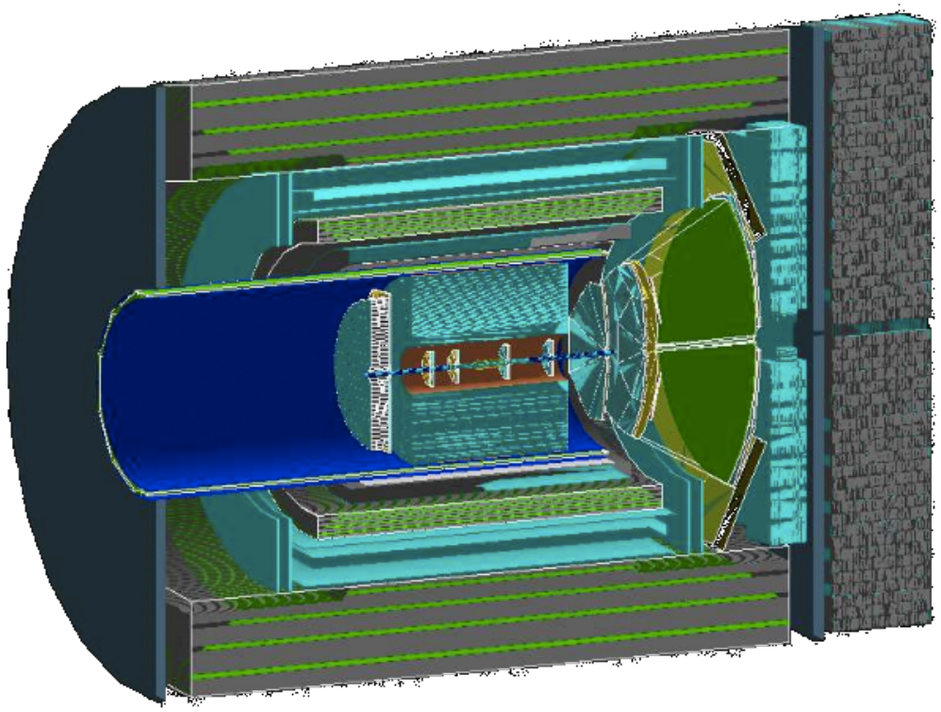
Plans for sPHENIX evolution to eRHIC

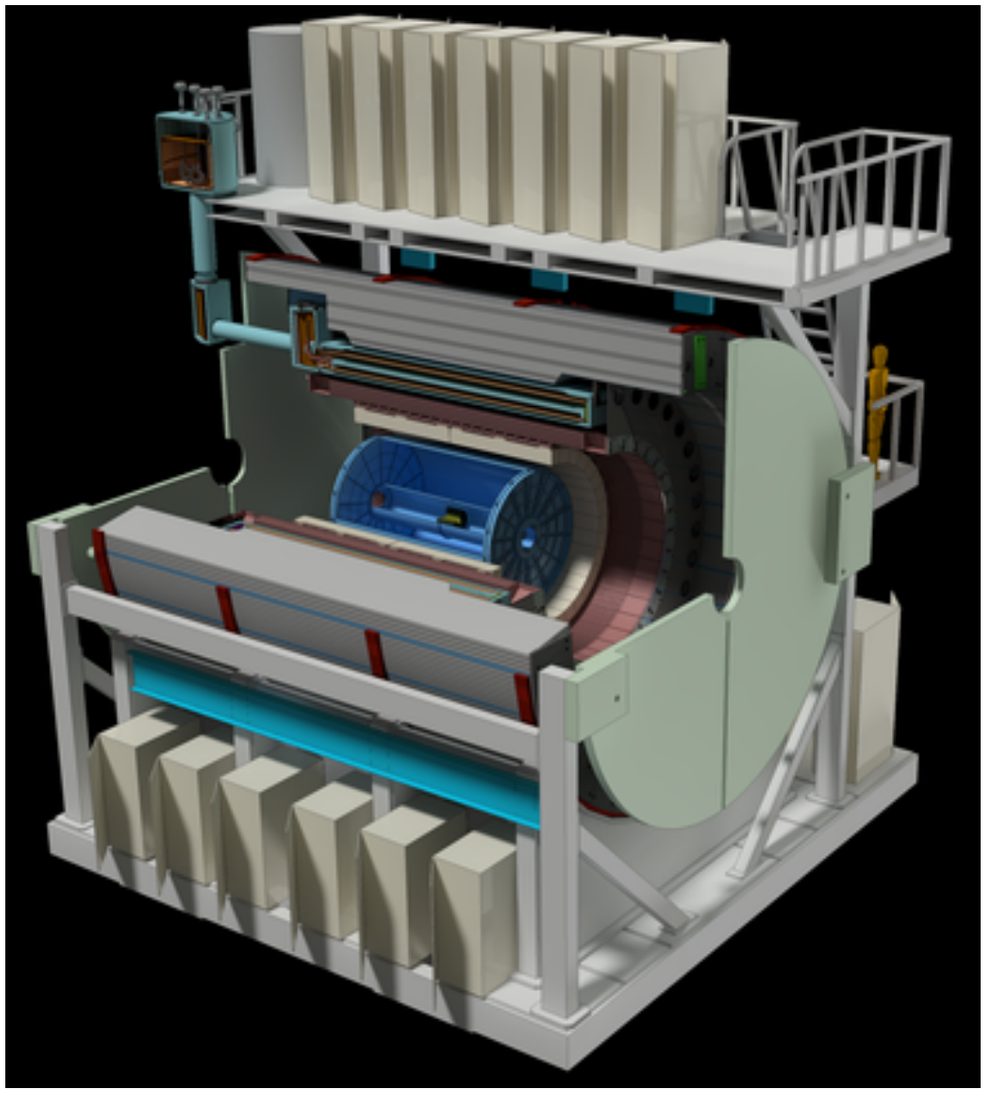


Christine Aidala, Nils Feege

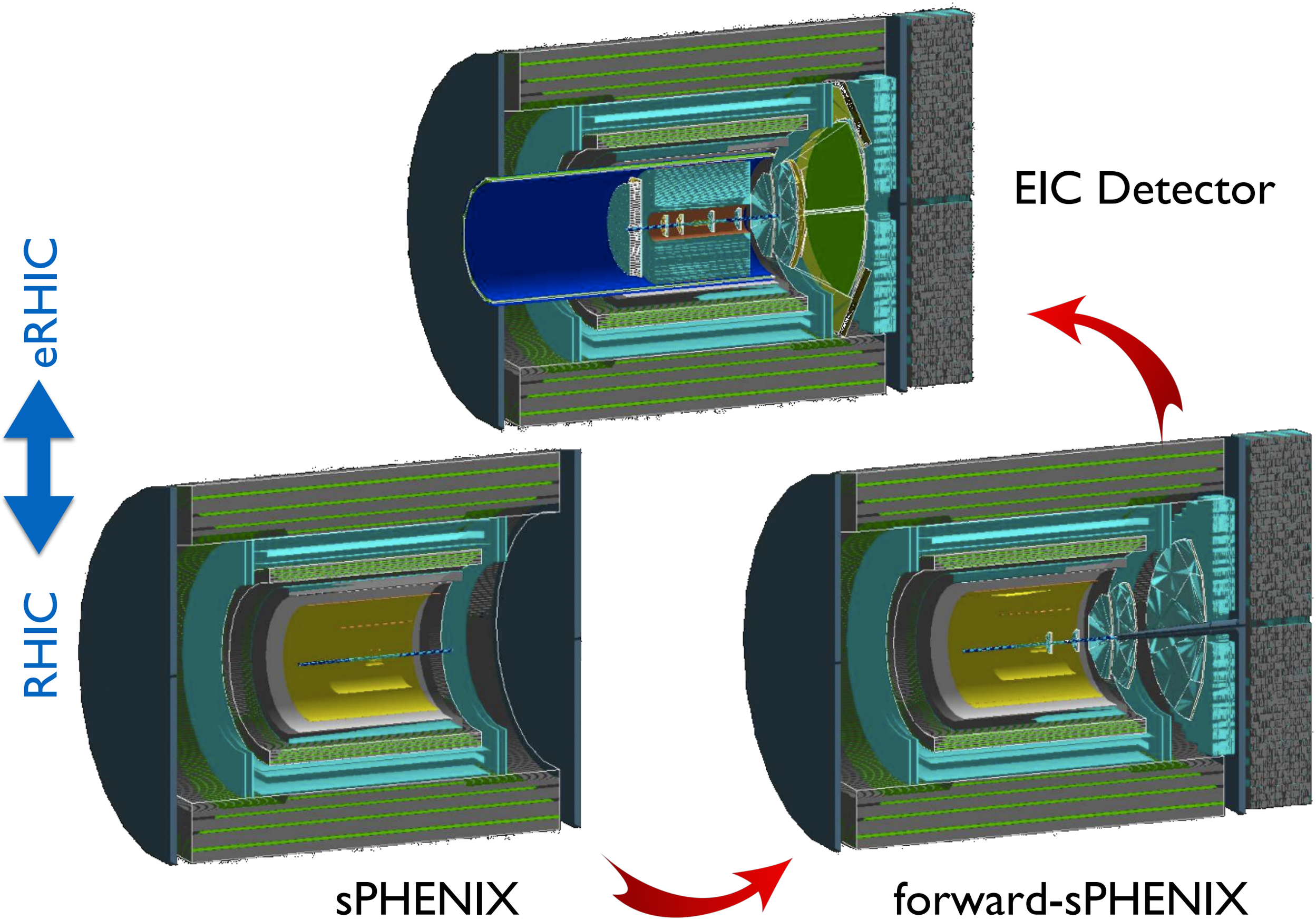
sPHENIX Cold QCD Topical Group Meeting

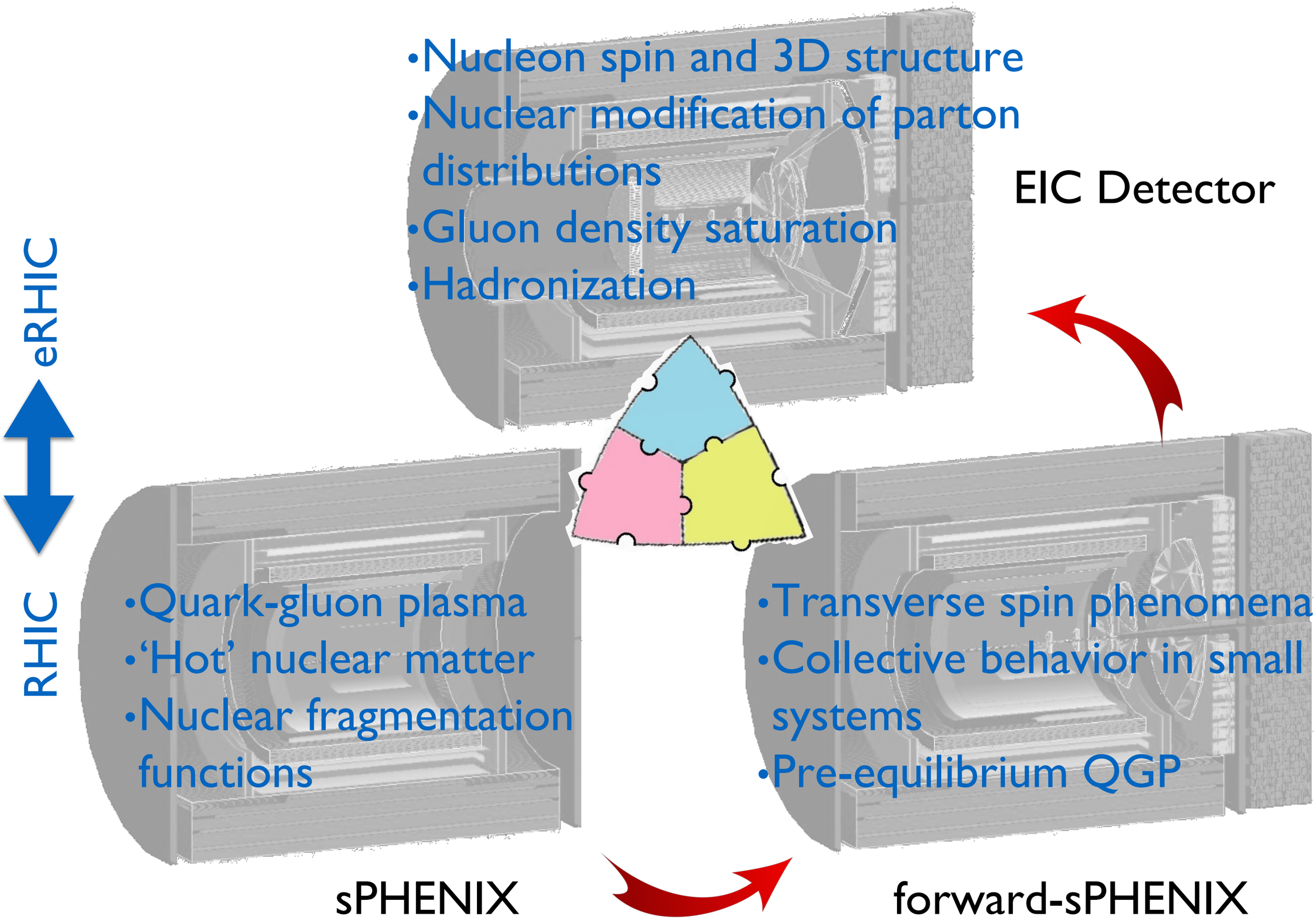
BNL, November 15, 2016

sPHENIX - the new RHIC IP8 experiment



- Primary objective: Study Quark Gluon Plasma with jet and Upsilon probes
- 1.5 T BaBar solenoid magnet with tracking, ECAL, and HCAL coverage $|\eta| < 1.1$
- Collaboration formed in December 2015
- CD-0 in October 2016

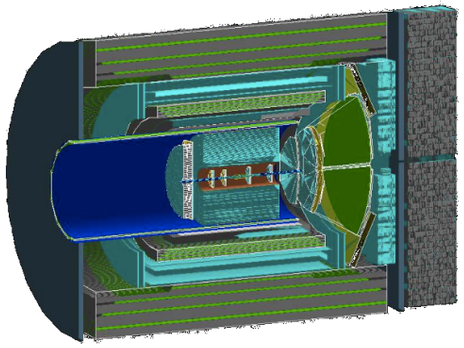

EIC Detector
eRHIC
RHIC
sPHENIX
forward-sPHENIX


•Nucleon spin and 3D structure
•Nuclear modification of parton distributions
•Gluon density saturation
•Hadronization
EIC Detector
eRHIC
RHIC
•Quark-gluon plasma
•'Hot' nuclear matter
•Nuclear fragmentation functions
•Transverse spin phenomena
•Collective behavior in small systems
•Pre-equilibrium QGP
sPHENIX
forward-sPHENIX

Adding a forward hadron spectrometer to sPHENIX

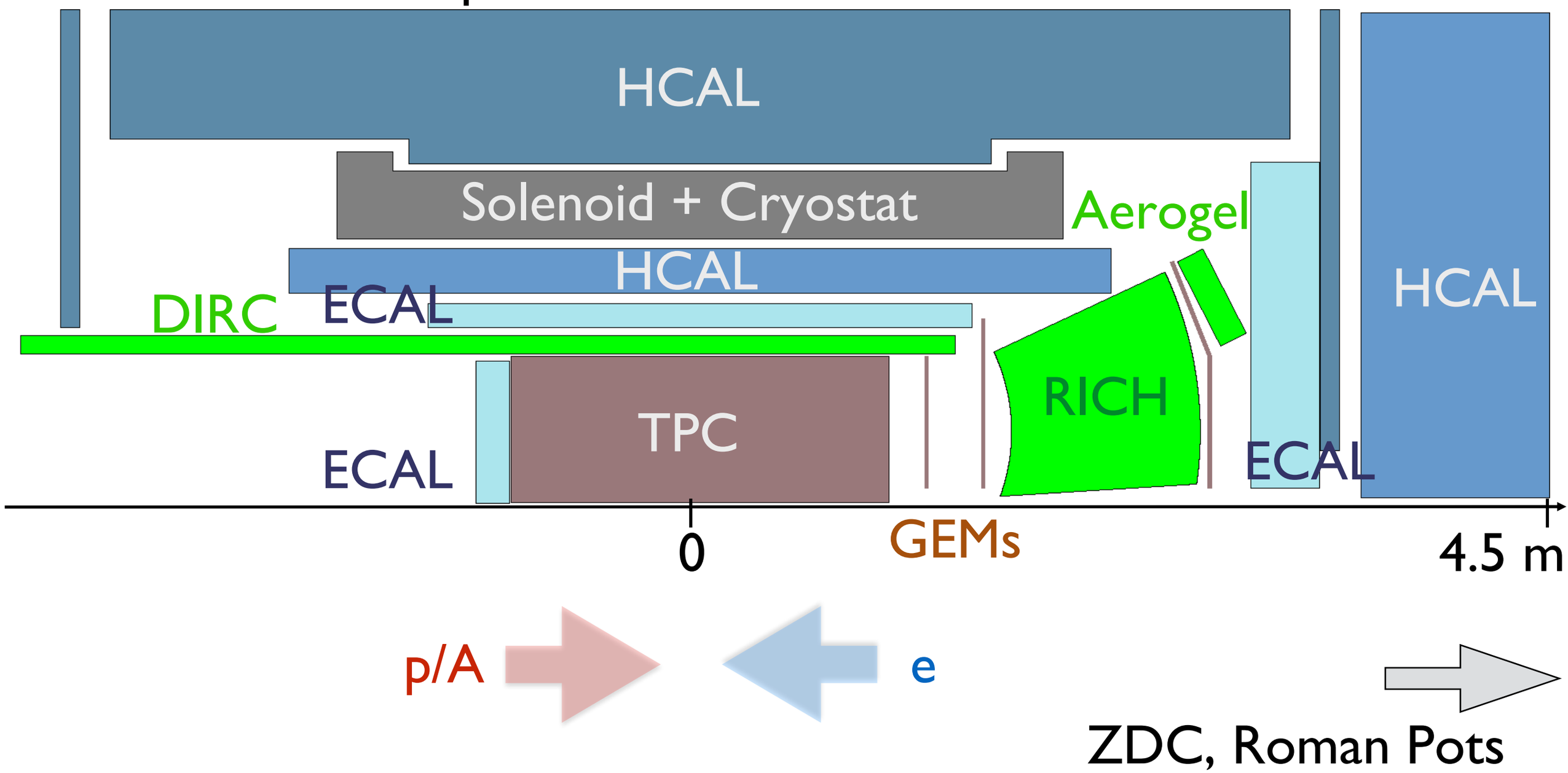
A hadron spectrometer at pseudorapidity ~1-4 is required for eRHIC. Implementing such a spectrometer while there are still hadronic collisions at RHIC would have significant scientific and community-building benefits in the years leading up to an EIC:

- Address science questions complementing the EIC program
- Enable long-range rapidity correlation measurements, which are of strong interest to the heavy ion community
  ➡ more cohesive sPHENIX collaboration
- Keep BNL's leading role in exploring the proton structure
- Engage more of the non-BNL EIC community at RHIC



EIC Detector Concept

'2016 revised concept'

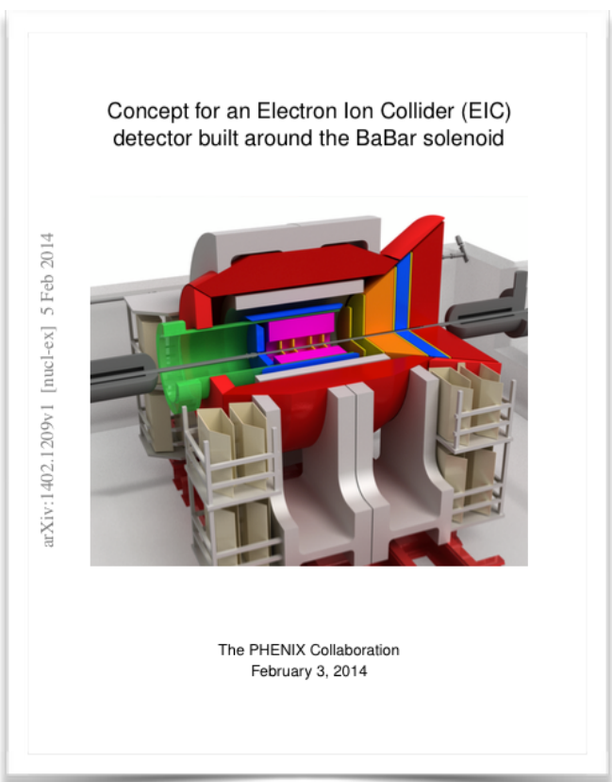


Setting the stage: 2014 LOI studies

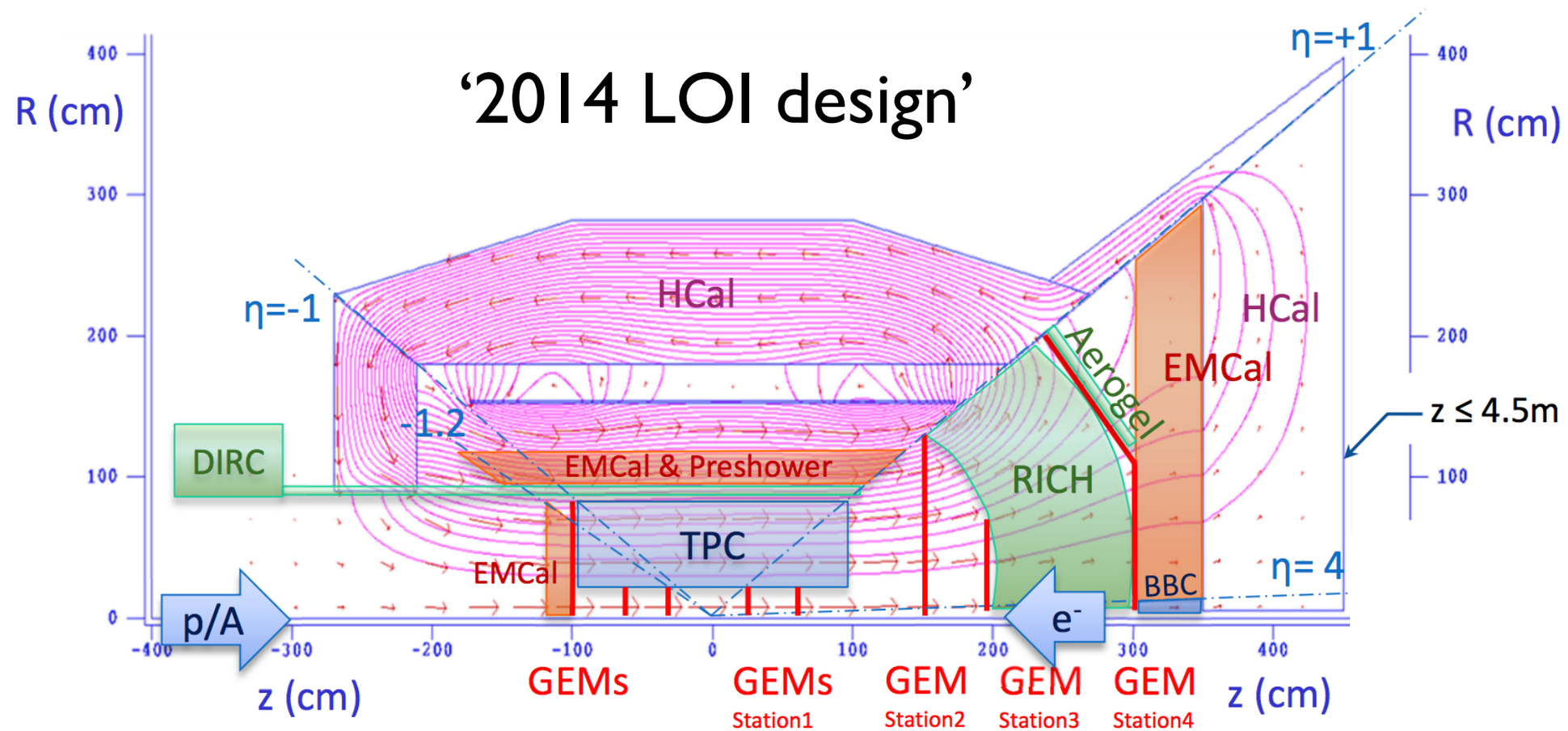
Maximum beam energies

e	10 GeV
p	255 GeV
Au	100 GeV / nucleon

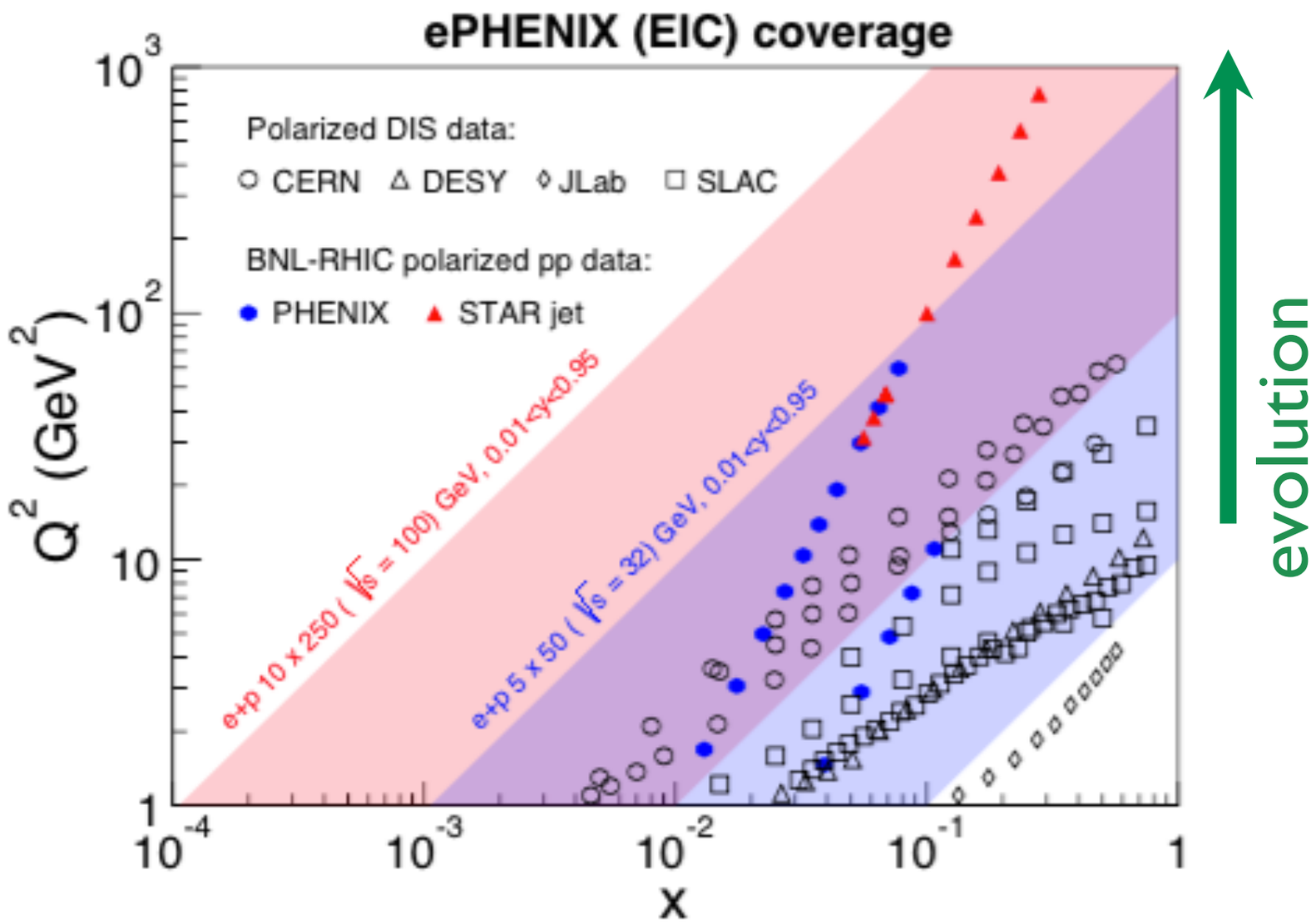
e+p Design luminosity (10 GeV on 255 GeV)
10^{33} $cm^{-2}s^{-1}$



[arXiv:1402.1209v1]



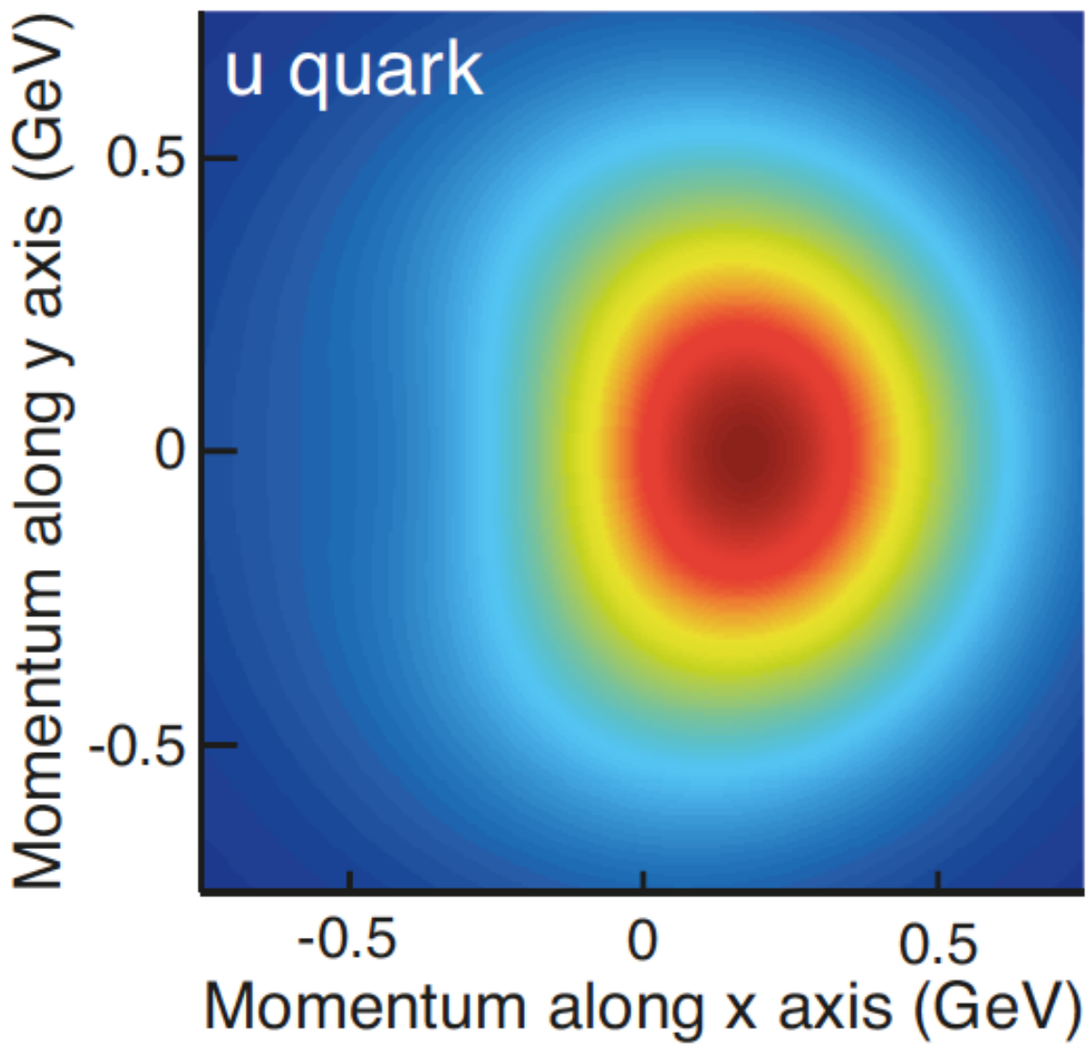
EIC Kinematics Coverage

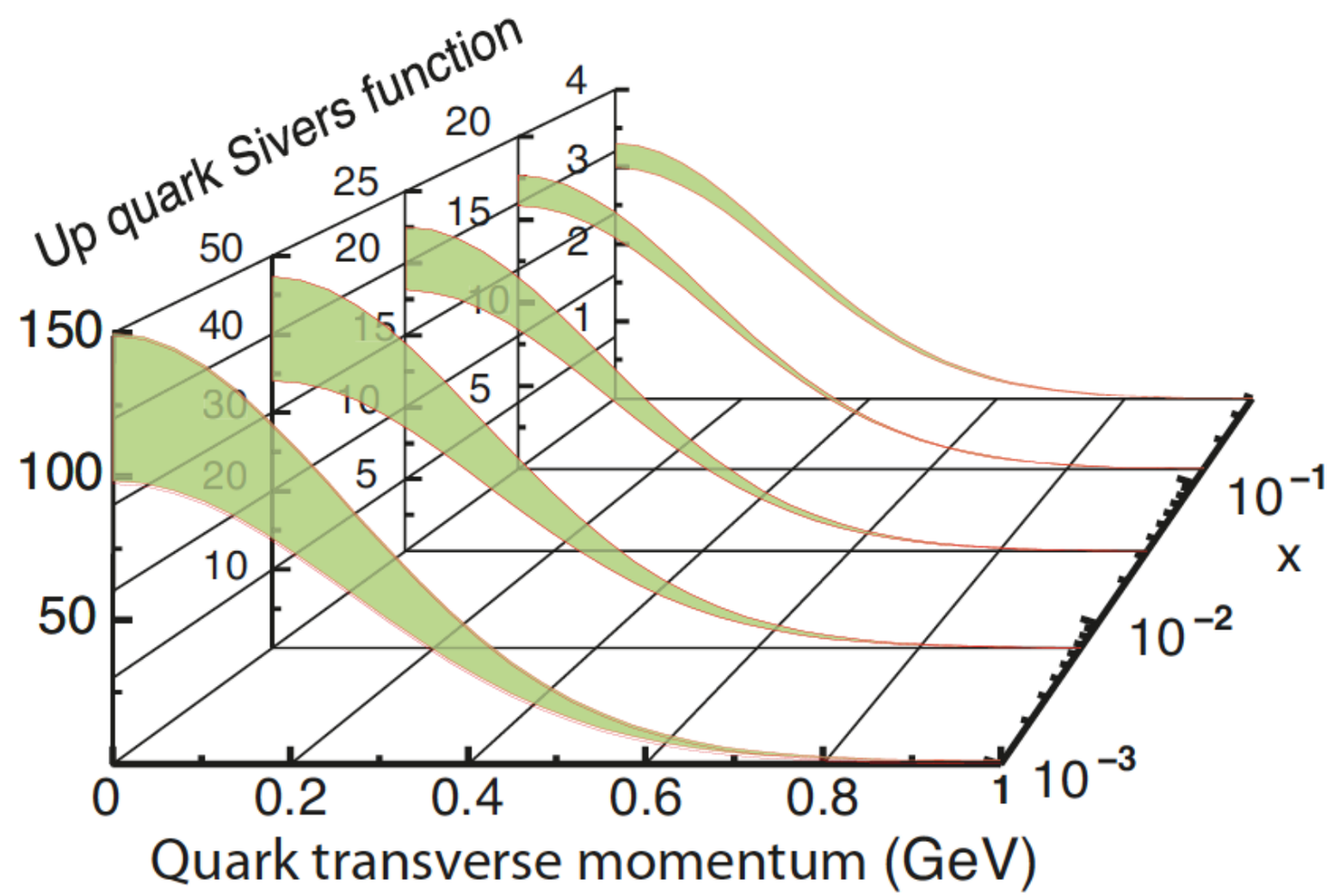


valence to low-x physics

arXiv:1402.1209v1

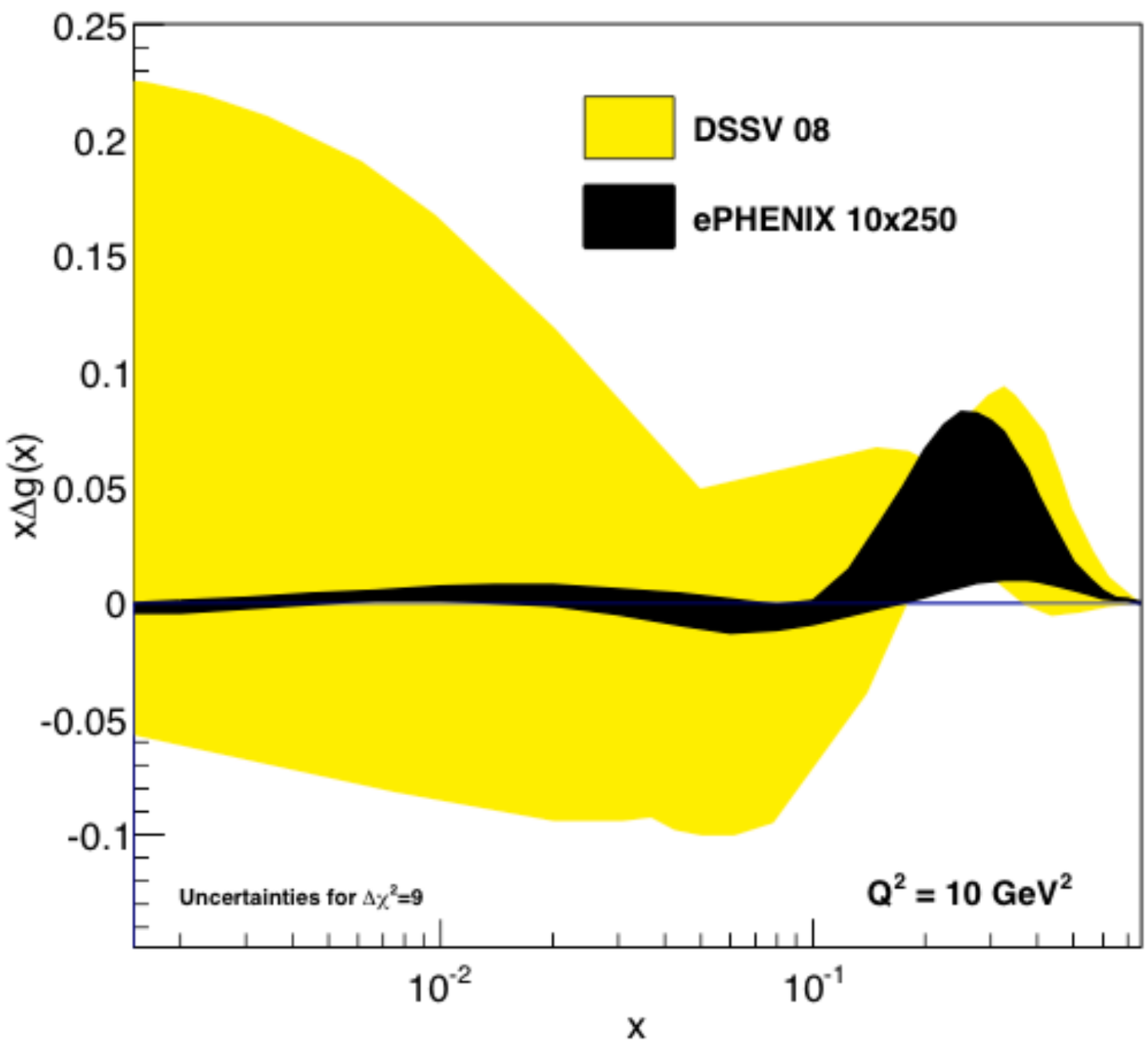
Transverse-momentum Distributions





arXiv:1402.1209v1

Proton Longitudinal Spin

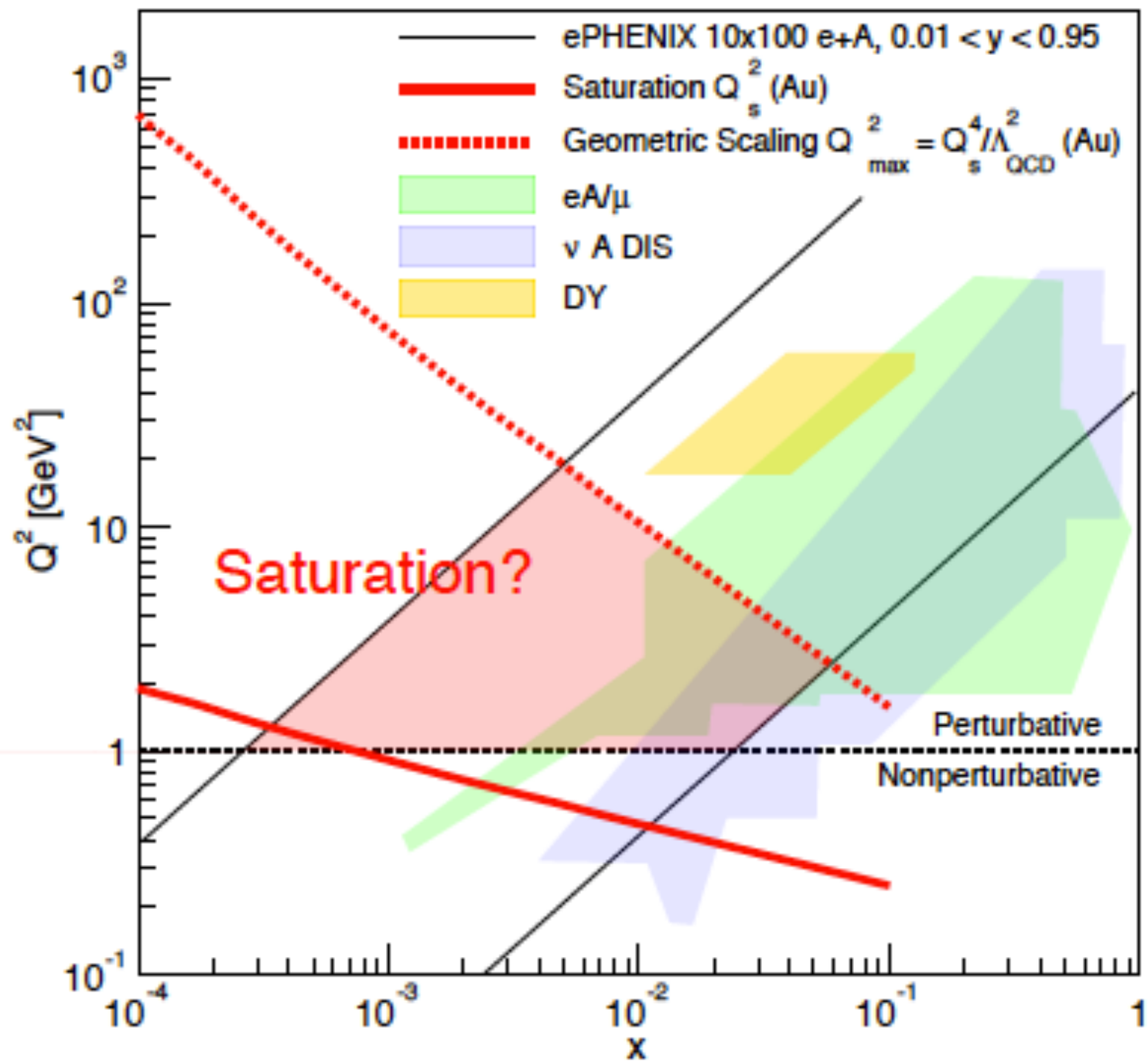


PHYTHIA generator and ePHENIX acceptance/efficiencies

10 fb^{-1} at 10GeV×250GeV

arXiv:1402.1209v1

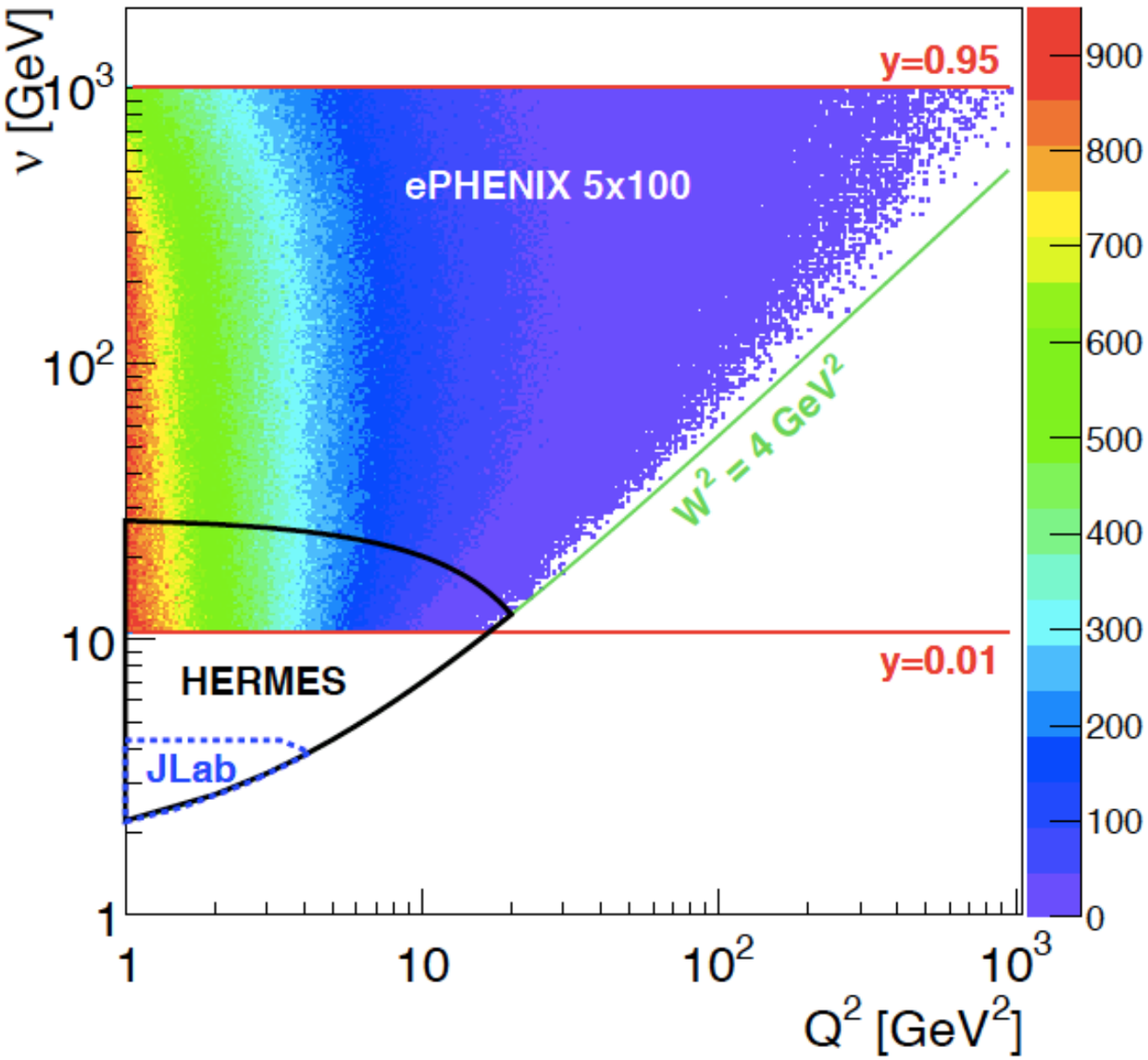
Probing Saturation in Nuclei

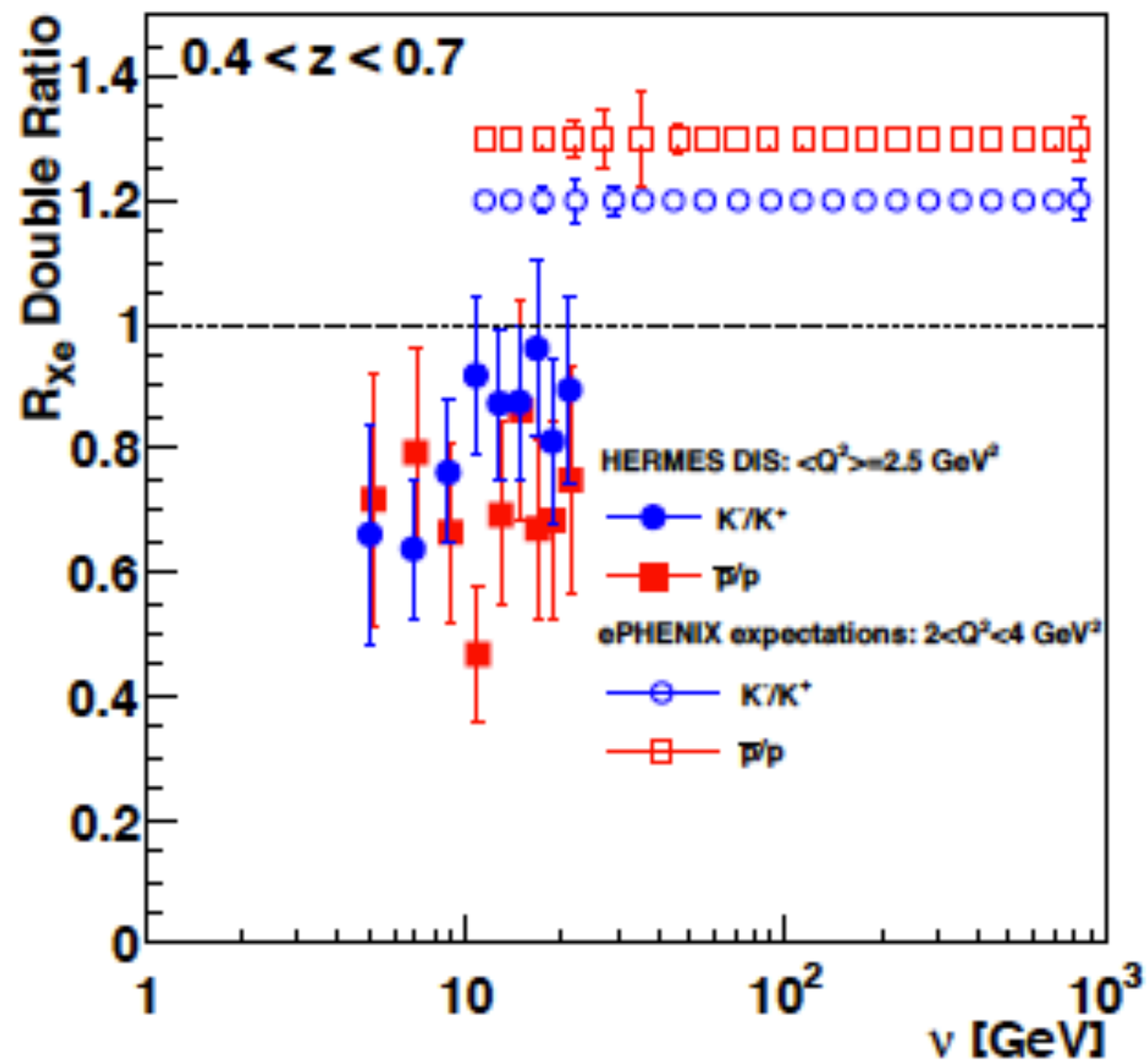


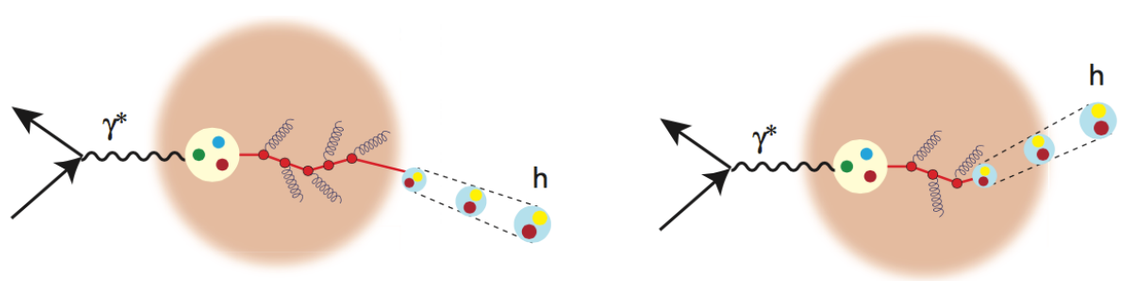
$$Q_s^2(x) \propto \left(\frac{A}{x}\right)^{1/3}$$

arXiv:1402.1209v1

Hadronization in Nuclei



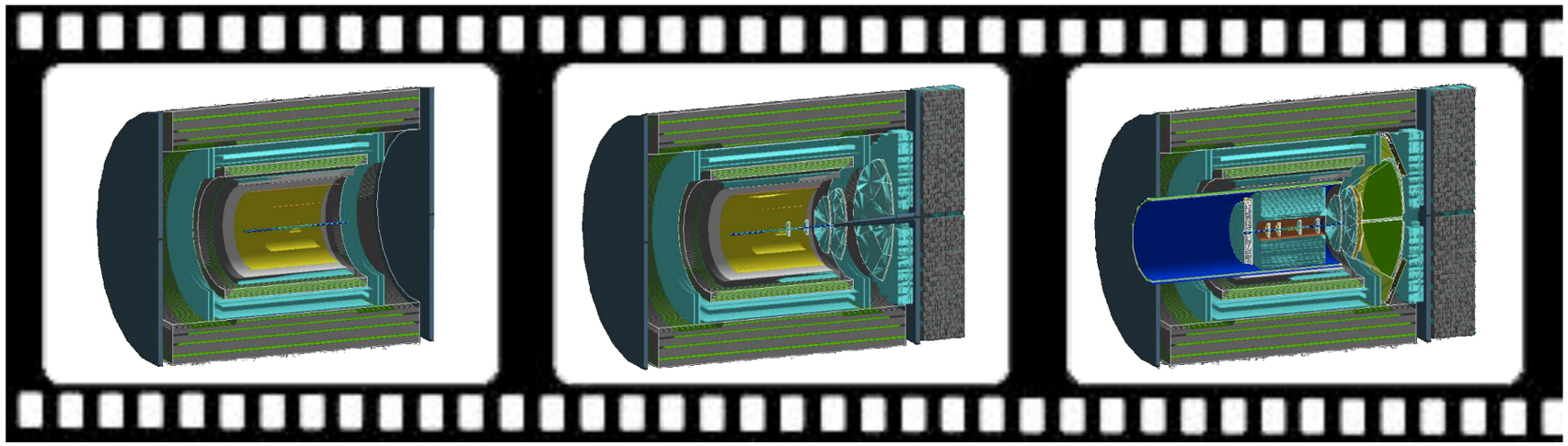




arXiv:1402.1209v1

Planned studies to update the LOI

- Using full Geant4 detector simulation to evaluate
  - EMCAL, tracking for Inclusive DIS for Day-1 physics
  - Hadron PID for various TMD measurements
  - EMCAL for photon-electron separation in DVCS for critical long-term physics
- Explore other low-luminosity, low-energy physics topics, e.g. hadronization in nuclei

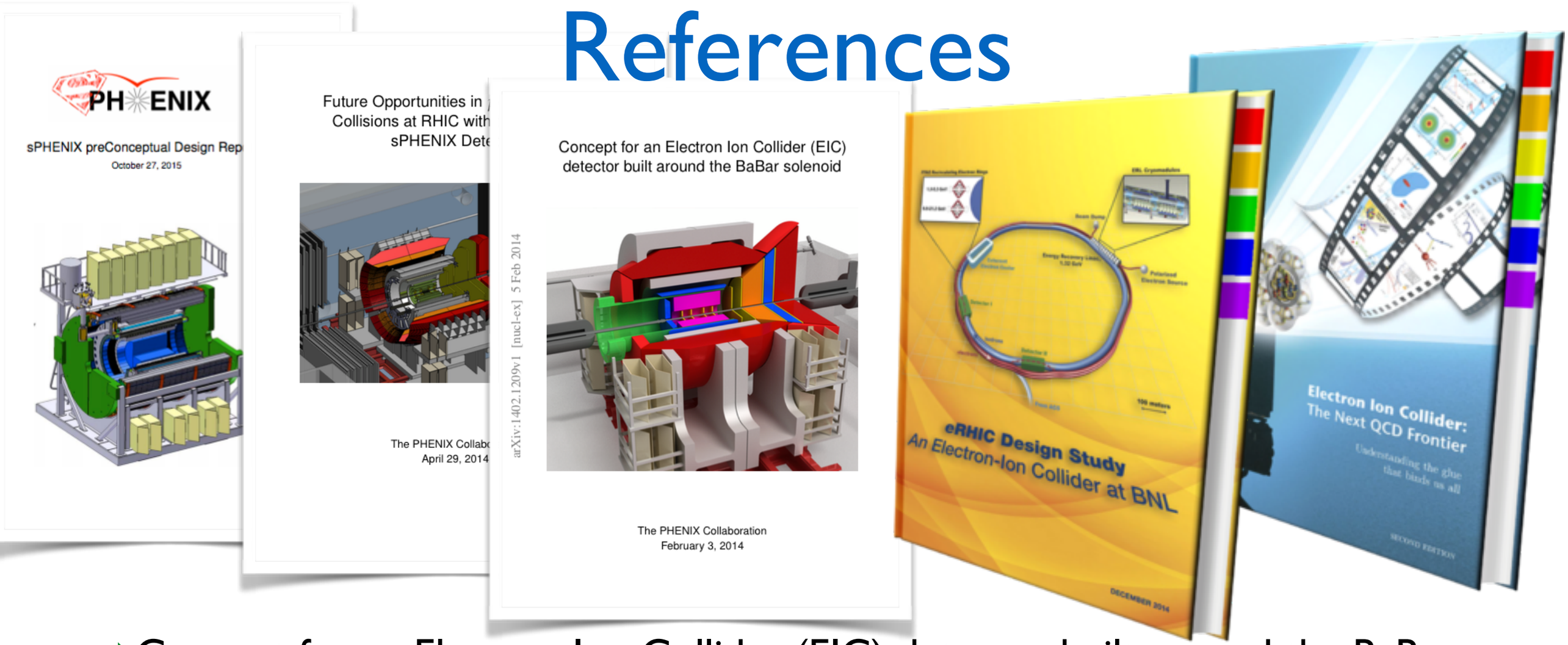


- The EIC detector design based on sPHENIX
  - ✓ evolves naturally from sPHENIX,
  - ✓ capitalizes on major sPHENIX investments,
  - ✓ covers critical acceptances,
  - ✓ addresses much of the EIC physics potential,
  - ✓ has compact length compatible with IR at eRHIC.

- Ongoing simulation and detector R&D activities keep advancing this design and offer lots of opportunities for novel ideas, new collaborators, and students.

Additional Slides

References



- ➡ Concept for an Electron Ion Collider (EIC) detector built around the BaBar solenoid [arXiv:1402.1209v1]
- ➡ sPHENIX preConceptual Design Report [https://indico.bnl.gov/getFile.py/access?resId=0&materialId=11&confId=1483]
- ➡ Future Opportunities in p+p and p+A Collisions at RHIC with the Forward sPHENIX Detector
- ➡ Electron Ion Collider: The Next QCD Frontier [arXiv:1212.1701v3]
- ➡ eRHIC Design Study [arXiv:1409.1633]