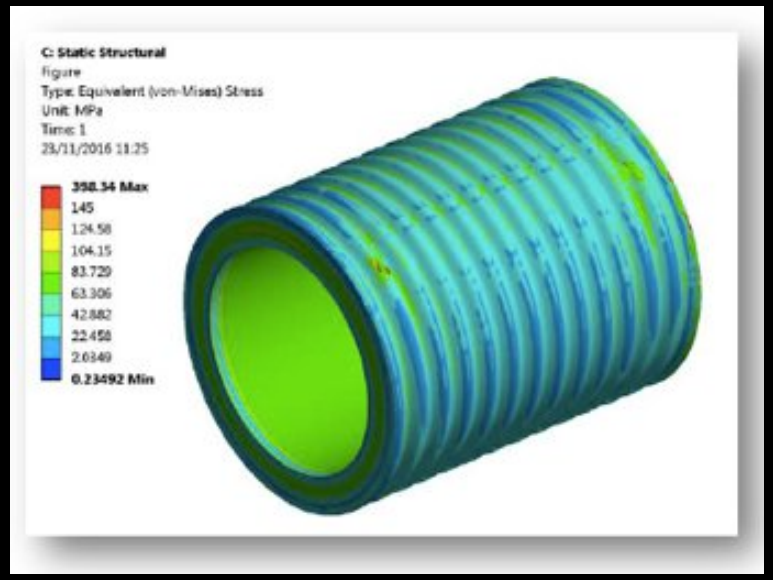


M. Mandurrino talk in Silicon detector session

Detector solenoid

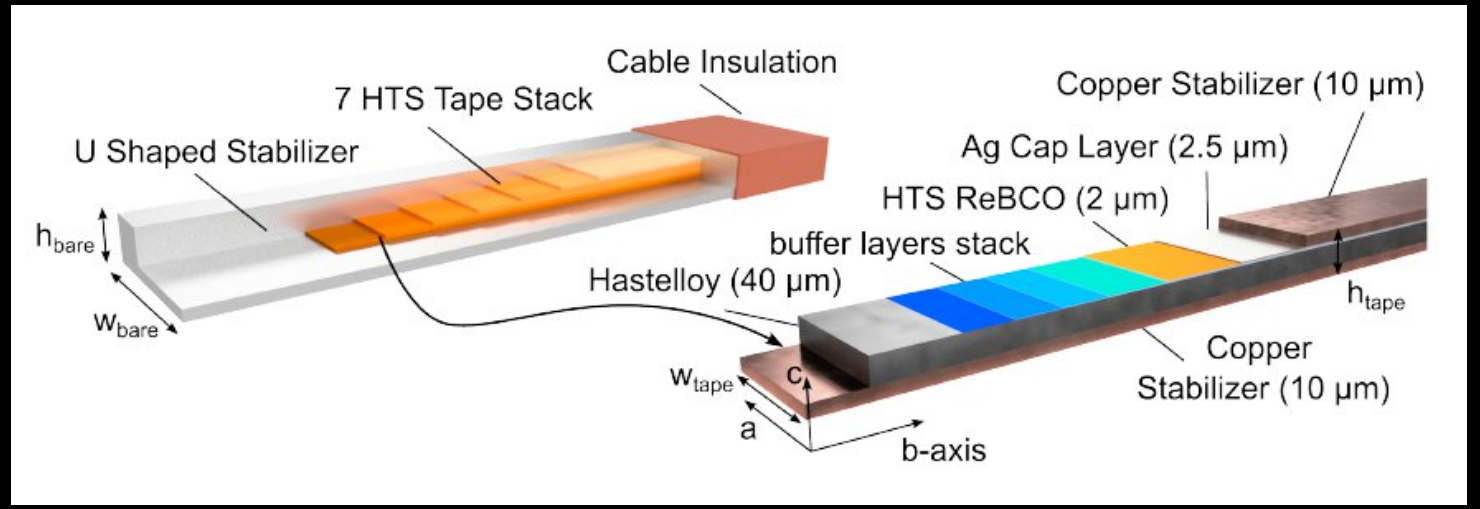
Two options: standard SC or HTS

- Light NbTi 2T field - Rin = 2.5 m
  - Total thickness ~30 cm
  - Total mass = 0.74 X_0 (0.16 λ) at θ = 90º



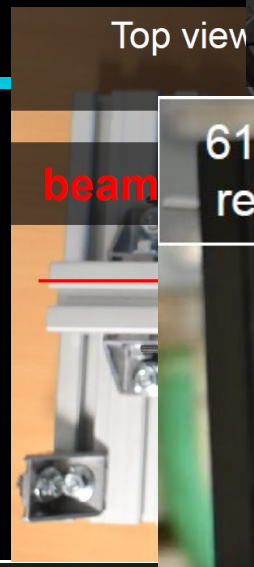
Current HTS baseline

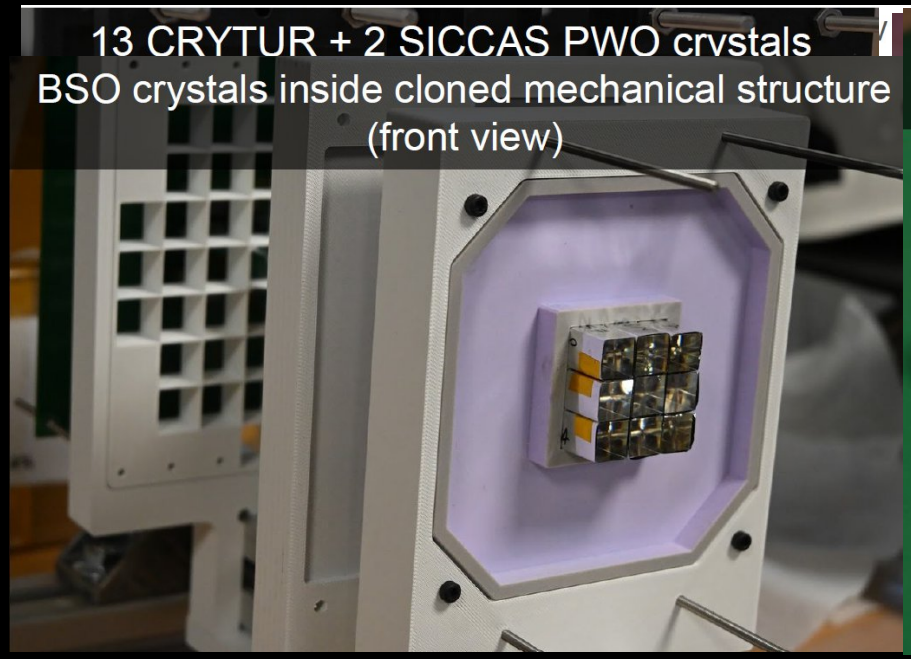
- HTS 2-3T field @20 K - Rin = 2.5 m
  - Total thickness ~30 cm
  - Total mass = 1.74 X_0 (0.38 λ) at θ = 90º
  - Studying impact of additional material

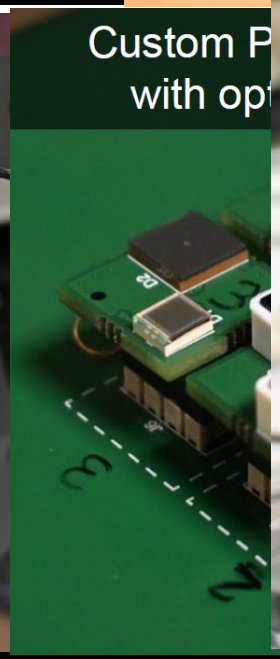


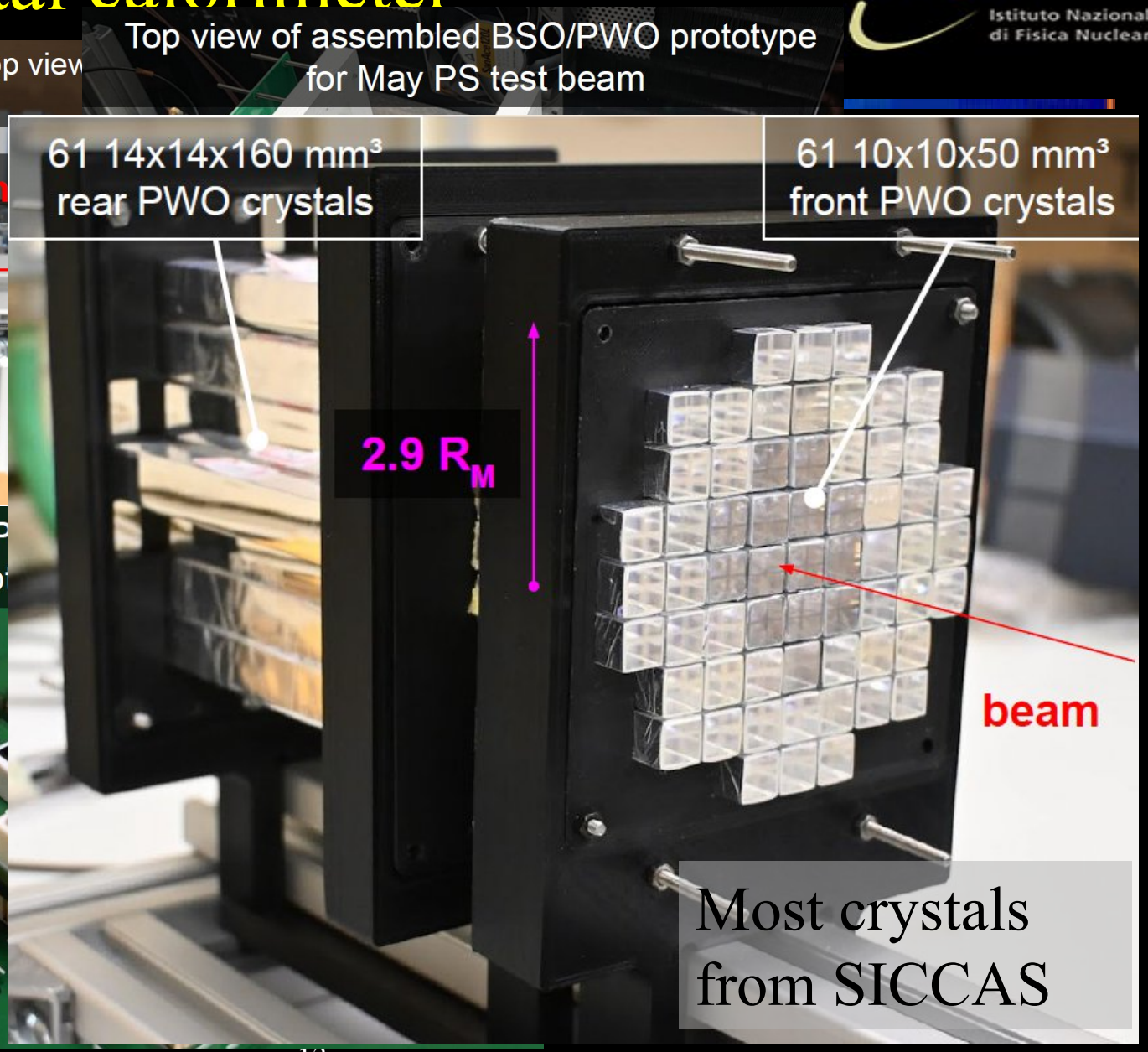
Crystal calorimeter

- Dual readout EM calorimeter
  - Two crystal options:
    - PWO: filters for Cherenkov
      - x15 matrix test at PS 1-5 GeV e-
      - x61+61 matrix at SPS with Hidra
    - BSO: filters and timing
      - x9 matrix test at PS 1-5 GeV e-



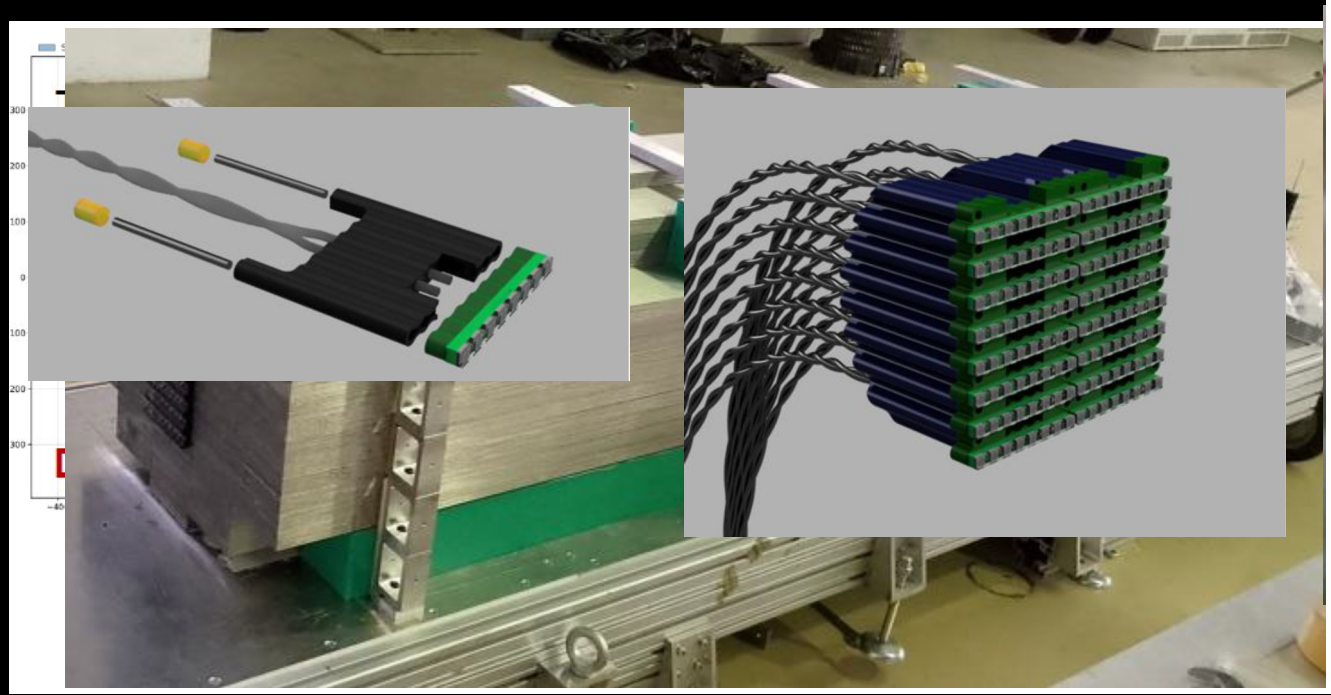


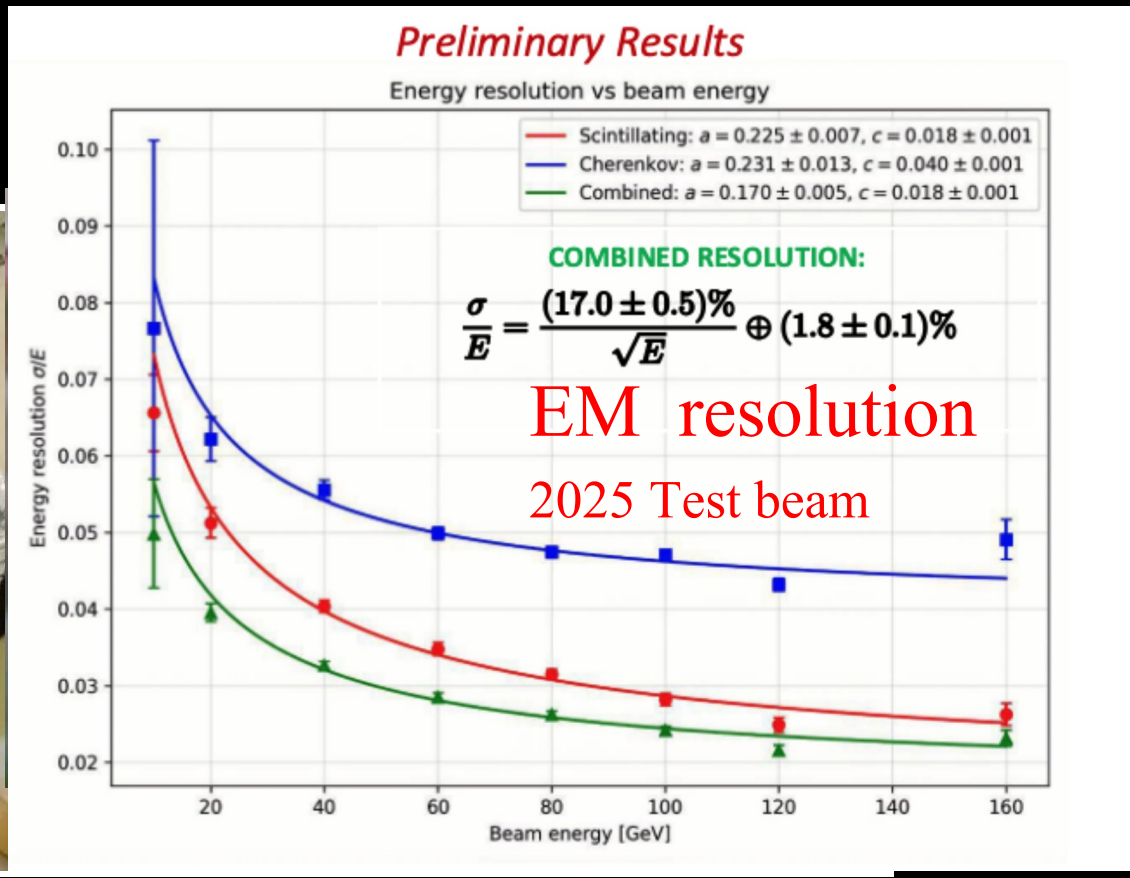




Fiber calorimeter baseline

- Large R&D efforts: from small prototype to scalable demonstrator
  - Now full containment prototype 2.5 m long – 65 cm wide
  - Structure based on fibers inside steel tubing
  - On-tube SiPM coupling



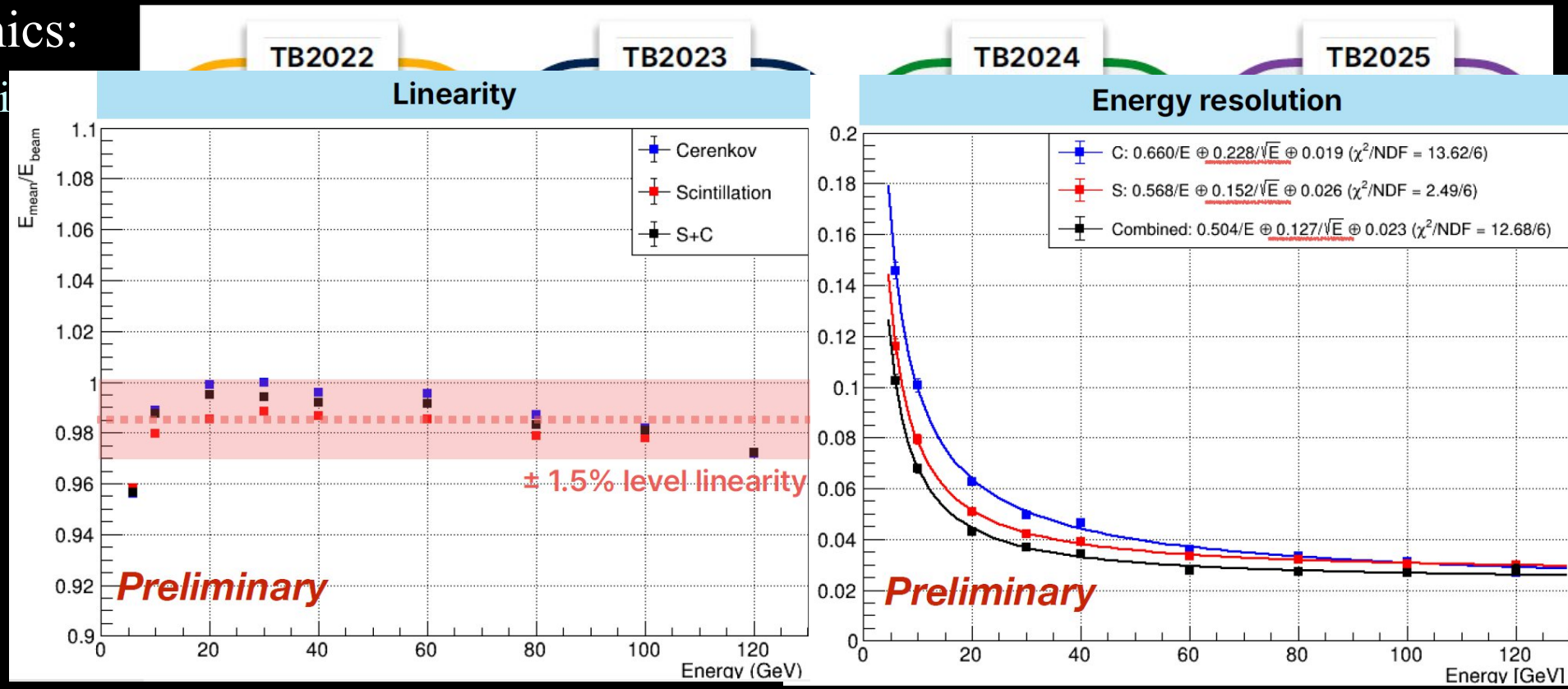


Fiber calorimeter options

Talk by Guk Cho in Calorimetry session

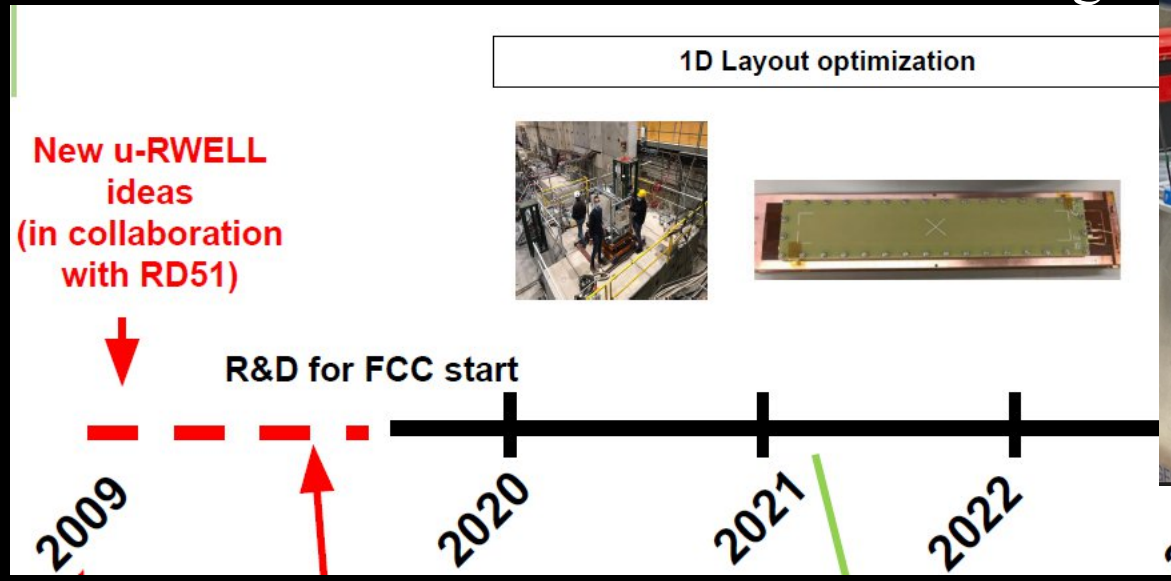
- Alternate options by Korean groups
  - Mechanics: Grooved Cu plate → 3D printing of copper → Skived fin heat sink
  - Front-end electronics:
    - Usual PMT and Si
      - Custom DAQ
    - MCP-PMT
      - ps timing
      - high sensitivity
- 2025 TB results
  - EM resolution

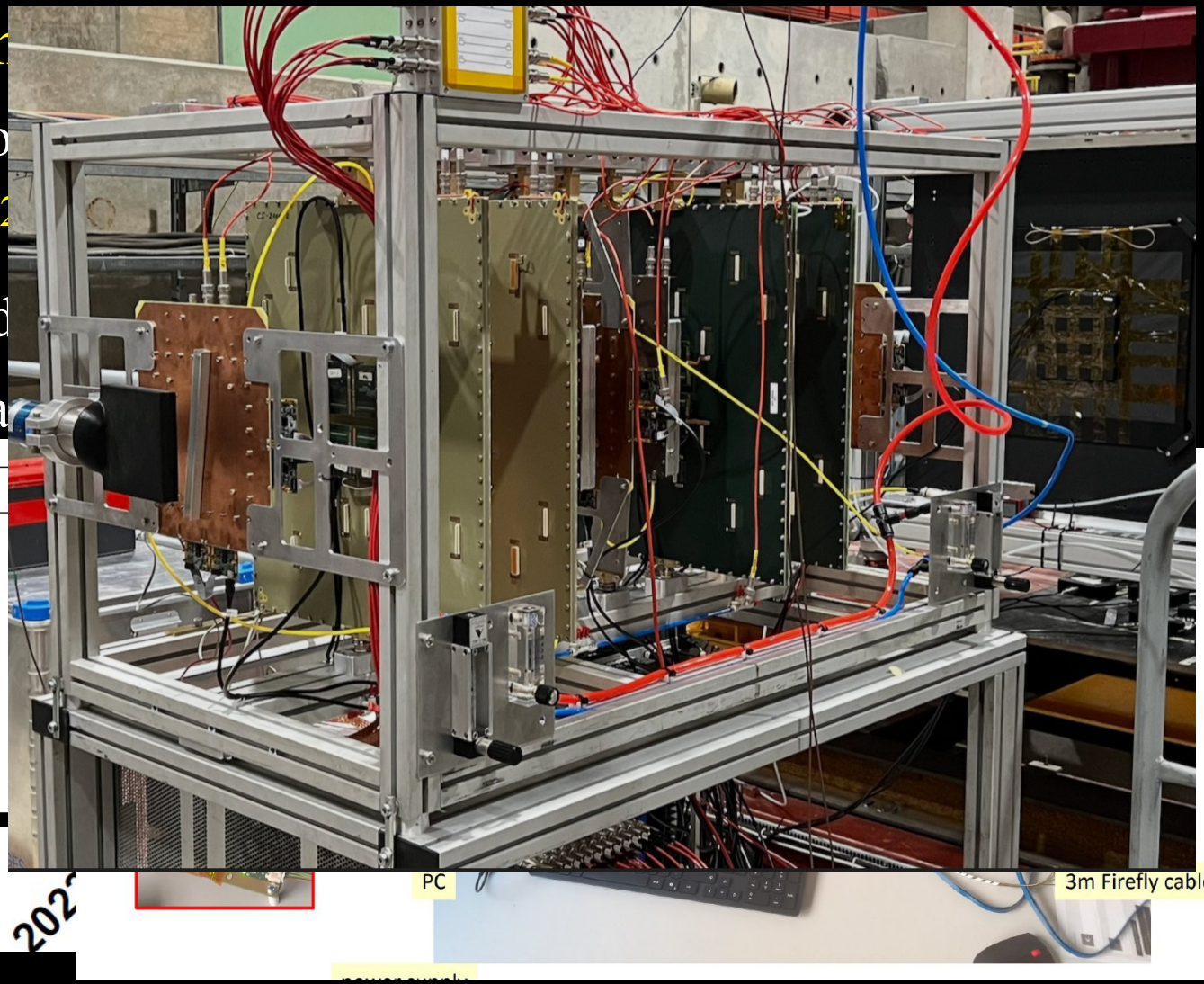
  $12.7\%/\sqrt{E} + 2.3\%$



Muon chambers

- Tracking muon system optimizatio
  - Required to track charged particles fro
- R&D – large area to cover: 1500 m
  - μ-Rwell: Involve industry in parts of d
  - Provide 2D resolution with a managea





Summary & comments

- IDEA detector concept satisfies FCC-ee requirements
- Major R&D in progress on all subdetectors demonstrate performance
- However:
  - In some case scalability/cost/risk may be an issue → need additional options
  - Some baseline technologies are old
    - New technologies may prove to be better than current baseline!
    - IDEA is still very open to new ideas that can improve on the current baseline design
  - Much more effort needed to go from prototypes to full detectors
    - More financial and manpower resources needed
- Great time for new groups to join and be part of the LoI when the accelerator is finally approved
    - May not take so long!