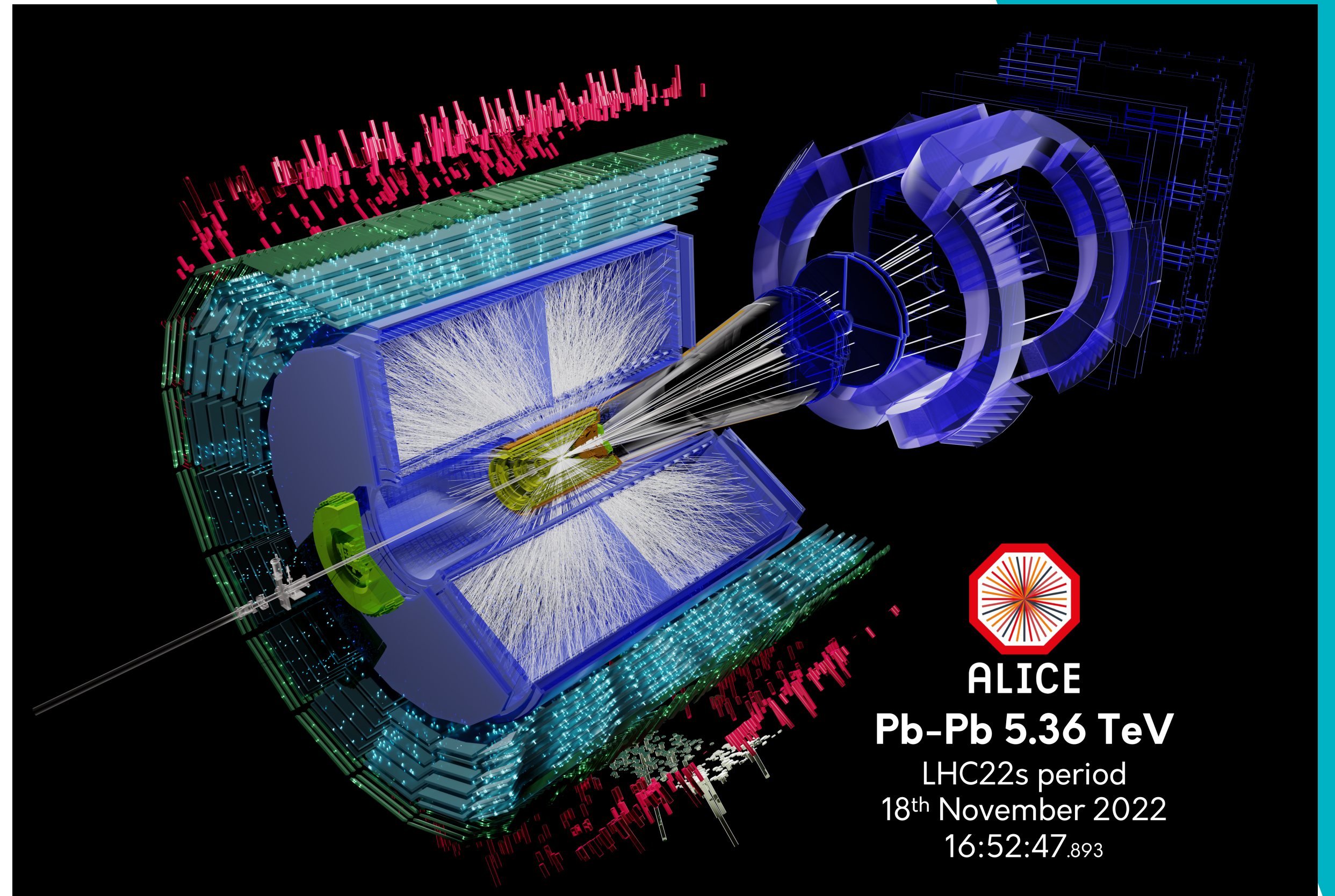


# OVERVIEW OF ALICE ACTIVITIES

Panos Christakoglou



# THE ALICE GROUP

Several key collaboration roles

- Ongoing positions: Editorial board, Conference committee, computing board, ...

Spokesperson



Scientific staff



R&D

GW

New hiring



Engineers



Administration



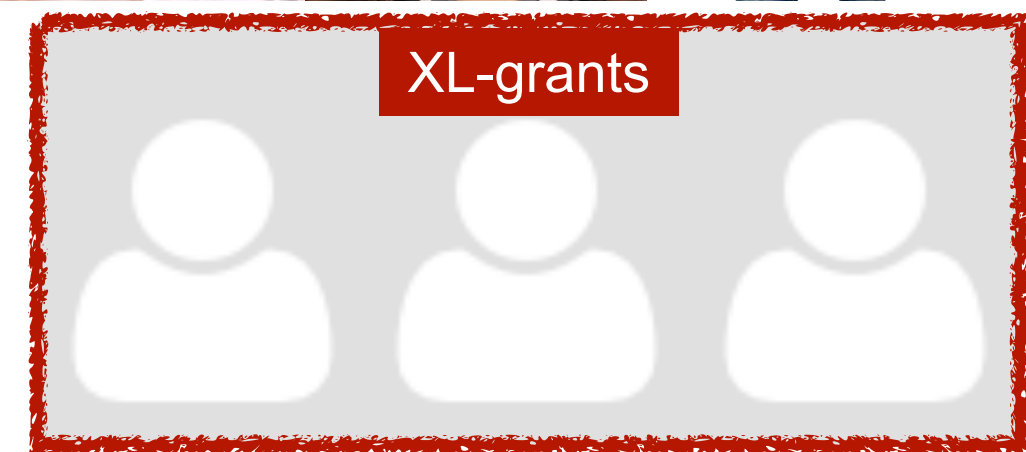
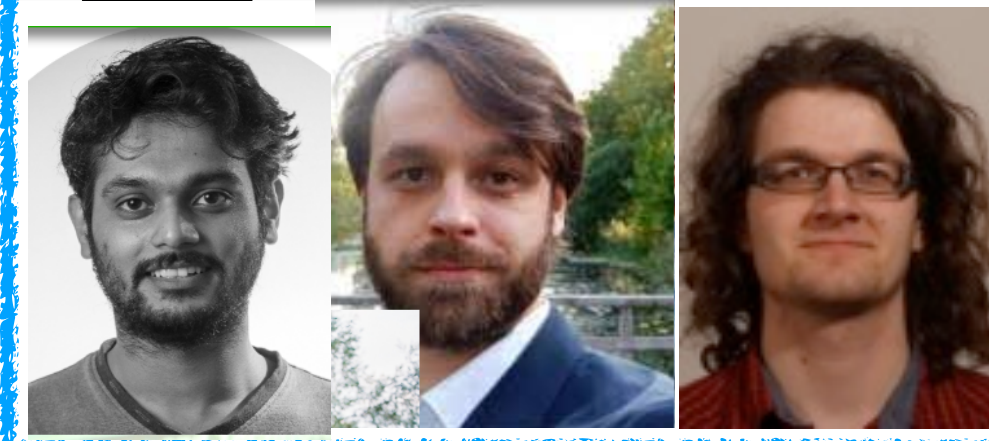
Postdocs & PhDs



Graduating



XL grant



XL-grants

Master students



# ALICE PHYSICS PROGRAM

Thermodynamics description of the medium, using macroscopic quantities

- EoS,  $V$ ,  $T$ ,  $\epsilon$ ,  $\eta/s$ ,  $\zeta/s$ ,...

Understand the microscopic details of the matter formed

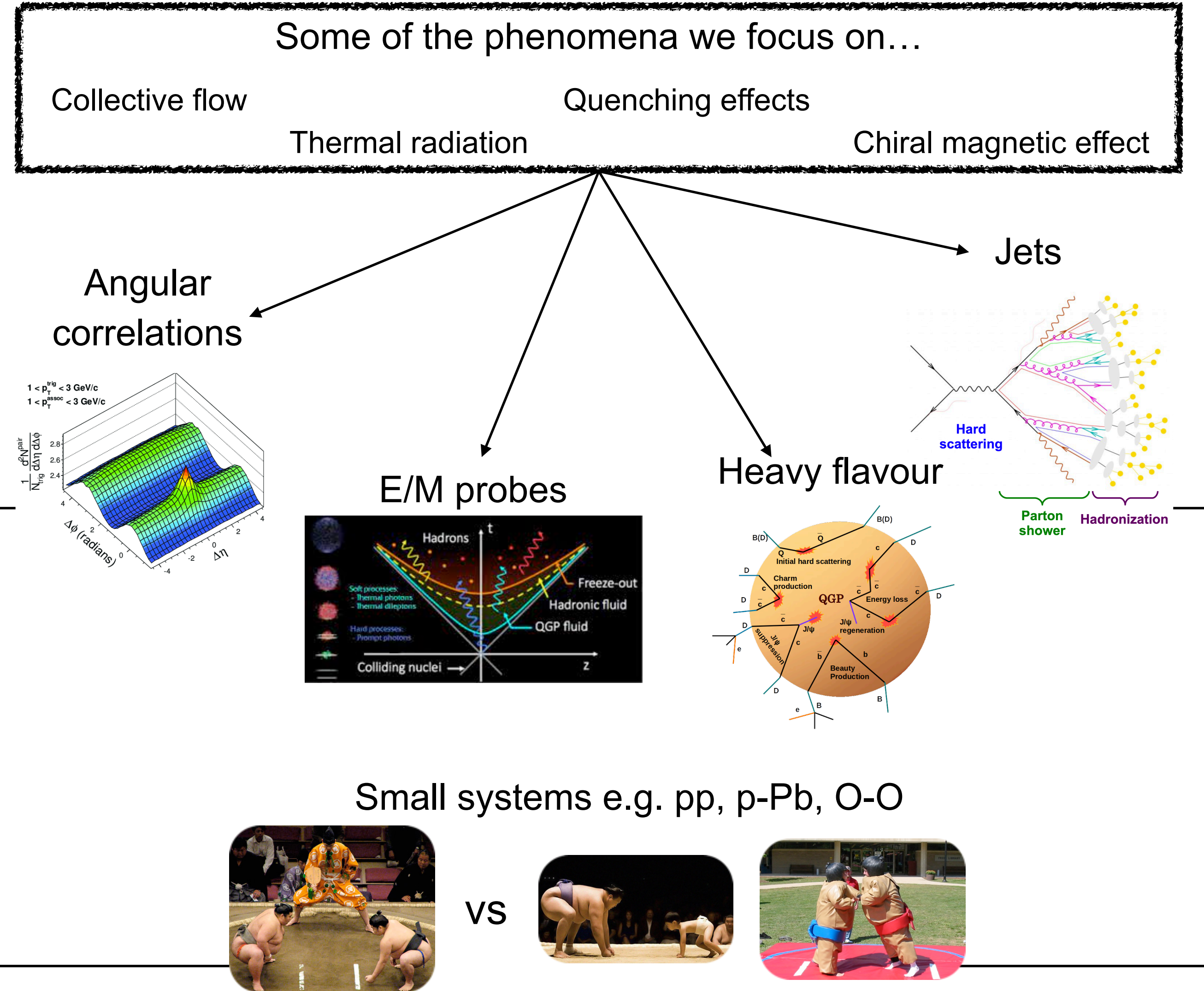
- Can we resolve quarks and gluons as the degrees of freedom?

Limit of QGP formation?

- Can “QGP signals” be switched off vs multiplicity or system size?

(non-QGP focused) QCD studies

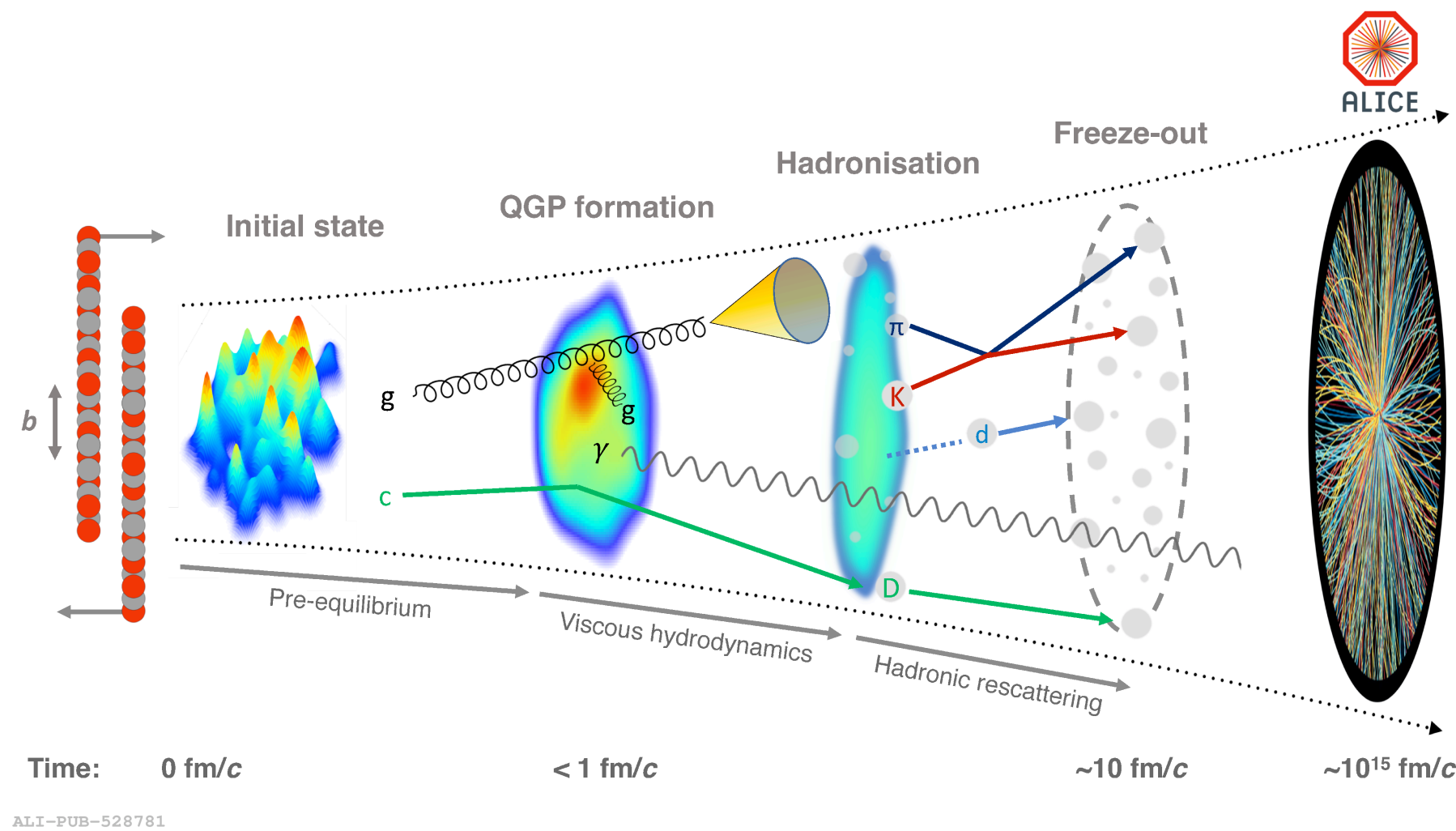
- Parity violation in strong interactions
- Strong interaction potentials
- ...



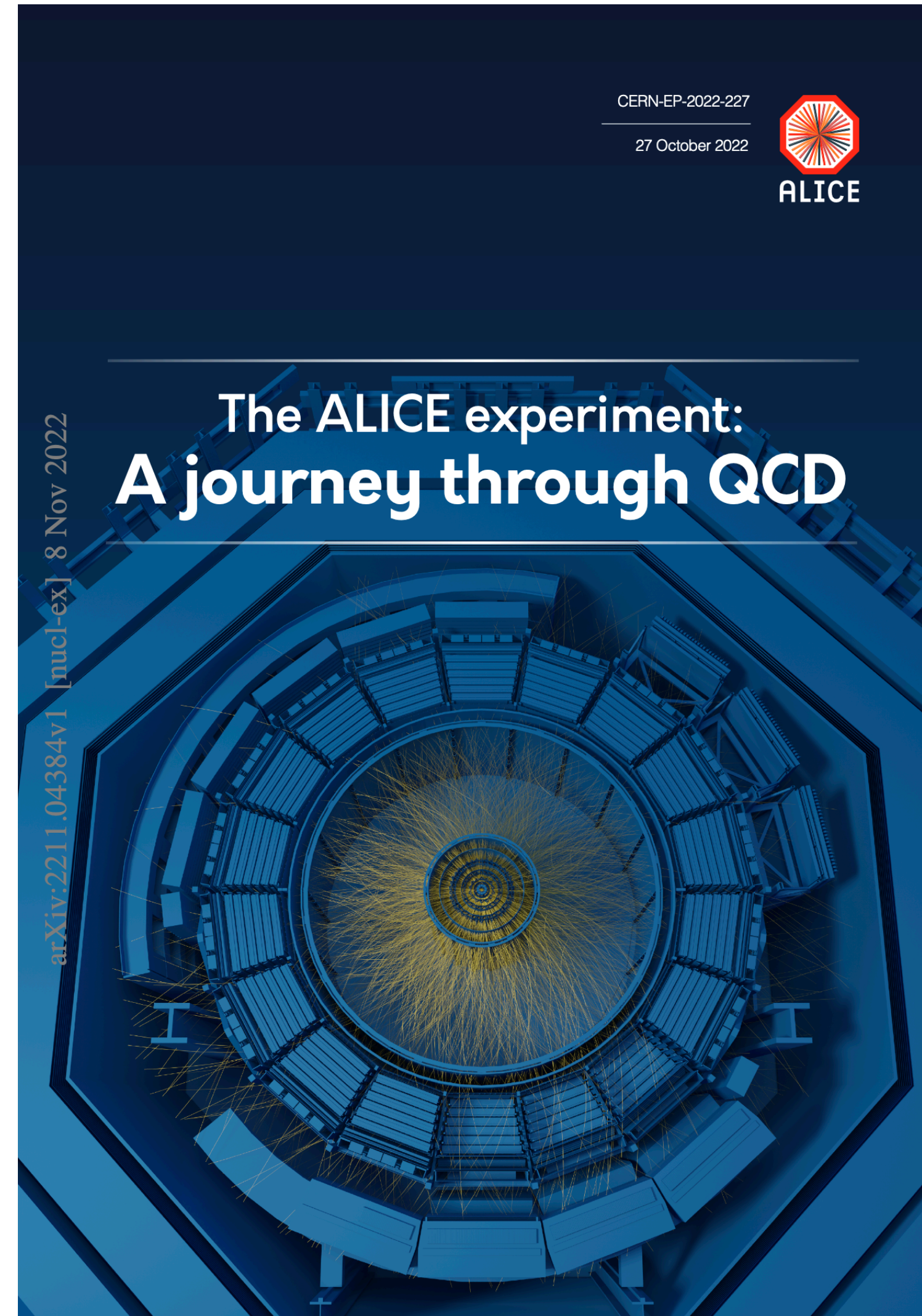
# REVIEW PAPER IS OUT!\*

arXiv:2211.04384

## Comprehensive description of the results from the first years of ALICE operations



\*After the Russian invasion, publications of all LHC collaborations were postponed → Resuming now publications



### Steering group members




Chapter convener

Many chapters contain mainly results from our group



A big thanks to all our (ex) postdocs and PhD students who contributed significantly with their results!!!


# SELECTION OF CONFERENCES...

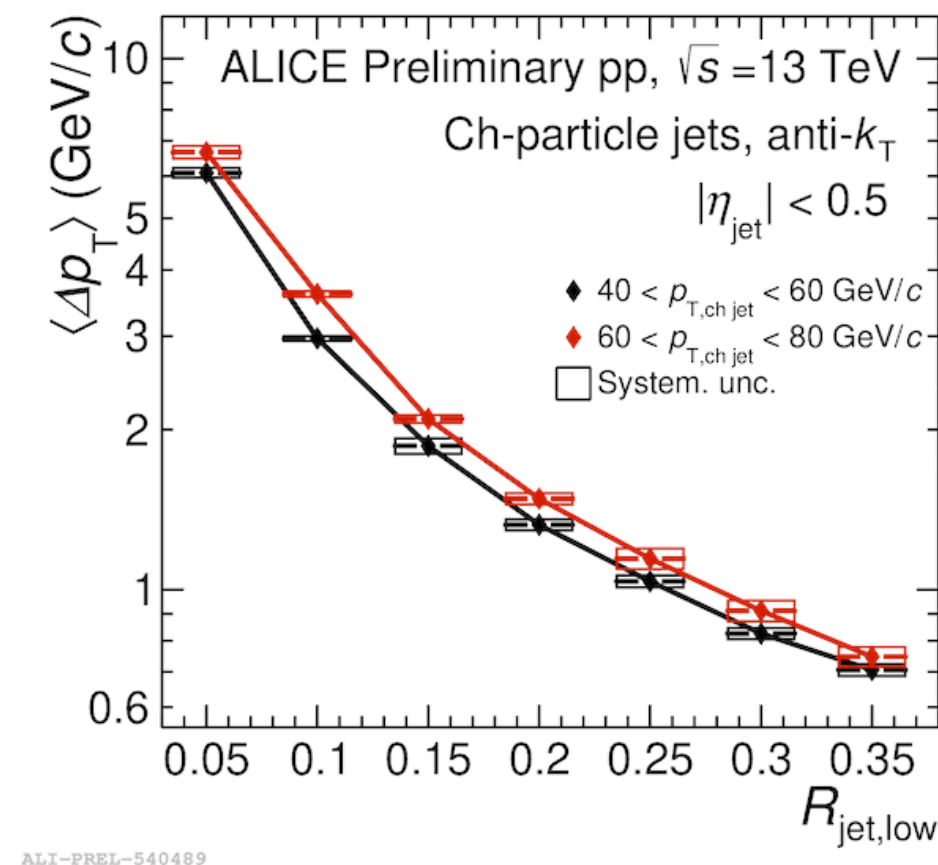


## Measurement of the $R$ -dependence of jet quenching in pp and Pb–Pb collisions with ALICE

11<sup>th</sup> Hard Probes conference, March 28<sup>th</sup> 2023  
Christos Pliatskas on behalf of the ALICE collaboration







Dependence on jet radius in pp  $\rightarrow$  comparison with Pb-Pb (next step) essential for extraction of physics conclusions about nature of quenching effects

## Studying the Chiral Magnetic Effect in Pb+Pb and Xe+Xe collisions using the AVFD model with ALICE

Shi Qiu



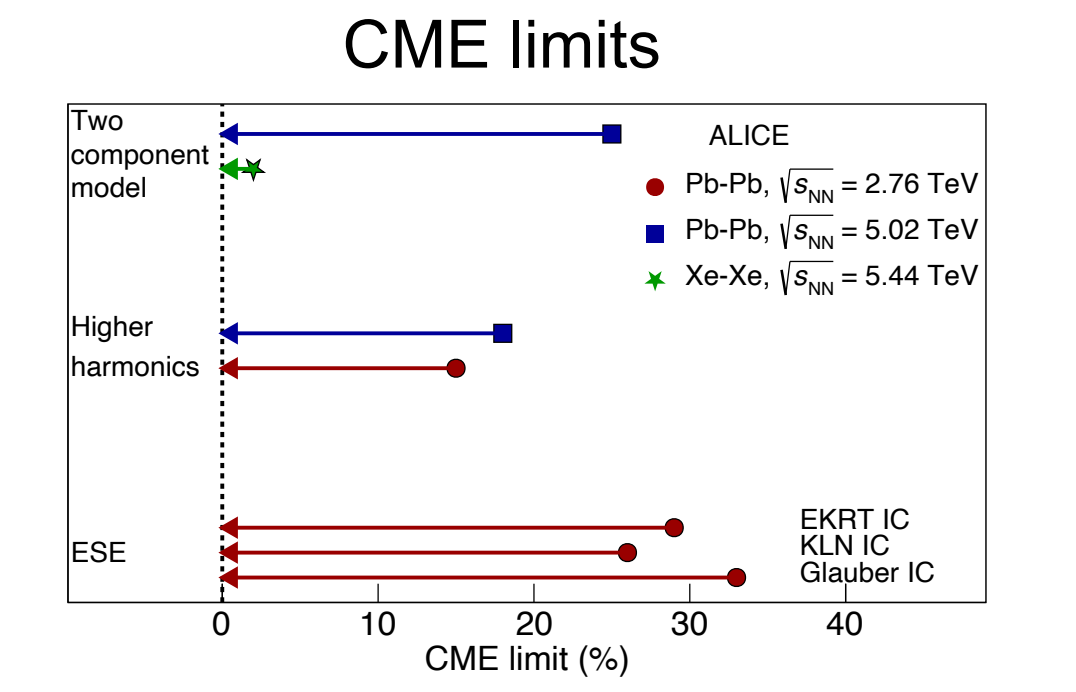




Collaborated with Panos Christakoglou, Joey Staa  
The European Physical Journal C volume 81, Article number: 717 (2021)

The XVth Quark Confinement and the Hadron Spectrum Conference, 5/8/2022

### Additional talks/contributions @ HP

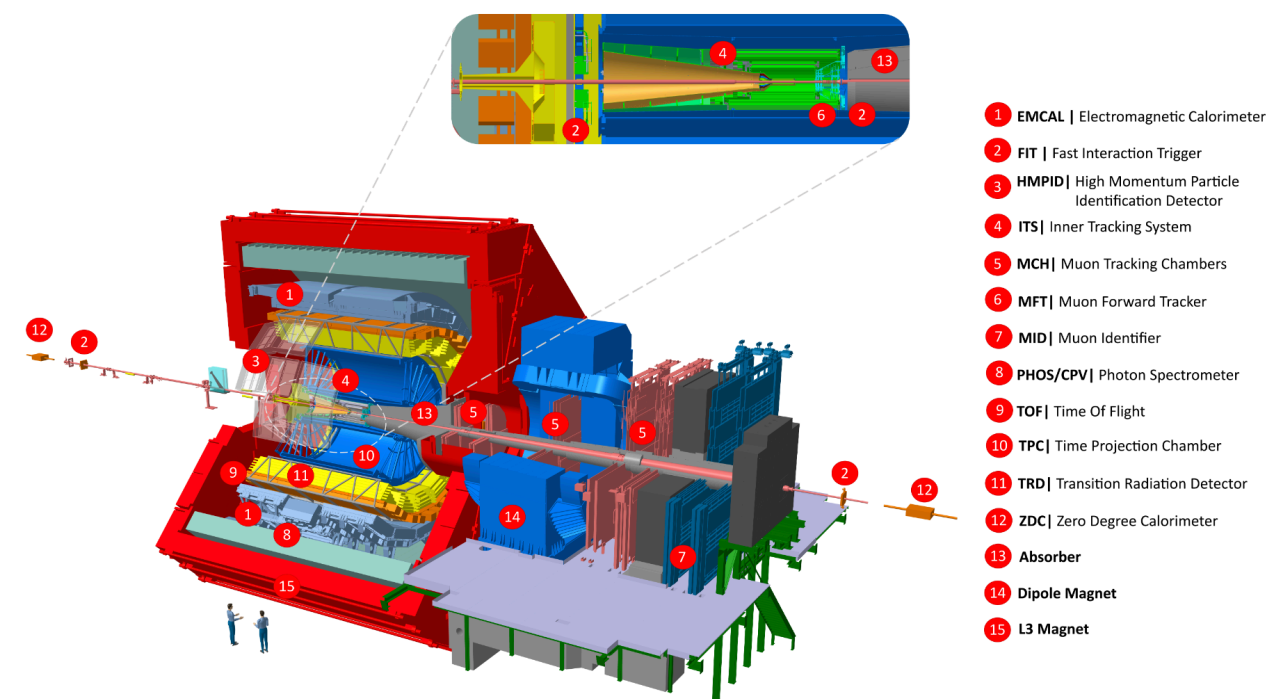


Parity violation studies provide limits (so far)

# ALICE STATUS AFTER LS2

Completed major upgrade during LS2

- TPC, forward muon tracker
- ITS2 3+2+2 layers of MAPS
  - NIKHEF/UU contribution



[arXiv:2302.01238](https://arxiv.org/abs/2302.01238)

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH



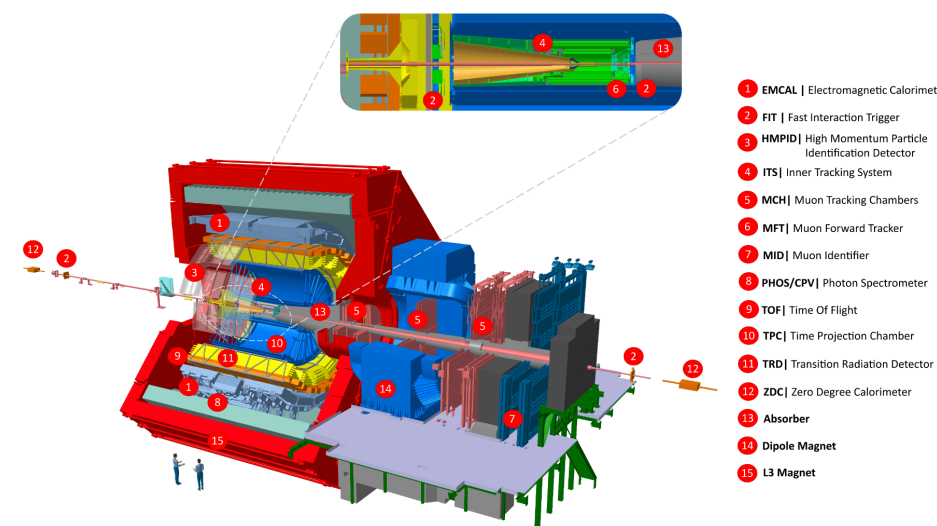
CERN-EP-2023-009  
27 January 2023

## ALICE upgrades during the LHC Long Shutdown 2

ALICE Collaboration

### Abstract

A Large Ion Collider Experiment (ALICE) has been conceived and constructed as a heavy-ion experiment at the LHC. During LHC Runs 1 and 2, it has produced a wide range of physics results using all collision systems available at the LHC. In order to best exploit new physics opportunities opening up with the upgraded LHC and new detector technologies, the experiment has undergone a major upgrade during the LHC Long Shutdown 2 (2019–2022). This comprises the move to continuous readout, the complete overhaul of core detectors, as well as a new online event processing farm with a redesigned online-offline software framework. These improvements will allow to record Pb–Pb collisions at rates up to 50 kHz, while ensuring sensitivity for signals without a triggerable signature.

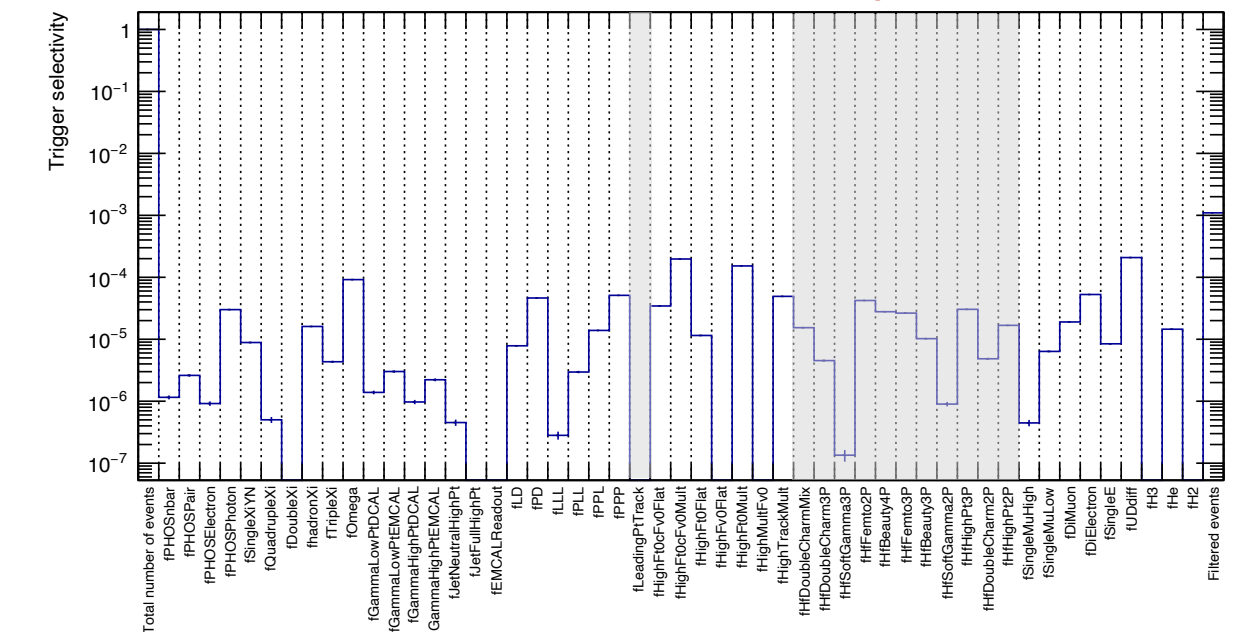


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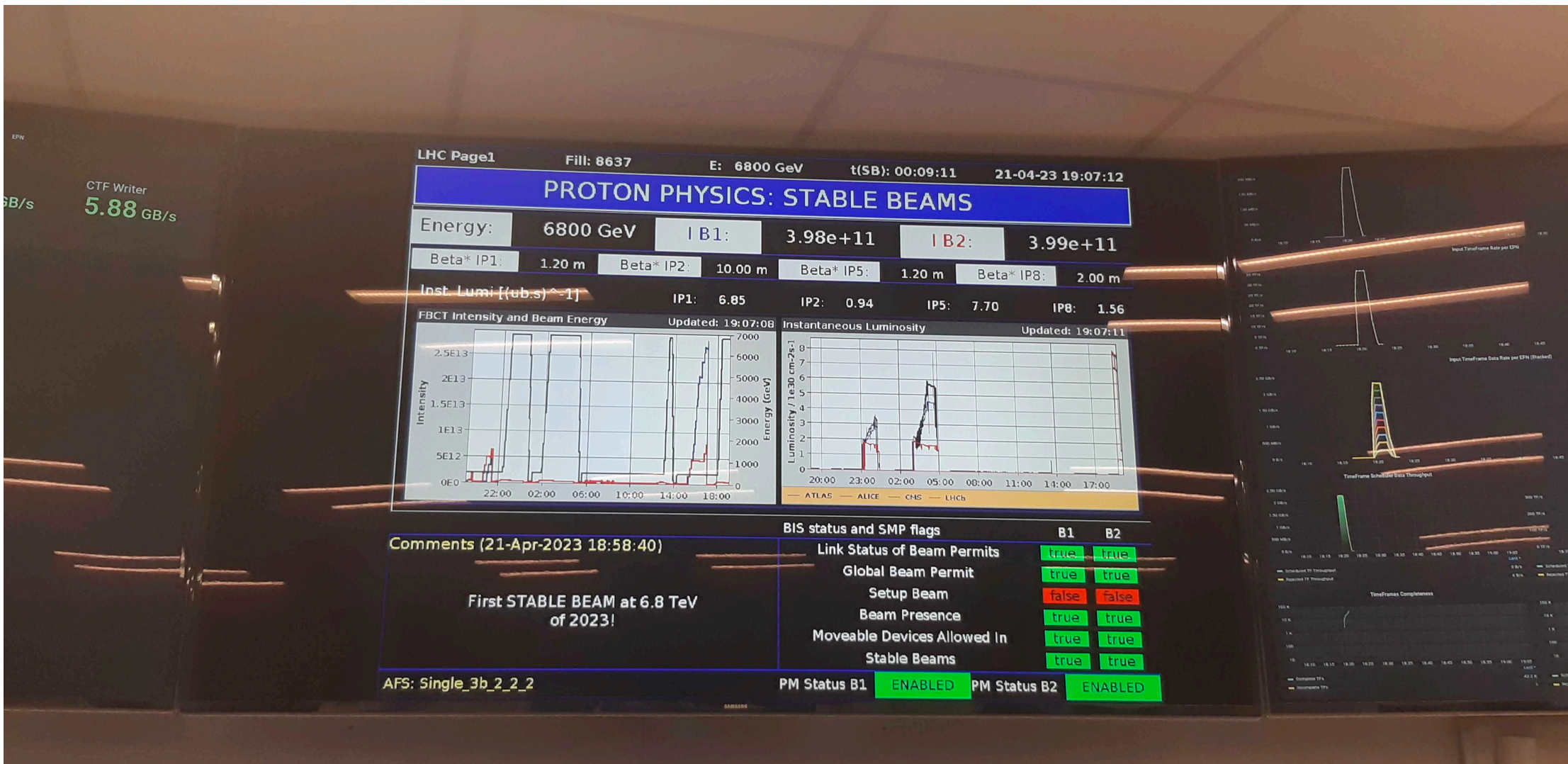
Collected 2022 luminosity: 17.6 pb<sup>-1</sup>

- 10<sup>12</sup> minimum bias events on disk
- Data reduction strategy
  - Keep ~1 pb<sup>-1</sup> MB+selected rare events (1 in 10<sup>4</sup>)
    - High multiplicity
    - Multi-strange baryons
    - Low-q baryon pairs for femtoscopy
    - Nuclei
    - PHOS/EMCAL triggers

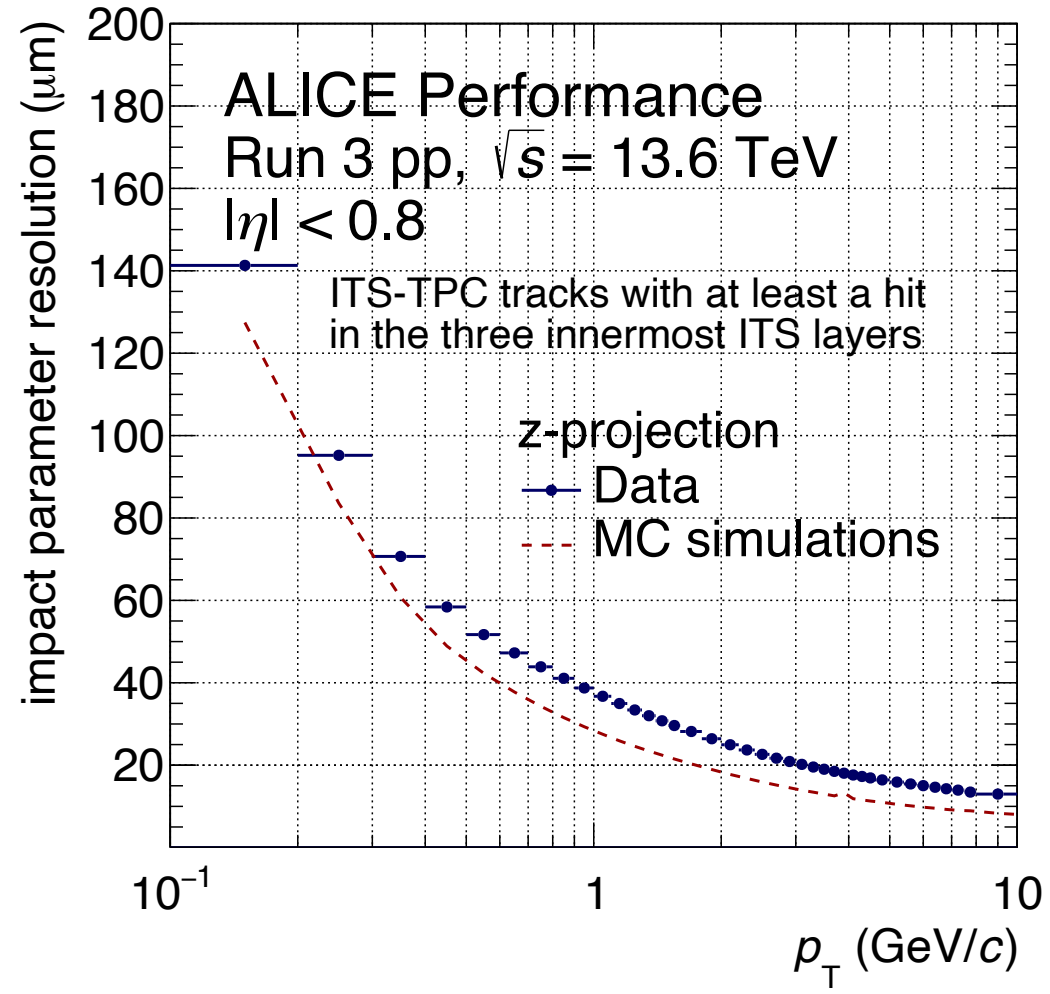
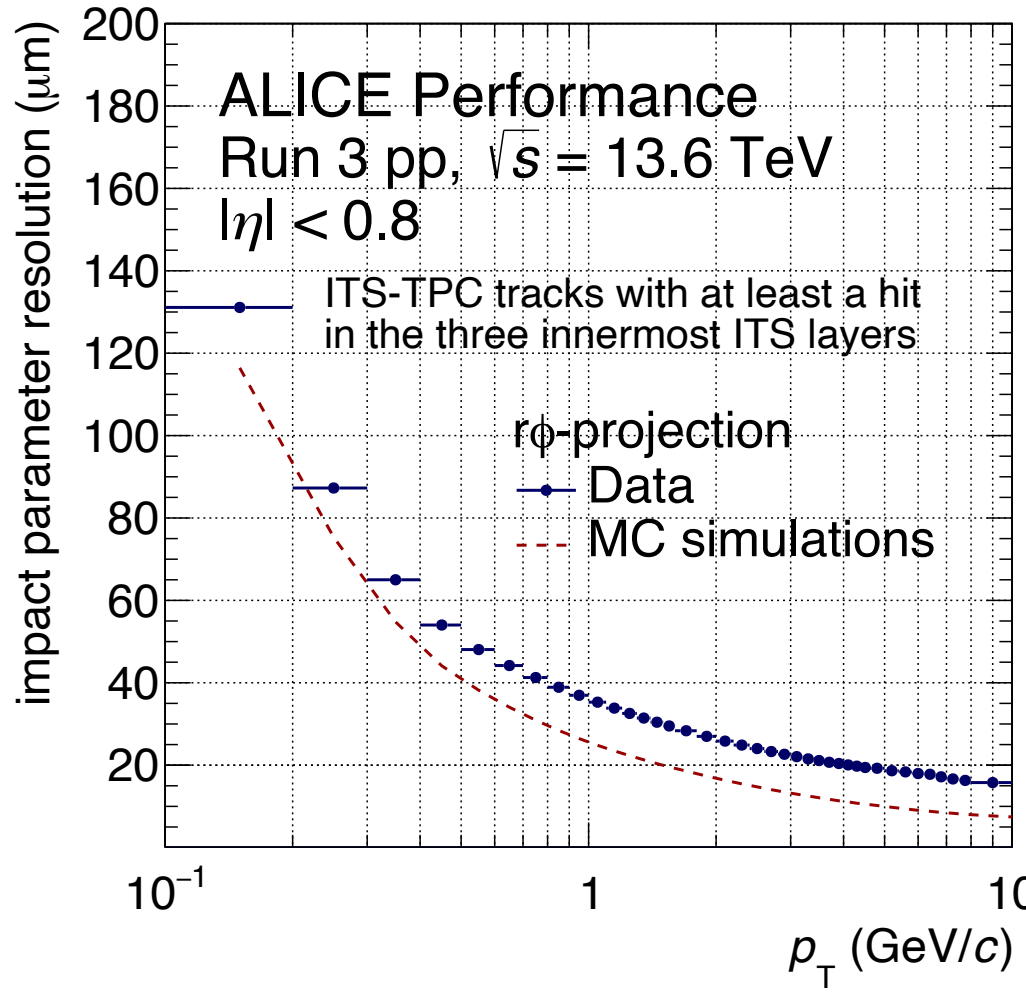
See talk of Gijs



# ALICE STATUS IN 2023



Johanna, Mariia, Rik, Bas from the ACR



First round of global alignment of central systems completed

- pointing resolution close to expected values → to be improved with further calibration

Excellent alignment status of muon (forward) system

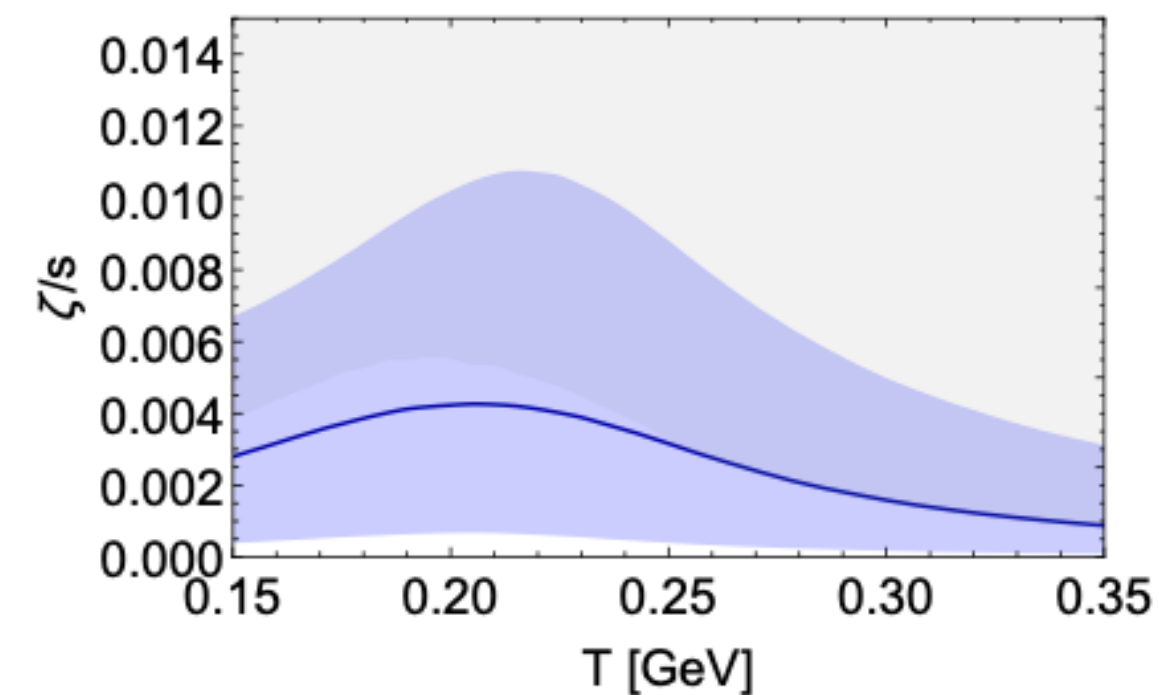
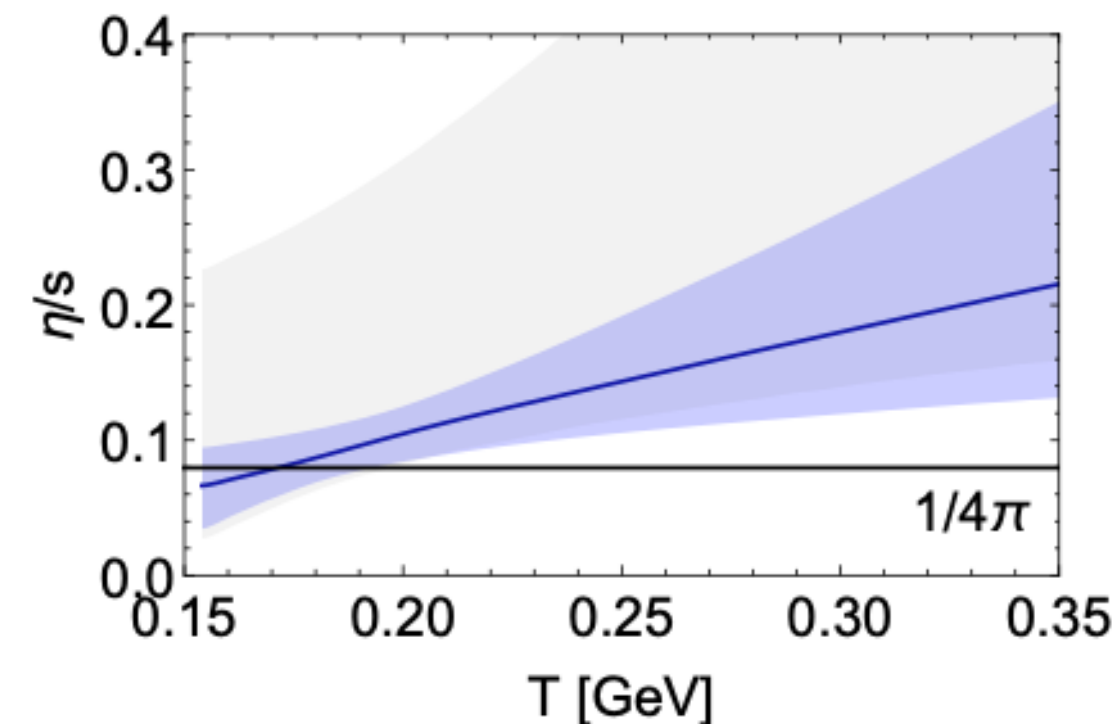
Getting ready for the HI run of 2023 (~3.25 nb<sup>-1</sup>)

# A LOT OF PROGRESS...BUT STILL PLENTY OF UNANSWERED QUESTIONS

- New phenomena (e.g. vorticity, magnetic fields, CME, CMW...)
- Exploring the QCD phase diagram
- Additional precision measurements (e.g. heavy quarks, jets) → knowledge of poorly constrained parameters
- Understanding hadronization
- Origin of collectivity in small systems → can this lead to a unified picture of how QCD matter evolves as a function event activity?
- Chiral symmetry restoration?

## How does a strongly coupled QGP emerge from QCD?

G. Nijs *et al.*, *Phys.Rev.C* 103 (2021) 5, 054909



### Similar studies

J. E. Bernhard *et al.*, *Nature Phys.* 15, 214 (2019)

(JETSCAPE Collaboration) *Phys. Rev. C* 104, 024905 (2021)

$$\mathcal{L} = \frac{1}{4g^2} G_{\mu\nu}^a G_{\mu\nu}^a + \sum_f \bar{\psi}_f (i\gamma^\mu D_\mu + m_f) \psi_f$$

where  $G_{\mu\nu}^a \equiv \partial_\mu A_\nu^a - \partial_\nu A_\mu^a + gf_{abc} A_\mu^b A_\nu^c$

and  $D_\mu \equiv \partial_\mu + i t^a A_\mu^a$

That's it!



# A LOT OF PROGRESS...BUT STILL PLENTY OF UNANSWERED QUESTIONS

- New phenomena (e.g. vorticity, magnetic fields, CME, CMW...)
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- Chiral symmetry restoration?

Some of the topics could have (direct) implications to GW physics

Full Application - NWO Open Competition Domain Science - XL, 2021-2022



## NWO Open Competition Domain Science - XL Round 2021-2022

Grant application form

### PART A: Scientific proposal

#### A.1 General information

##### A.1.1 Grant application title

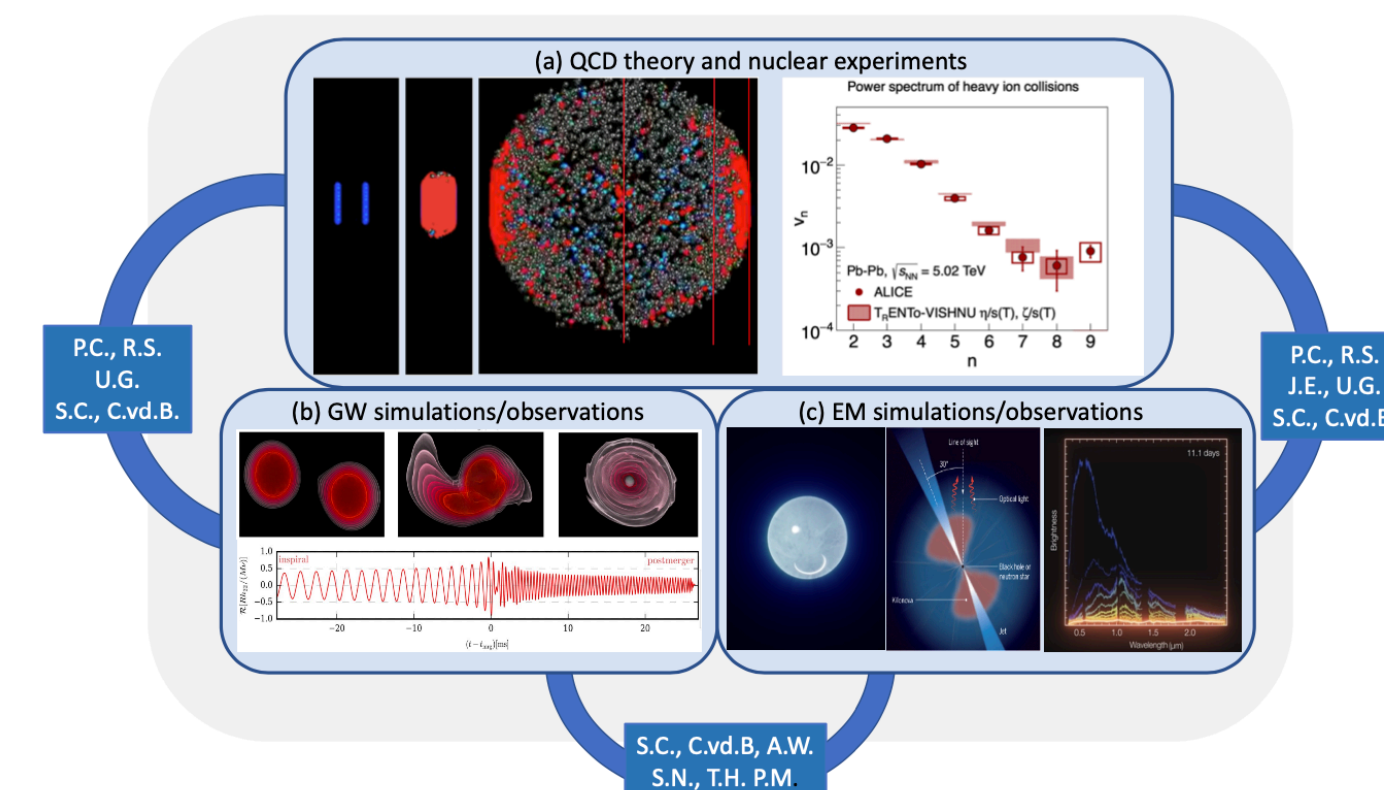
Probing the phase diagram of quantum chromodynamics



PD



PhD



Julia Even (RUG), Anna Watts (UvA), Samaya Nissanke (UvA), Tanja Hinderer (UU), Philipp Moesta (UvA), Umutursoy (UU), Chris van den Broeck (UU)

# A LOT OF PROGRESS...BUT STILL PLENTY OF UNANSWERED QUESTIONS

- New phenomena (e.g. vorticity, magnetic fields, CME, CMW...)
- Exploring the QCD phase diagram
- Additional precision measurements (e.g. heavy quarks, jets) → knowledge of poorly constrained parameters
- Understanding hadronization
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- Chiral symmetry restoration?

Some of the topics need new ideas/technologies

Full Application - NWO Open Competition Domain Science - XL, 2021-2022



## NWO Open Competition Domain Science - XL Round 2021-2022

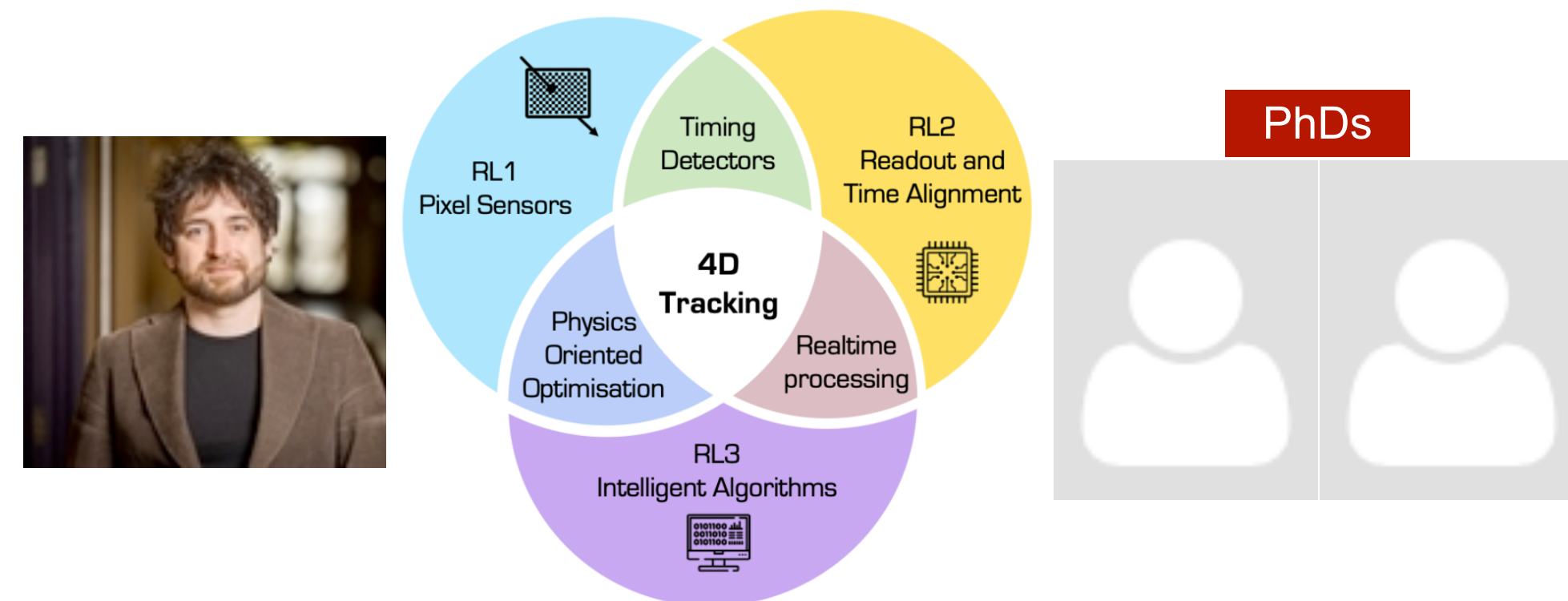
Grant application form

### PART A: Scientific proposal

#### A.1 General information

##### A.1.1 Grant application title

Fast sensors and Algorithms for Space-time Tracking and Event Reconstruction (FASTER)



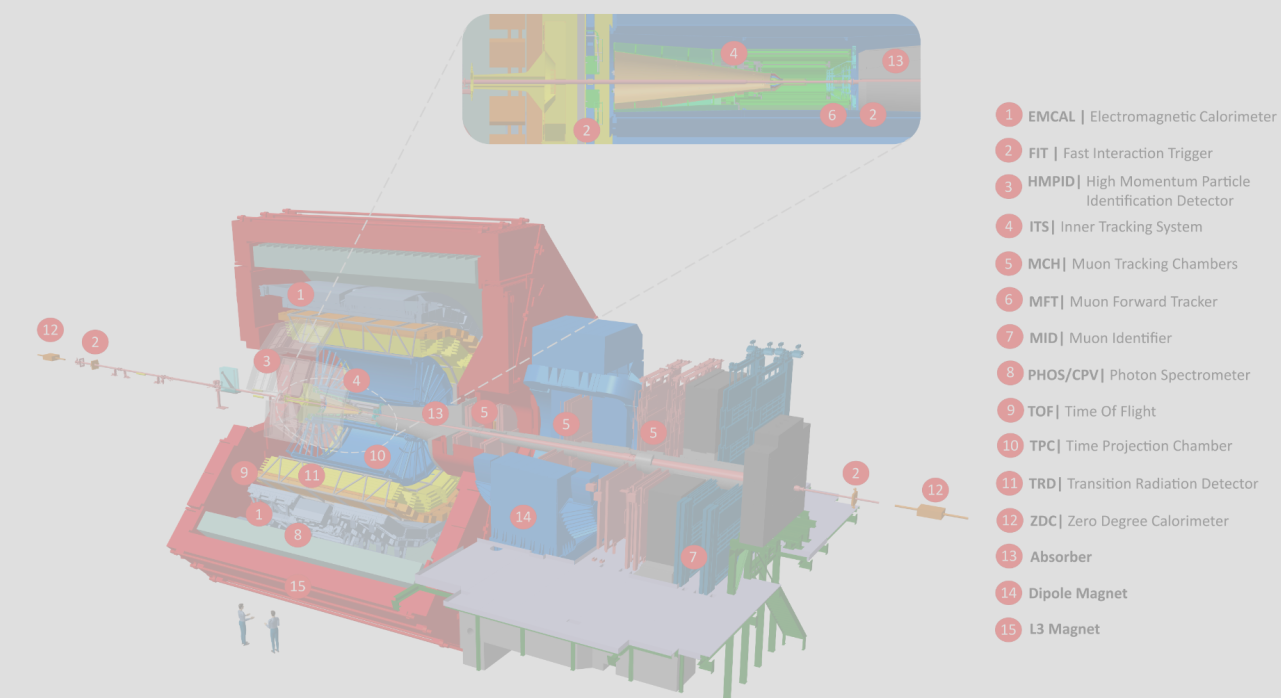
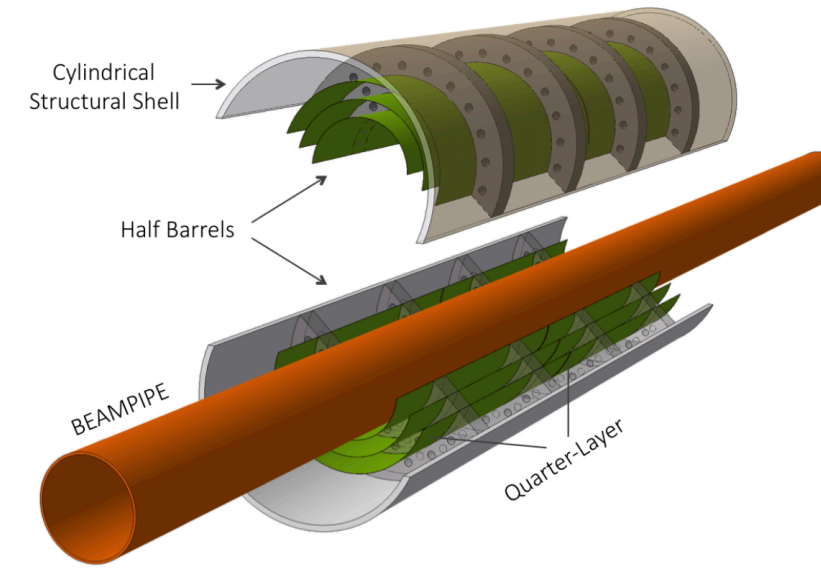
Hella Snoek (UvA), Jory Sonneveld (UvA), Mengqing Wu (RU), Daniel Perez (MU), Jacco de Vries (MU), Kristof de Bruyn (RUG), Martin van Beuzekom (Nikhef), Kazu Akiba (Nikhef), Roel Aaij (Nikhef)

# LOOKING AHEAD...



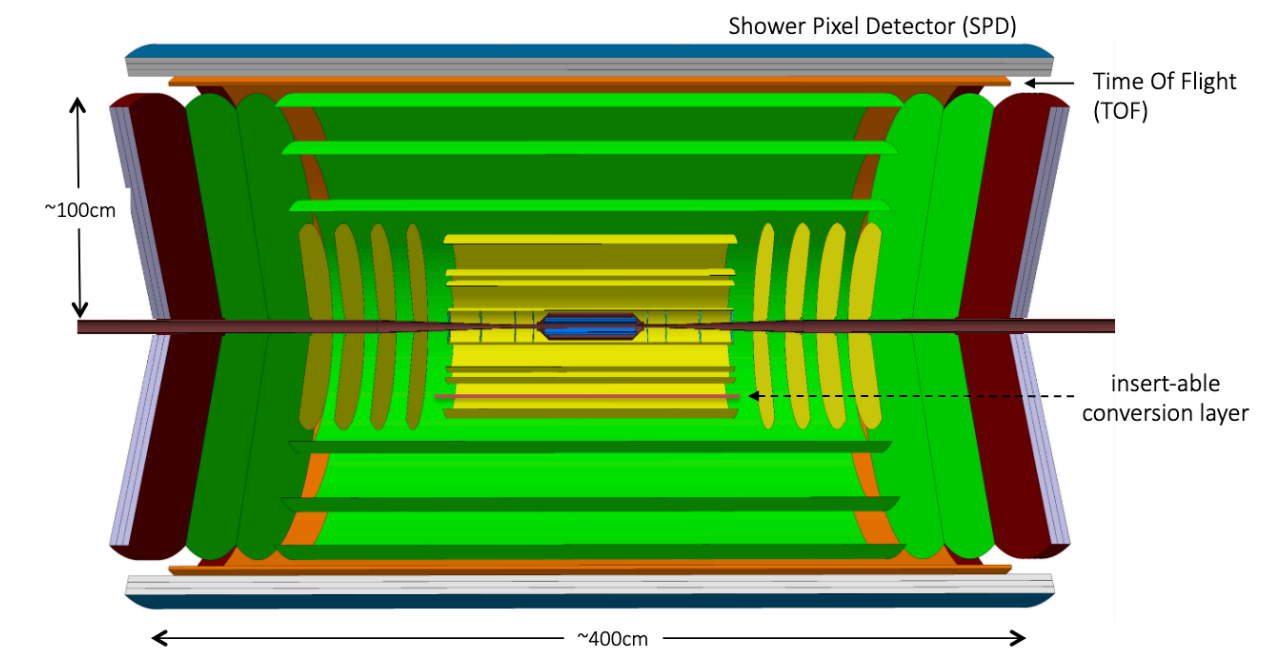
Completed major upgrade during LS2

- TPC, forward muon tracker
- ITS2 3+2+2 layers of MAPS
  - NIKHEF/UU contribution



## ITS2 → ITS3

- Replace 3 innermost layers
- Bent, wafer-scale monolithic pixel sensors
- Move from water to air cooling



# FOLLOW THE ALICE TALKS...

MAPS



Jory Sonneveld

Jet studies



Gijs van Weelden

Thank you for  
your attention!



After the Russian invasion, publications of all LHC collaborations were postponed

Discussions of institutional acknowledgement on publications resulted in a joint decision by Collaboration Boards of the four large experiments:

- Authors affiliated with Russian or Belarussian institutes, or with JINR, sign the Collaboration's scientific publications with their names and ORCID identifiers (where available), and the institute affiliation is replaced, respectively, by the reference: "Affiliated with an institute [or an international laboratory] covered by a cooperation agreement with CERN." The complete author list including all institute affiliations is made available to the journal in a non-public form for the purpose of machine-readable analysis or as historical data.
- No acknowledgement to the Russian and Belarussian funding agencies and JINR is made. On request, the experiment management will release a certificate attesting the contribution of the aforementioned institutes and funding agencies, or of JINR, to the work presented in the publication.

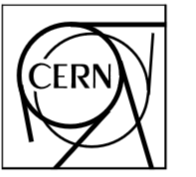
# ALICE STATUS & PLANS

System	Year	$\sqrt{s}$ (TeV)	$L_{int}$
pp	2009 - 2013	0.9	$\sim 200 \mu\text{b}^{-1}$
		2.76	$\sim 100 \text{nb}^{-1}$
		7	$\sim 1.5 \text{pb}^{-1}$
	8	$\sim 2.5 \text{pb}^{-1}$	
	2015, 2017	5.02	$\sim 1.3 \text{pb}^{-1}$
	<b>2023-2030</b>	<b>13.6</b>	<b><math>\sim 200 \text{pb}^{-1}</math></b>

System	Year	$\sqrt{s_{NN}}$ (TeV)	$L_{int}$
Pb-Pb	2010, 2011	2.76	$\sim 75 \mu\text{b}^{-1}$
	2015, 2018	5.02	$\sim 0.8 \text{nb}^{-1}$ $\sim 2 \text{nb}^{-1}$
	<b>2023-2030</b>	<b>5.3</b>	<b><math>\sim 13 \text{nb}^{-1}</math></b>
Xe-Xe	2017	5.44	$\sim 0.3 \mu\text{b}^{-1}$
p-Pb	2013, 2016	5.02	$\sim 18 \text{nb}^{-1}$ $\sim 50 \mu\text{b}^{-1}$
	2016	8.16	$\sim 25 \text{nb}^{-1}$ $\sim 186 \text{nb}^{-1}$
	<b>2023-2030</b>	<b>8-8.5</b>	<b><math>0.6 \text{pb}^{-1}</math></b>
O-O			
p-O	<b>2024</b>	<b>7</b>	<b><math>0.5 \text{nb}^{-1}</math></b>

arXiv:2302.01238

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH



CERN-EP-2023-009  
27 January 2023

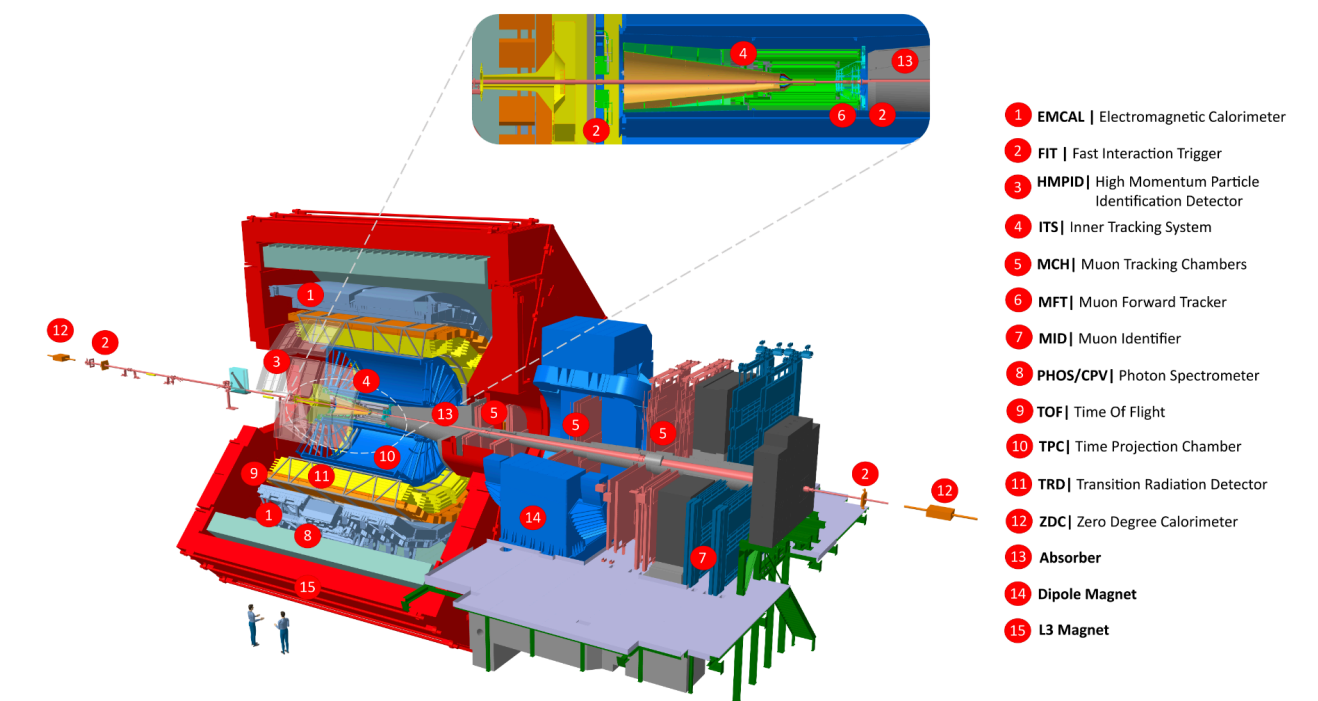
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arXiv:2302.01238v1 [physics.ins-det] 2 Feb 2023



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Rik Spijkers  
@ ACR



# ITS3 @ NIKHEF/UU

## Significant contribution on

- Mechanics
  - bended/stretched sensors, cooling
- Microelectronics
  - Serialiser, bandgaps...

26cm x 2.5mm sensor (stitched) with timing capabilities

Nikhef contribution on design

Nikhef design and production of the carrier and proximity boards and mechanical handling tools





# ALICE3: LETTER OF INTENT

Full azimuthal coverage with  $|\eta|$

$< 4$

Retractable first layers inside the beam pipe

Fast timing silicon detectors, TOF, RICH, muon detector

Physics focus

- (Multi-)heavy flavour states
- Quarkonia states
- Soft photons
- Exotic states
- Chiral symmetry restoration

[arXiv:2211.02491](https://arxiv.org/abs/2211.02491)

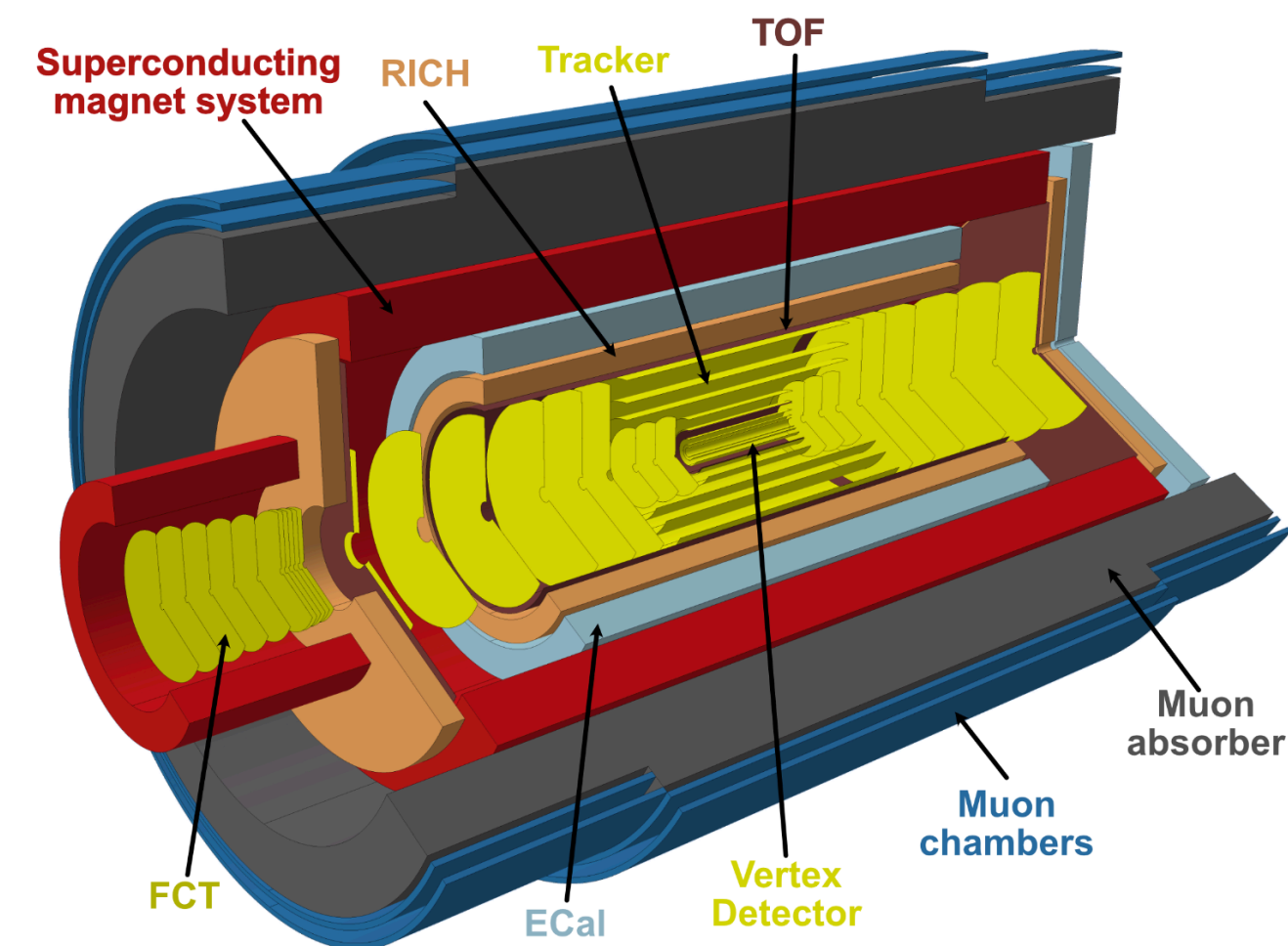
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CERN-LHCC-2022-009  
LHCC-I-038

arXiv:2211.02491v1 [physics.ins-det] 4 Nov 2022

Letter of intent for ALICE 3:  
A next-generation heavy-ion experiment at the LHC  
Version 2



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## Steering group members



Upgrade coordinator



Chapter convener

