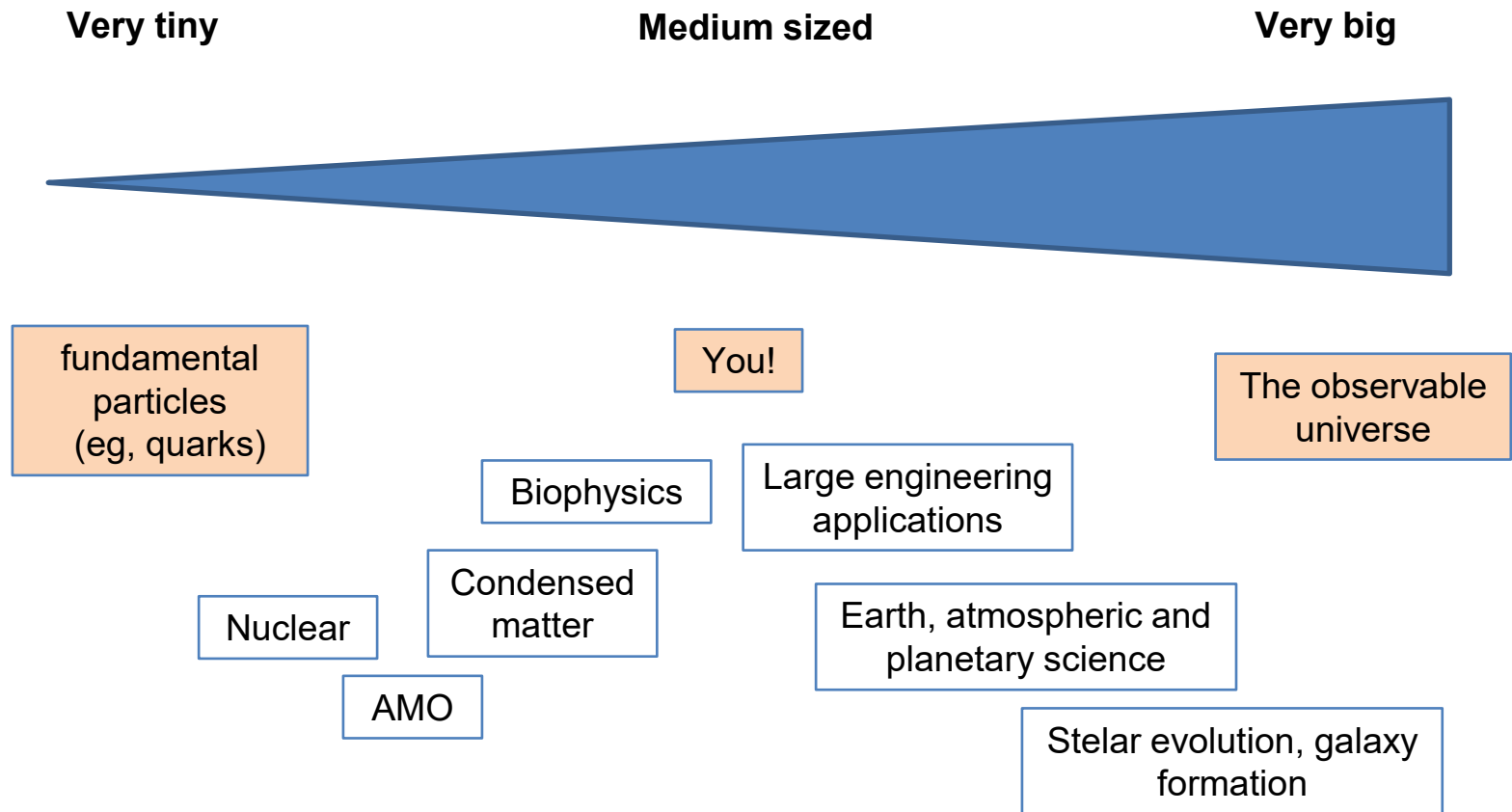


Particle Physics Research at Purdue

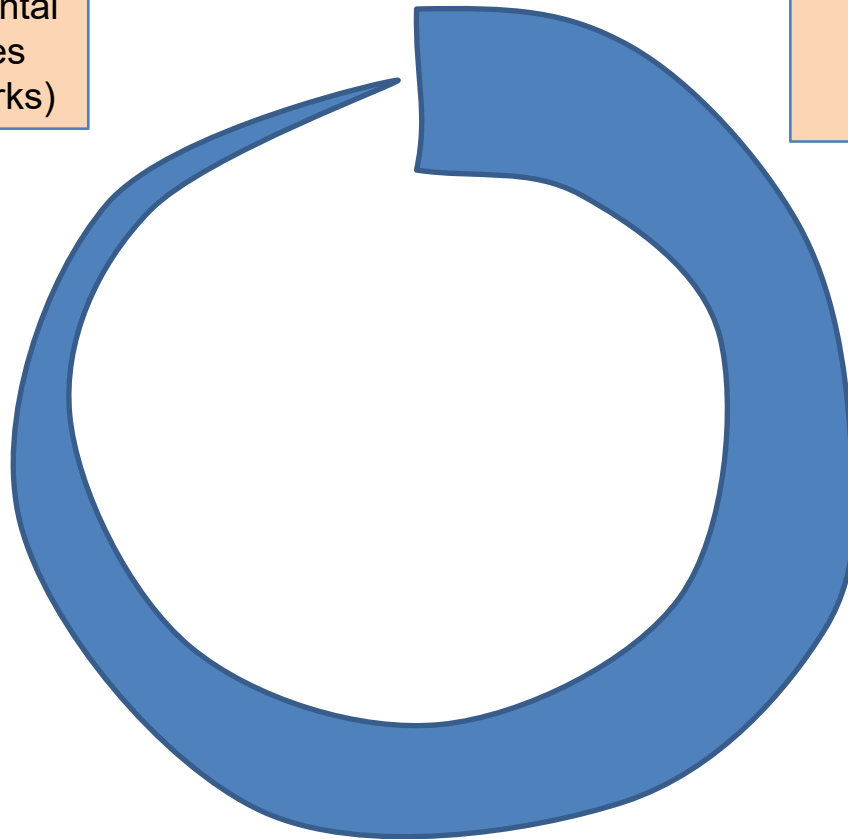
Sub-disciplines of Physics



It Turns Out That...

fundamental
particles
(eg, quarks)

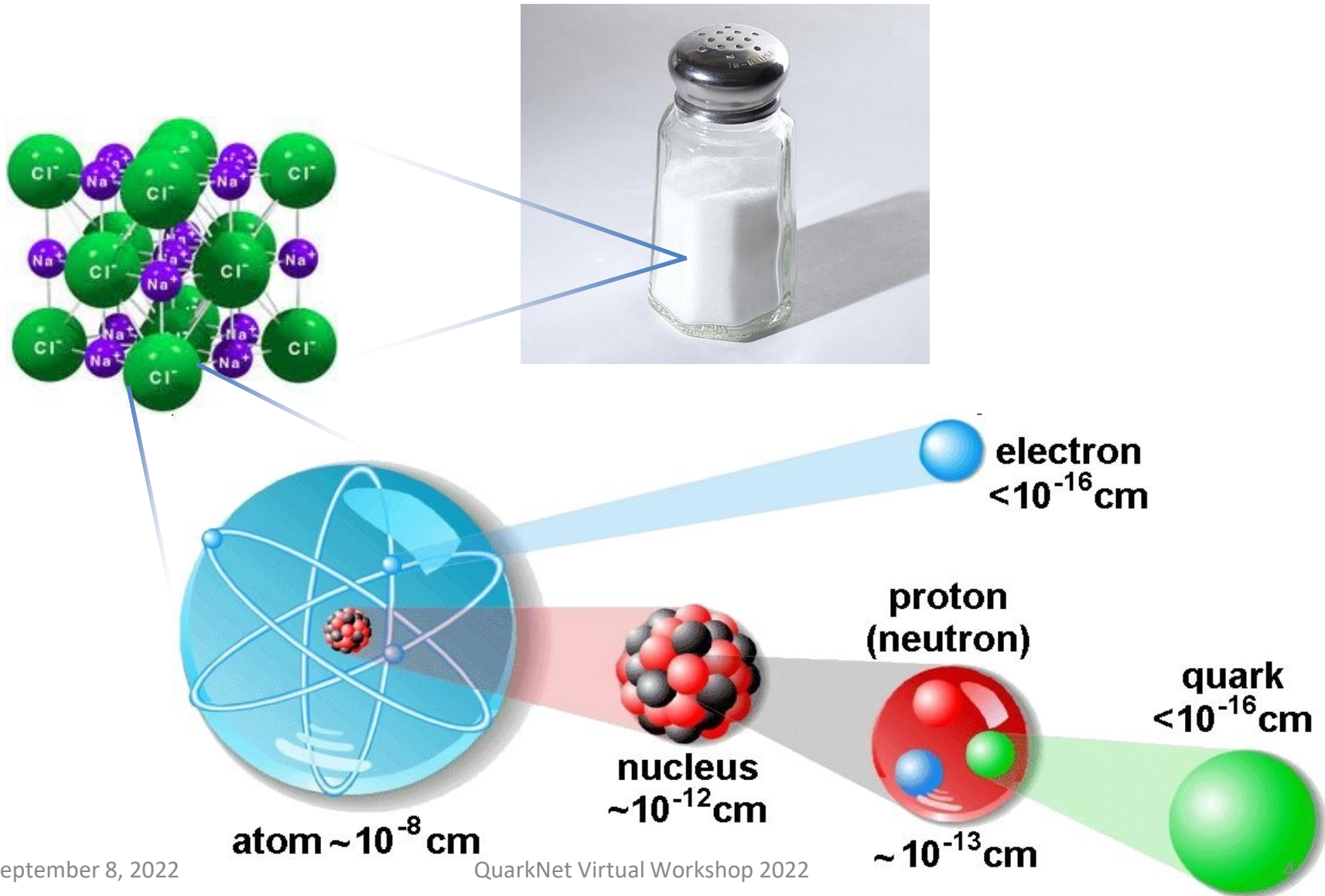
The observable
universe



you

An understanding of
fundamental particle
physics is essential
for explaining the
structure and
evolution of the
universe.

What is everything made of?



Big Questions

- Is there substructure? Are there new particles we can discover?
- What is dark matter? Can we make it in the lab?
- Why is the top quark so heavy? Why are neutrinos so light?
- What is the structure of spacetime? Are there extra dimensions?
- We know the standard model is incomplete. What else is there?

Answering Big Questions



**Fermi National Accelerator
Laboratory (FNAL)**
(Near Chicago, IL)



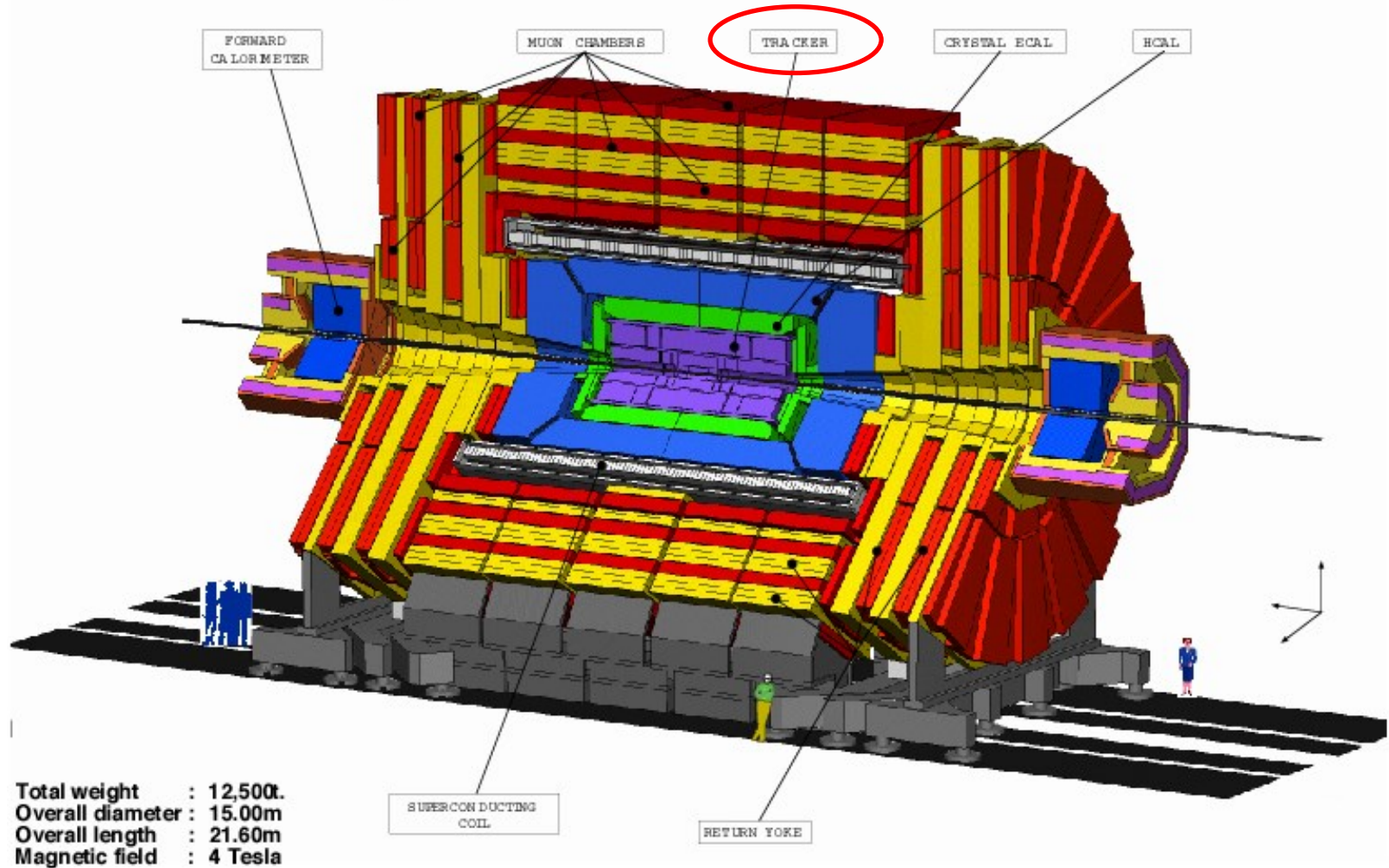
**Conseil Européen pour la Recherche
Nucléaire (CERN)**
(Near Geneva, Switzerland)

The Large Hadron Collider

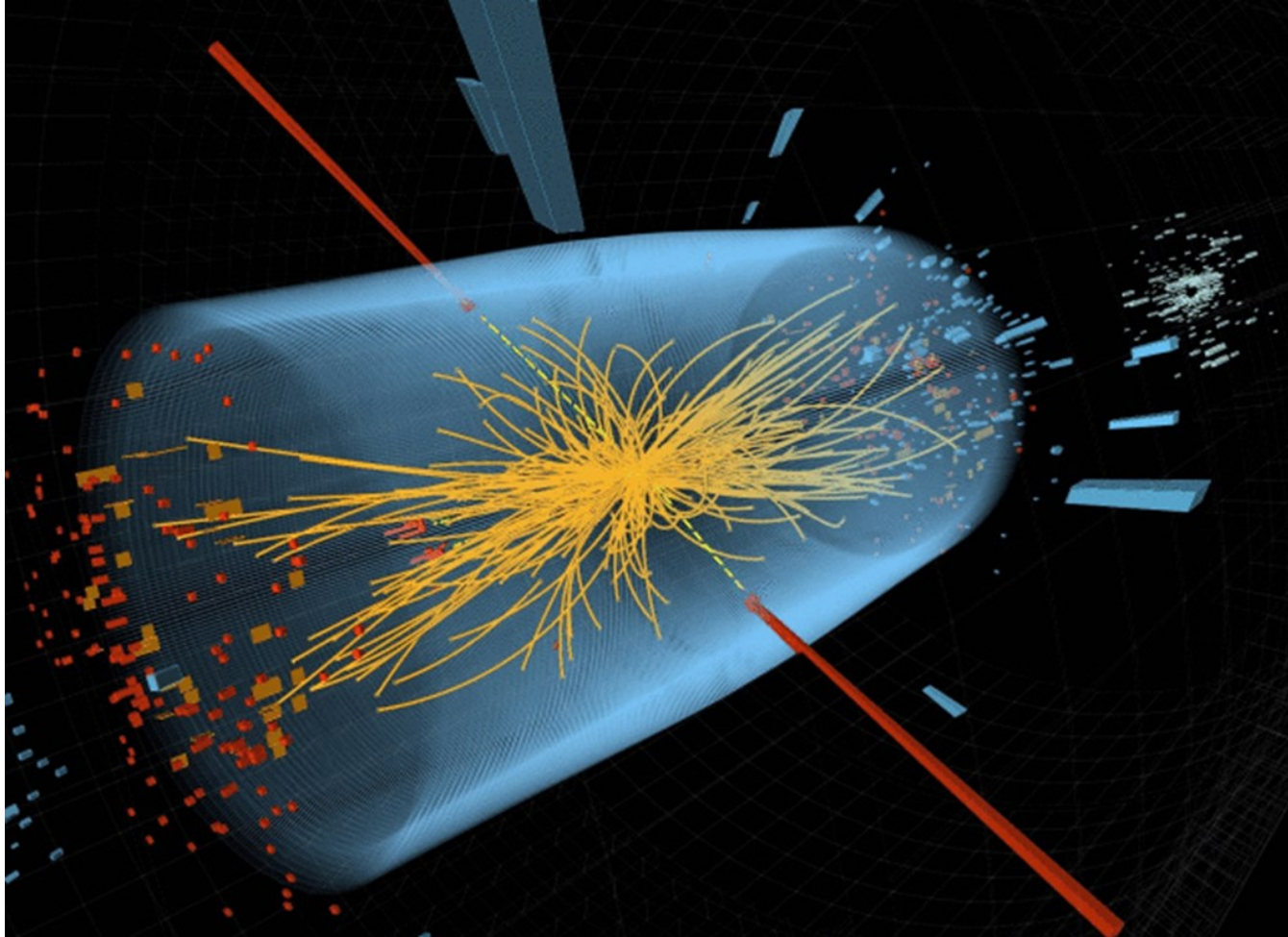


The CMS Experiment

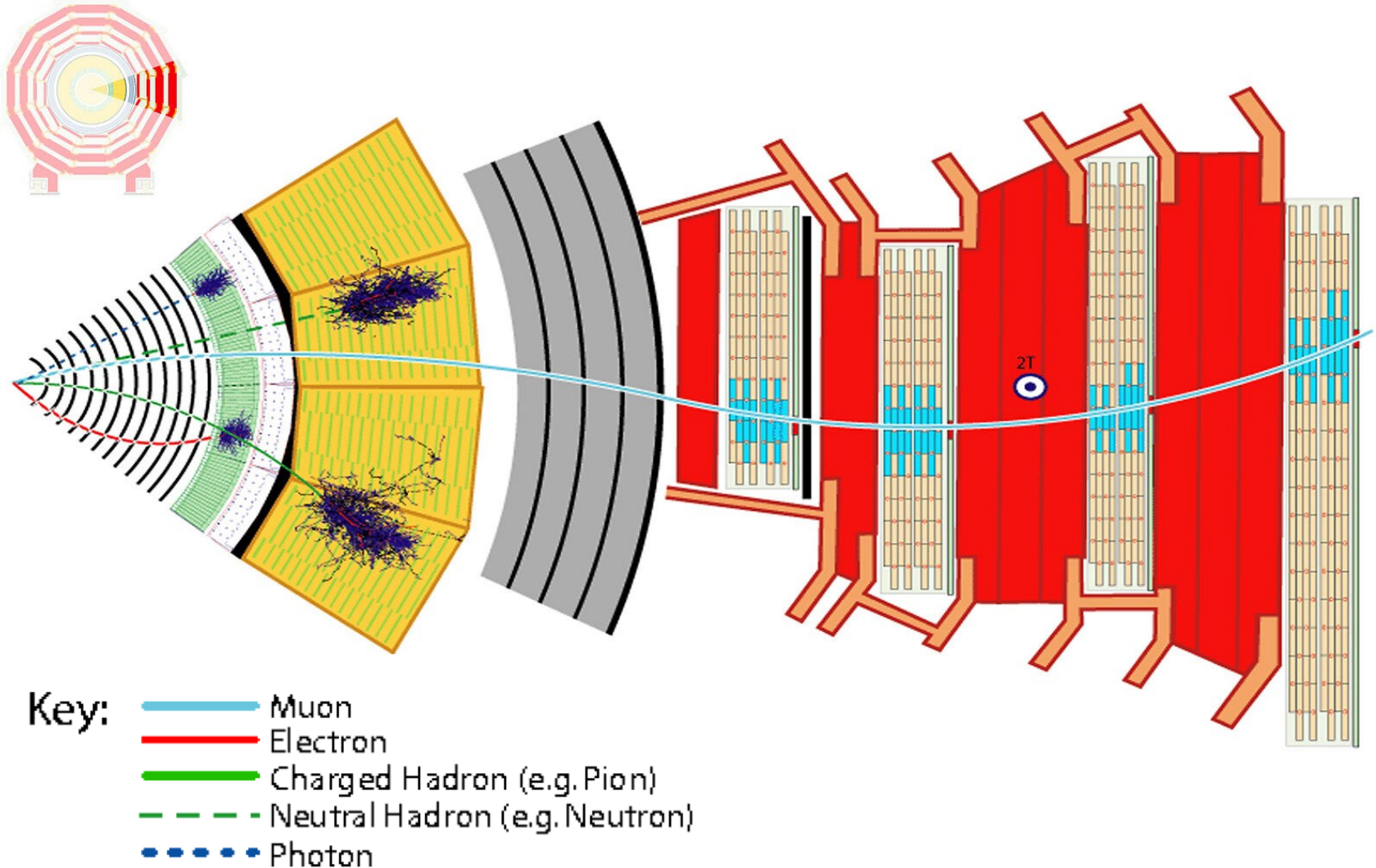
A Compact Solenoidal Detector for LHC



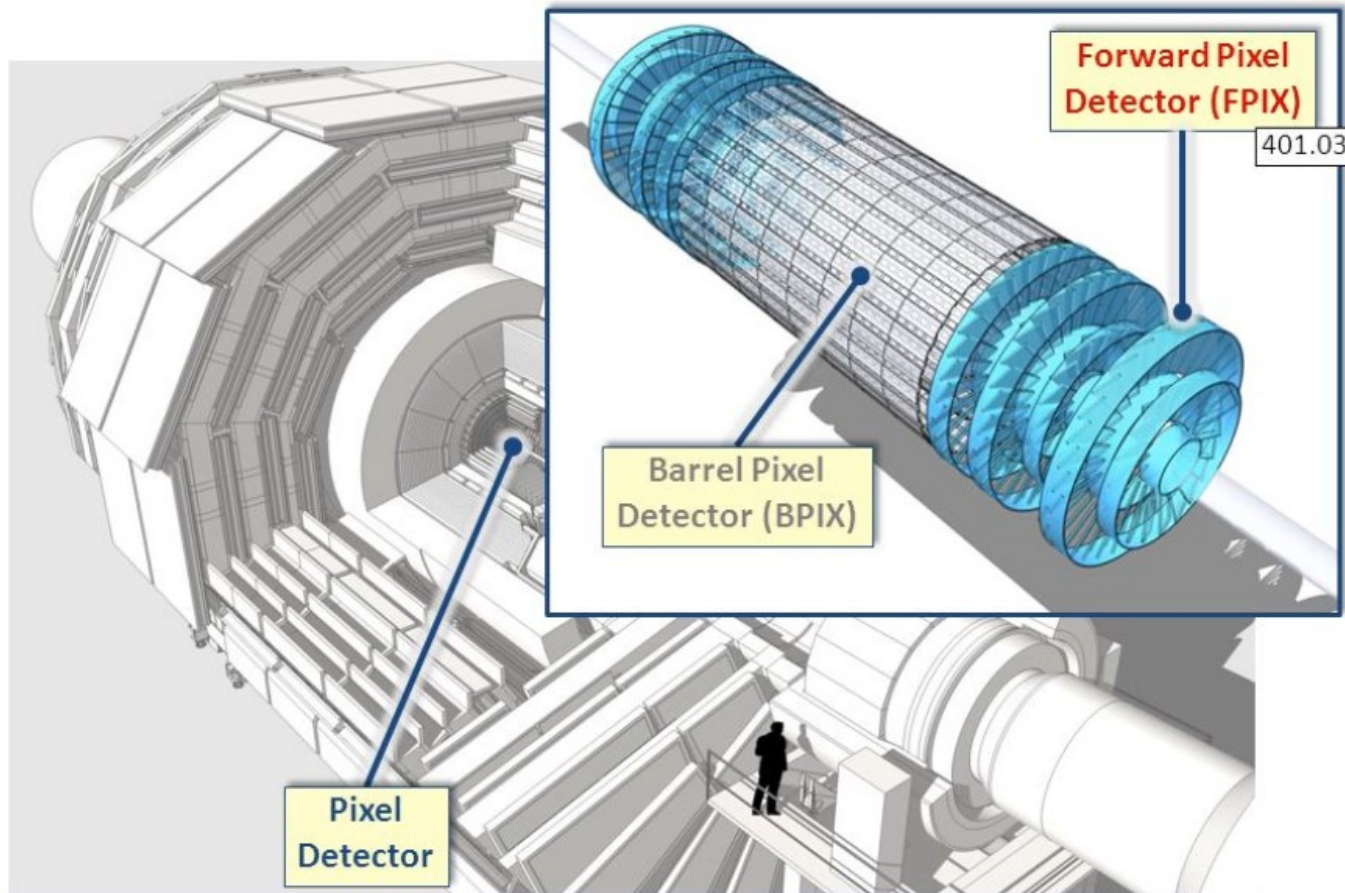
CMS Data



Tracks in CMS



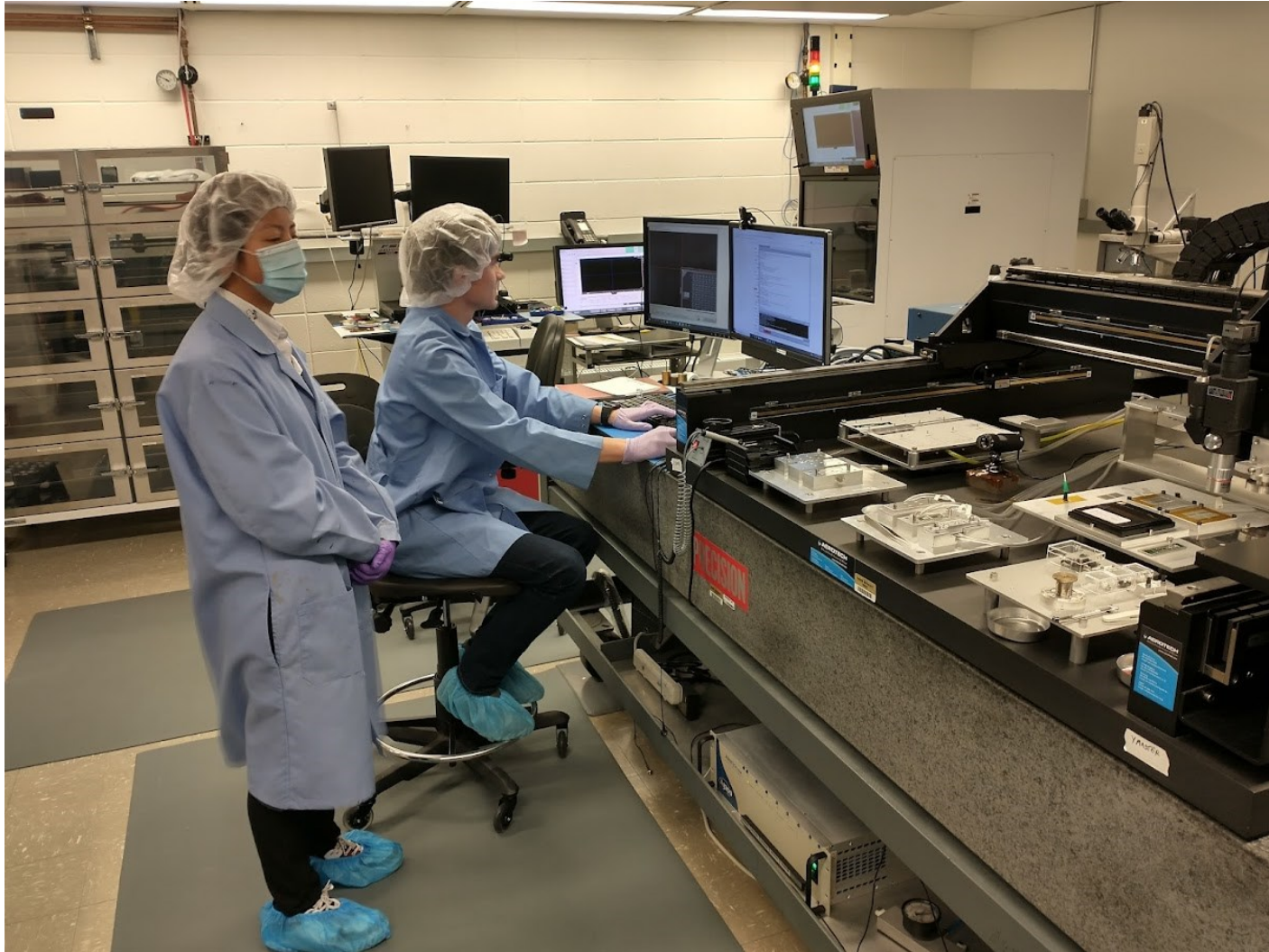
The CMS Pixel Detector



CMS Pixel Detector

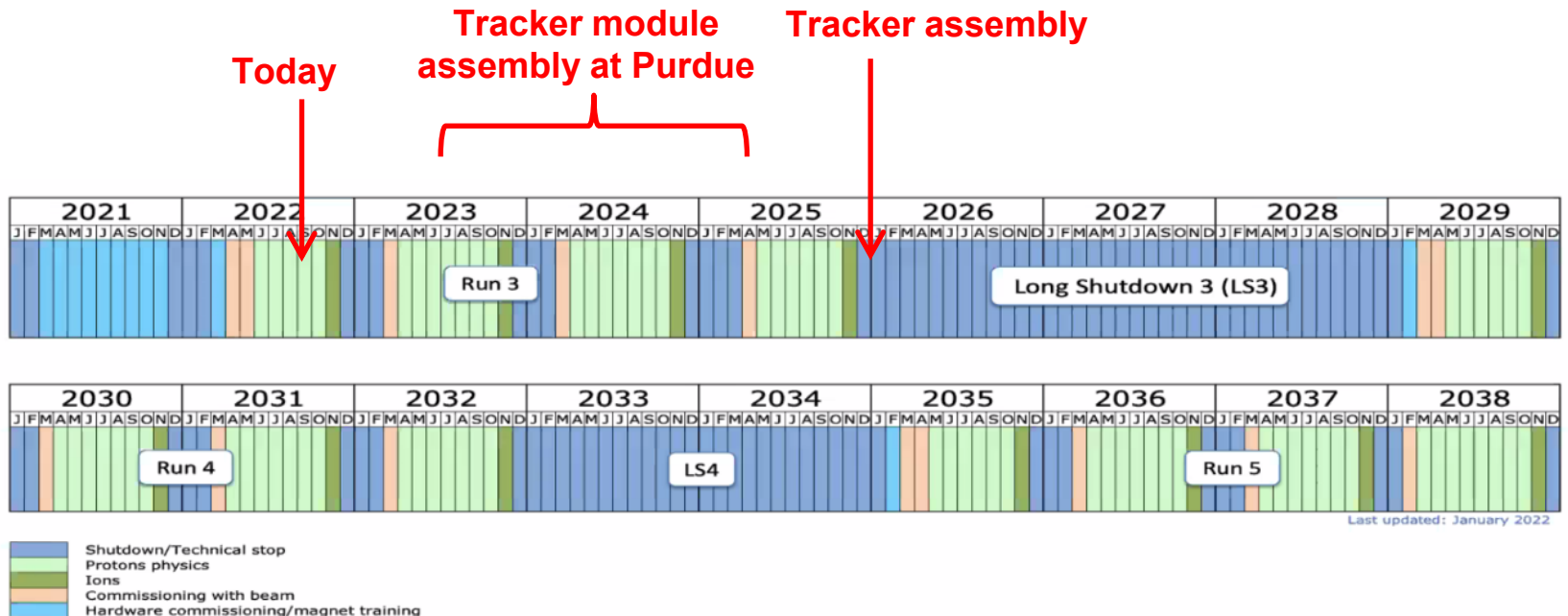
- Purdue is part of an international effort to replace the pixel detector to prepare for the High Luminosity LHC
 - Smaller pixels
 - Must survive 10x the amount of radiation
 - Larger internal memory to store events
 - Larger area covered by active sensors
 - More efficient power distribution

Pixel Detector Upgrade at Purdue



The CMS Experiment

- Run 3 has started! Opportunity to analyze the largest dataset ever over the next 3 years.
- Upgrades are being constructed to prepare for run 4. Opportunities for lots of hardware experience.



Summary

- Particle physicists seek answers to fundamental questions using experiments like CMS
- One key piece of recorded data are the reconstructed tracks
- Purdue has an important role in upgrades to the tracking detector
- Work ongoing through 2024 followed by installation and commissioning