I·AN Inter-American Network of Networks QCD

NSF EPSCoR

The Inter-American network of networks of QCD challenges

AccelNet: ***Accelerating Research through International Network-to-Network Collaborations***

Design phase: *2021 – 2026*
Implementation phase 1: *2025 – 2029*

I·AN Inter-American Network of Networks QCD

Program goals

(1) Develop strategic partnerships across the various physics research networks in the Americas to tackle QCD challenges;

(2) Identify the needs, strengths and synergies of network partners for developing large scale science projects in the US;

(3) Design activities for researchers in the U.S., Canada, and Latin America that will facilitate leveraging complementary resources for QCD research, and

(4) Enhance the training of the next generation of researchers in a novel set of skills that include international multi-team experience.

I·AN Inter-American Network of Networks QCD

Research areas related to QCD

- Accelerator technologies
- Theory
- High performance computing
- Particle detectors, instrumentation and electronics
- Real-time event selection
- Software development, and development of Monte Carlo simulation
- AI and QIS tools

Leveraging resources to support the community of communities

Kick-off meeting at CFNS on Dec 16, 2021
120 participants
https://indico.bnl.gov/event/13562/

I·AN Inter-American Network of Networks QCD

List of invited networks

We are an open network: future networks can also participate

- Electron-Ion Collider User Group
- Jefferson Lab Users Association
- RHIC and AGS User's Group
- US LHC Users Association
- Association of Latin American Nuclear Physics and Applications (ALAFNA),
- Southeastern Universities Research Association (SURA)
- Latin American Association for High Energy, Cosmology and AstroParticle Physics
- Nuclear Physics and Applications (INCT-FNA)
- Rede Nacional de Física de Altas Energias (RENAFAE)
- Mexican Particle Accelerator Community (CMAP)
- EIC-Canada Collaboration
- California EIC Consortium

I·AN Inter-American Network of Networks QCD

List of invited network partners

We are an open network: future networks can also participate

- Center for Frontiers in Nuclear Physics (CFNS) at Stony Brook University & Brookhaven National Laboratory
- The Electron-Ion Collider Center at Jefferson Lab
- Center for Accelerator Science at Old Dominion University
- The ICTP South American Institute for Fundamental Research (ICTP-SAIFR)
- Canadian Institute of Nuclear Physics
- TRIUMF. Canada's Particle Accelerator Center
- The Institute of Nuclear Theory
- Center for Nuclear Femtography
- EIC Theory Institute at BNL

I·ANNQCD Network of Networks Inter-American

New phase of the program from September 2025

Track 1:

- Early career researchers workshop
- Bi-national or international meetings aligned to I.ANNQ QCD objectives
- Use case workshops (AI/QIS, detector R&D, theory-focused, etc)
- Short courses and mentoring sessions
- I.ANN QCD Summit, including science diplomacy

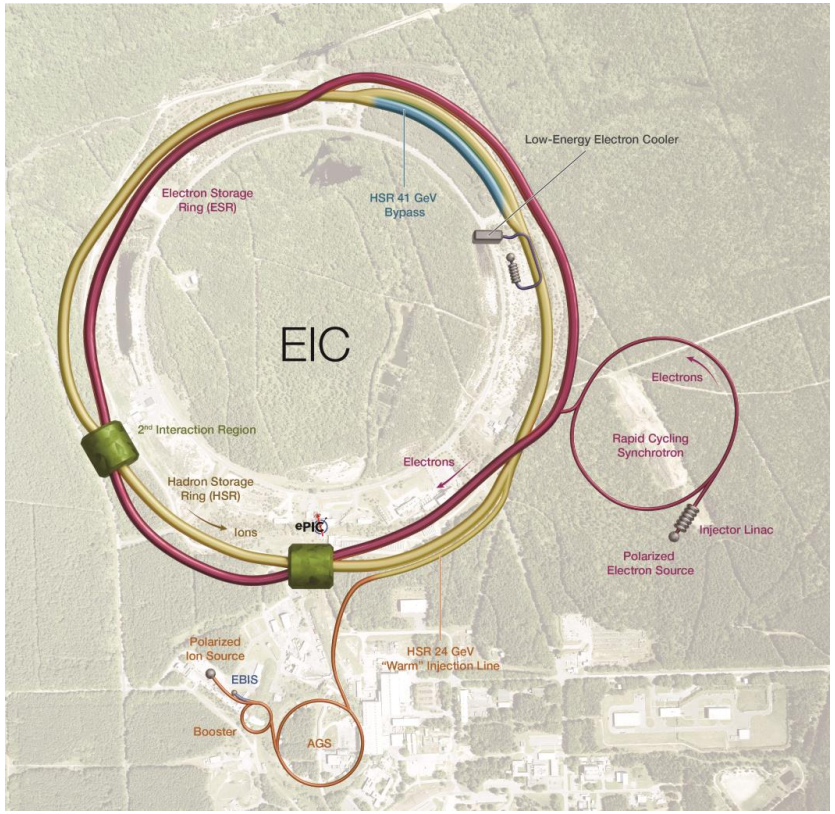
Track 2:

- Visiting and exchange programs
- QCD ambassadors program

New activities from 2025 based on community inputs from the initial phase!

The Electron-Ion Collider (EIC)

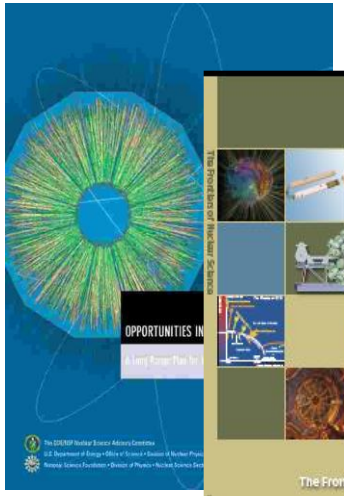
- Being Built at Brookhaven National Lab
- $1.7-2.8B investment
  - CD-1 (2021), CD-3A (2024), CD-3B (2025), CD-2/3 (2026)
- Explore the structure of matter via QCD:
  - Origin of Nucleon Mass & Spin
  - Confinement
  - Nucleon / Nuclear Femtography
  - Dense Gluon States
  - BSM
- Operations as soon as 2034



From John Lajoie

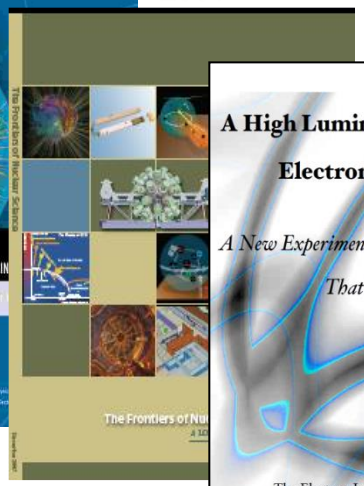
The Scientific Foundation for an EIC was Built Over Two Decades

2002



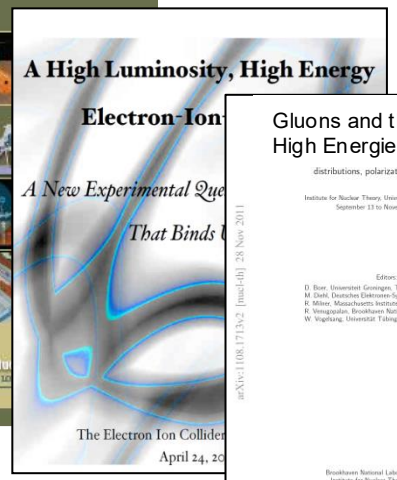
"…essential accelerator and detector R&D [for EIC] should be given very high priority in the short term."

2007



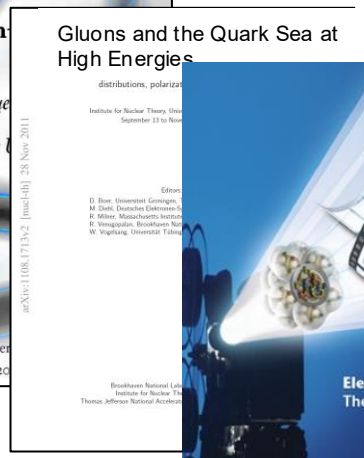
"We recommend the allocation of resources …to lay the foundation for a polarized Electron-Ion Collider…"

2009



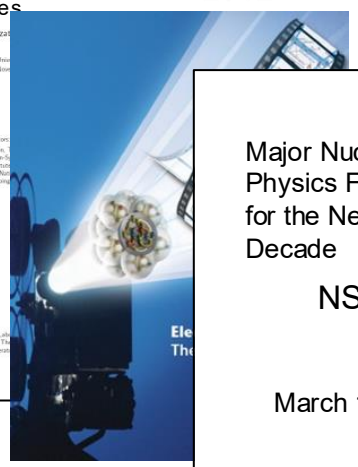
"..a new dedicated facility will be essential for answering some of the most central questions."

2010

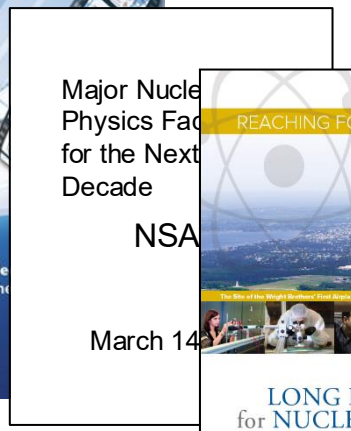


"The quantitative study of matter in this new regime [where abundant gluons dominate] requires a new experimental facility: an Electron Ion Collider.."

2012



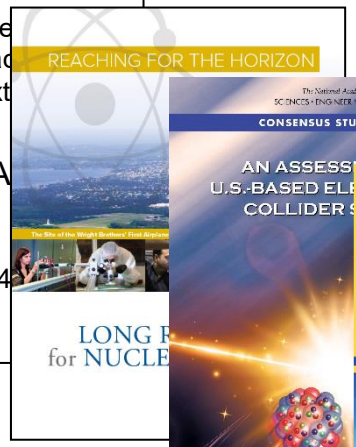
2013



Electron-Ion Collider..*absolutely central* to the nuclear science program of the next decade.

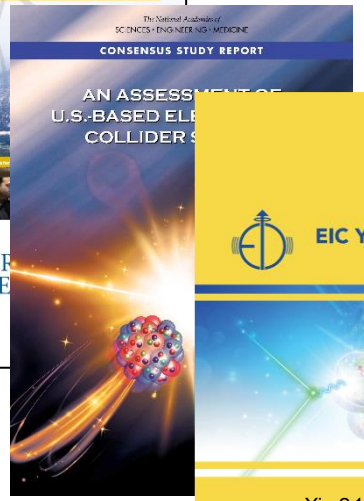
"a high-energy high-luminosity polarized EIC [is] the highest priority for new facility construction following the completion of FRIB."

2015



The science questions that an EIC will answer are central to completing an understanding of atoms as well as being integral to the agenda of nuclear physics today."

2018



Science Requirements and Detector Concepts for the EIC – Drives the requirements of EIC detectors

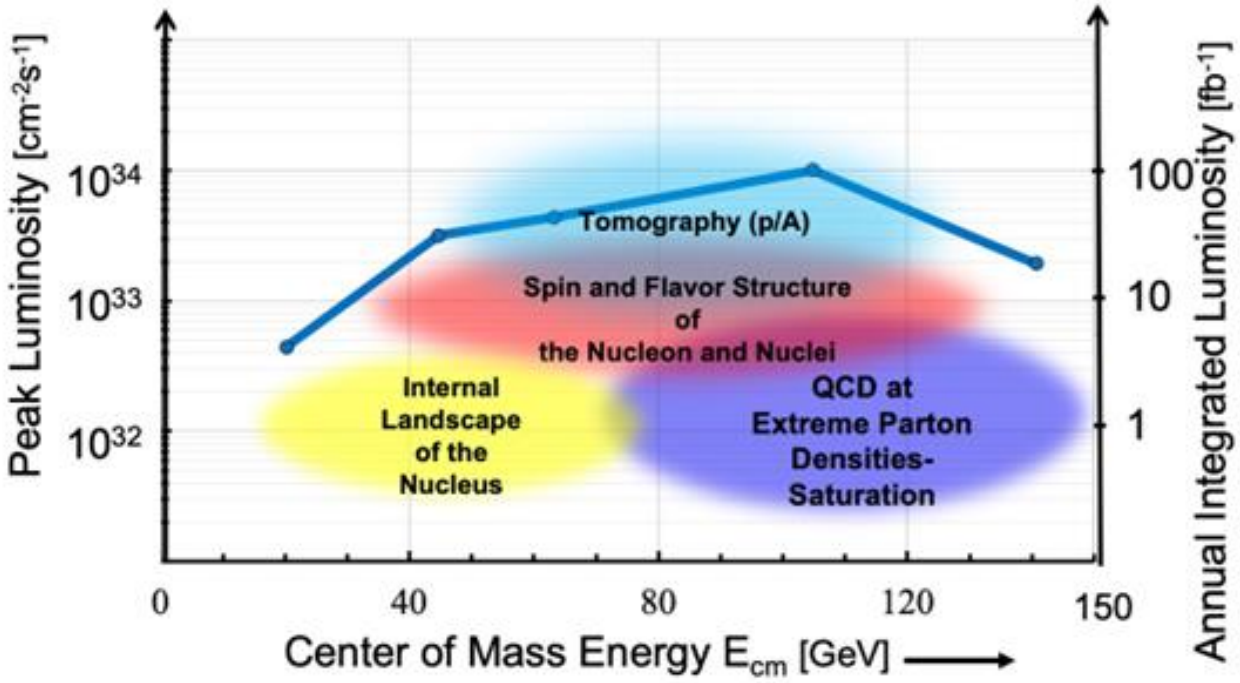
2021

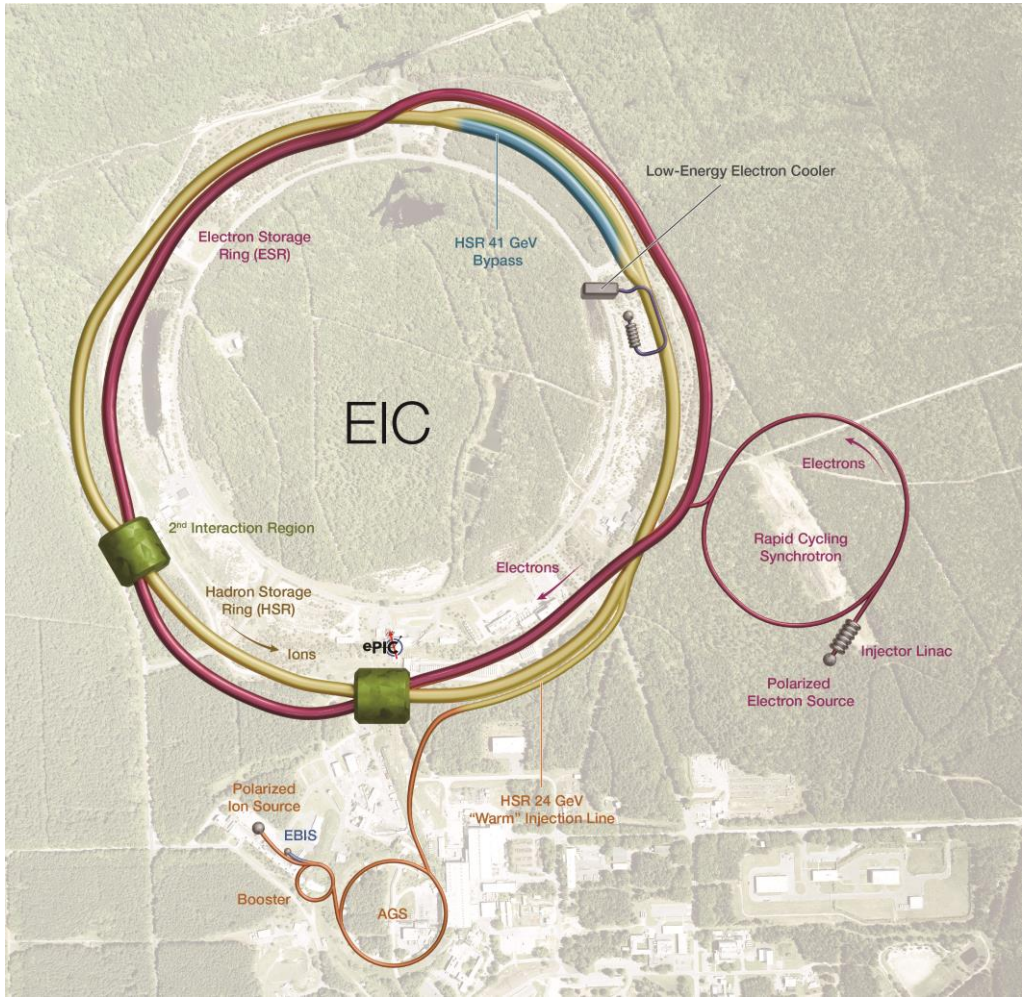
2023

We recommend the expeditious completion of the EIC as the highest priority for facility construction.

From John Lajoie

EIC Machine Parameters





- Center of mass energy: 28 – 140 GeV
  - Electrons: 5 – 18 GeV
  - Protons: 40 – 275 GeV (ions: Z/A x E_{proton})
- Luminosity: 10^{34} /cm^2/sec

- Polarization: <70% (both electron and ion)
- Ion Species: proton - Uranium
- Detectors: up to 2 interaction regions with (almost) complete coverage

From John Lajoie

EIC NAS Science Pillars

From John Lajoie

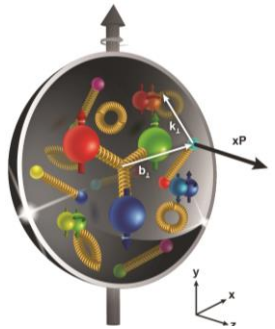
The EIC will unravel the different contribution from the quarks, gluons and orbital angular momentum

SPIN is one of the fundamental properties of matter.
All elementary particles, but the Higgs carry spin.
Spin cannot be explained by a static picture of the proton
It is the interplay between the intrinsic properties and interactions of quarks and gluons

Does the mass of visible matter emerge from quark-gluon interactions?

Atom: Binding/Mass = 0.00000001
Nucleus: Binding/Mass = 0.01
Proton: Binding/Mass = 100

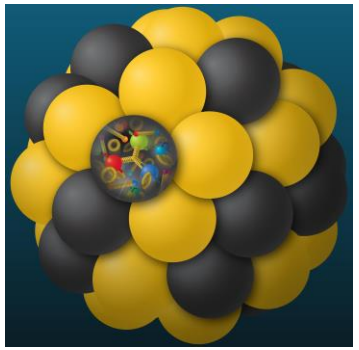
For the proton the EIC will determine an important term contributing to the proton mass, the so-called “QCD trace anomaly



How can we understand their dynamical origin in QCD?
What is the relation to Confinement

How are the quarks and gluon distributed in space and momentum inside the nucleon & nuclei?

How do the nucleon properties emerge from them and their interactions?

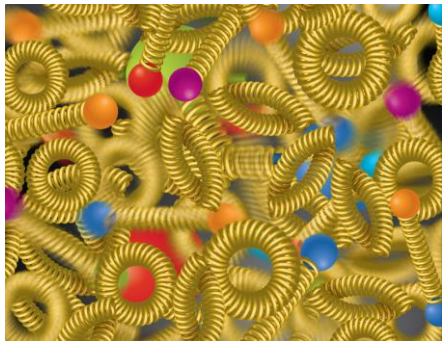


How do the confined hadronic states emerge from quarks and gluons?

Is the structure of a free and bound nucleon the same?

How do quarks and gluons, interact with a nuclear medium?

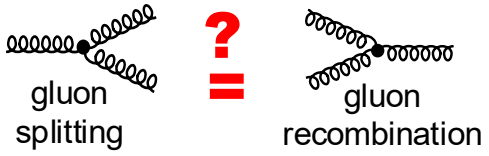
How do the quark-gluon interactions create nuclear binding?



What happens to the gluon density in nuclei? Does it saturate at high energy?

How many gluons can fit in a proton?

How does a dense nuclear environment affect the quarks and gluons, their correlations, and their interactions?



EIC Users Group

https://www.eicug.org

While Paper on the EIC Latin America (2024), mainly theory

https://arxiv.org/abs/2409.18407

arXiv > nucl-ex > arXiv:2409.18407

Search...

Help | Adv

Nuclear Experiment

[Submitted on 27 Sep 2024 (v1), last revised 29 Apr 2025 (this version, v2)]

The glue that binds us all -- Latin America and the Electron-Ion Collider

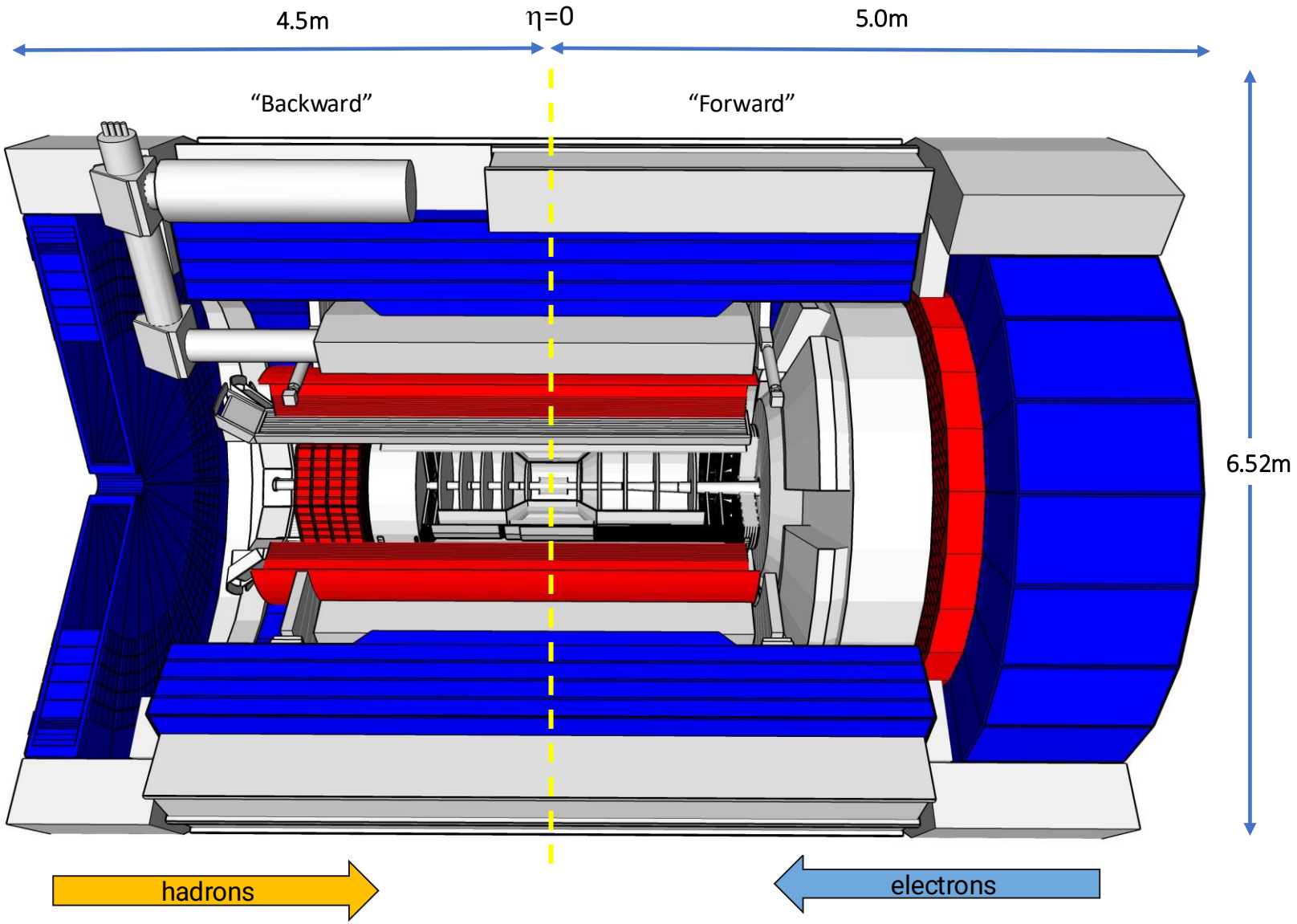
A. C. Aguilar, A. Bashir, J. J. Cobos-Martínez, A. Courtoy, B. El-Bennich, D. de Florian, T. Frederico, V. P. Gonçalves, M. Hentschinski, R. J. Hernández-Pinto, G. Krein, M. V. T. Machado, J. P. B. C. de Melo, W. de Paula, R. Sassot, F. E. Serna, L. Albino I. Borsa, L. Cieri, I. M. Higuera-Angulo, J. Mazzitelli, Á. Miramontes, K. Raya, F. Salazar, G. Sborlini, P. Zurita

The Electron-Ion Collider, a next generation electron-hadron and electron-nuclei scattering facility, will be built at Brookhaven National Laboratory. The wealth of new data will shape research in hadron physics, from nonperturbative QCD techniques to perturbative QCD improvements and global QCD analyses, for the decades to come. With the present proposal, Latin America based physicists, whose expertise lies on the theory and phenomenology side, make the case for the past and future efforts of a growing community, working hand-in-hand towards developing theoretical tools and predictions to analyze, interpret and optimize the results that will be obtained at the EIC, unveiling the role of the glue that binds us all. This effort is along the lines of various initiatives taken in the U.S., and supported by colleagues worldwide, such as the ones by the EIC User Group which were highlighted during the Snowmass Process and the Particle Physics Project Prioritization Panel (P5).

Comments: White Paper contribution to the Latin American Strategy Forum for Research Infrastructure (III LASF4RI). Updated version includes an extended discussion of the

Prepared for the Latin American Strate
Forum for
Research Infrastructure (LASF4RI) for
High Energy, Cosmology and Astropar
Physics (HECAP): Update of
the Strategic Plan 2024

ePIC Detector Design



Tracking:

- New 1.7T (2.0T) solenoid
- Si MAPS Tracker
- MPGDs (μRWELL/μMegas)

PID:

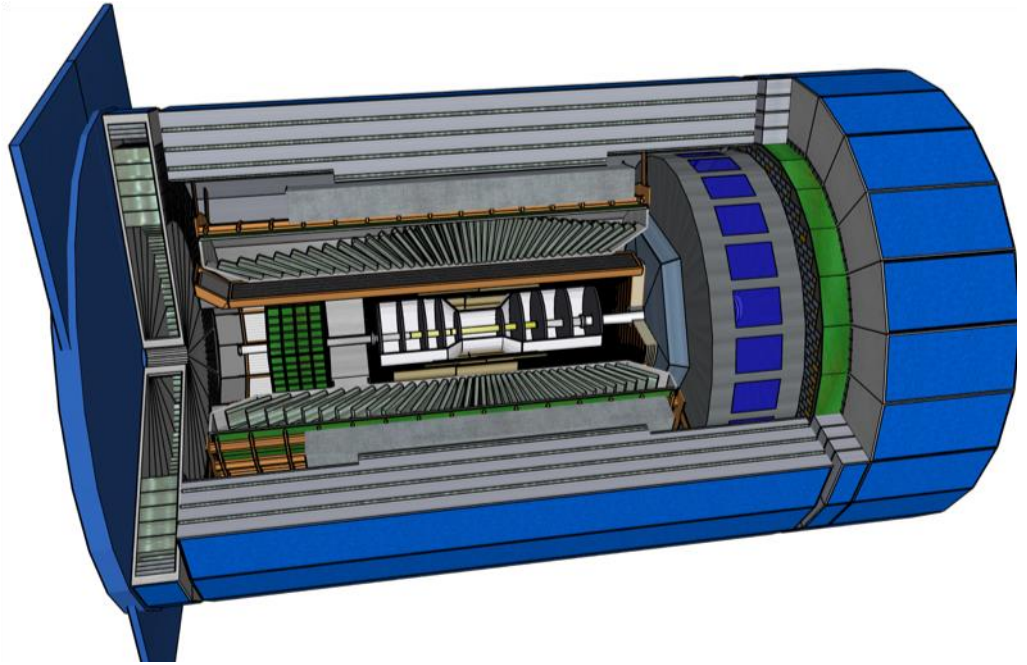
- high-performance DIRC
- proximity-focused RICH
- dual-radiator RICH
- AC-LGAD (~30ps TOF)

Calorimetry:

- Imaging Barrel EMCal
- PbWO4 EMCal (backwards)
- Finely segmented EMCal +HCal in forward direction
- Outer HCal (sPHENIX re-use)
- Backwards HCal (tail-catcher)

A Brief Timeline

- EICUG Yellow Report (2020-21)
- Call for proposals issued jointly by BNL and JLab in March 2021
  - Proposals due Dec. 1, 2021
  - ATHENA, CORE and ECCE proposals submitted
- Public DPAP meetings Dec. 13-15, 2021
  - Presentations from proto-collaborations
  - Panel-assigned homework questions
- Second DPAP session Jan. 19-21, 2022
- DPAP closeout March 8th, 2022
  - Final report available March 21st, 2022
  - ECCE proposal chosen as basis for Detector-1 reference design
- Spring/Summer 2022 – ATHENA and ECCE form joint leadership team
  - Joint WG's formed and consolidation process undertaken
  - Coordination with EIC project on development of technical design
- Collaboration formation process started July, 2022
  - First IB Meeting July 18th
  - Charter writing committee formed and active – DE&I built in from start!
- First ePIC Collaboration meeting July 26-29, 2022



ePIC Detector

- To be sited at IP6 (25mr crossing angle)
- Addresses EIC science program as outlined in the EIC white paper and NAS report
- Must be ready for Day-1 EIC operations
- Working towards pre-TDR and CD-2/3A

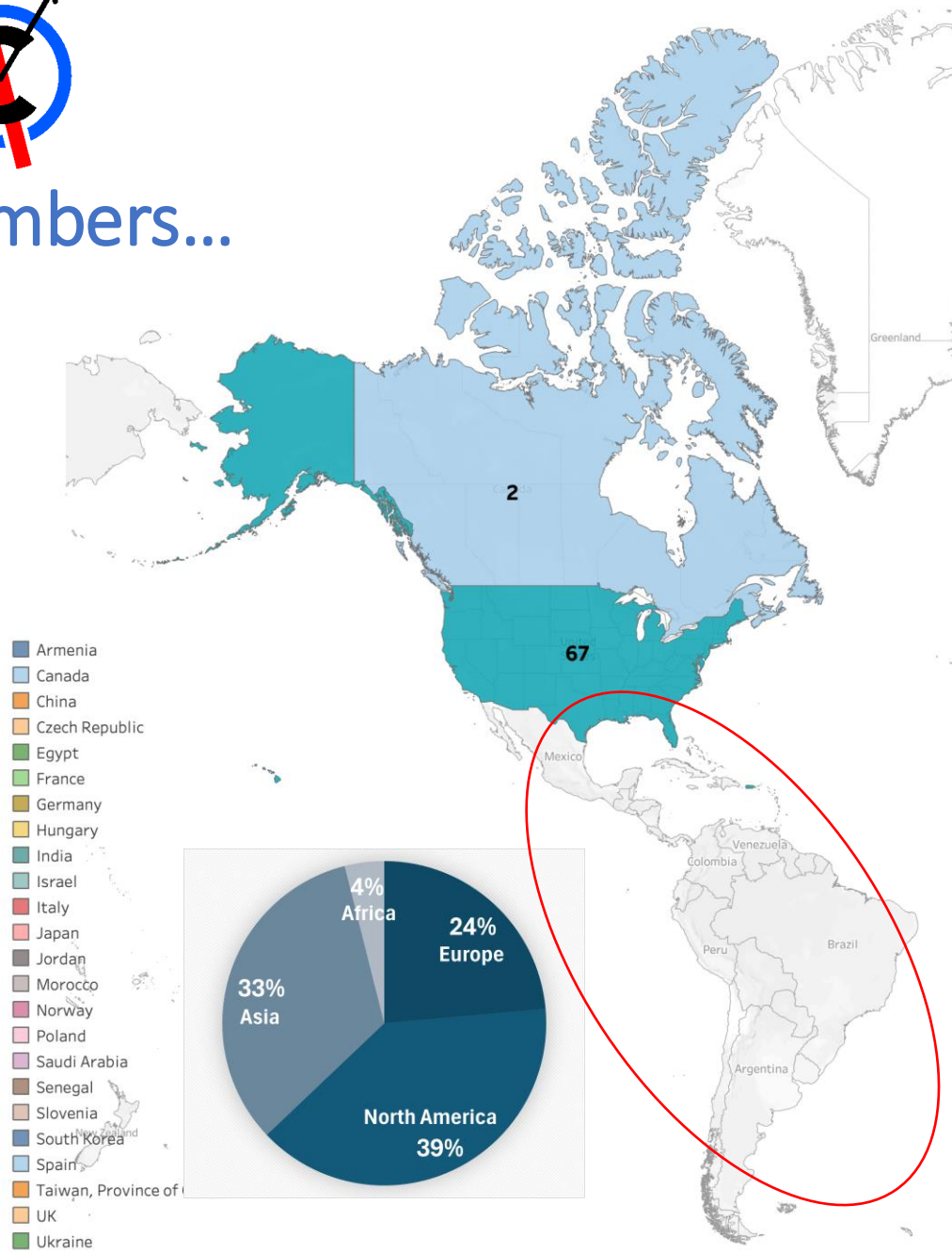
By the numbers…

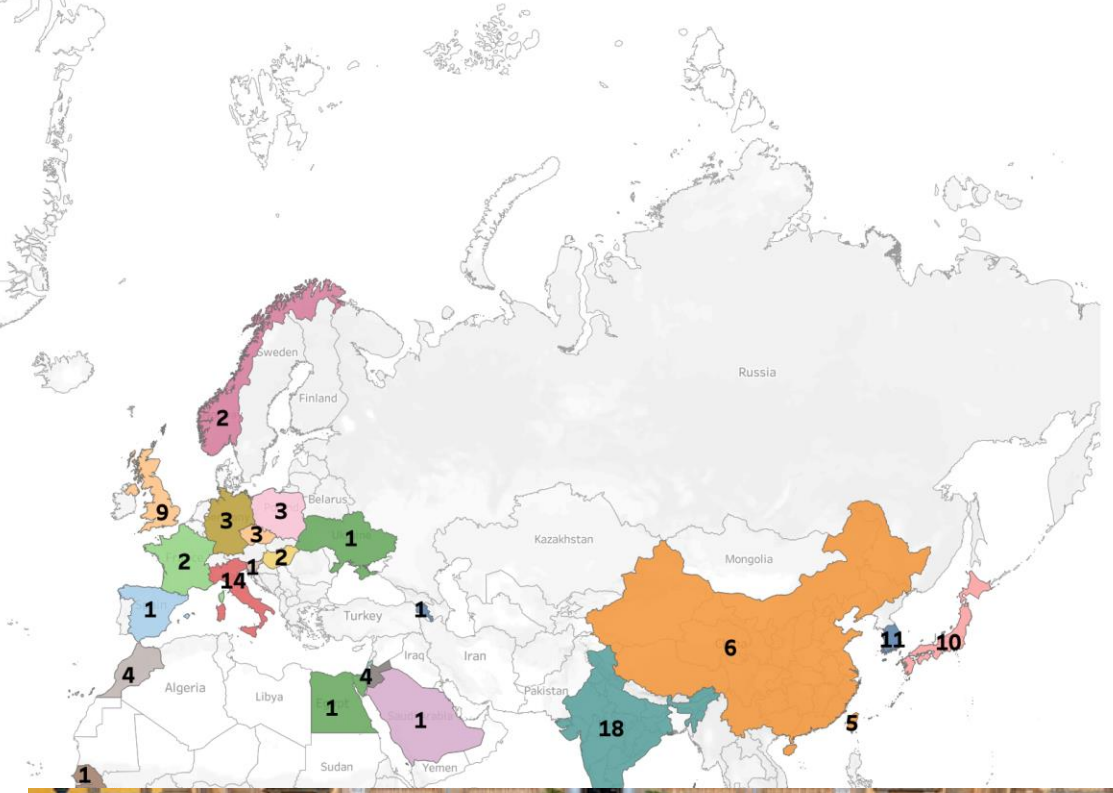
ePIC Institutions
180

ePIC Countries
25

ePIC World Region
4

Currently: >1000 collaborators (from 2025 Institutional Survey)





Frascati – January 2025

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Some examples

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Some examples

Advances in QCD at the LHC and the EIC

9–15 Nov 2025
CBPF, Rio de Janeiro
America/Sao_Paulo timezone

Enter your search term

- Overview
- Call for Abstracts
- Timetable
- Registration
- Accommodation
- Fees and financial support
- How to get to CBPF

Jointly with the CLAF Symposium on Opportunities for Latin-American Cooperation in High Energy Physics with CERN

EIC Latin America

Thanks to the **Universidad Autónoma del Estado de Hidalgo** and SMF DPyC leadership team, and the scientific program committee

Three different meetings

Monday, May 19:
Report from the coordination and from countries. We expect Network reports at future meetings

Tuesday, May 20:
EIC Latin America meeting

Wednesday, May 21:
Joint EIC Latin America with annual meeting of SMF DPyC: RADPYC 2025

https://indico.ku.edu/event/478

Three different meetings

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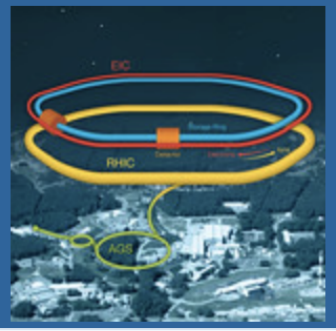
I·AN Inter-American Network of Networks QCD

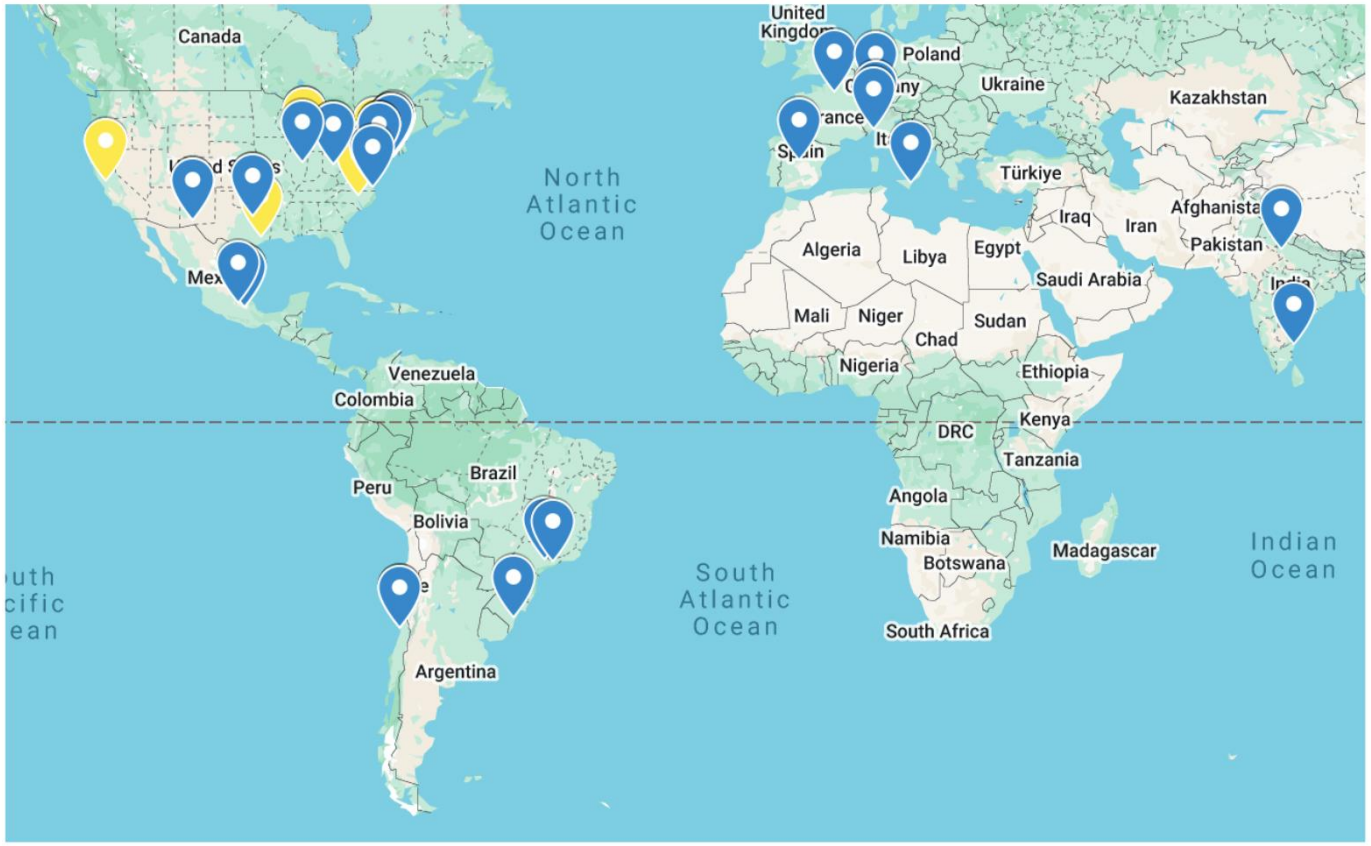
Some examples



The 2025 CFNS-SURGE Summer Workshop on the Physics of the Electron-Ion Collider

Jun 2 – 13, 2025
Physics Building; CFNS
America/New_York timezone

This year we have 30 students from 9 countries from North and South Americas, Europe, and Asia.



The CFNS EIC school is next week

Ongoing conversations

- While the program is centered in the Americas, we have been encouraged to have partnership with other regions
- Currently exploring a joint application between I.ANN QCD and a EU program
- Contacted by groups in Asia that would like to joint I.ANN QCD as associate members

New phase of the program from September 2025

Track 1:

- Early career researchers workshop
- Bi-national or international meetings aligned to I.ANNQ QCD objectives
- Use case workshops
- Short courses and mentoring sessions
- I.ANN QCD Summit, including science diplomacy

Track 2:

- Visiting and exchange programs
- QCD ambassadors program

I·AN Inter-American Network of Networks QCD

Contacts

Coordination team:

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Christine Aidala, co-PI

Carlos Bertulani, co-PI

Talal Chowdhury, Coordinator

Abhay Deshpande, co-PI

I·ANN QCD Network of Networks Inter-American

Join us for accelerating discoveries in fundamental physics

Please help us advertising this program and get engaged !

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