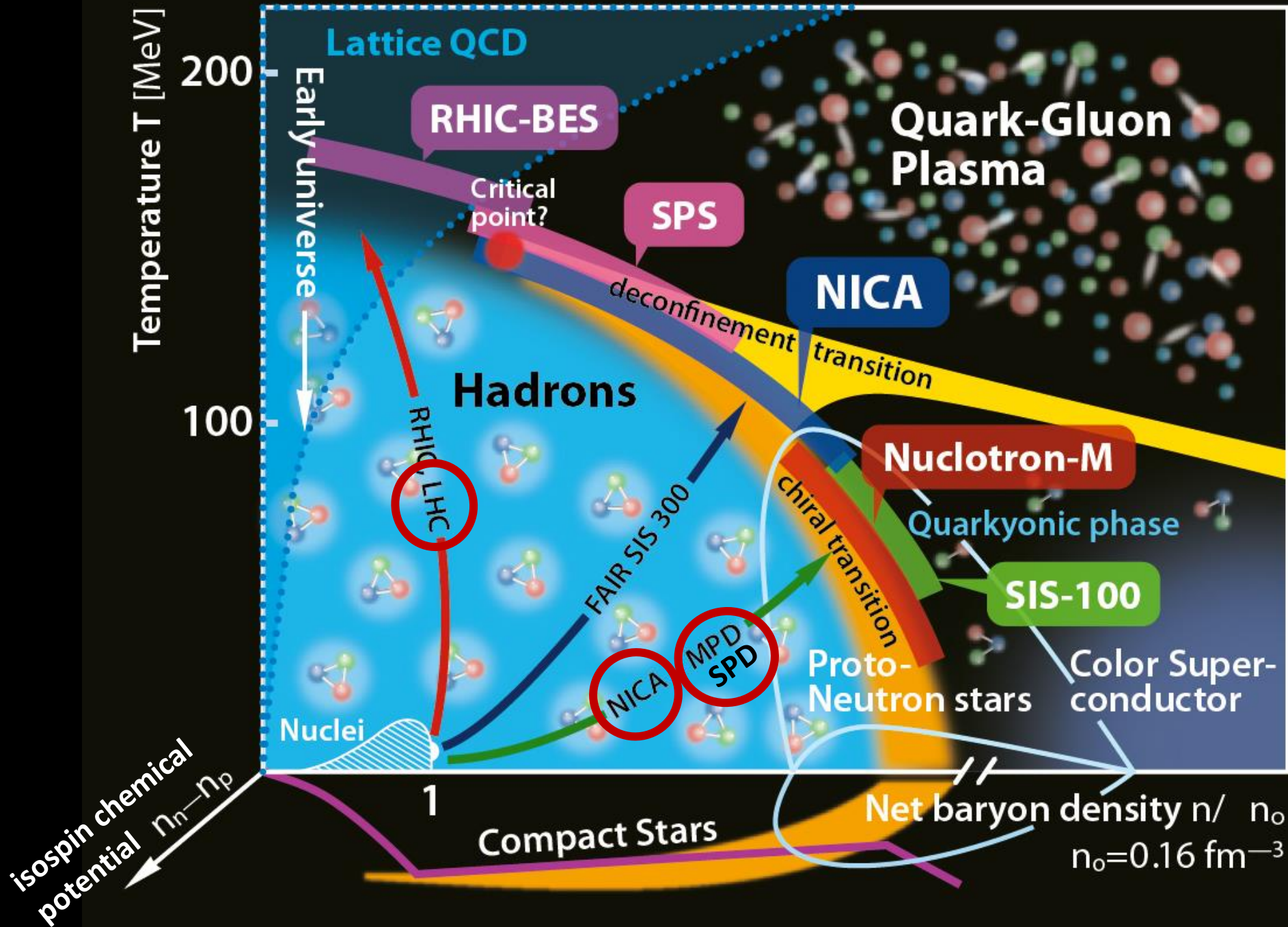


QCD research (experimental) in Mexico potential for national research networks

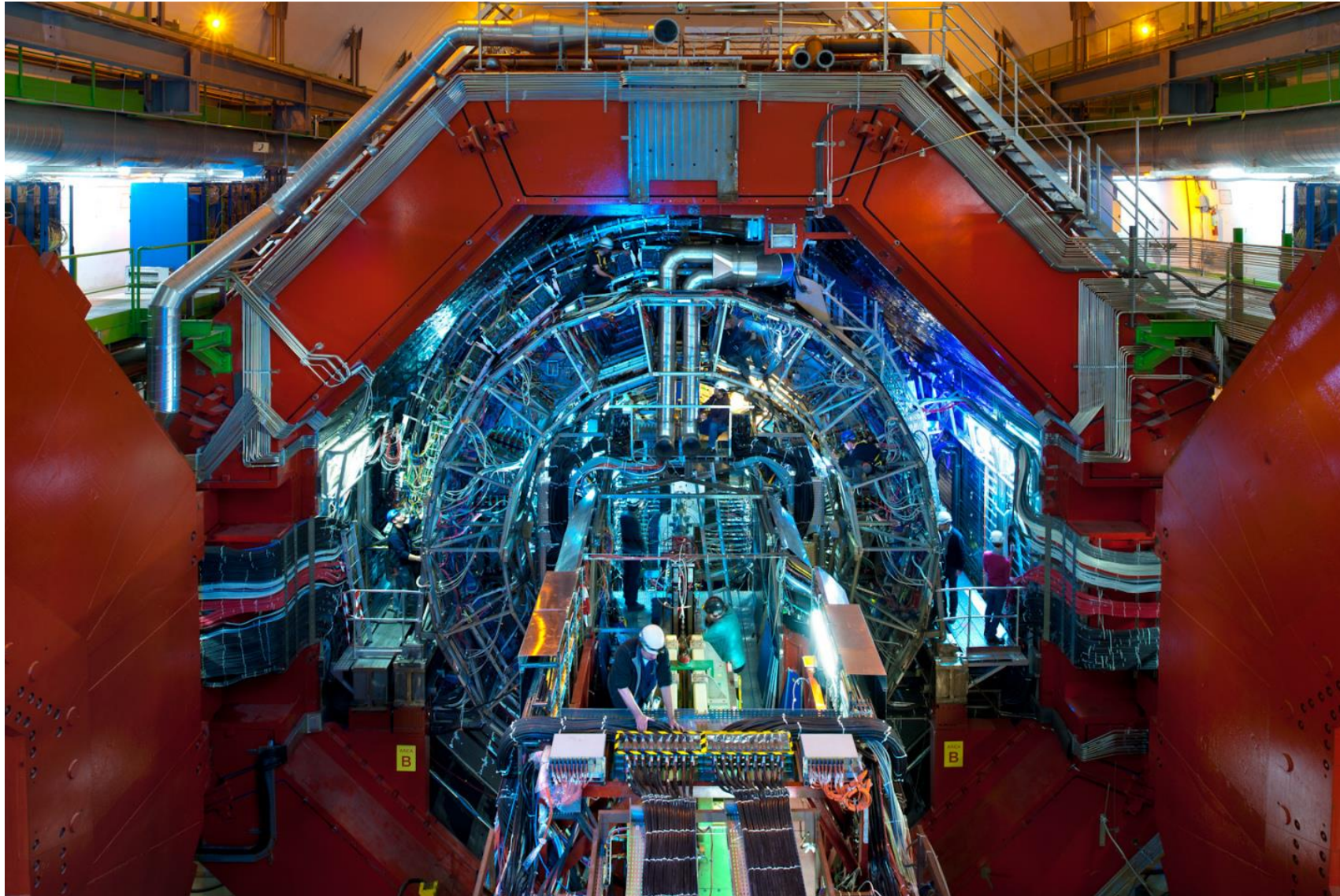
Inter-American Research on Nuclear Science

Inter-American Network of Networks of QCD challenges



criteria

A Large Ion Collider Experiment at the LHC

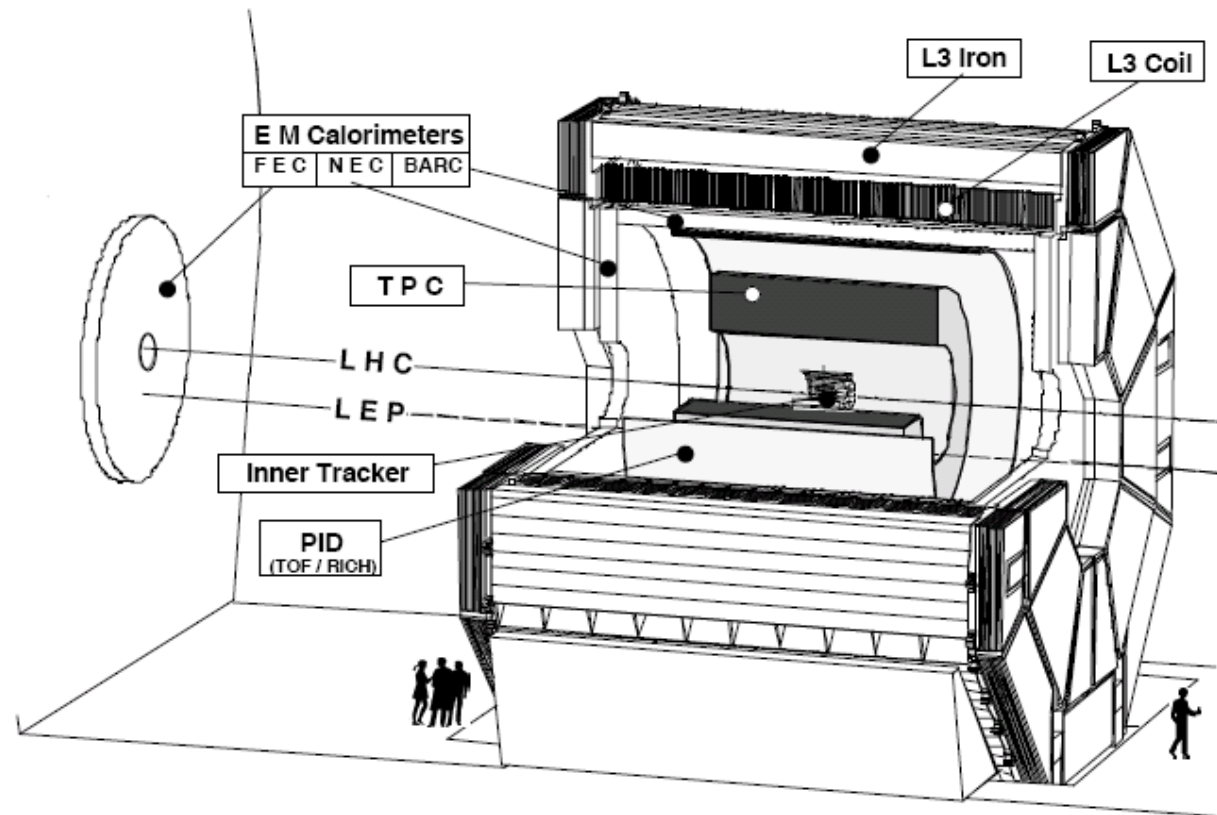


ALICE Letter of Intent . CERN /LHCC/93-16, 1st March, 1993



Mexico
joins ALICE end of 1994

27 years
of
ALICE – Mexico



ALICE Technical Proposal CERN /LHCC/95-71, 15 December, 1995

A Large Ion Collider Experiment



The ALICE-Mexico team is composed by 30 members including 15 Scientists and 15 PhD Students

[Funding Agency CONACyT \(Consejo Nacional de Ciencia y Tecnología\)](#)

Link person: Maria Elena Álvarez Buylla - Director General

❖ Institutions

[BUAP \(Benemérita Universidad Autónoma de México\)](#)

Link person: Arturo Fernández Téllez

[CINVESTAV \(Centro de Investigación y de Estudios Avanzados del IPN\)](#)

Link person: Gerardo Herrera Corral

[UAS \(Universidad Autónoma de Sinaloa\)](#)

Link person: Ildefonso León Monzón

[IF UNAM \(Instituto de Física de la Universidad Nacional Autónoma de México\)](#)

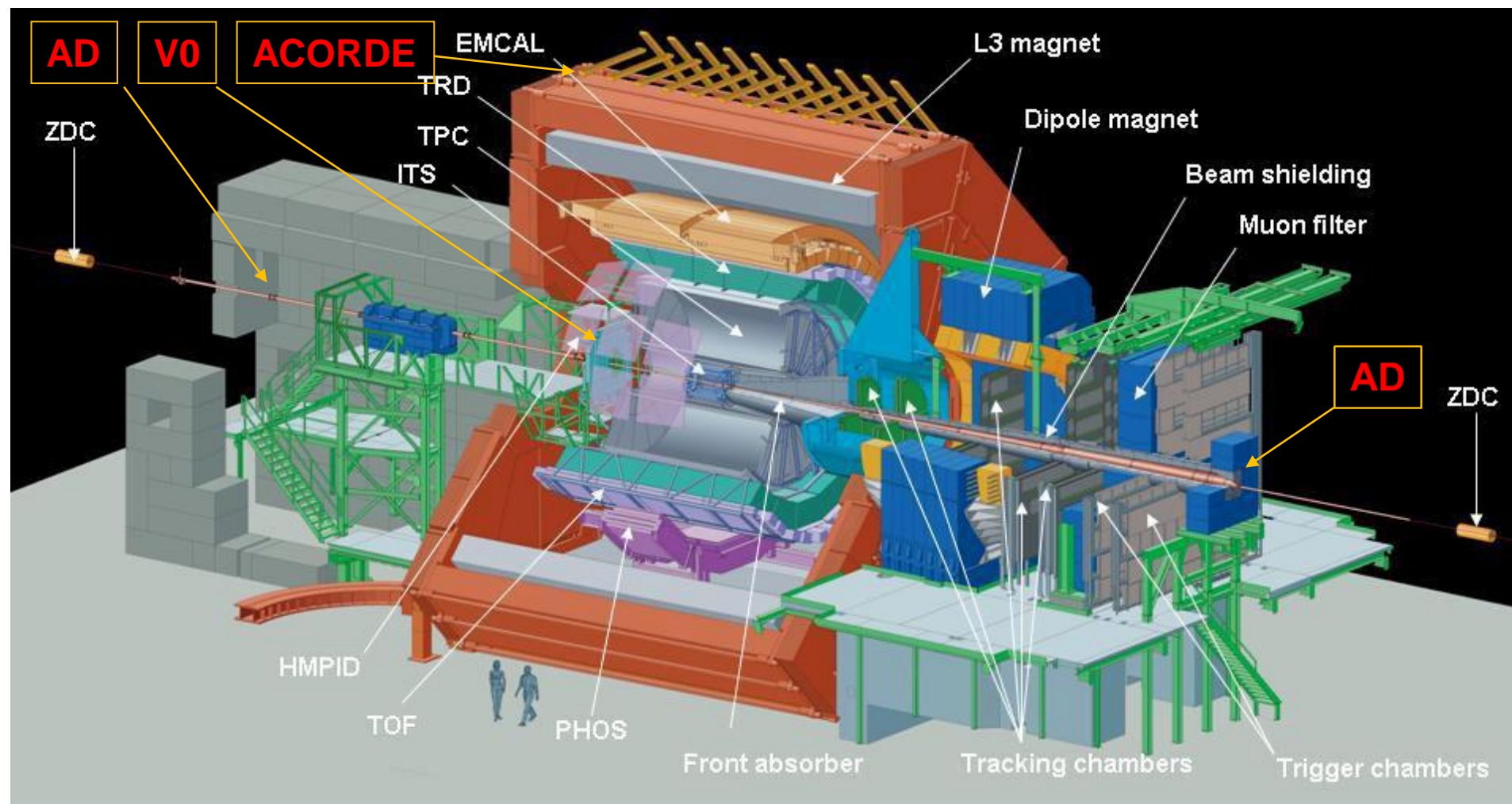
Link person: Arturo Menchaca Rocha

[ICN UNAM \(Instituto de Ciencias Nucleares de la Universidad Nacional Autónoma de México\)](#)

Link person: Guy Paic

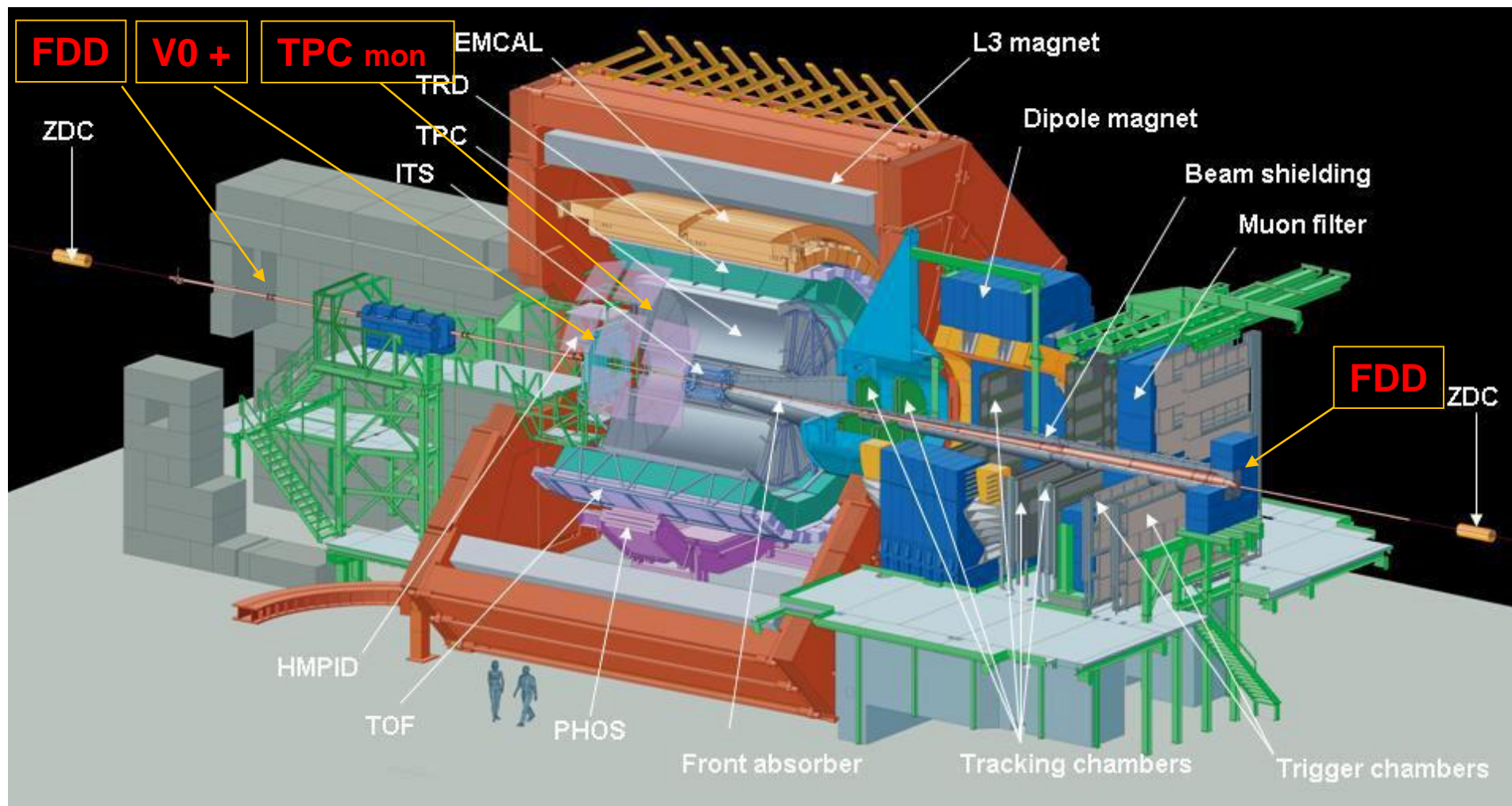
2009 - 2018

México - ALICE



2021 - 2024

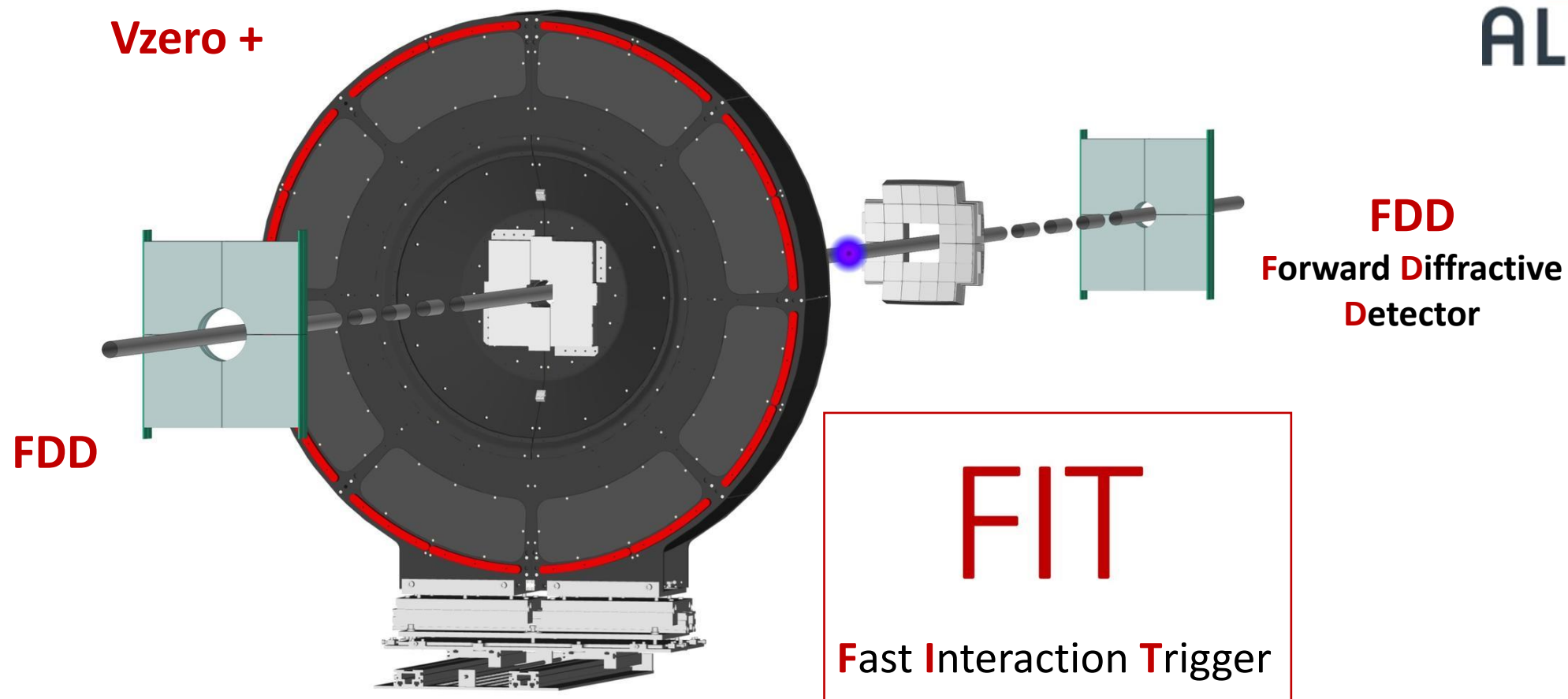
México - ALICE



FIT



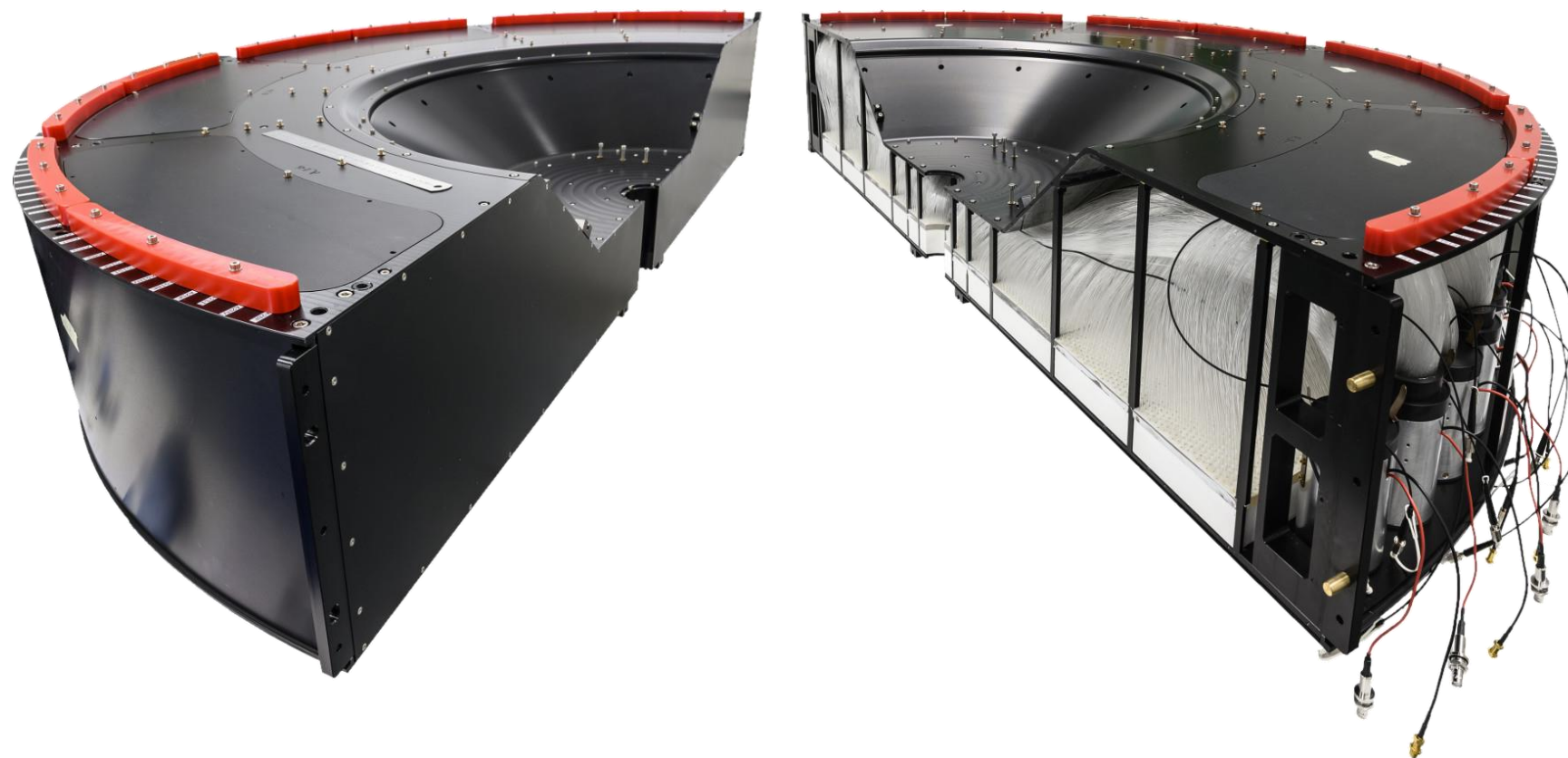
ALICE



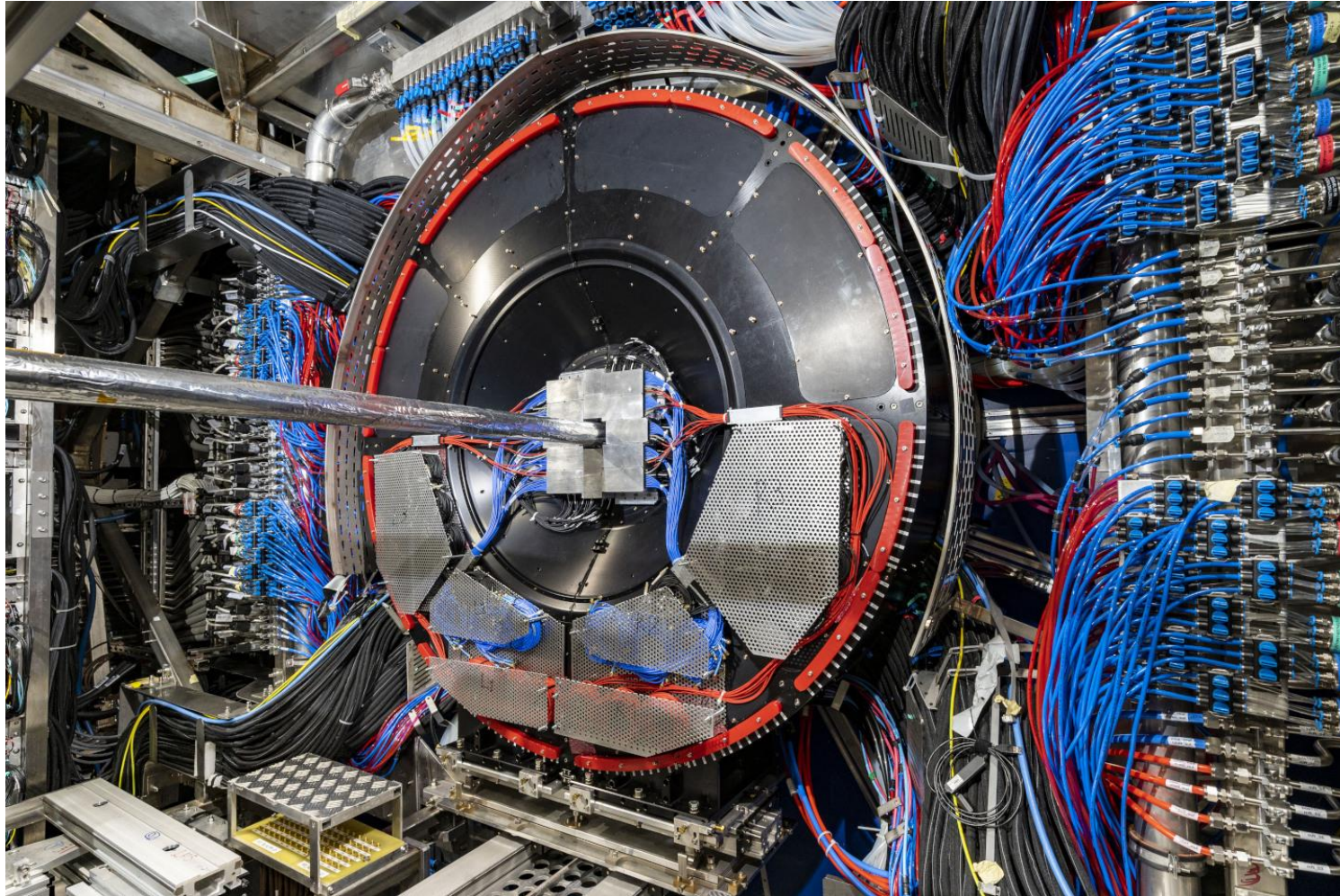
V0+



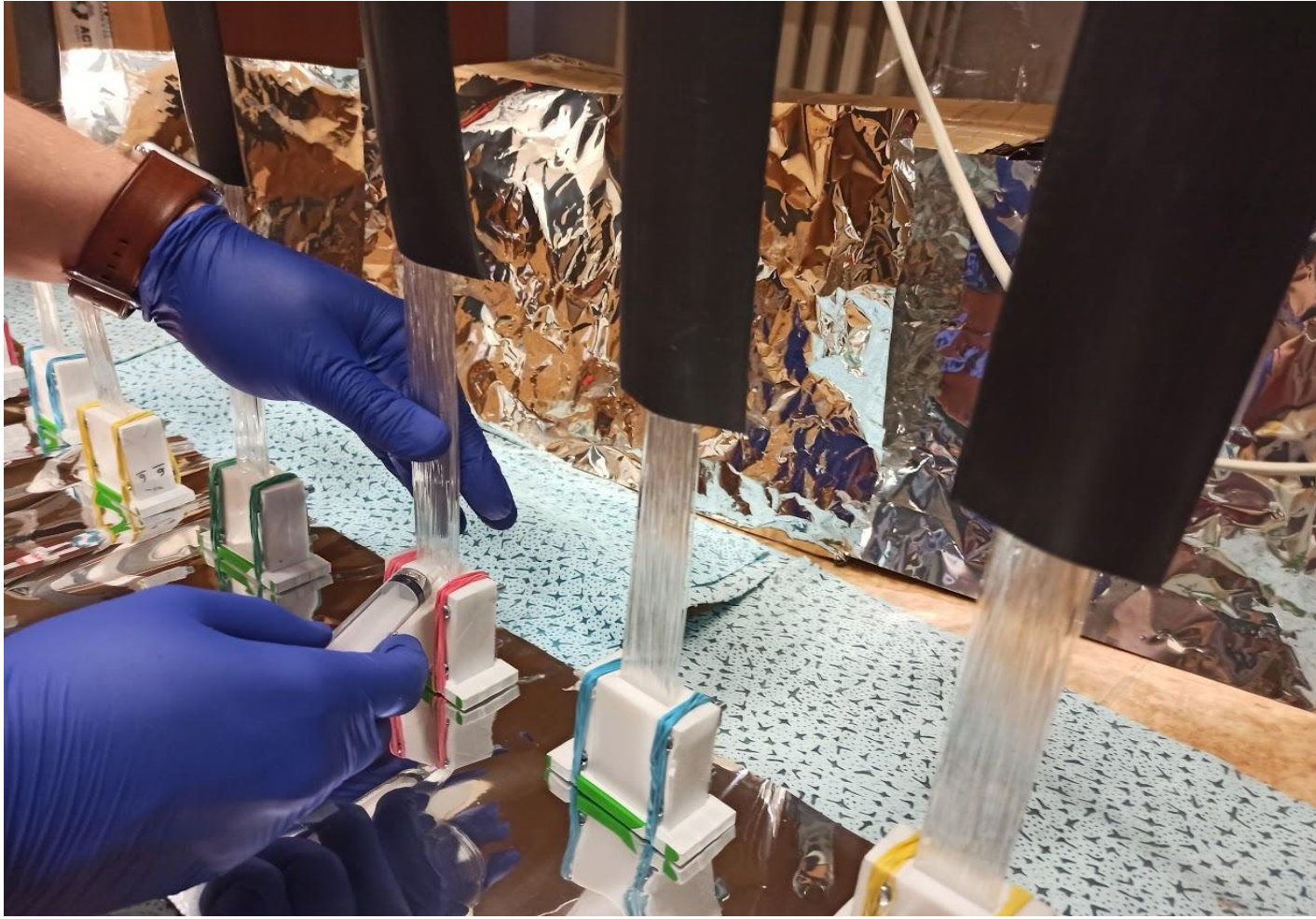
ALICE



V0+



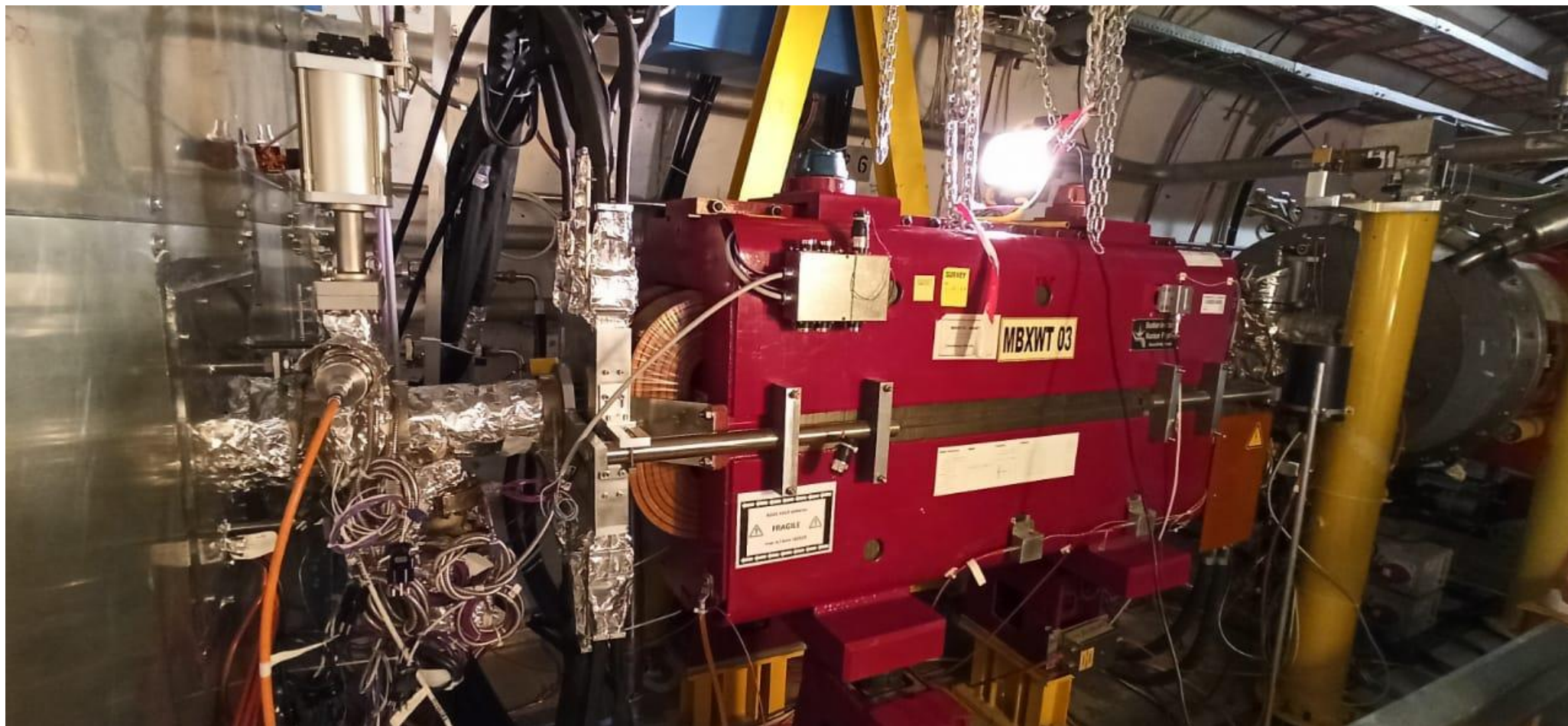
FDD



FDD



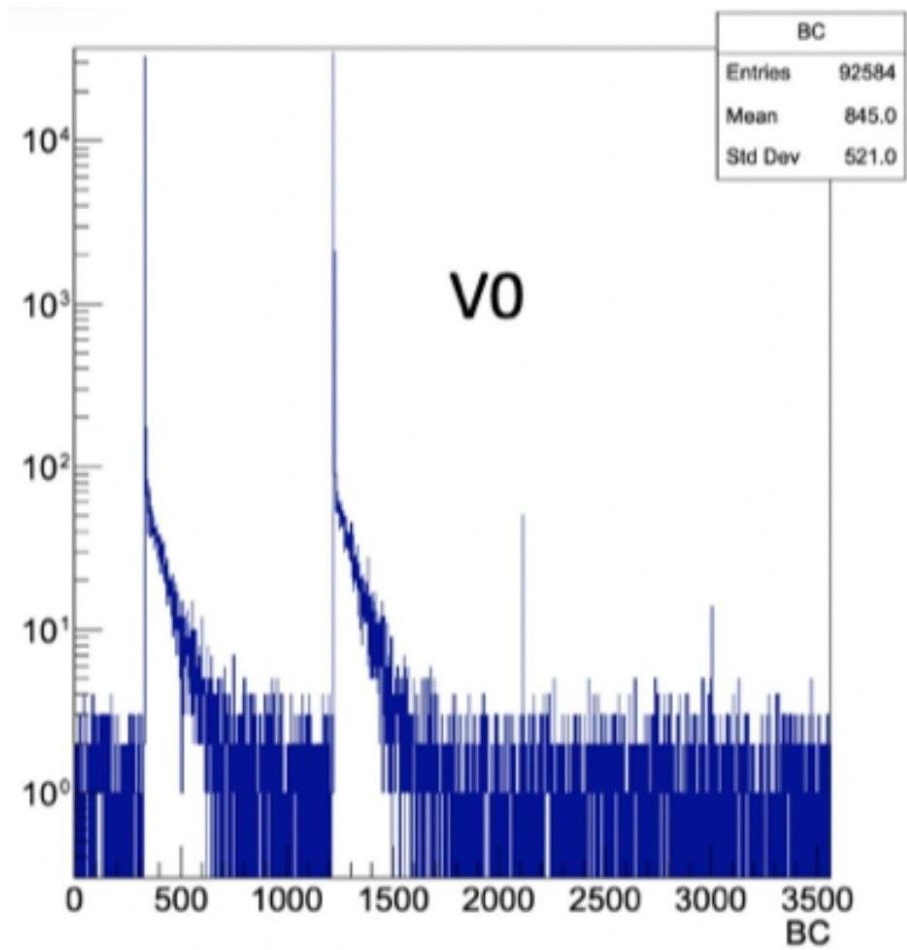
FDD



ALICE

FDD

V0+

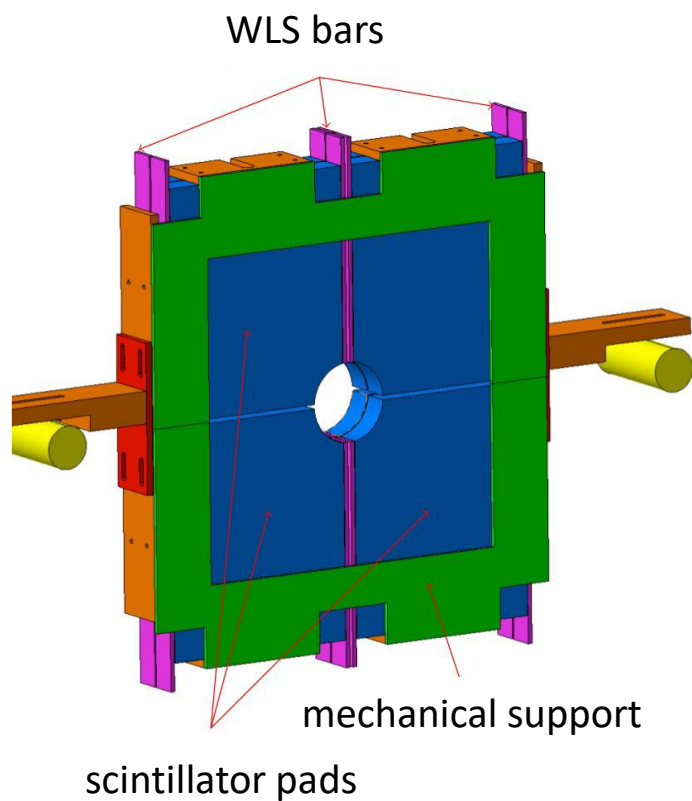


ALICE

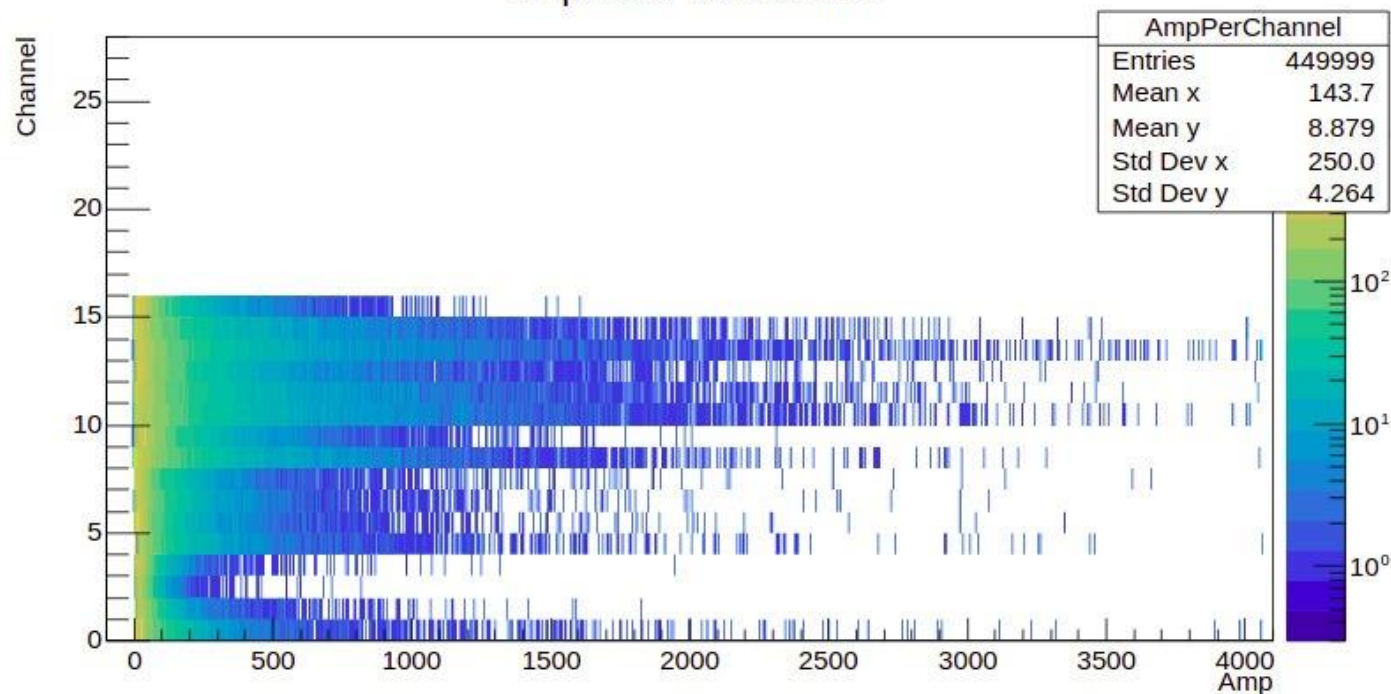
FDD

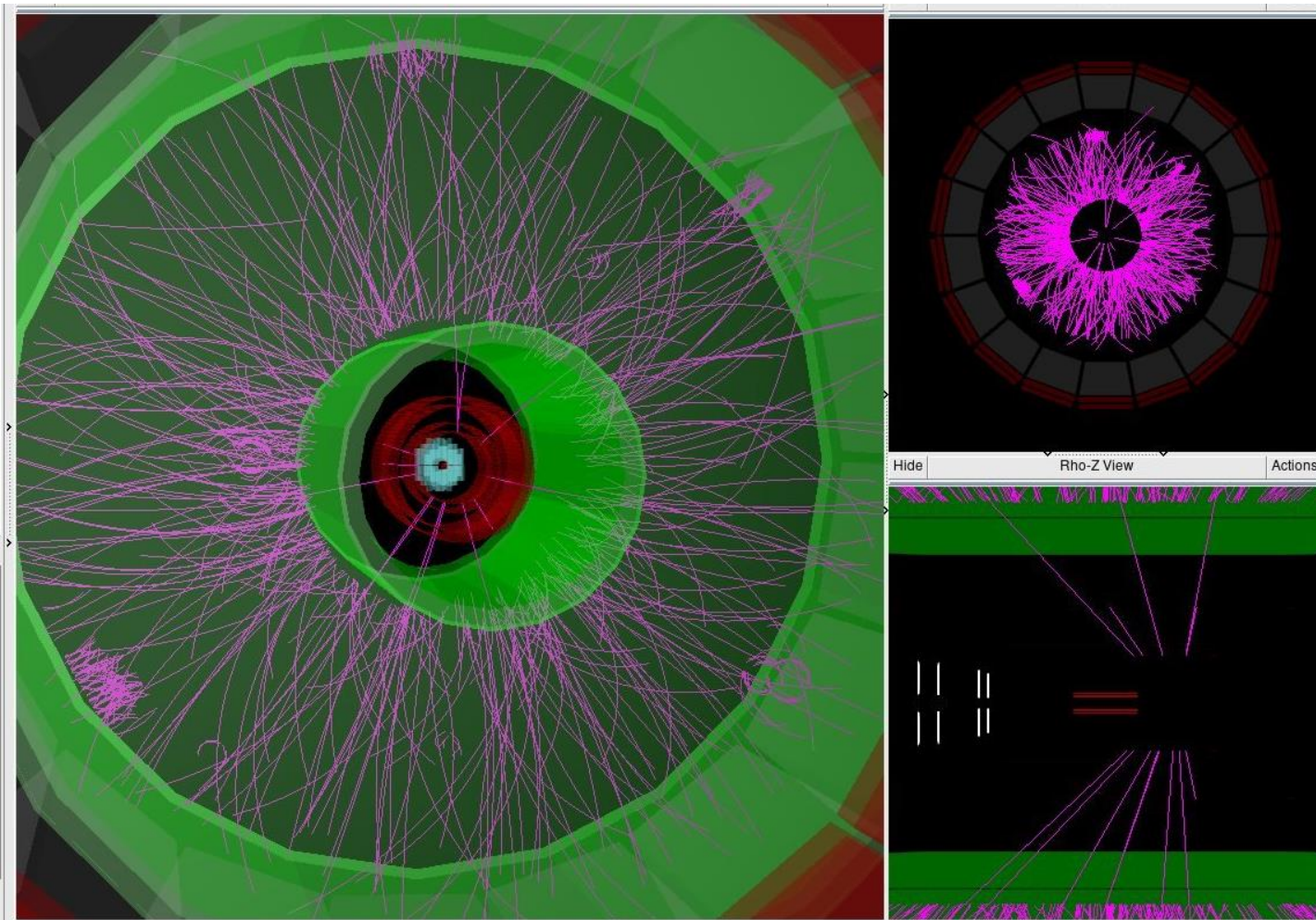


ALICE



Amplitude vs Channel





Mexico participated
in the design of the
pico-amperimeter
for the hv-supplies

Time
Projection
Chamber

TPC

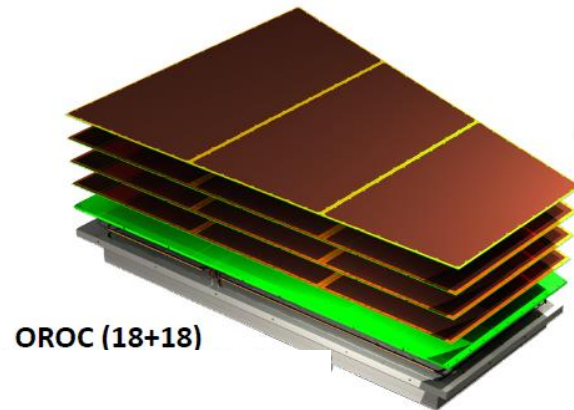
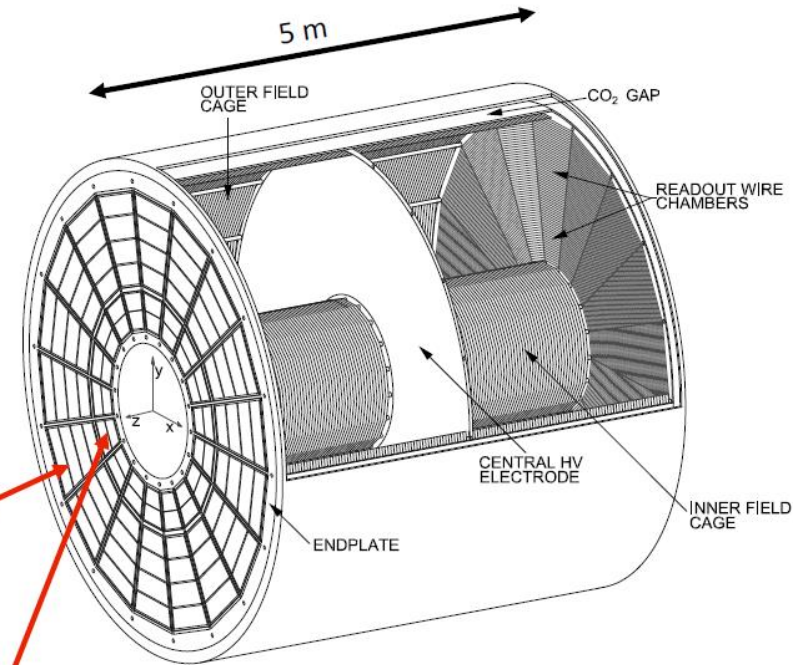
actively regulated voltage dividers

precise current monitoring (100 pA - 100 microA

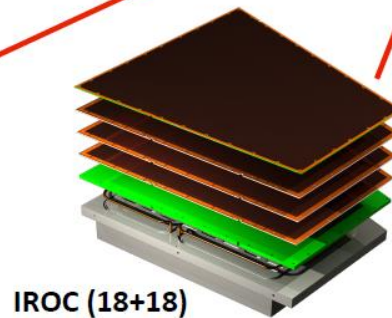


TPC Upgrade

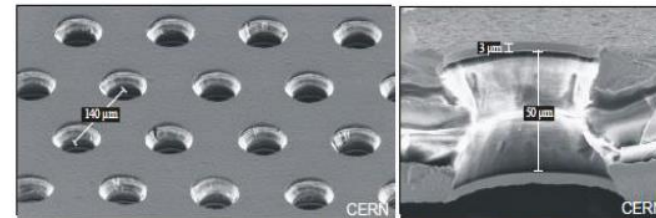
- Goal: replace existing MWPC-based Readout Chambers and Front-End Electronics in LS2 to allow **continuous readout** of Pb-Pb collisions at 50 kHz in RUN3 and 4
- Technical solution: **4-layer GEM** detectors



OROC (18+18)

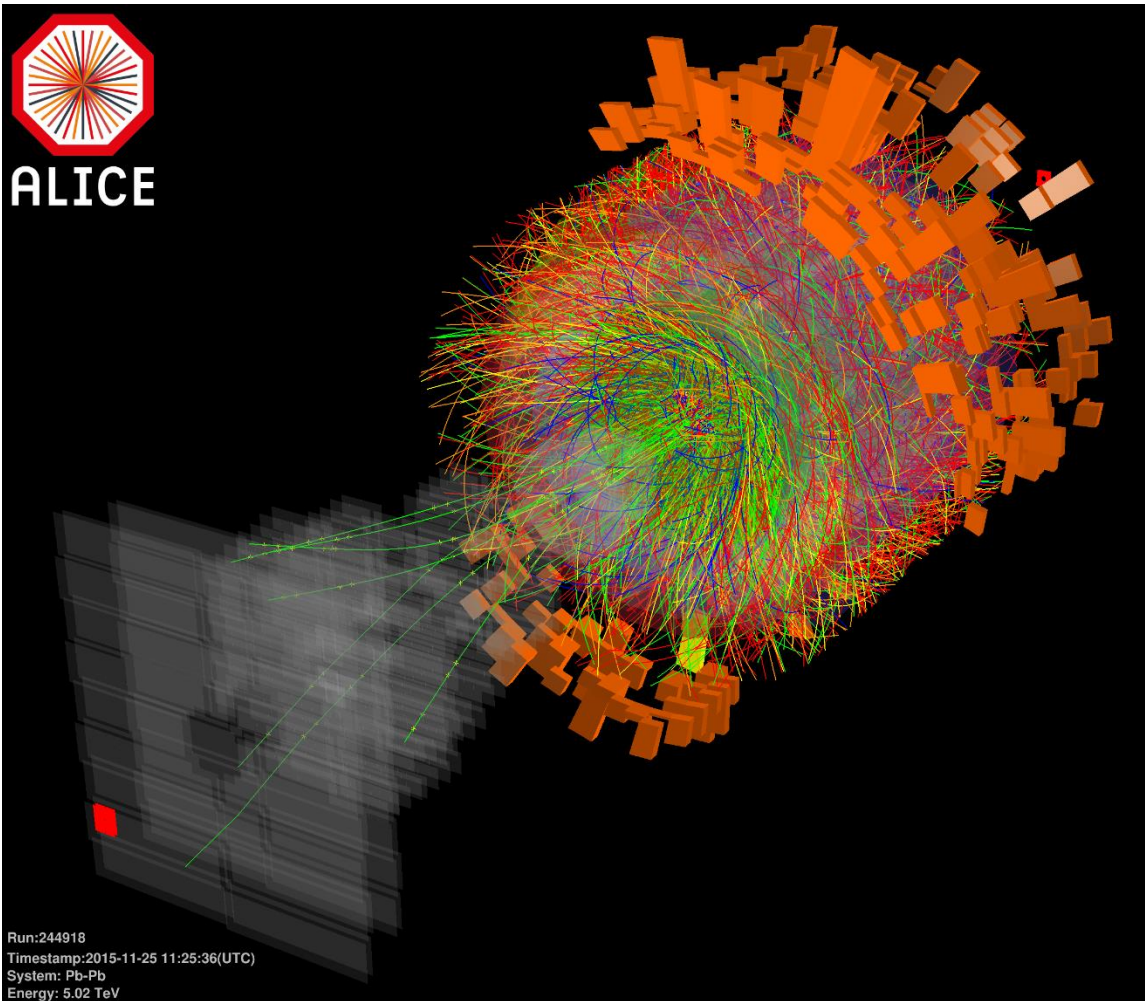


IROC (18+18)



Electron microscope photograph of a GEM foil

Data Analysis



The mexican group has participated in several data analysis that conducted to publications. Some but not all are:

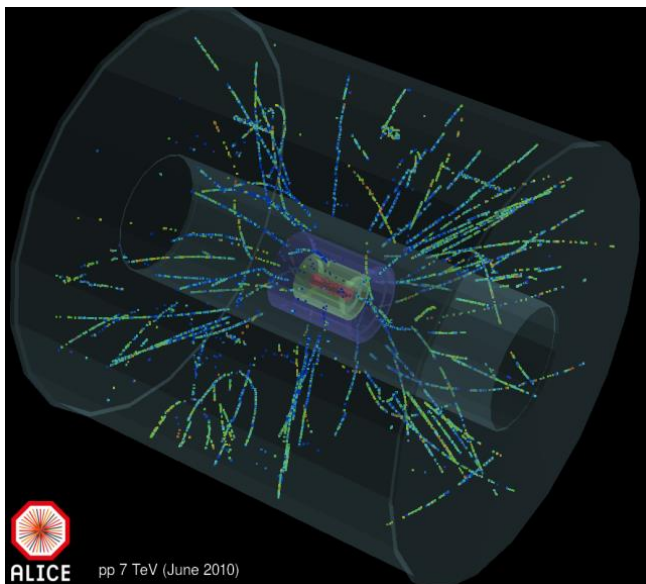
What is the temperature at which hadrons (like protons) form?
Phys. Rev. C101 (2020) 044907

What happens when a fast gluon propagates through the QGP (jet quenching)?
Phys. Lett. B736, 196-207 (2014) / Phys. Rev. C93 034913 (2016)

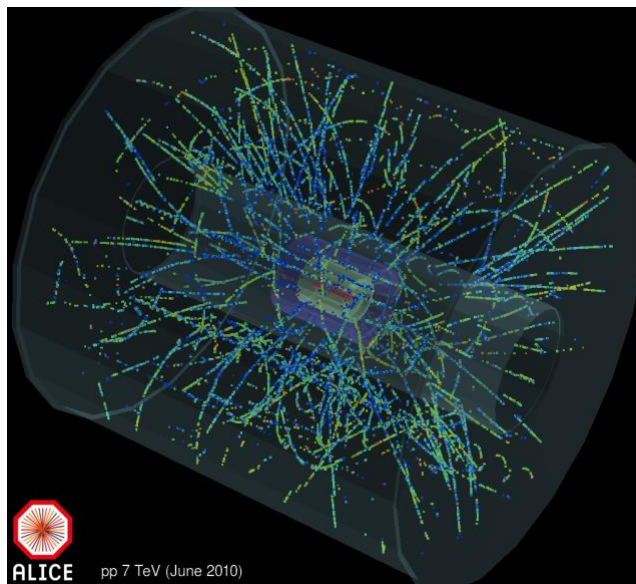
Is there any color charge effect?
JHEP 11 (2015) 205 / JHEP 03 (2016) 081

What happens if we collide lighter ions like xenon?
Phys. Lett. B788 (2019) 166-179

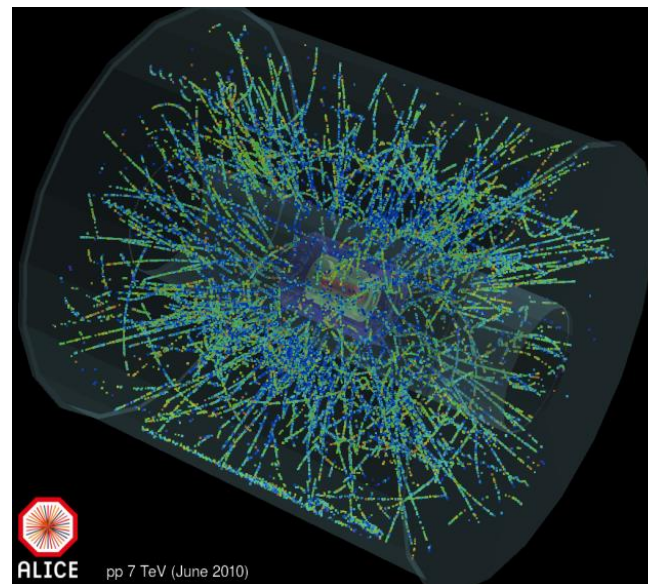
Data Analysis



Low
pp collisions at 7 TeV, recorded in June 2010



Medium



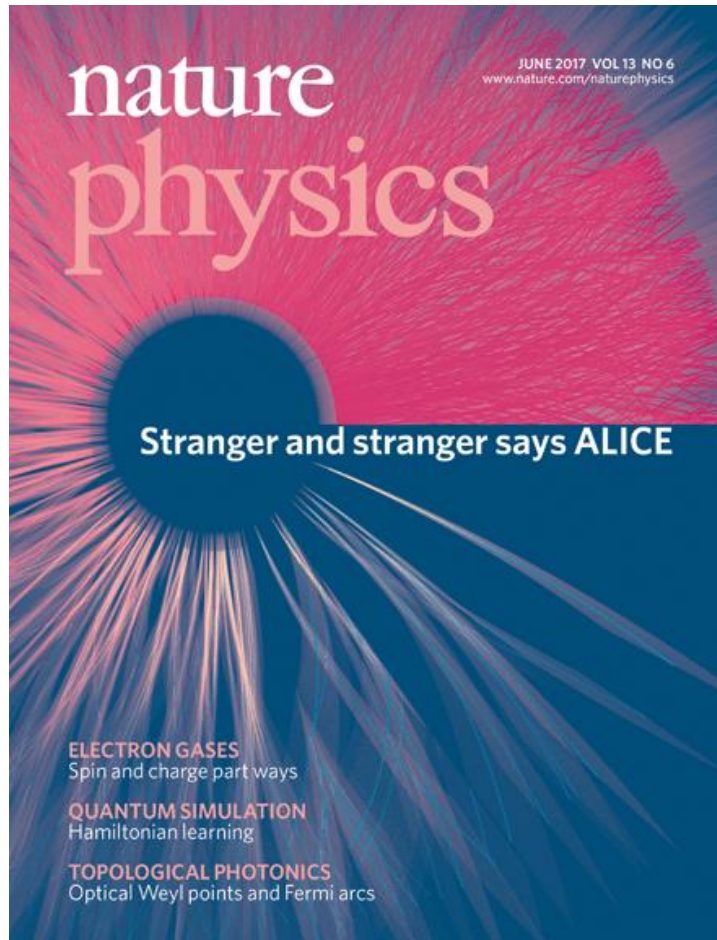
High multiplicities

The Mexican group led the initial efforts on the study of pp collisions as a function of the event multiplicity

Novel tools were developed for this purpose: *Eur. Phys. J. C72 (2012) 2124* / *Eur. Phys. Journ. C79 (2019) 857*

a new concept: **sphericity - spherocity**

Data Analysis



Discovery of heavy ion like effects in proton-proton and proton-Pb collisions at the LHC

The mexican team contributed to understand the origin of it.

Phys. Lett. B728, 25-38 (2014) Phys. Lett. B760 (2016) 720-735

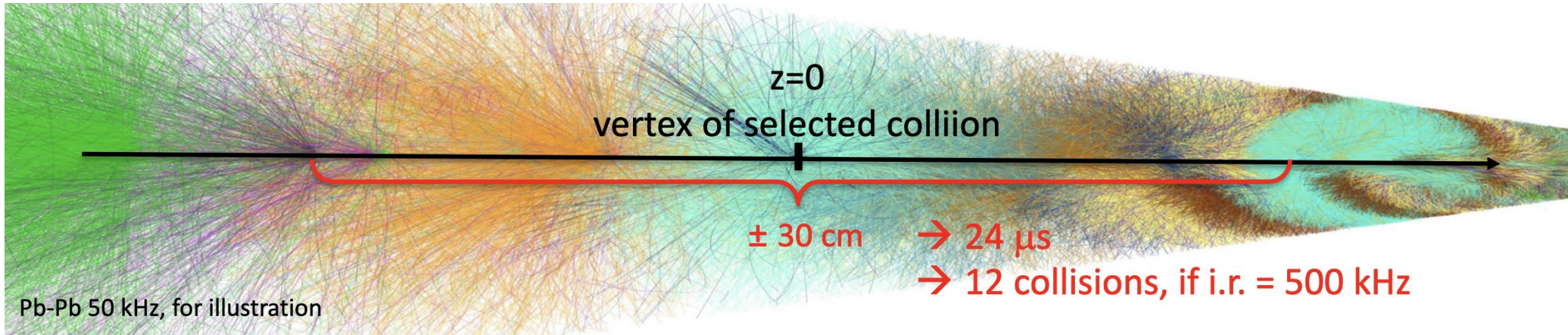
Phys. Rev. Lett. 127, 202301 (2021)



“... A revolution in the field is under way, spearheaded by the discovery of similar collective, fluid-like phenomena in much smaller systems including $p+p$, $p+A$, $d+Au$, and $^3\text{He}+Au$ collisions...”

Have we created in the lab the smallest drop of QGP of the Universe?

The answer is expected to come from the analysis of the LHC runs 3 and 4



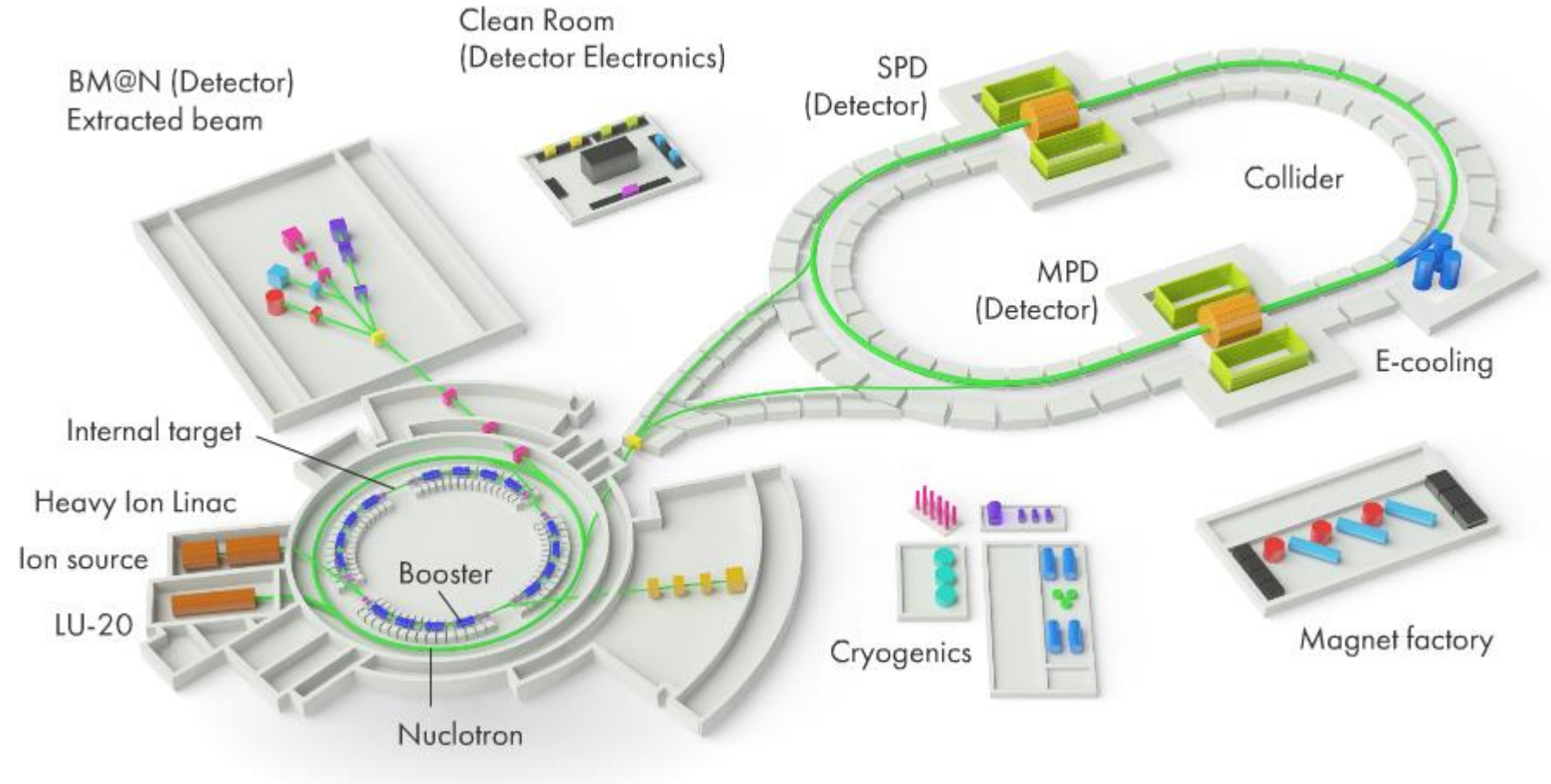
Standard processing chain:
synchronous pass \rightarrow calibrations \rightarrow asynchronous pass reconstruction
with event selection during asynchronous pass (offline triggers)

Mexican team: high multiplicity
trigger in pp collisions / explore
more refined multiplicity
selections (tag "hedgehog"-like
events)



Nuclotron-based Ion Collider fAcility

Joint Institute for Nuclear Research
Dubna, Rusia



Heavy Ions

[Ion source \(KRION-6T\)](#)

[Heavy Ion Linac \(HILac\)](#)

[Booster](#)

[BM@N \(Detector\)](#)

[MPD \(Detector\)](#)

Polarised beams

[LU-20](#)

[Nuclotron](#)

Extracted beam

Internal target station

[SPD \(Detector\)](#)

Superconducting accelerator complex NICA

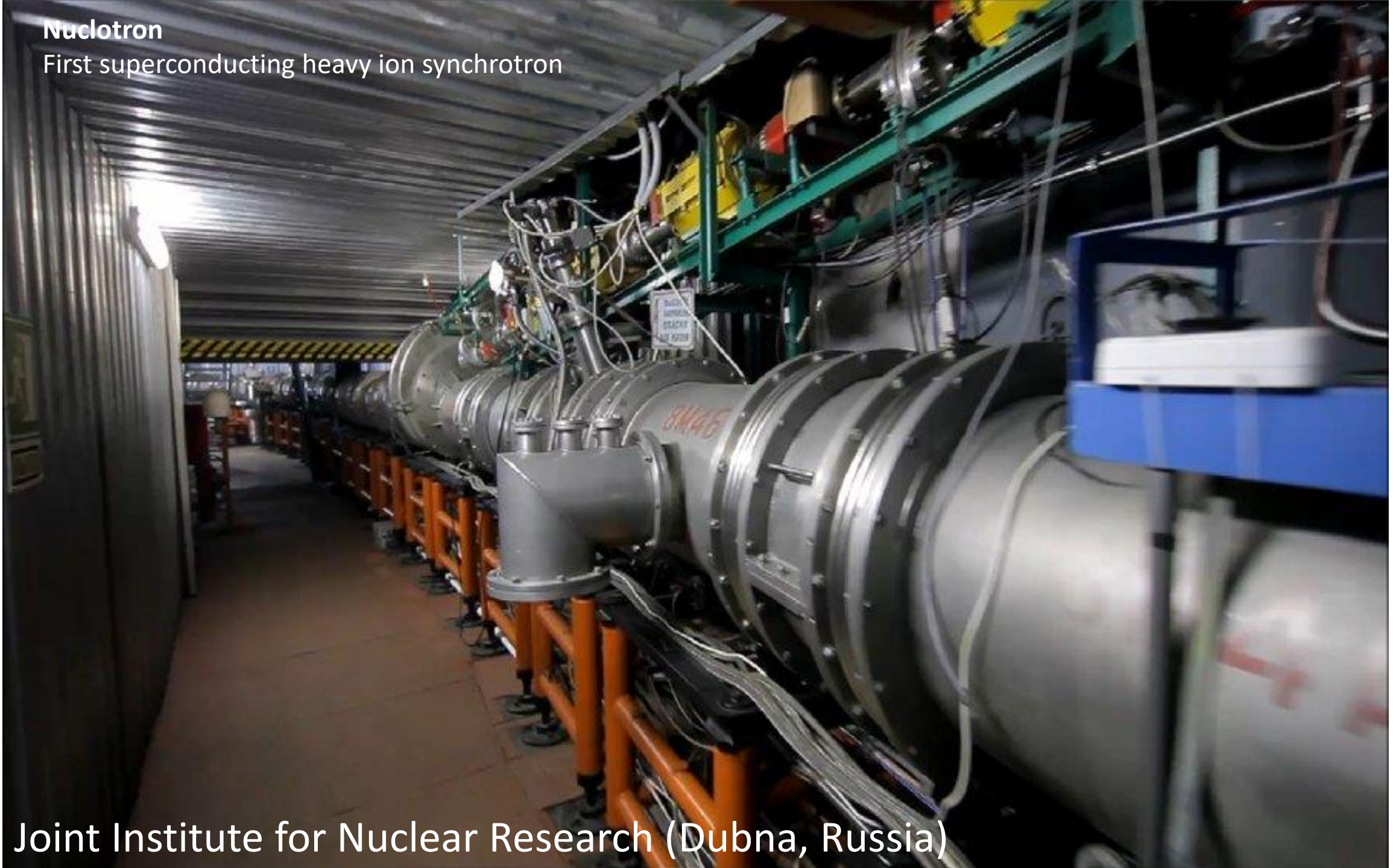


HILac
Heavy Ion Linear Accelerator



Nuclotron

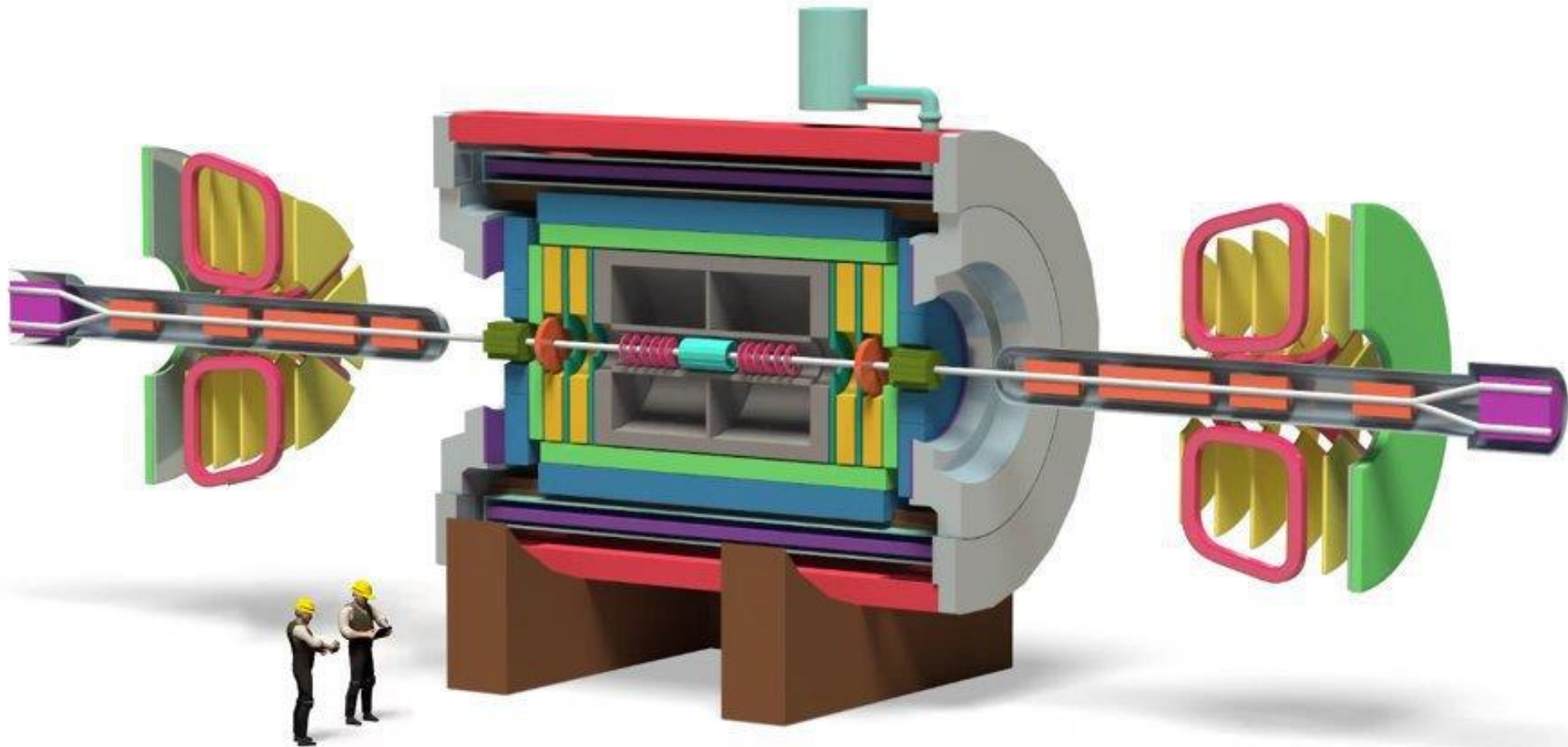
First superconducting heavy ion synchrotron



Joint Institute for Nuclear Research (Dubna, Russia)

MPD

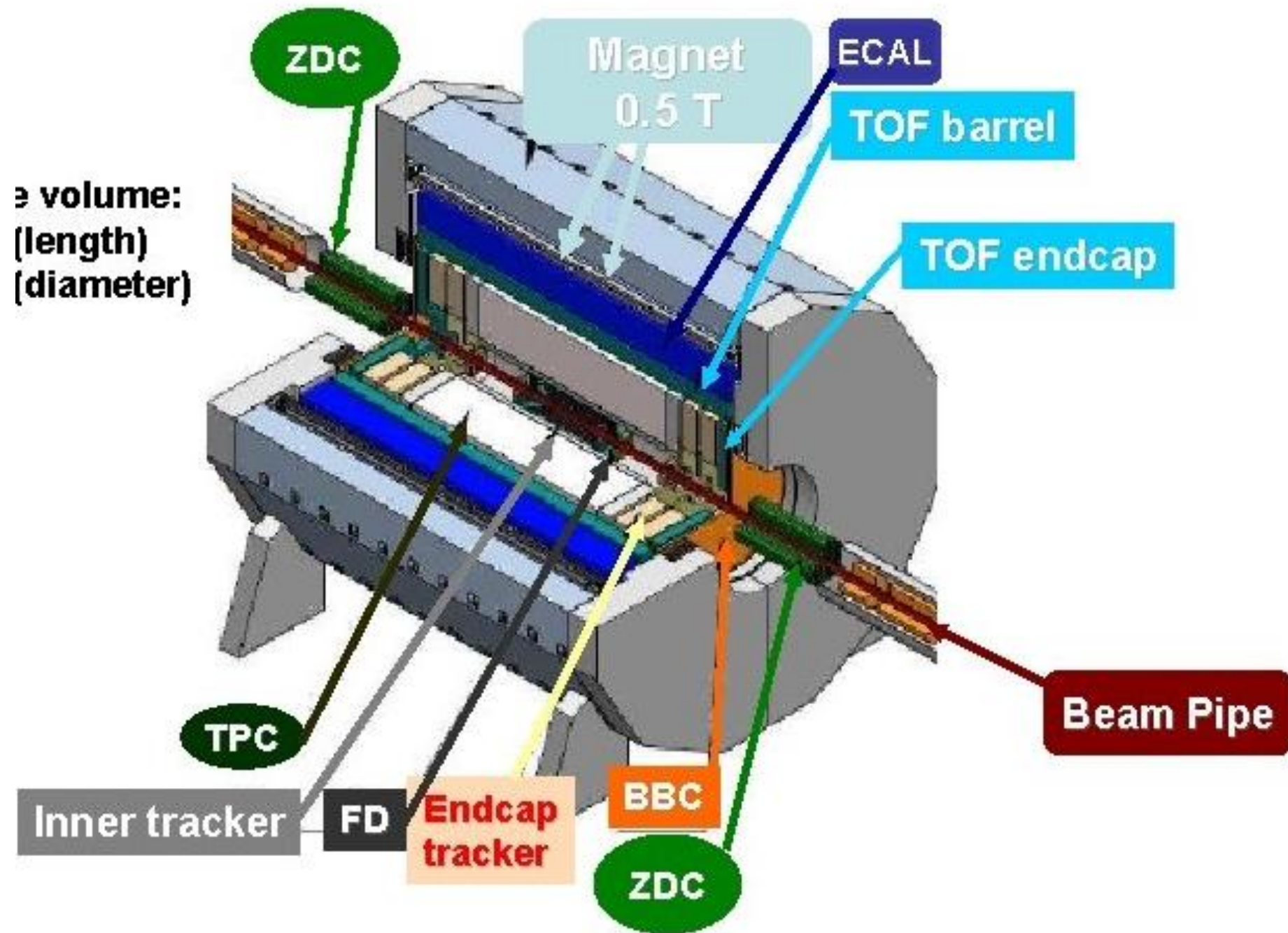
Multi-Purpose Detector



Start of the construction: 2013.

Commissioning: 2022

Data taking 2023 and beyond



NICA

protons up to 12.6 GeV

polarized deuterons

gold ions up to kinetic energy of 4.5 GeV per nucleon,

The two interaction points are foreseen at the NICA collider rings:

- for heavy-ion studies with the MPD detector
- for polarized beams for the SPD experiment.

MEXnICA group members

- Universidad Autónoma de Sinaloa:
 - Isabel Domínguez, Pedro Podesta, Ivonne Maldonado
- Benemérita Universidad Autónoma de Puebla:
 - Heber Zepeda, Eduardo Moreno, Sergio Vergara, Aurora Vargas
- Universidad de Colima:
 - María Elena Tejeda Yeomans
- Universidad Autónoma Metropolitana
 - Luis Alberto Hernández Rosas
- Universidad Nacional Autónoma de México:
 - Alejandro Ayala, Eleazar Cuautle, Wolfgang Bietenholz, Lucio Rebolledo, Jaime Guerra

On 12 October 2019, a Memorandum of Understanding between the Joint Institute for Nuclear Research and a community of scientific and research institutes of Mexico was signed thus proving joint participation in the implementation of the mega-science project [NICA](#)

<http://www.jinr.ru/posts/mexico-officially-joined-the-implementation-of-the-nica-project/>

By the way ... Chile is part of the collaboration too

SPD Spin Physics Detector

Measurements of asymmetries in the lepton pair (Drell-Yan) production in collisions of non-polarized, longitudinally and transversally polarized protons and deuterons beams

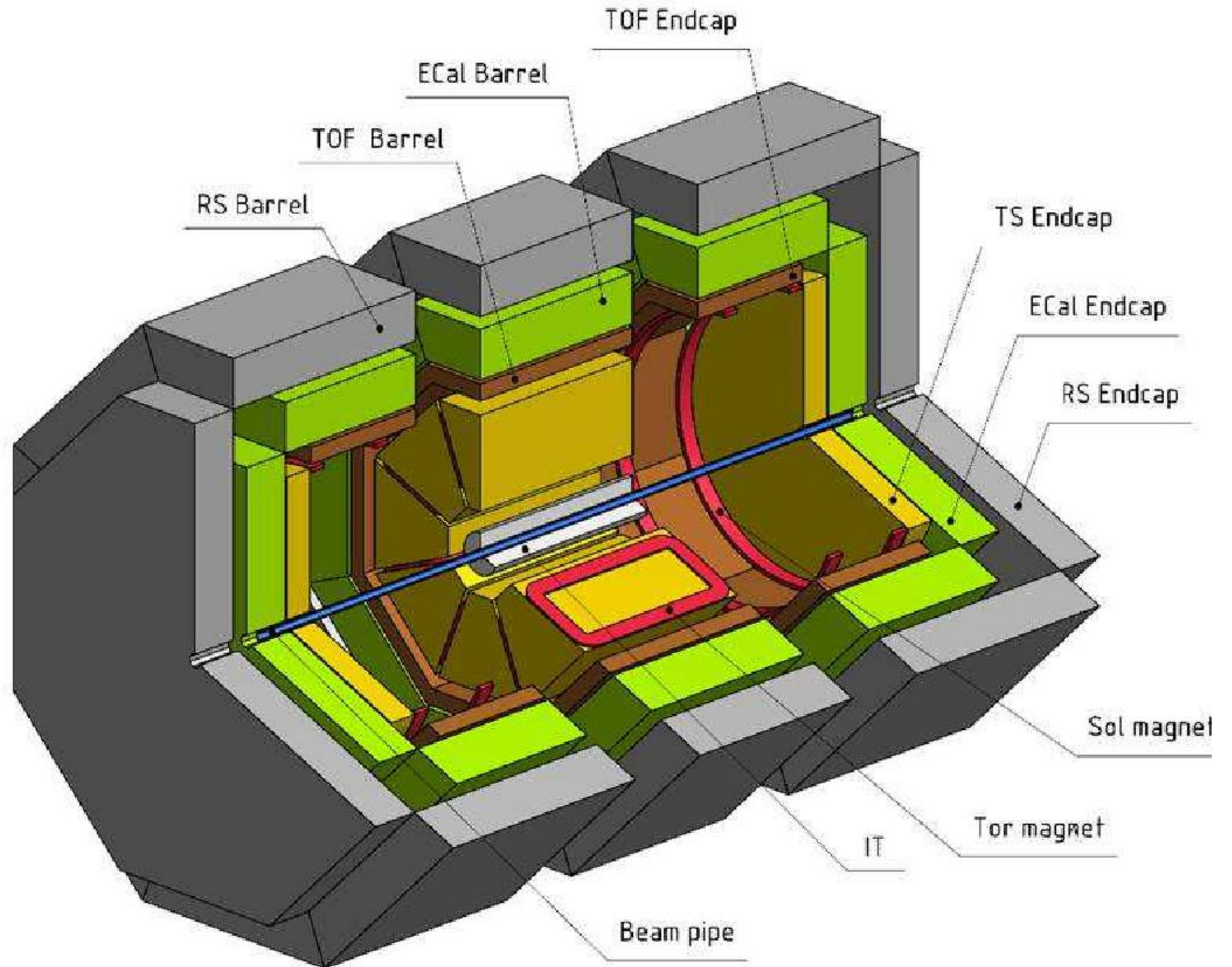
These measurements can provide an access to all leading twist collinear and Transverse-Momentum Dependent distribution functions of quarks and anti-quarks in nucleons.

The measurements of asymmetries in production of J/ψ and direct photons, which supply complimentary information on the nucleon structure, will be performed simultaneously with Drell-Yan data using dedicated triggers.

The set of these measurements permits to tests the quark-parton model of nucleons at the QCD twist-2 level with minimal systematic errors.

SPD

Spin Physics Detector



Non official image

Physics > Instrumentation and Detectors

*[Submitted on 6 Oct 2021]***Performance of BeBe, a dedicated beam-beam monitoring detector for the MPD-NICA experiment at JINR**

Marco Alberto Ayala Torres, Lucina Gabriela Espinoza Beltrán, Marcos Aurelio Fontaine Sánchez, Luis A. Hernández-Cruz, Luis Manuel Montañó, Braian Adair Maldonado Luna, Eduardo Moreno-Barbosa, Lucio Fidel Rebolledo Herrera, Mario Rodríguez-Cahuantzi, Guillermo Tejeda-Muñoz, C.H. Zepeda Fernández

The Multipurpose Detector (MPD) is an experimental array, currently under construction, designed to study the nuclear matter created during the collisions that will be provided by the Nuclotron-based Ion Collider fAcility (NICA) at JINR. The MPD-NICA experiment consists of a typically array of particle detectors as those used to study heavy-ion collisions at LHC and RHIC. To complement the current trigger system of MPD-NICA, conformed by the forward detectors FFD and FHCAL, the BeBe detector has been proposed. Based on Monte Carlo simulations, a discussion of the potential physics performance of BeBe detector is given for triggering tasks and for the resolution in the determination of the event plane reaction and the centrality of the collisions at NICA. This document is a first public version that will be updated when submitted for publication to JINST. Most of the authors are former members of the MPD-NICA experiment. This written is a report of the acquired commitments in the signed M&O between experimental groups of BUAP and CINVESTAV Mexican institutes with MPD-NICA Collaboration. Warning: This version may need a proofreading.

<https://arxiv.org/abs/2110.02506>

an array of 80 cells, 1 cm width, arranged in five concentric rings, see Fig. 10. The considered geometry for BeBe is similar to the one used for the VZERO-ALICE [8] detector during the Run 1 and 2 of the LHC.

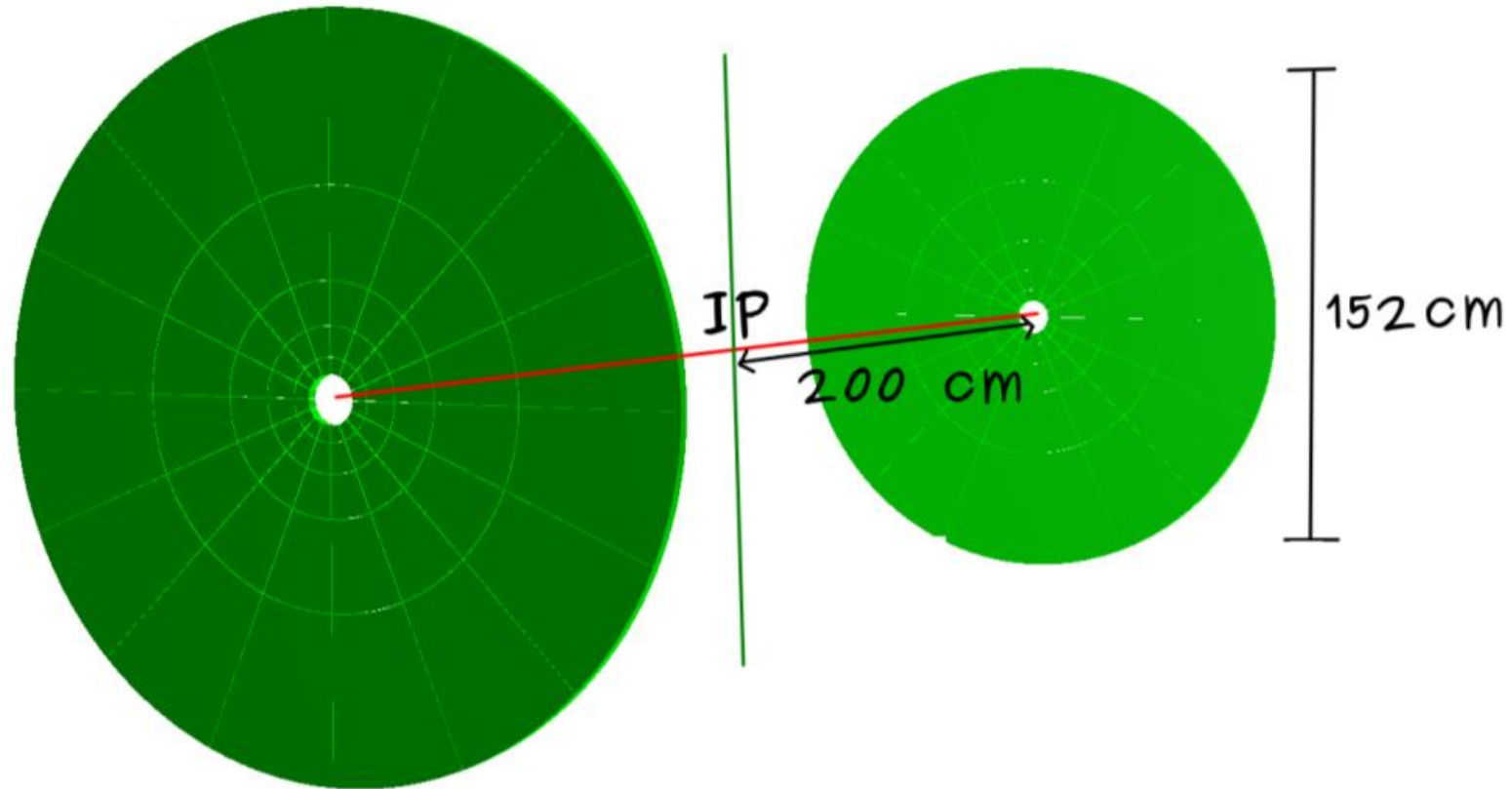


Figure 1. BeBe design geometry as rendered by the MPD offline environment.

talks with SPD collaboration on going

CINVESTAV: Dr. Luis Manuel Montaña Zetina and M.C. Heber Zepeda,

BUAP - in stand by

The Electron Ion Collider

An incipient experimental group:

University of Sinaloa

CINVESTAV

BUAP (Universidad de Puebla)

expressed interest on the project

**There is potential for construction
of a larger collaboration joining EIC
in experimental aspects**

