EIC Detector(s)
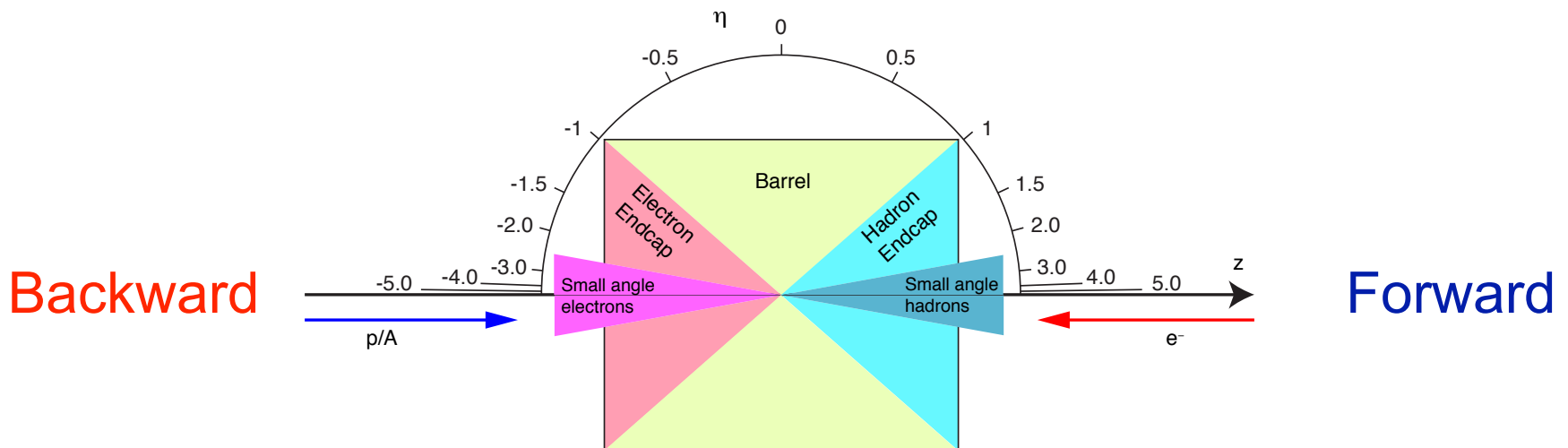
- Consensus within the EIC community:
  - ▸ A least 1 general purpose detector
  - ▸ Needs for a second detector - majority favors a second general purpose detector instead of more specialized detector
  - ▸ Arguments for 2 detectors similar as for every collider
  - ▸ The 2 detectors should be complementary
 - ▸ Both machine designs include at least 2 IRs

Backward   Forward

Unique Requirements

- **Challenges**
  - Hermeticity
  - Precision + compactness ⇒ large fields (~ 3 T)
  - Low mass precision tracking
  - Broad PID range (e and π/K/p)
    - 250 MeV/c - 50 GeV/c
  - Good calorimetry
    - HCAL: extreme req. in forward region (<50%/√E)
    - EMCAL: extreme req. backwards region (<2%/√E)
- **Moderate Requirements**
  - Modest radiation hardness requirements, low pile-up, low multiplicity
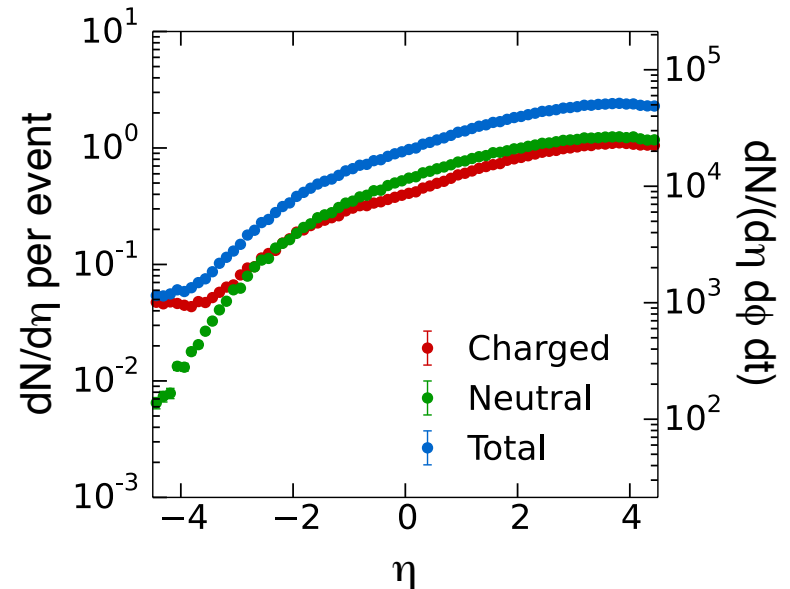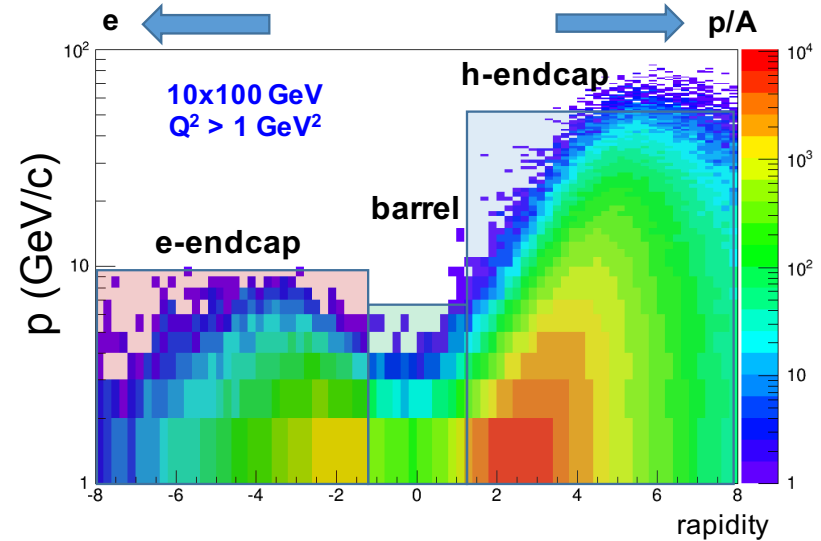
R&D Efforts

- Laboratory Directed Research & Development Programs (LDRDs) at National Labs in the US (BNL, JLAB, ANL)
- R&D at Belle-II and Panda has some overlap with EIC
- CERN/LHC
  - ▸ No R&D on key EIC challenges (PID, ECal)
  - ▸ R&D for phase-I upgrades ended, phase-II focus on radiation hardness and rate
- Generic EIC Detector R&D Program
  - ▸ Started in 2011 by BNL, in association with JLab and DOE NP
  - ▸ Funded by DOE NP, through RHIC operations
  - ▸ Program explicitly open to international participation
  - ▸ Standing EIC Detector Advisory Committee with internationally recognized detector experts

** Chair

Current: Marcel Demarteau** (ANL), Carl Haber (LBNL), Peter Krizan (Ljubljana), Ian Shipsey (Oxford), Rick Van Berg (UPenn), Jerry Va'vra (SLAC), Glenn Young (JLab)

Generic EIC Detector R&D Program

- Typical 10-11 projects supported at any time
- Attempt to merge projects in larger consortia when related (calorimetry, tracking, PID, Si-Vertex)
- Participation:
  - 46 institutions (13 non-US), 6 Natl. Labs
  - 187 participants
  - Important seed for formation of EIC collaborations
  - Since 2016 budget flat at $1M/year
- Requested funds exceed available funds by factor 2.5 (FY18)
- Despite being underfunded projects make steady and excellent progress.
- Need for increased R&D to meet challenges as recommended in 2015 LRP
  - Funding is spread too thin
  - Funding fewer would discourage many & excludes groups with expertise that want to get involved

N.B.: *Generic* RHIC detector funding was ~$4M in 2018$

Supporting Slides

Funding per FY
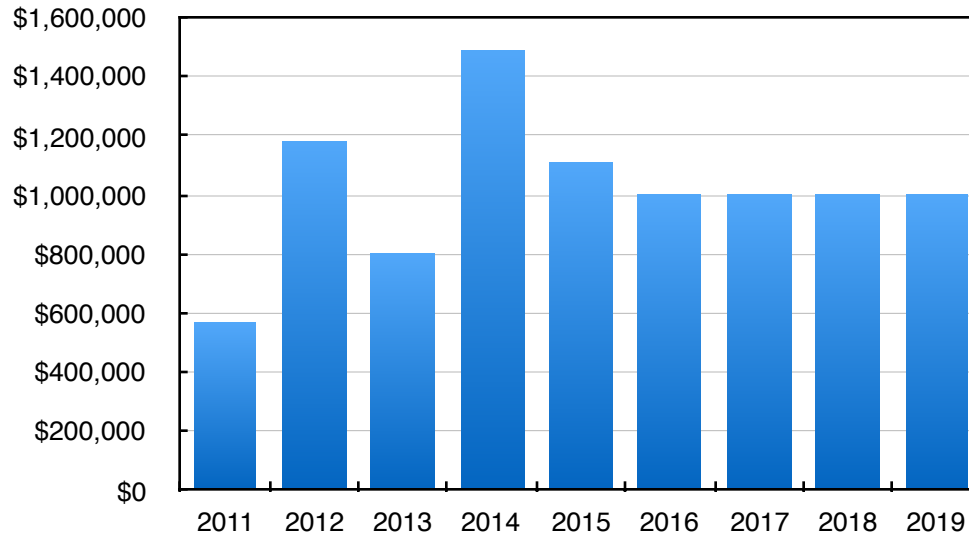
FY19 Projects

- 11 Projects approved for FY19
  - ▸ eRD1 - Calorimeter consortium
  - ▸ eRD6 - Tracking/PID consortium
  - ▸ eRD14 - PID consortium
  - ▸ eRD22 - GEM Transition Radiation Detector (TRD)
  - ▸ eRD16 - Fwd Silicon tracking
  - ▸ eRD18 - Central Si tracking/Si sensors
  - ▸ eRD15 - Compton spectrometer
  - ▸ eRD17 - e+A Simulations/Nuclear Breakup (BEAGLE)
  - ▸ eRD20 - Software consortium
  - ▸ eRD21 - Background studies
  - ▸ New - DAQ/Streaming Readout

Green = consortia

Look back at RHIC Detector R&D

R&D Effort	FY 90 $	FY 91 $	FY 92 $	FY 93 $	FY 94 $	FY 95 Plan	Total
Detector R&D Funding Summary							
Total Generic	1,121,437	1,620,751	215,000	20,000	50,000		3,027,188
Total STAR			1,125,000	1,267,000	1,467,365	1,100,000	4,959,365
Total PHENIX			1,200,523	1,463,984	1,147,300	1,000,000	4,811,807
Total PHOBOS				288,000	340,000	200,000	828,000
Total Allocations	1,121,437	1,620,751	2,540,523	3,038,984	3,004,665	2,300,000	13,626,360
Administration & BNL Support	228,563	331,249	269,477	376,016	450,335	296,000	1,951,640
R&D Total	1,350,000	1,952,000	2,810,000	3,415,000	3,455,000	2,596,000	15,578,000

2018 $ $2,598,651.87 https://www.usinflationcalculator.com
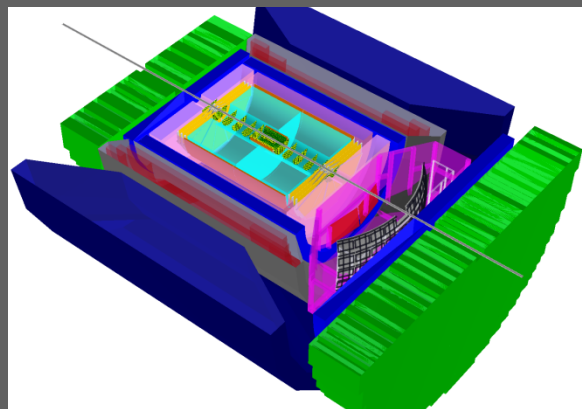
$3,605,725.23

$5,038,932.86

$5,945,834.05
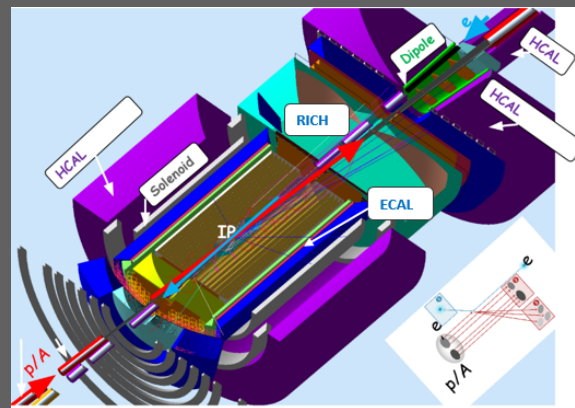
$5,865,293.79

$4,285,580.37

- Current generic R&D level for EIC: $1M
- EIC detector has 2-3 more subsystems than RHIC detectors
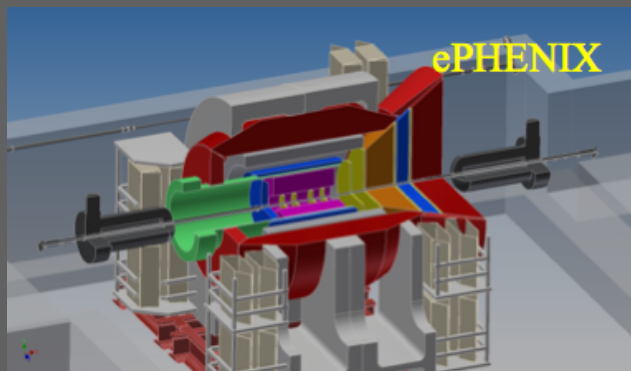
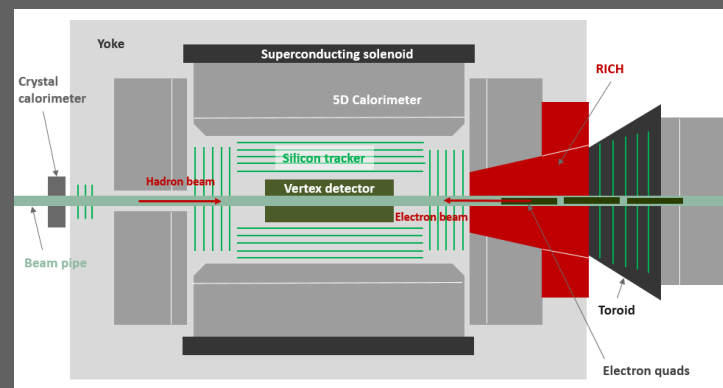# Current EIC Detector Concepts

Brookhaven concept: BEAST

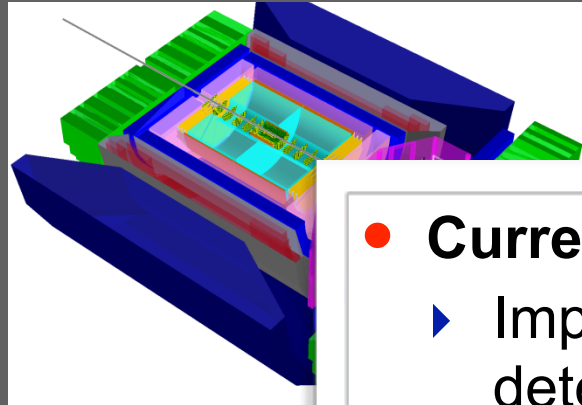**Jefferson lab concept: JLEIC**

sPhenix → ePhenix

Argonne concept: TOPSiDE

Current EIC Detector Concepts

Brookhaven concept: BEAST

Jefferson lab concept: JLEIC

sPhenix → e ... **ept: TOPSiDE**
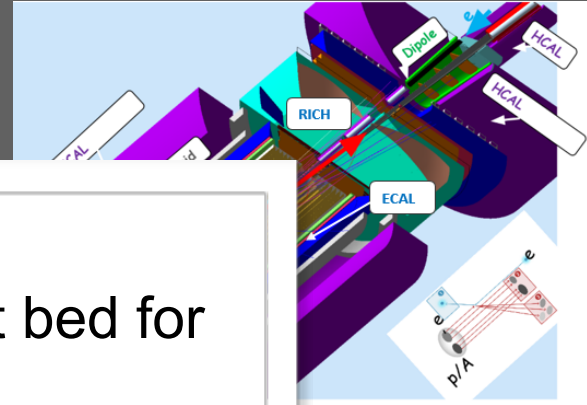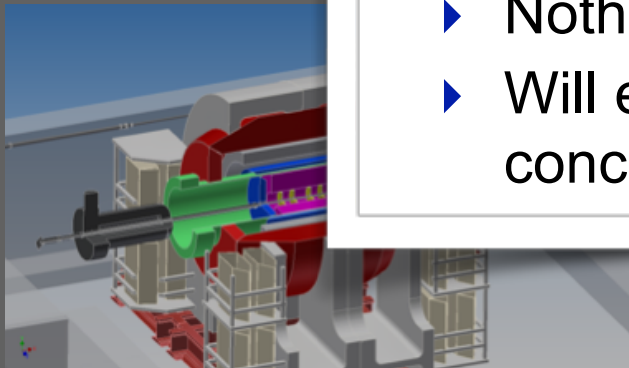
- **Current Concepts**
  - ▸ Important as test bed for detector R&D
  - ▸ Each attempt to match requirements
  - ▸ Nothing is cast in stone
  - ▸ Will evolve as new concepts are developed