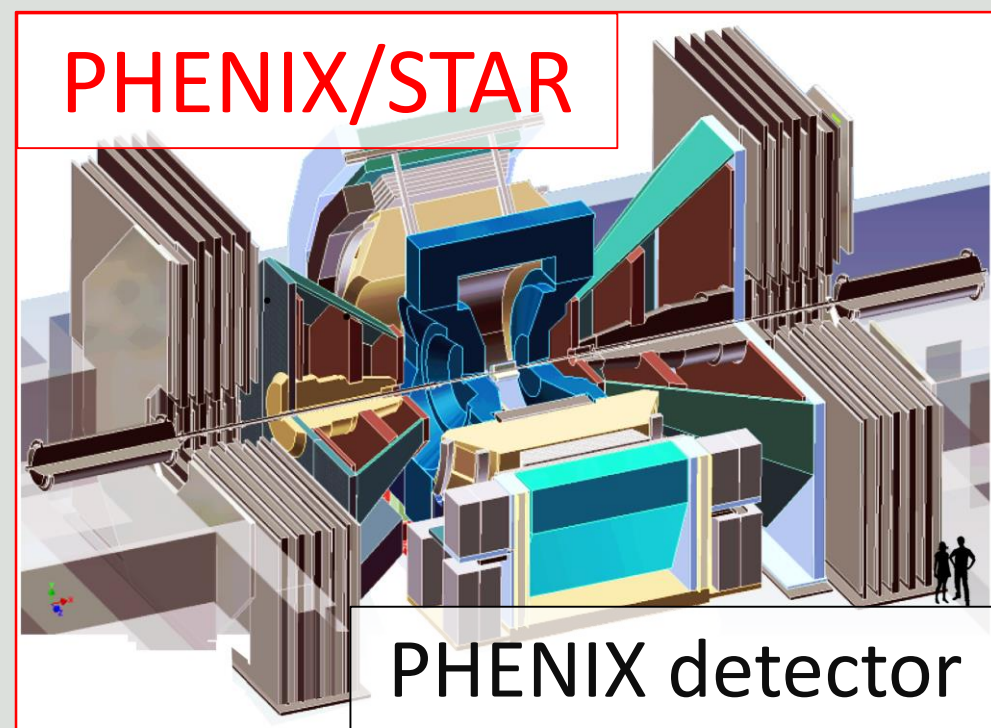




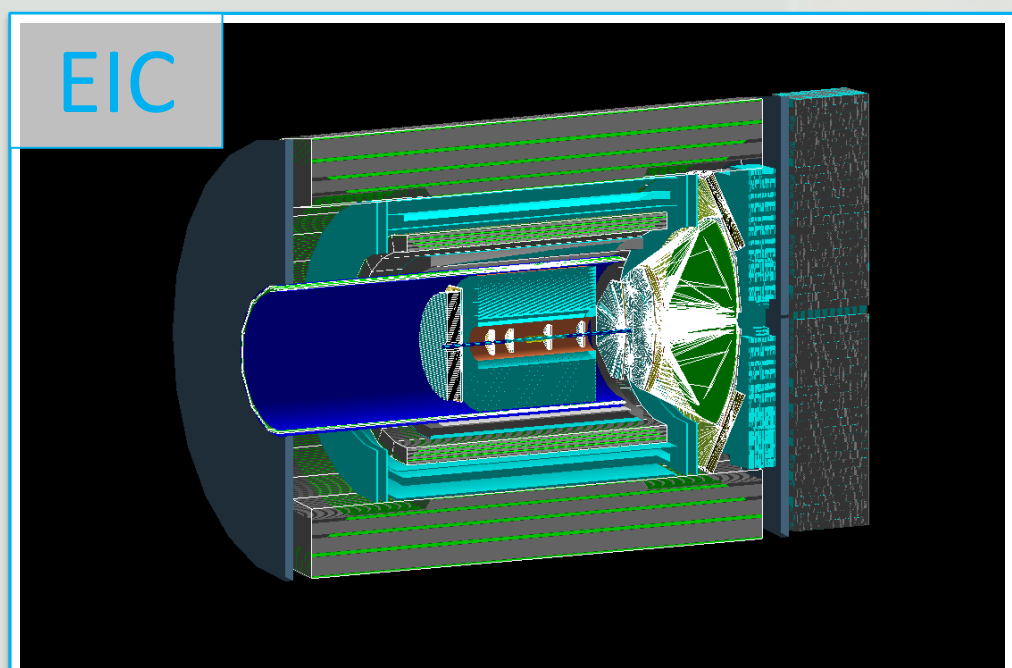
Studying Proton Structure, the Partonic Structure of Nuclei, and Hadronization at sPHENIX

Chong Kim, for the sPHENIX Collaboration

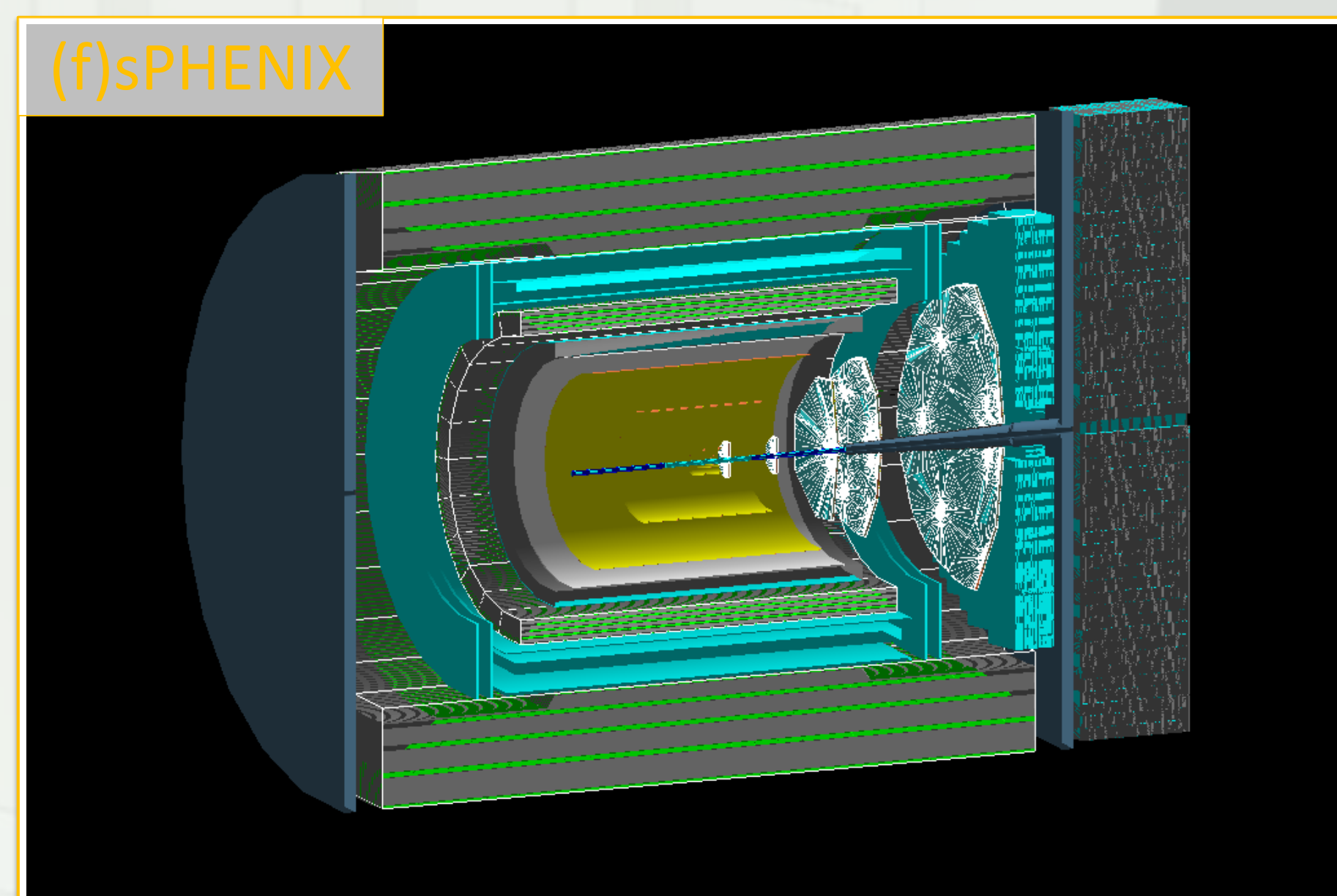
The sPHENIX: a bridge connects RHIC and future EIC



- PHENIX: 2000 - 2016 (finished)
- STAR: 2000 - 2020
- p+p, p+A, and A+A with max. $\sqrt{s} = 510, 200, \text{ and } 200 \text{ (GeV)}$
- Longitudinally or Transversely polarized protons
- Last $p^\uparrow + p$ @ $\sqrt{s} = 510$ in 2017 in STAR



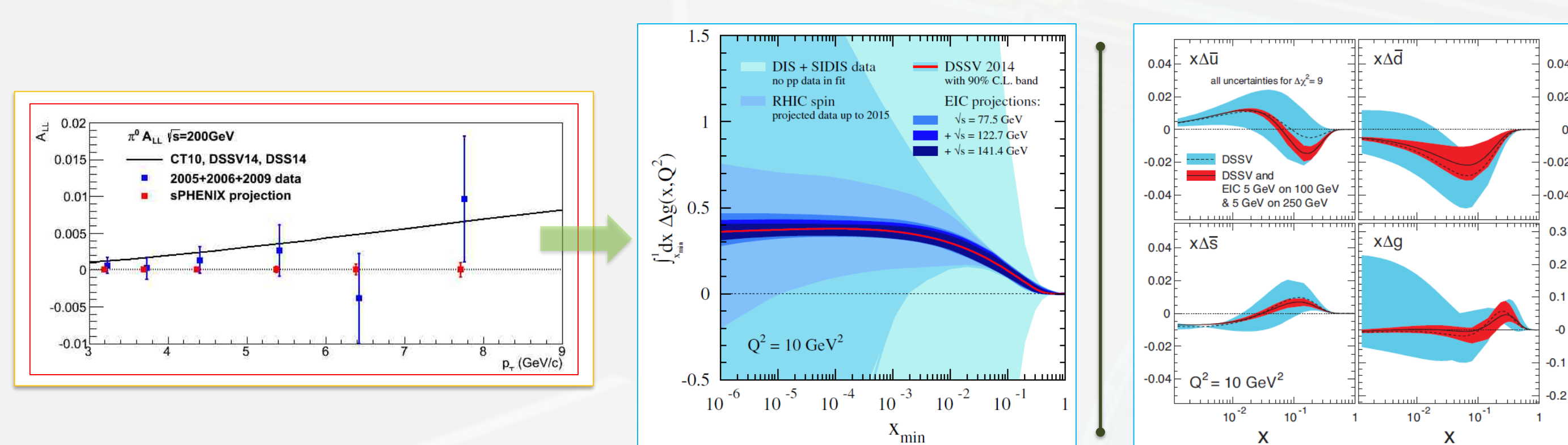
- Late 2020s
- e+p / e+A
- Likely to lose A+A capability
- Back to the DIS with improved L and \sqrt{s}



- Early 2020s
- Continue unique p+p & p+A
- sPHENIX (midrapidity):
 - Inner/Outer trackers + EMCal + Inner/Outer HCal based on BaBar Solenoid
 - CD0 granted (Sep. 2016)
- Forward sPHENIX:
 - GEM trackers + EMCal + HCal
 - Under design/simulation

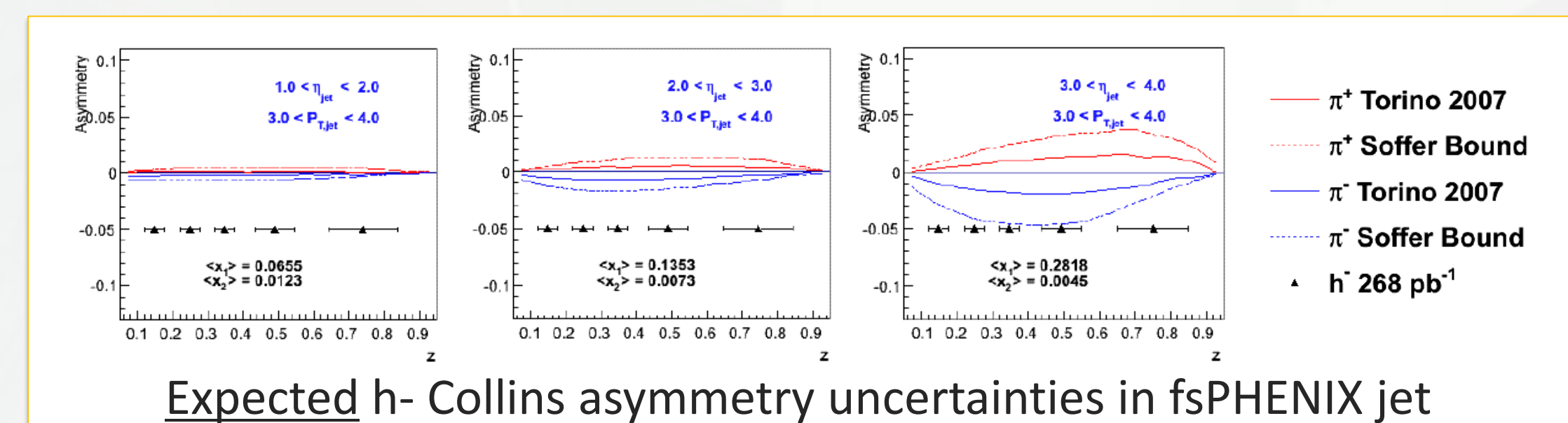
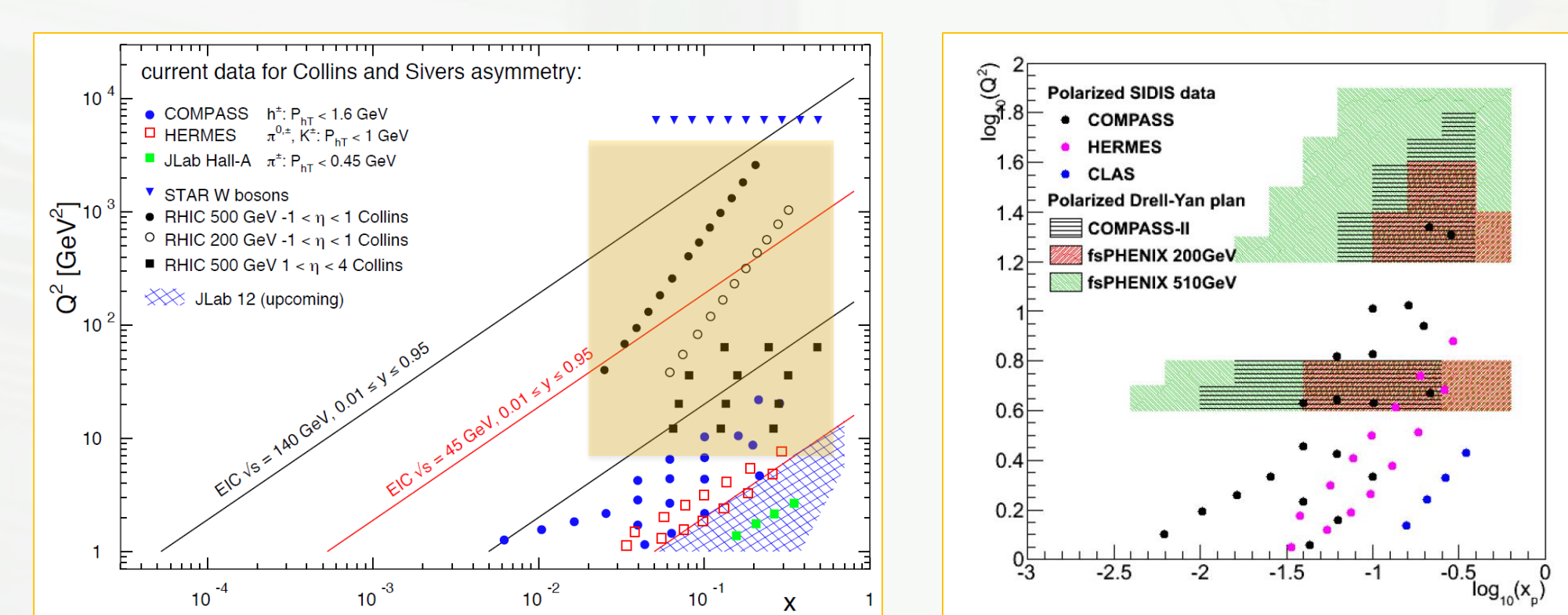
Studying QCD system and process in Cold Nuclear Matter

Longitudinal spin structure of proton



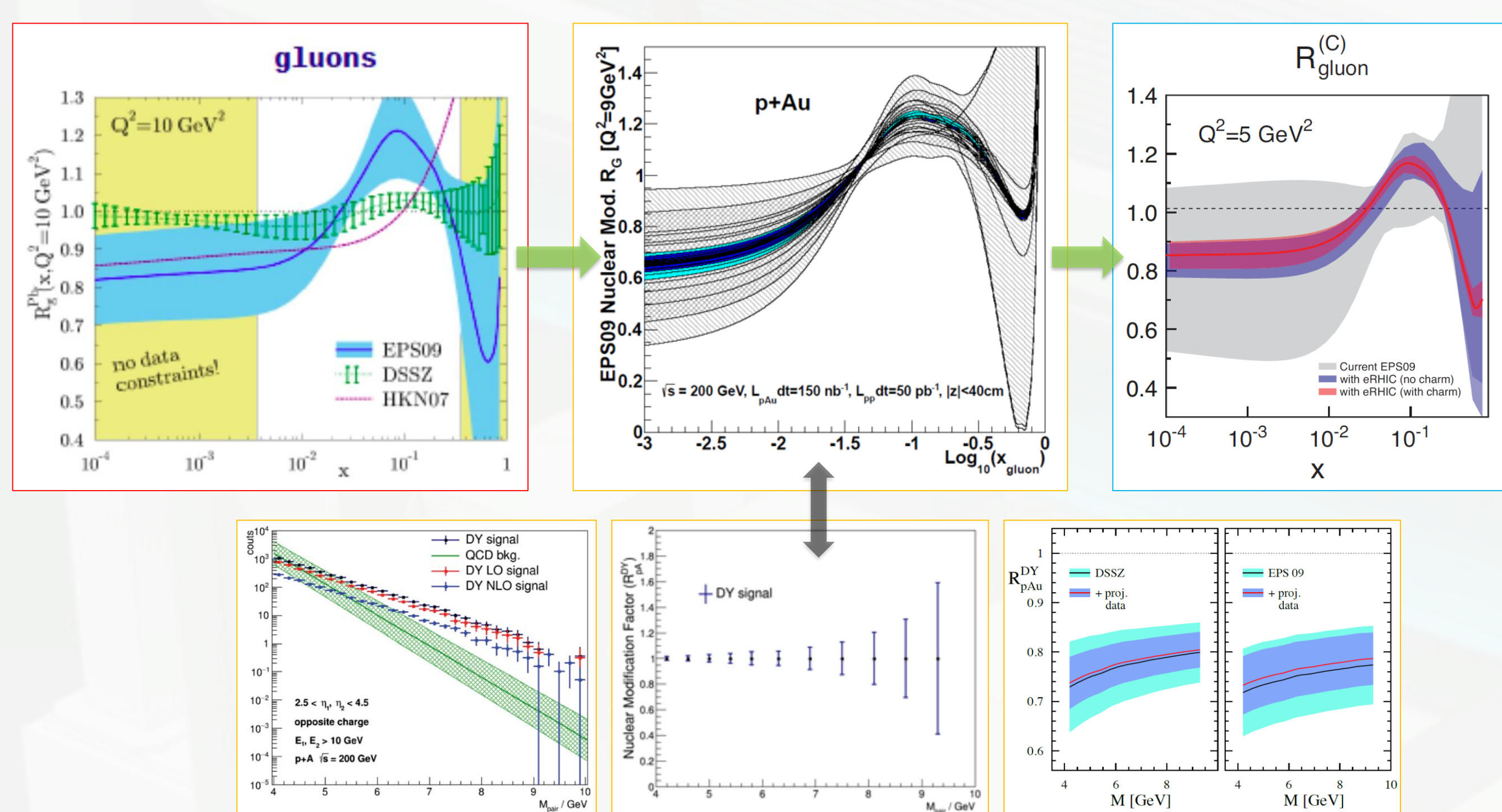
- Jaffe-Manohar spin sum rule: $S_p = \frac{1}{2} = \frac{1}{2} \Delta \Sigma + \Delta G + L_z$
- Unique & Precise measurements at RHIC: ΔG via jet/ π^0 , $\Delta \bar{q}$ via W/Z^0
- Expect even further constraint in future EIC

Transverse spin phenomena of proton



- Origin of large transverse A_N in forward rapidity?
- Separate intrinsic property & interaction dependent dynamics
- Competing & Complementing frameworks: TMD and Collinear Twist-3

Nuclear PDFs & Hadronization



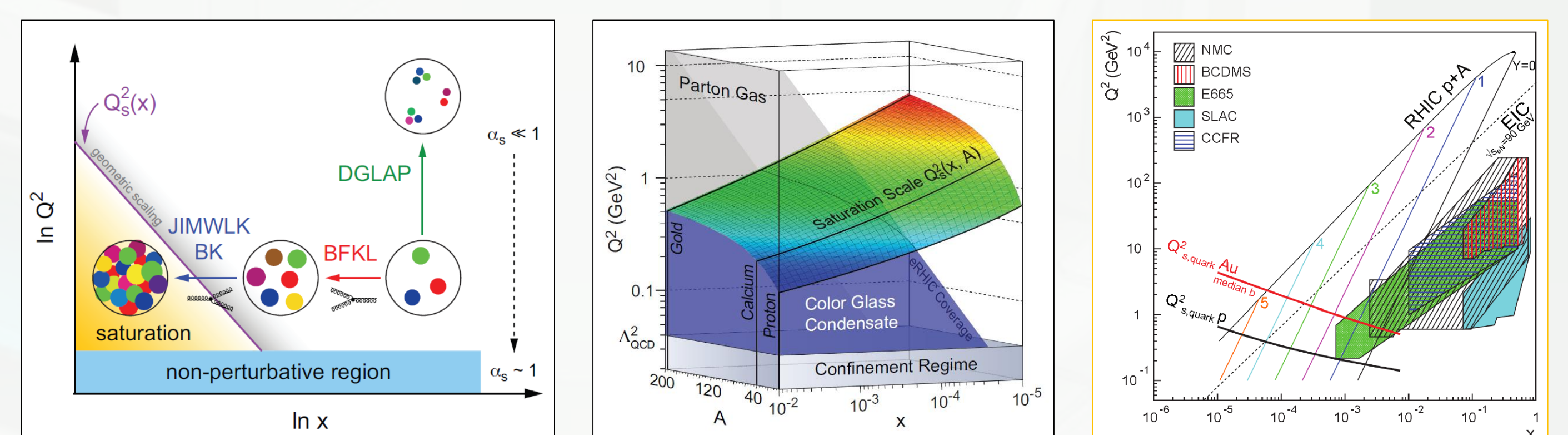
Nuclear PDFs

- Study on initial conditions of HI nucleus before the collision:
 - Essential, but still very limited understanding
 - R_{dA} : only existing direct probe for gluons in the nucleus, but suffer the nuclear effect in final state $\rightarrow R_{pA}$ (DY)
- Uniqueness of RHIC:
 - Appropriate kinematic regime (medium-to-low x with moderate Q^2)
 - Varying nucleus in p+A: a knowledge cannot be predicted by pQCD

Hadronization

- Discrepancy in SIDIS pID hadron production rate between e+p and e+A
- is effect in CNM persist in higher \sqrt{s} and Q^2 ?

Gluon saturation



- Definitive constraint of gluon saturation regime:
 - Allows precise theoretical expectation based on pQCD
 - Benefits understanding small- x evolution of TMDs
- Q_s (Saturation scale) vs. A and Q_s vs. x :
 - PDFs' growth with decreasing x : $Q_s \propto 1/x$
 - Parton concentration in limited transverse plane: $Q_s \propto A$
- Complete the scheme with p+A:
 - Complementary measurement before EIC
 - Requires forward detector to reach $Q^2 > 1 \text{ (GeV}^2\text{)}$
 - Final state effect free measurement via R_{pA} (DY)