PHENIX at the MEIC?
MEIC layout at the JLab site

~2.2 km circumference

Electron ring from SLAC (PEP-II)

2 interaction regions

12 GeV CEBAF used as injector

Fixed target infrastructure (including detectors) would remain
MEIC-IP1 interaction region

(top view)

low-Q$^2$ electron detection and Compton polarimeter

50 mrad beam (crab) crossing angle

 MEIC Collider Rings

IP1

Booster
Linac
Ion Source

Electron Injector
12 GeV CEBAF

Hall D

Halls A, B, C

IP1

MEIC Collider Rings

1 m

 ion quadrupoles

0.7 m
dipole

Electron quadrupoles

Intermediate dipole useful for tracking small-angle particles that do not pass through the FFQs, but perhaps only needed at one IP.
ePHENIX dropped into IP1

Compton polarimeter and Low-Q2 tagger chicane (~25 m)

- Not ideal since forward HCAL not compatible with first dipole
- Could work for sPHENIX with a different endcap design
- But IP2 can be optimized as desired!

Forward ion detection
MEIC-IP1 and ePHENIX detectors

- The central detector concepts developed at JLab (MEIC-IP1) and BNL (ePHENIX) are generally similar, but offer complementary capabilities
  - Central tracker technologies
  - Endcap Cherenkov detectors
  - HCal location and coverage
  - Forward dipole in front of FFQs

- **MEIC-IP1 detector**
  - Focus: SIDIS and exclusive
  - Forward HCal optional (integrated with dipole?)
  - Lots of space for PID

- **ePHENIX**
  - Focus on jet-physics
  - Good HCal coverage
  - No intermediate tracker
  - Asymmetric endcaps possible/desirable?
MEIC-IP1 and ePHENIX detectors

- The MEIC-IP1 detector is designed around an identical solenoid as sPHENIX (4 m long, 3 m diameter)
  - CLEO solenoid or new magnet

- The IP location is doubly asymmetric
  - Inside the coil (1.6 m + 2.4 m)
  - Endcaps (1.4 m and 2.6 m)
  - HCal could go outside of forward ion dipole (first ion FFQ is 7 m from IP)

- Luminosity scales linearly with total distance between ion FFQs – but the IP does not have to be in the middle!

- ePHENIX at eRHIC has a doubly symmetric location
  - IP in the middle of coil (2+2 m)
  - Both FFQs are located 4.5 m away

- Easy to keep former but adjust latter!
  - Suggestion: use 4 + 5 m distance!
  - More space for ion-side encap!
The initial stage of the MEIC will not post-accelerate electrons from CEBAF giving a 12 GeV max energy.

A relatively inexpensive threshold Cherenkov can provide $\pi/K$ separation up to 9 GeV on the electron endcap.

- Would also work at eRHIC

EM calorimetry in electron endcap follows the proved formula from CLAS with an inner crystal calorimeter and a cheaper outer one.

More space on the ion side allows for a dual-radiator RICH, conceptually similar to the one at LHCb, with mirrors in the shadow of the barrel detectors.
ePHENIX@IP2 ion optics

- Luminosity is proportional to the total distance between FFQs
- FFQ gradients are proportional to the $1/distance$ to the IP
- FFQ peak fields are gradient $\times$ aperture
  - Large aperture only needed downstream
- Asymmetric endcaps generally make life a little easier...

Crossing angle: can be up to 50 mrad
ePHENIX@IP2 electron optics

- Small electron FFQs can be placed in the endcaps
- Outer FFQ dimensions are small, only ~7 cm (see next slide)
1. Could use MgB₂ windings ~same gradient, operating at 10K.
2. Could incorporate an active shield winding to kill fringe field @ e-beam
Electron polarimetry

- Experience from HERA: uncertainty > 1%
  - Limited to detection of Compton photon only
  - Accelerator limitations (non-colliding bunches)

- Experience from JLab and SLAC
  - SLD at SLAC reached 0.5% detecting the Compton electron
  - Compton polarimeters in Halls A and C at JLab reach ~1% detecting both the photon and the electron for cross check

  Laser at Chicane center ensures that polarization is identical to IP
Polarimetry options at the two IPs

- One IP (which one?) will have larger version of the JLab Compton chicane
  - Detection of both electron and photon, the latter with low synchrotron background
- Second IP will have a similar chicane optimized for electron detection
  - Goal is to push the uncertainty of the polarimeter towards what SLAC achieved