Discovery through Complementarity

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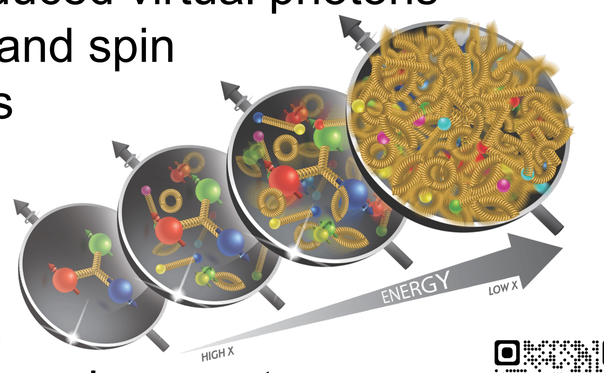
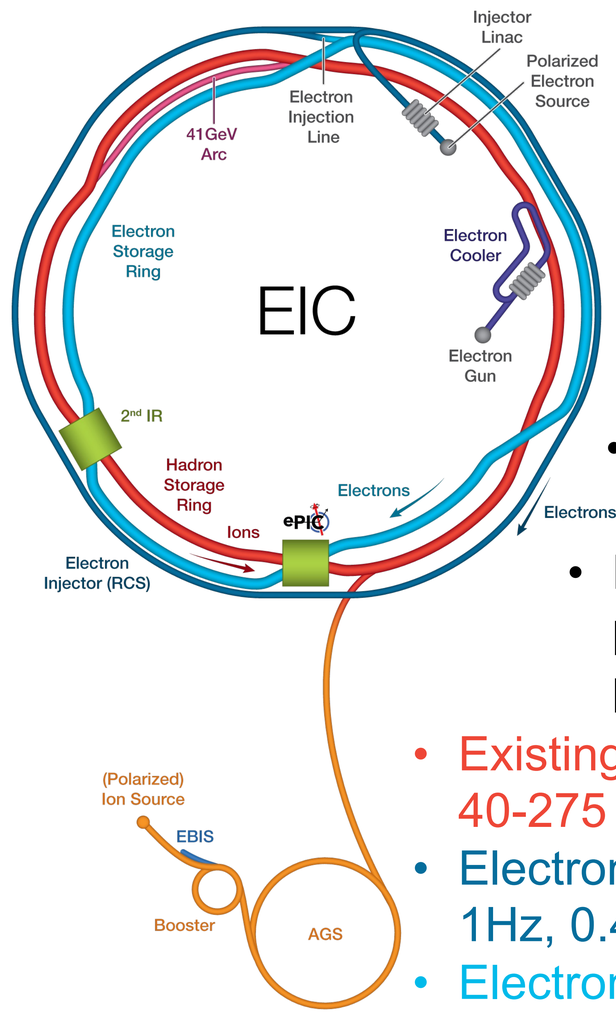
1. The Electron-Ion Collider Experiments

The **finest microscope** to look inside the nucleons using electromagnetic-induced virtual photons

1. Origin of proton mass and spin
2. Sea quarks and gluons distributions in spatial and momentum space
3. Gluon saturation?
4. Hadronization process
5. QCD at dense nuclear environment
6. Physics beyond standard model

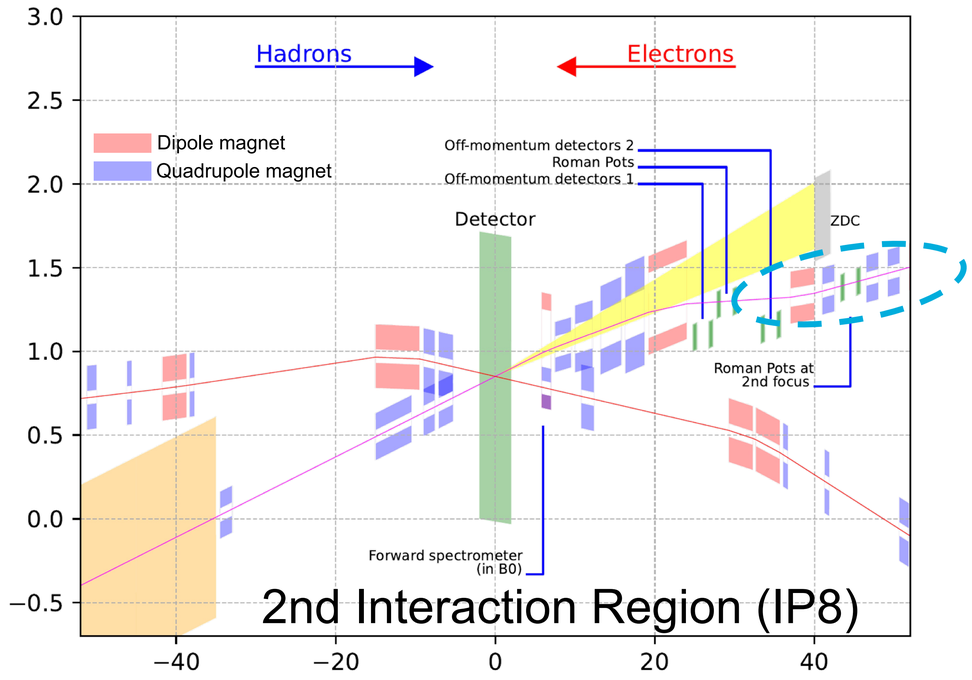


2. The Accelerator



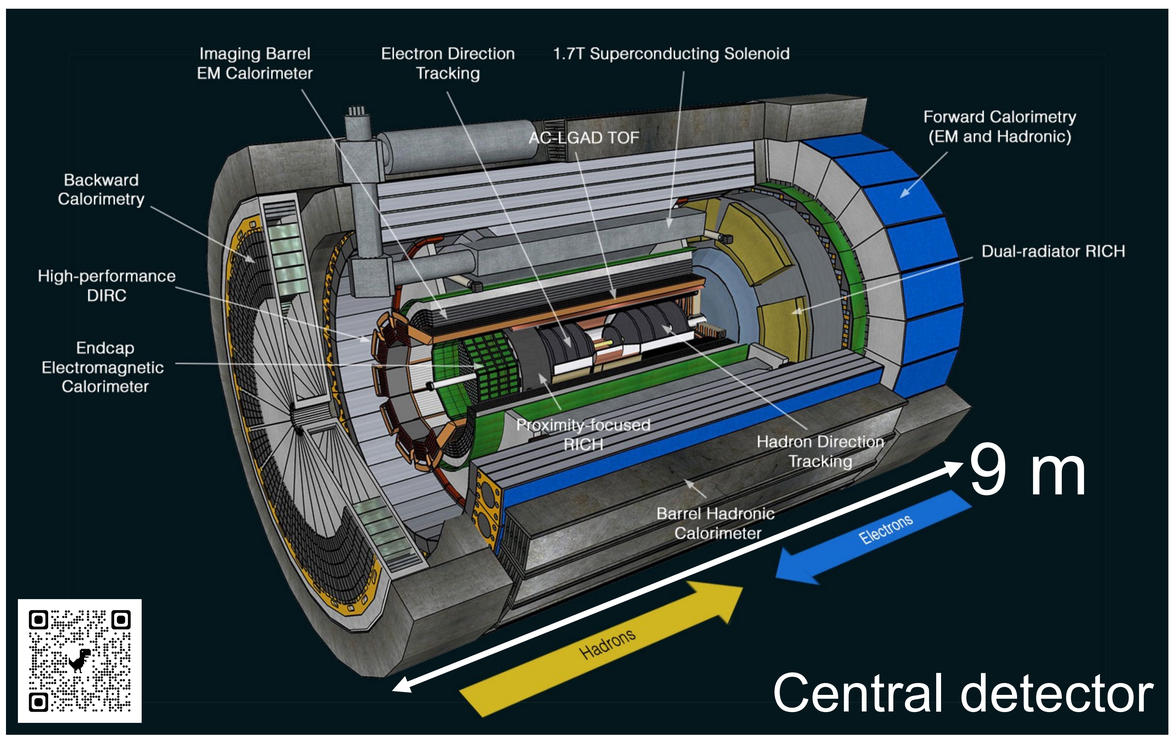
- High luminosity 10^{33} – 10^{34} $cm^{-2}s^{-1}$
- Variety of nuclear beams: d to Pb
- Wide center-of-mass energy ranging 20-140 GeV
- High number of bunches 1160,10ns separation
- First collider that provides polarized electron and proton beams
- Existing hadron storage ring 40-275 GeV
- Electron rapid cycling synchrotron 1Hz, 0.4-18 GeV
- Electron storage ring 2.5-18 GeV

3. The Interaction Regions



- 25 mrad (35 mrad) crossing angle at IP6 (IP8) → reduce synchrotron radiation background
- Crab crossing → restore head-on collision
- **2nd beam focusing lattice at IP8** → Improve low p_T (~0 GeV) acceptance at far-forward roman pots

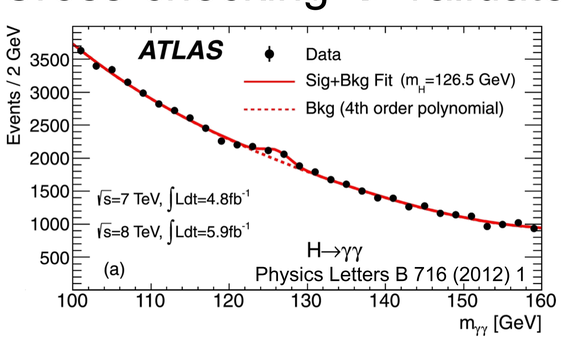
4. The ePIC Detector

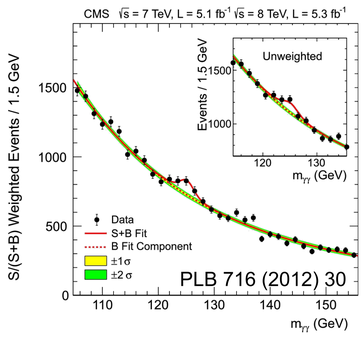


- **16 subdetectors** in the central region
- **Far-forward and far-backward** detectors for ion fragments and scattered electron measurements
- Using **machine learning** techniques on track reconstruction, and particle identification
- 171 institutions from 24 countries and counting

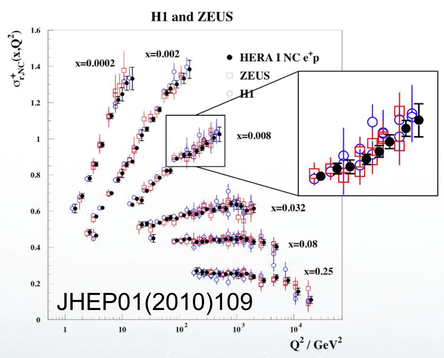
5. The Complementarity of a Second Detector

- Cross-checking → validate discoveries





- Cross Calibration → improve uncertainty
- Different physics focuses
- Technology Redundancy → mitigate risks
- Potential detector technologies
  - Muon Identification vs electromagnetic calorimeter
  - Wired/gas tracker vs silicon tracker



4. Join Us

- Science Undergraduate Laboratory Internship (SULI)
  10-week/semester-long internship at the national lab
- Work with us on physics/detector simulations and detector R&D

Electron-Ion Collider

Brookhaven National Laboratory · Jefferson Lab · U.S. DEPARTMENT OF ENERGY | Office of Science