

From RHIC to EIC

And Present Detector Proposals

Rachid Nouicer

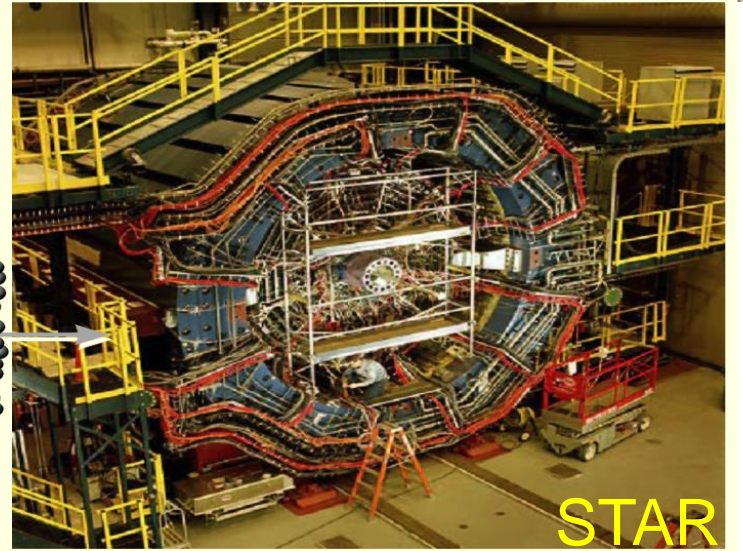
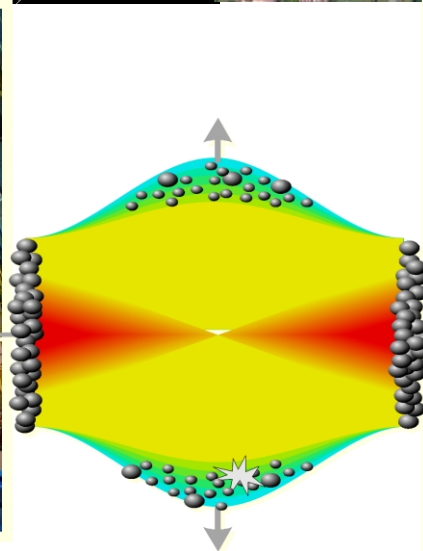
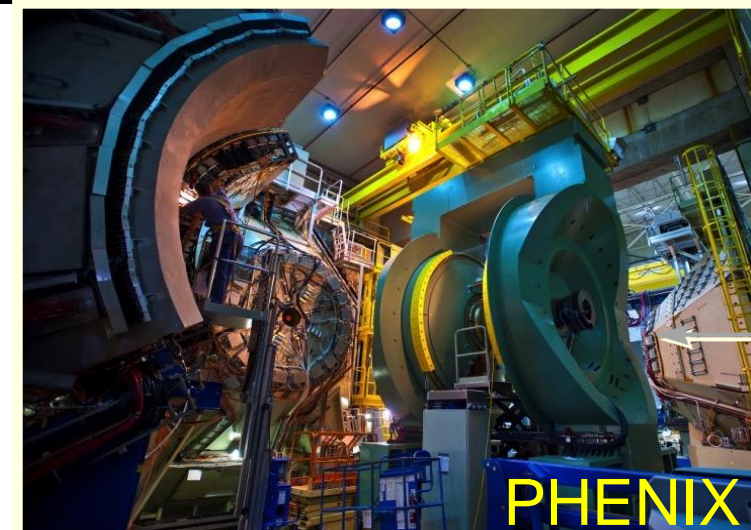
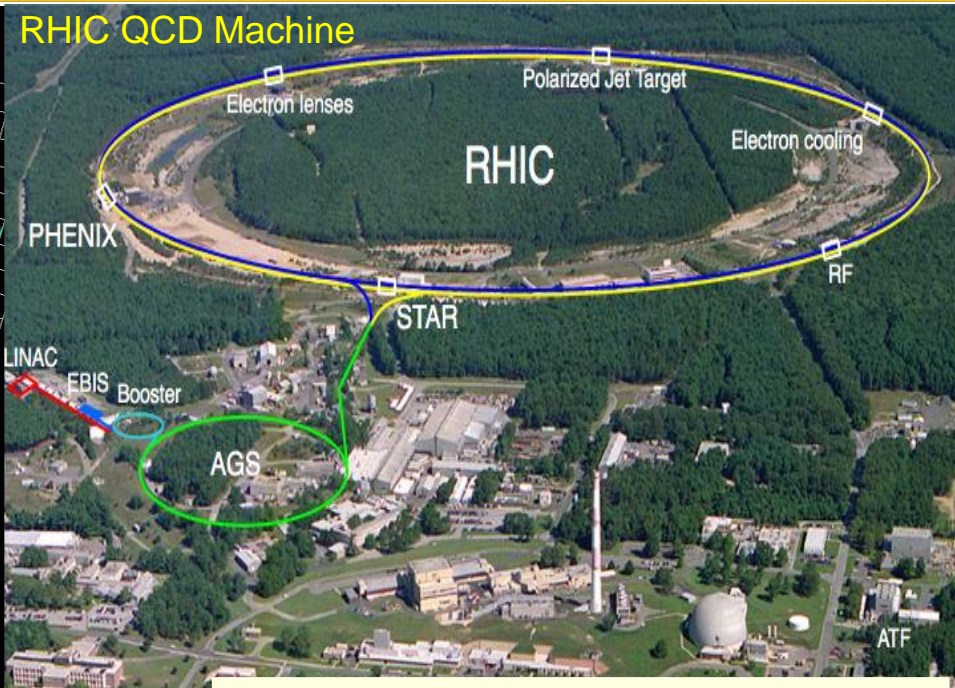
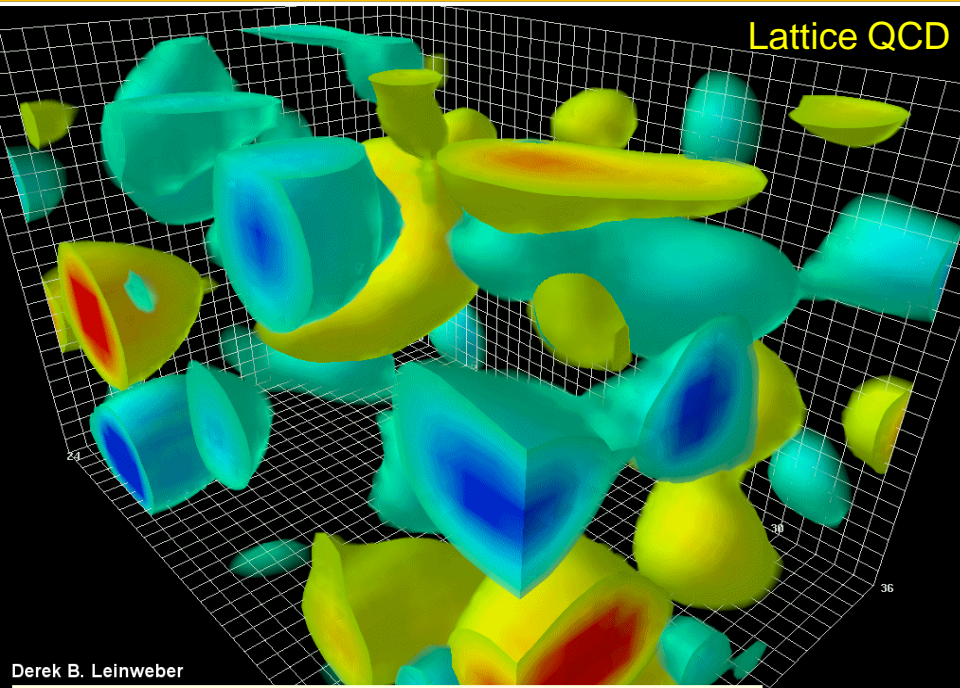
Brookhaven National Laboratory

SOI Meeting

June 11, 2018



RHIC Amazing QCD Machine: Many Species and Many Energies!



PHENIX

Mid-rapidity $J/\psi, \Upsilon \rightarrow e^+ e^-$

RICH

EMCal

PC

Forward rapidity: $J/\psi, \Upsilon \rightarrow \mu^+ \mu^-$

DC

Si-VTX

MuID

MuTr

Si-FVTX

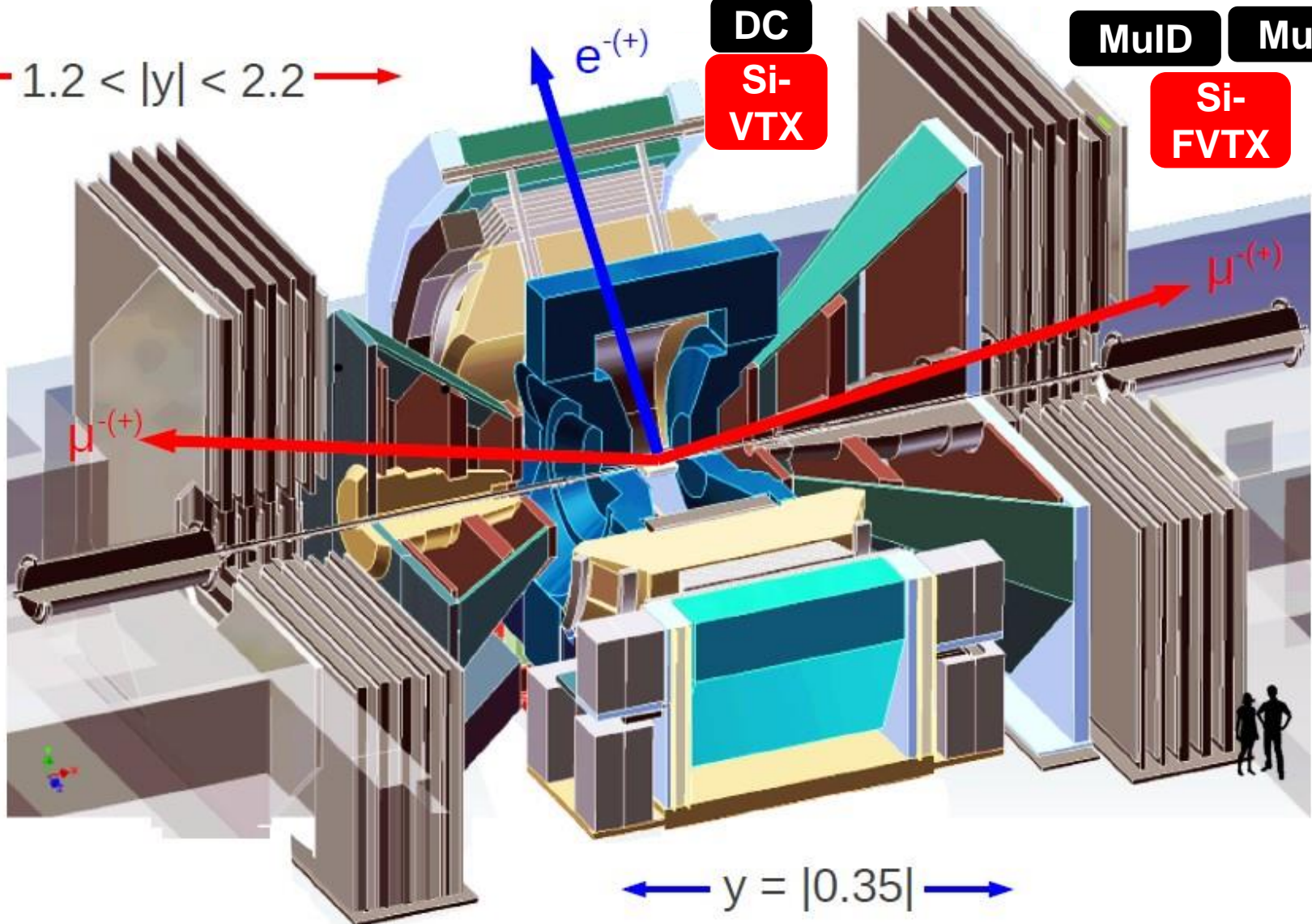
$1.2 < |y| < 2.2$

$e^{-(+)}$

$\mu^{-(+)}$

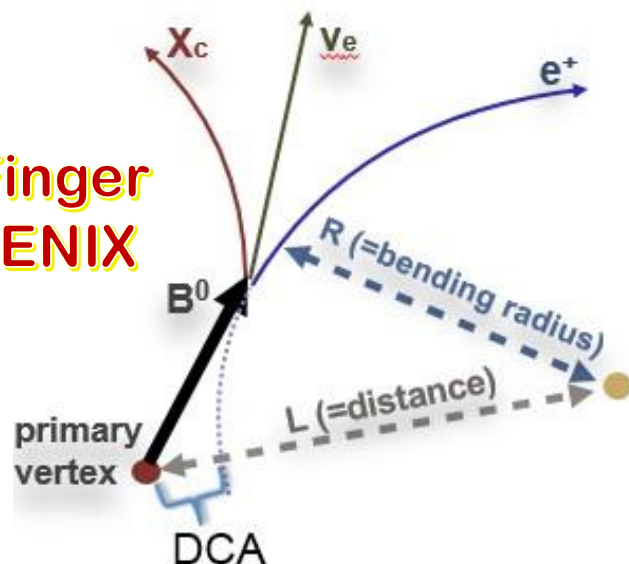
$\mu^{-(+)}$

$y = |0.35|$



PHENIX: Central Heavy Flavor Tracker

Manabu's Finger
Print at PHENIX



DCA_T Distributions: b/c separation

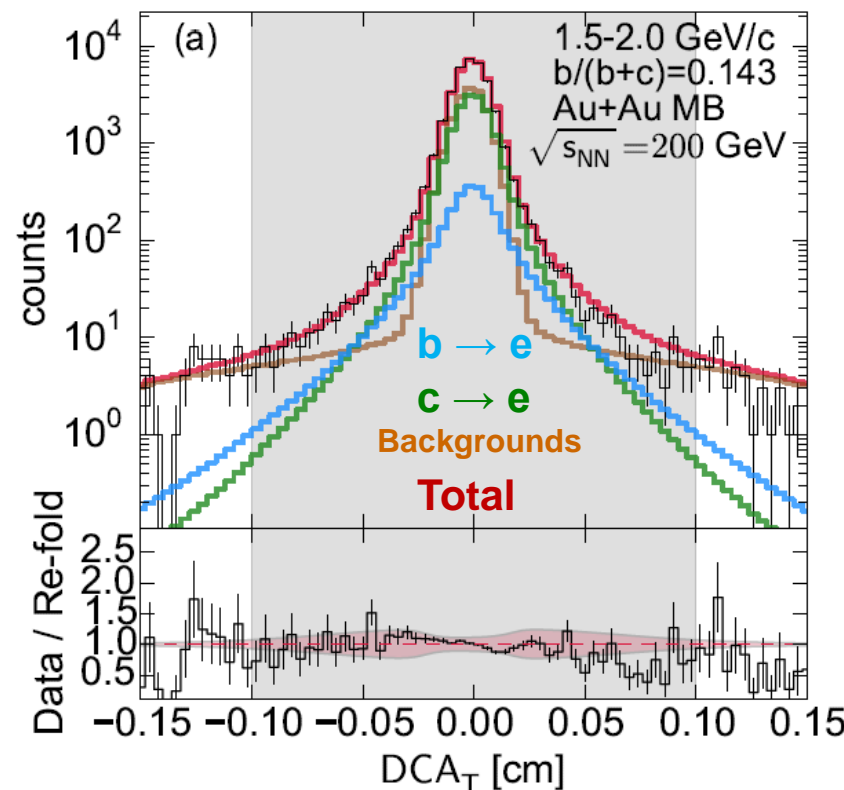
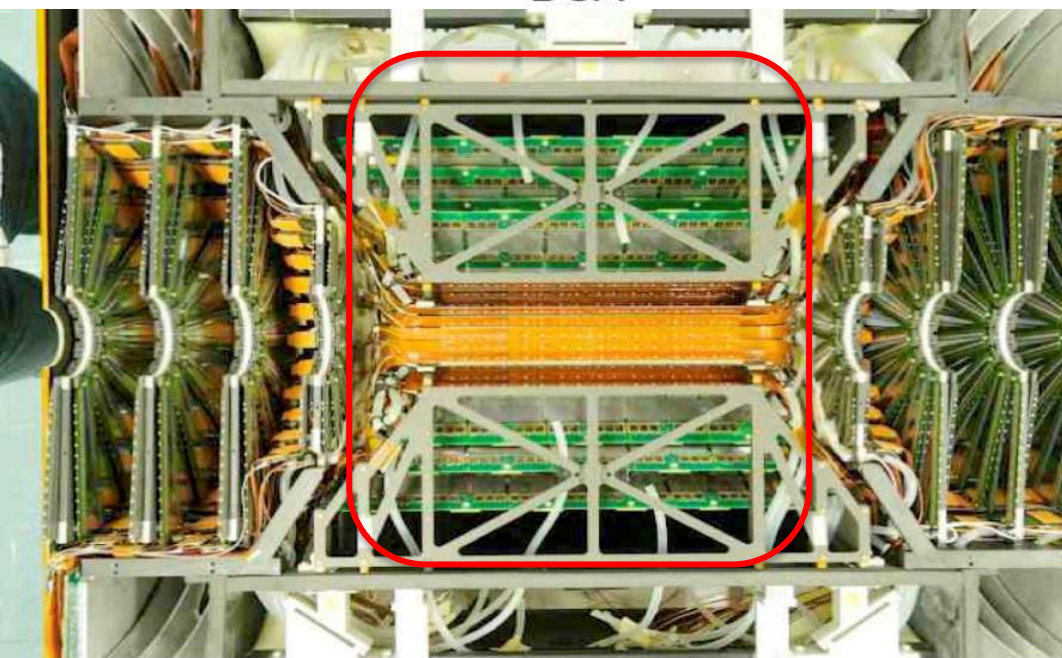
- VTX: $|\eta| < 1.2$
 - Au+Au 200 GeV: DCA_T resolution $\sim 60 \mu\text{m}$

Life time ($c\tau$)

D^0 : 123 μm

B^0 : 464 μm

PHENIX: PRC 93, 034904 (2016)



STAR

EEMC

Magnet

MTD

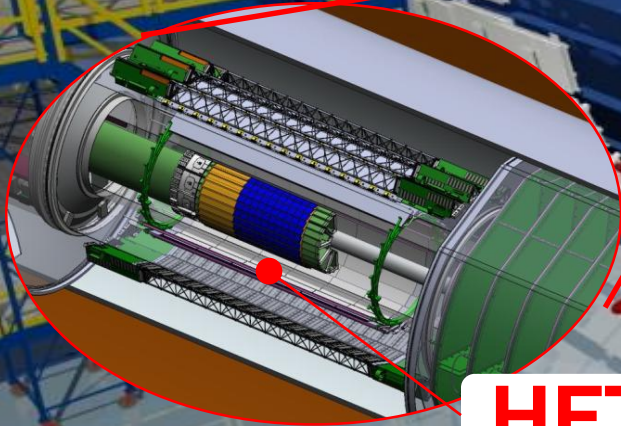
BEMC

TPC

TOF

VPD

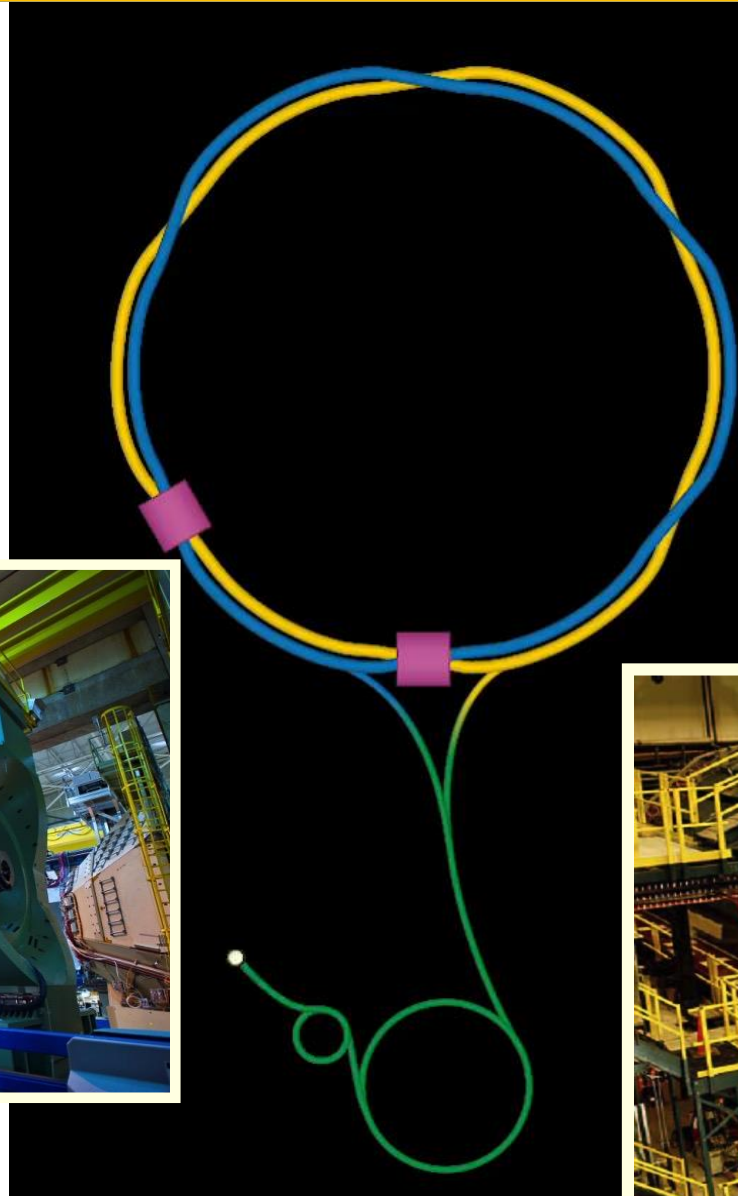
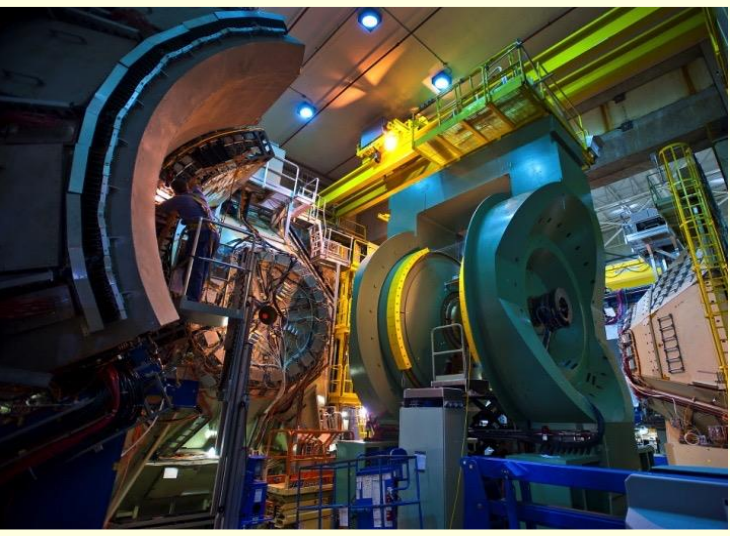
BBC



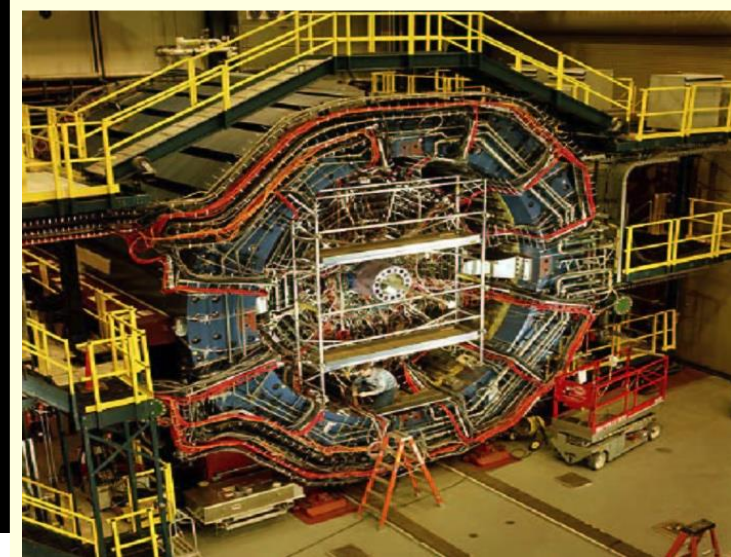
HFT

TPC/TOF/BEMC: $|\eta| < 1$
HFT: $|\eta| < 1$
MTD: $|\eta| < 0.5$

PHENIX
2000-2016



STAR
2000-
to present

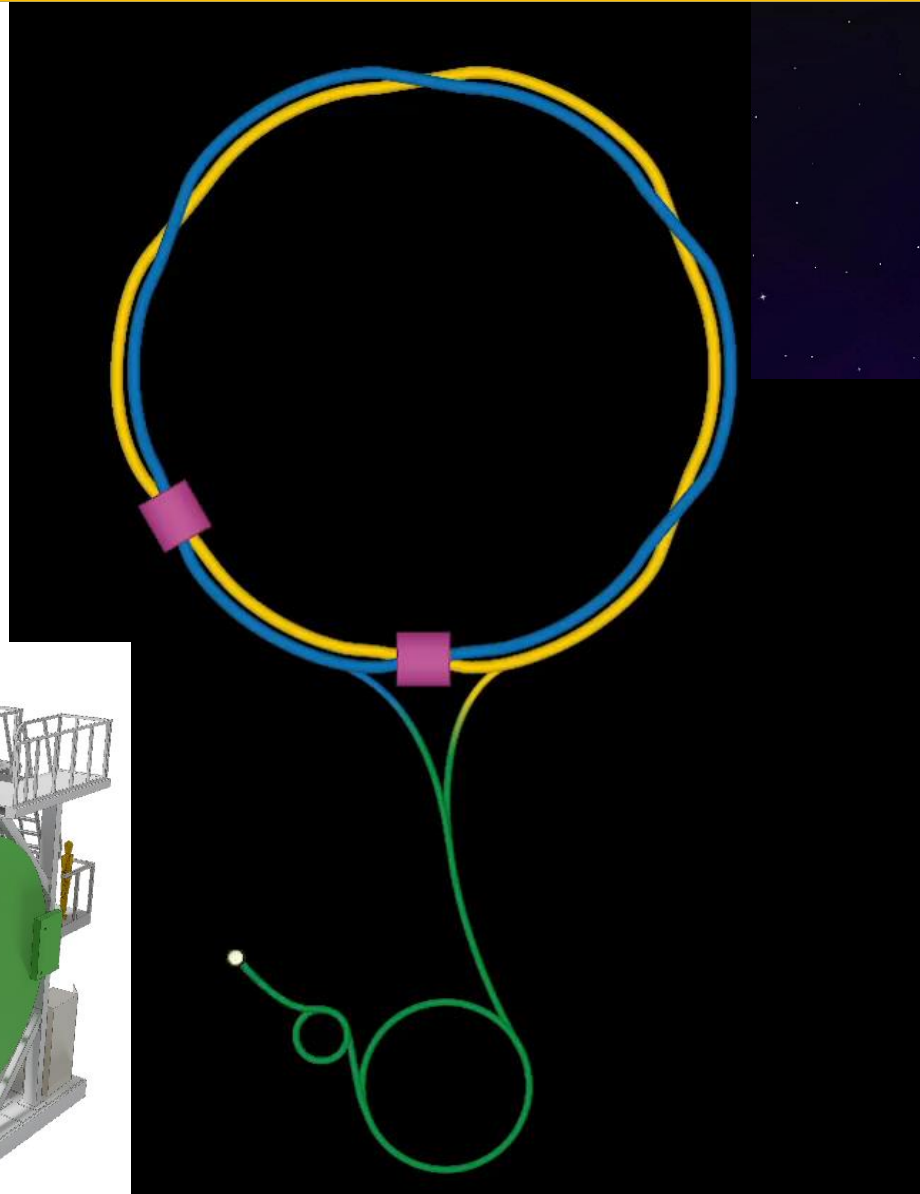
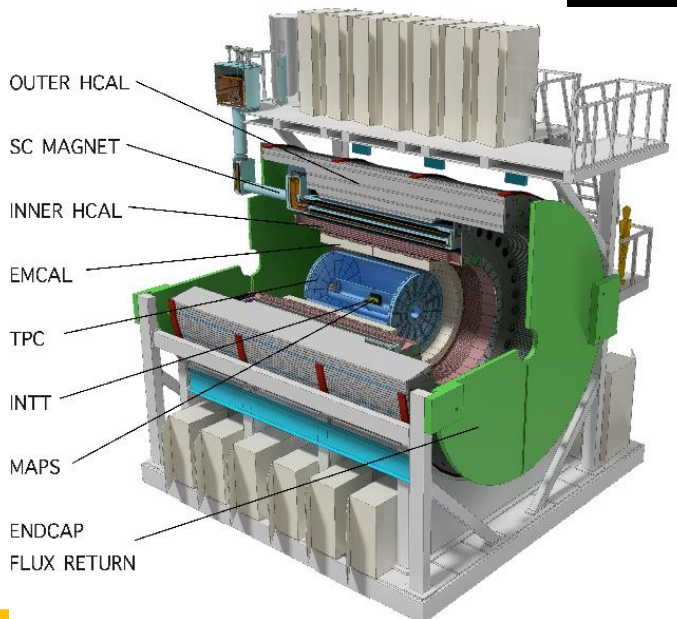


New Detector at RHIC-II

sPHENIX

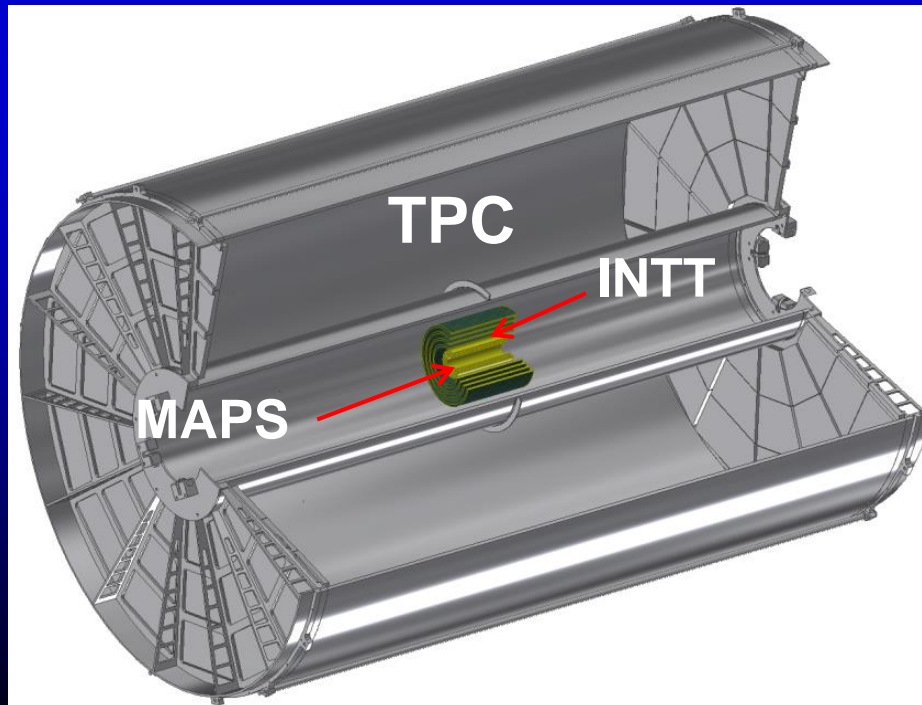
2016-2023
construction

2023 – 2029
(when EIC start)



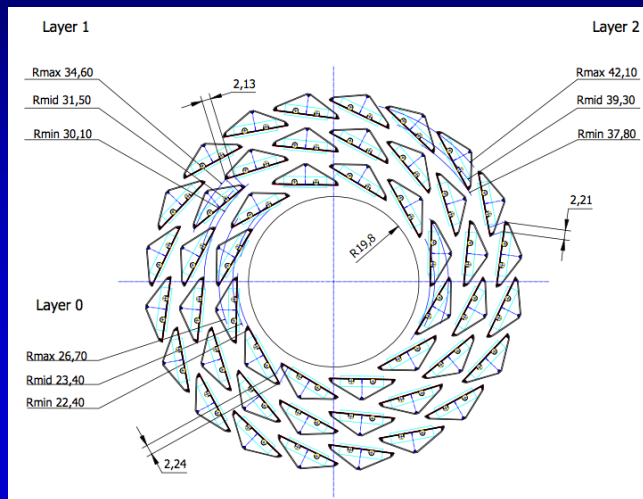
sPHENIX: Importance of Tracking

Physics Goal	Detector Requirement
Fragmentation Functions	Excellent Momentum Resolution: $dp/p \sim 0.2\%p$ to $> 40 \text{ GeV}/c$
Jet Substructure	Excellent track pattern recognition
Distinguish Upsilon States	Mass resolution: $\sigma_M < 100 \text{ MeV}/c^2$
HF jet tagging	Precise DCA resolution $\sigma_{DCA} < 100 \mu\text{m}$
High Statistics Au+Au 200 GeV	Handle multiplicity and full RHIC luminosity



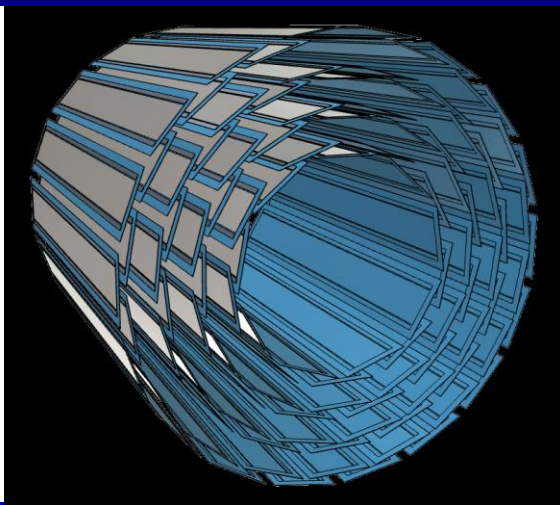
sPHENIX: Tracking Subsystems

MAPS



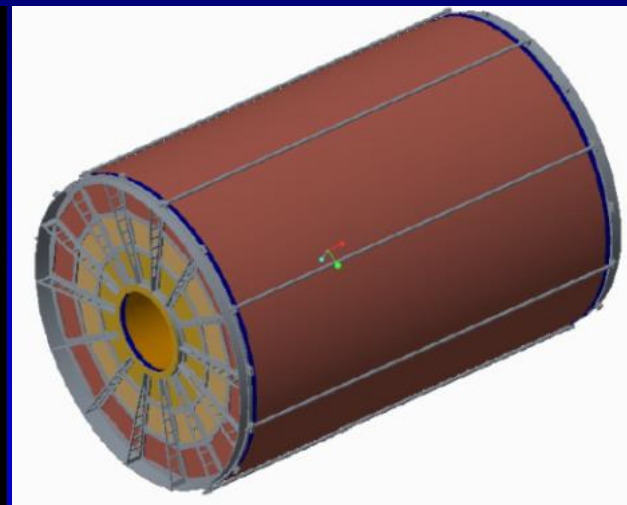
- 3 layers Si sensors
- Based on ALICE ITS upgrade
- $DCA_{xy} < 70 \mu\text{m}$
- $|z_{\text{vtx}}| < 10 \text{ cm}$

INTT



- 4 layers Si strips
- Use PHENIX-FVTX electronics
- Pattern recognition, DCA, connect tracking systems, reject pile-up
- Trigger

TPC



- Radius 20–78 cm
- $\sim 250 \mu\text{m}$ effective hit resolution
- Continuous (non-gated) readout
- Pattern recognition, momentum resolution, p_T 0.2-40 GeV/c

RHIC collider at BNL has a bright future → Electron-Ion Collider (EIC)

ENERGY.GOV

SCIENCE & INNOVATION

ENERGY ECONOMY

SECURITY & SAFETY



SAVE ENERGY, SAVE MONEY



Department of Energy

U.S. Department of Energy Selects Brookhaven National Laboratory to Host Major New Nuclear Physics Facility

JANUARY 9, 2020

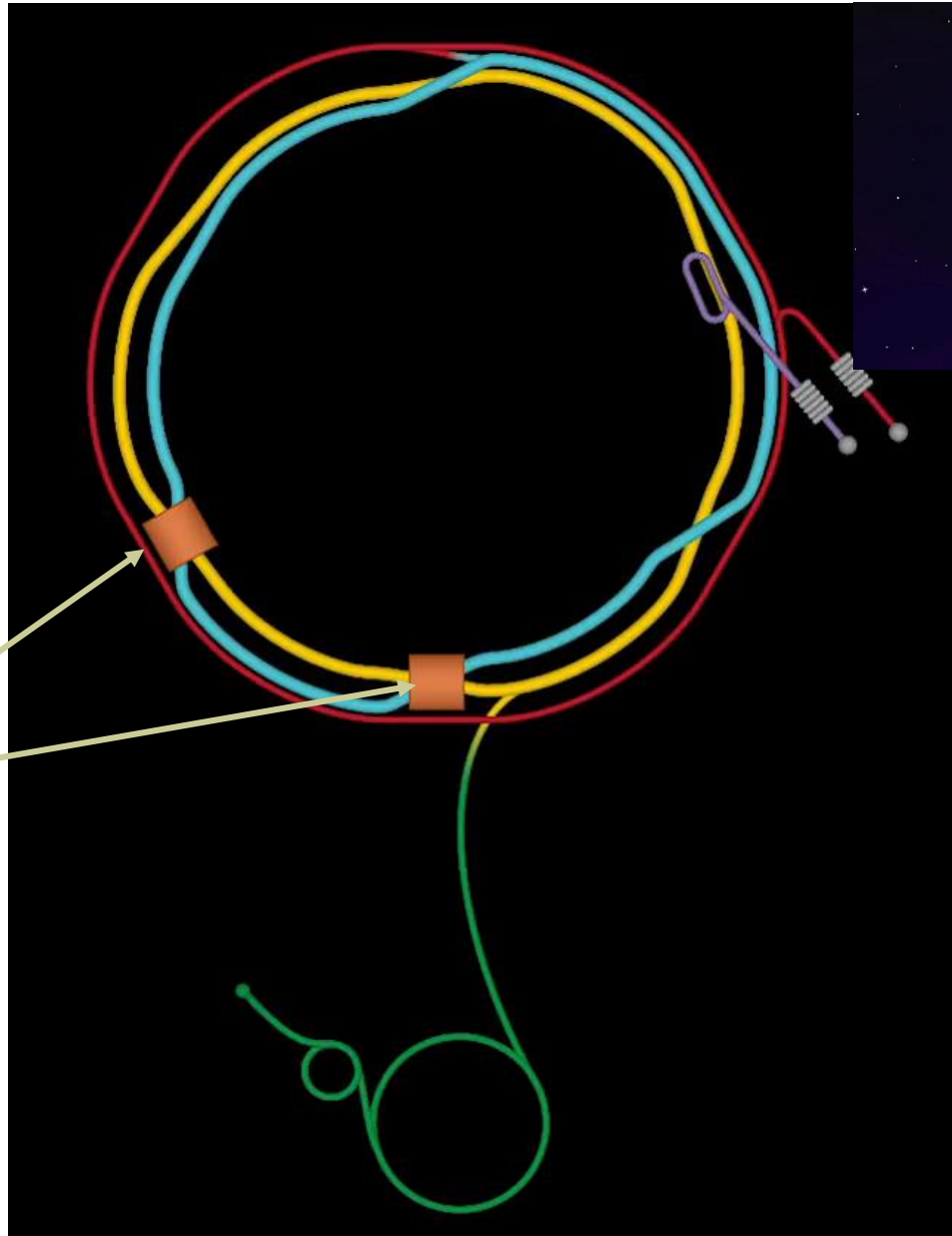


[Home](#) » U.S. Department of Energy Selects Brookhaven National Laboratory to Host Major New Nuclear Physics Facility

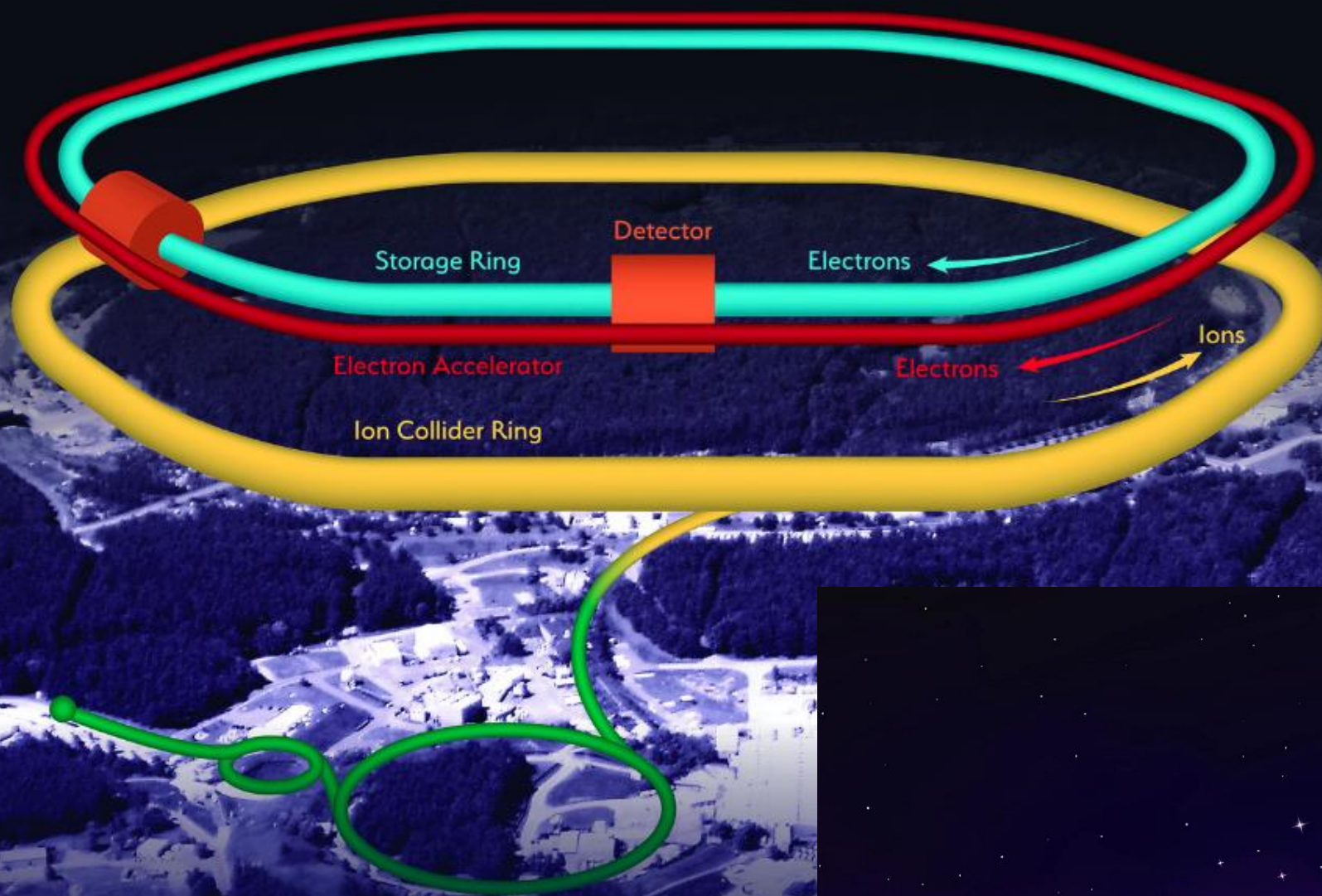
WASHINGTON, D.C. – Today, the **U.S. Department of Energy (DOE)** announced the selection of Brookhaven National Laboratory in Upton, NY, as the site for a planned major new nuclear physics research facility.

The Electron Ion Collider (EIC), to be designed and constructed over ten years at an estimated cost between \$1.6 and \$2.6 billion, will smash electrons into protons and heavier atomic nuclei in an effort to penetrate the mysteries of the “strong force” that binds the atomic nucleus together.

Two
experiments

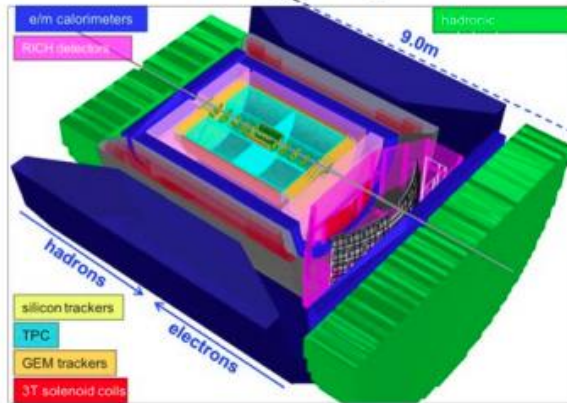


EIC Concept

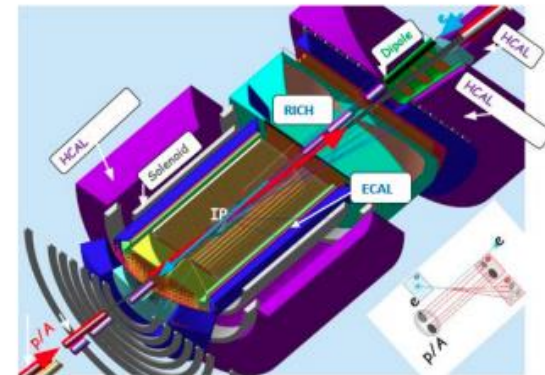


Current EIC General Purpose Detector Concepts

Brookhaven concept: BEAST

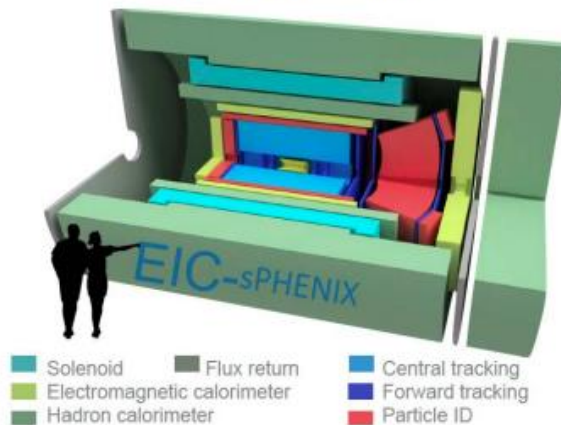


Jefferson lab concept: JLEIC

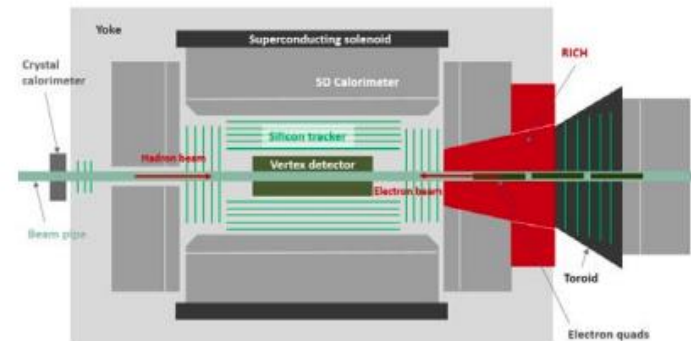


Courtesy of
Abhay
Deshpande

sPHENIX → EIC



Argonne concept: TOPSiDE



Critical Decision Process DOE

Courtesy of
Abhay
Deshpande

PROJECT ACQUISITION PROCESS AND CRITICAL DECISIONS						
Project Planning Phase			Project Execution Phase			Mission
Preconceptual Planning	Conceptual Design	Preliminary Design	Final Design	Construction	Operations	
	i CD-0 Approve Mission Need	i CD-1 Approve Preliminary Baseline Range	i CD-2 Approve Performance Baseline	i CD-3 Approve Start of Construction	i CD-4 Approve Start of Operations or Project Closeout	

Expected
Soon (2019)

Technical
feasibility
(~2029)

CD-0	CD-1	CD-2	CD-3	CD-4
Actions Authorized by Critical Decision Approval				
<ul style="list-style-type: none"> Proceed with conceptual design using program funds Request PED funding 	<ul style="list-style-type: none"> Allow expenditure of PED funds for design 	<ul style="list-style-type: none"> Establish baseline budget for construction Continue design Request construction funding 	<ul style="list-style-type: none"> Approve expenditure of funds for construction 	<ul style="list-style-type: none"> Allow start of operations or project closeout

January 11th, 2019

PED: Project Engineering & Design

The US Electron Ion Collider Project: Abhay Deshpande

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**The main question that we hope to get
an answer during the discussion
session at the end of this meeting:**

**Is a 4π Monolithic Pixel Silicon Tracker
in SOI technology
would satisfy some of
EIC Physics requirements?**