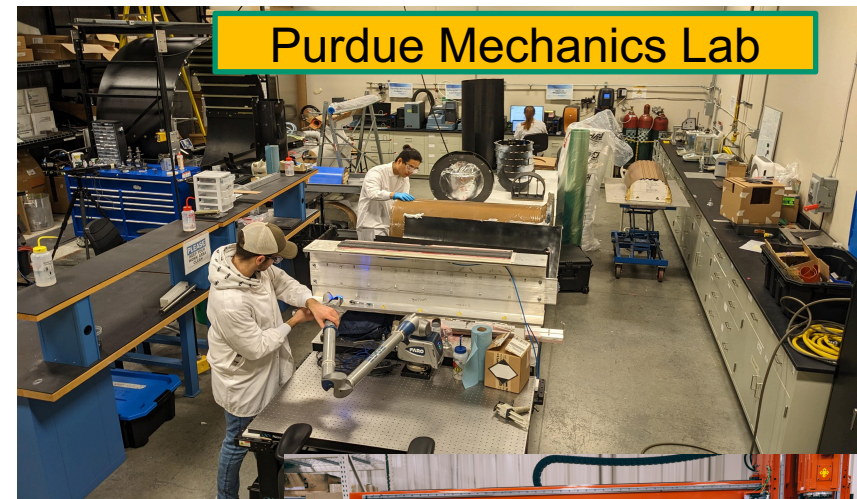


# Leaping into the future - R&D for next detectors at future colliders

- The need
- Today's capabilities & Future R&D (biased view's)
- Remarks
- Summary

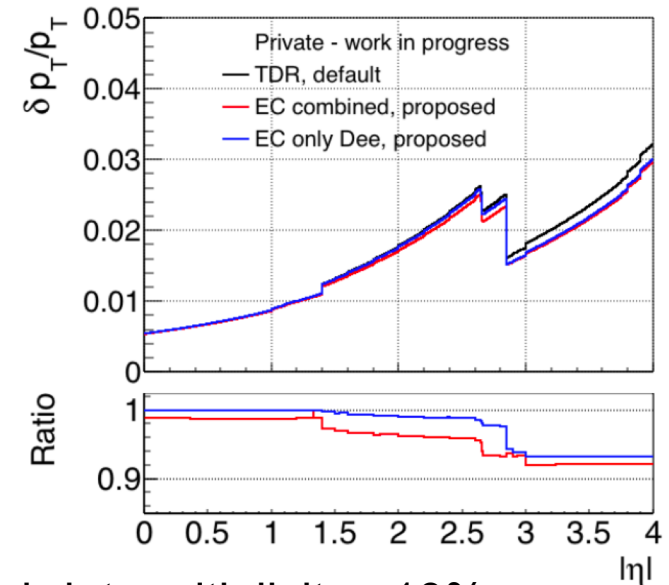
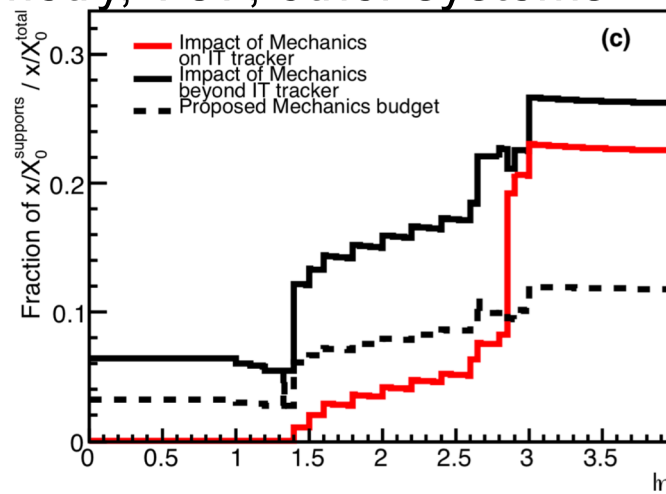
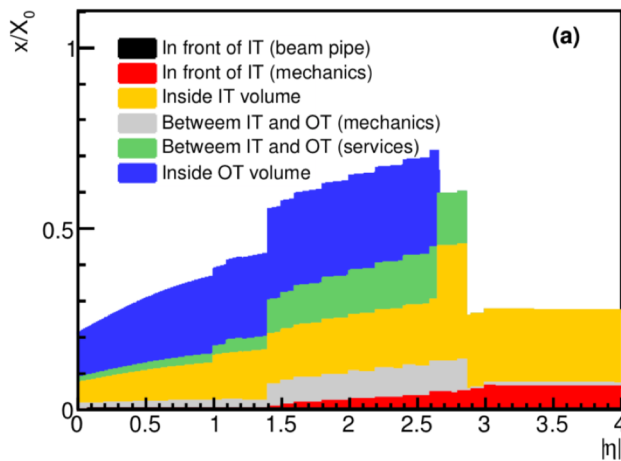
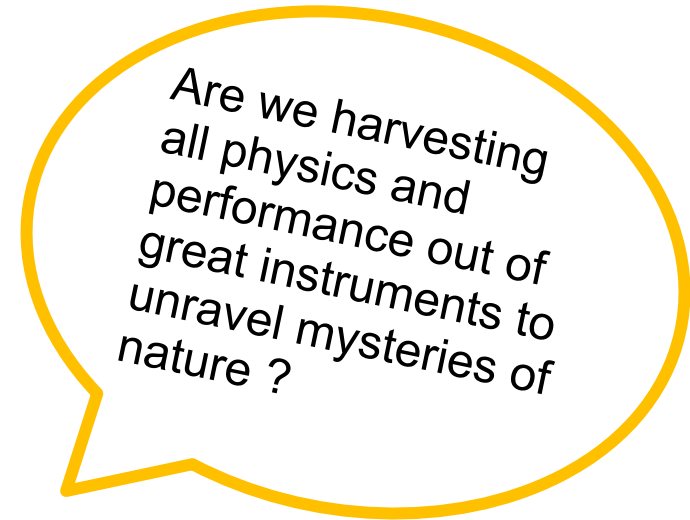


**Andy Jung**  
P5 Townhall meeting, 27<sup>th</sup> June 2023

**June 27<sup>th</sup>, 2023**

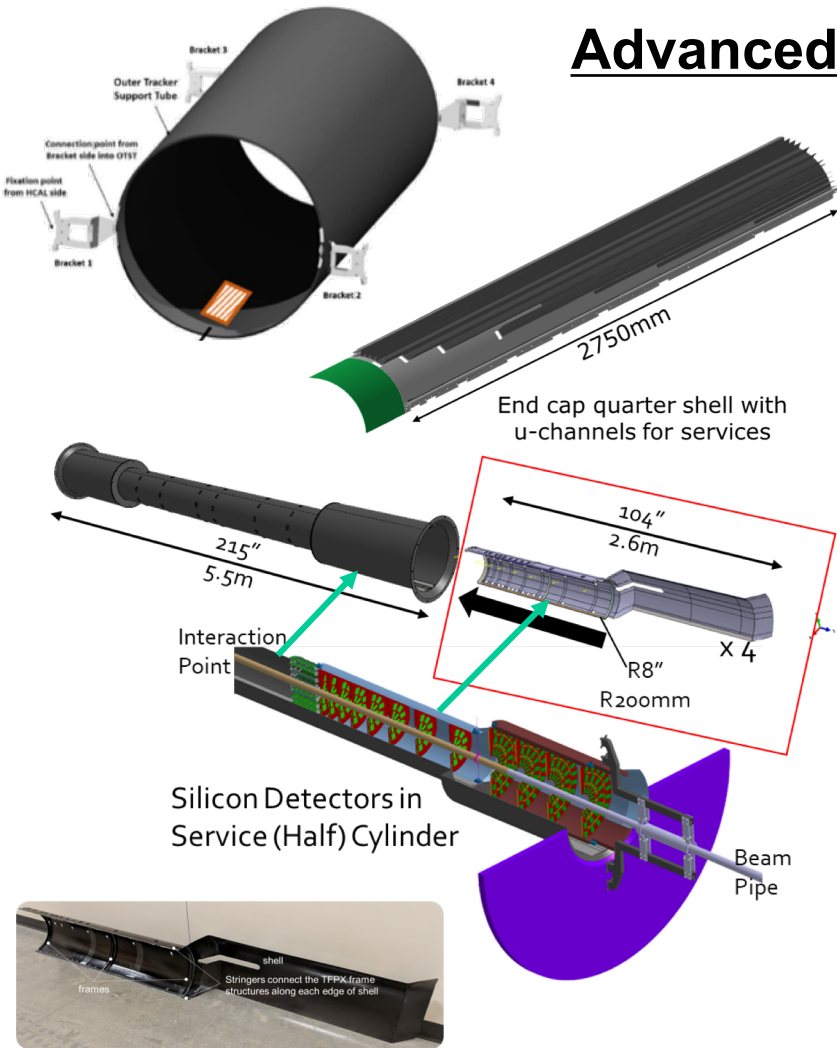
## Carbon Fiber: Gold-standard and versatile material

- Not just structural aspects, continuous carbon fibers mono-filaments can also be used for “drift chamber” wires and reduce mass
- Holistic approach for services, structures and cooling choices
- Applicable also to calorimetry, TOF, other systems



- Can improve b-ID efficiencies by ~2% per b-jet and high b-jet multiplicity ~10%
- Significant improvement by novel approach, b-ID relevant for top & Higgs physics

## Advanced Mechanics & Composites activities at Purdue



### Large Support Structures – light-weight but rigid

1. BTL Tracker Support Tube (CMS)
2. Inner Tracker Support Tube (CMS)
3. Inner Tracker Service Cylinder (CMS)
4. End Cap Quarter-Shells (ATLAS)

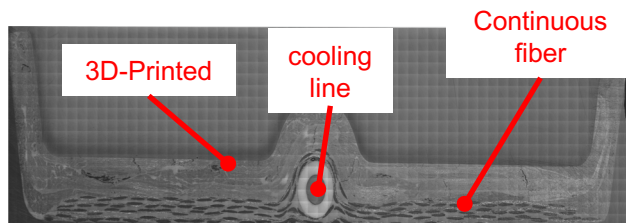
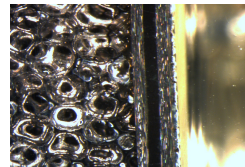
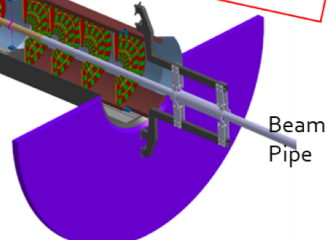
### Small Structures – extremely flat and thin

1. Pixel Dees Support Structure (CMS)
2. High-TC flat sheets for silicon modules (CMS)

### Irradiation campaigns:

- In collaboration with US TFPX institutes (Cornell, Rice, others)

Silicon Detectors in Service (Half) Cylinder



### **Future Mechanics and R&D:**

1. “BlueSky Mechanics” for detectors at future Colliders (FCC, muon, LC, etc.) <https://arxiv.org/abs/2203.14347>
2. “CalVision” project for mechanics of dual readout calorimetry <https://arxiv.org/abs/2203.04312>

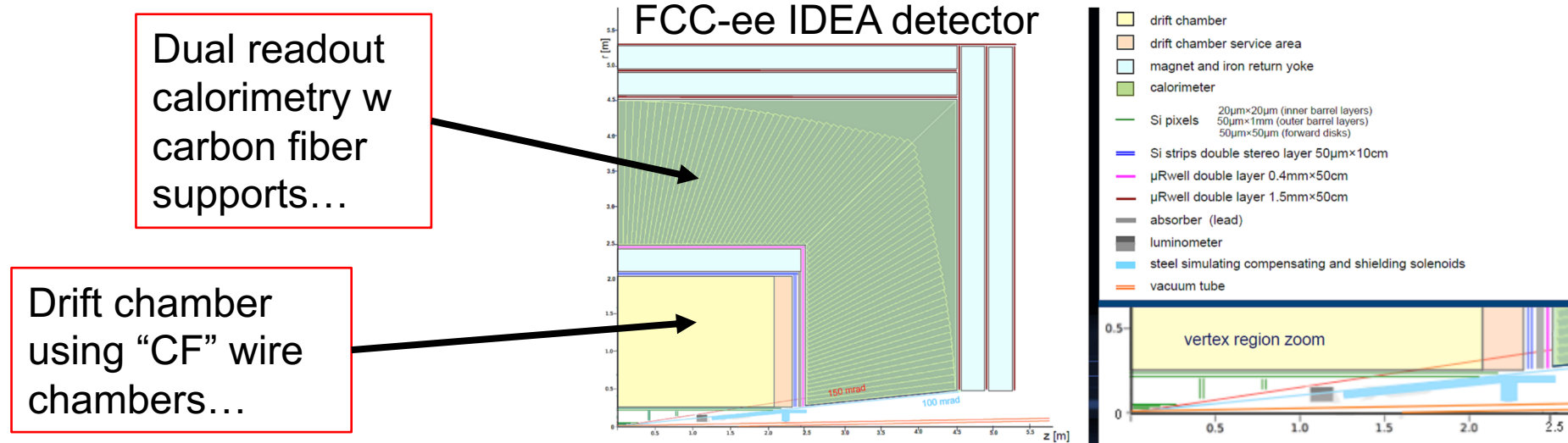


Figure 6: Cross section of the proposed layout for the IDEA detector concept.

- Example of "large detector" but detector mechanics / services / cooling play a significant role in a detector's performance
- **Highly relevant also to small experiments**

Exchange of ideas & progress across existing collaborations:

- "CPAD RDC 10": R&D Collaboration for "Detector Mechanics R&D"
- 9 others, so covers also your favorite topic's
- Bridges nuclear, high energy physics but space applications / satellites too – broad field!

<https://cpad-dpf.org>



Detector mechanics / services / cooling play a significant role in a detector's performance and are applicable to:

- HL-LHC, future large colliders but also small scale experiments (!)
- Are we harvesting all physics and performance out of great instruments to unravel mysteries of nature ?

→ **Asking for a strong support for detector R&D in general**

- Excellent workforce education opportunities
- Need for clear deliverables, i.e. “demonstrators” for small and large scale experiments

Personal comments:

- Community building in the US around CPAD and Snowmass
- Interdisciplinary R&D can realize additional synergistic activities
- Carbon Fiber is a “driver” into more sustainable future in general
- Mechanics, ML/AI optimization for manufacturing are exciting topics to UG students: physicists, engineering, material science