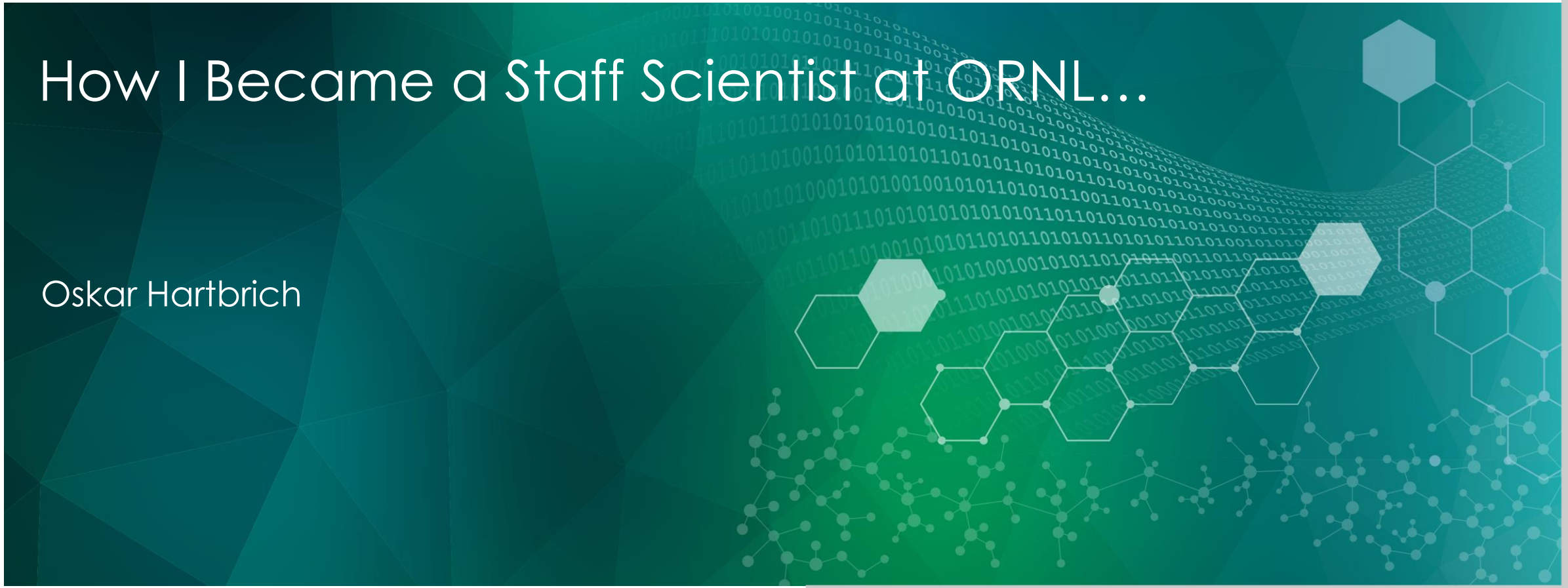
OAK RIDGE National Laboratory

How I Became a Staff Scientist at ORNL…

Oskar Hartbrich



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U.S. DEPARTMENT OF ENERGY

From Undergrad to PhD

- BSc. Physics + computer science at Uni Wuppertal, Germany
  - My hometown, very imaginative
  - Planned to go towards computer science at first..
  - Then planned to do solid state physics, but randomly ended up in a particle physics lecture. Then learned Wuppertal has a great HEP program.
- MSc. Particle Physics, still at Wuppertal, largely working at DESY
- PhD at DESY Hamburg (Germany)
  - still technically Wuppertal…
  - Working on high granularity calorimeters for ILC
- What to do next?
  - I was interested in "cool" instrumentation and detectors
  - Belle II startup was on the horizon…

Postdoc at University of Hawaii

- 2016-2021: Postdoc at UH with Gary Varner and Tom Browder
  - Primarily working on TOP detector and its readout electronics
- My dream was to be part of the startup of a new experiment
  - I was in the control room for first collisions of Phase 2
  - I pressed "START" (and a lot of SALS…) for first collisions of Phase 3
- Got to work on cutting-edge detectors and instrumentation
  - Even proposed a new one for a Belle II upgrade: STOPGAP

The Way Forward…

- You do not want to stay a postdoc forever.
  - Become an assistant professor at a University
  - Become a national lab staff scientist
  - Become a consultant, data scientist, software engineer, entrepreneur (…) in the "real world"
    - "Industry" loves physicists!
    - "Industry" does not value your knowledge of physics, but the skills you picked up on the way!
    - "Industry" rarely advertises positions for physicists, but they will almost always consider one!
- My plan: go big or go home.
  - I applied to get funding to start my own research group in Germany
    - (I was laughed out of the room)
  - I was ready and happy to leave academia
- Tom convinced me to try for some National Lab positions
  - … and he might have made some phone calls as well
  - I ended up at Oak Ridge National Lab and could not turn down that opportunity

National Labs

- Pros:
  - Huge, Big infrastructure
  - Big opportunities for funding, initiating big projects
  - (Pays better than Uni Hawaii did)
- Con:
  - Bureaucracy (Time sheets! Travel application forms!)
  - Constant pressure to procure more funding
  - Less “freedom” (Tom: “corporate science for hire”)
  - Takes a while to get used to structures and getting to know the right people
    - After two years at ORNL, I start to feel like I know a few folks there…

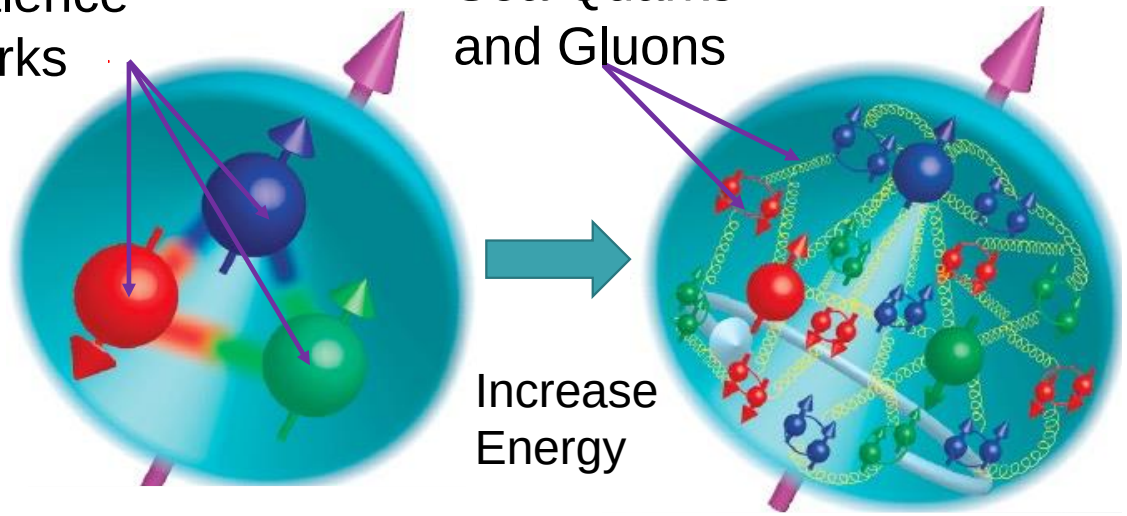
Me at ORNL

- Now permanent(*) staff scientist at Oak Ridge National Lab
- Working in Relativistic Nuclear Physics Group
  - Nuclear Physics with accelerators: ALICE@LHC, sPHENIX@RHIC, ePIC@EIC, (CMS@LHC)
  - Not High Energy Physics, completely different community, same technologies
- Strongly involved in building various detectors for upcoming ePIC detector:
  - Forward hadron calorimetry (back to my PhD roots!)
  - TOF particle ID system (almost like STOPGAP, but bigger! AC-LGADs!)
  - Also became deputy technical coordinator of the ePIC experiment

The Structure of the Proton

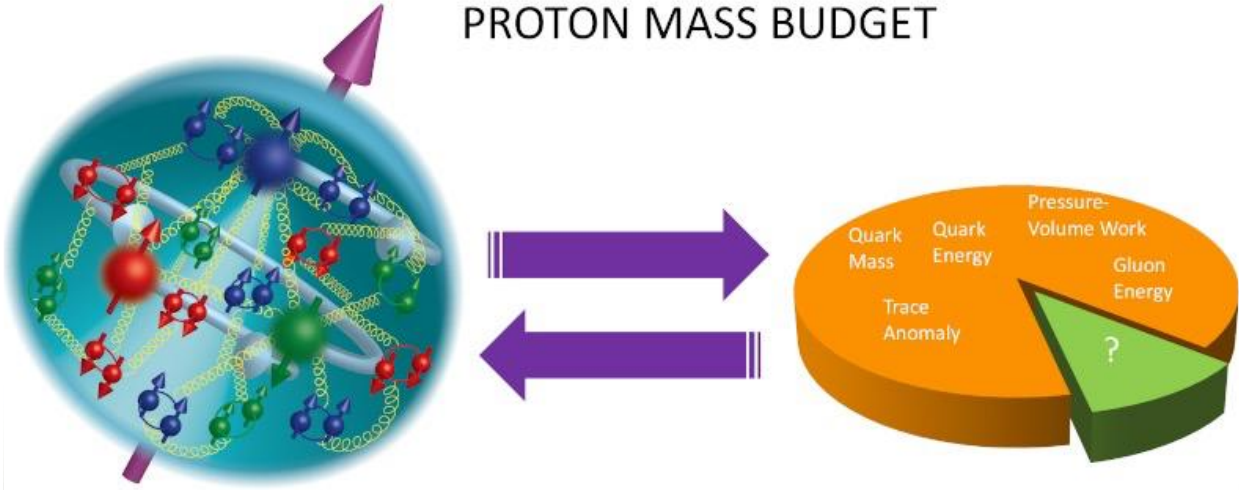
3 Valence Quarks

Sea Quarks and Gluons



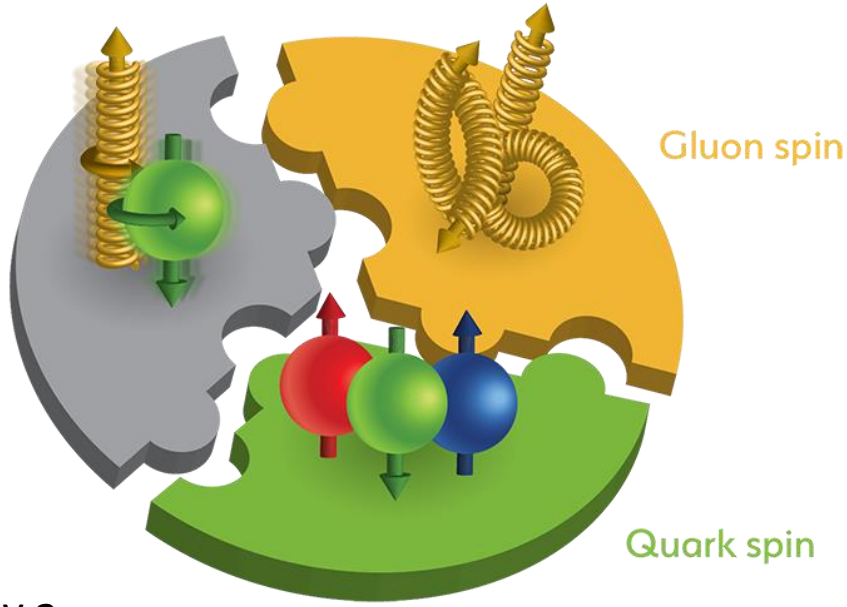
Increase Energy

PROTON MASS BUDGET



Only 20-30% of the proton spin comes from the valence quarks!

Quark and gluon internal motion



Mass is driven by a complicated sum of various QCD interactions!

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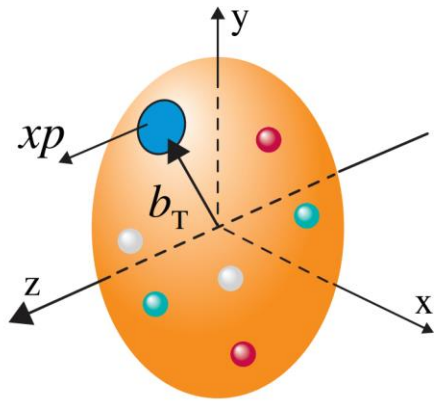
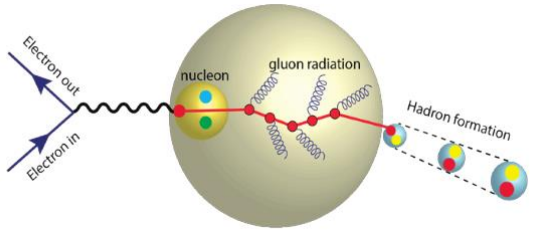
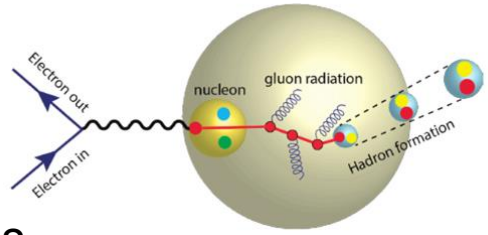
The Collaboration Pursues the Science

- How do the nucleon properties like mass and spin emerge from quarks and their interactions?

- How are the sea quarks and gluons distributed in space and momentum inside the nucleon? How is spin dynamically generated?







- In what manner do color-charged quarks and gluons, along with colorless jets, interact with the nuclear medium? And how do the confined hadronic states emerge from these quarks and gluons?

- What impact does a high-density nuclear environment have on the interactions, correlations, and behaviors of quarks and gluons?

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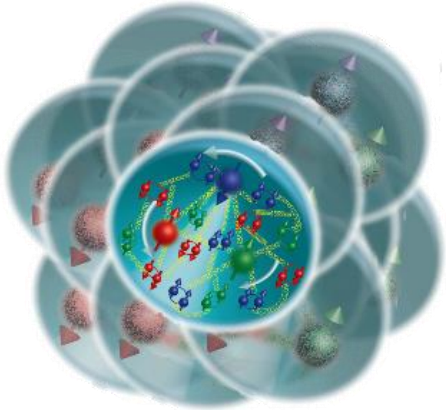
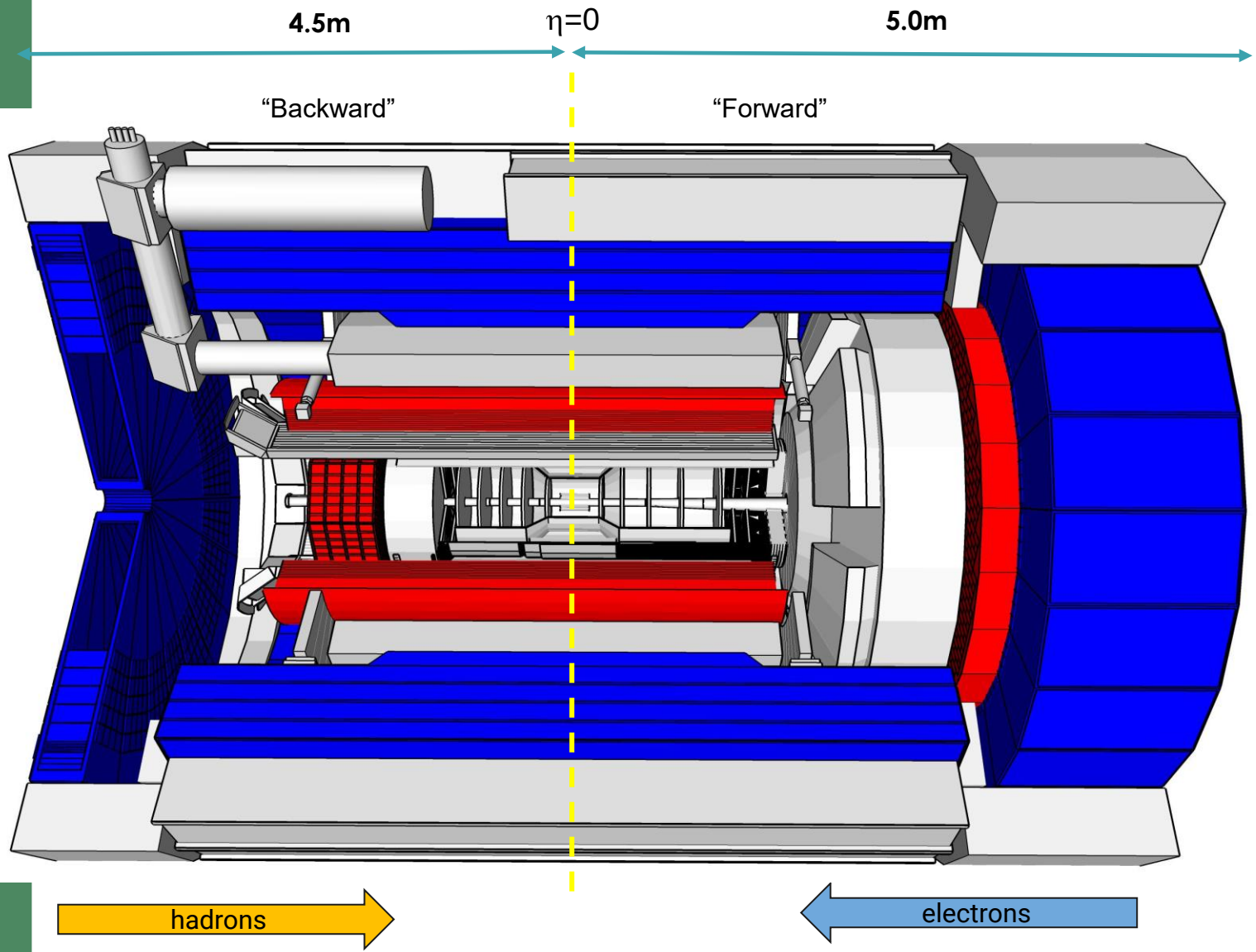
- What is the mechanism through which quark-gluon interactions give rise to nuclear binding?



- Is there a saturation point for the density of gluons in nuclei at high energies, and does this lead to the formation of gluonic matter with universal properties across all nuclei, including the proton?

ePIC Detector Design



Tracking:

- New 1.7T (2.0T) solenoid
- Si MAPS Tracker
- MPGDs (μRWELL/μMegas)

PID:

- high-performance DIRC
- proximity-focused RICH
- dual-radiator RICH
- AC-LGAD (~30ps TOF)

Calorimetry:

- Imaging Barrel EMCal
- PbWO4 EMCal (backwards)
- Finely segmented EMCal +Hcal in forward direction
- Outer HCal (sPHENIX re-use)
- Backwards HCal (tail-catcher)

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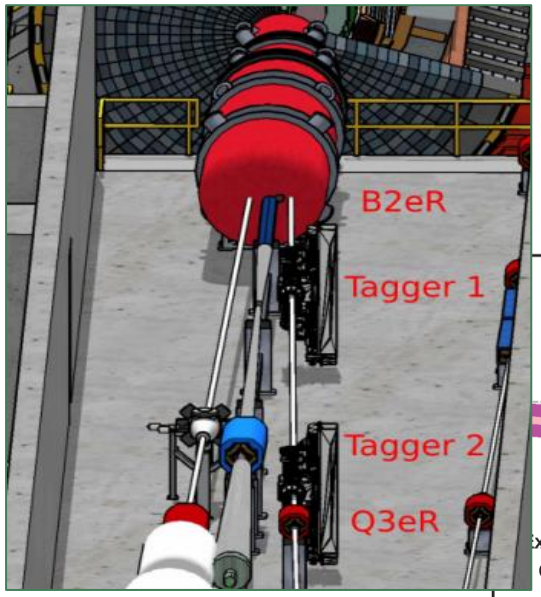
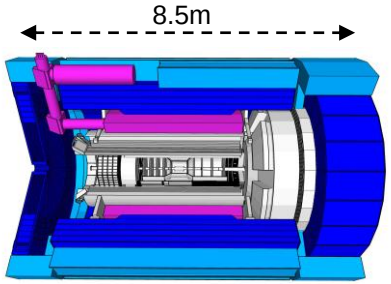
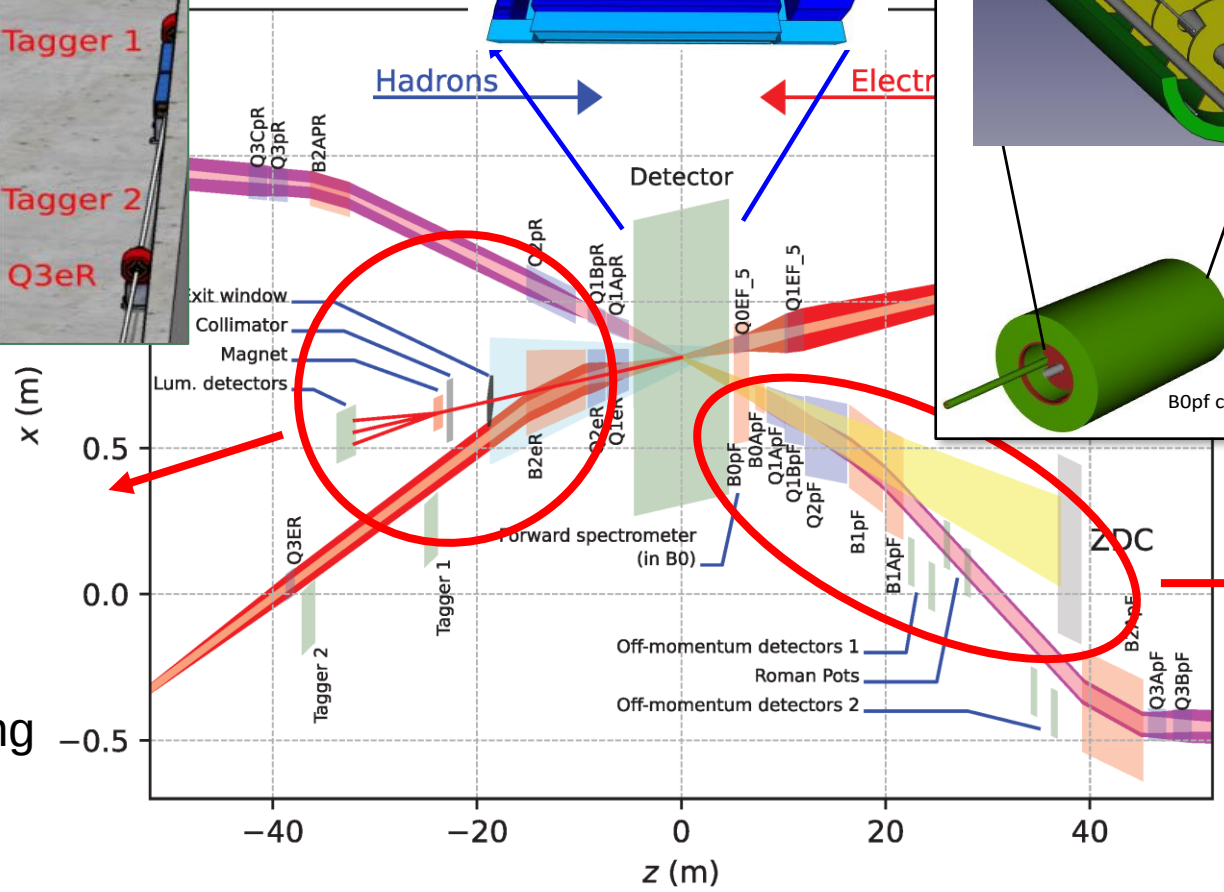
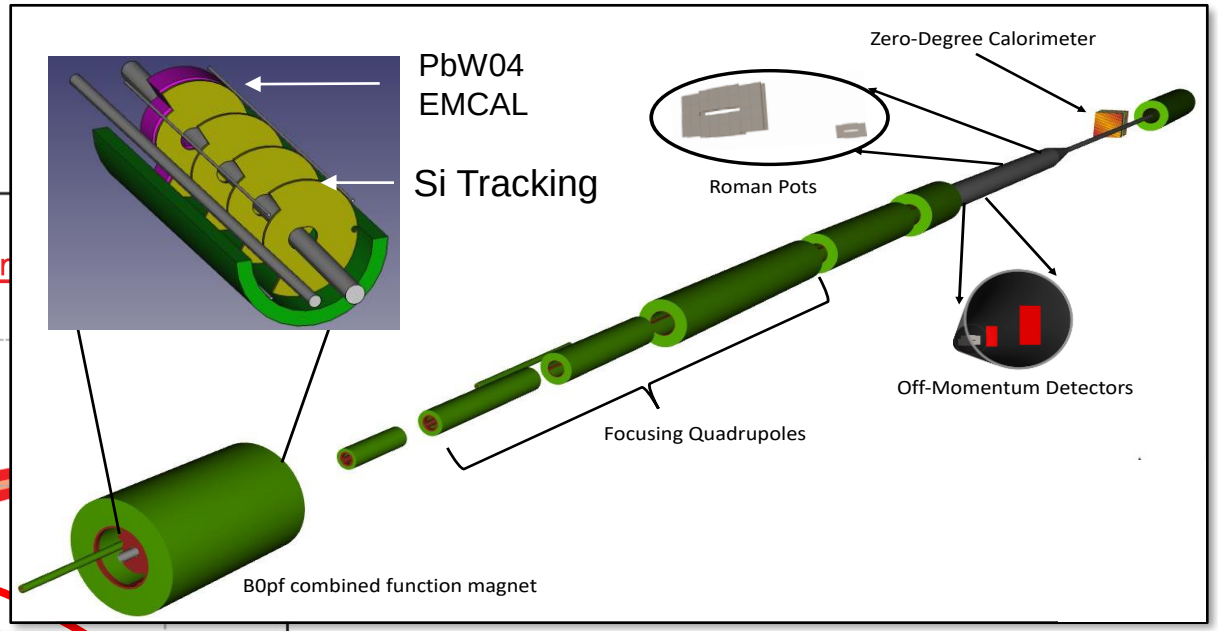
Far-Forward and Far-Backward Detectors









Far-Backward Detectors

- Luminosity monitor
- Low-Q^2 Tagging Detectors

Far-Forward Detectors

- B0 Tracking and Photon Detection
- Roman Pots and Off-Momentum Detectors
- Zero-Degree Calorimeter

CPAD 2024 in Knoxville, TN

- November 19-22 2024
- Hosted by ORNL & UTK
  - Tova Holmes, Lawrence Lee (UTK)
  - Mathieu Benoit, Friederike Bock, Marcel Demarteau, OH (ORNL)
- Join the workshop, stay for a visit to the Great Smoky Mountains!
- https://indico.phy.ornl.gov/event/510/