AFRICA AND THE EIC

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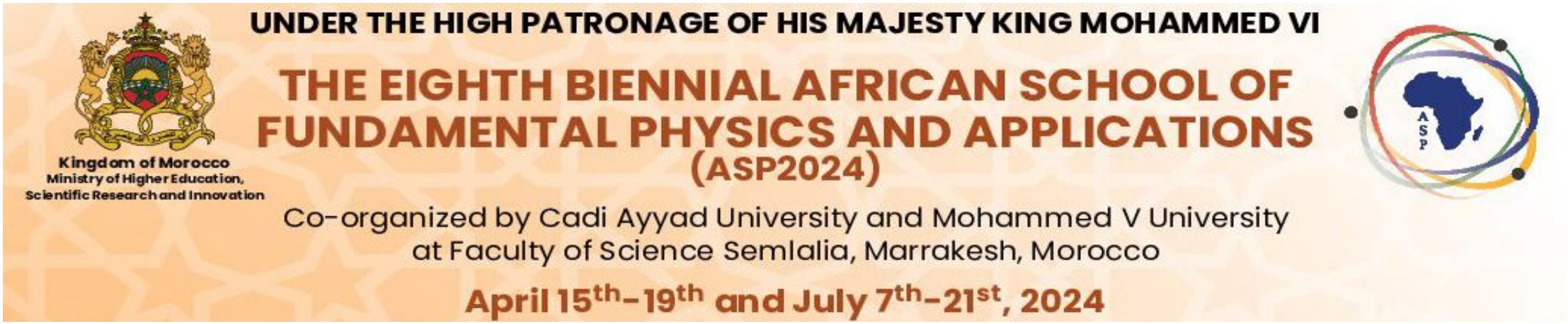


OUTLINE

EIC Overview
- What is EIC?
- EIC synopsis
- EIC site

Africa and EIC Research
- Africa overview and research output
- Africa's EIC physics research plans/objectives
- Africa's EIC Institutions

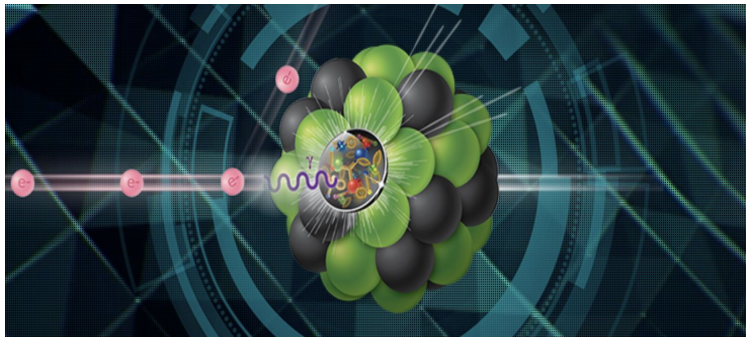
EIC User Group - EICUG
- EIC User Community
- EIC-Africa Community Expansion Opportunities

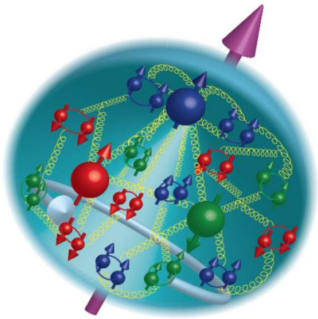
Summary

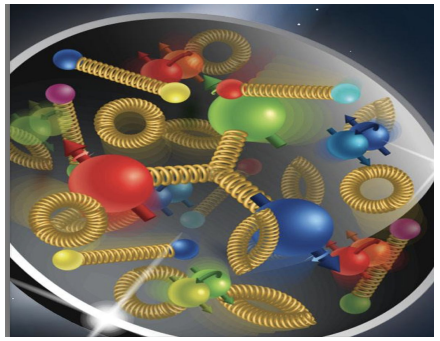
EIC OVERVIEW

What is EIC?

- **EIC** - **E**lectron **I**on **C**ollider
- Machine being designed to unlock secrets of the strongest force in nature.
- **Particle accelerator machine:** collider of electrons with protons/nuclei to reveal internal structure (quarks & gluon) snapshots - like atoms CT scanner.







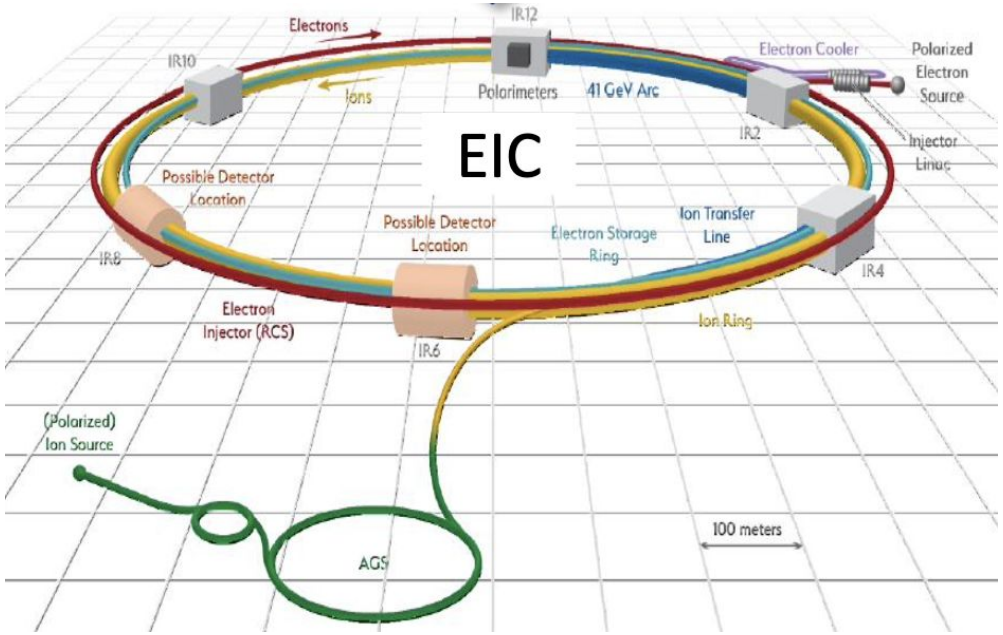
- **EIC** - planned for construction at **Brookhaven National Laboratory (BNL)** in partnership with **Jefferson Lab (JLab)** in the **United States** with the support of the **Department of Energy (DoE).**

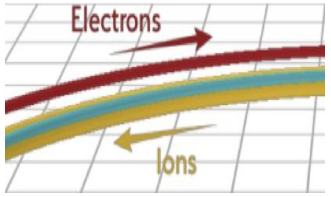
EIC OVERVIEW

EIC Synopsis

EIC will consist of two intersecting accelerators:

- One accelerator producing an intense beam of **electrons**
- Other a beam of **protons or heavier atomic nuclei**
- Two beams steered into head-on collisions





EIC Project Requirements:

- Highly polarized beam: **70%**
- Large centre of mass energy range - **E_{cm} = 20 - 140 GeV**
- Large ion species range: **protons - uranium**
- High luminosity: **$L = 10^{33} - 10^{34}$ $cm^{-2}sec^{-1}$**
- Large detector acceptance and good background conditions.

EIC Site

Brookhaven National Laboratory (BNL) - New York, Long Island, United States

BNL to host the Electron Ion Collider

Africa Overview and Research Output

Africa Overview

- World's second-largest and second-most populous continent after Asia.
- Area - 30, 370, 000 km^2
- Population - 1, 393, 676, 444 (2021) *https://population.un.org/wpp/*

Africa Research Output

Despite Africa's second-largest land size and population globally:

- Continent's research output remains the lowest ~ 1%
  https://doi.org/10.48550/arXiv.2206.15171

To develop economically, technologically, socially and politically, higher education and scientific research are not options.
https://doi.org/10.48550/arXiv.2206.15171

With investment in scientific research, deadly diseases, poverty, and major effects of climate change - countered.

EIC research benefits include technological breakthroughs with broad-range impact on human health and national challenges.

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Young Physicists Forum and the Importance for Education and Capacity Development for Africa

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Abstract

Higher education and advanced scientific research lead to social, economic, and political development of any country. All developed societies like the current 2022 G7 countries: Canada, France, Germany, Italy, Japan, the UK, and the US have all not only heavily invested in higher education but also in advanced scientific research in their respective countries. Similarly, for African countries to develop socially, economically, and politically, they must follow suit by massively investing in higher education and local scientific research.

Keywords: Young Physicists Forum, YPF, African Strategy for Fundamental and Applied Physics, ASFAP, Second Edition of the African Conference on Fundamental and Applied Physics, ACP2021, African School of Physics, ASP, Physics Working Groups, YPF-Survey

NOTE THAT:

- **Every-day use of computers and smartphones** depends on what we have learned about the atom.

- **All information technology** - and much of our economy today - relies on understanding the electromagnetic force (EM) between the atomic nucleus and electrons that orbit it.

Justifiable reasons Brookhaven National Laboratory is building a new machine, an electron ion collider (EIC) - to look inside the nucleus of an atom and its protons and neutrons (nucleons).

Africa's EIC Physics Research Plans/Objectives:

- Contribute to EIC **detector design**, **simulations** and **development** of the experimental data-analysis software kit.
- **Study of generalized parton distributions (GPDs)** - GPDs provide three-dimensional description of nucleon constituents: quarks and gluons.
- **Study of factorization, jet broadening and parton energy loss** in electron-proton (ep) and electron-nucleus (eA) collisions.
- **Extension of comprehensiveness of high-dimensional phase space integration** taking into account radiations from the initial and final states occurring in electron-ion collisions using Monte Carlo integration method.
- **Study of final state particle production mechanisms via spin asymmetries** following initial state electron-proton (ep), electron-nuclei (eA) particle collisions.

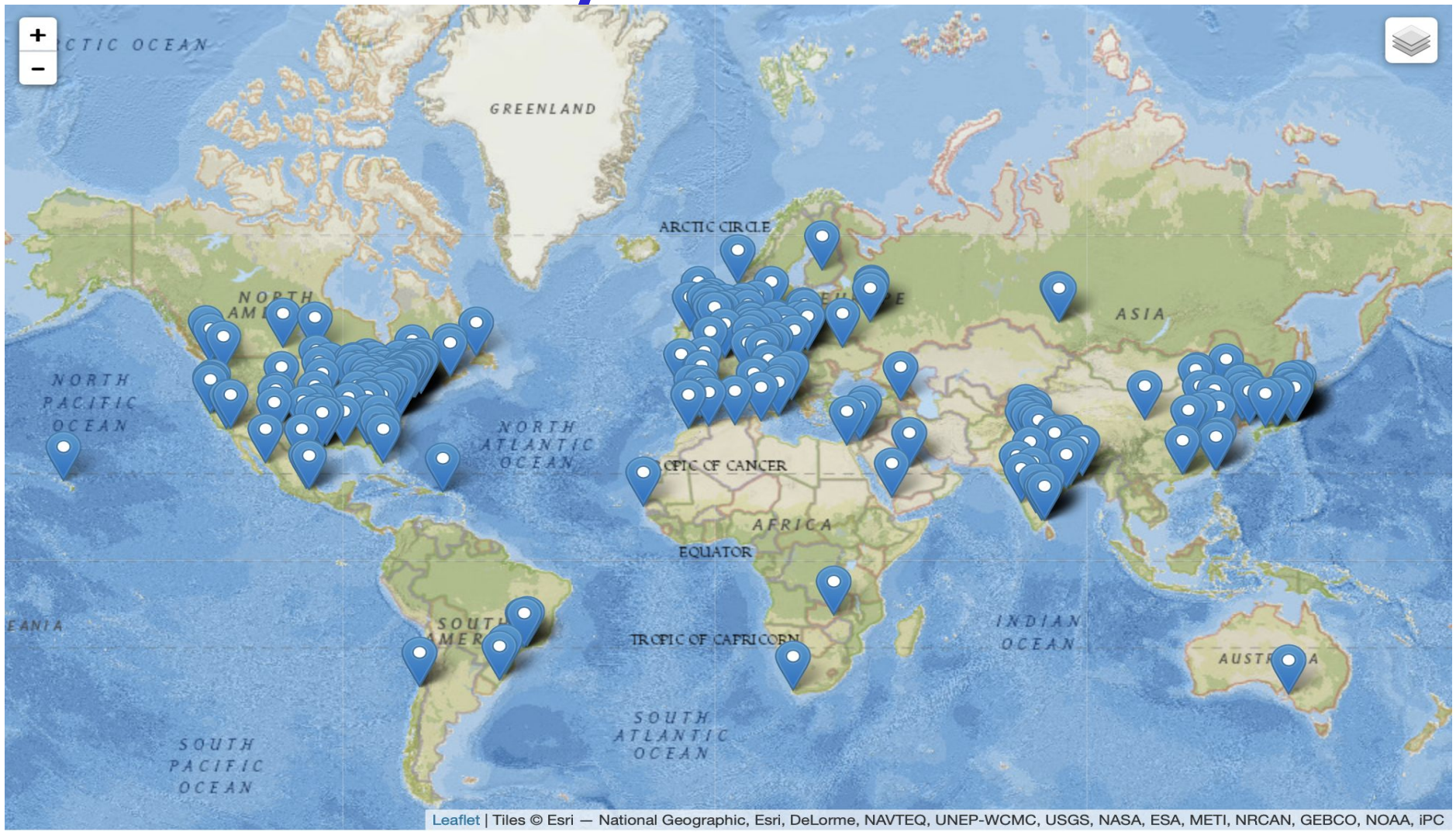
Africa's EIC Institutions

S/N	African EIC Institution	African Country	Institution representative
1.	Faculty of Sciences, University Mohammed V in Rabat	Morocco	Yahya Tayalati
2.	Faculty of Sciences, University Ibn-Tofail	Morocco	Mohamed Gouighri
3.	University Mohammed First in Oujda, Faculty of Sciences	Morocco	Abdelilah Moussa
4.	American University in Cairo	Egypt	Ahmed Hamed
5.	Egyptian Centre for Theoretical Physics	Egypt	Abdel Nasser Tawfik
6.	University Mohamed Boudiaf of M'sila	Algeria	Essma Redouane Salah
7.	Faculty of Sciences of Monastir	Tunisia	Malek Mazouz
8.	University Cheikh Anta Diop	Senegal	Oumar Ka
9.	University of Cape Town	South Africa	William Horowitz
10.	University of Zambia	Zambia	Benard Mulilo

EIC User Community

- **EIC user group** - vibrant scientific physics community.
- Consists of an international community - **user group now stands at 1, 537 members.**
- **1010** experimental scientists, **377** theory scientists, **133** accelerator scientists, **10** computer scientists, **4** support staff and other - **3**.
- **Members** are from over **297 institutions** in **40 countries** from **6 world regions.**
- **Ten (10)** of the **297 institutions** globally are African institutions from **7 African countries.**
- **EIC user community** is still growing.

EIC User Community - Global Locations



EIC-Africa Community Expansion Opportunities

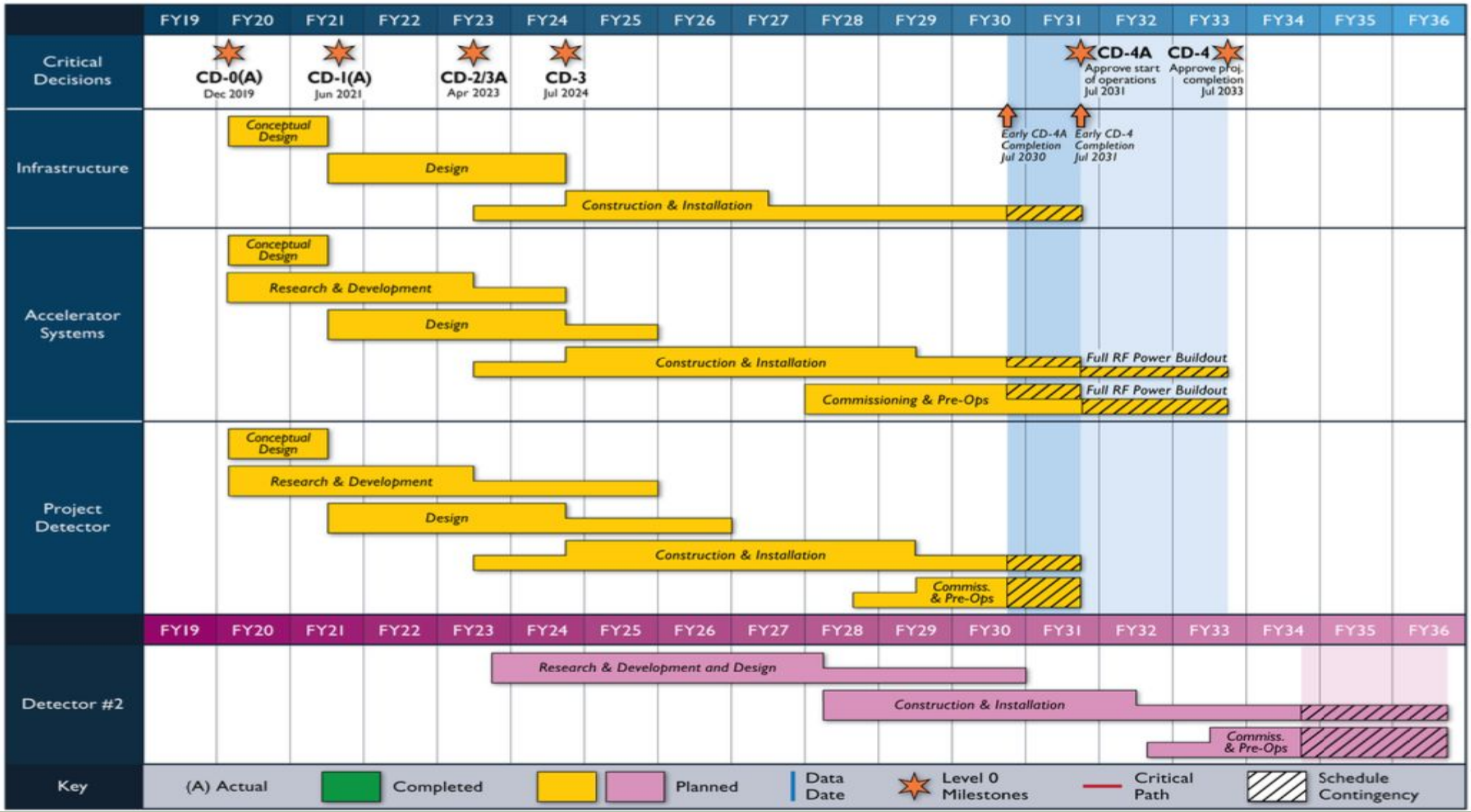
- African institutions and institutions outside Africa with research interest in nuclear, particle and high-energy physics are **free to join, contribute and benefit from the new physics to be discovered by the EIC machine.**
- Minimum qualification for an institution to join the EIC - **form a physics research group within your institution with at least one member, particularly, an institution representative, having a background of particle and high-energy physics.**
- Group members may consist of academic and technical staff including postdocs, postgraduate masters and doctoral students. **New institutions can also collaborate with already existing institutions and work together.**
- Great opportunity for **postgraduate students (Masters & PhD)** to do research with EIC.

SUMMARY

- **EIC** - discovery machine to unlock the secrets of the "glue" or force that binds the building blocks of visible matter in the universe.
- **EIC** - will comprise intersecting accelerators: one producing intense beam of electrons, the other a beam of protons or heavier atomic nuclei that will be steered into head-on collisions.
- **Beyond sparking scientific discoveries in fundamental physics**, the EIC will trigger technological breakthroughs having broad-ranging positive impact on human health and other societal challenges.
- **Powerful and unique tools of the EIC** will cast fresh light on the forces that bind nucleons (protons and neutrons) together to form nuclei.
- **To join EIC collaboration**, contact the EIC PhoneBook manager at: **register@eicug.org**

Glad to be associated with ASP2024 - Contact benard.mulilo@gmail.com for any query.

BACKUP



Electron Ion Collider Schedule - Courtesy of Andrei Seryi EIC schedule slide