

Not ALICE highlights...

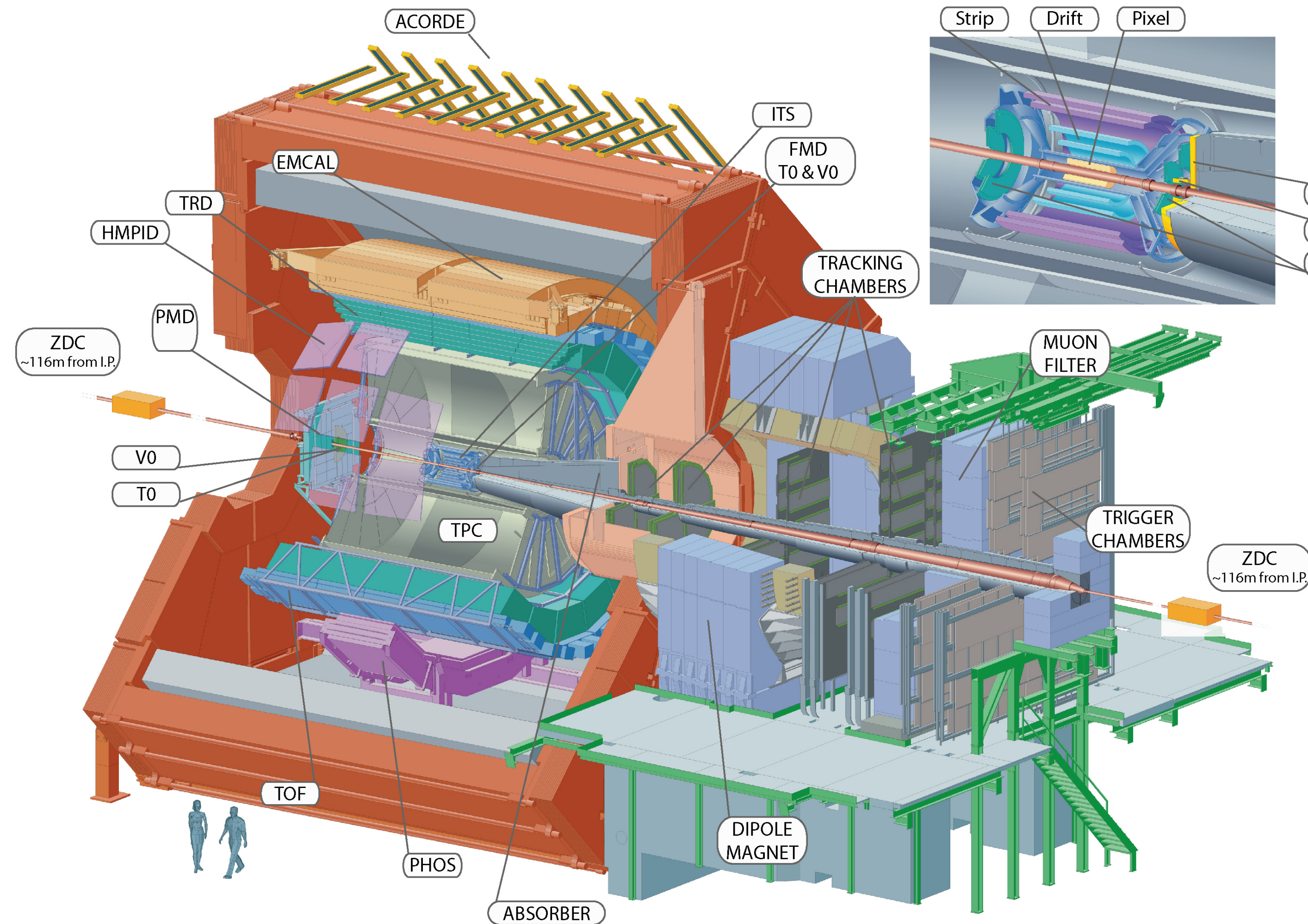


Xiaoming Zhang (张晓明)
Central China Normal University

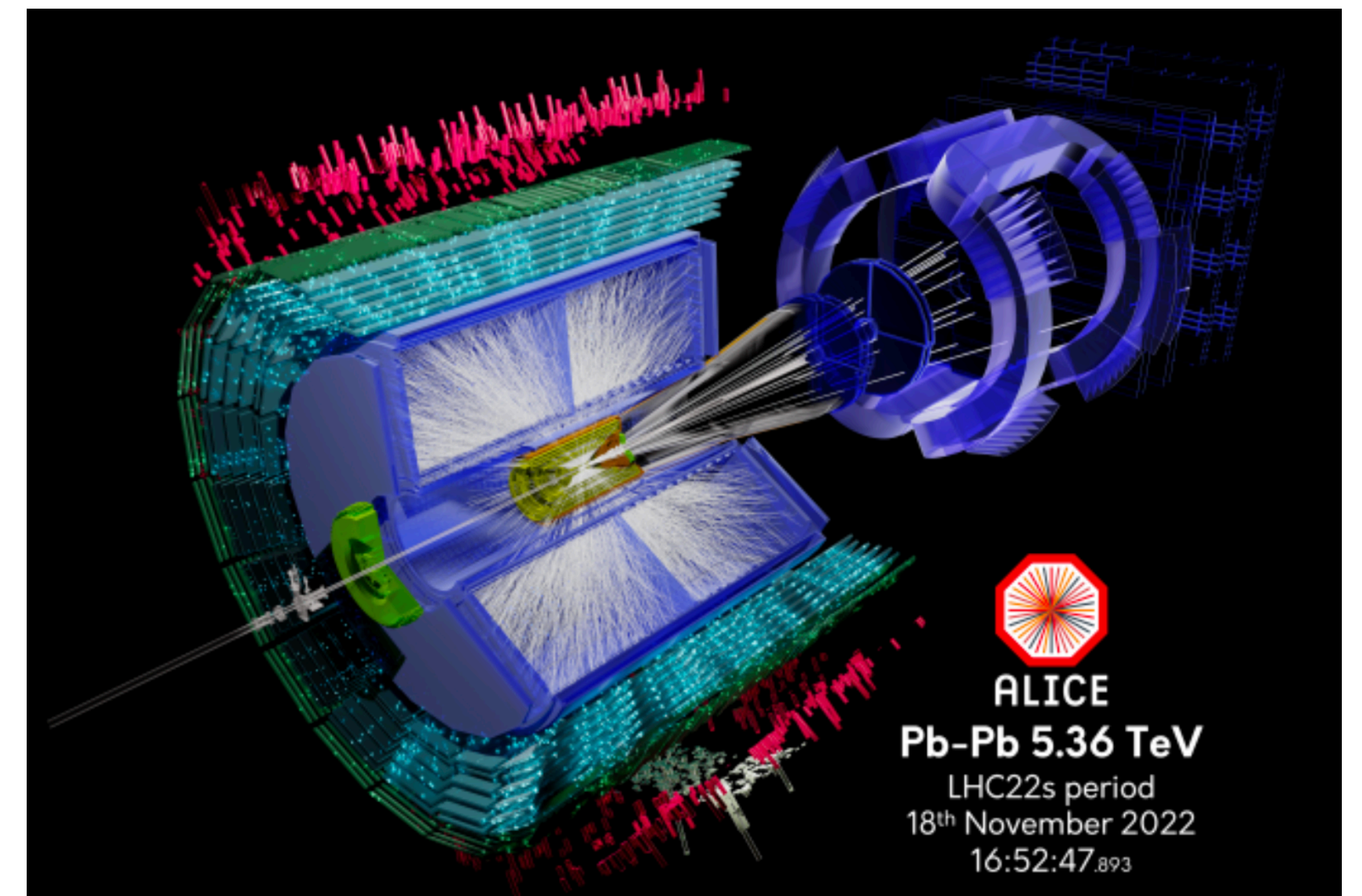
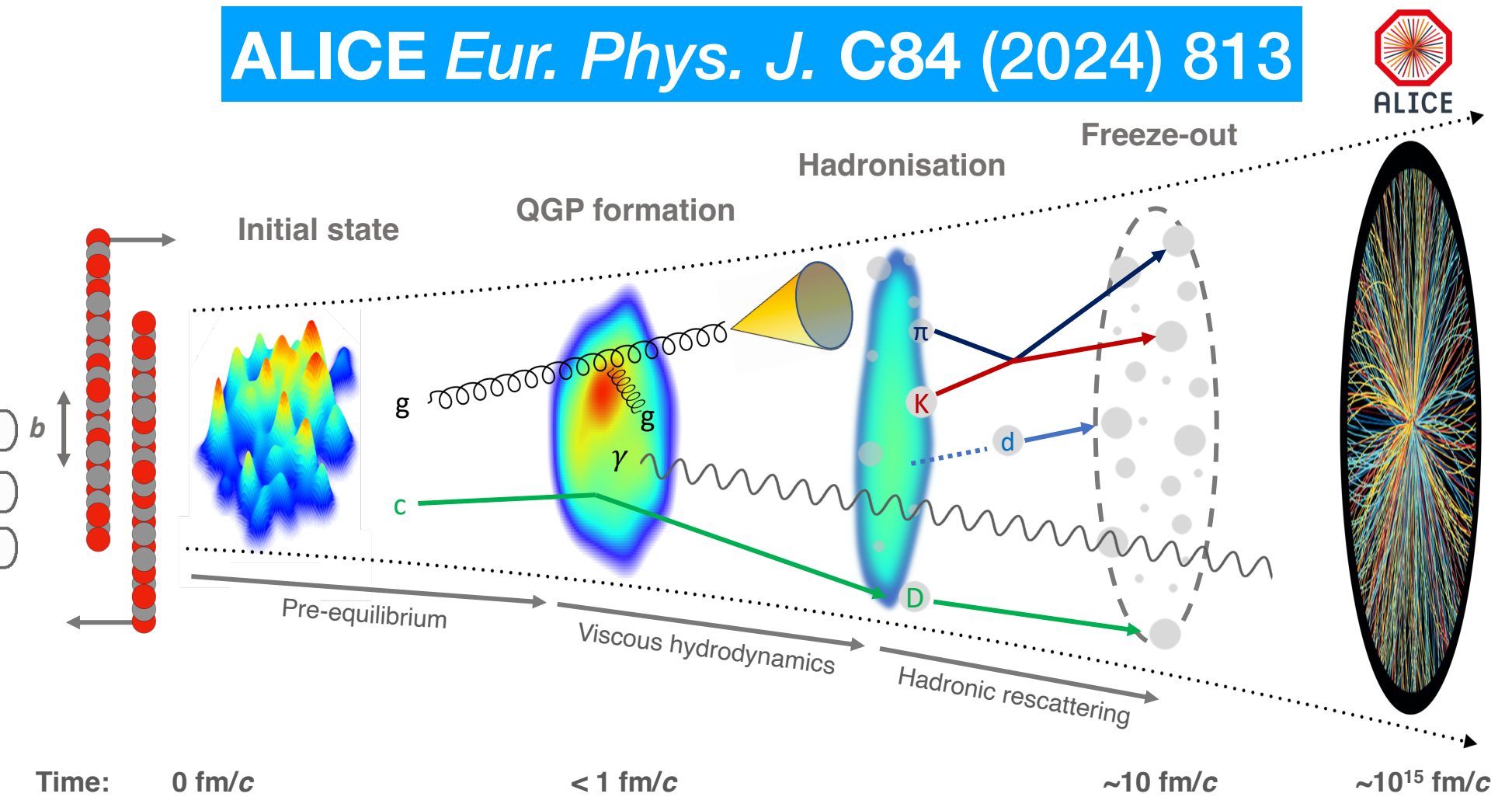


International Workshop on Nuclear Physics at the Energy Frontier
5–6 Aug 2026, Copenhagen, Denmark

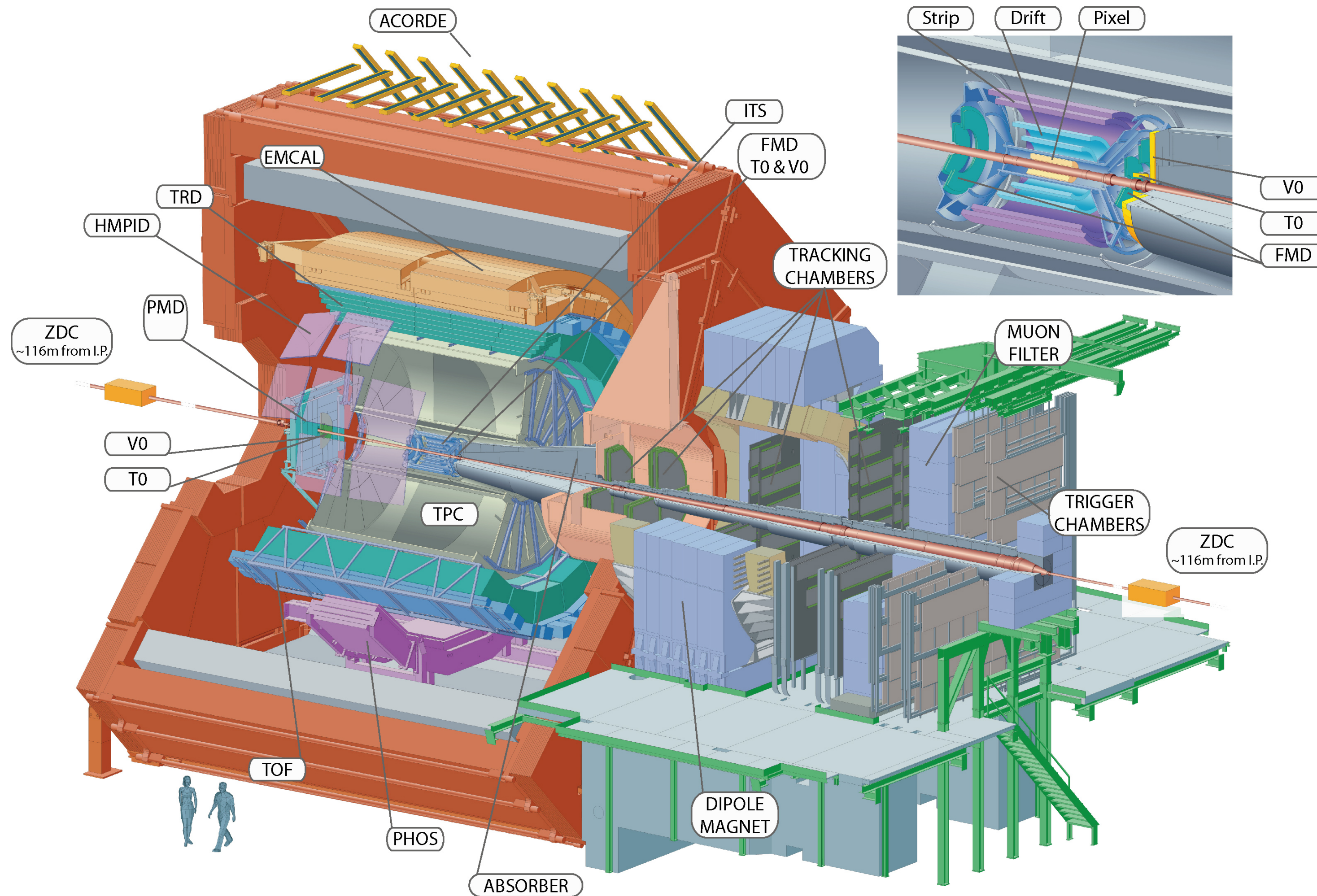
ALICE experiment at the LHC



ALICE *Eur. Phys. J. C*84 (2024) 813



A journey through QCD



CERN-EP-2022-227

27 October 2022



ALICE *Eur. Phys. J. C*84 (2024) 813

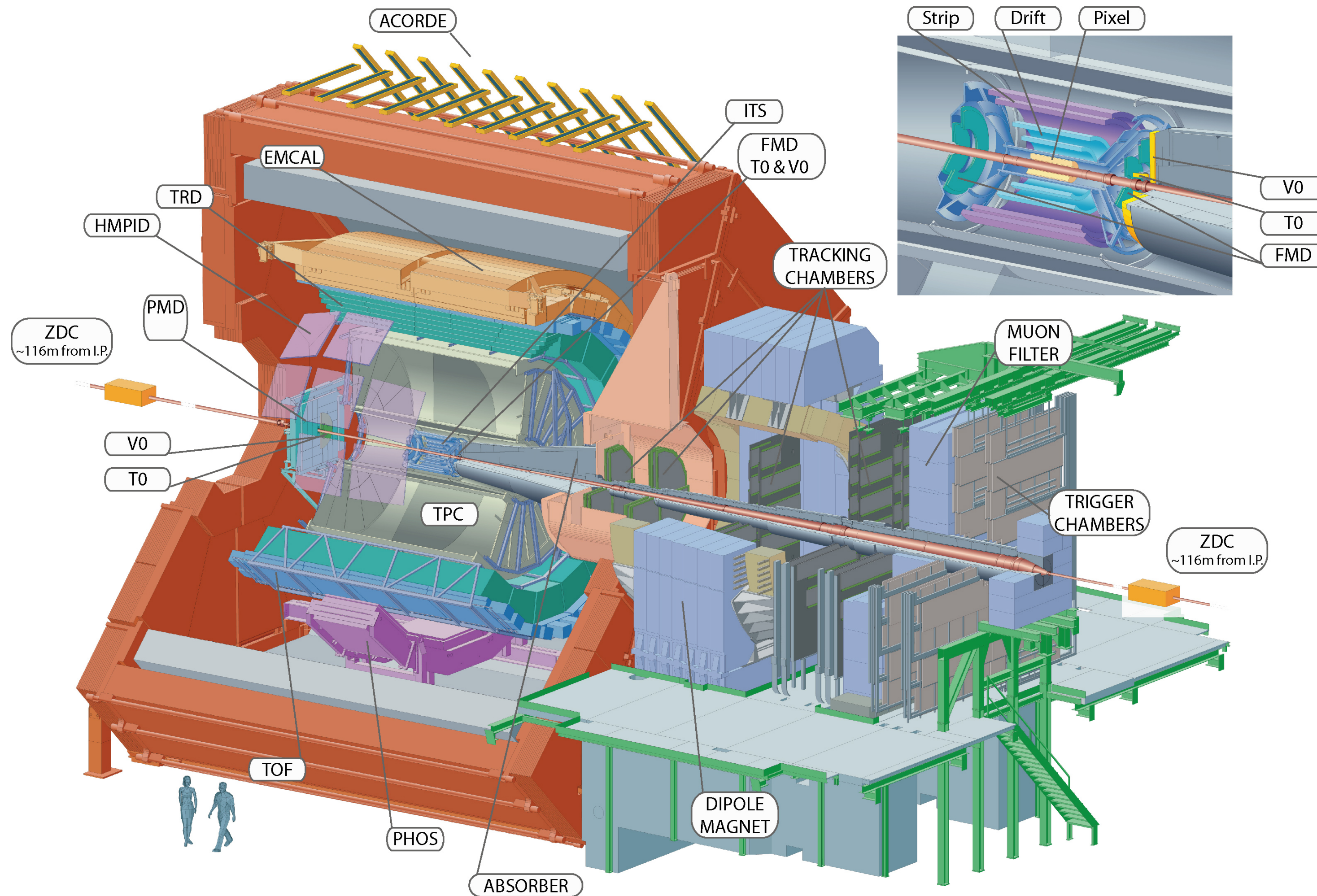
The ALICE experiment:
A journey through QCD

**ALICE Physics achievement
2009–2018**

→ QGP properties

- Nuclear structures
- Spin physics
- Hadronic physics
- Fundamental symmetries
- Contribution to cosmology

A journey through QCD



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ALICE *Eur. Phys. J. C*84 (2024) 813

The ALICE experiment:
A journey through QCD

**ALICE Physics achievement
2009–2018**

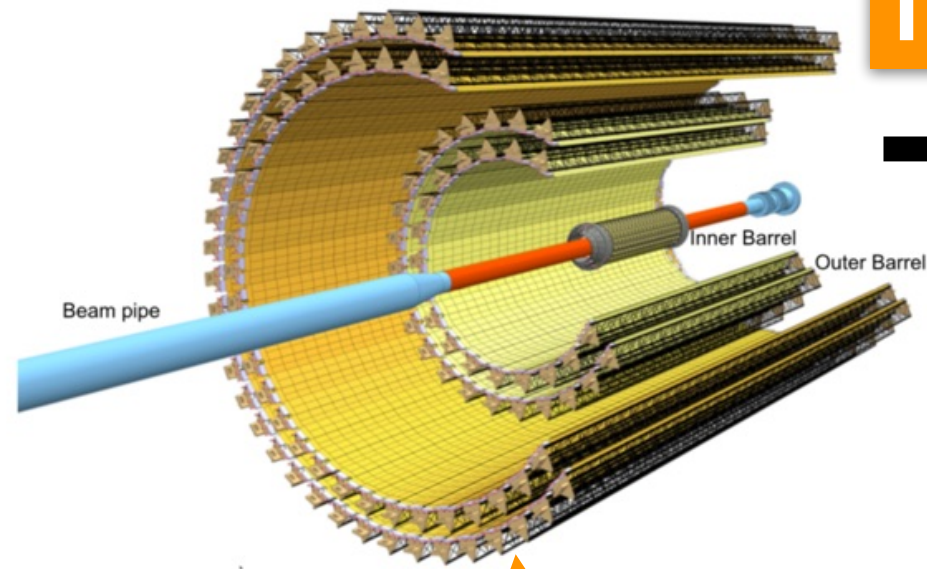
- QGP properties
 - ➔ Nuclear structures
 - ➔ Spin physics
 - ➔ Hadronic physics
 - ➔ Fundamental symmetries
 - ➔ Contribution to cosmology

ALICE at LHC Run 3 (2022–Jul 2026)



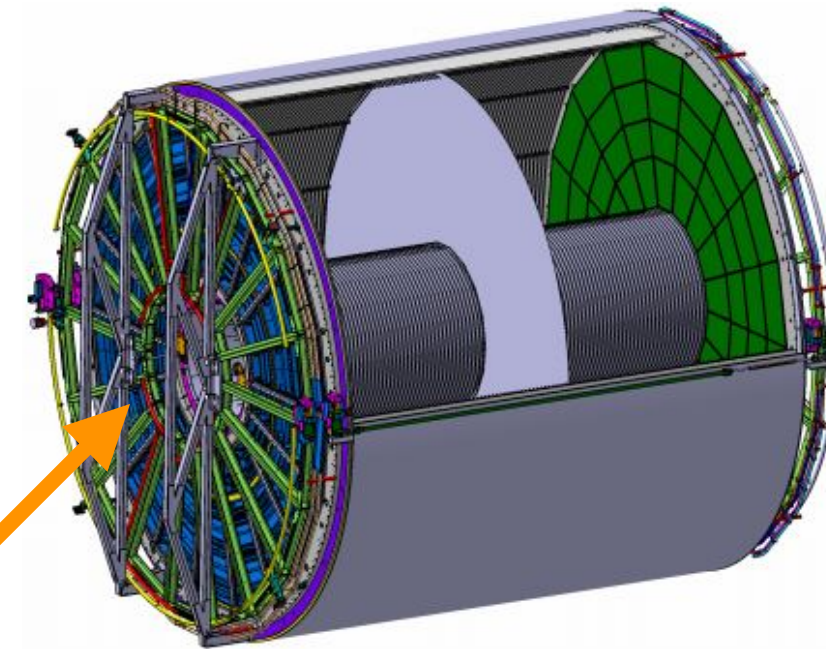
The 2nd generation inner tracking system (ITS2)

→ 7 layers MAPS detector, the innermost layer closer to interaction point



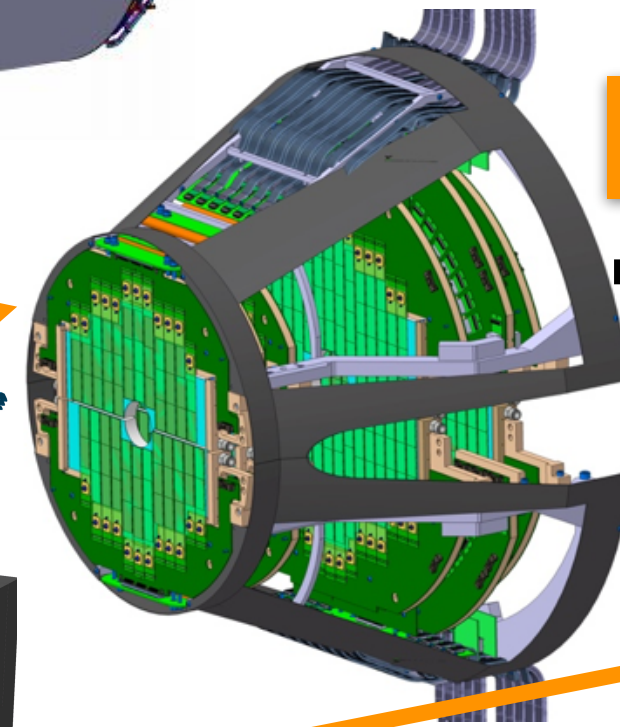
Time projection chamber (TPC)

→ New readout: MWPC → GEM



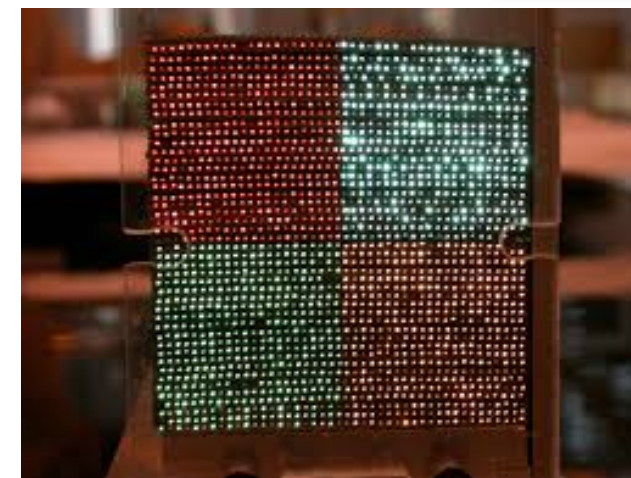
Muon forward tracker (MFT)

→ 5 planes of MAPS, vertexing for forward rapidity muons



Zero-degree calorimeter (ZDC)

→ First order event plane (EP) determination via measurement of spectator fragments

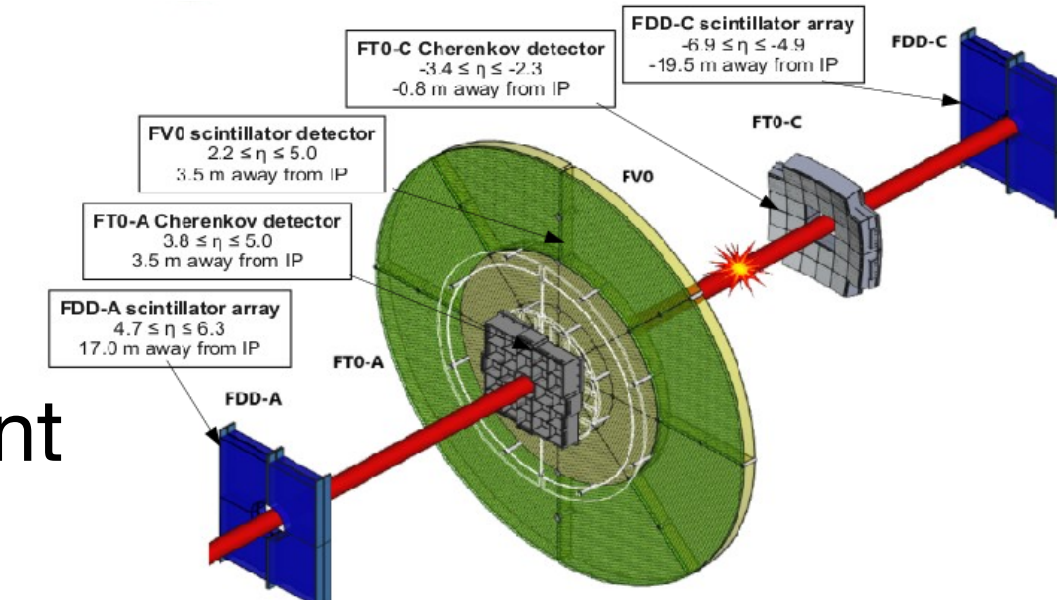


Readout of most detectors are upgraded to allow continuous readout

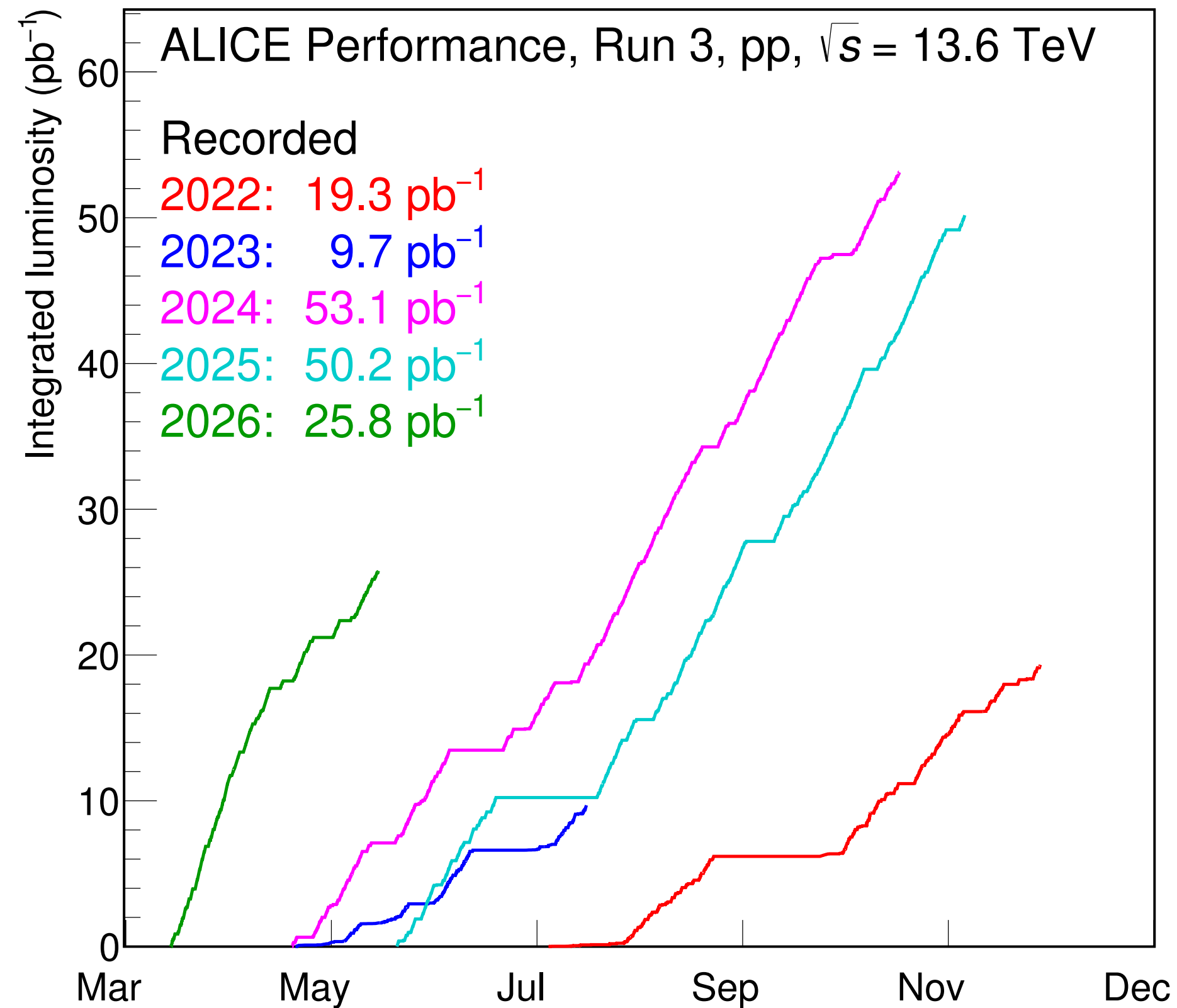
- pp data taking at 500 kHz
- Pb–Pb data taking up to 50 kHz
- Improved vertexing
- Improved tracking at low p_T

Fast integration trigger (FIT)

→ Event trigger, luminometer, EP reconstruction

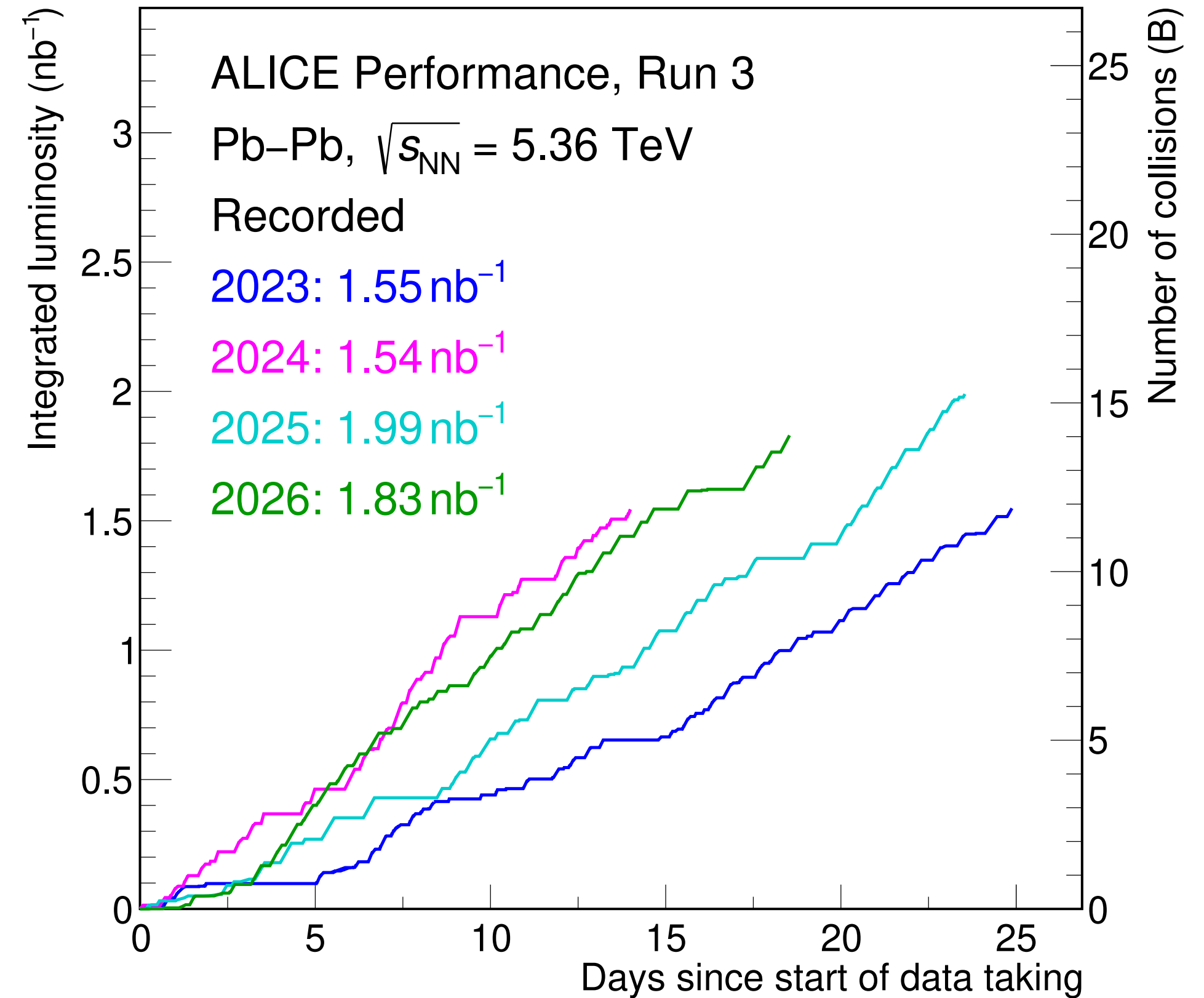


ALICE date taking in Run 3



ALI-PERF-632114

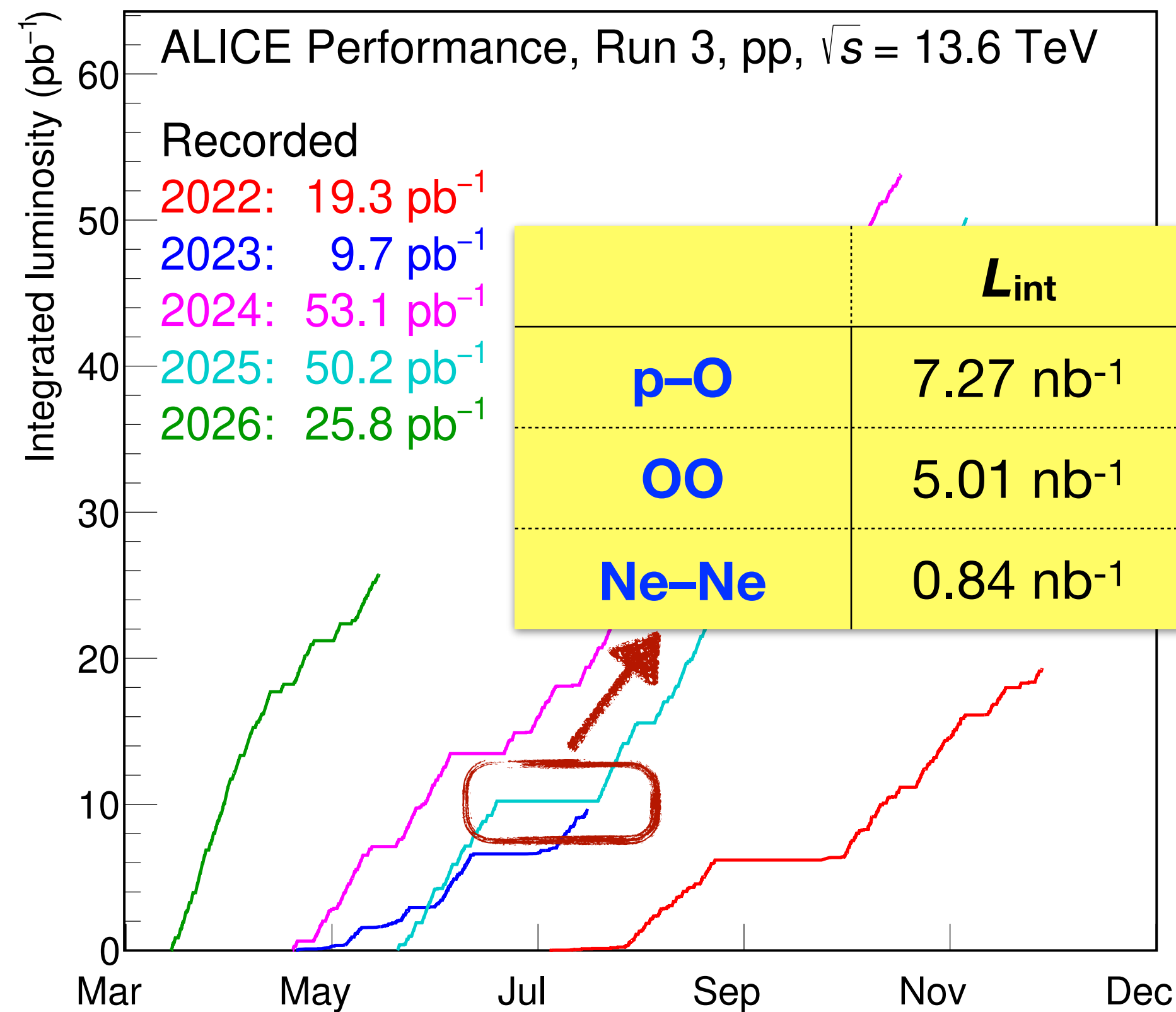
pp: 8 trillion MB events
×1000 more than Run 1+2



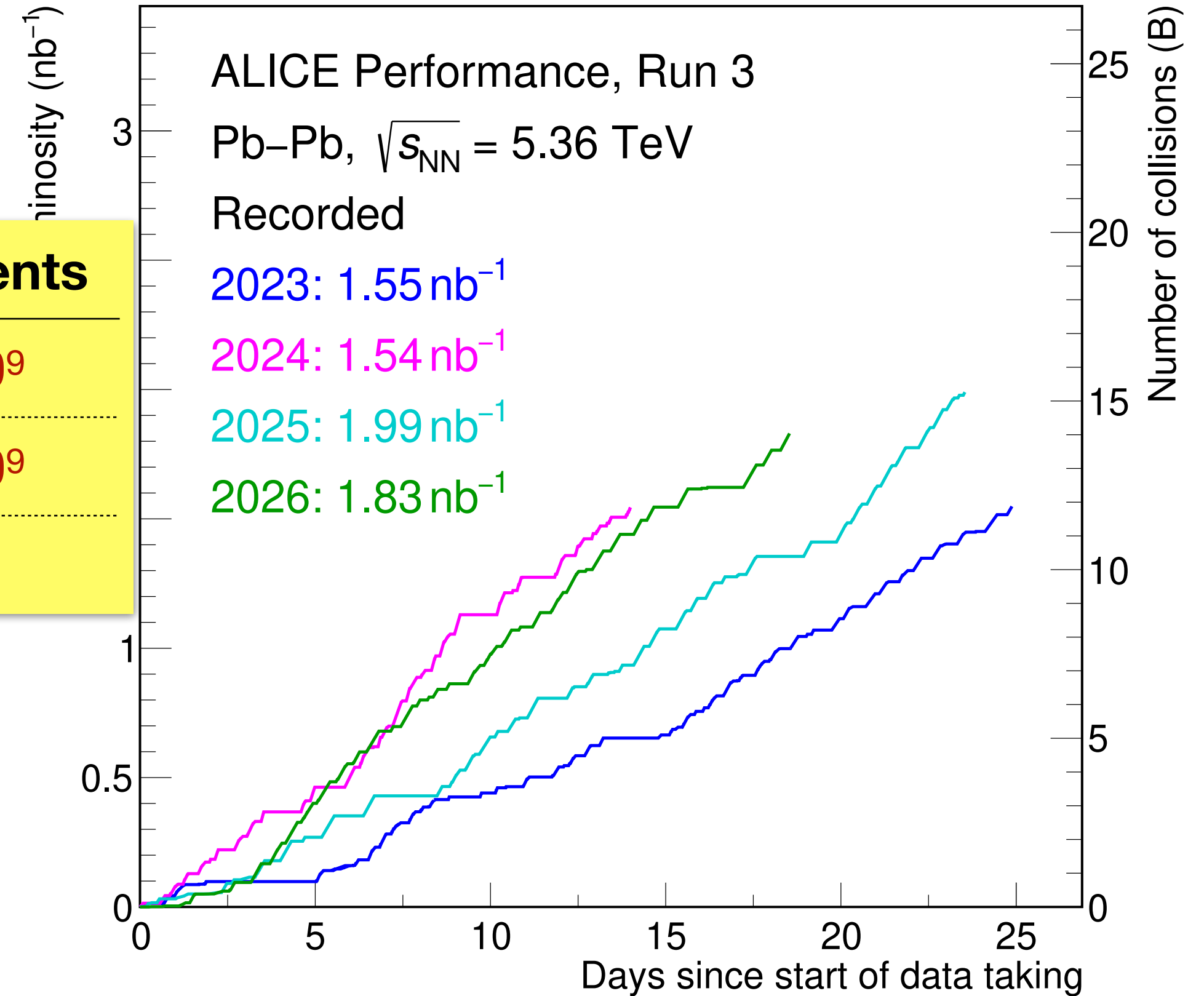
ALI-PERF-634120

Pb–Pb: 52 billion MB events
×160 more than Run 1+2

ALICE date taking in Run 3



ALI-PERF-632114



ALI-PERF-634120

pp: 8 trillion MB events
×1000 more than Run 1+2

Pb-Pb: 52 billion MB events
×160 more than Run 1+2

Charged particle density

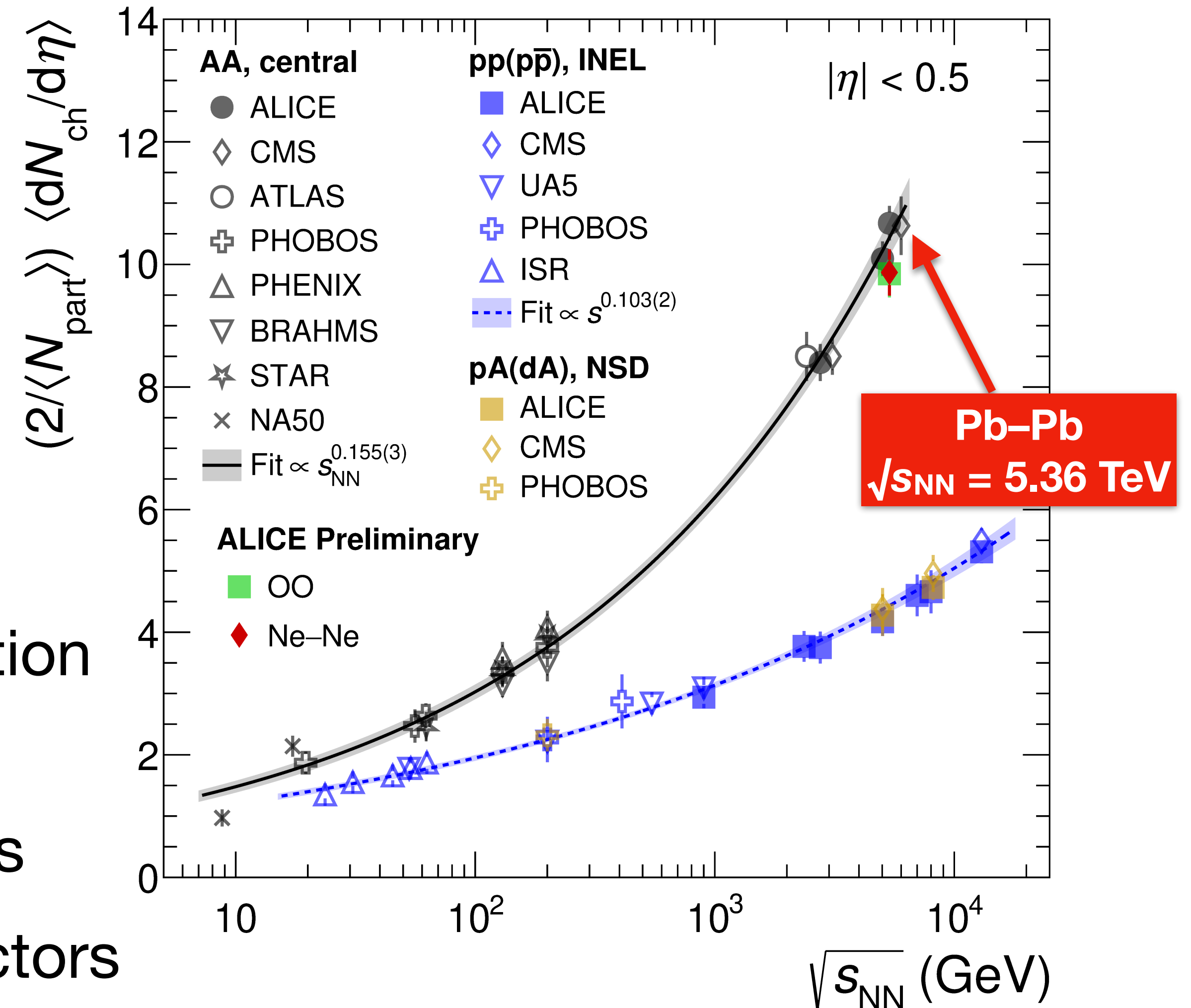


- Energy density from Bjorken estimation

$$\epsilon = \frac{1}{\tau_0 A_{\perp}} \frac{dN_{\text{ch}}}{dy} \langle m_T \rangle$$

J. D. Bjorken, *Phys. Rev. D* **27** (1983) 140

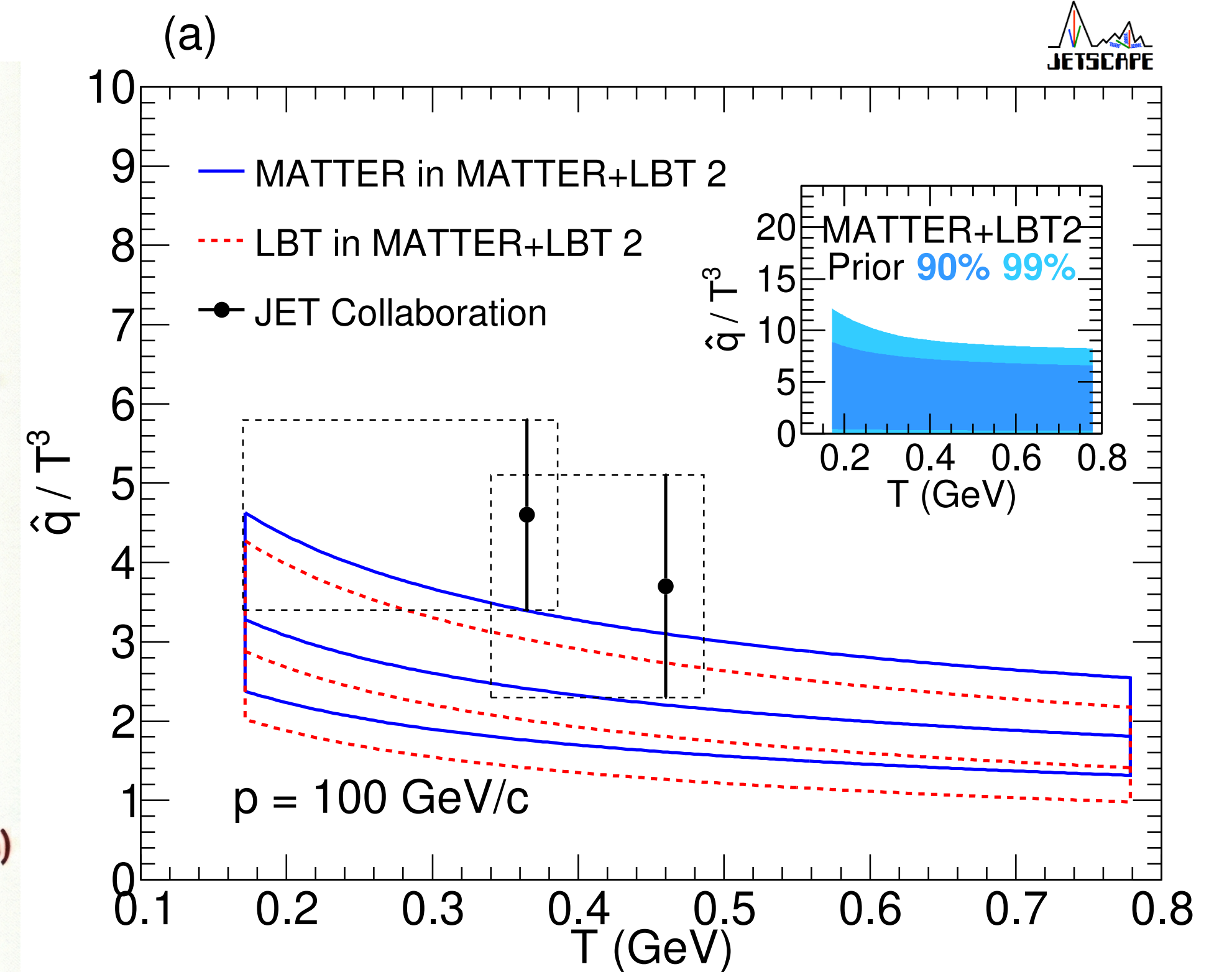
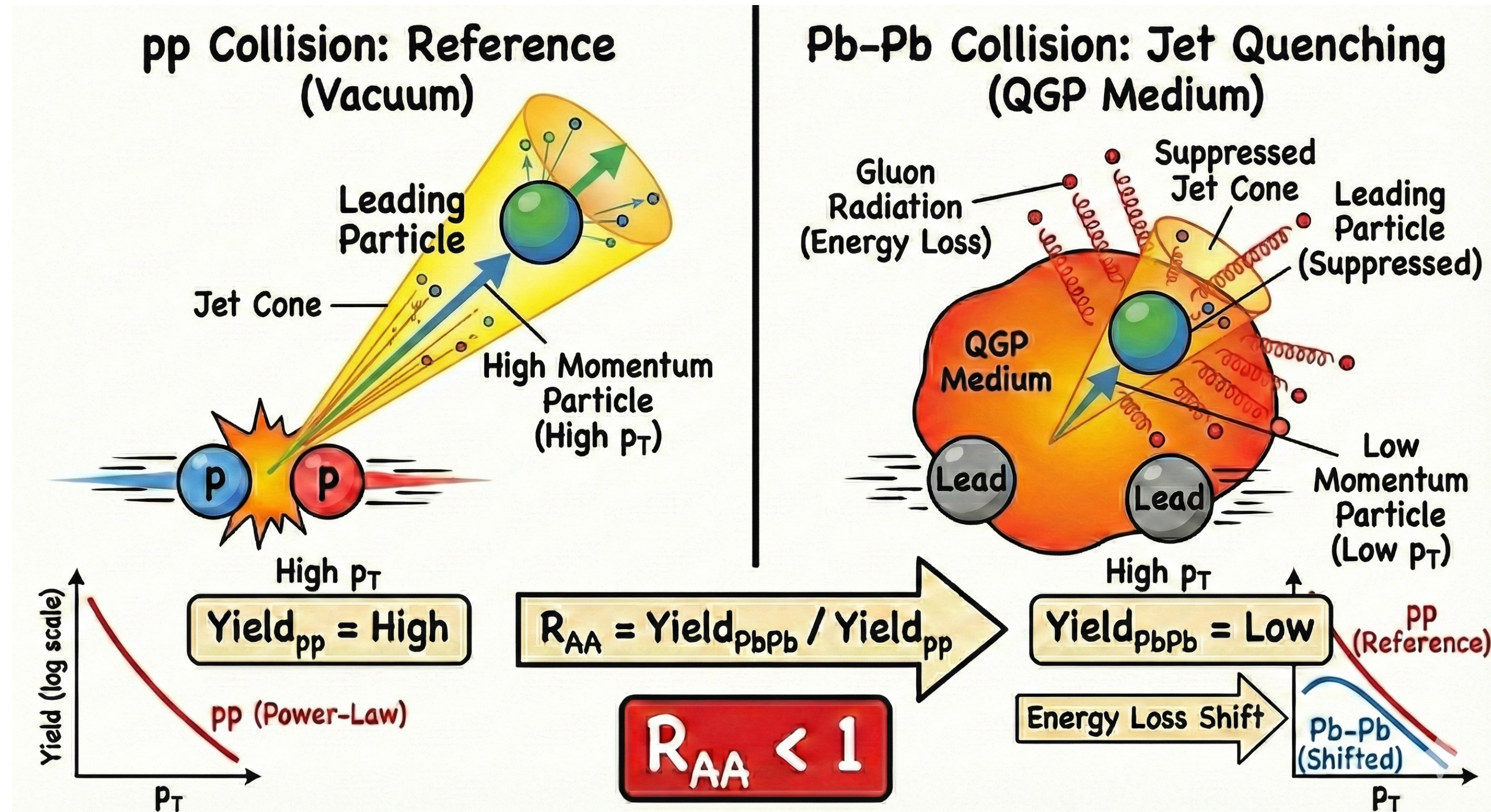
- ➔ LHC Pb–Pb: $\epsilon \sim 18 \text{ GeV/fm}^3$
- ➔ Much higher than deconfinement condition: $\epsilon \sim 1 \text{ GeV/fm}^3$
- Energy dependence in line with expectation from lower energies
- ➔ Including also OO and Ne–Ne collisions
- ➔ Important validation of upgraded detectors



ALI-PREL-610448

See also **ALICE** arXiv:2504.02505

Jet quenching in QCD medium



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

RHIC Au+Au $\sqrt{s_{NN}} = 200 \text{ GeV}$
STAR *Phys. Rev. Lett.* **91** (2003) 172302
PHENIX *Phys. Rev. Lett.* **101** (2008) 232301
PHENIX *Phys. Rev.* **C87** (2013) 034911

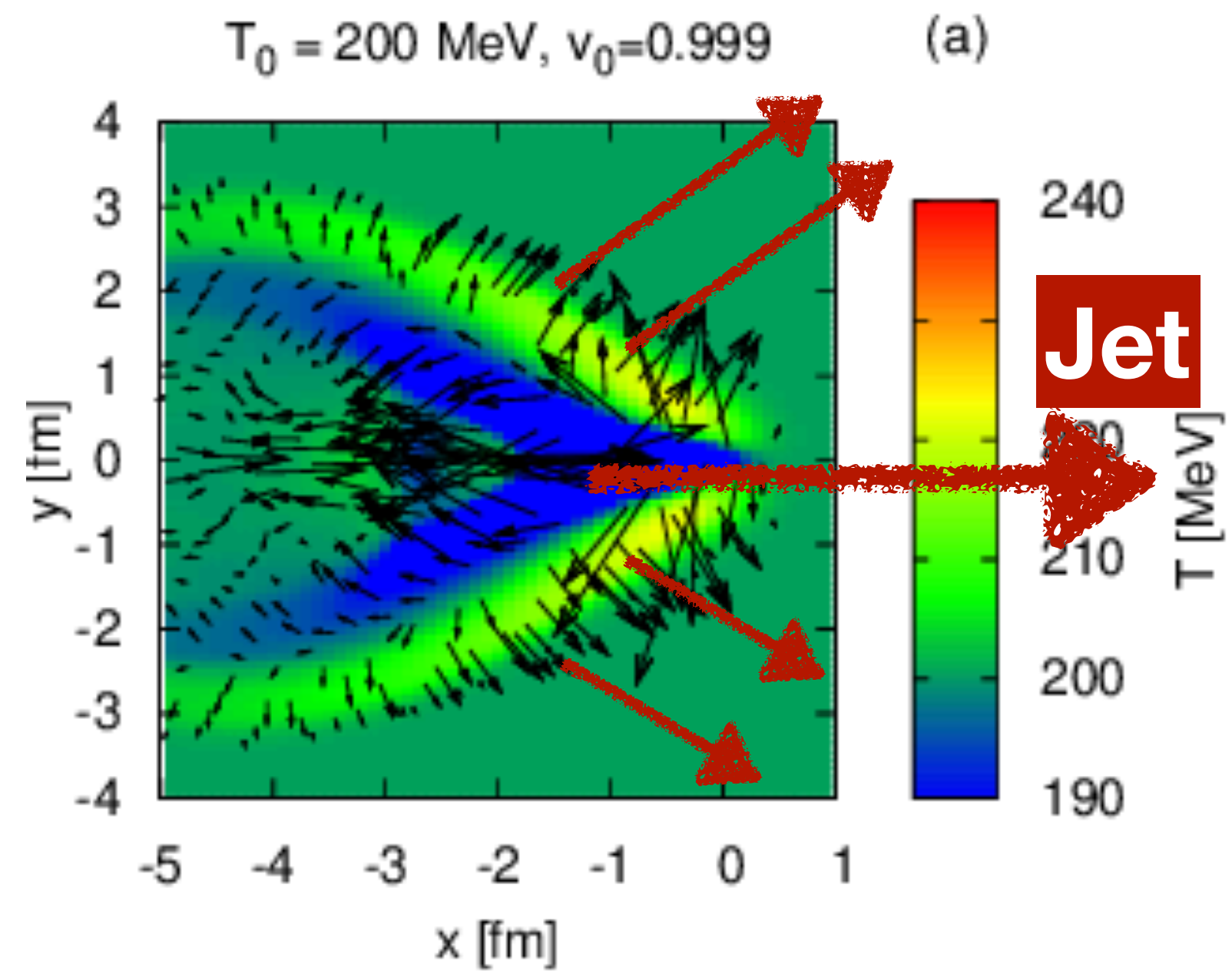
LHC Pb-Pb $\sqrt{s_{NN}} = 2.76 \text{ GeV}$
ALICE *Phys. Lett.* **B696** (2011) 30
ALICE *Phys. Lett.* **B720** (2013) 52
CMS *Eur. Phys. J.* **C72** (2012) 1945
ATLAS *Phys. Lett.* **B748** (2015) 392
ATLAS *Phys. Lett.* **B719** (2013) 220

LHC Pb-Pb $\sqrt{s_{NN}} = 5.02 \text{ GeV}$
ALICE *JHEP* **1811** (2018) 013
CMS *JHEP* **1704** (2017) 039
ATLAS *Phys. Lett.* **B763** (2016) 313

Jet induced diffusion wake



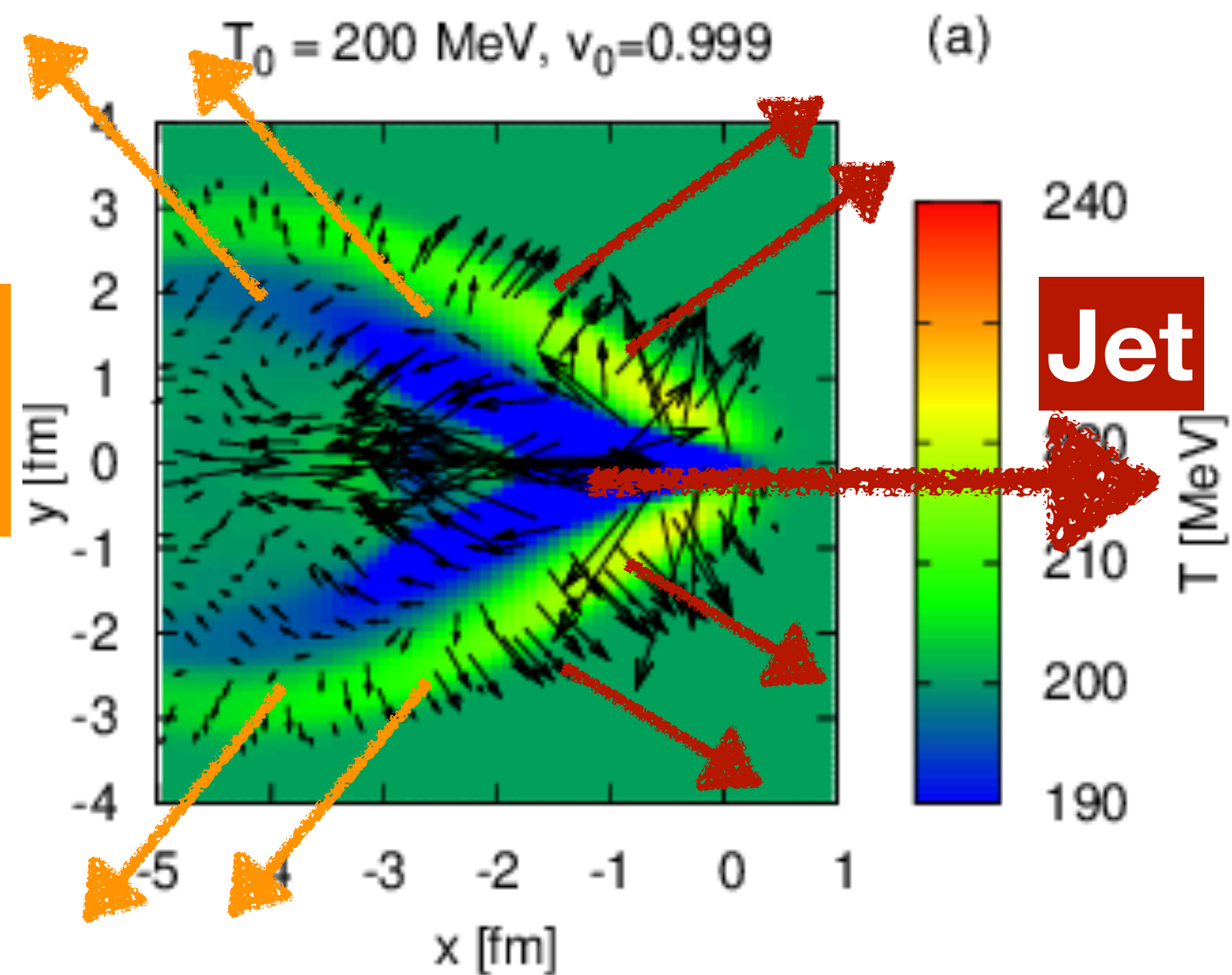
Jet induced diffusion wake



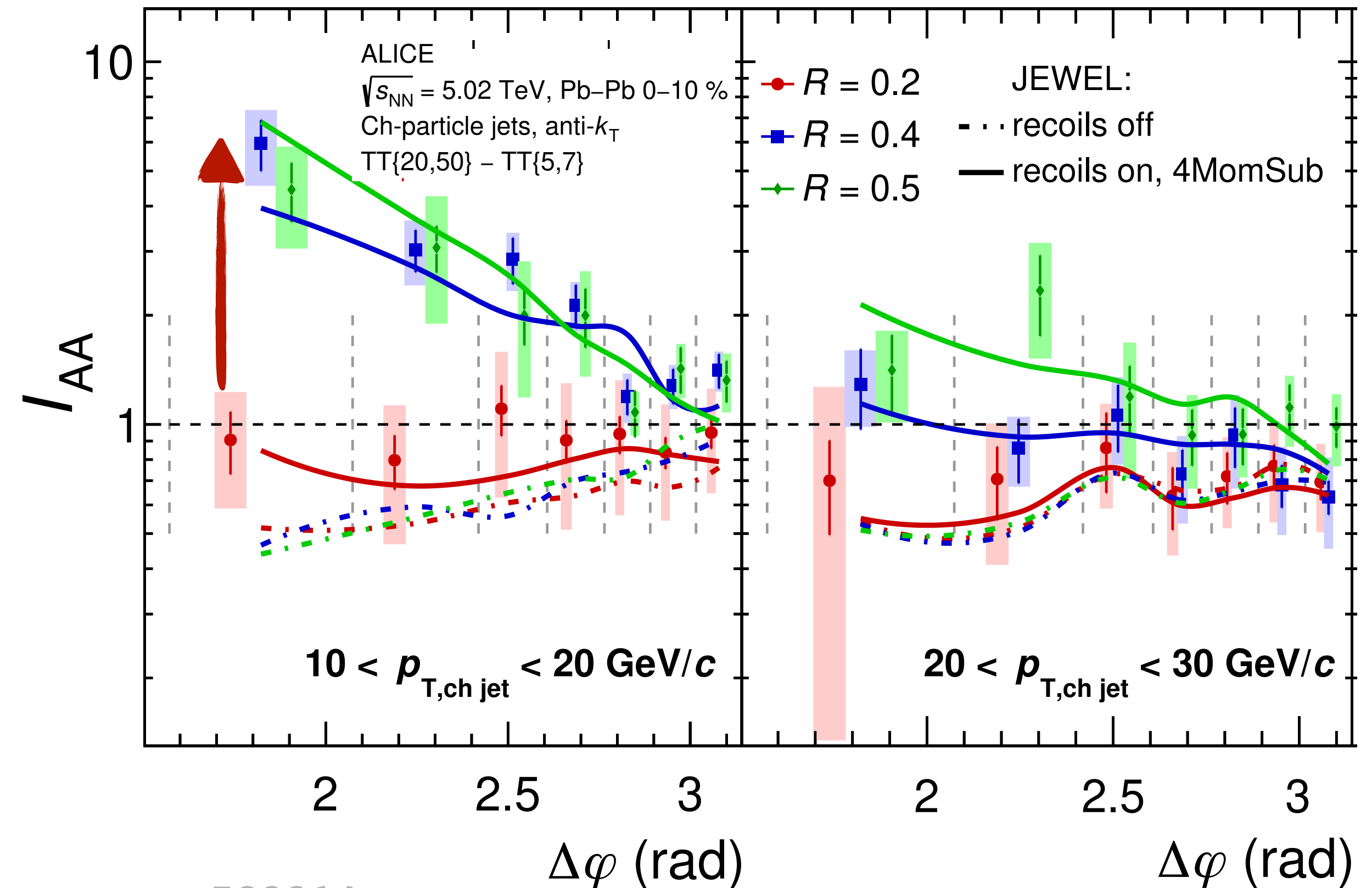
Jet induced diffusion wake



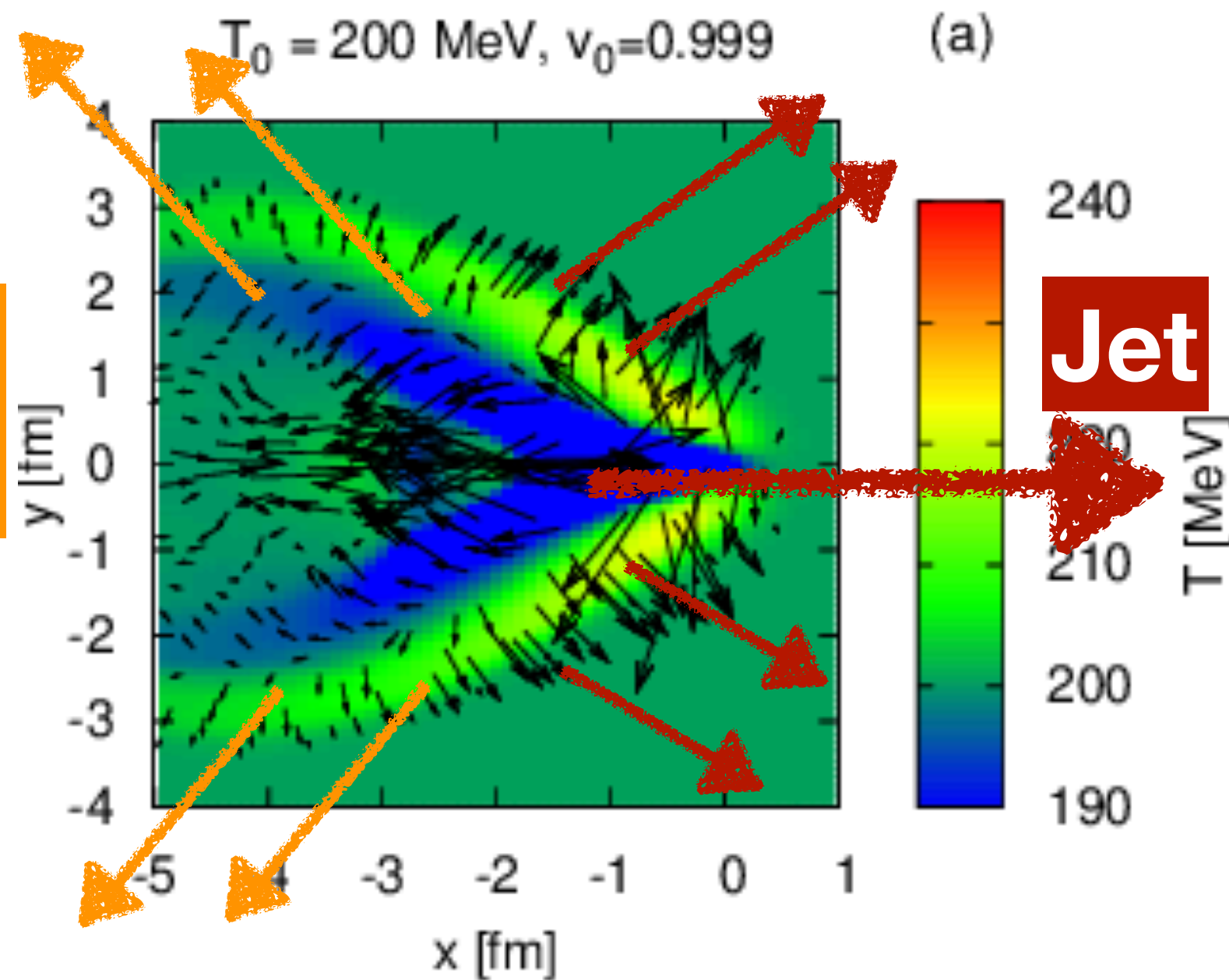
Diffusion
wake



Jet induced diffusion wake



Diffusion
wake



ALI-PUB-583314

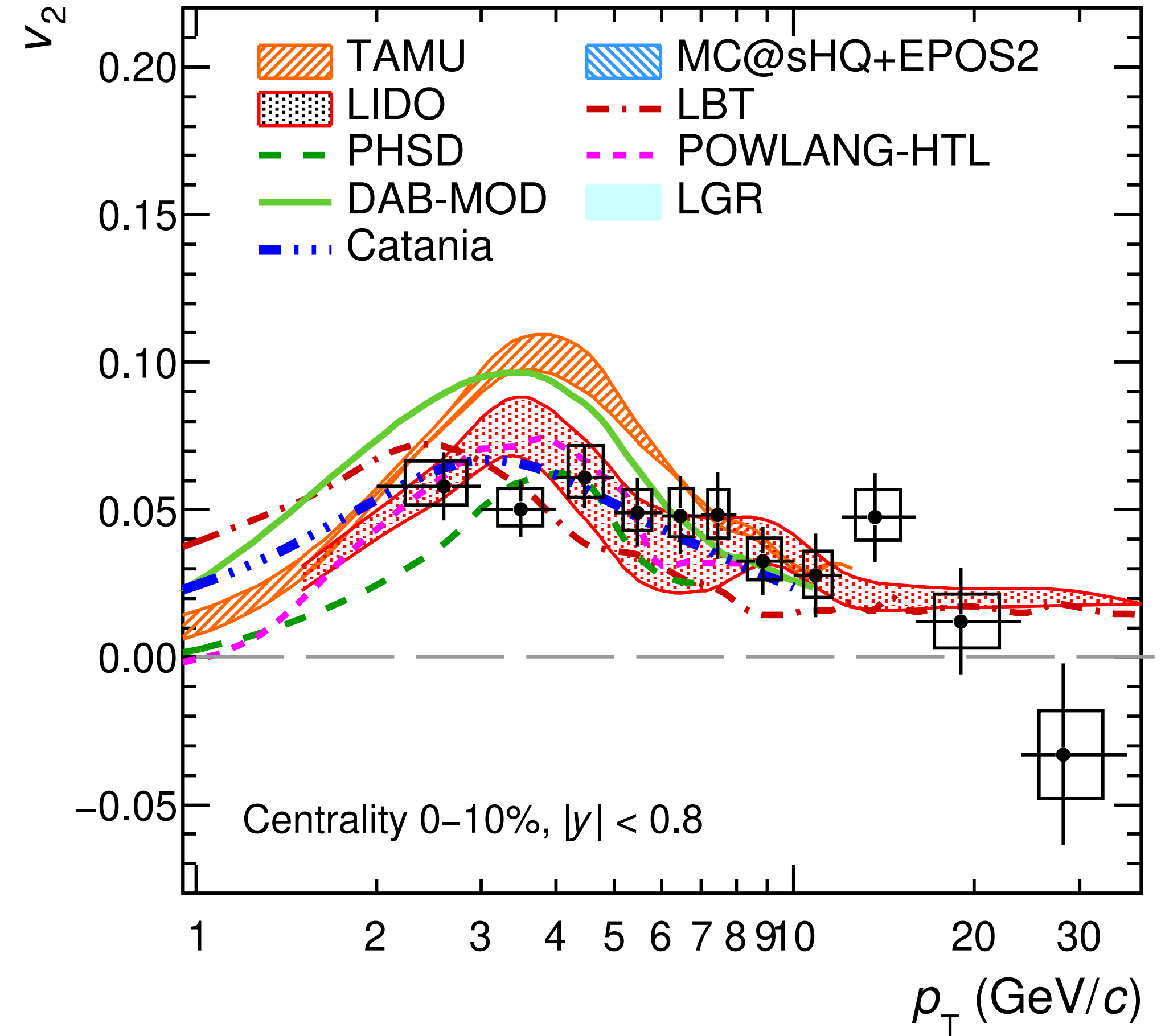
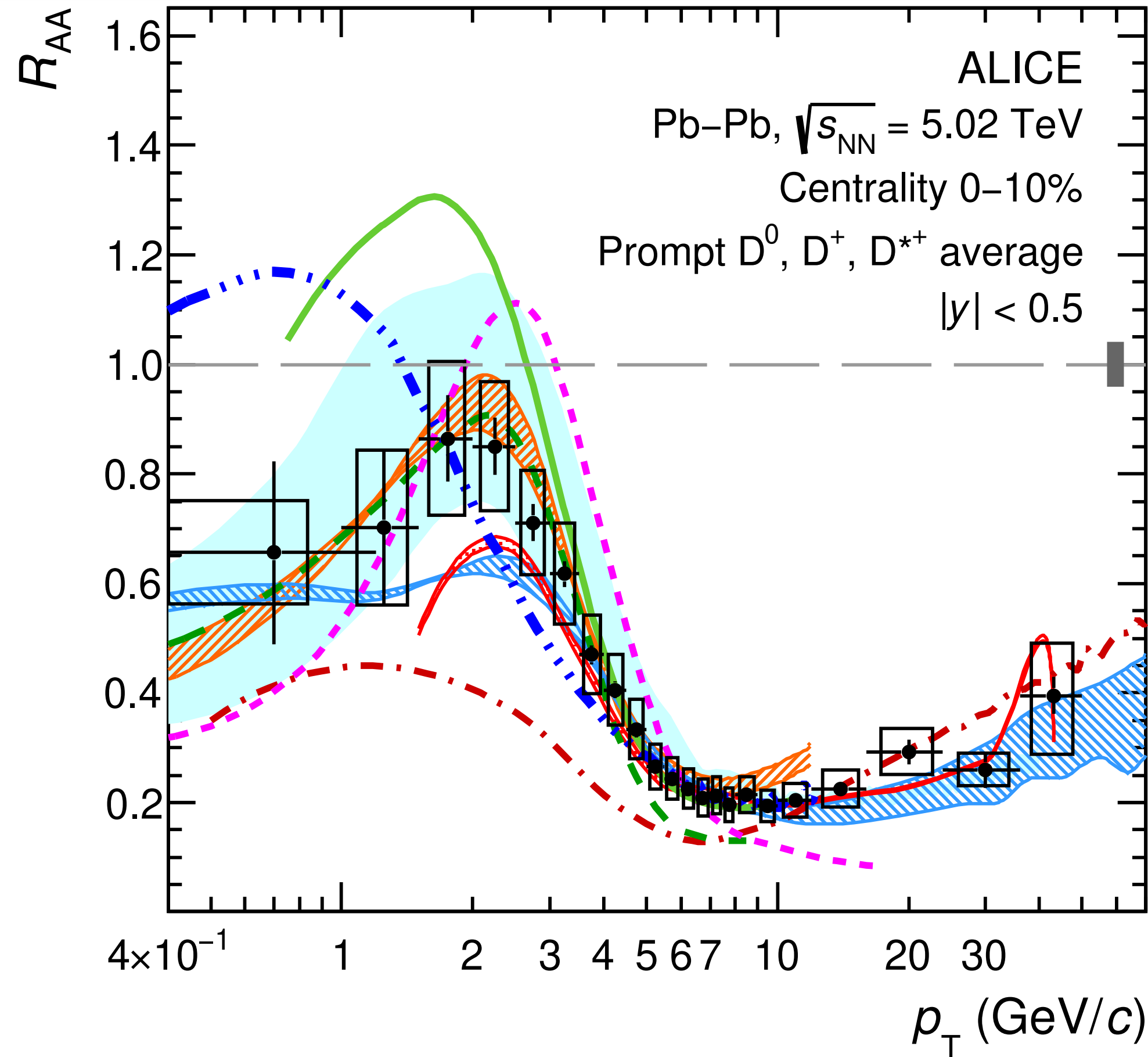
ALICE *Phys. Rev. Lett.* **133** (2024) 022301

Acoplanarity increases with R at low p_T

➡ Diffusion wake signature

➡ Scattering is debated See also ALICE arXiv:2606.20061
 ALICE *Phys. Lett. B* **864** (2025) 139409

R_{AA} and v_2 of D mesons at the LHC



ALI-PUB-501952

ALICE *JHEP* **2201** (2022) 174

ALICE *Phys. Lett.* **B813** (2021) 136054

CMS *Phys. Lett.* **B816** (2021) 136253

CMS *Phys. Lett.* **B782** (2018) 474

TAMU *Phys. Rev. Lett.* **124** (2020) 042301

LIDO *Phys. Rev.* **C100** (2019) 064911

PHSD *Phys. Rev.* **C92** (2015) 014910

DAB-MOD *Phys. Rev.* **C102** (2020) 024906

MC@sHQ+EPOS2 *Phys. Rev.* **C89** (2014) 014905

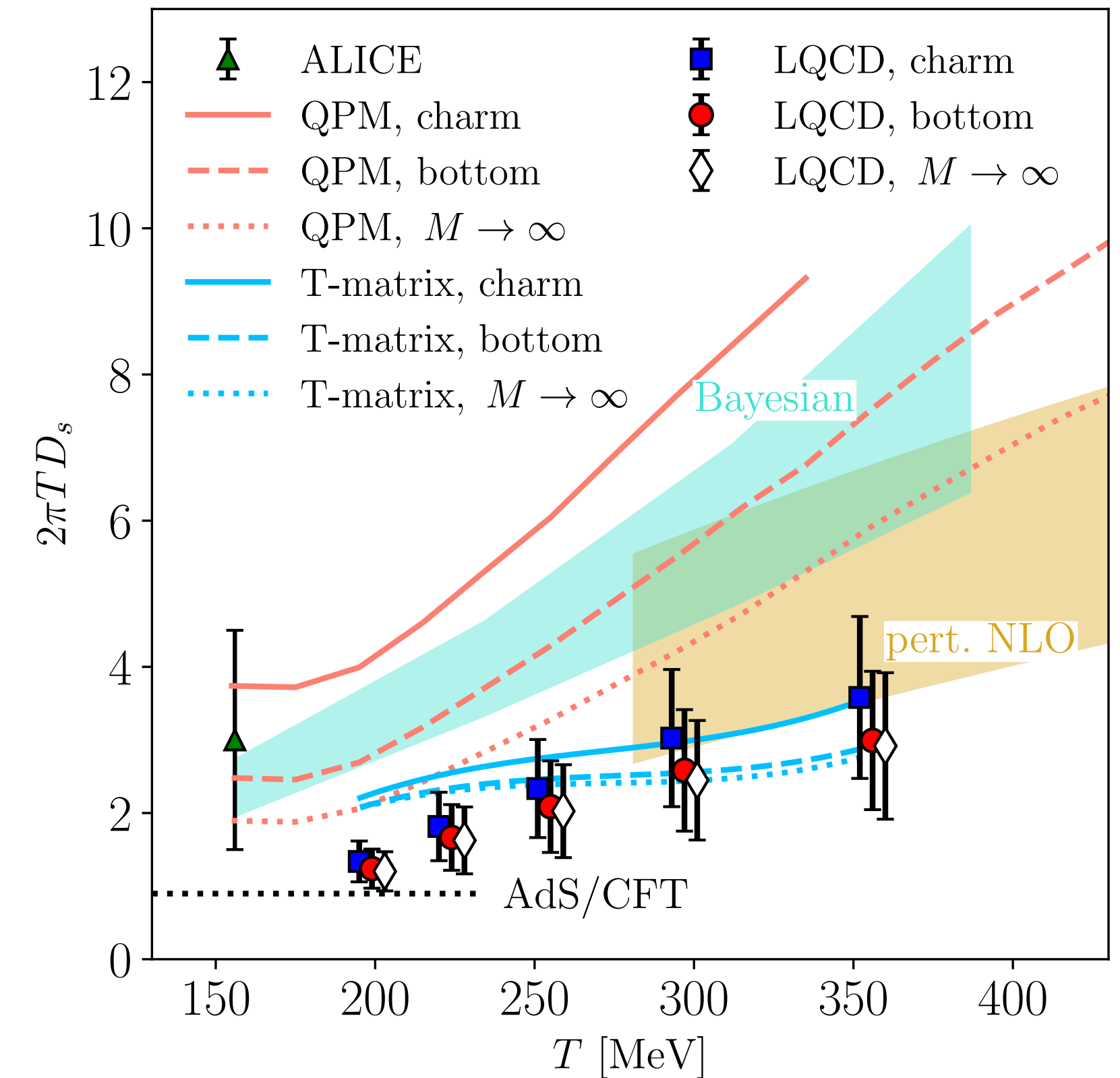
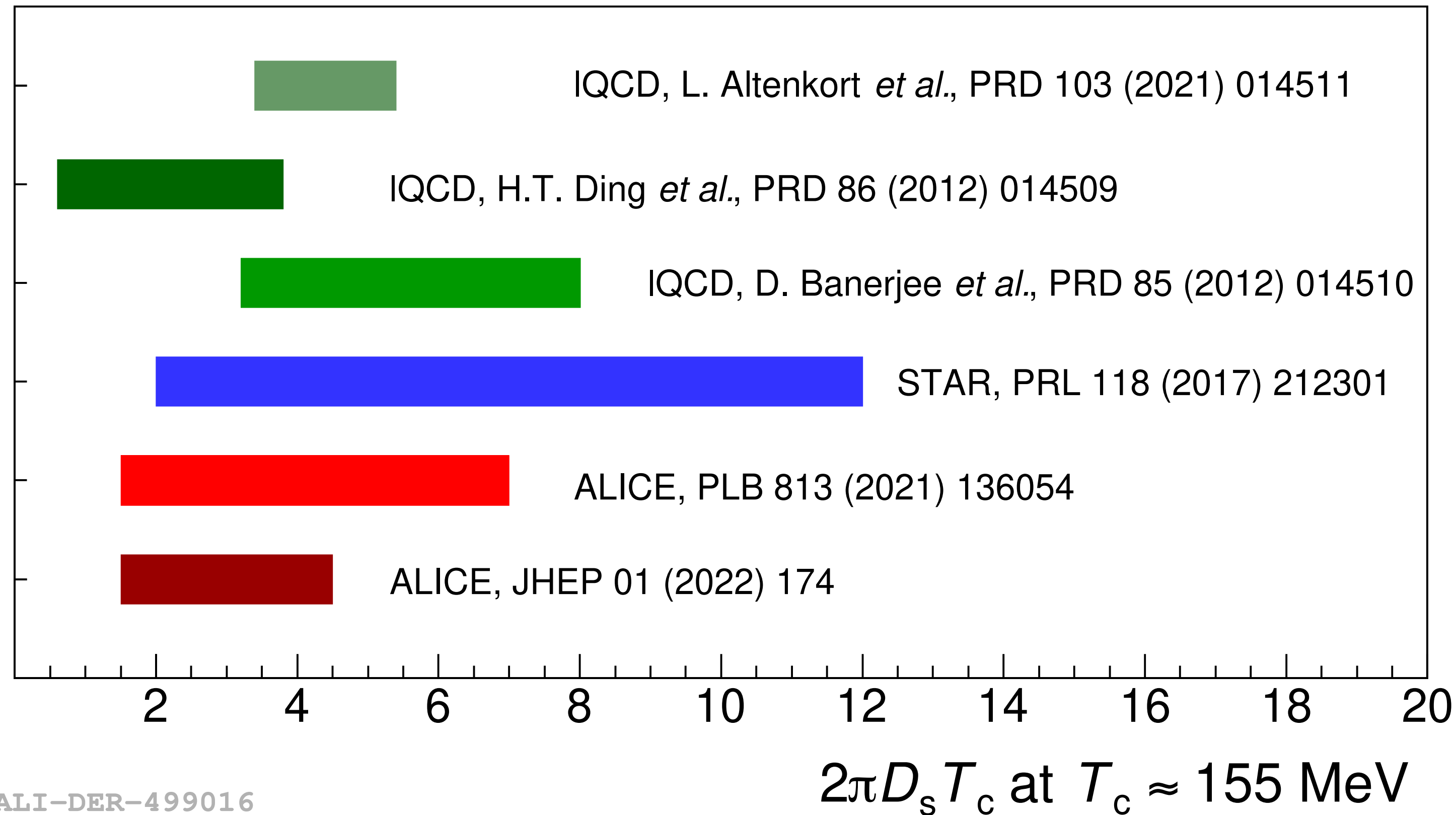
Catania *Phys. Lett.* **B805** (2020) 135460

LBT *Phys. Lett.* **B777** (2018) 255

POWLANG-HTL *JHEP* **1802** (2018) 043

LGR *Eur. Phys. J.* **C80** (2020) 671

Charm quark transport

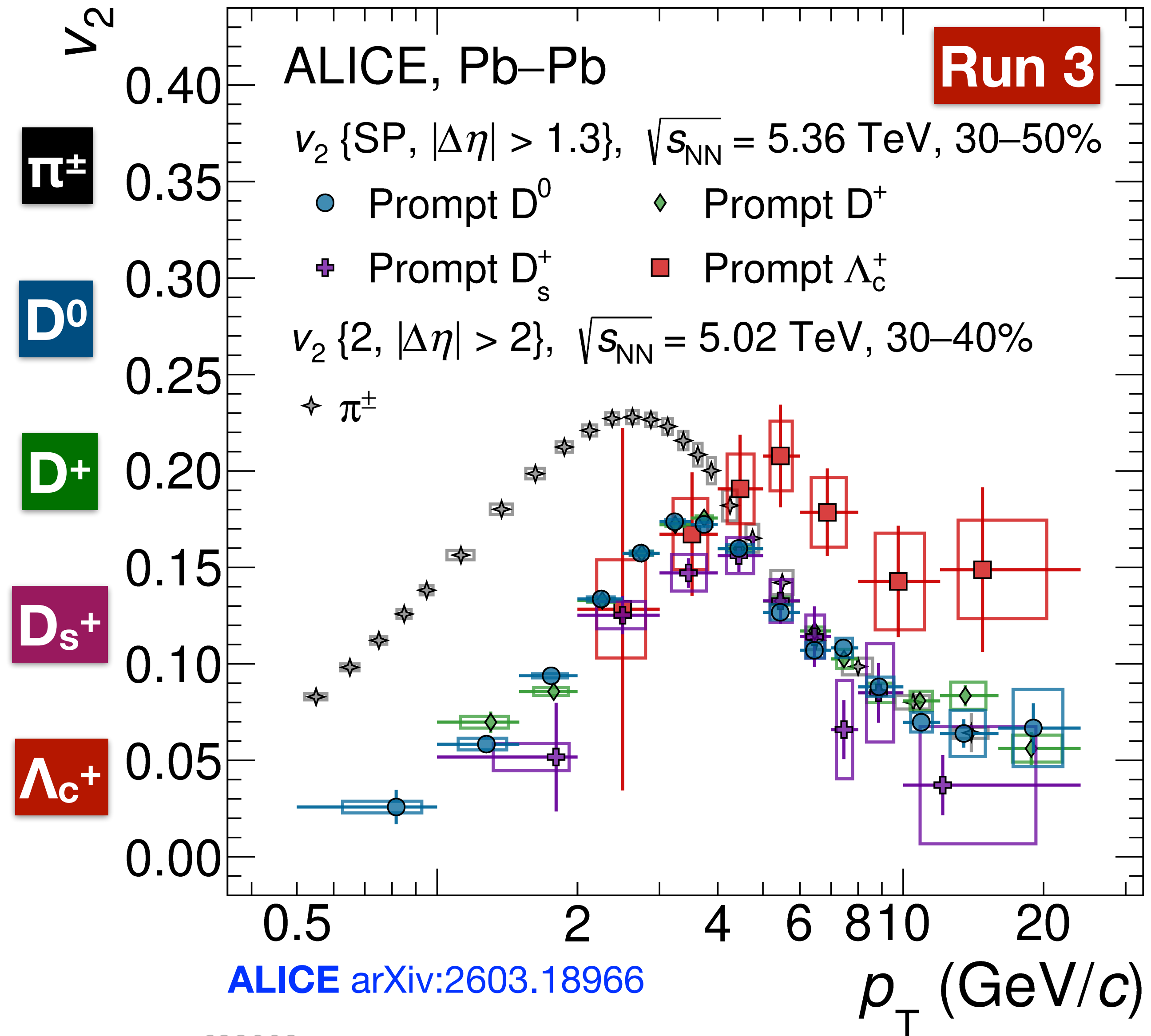


Hot QCD Phys. Rev. Lett. 132 (2024) 051902

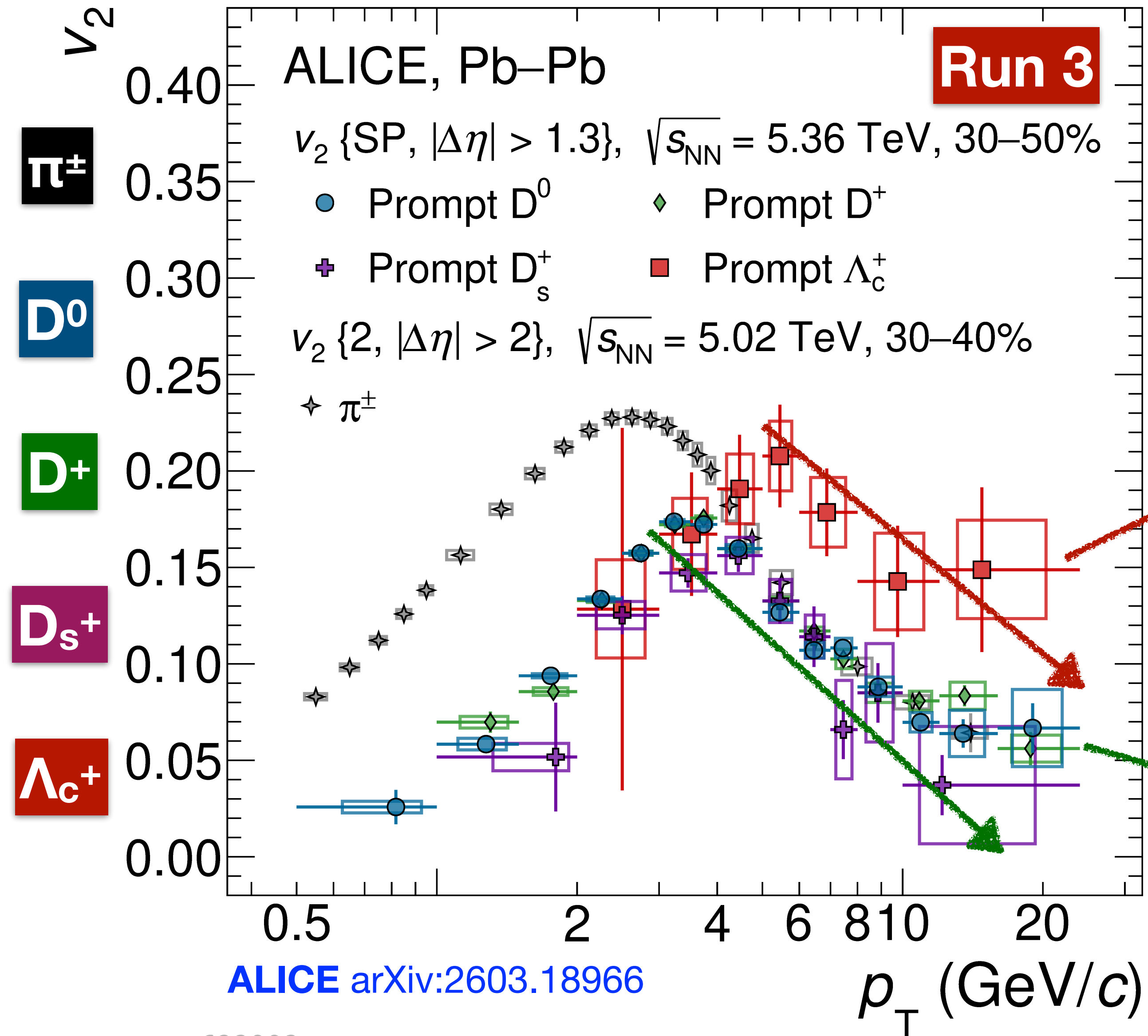
$$1.5 < 2\pi D_s(T) < 4.5, \tau_{\text{charm}} = (m_{\text{charm}} / T) D_s(T) = 3-9 \text{ fm}/c < \tau_{\text{medium}} \approx 10 \text{ fm}/c$$

➡ Indicate charm may thermalize in the QCD medium

Charmed hadron flow



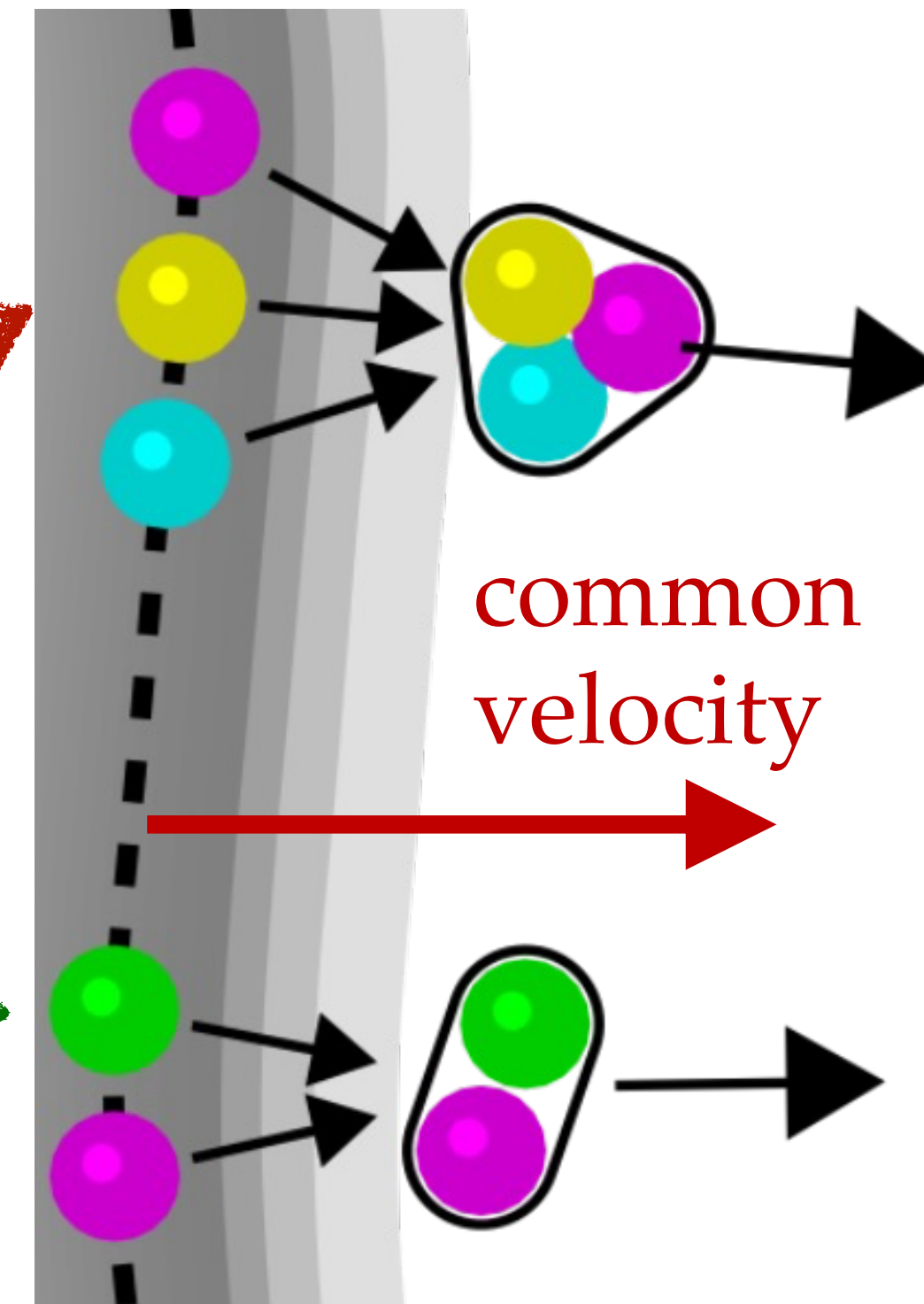
Charmed hadron flow



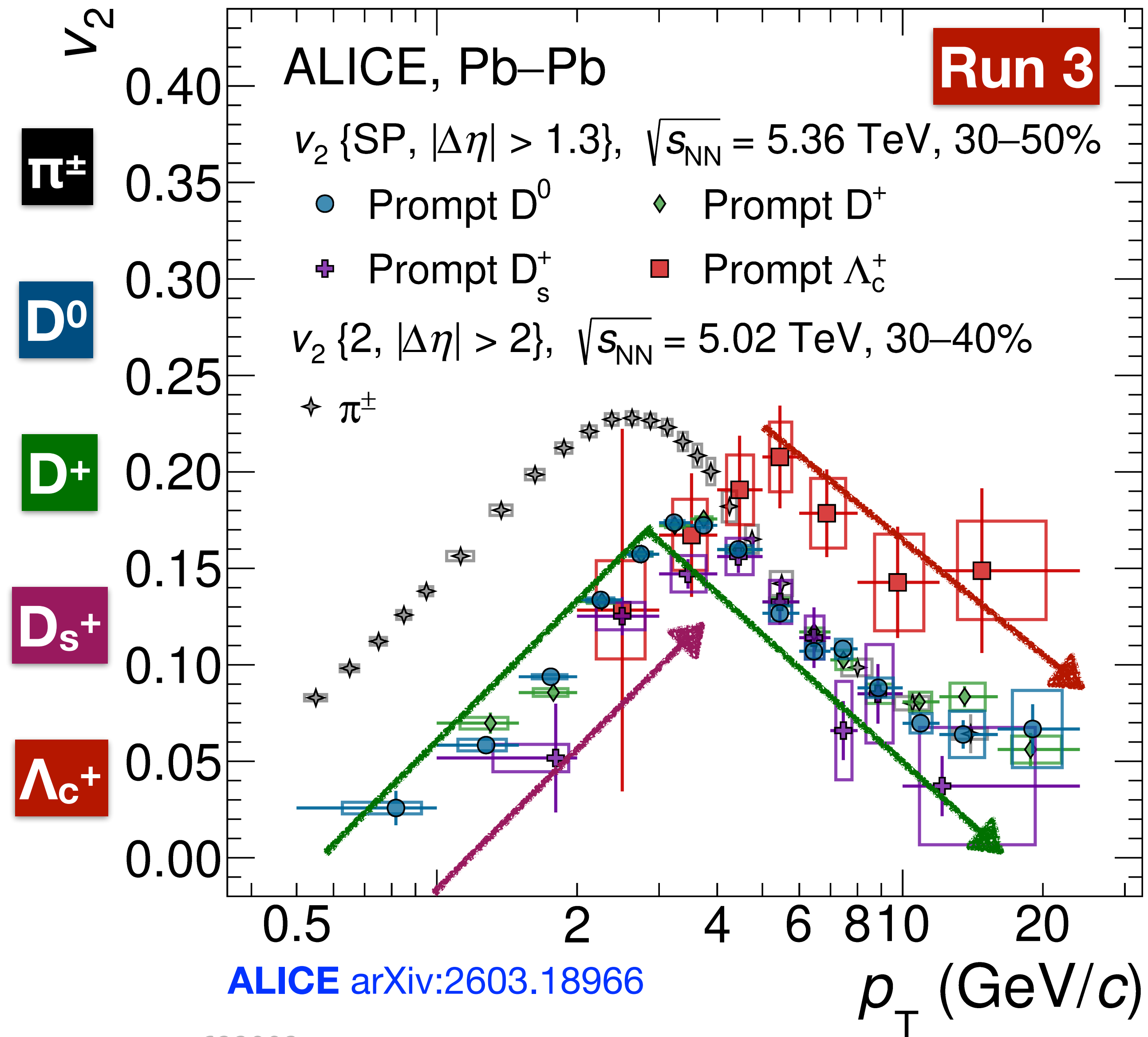
Intermediate and high- p_T

$$v_2(\Lambda_c^+) > v_2(D_s^+) \approx v_2(D^0) \approx v_2(D^+) \approx v_2(\pi^\pm)$$

➔ **Strong evidence of coalescence**



Charmed hadron flow



Intermediate and high- p_T

$$v_2(\Lambda_c^+) > v_2(D_s^+) \approx v_2(D^0) \approx v_2(D^+) \approx v_2(\pi^\pm)$$

➔ Strong evidence of coalescence

Low and intermediate- p_T

$$v_2(D_s^\pm) < v_2(D^0) \approx v_2(D^\pm) < v_2(\pi^\pm)$$

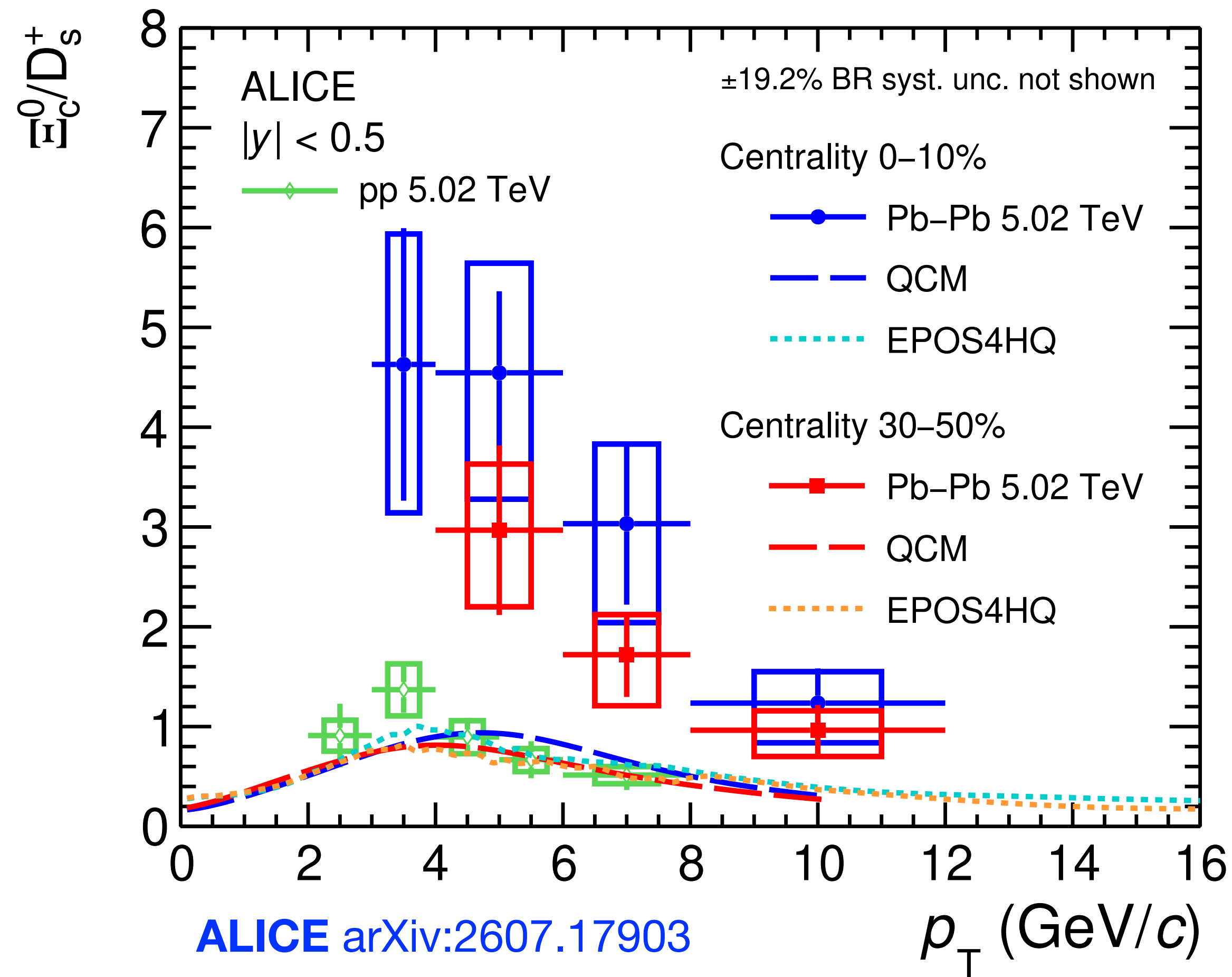
➔ Sequential hadronization

Zhuang et al., *Phys. Rev. Lett.* **136** (2026) 232301

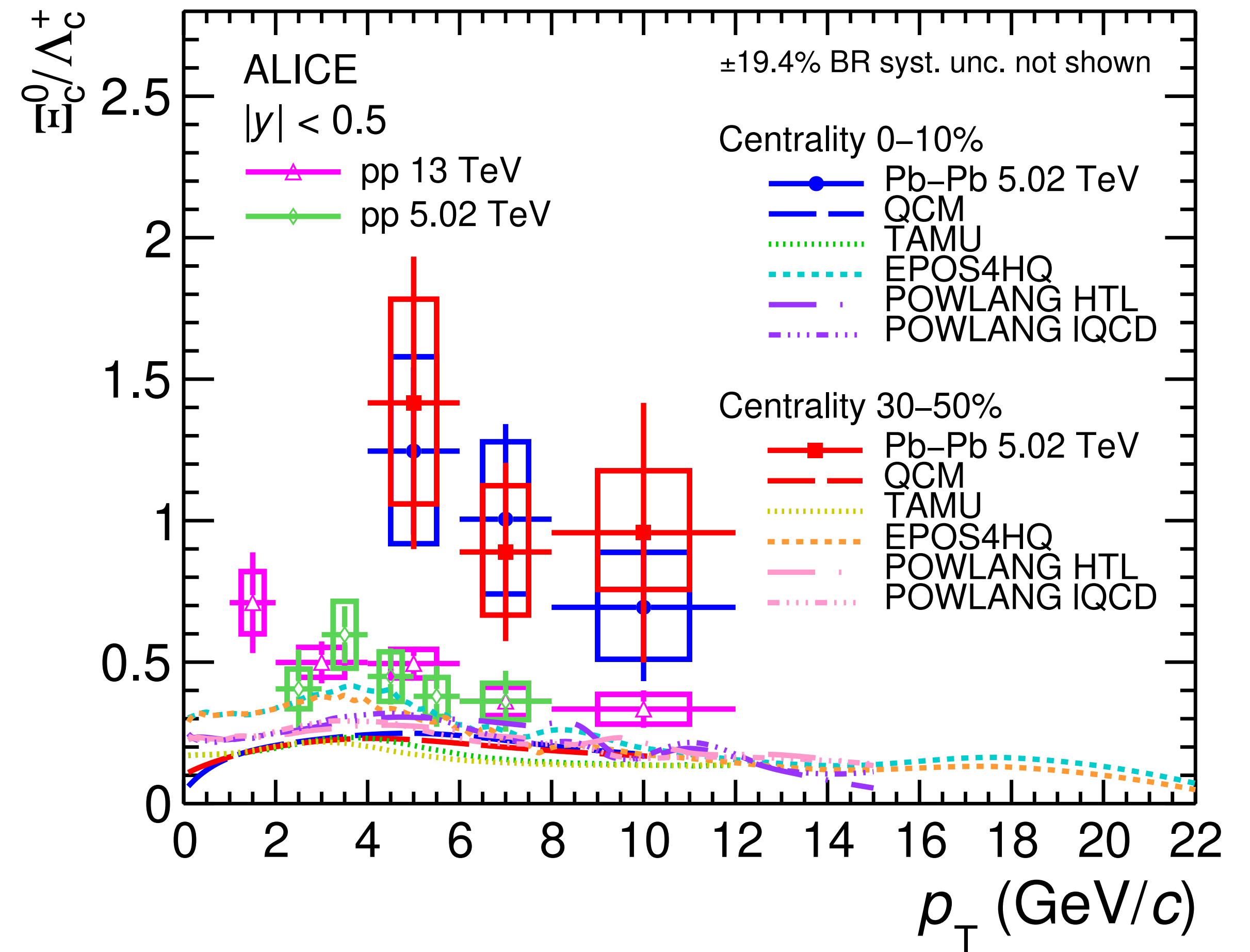
Springer Proc. Phys. **250** (2020) 275

Further reveal transport dynamics of heavy quarks in the QGP medium and provide high-precision microscope tomography of the QGP

Ξ_c production in Pb–Pb



ALI-PUB-639062

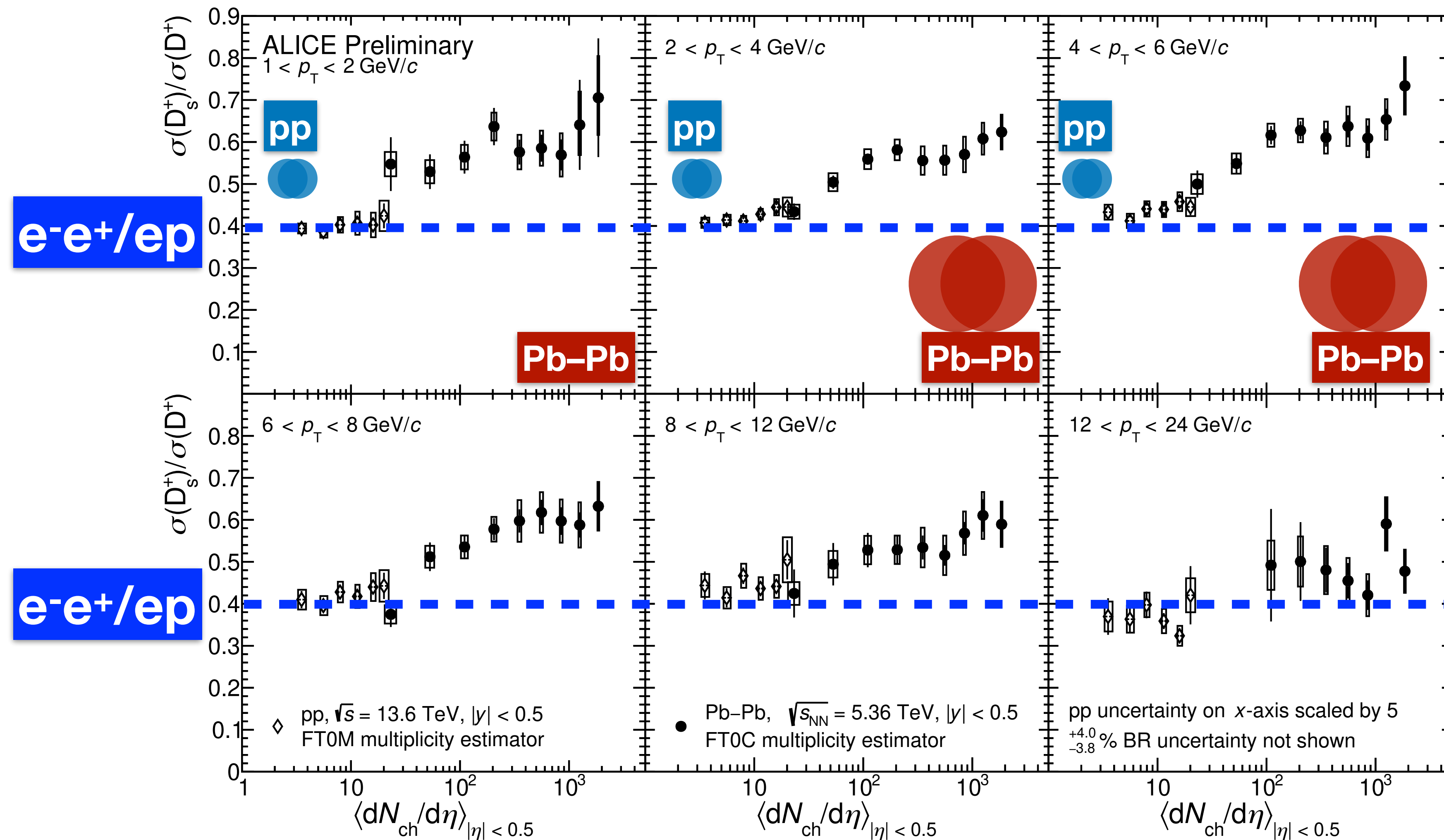


ALI-PUB-639067

Both Ξ_c^0/D_s^+ and Ξ_c^0/Λ_c^+ ratios are enhanced **Pb–Pb** compared to **pp**

➡ Challenging the model predictions

D_s^+/D^+ ratio vs. multiplicity



pp Consistent with LEP and independent on p_T and multiplicity

Pb-Pb Increase with multiplicity at intermediate- p_T

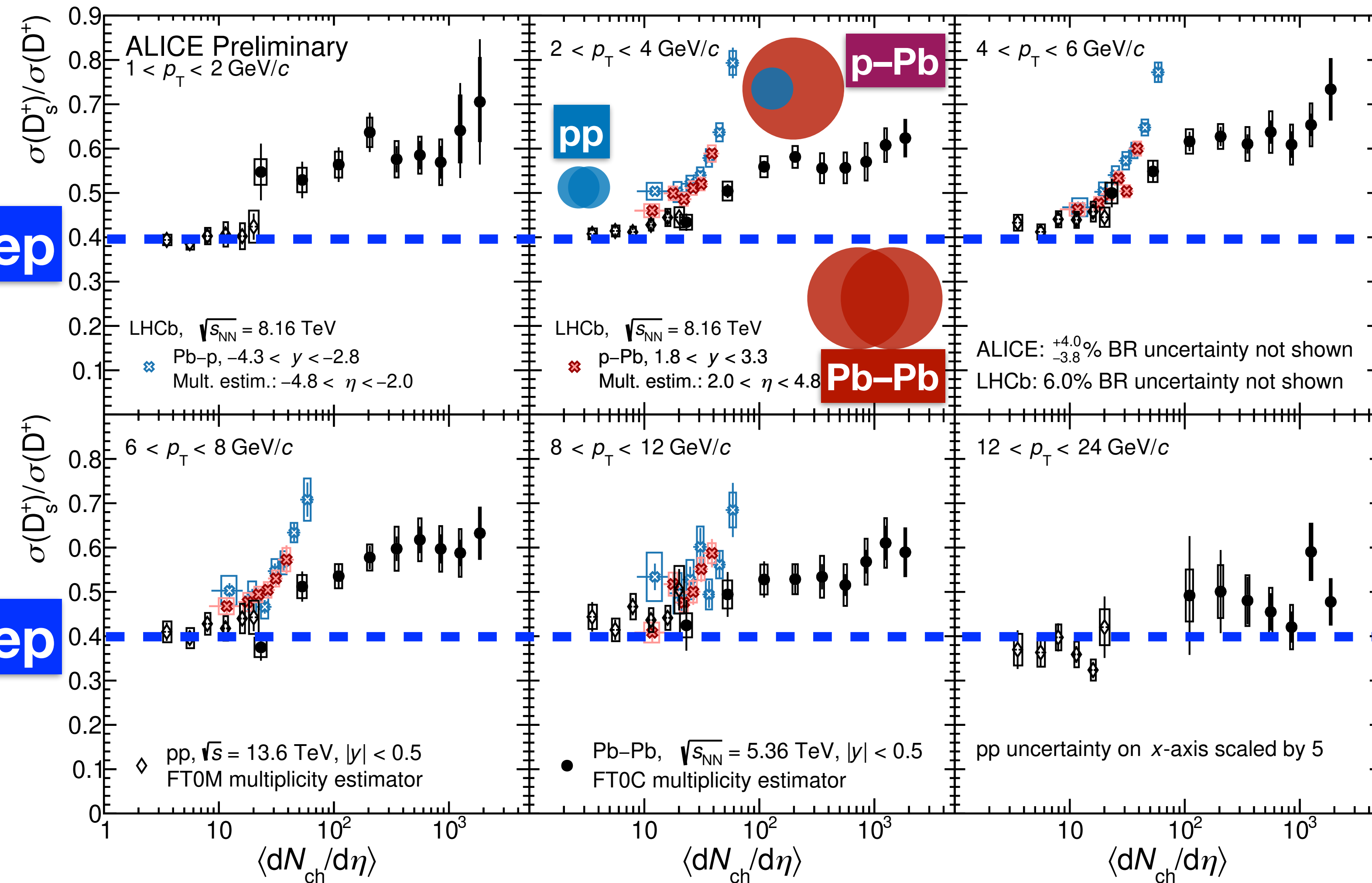
ALI-PREL-621117

D_s^+/D^+ ratio vs. multiplicity



e-e+/ep

e-e+/ep



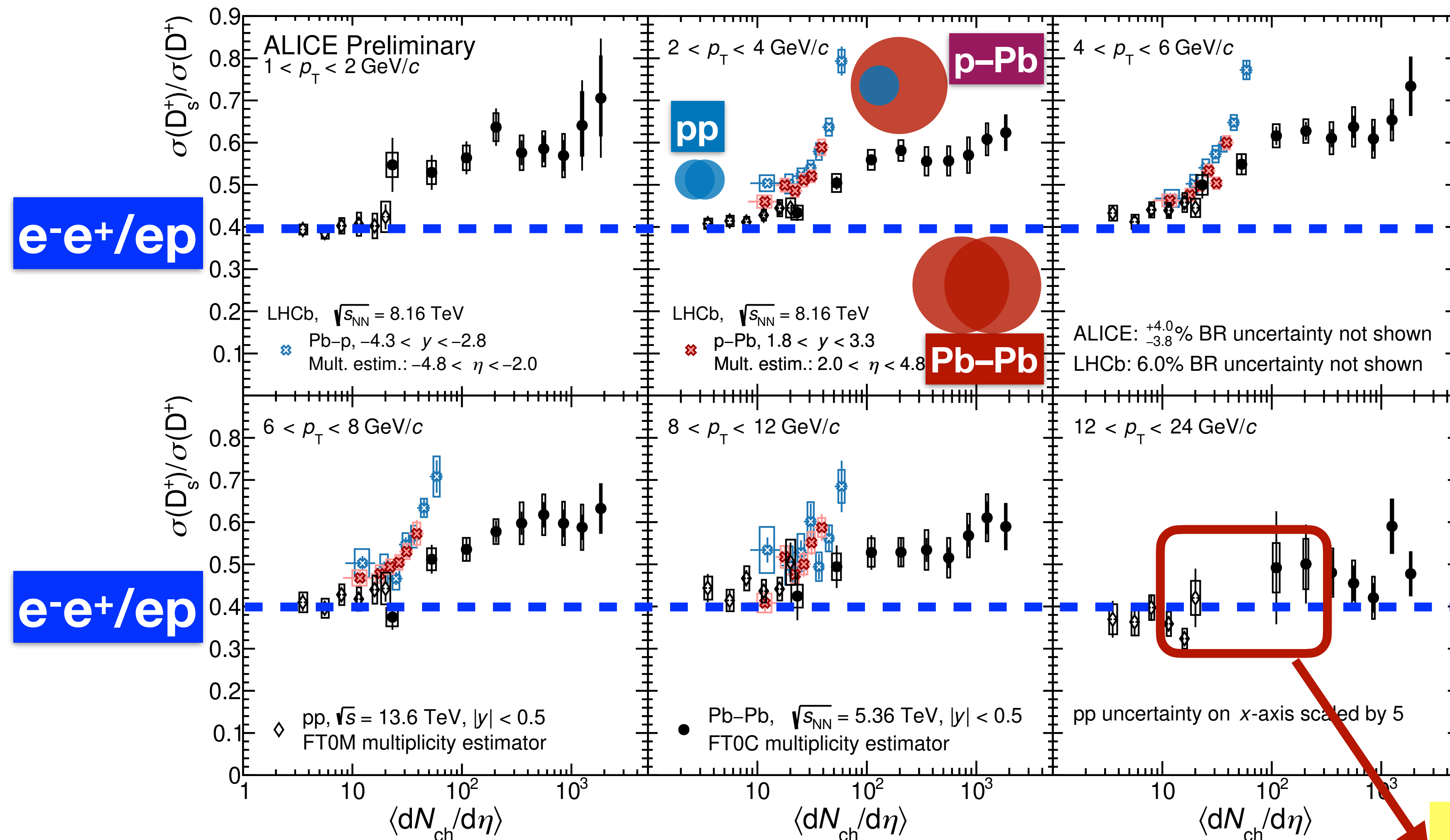
pp Consistent with LEP and independent on p_T and multiplicity

Pb-Pb Increase with multiplicity at intermediate- p_T

p-Pb Steeper increasing
 ➔ LHCb measurements in different rapidity

ALI-PREL-621122

D_s^+/D^+ ratio vs. multiplicity



pp Consistent with LEP and independent on p_T and multiplicity

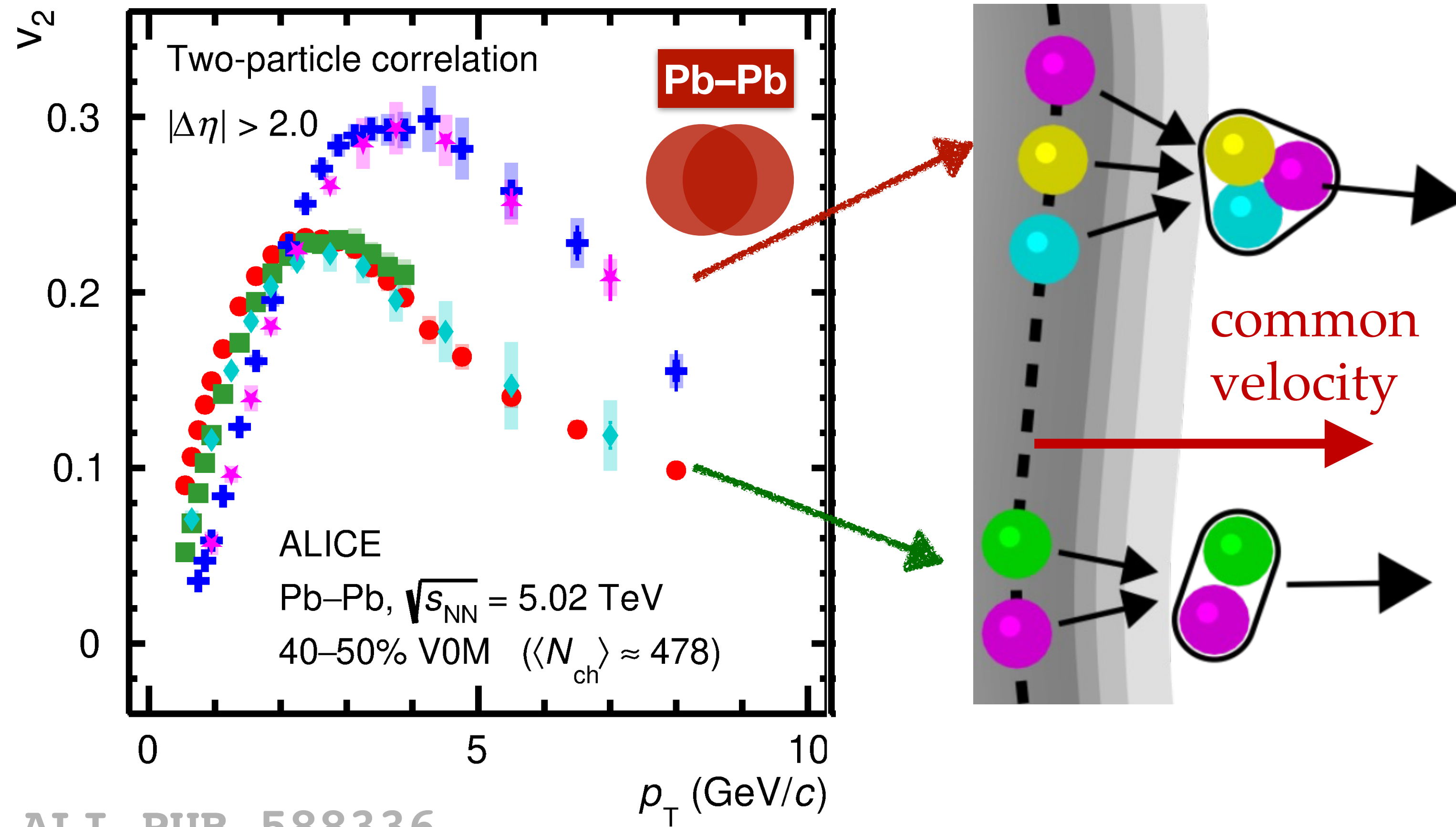
Pb-Pb Increase with multiplicity at intermediate- p_T

p-Pb Steeper increasing
 ➔ LHCb measurements in different rapidity

Light-ion systems are important to fill the gap

What is the particle production mechanism cross systems?

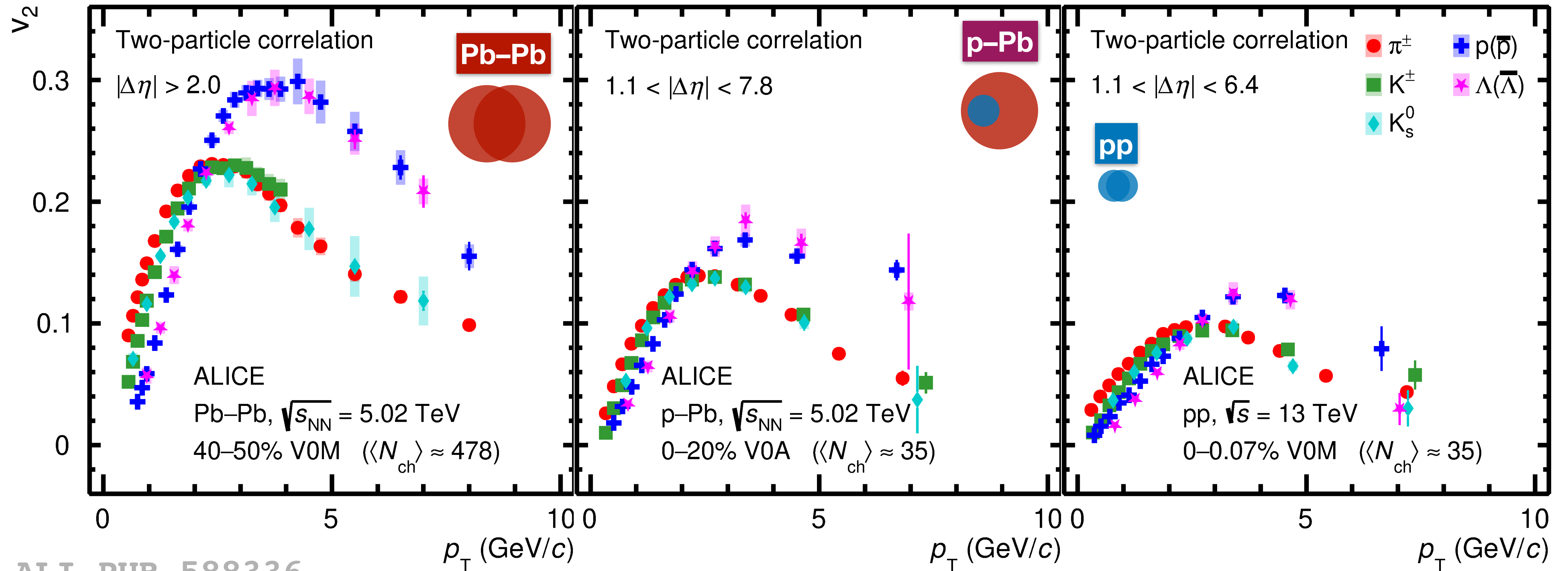
Baryon/meson grouping



ALI-PUB-588336

ALICE Nat. Comm. 17 (2026) 2585

Baryon/meson grouping cross systems

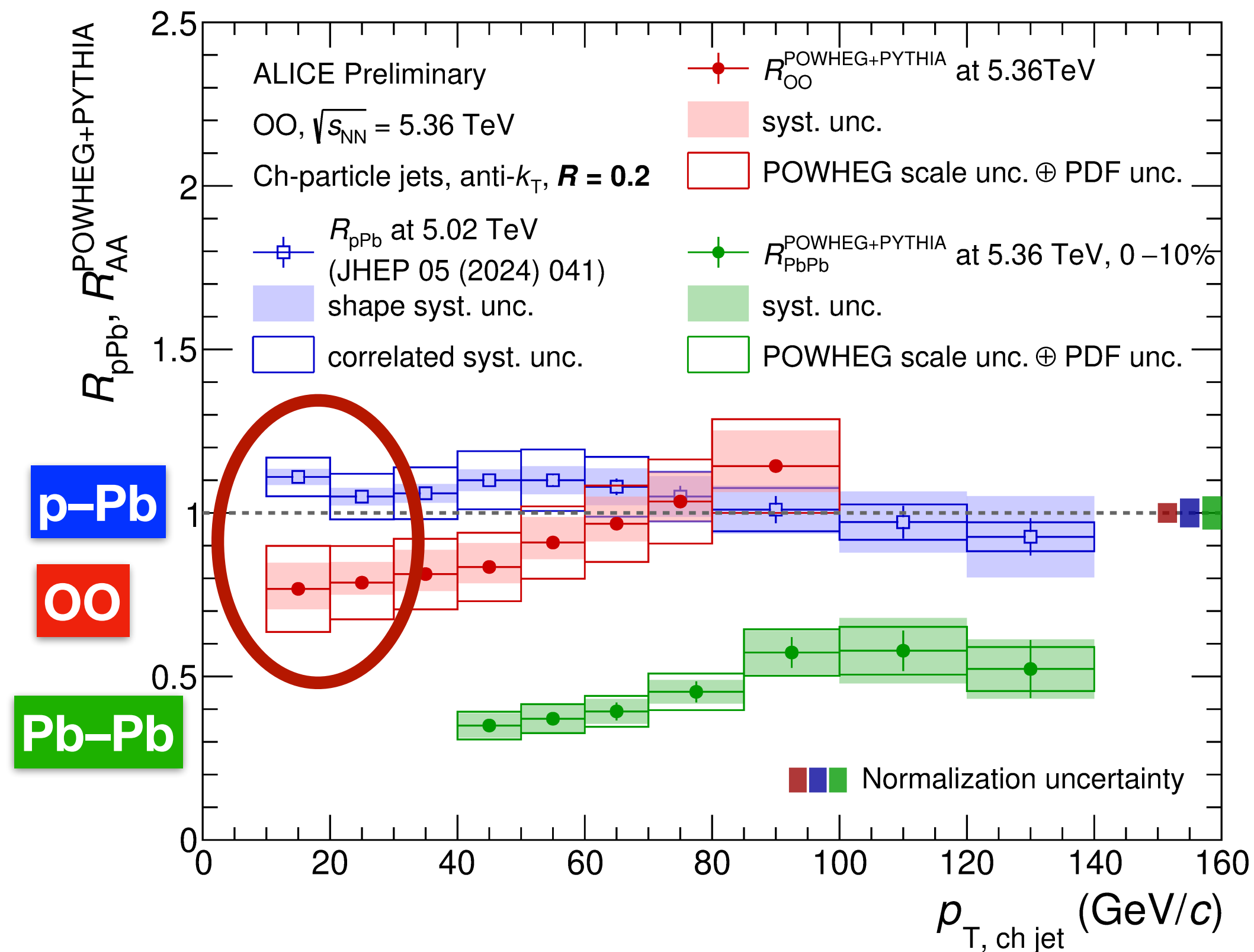


ALI-PUB-588336

ALICE *Nat. Comm.* **17** (2026) 2585

- Baryon/meson grouping also observed in high-multiplicity pp and p-Pb
- Evidence of high-multiplicity p-Pb and pp include partonic collectivities

QGP signature in 00

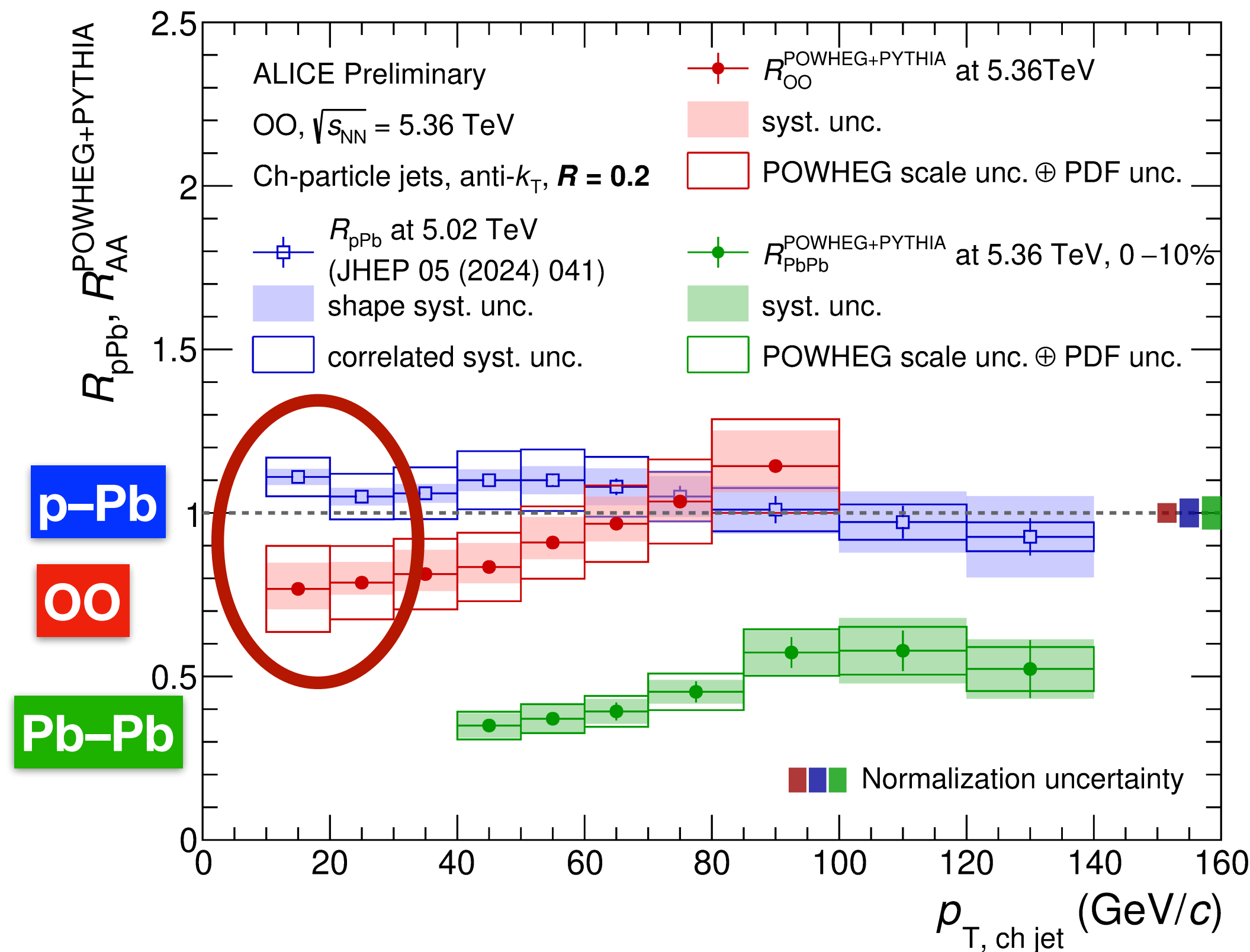


ALI-PREL-635353

Nuclear modification factor of
charged particle jets in 00

➡ Exceed suppression at low p_T
than **p-Pb** See also **ALICE** arXiv:2606.19967

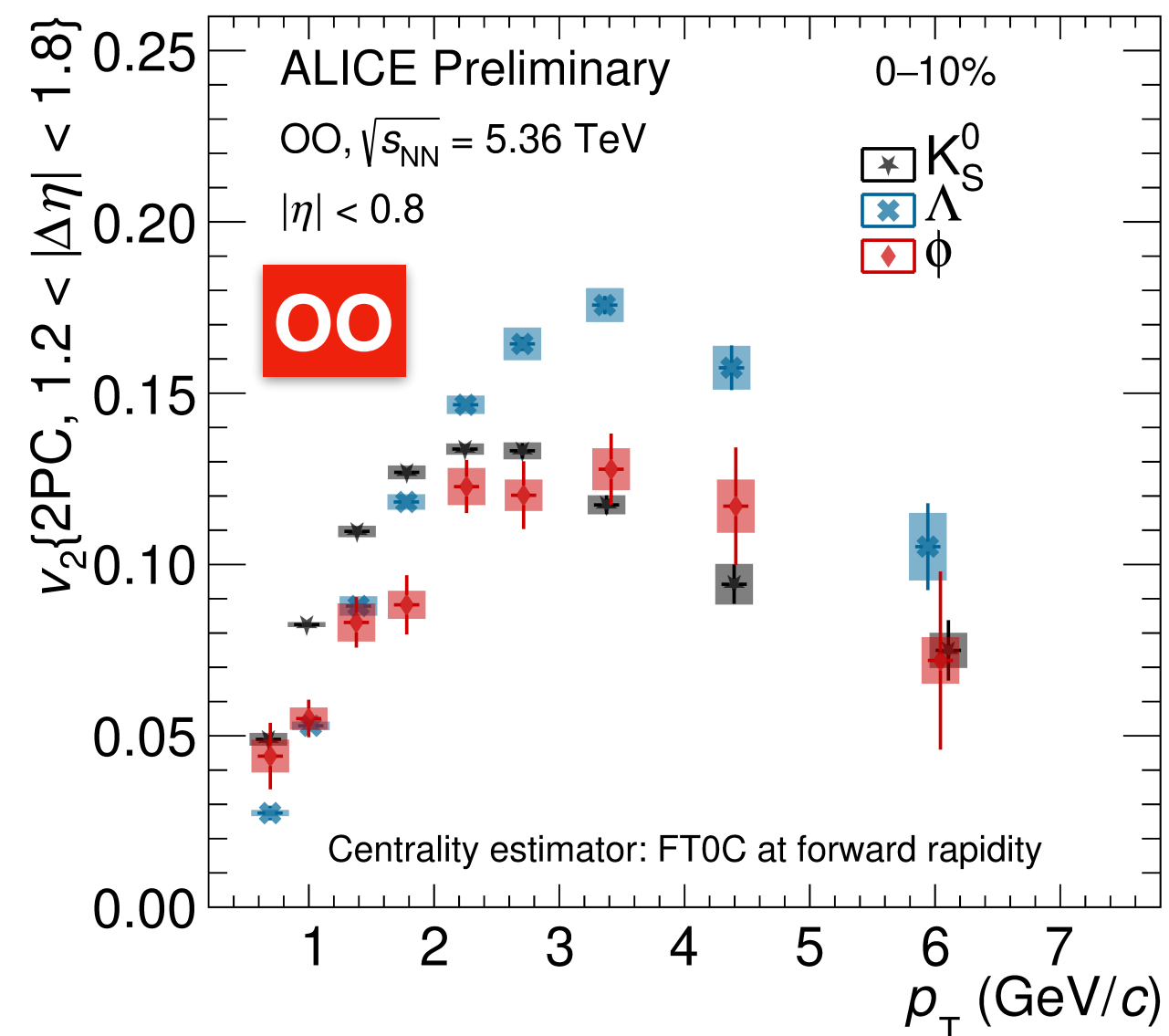
QGP signature in OO and Ne-Ne



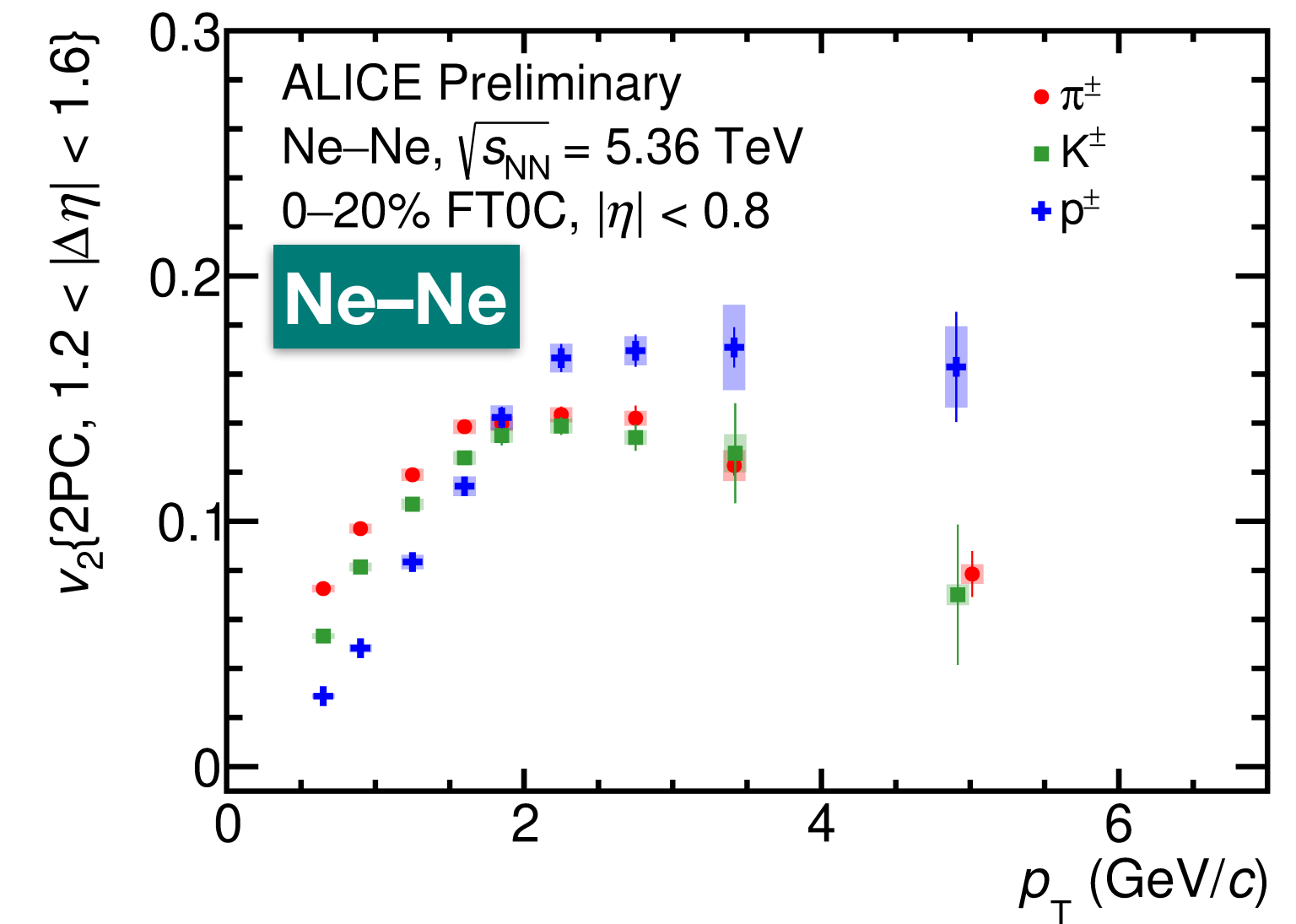
ALI-PREL-635353

Nuclear modification factor of charged particle jets in OO

➡ Exceed suppression at low p_T than p-Pb See also ALICE arXiv:2606.19967



ALI-PREL-623904

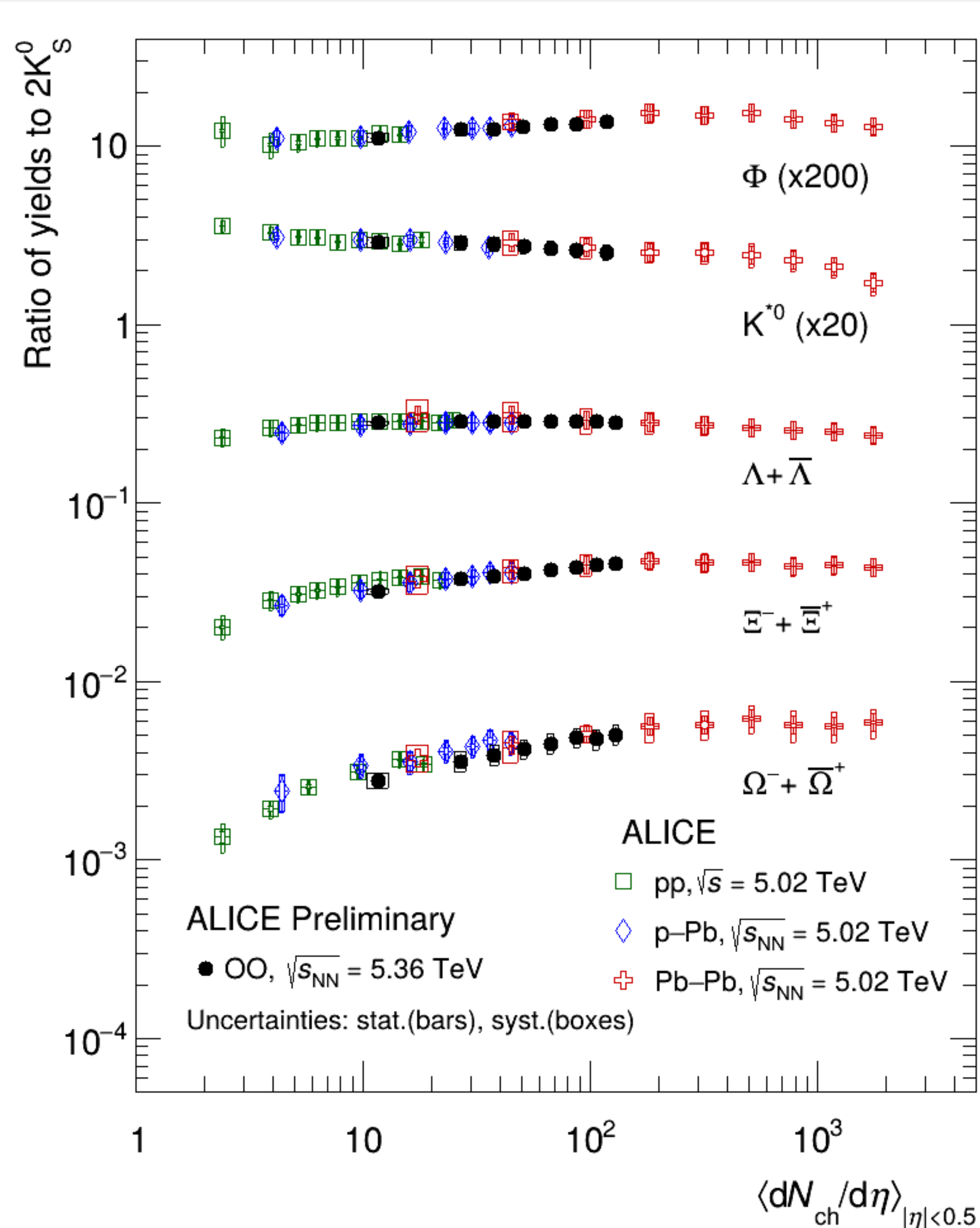


ALI-PREL-635195

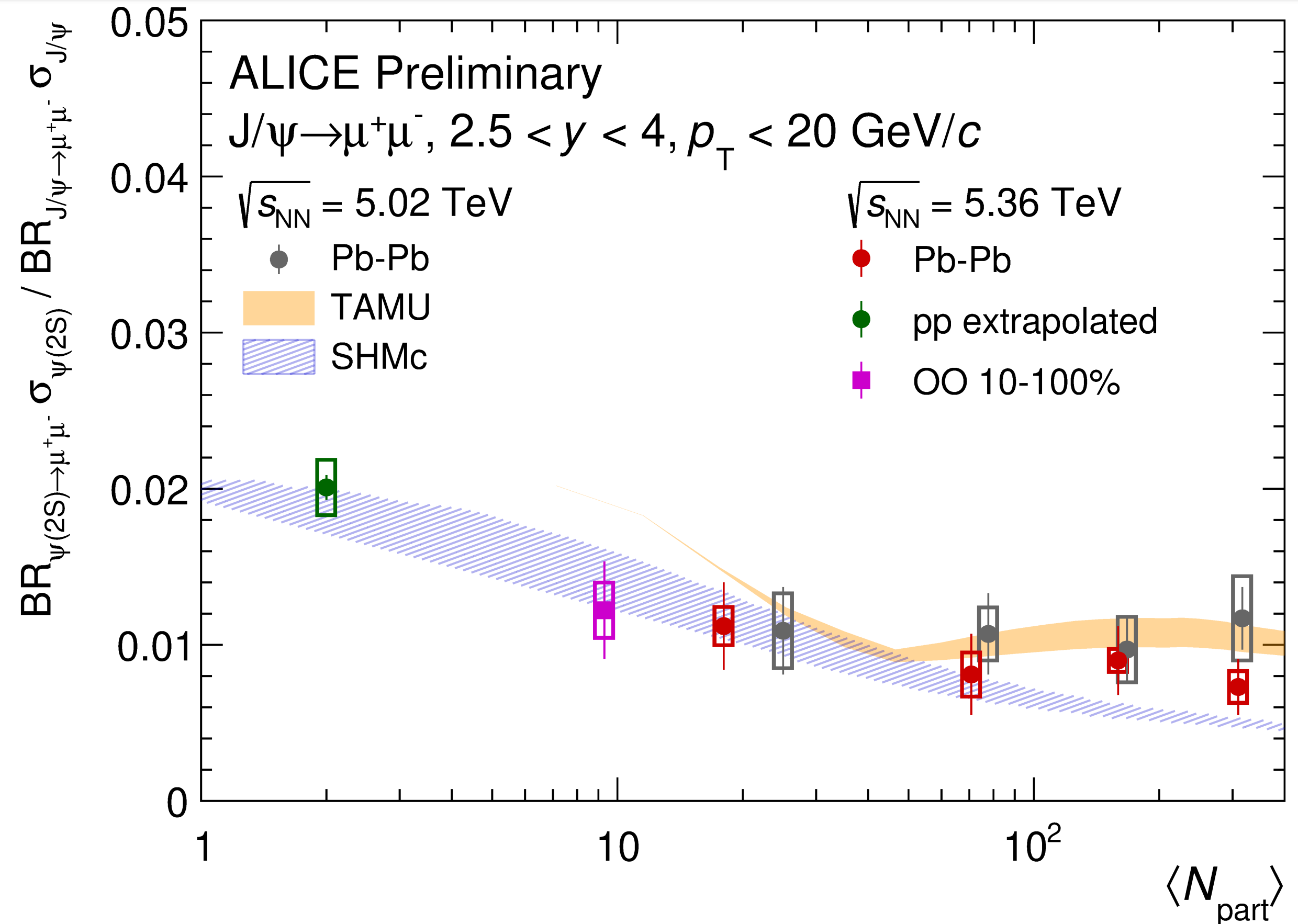
Elliptic flow in OO and Ne-Ne

- Mass ordering at low- p_T
 - ➡ Collective expansion of the medium
- Baryon/meson grouping at intermediate p_T
 - ➡ Driven by quark constituents

Particle production cross systems



ALI-PREL-624137



ALI-PREL-633454

Crucial input to the study of the relationship between many-body QCD phenomenology and QGP signatures

Geo-driven flow in OO and Ne–Ne



High energy nuclear collisions provide “snap-shoot” for the initial nuclear geometry

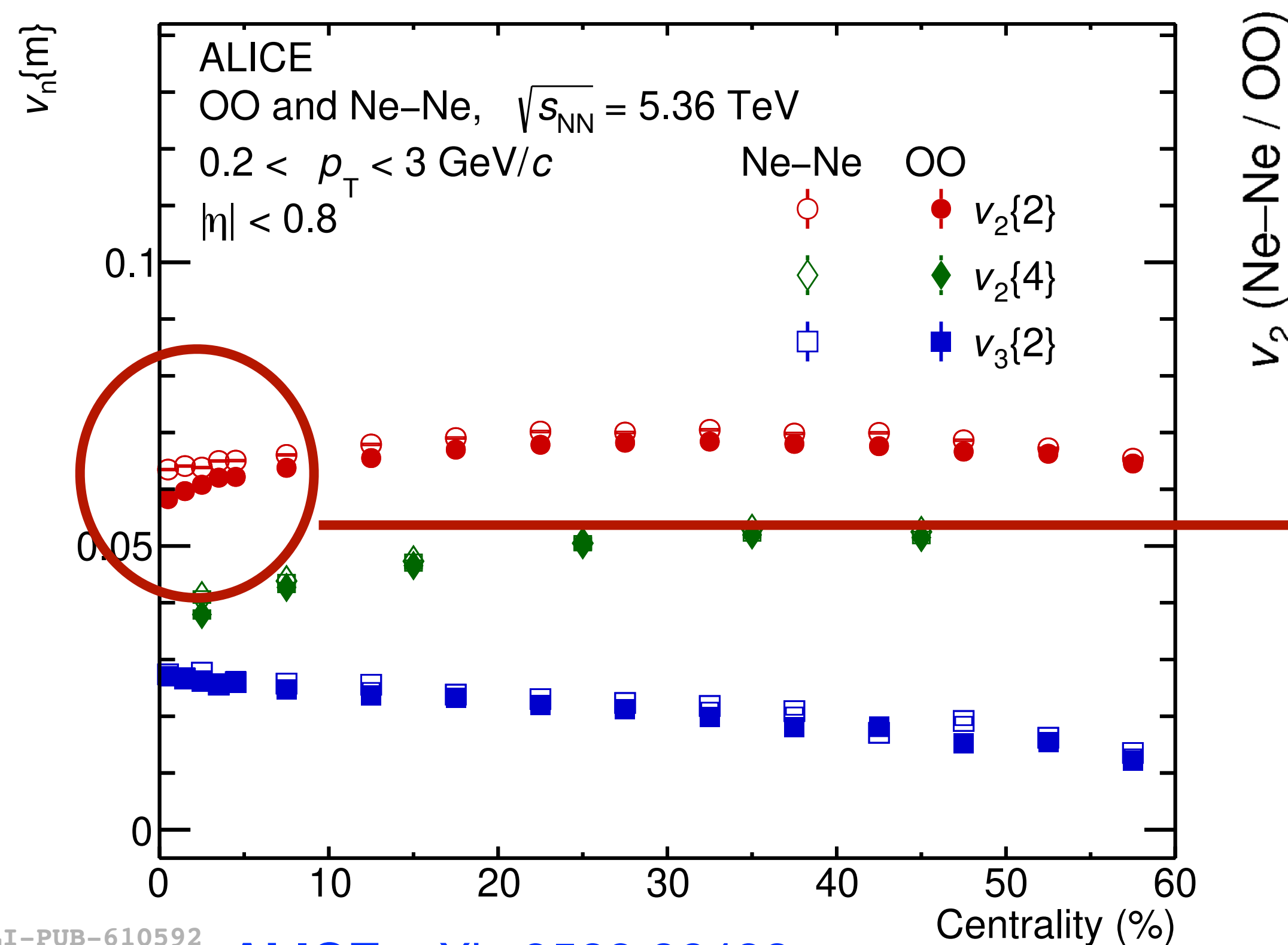
v_2 Ne–Ne/OO ratio enhancement at small centrality

S. Zhang, Y.-G. Ma *et al.*, *Phys. Rev.* **C95** (2017) 064904

W.-B. He, Y.-G. Ma *et al.*, *Phys. Rev.* **C94** (2016) 014301

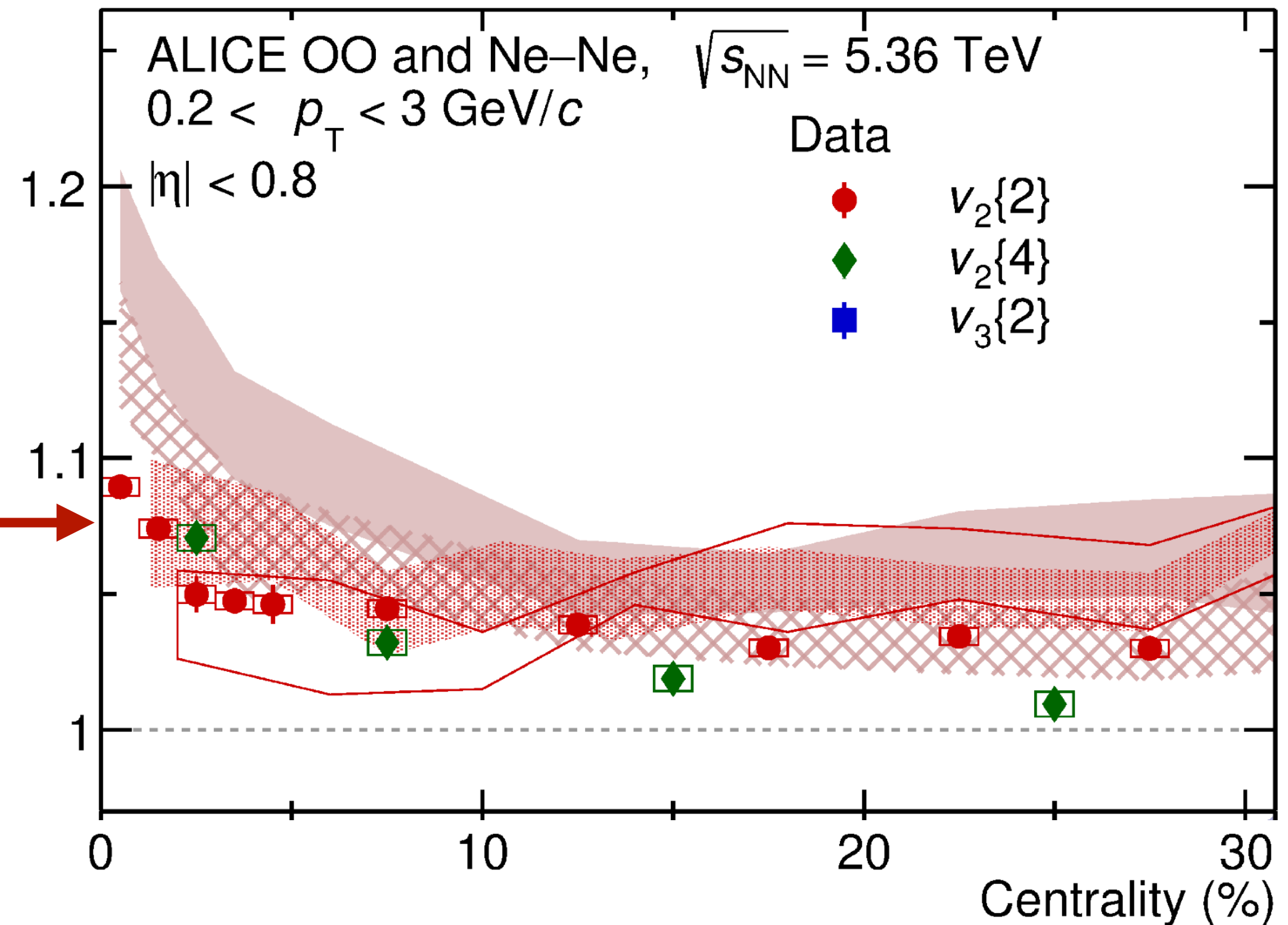
➔ Reveals a deformed shape of ^{20}Ne

See also **ALICE Phys. Lett.** **B869** (2025) 139855

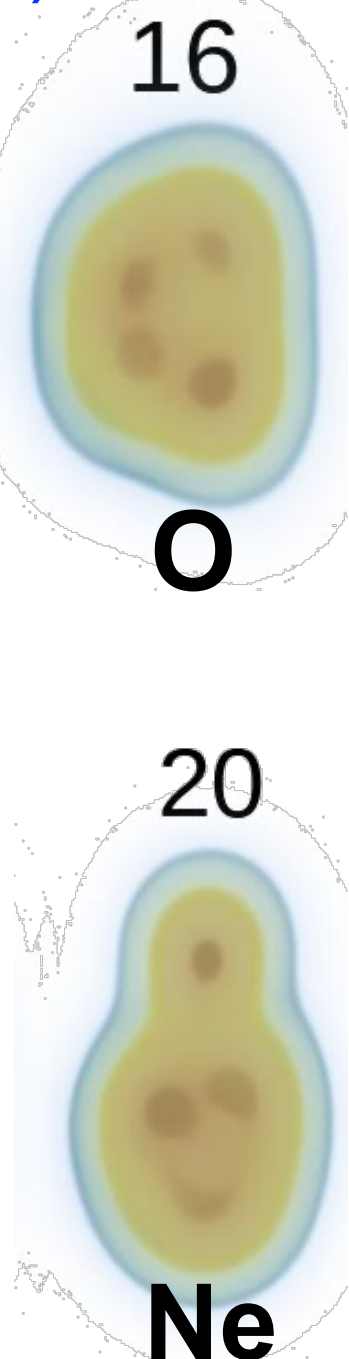


ALI-PUB-610592

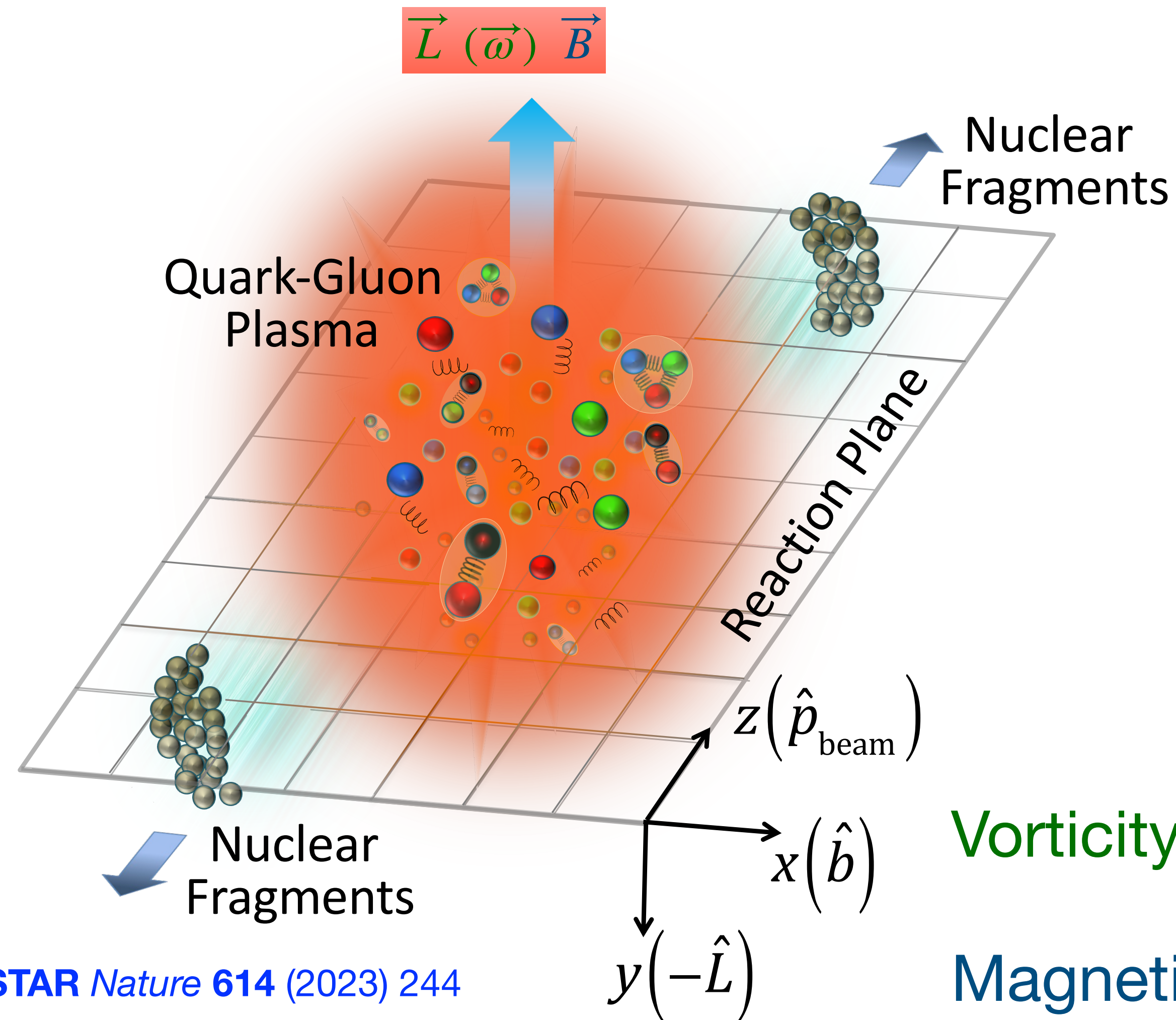
ALICE arXiv:2509.06428



ALI-PUB-610602



QGP in extreme fields



STAR *Nature* **614** (2023) 244

High temperature (T) limit

[F. Becattini *et al.*, *Phys. Rev.* **C95** (2017) 054902]

$$\vec{P} = \frac{\langle \vec{s} \rangle}{s} \approx \frac{s+1}{3} \frac{\vec{\omega} + \mu/s \vec{B}}{T}$$

Spin-orbit coupling [S. J. Barnett, *Phys. Rev.* **6** (1915) 239]

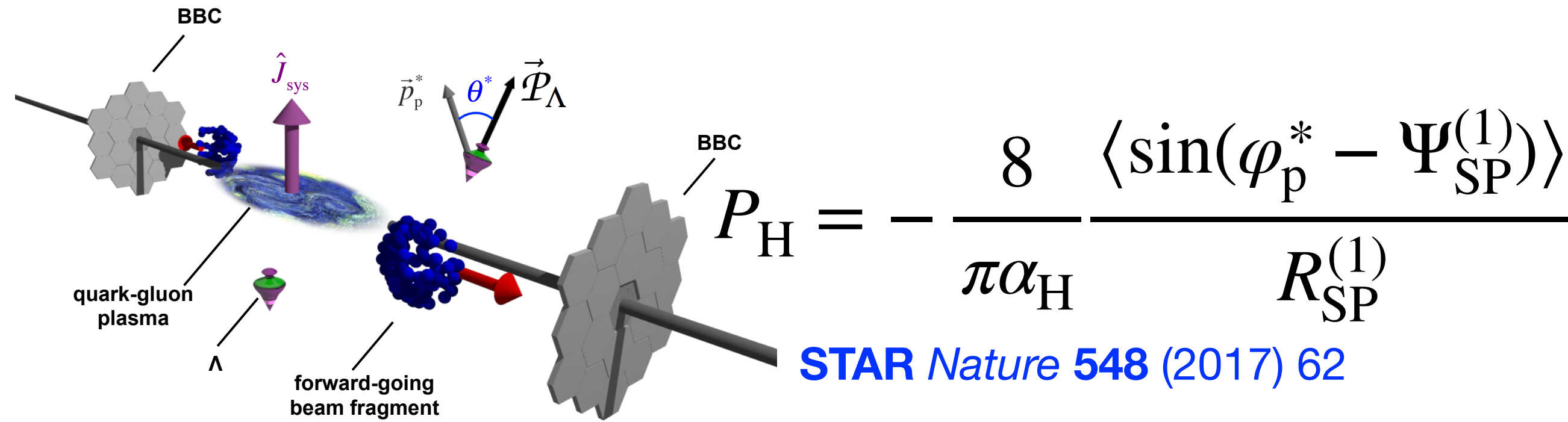
Z.-T. Liang and X.-N. Wang, *Phys. Rev. Lett.* **94** (2005) 102301

Z.-T. Liang and X.-N. Wang, *Phys. Lett.* **B629** (2005) 20

Vorticity ($\vec{\omega}$) $\Rightarrow$ polarization independent on charges

Magnetic Field ($\vec{B}$) $\Rightarrow$ charge-dependent polarization

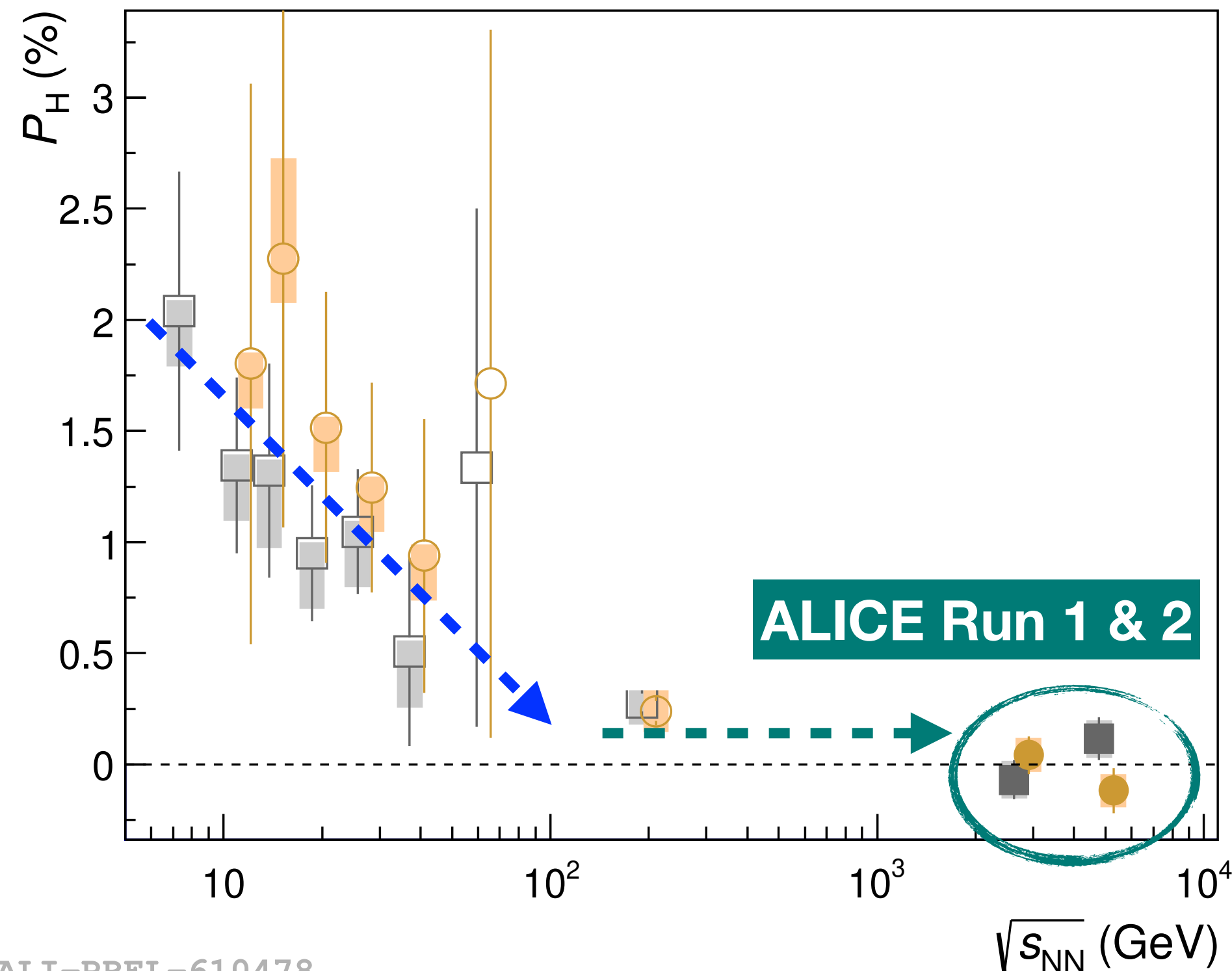
Global polarization of Λ — RHIC & LHC



ALICE Run 1 & 2

- $P_H \sim 0$ within large uncertainties
- Correlation of P_H and dv_1/dy

S. A. Voloshin, *EPJ Web Conf.* 171 (2018) 07002

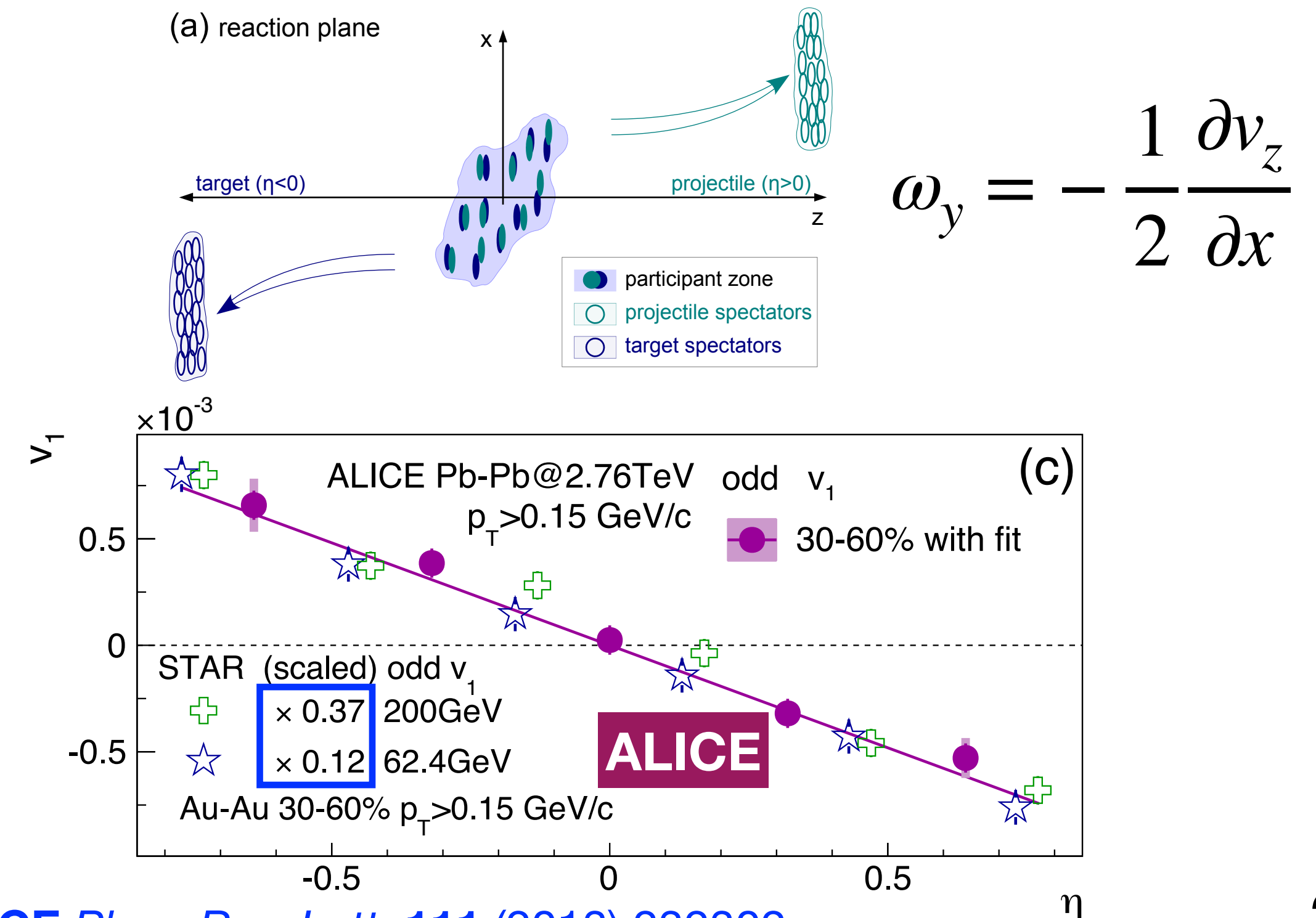


ALICE *PRC* 101, 044611 (2020)

Λ $\bar{\Lambda}$
Pb-Pb 15–50%
 $0.5 < p_T < 5$ GeV/c
 $|y| < 0.5$

STAR *Nature* 548, 62–65 (2017)

Λ $\bar{\Lambda}$
Au-Au 20–50%
 $0.5 < p_T < 6$ GeV/c
 $|\eta| < 0.8$

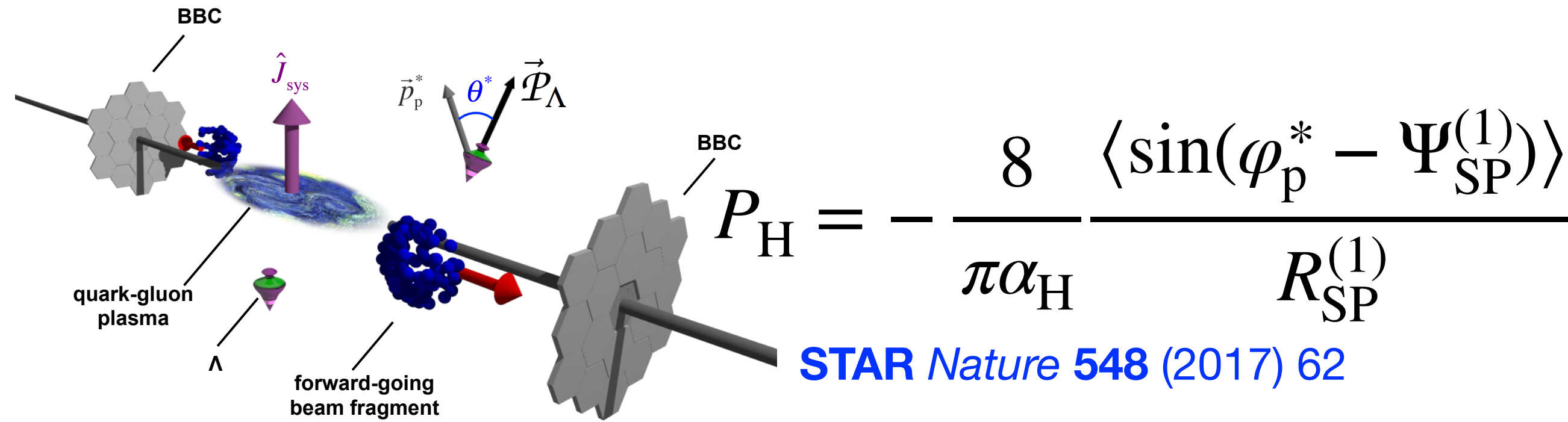


ALI-PREL-610478

ALICE *Phys. Rev. C* 101 (2020) 044611

ALICE *Phys. Rev. Lett.* 111 (2013) 232302

Global polarization of Λ — New Run 3



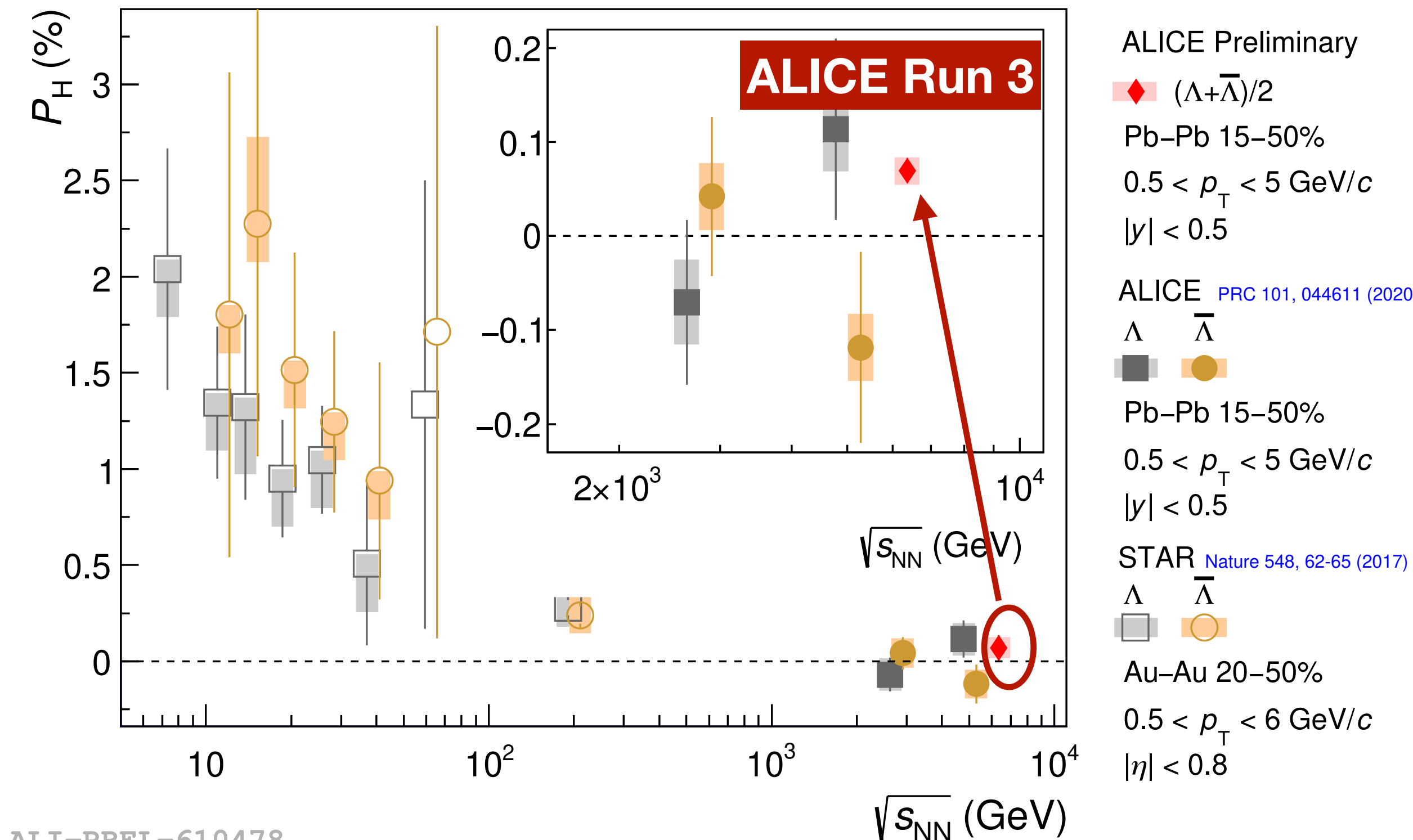
New ALICE Run 3

- First observation of polarized Λ at LHC energies with 5σ

- $\omega \sim 10^{20} \text{ s}^{-1}$ at the LHC

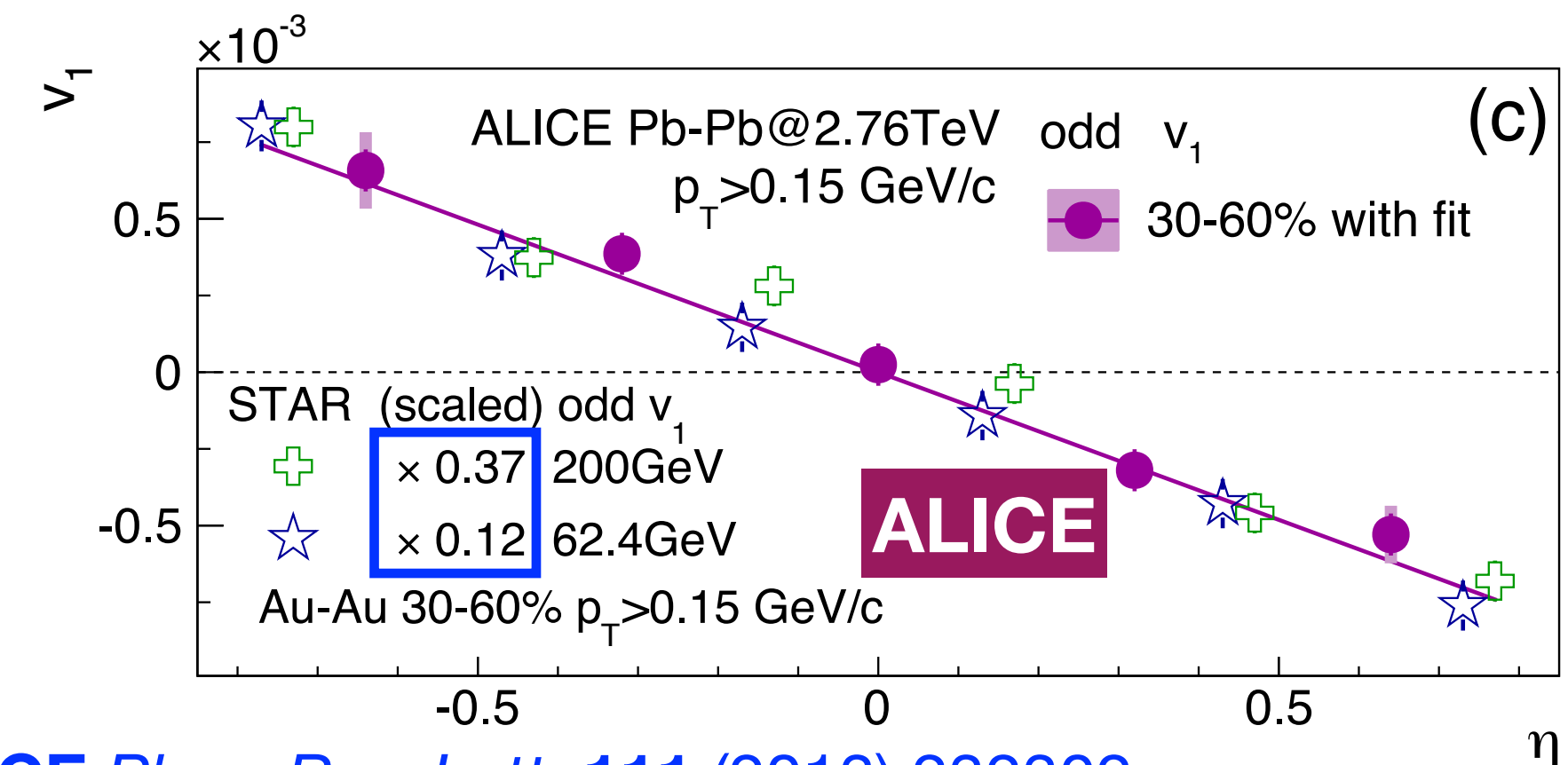
➡ $\omega \sim 10^{21} \text{ s}^{-1}$ at RHIC

➡ Consistent with the empirical prediction based on dv_1/dy



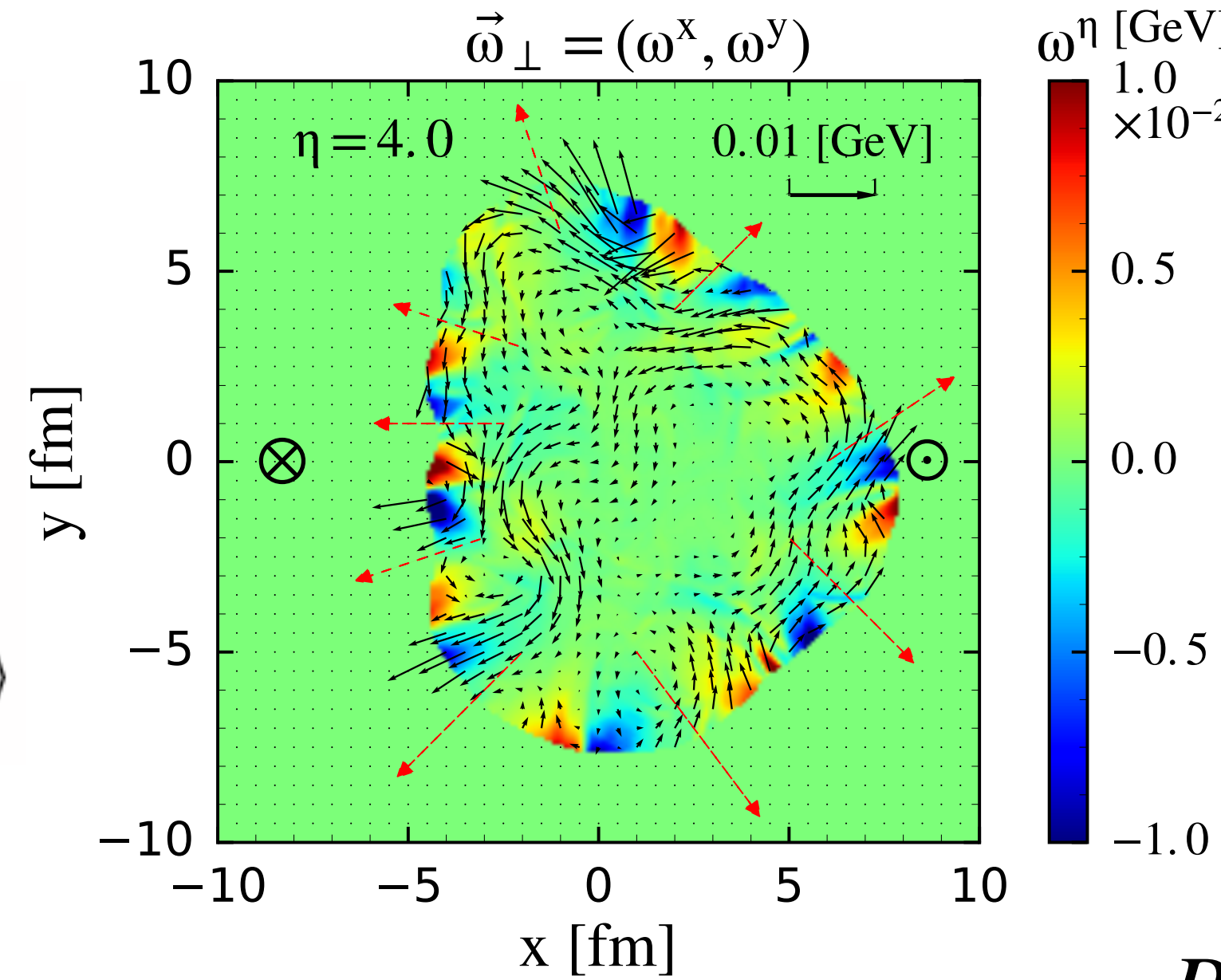
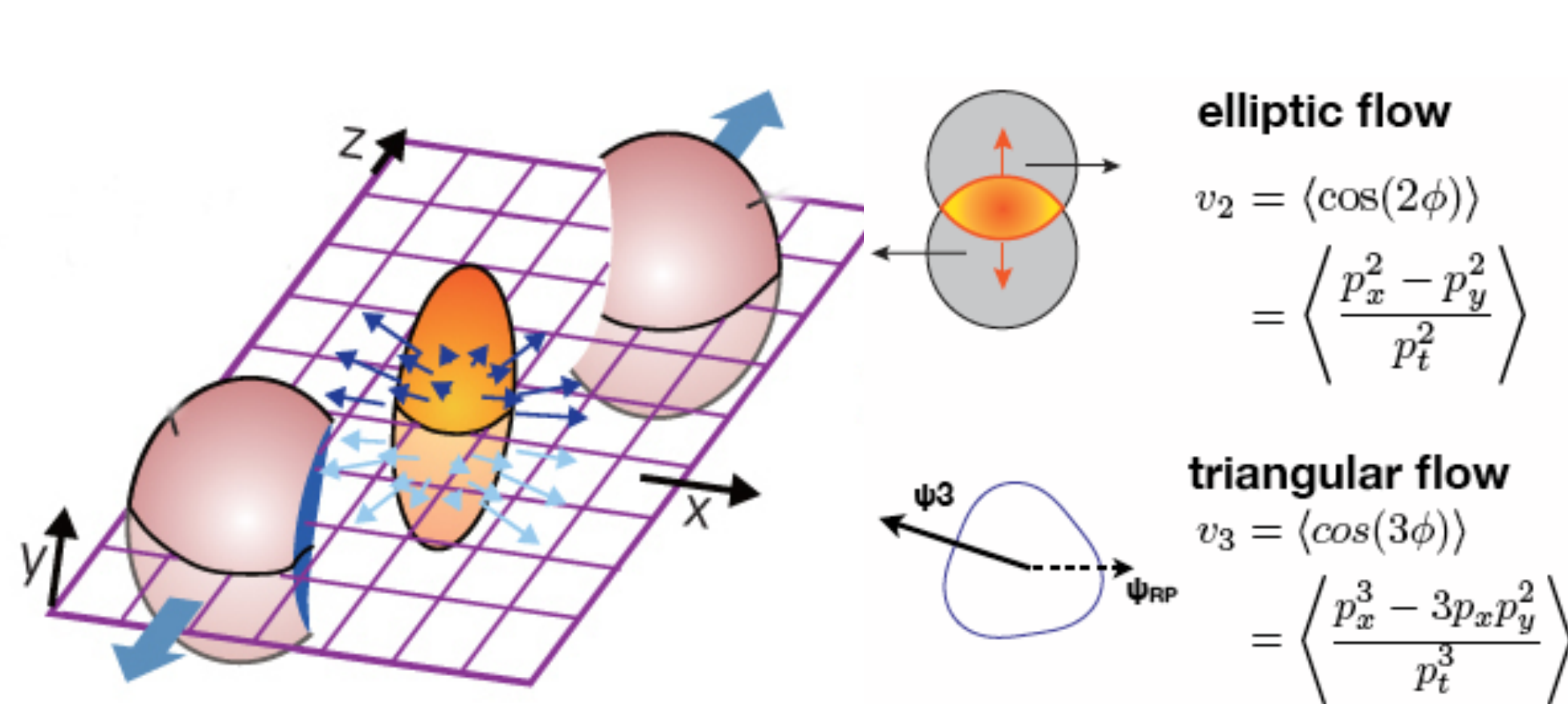
ALI-PREL-610478

ALICE *Phys. Rev. C* 101 (2020) 044611



ALICE *Phys. Rev. Lett.* 111 (2013) 232302

Polarization along the beam direction

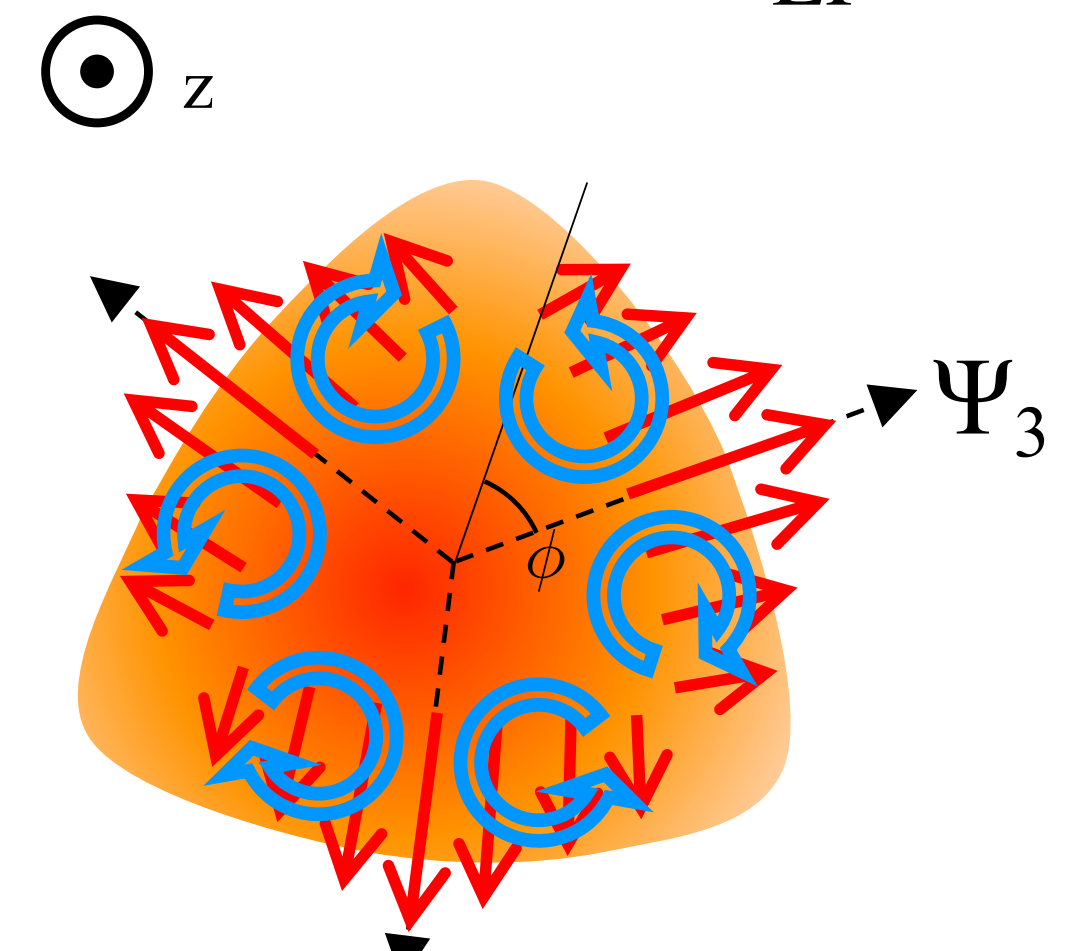
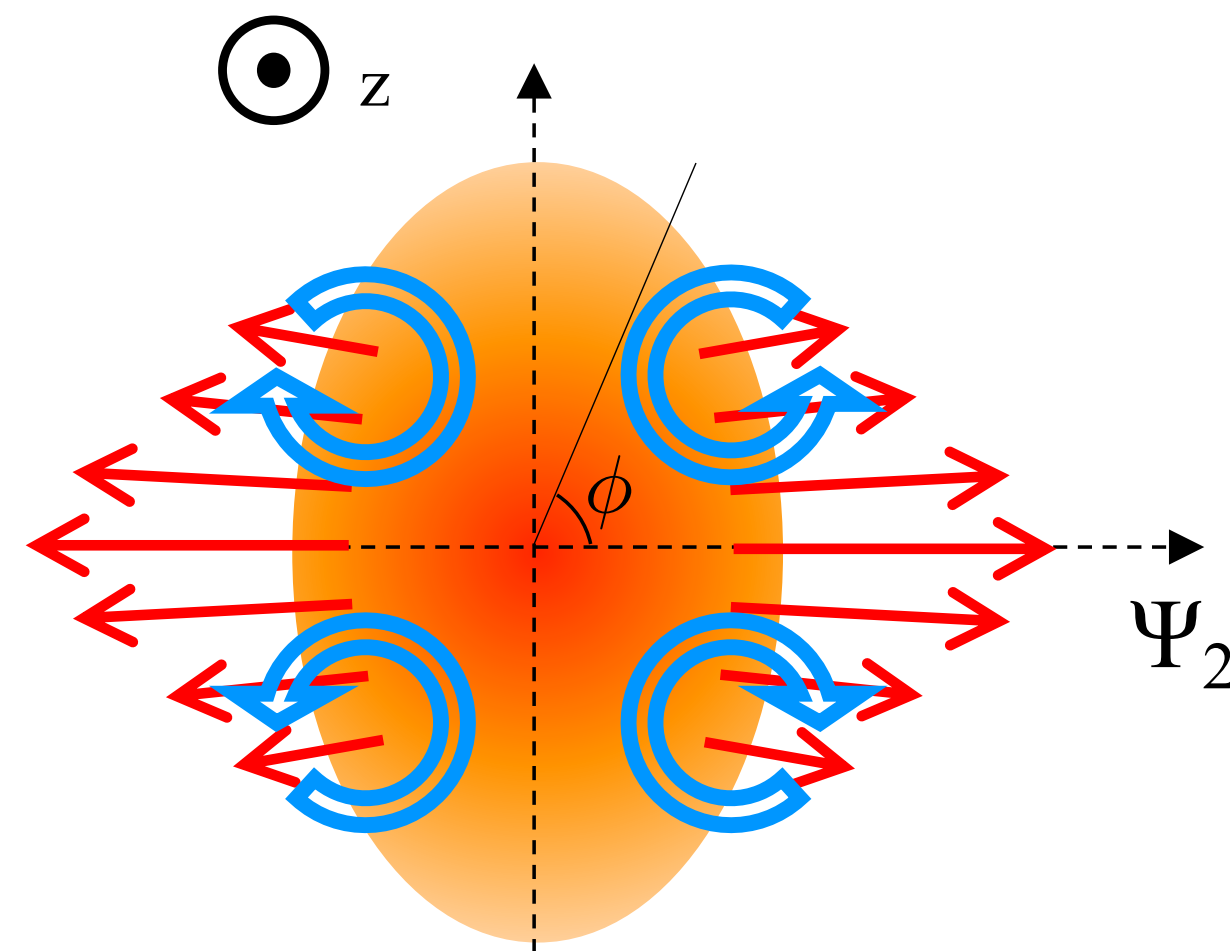
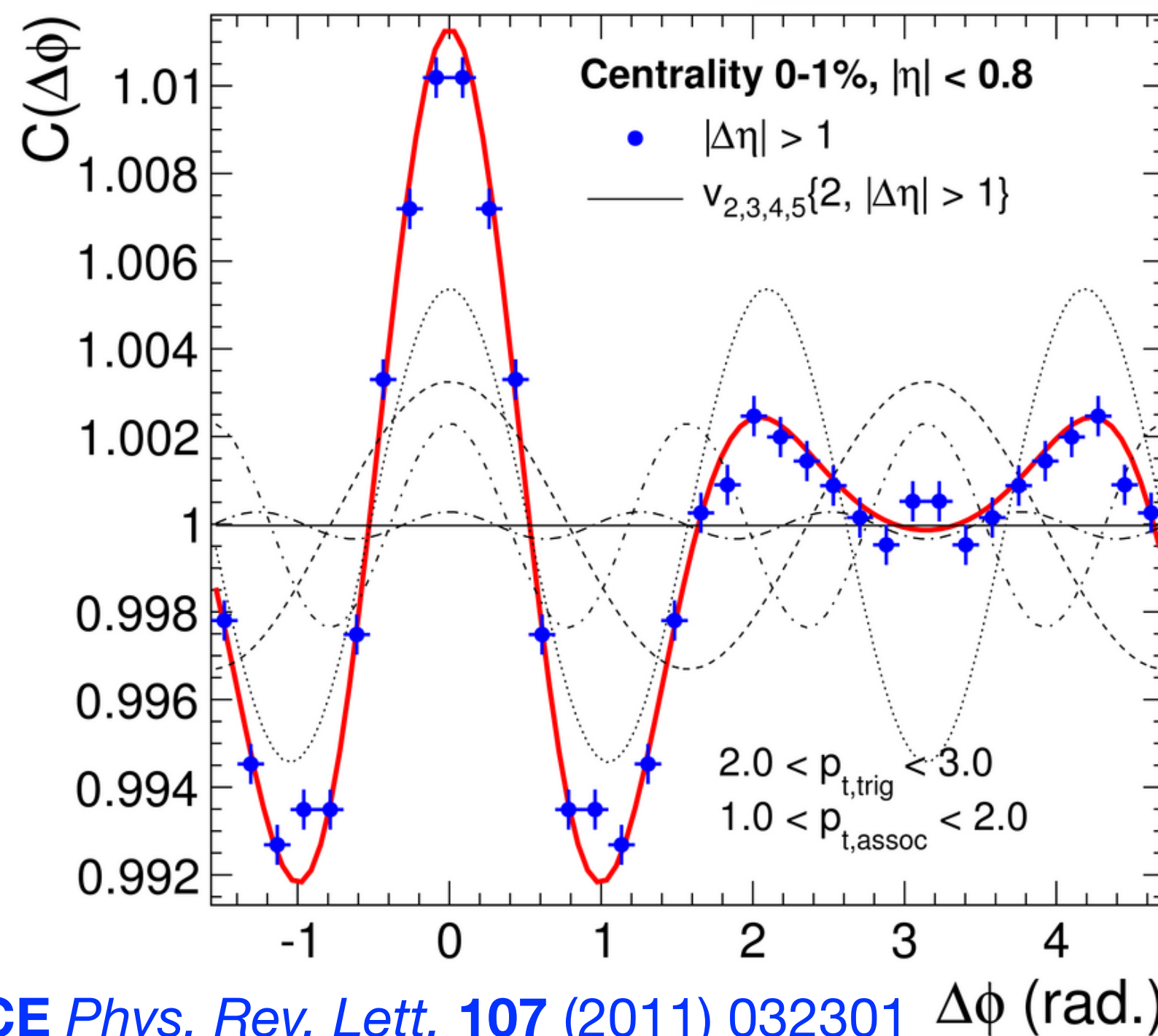


L.-G. Pang, Q. Wang, X.-N. Wang *et al.*
Phys. Rev. Lett. **117** (2016) 192301

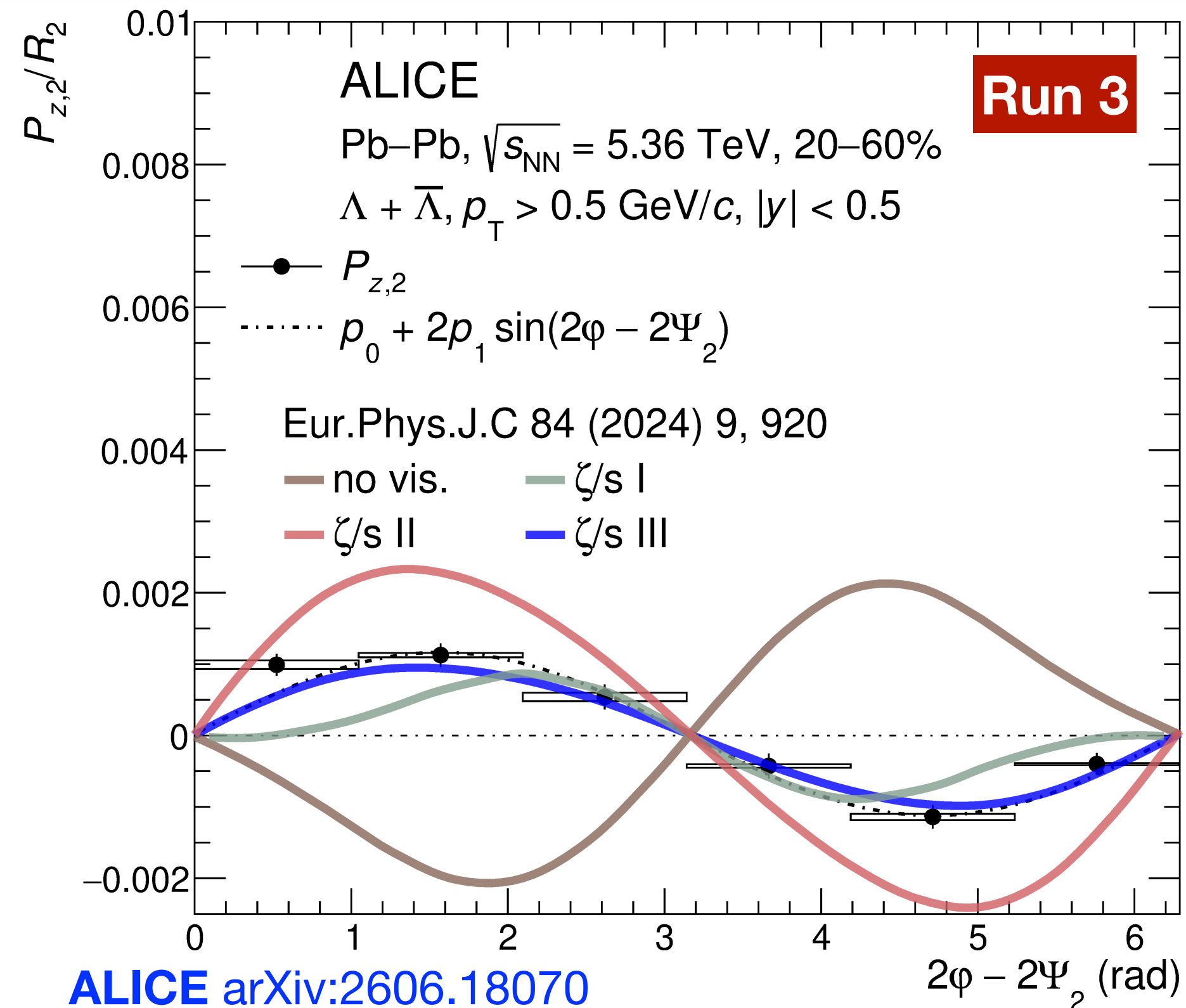
S. A. Voloshin, T. Niida
Phys. Rev. **C94** (2016) 021901

$$P_z = \frac{\langle \cos \theta_p^* \rangle}{\alpha_H \langle \cos^2 \theta_p^* \rangle}$$

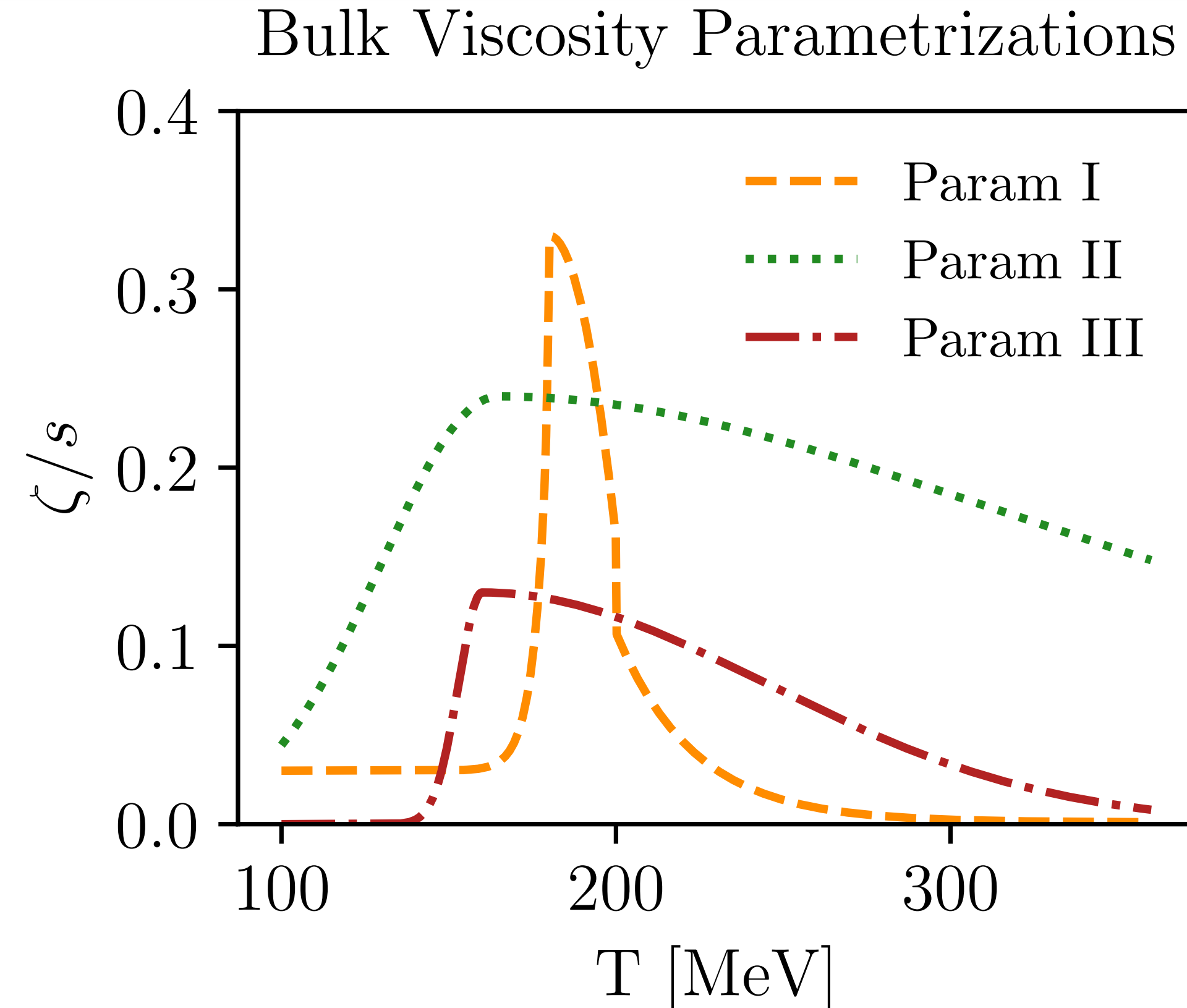
$$P_{z,sn} = \frac{\langle P_z \sin n(\varphi_H - \Psi_n) \rangle}{R_{EP}^{(n)}}$$



New Run 3 results compare to model



ALI-PUB-635098



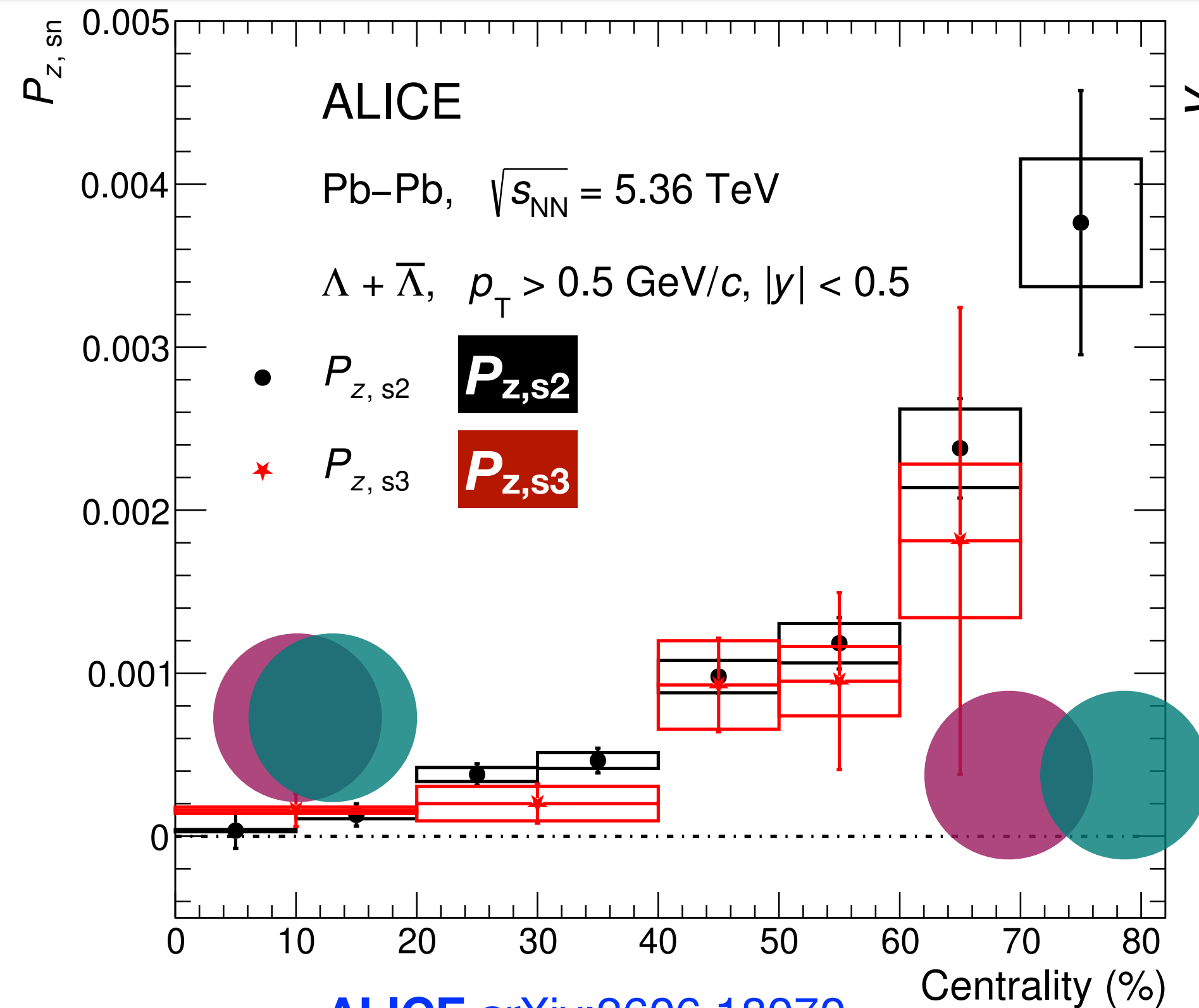
A. Palermo et al., *Eur. Phys. J.* **C84** (2024) 920

B. Fu et al., *Phys. Rev. Lett.* **127** (2021) 142301

Good agreement between data and model including

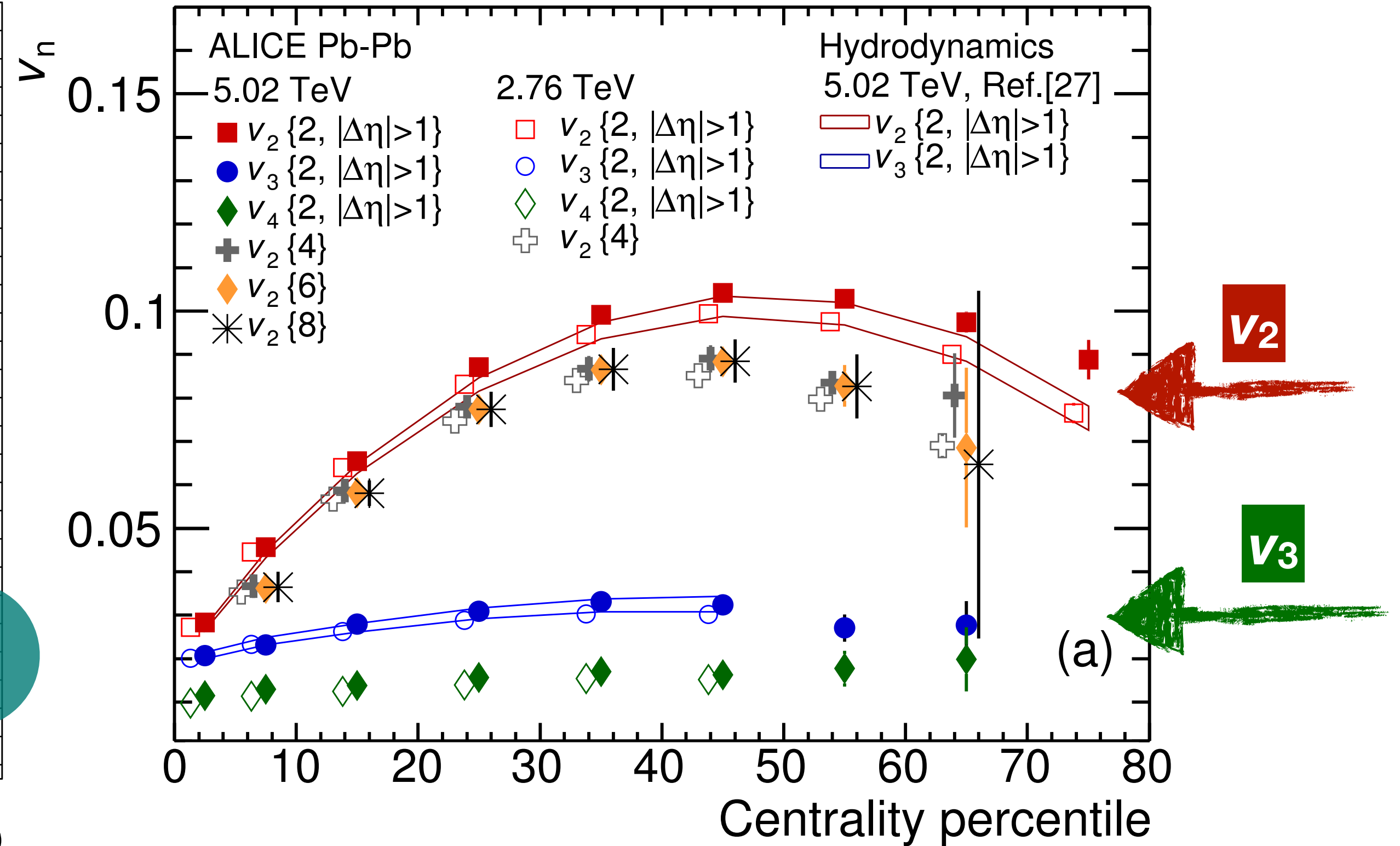
- ➡ Shear-induced polarization
- ➡ Assuming a temperature dependent bulk viscosity ζ/s (**par III**)
- ➡ An isothermal hadronization hypersurface

Polarization induced by triangle flow



ALICE arXiv:2606.18070

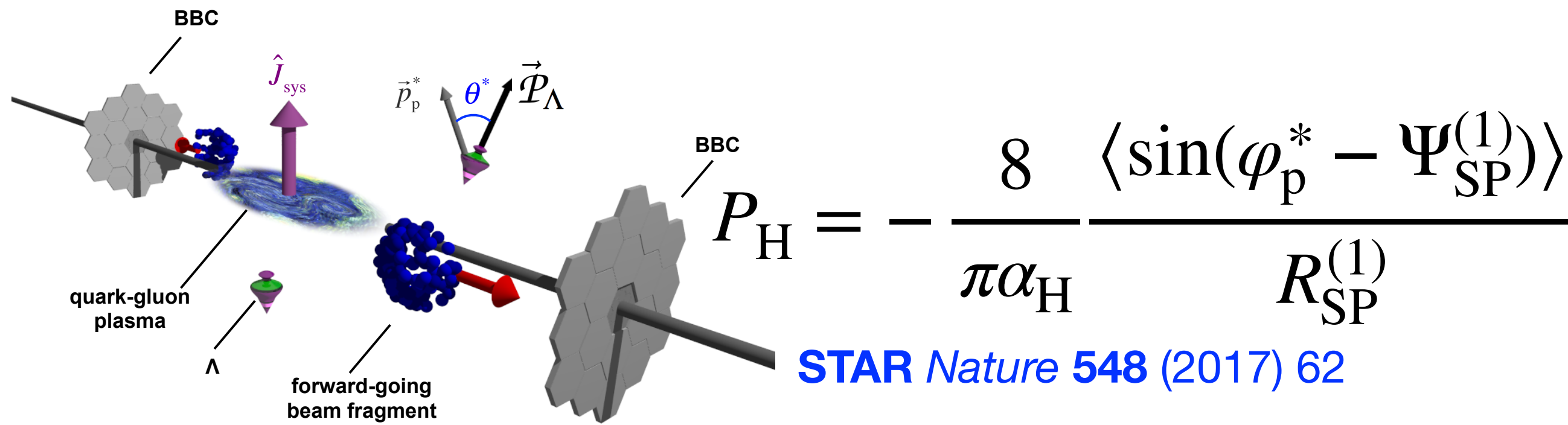
ALI-PUB-635118



ALICE Phys. Rev. Lett. **116** (2016) 132302

- $P_{z,s3}$ is compatible with $P_{z,s2}$, despite the v_3 is smaller v_2
- ➡ Similar relations is observed by STAR [STAR Phys. Rev. Lett. **131** (2023) 202301]
- ➡ Model predictions are needed to interpret these results

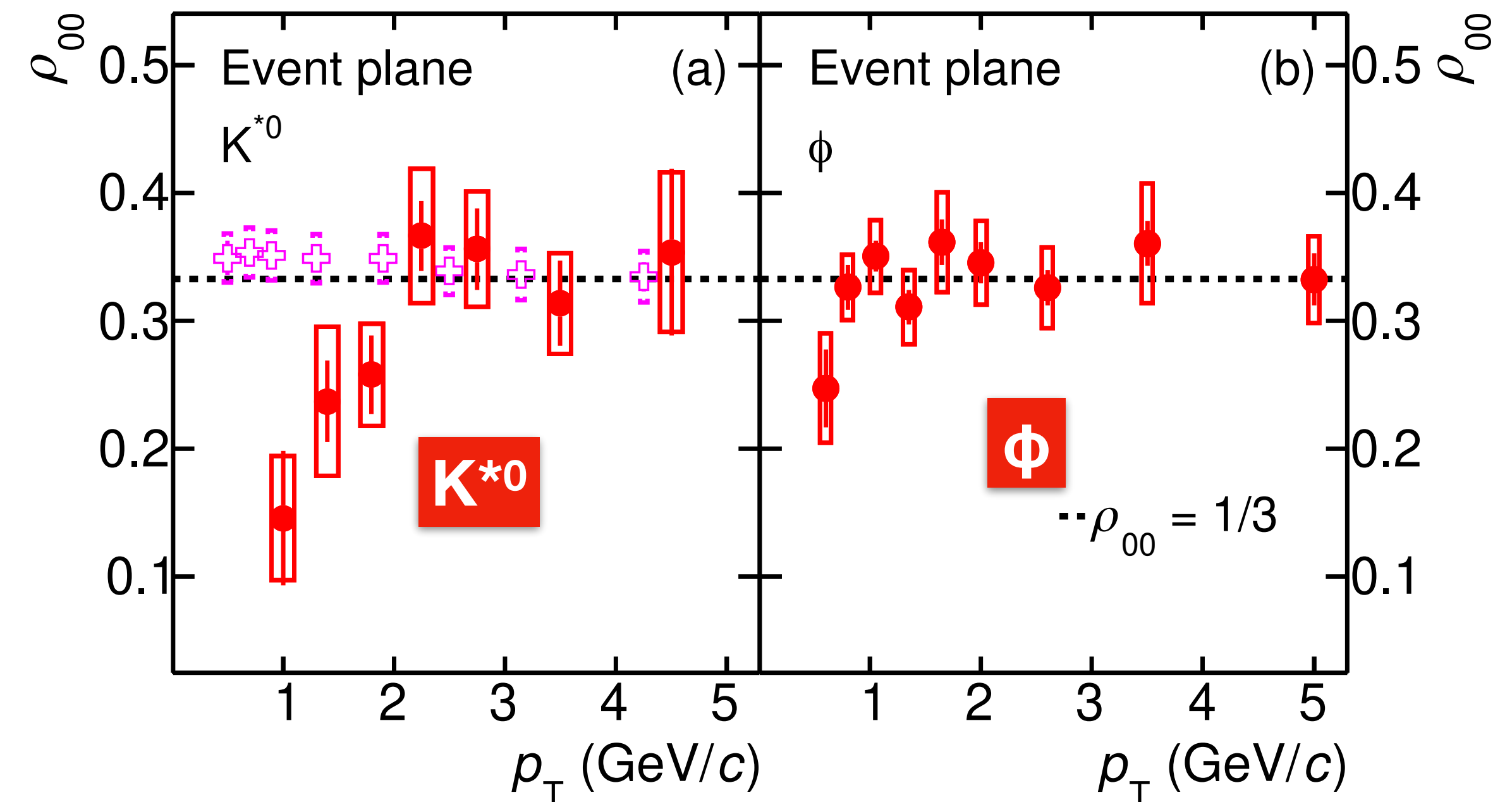
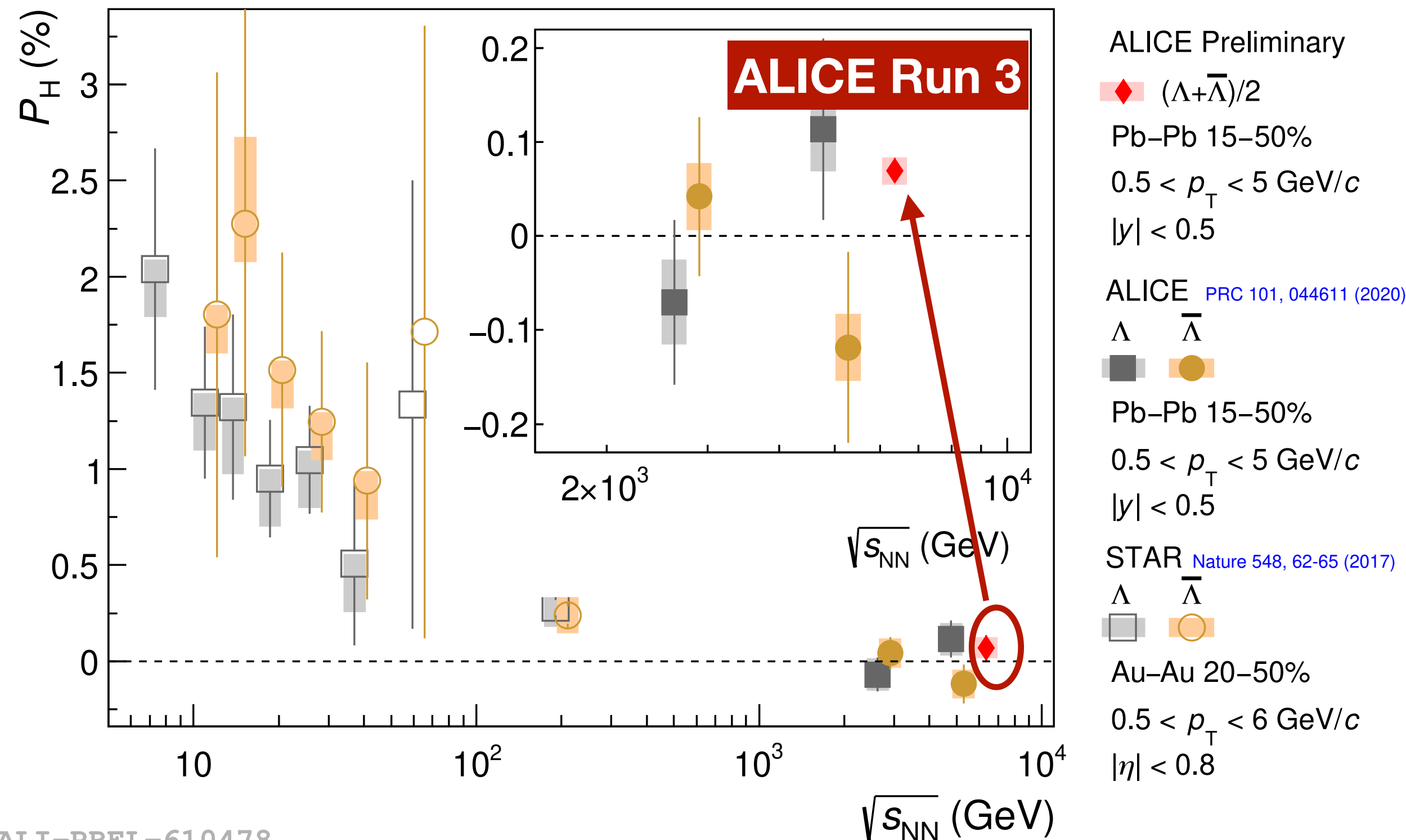
Polarization puzzle



Thermal estimation

$$\rho_{00} - 1/3 \sim \mathcal{O}(P_H^2)$$

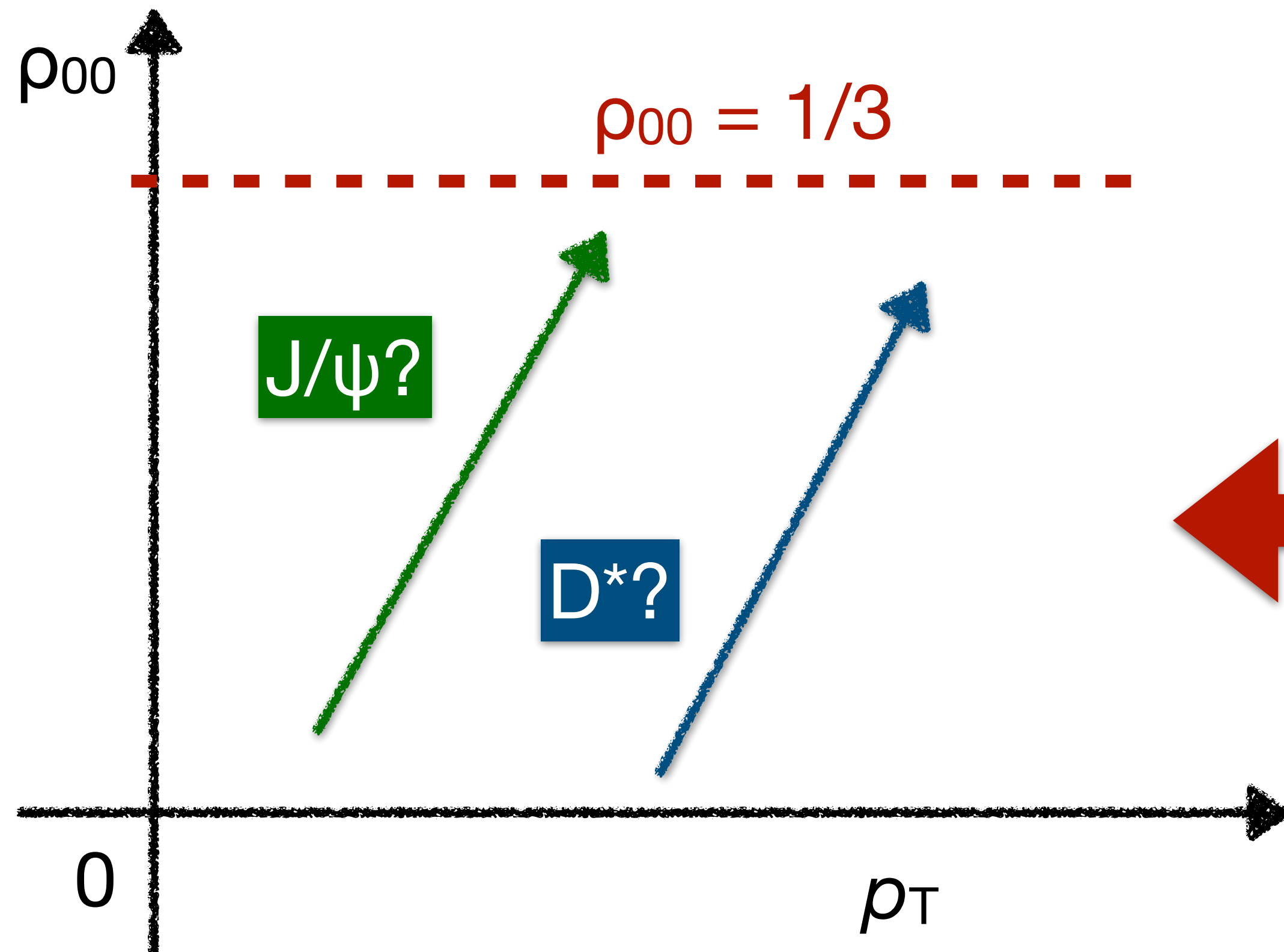
$$P_H < 0.1\% \rightarrow \rho_{00} - 1/3 \sim 0$$



Spin alignment of HF particles



Prediction at heavy-quark sector

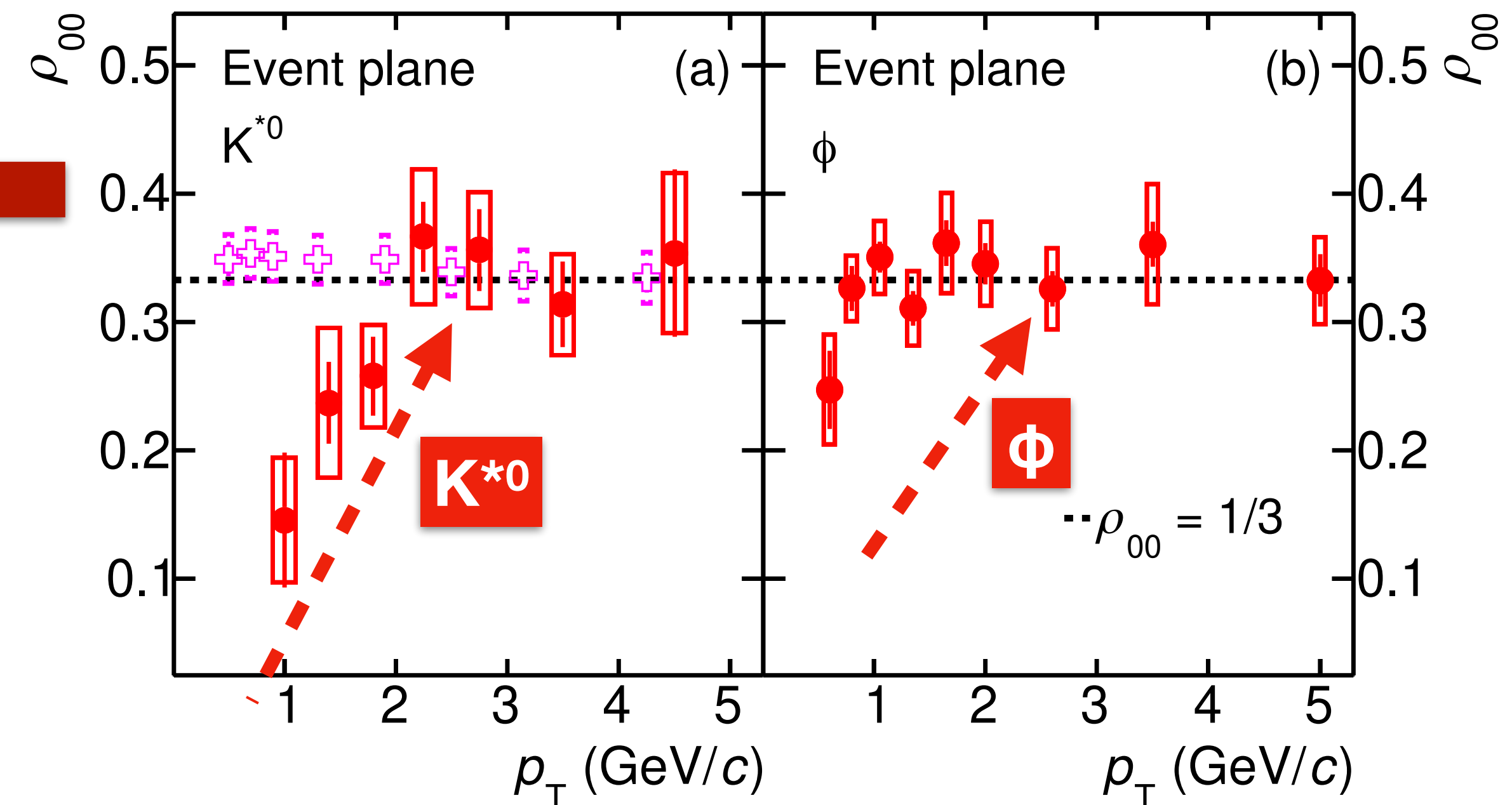


Would a similar trend show at heavy-quark sector?

Thermal estimation

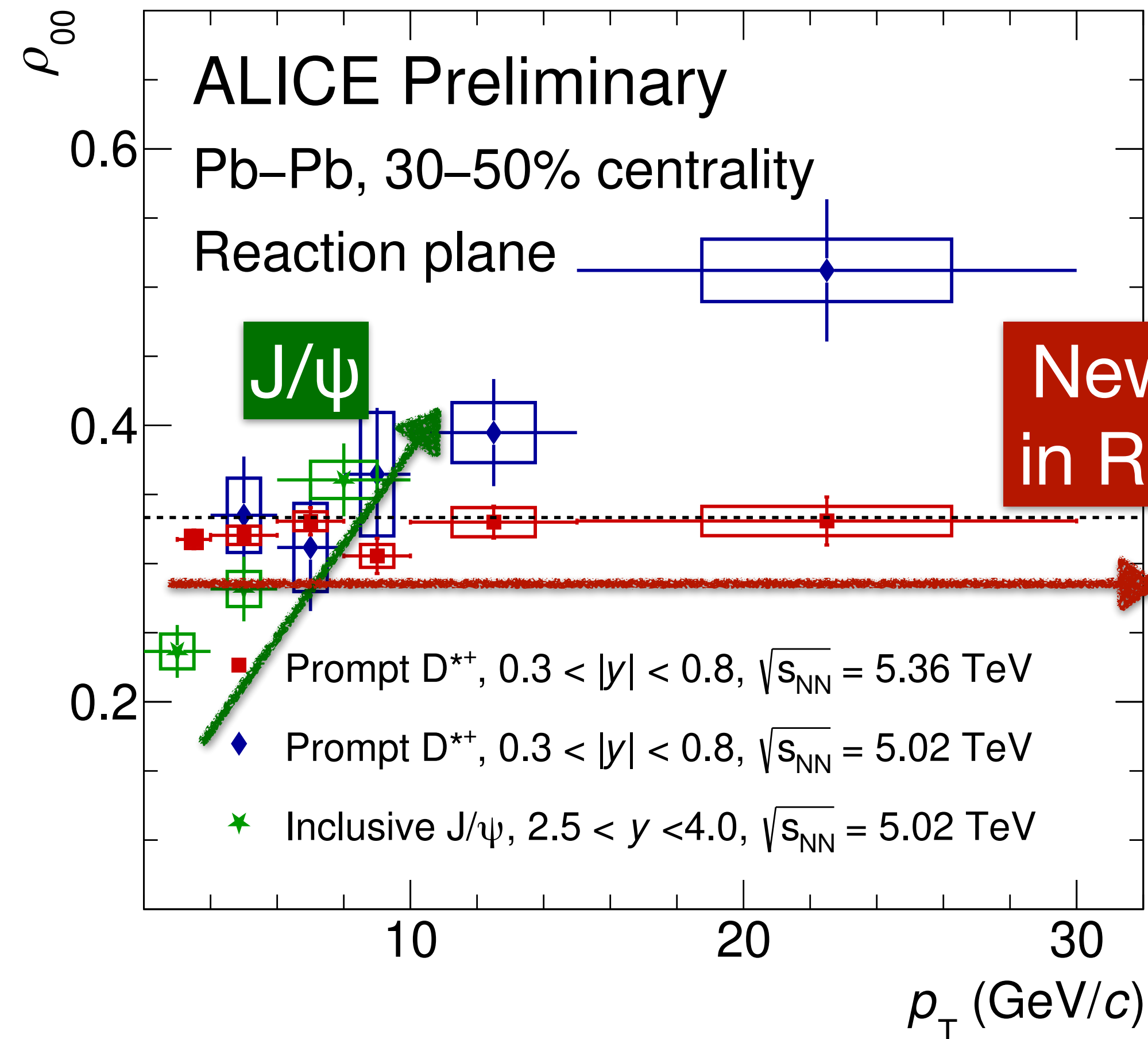
$$\rho_{00} - 1/3 \sim \mathcal{O}(P_H^2)$$

$$P_H < 0.1 \% \rightarrow \rho_{00} - 1/3 \sim 0$$



ALI-PUB-520388

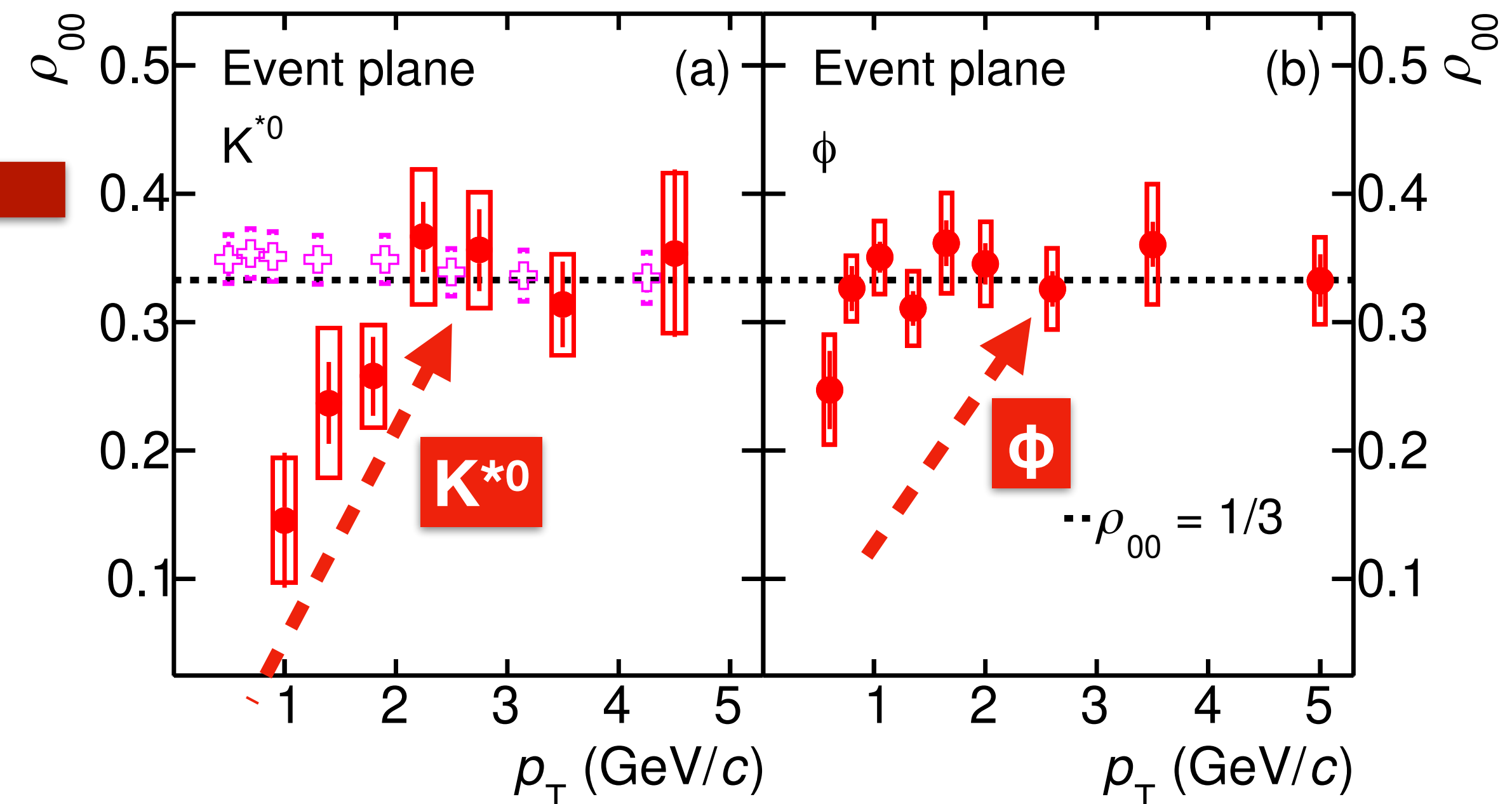
Spin alignment of HF particles



Thermal estimation

$$\rho_{00} - 1/3 \sim \mathcal{O}(P_H^2)$$

$$P_H < 0.1\% \rightarrow \rho_{00} - 1/3 \sim 0$$



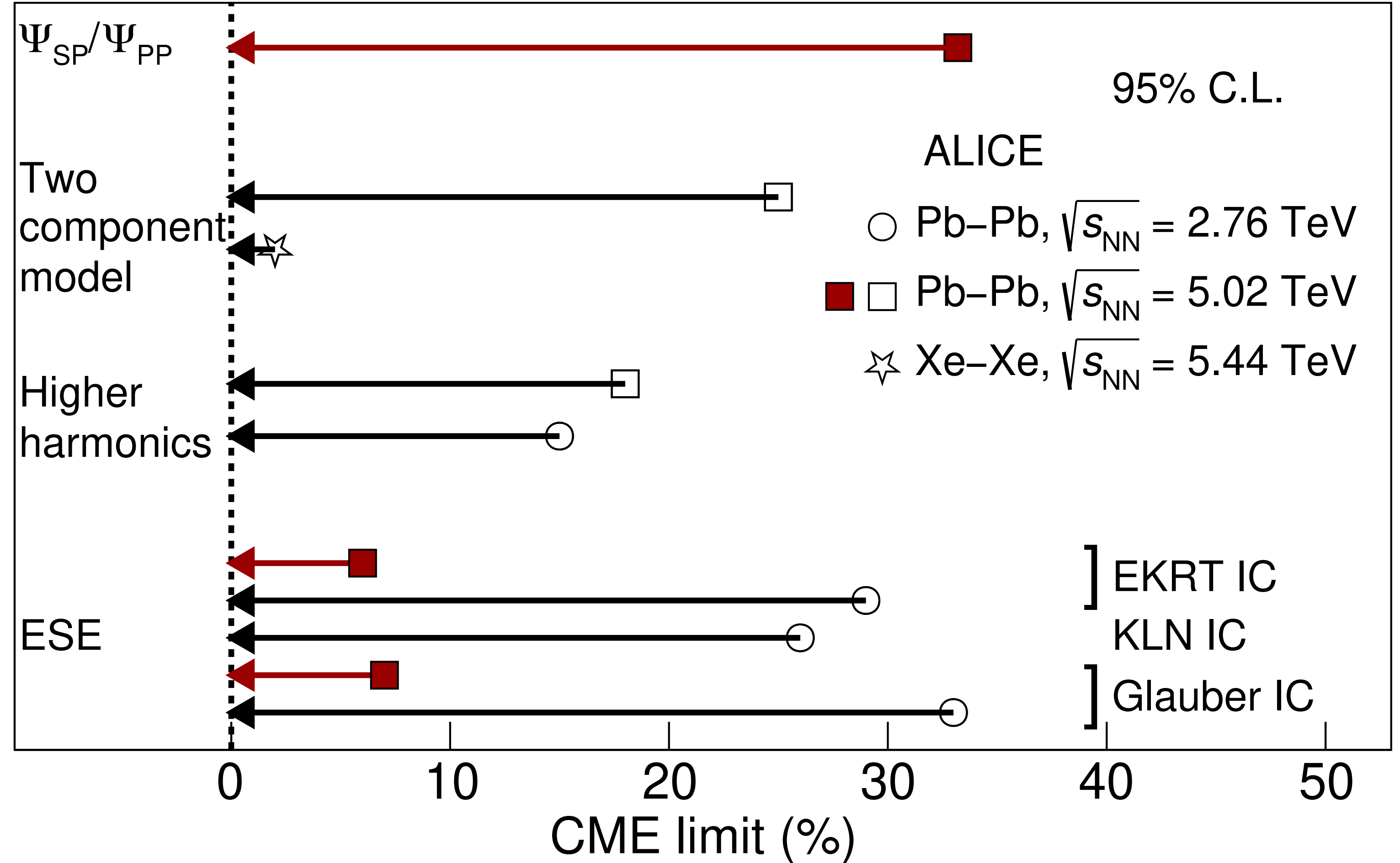
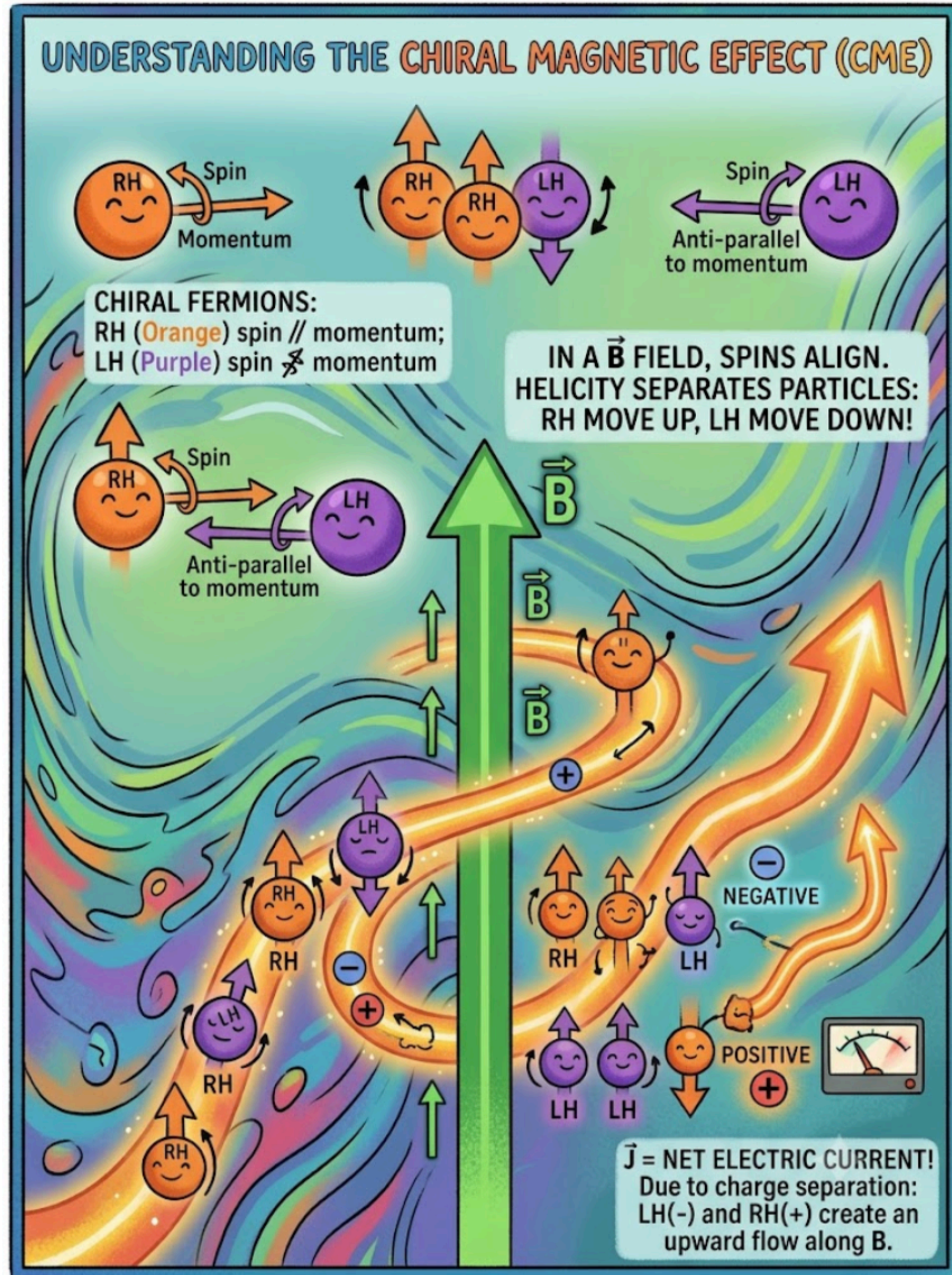
ALI-PREL-633298

ALI-PUB-520388

Charm quarks exhibit different spin alignment and polarization behaviors

ALICE Phys. Rev. Lett. **125** (2020) 012301

Test limits of CME at the LHC



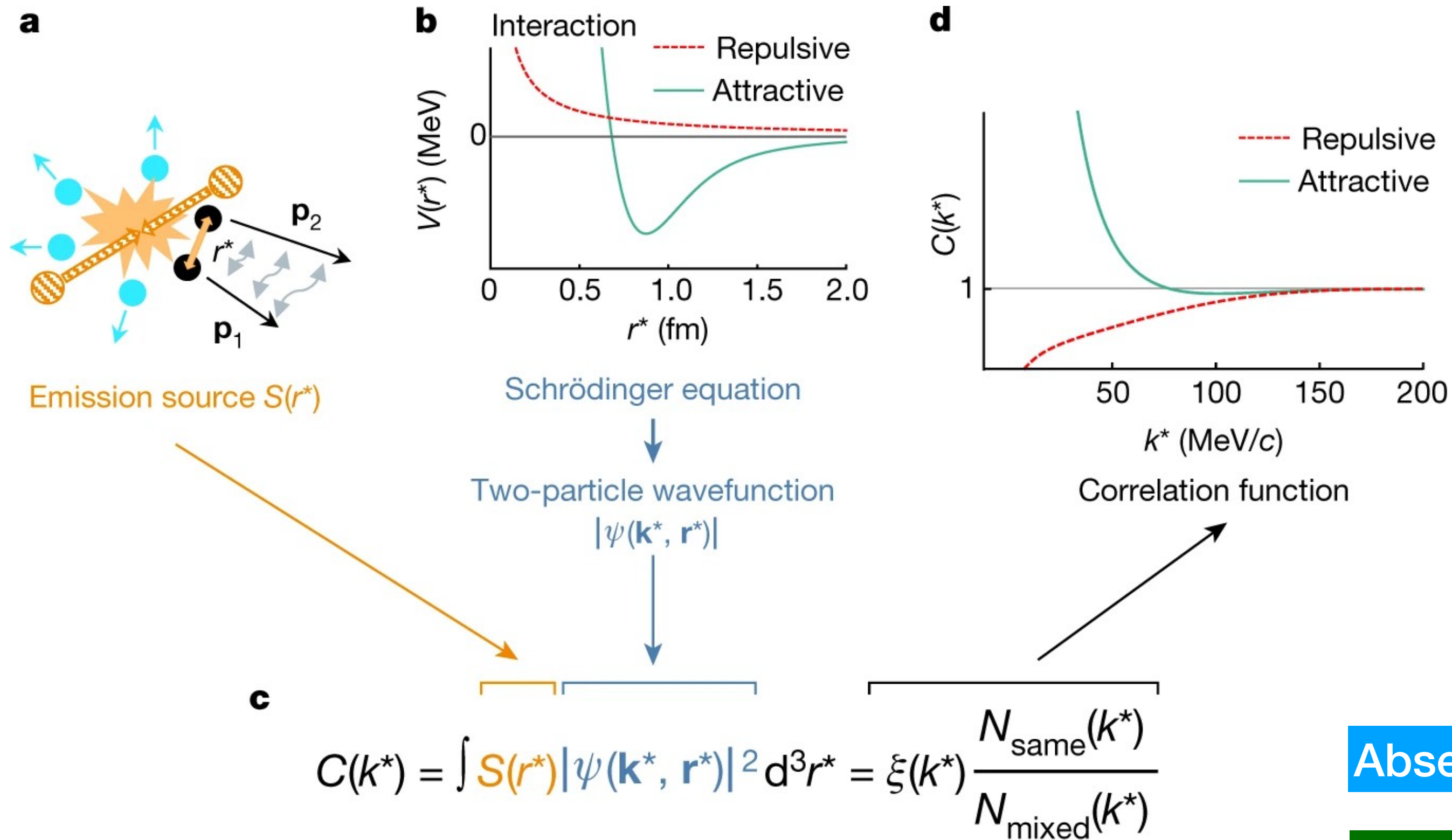
ALI-PUB-620672

ALICE Phys. Lett. B880 (2026) 140672

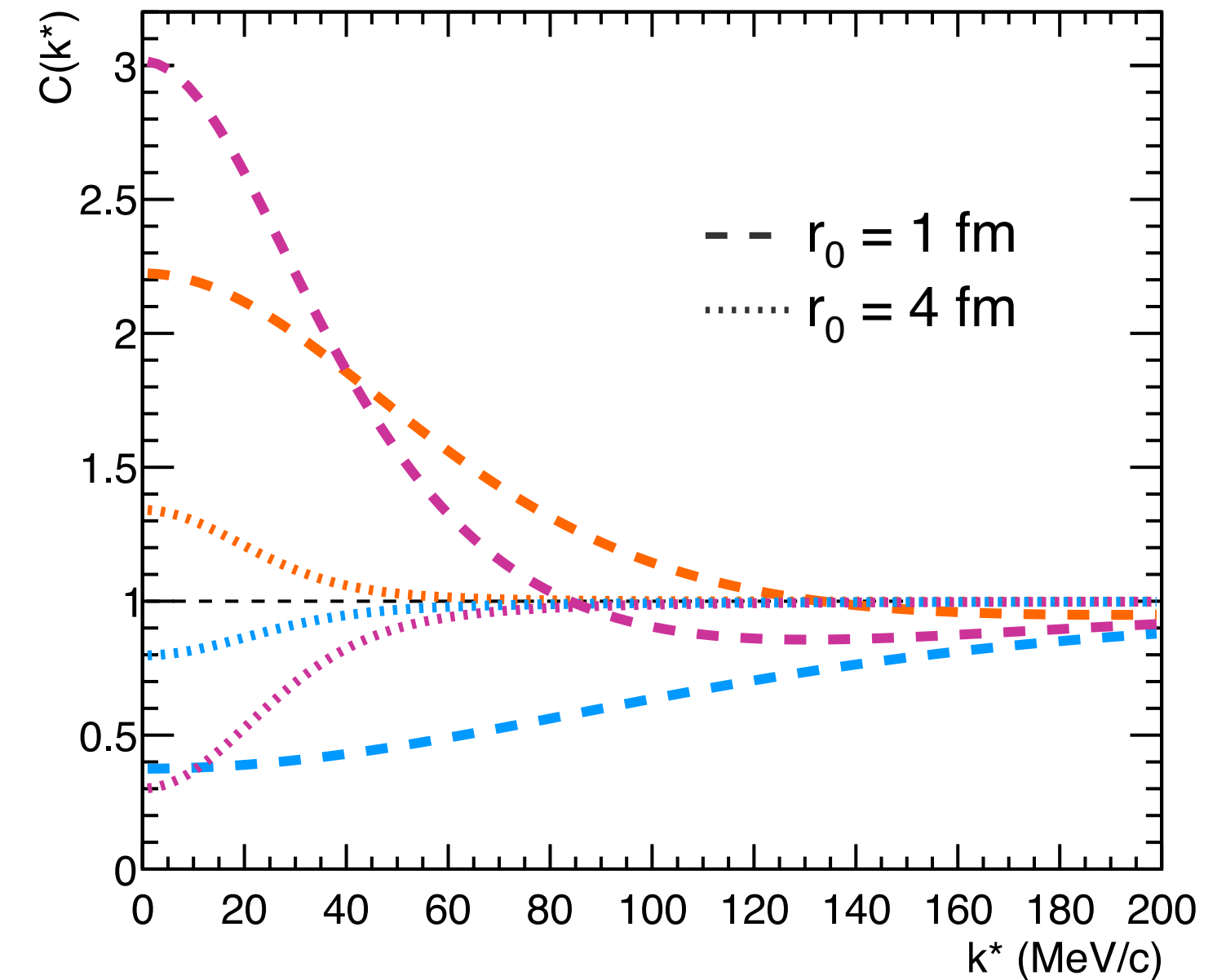
Newest constraint on CME with Event Shape Engineering (ESE) at the LHC

Two-body femtoscopy

ALICE *Nature Physics* 588 (2020) 232



Ann. Rev. Nucl. Part. Sci. 71 (2021) 377



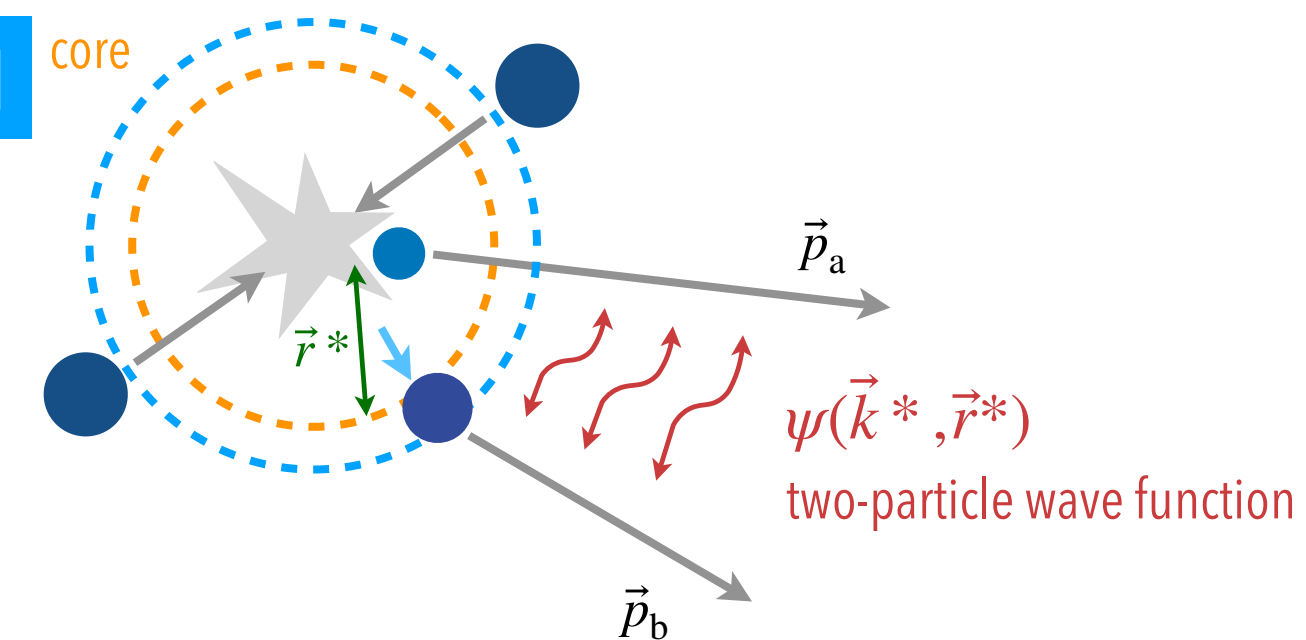
- Further constraints on the residual strong interaction between NN, YN and YY
- Important input of EoS of neutron stars

Absence interaction $C(k^*) = 1$

Attractive potential $C(k^*) > 1$

Repulsive potential $C(k^*) < 1$

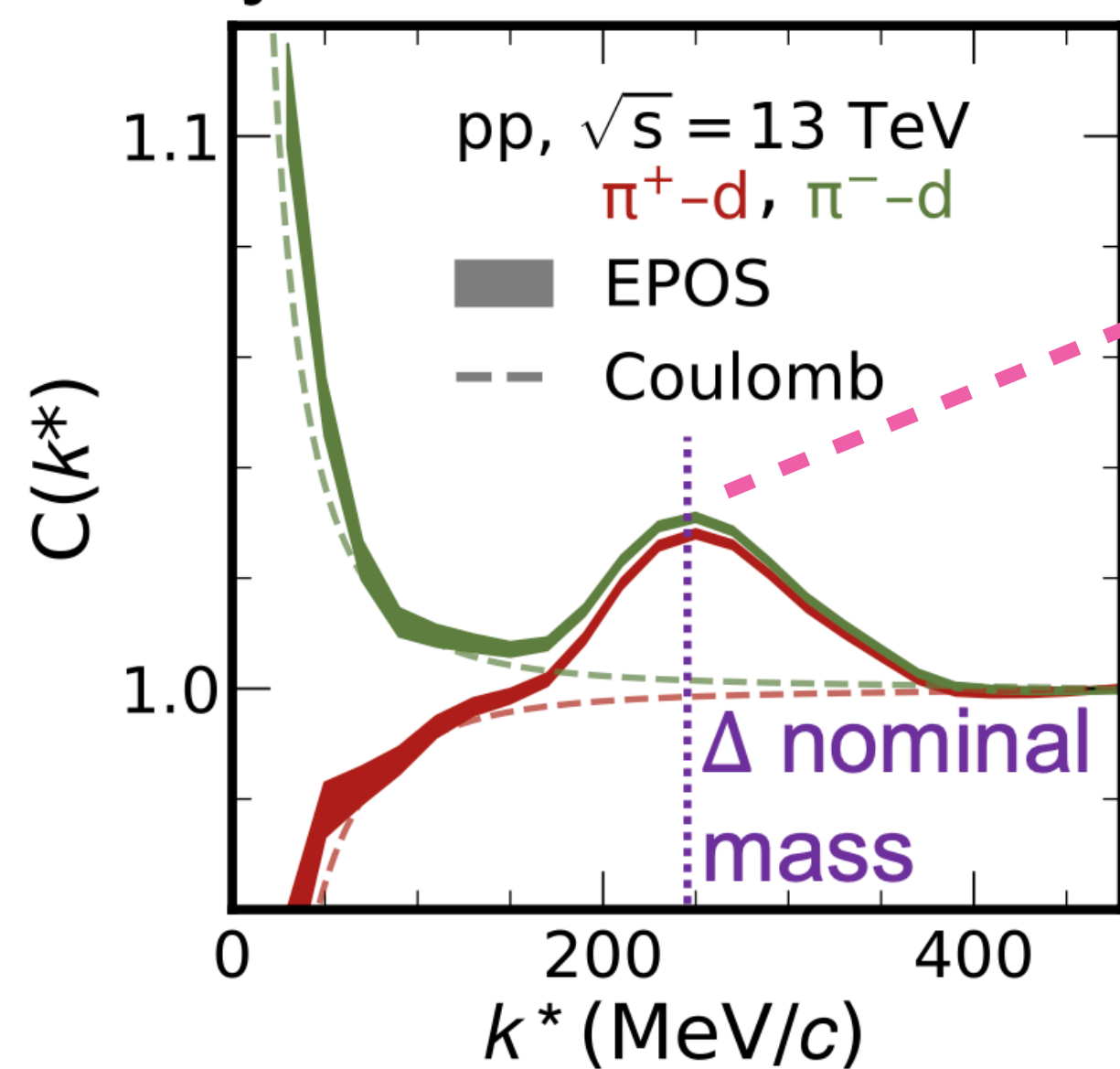
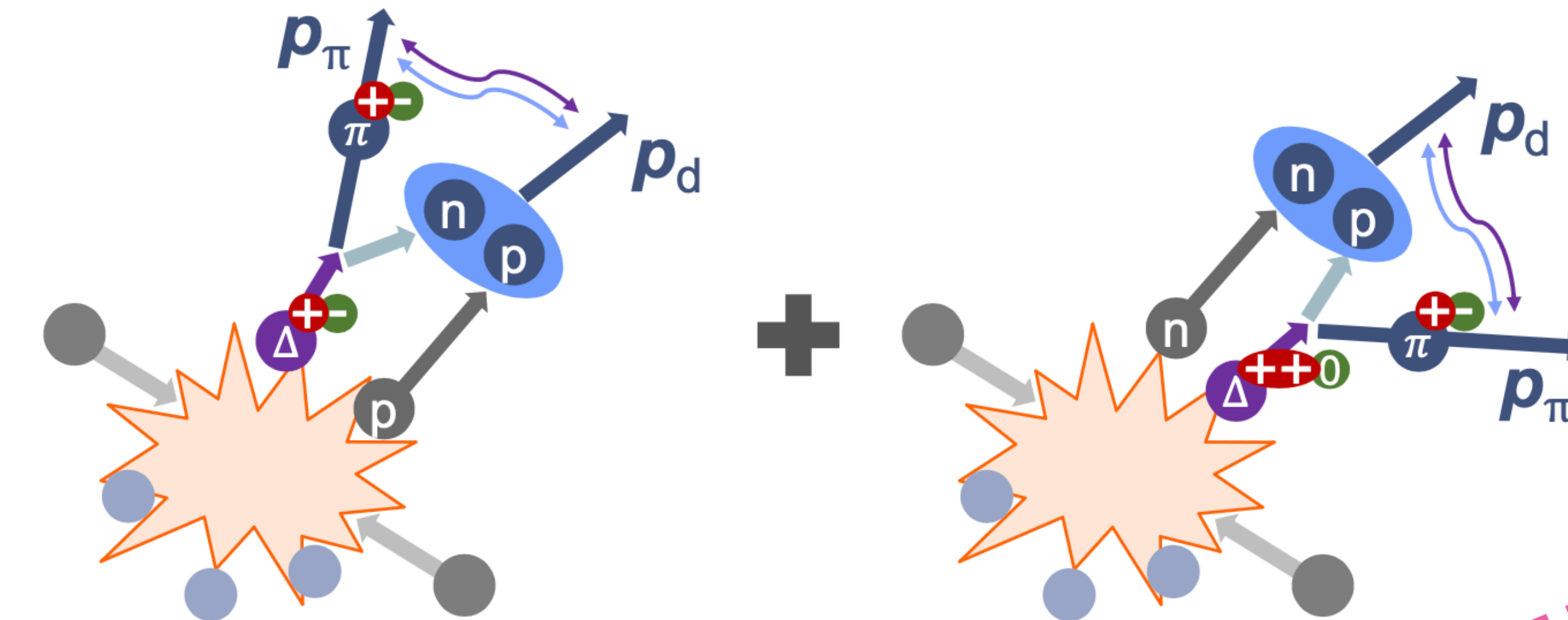
Bound-state formation $C(k^*) \gtrless 1$



π^+-d correlations

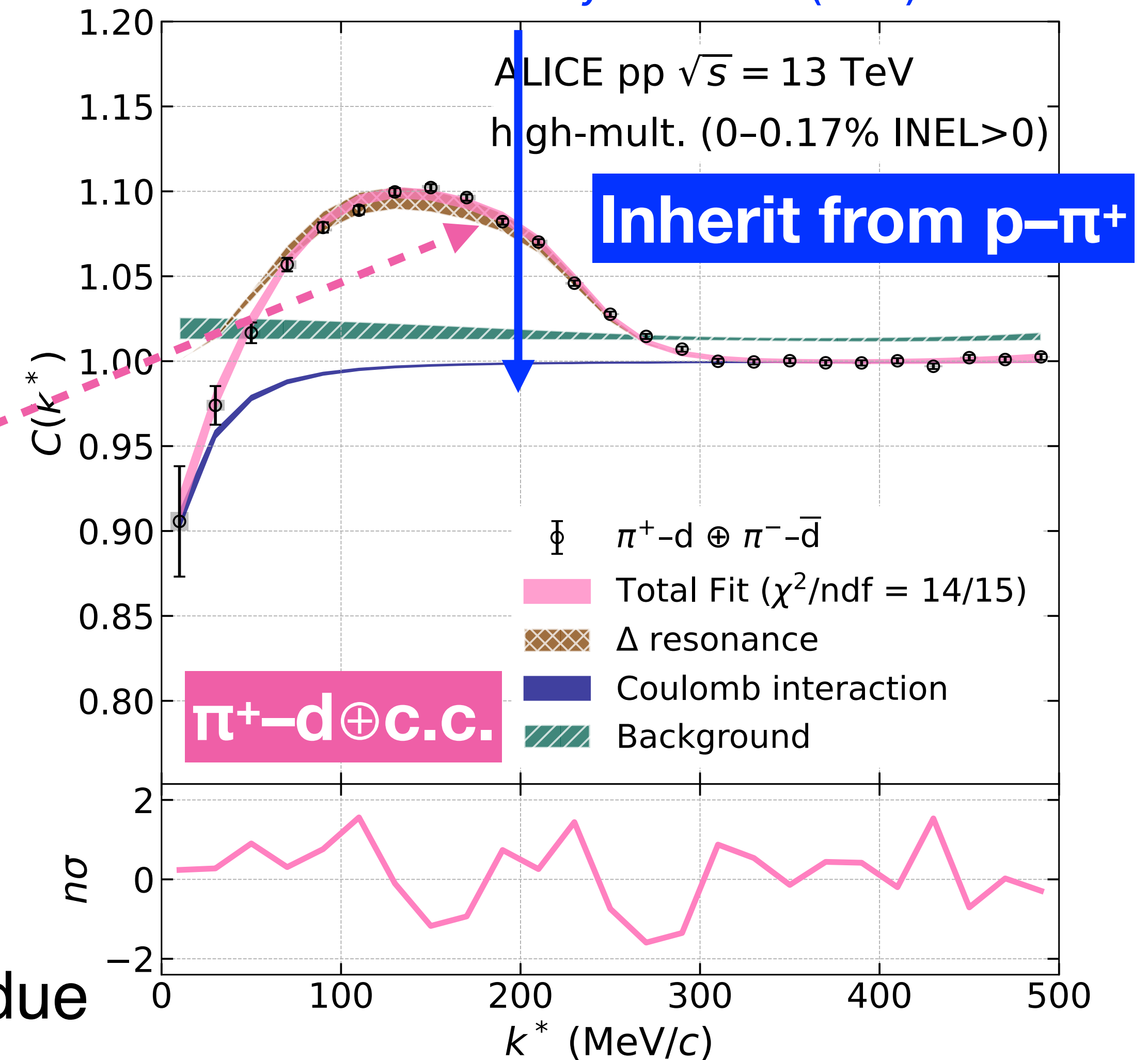
ALICE *Nature* 648 (2025) 306

ALICE *Phys. Rev. X* 14 (2024) 031051



Inelastic interactions

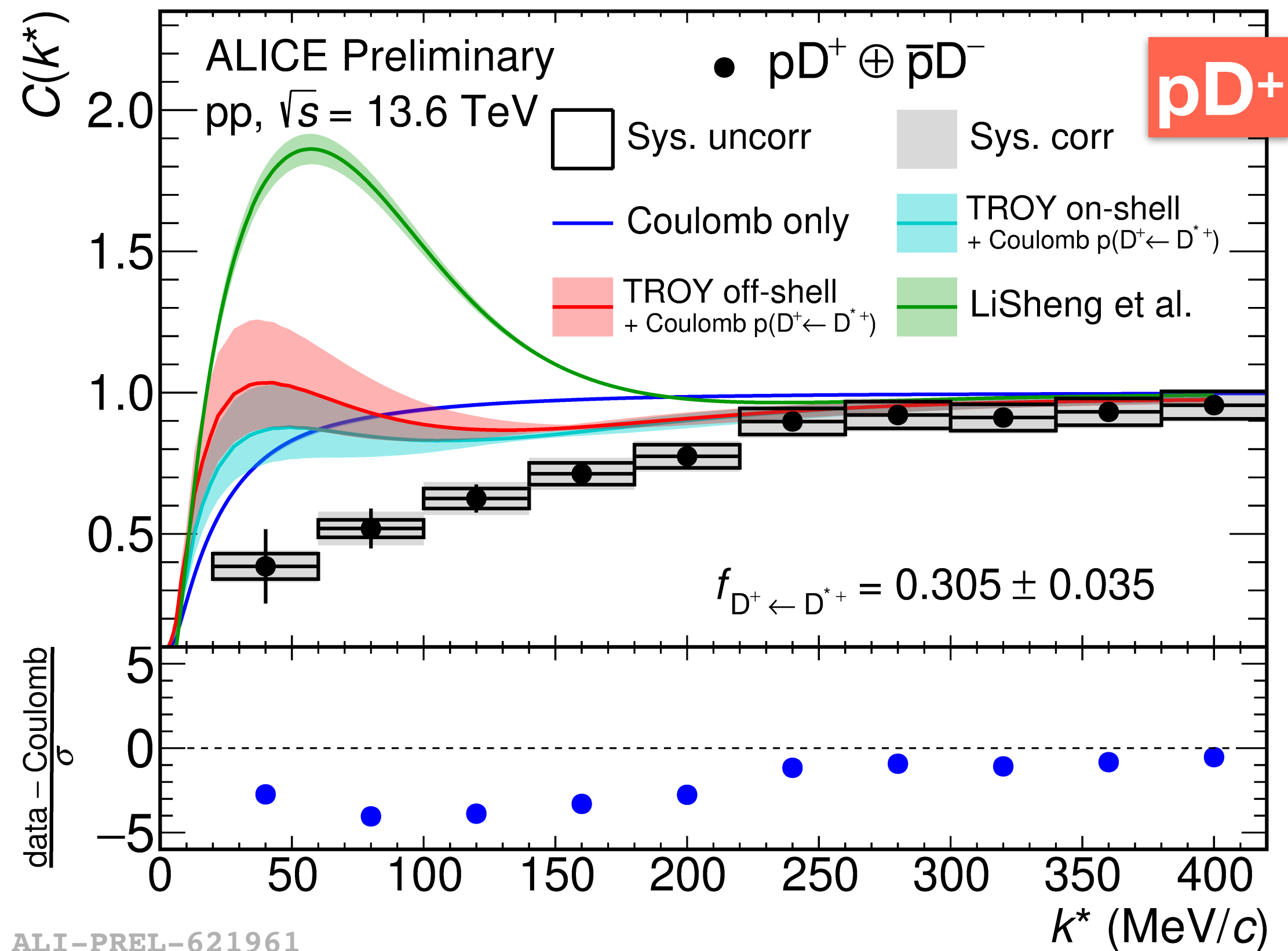
➔ Correlated nucleon in deuterons and pions due to the common Δ mother



New p-D correlations in Run 3



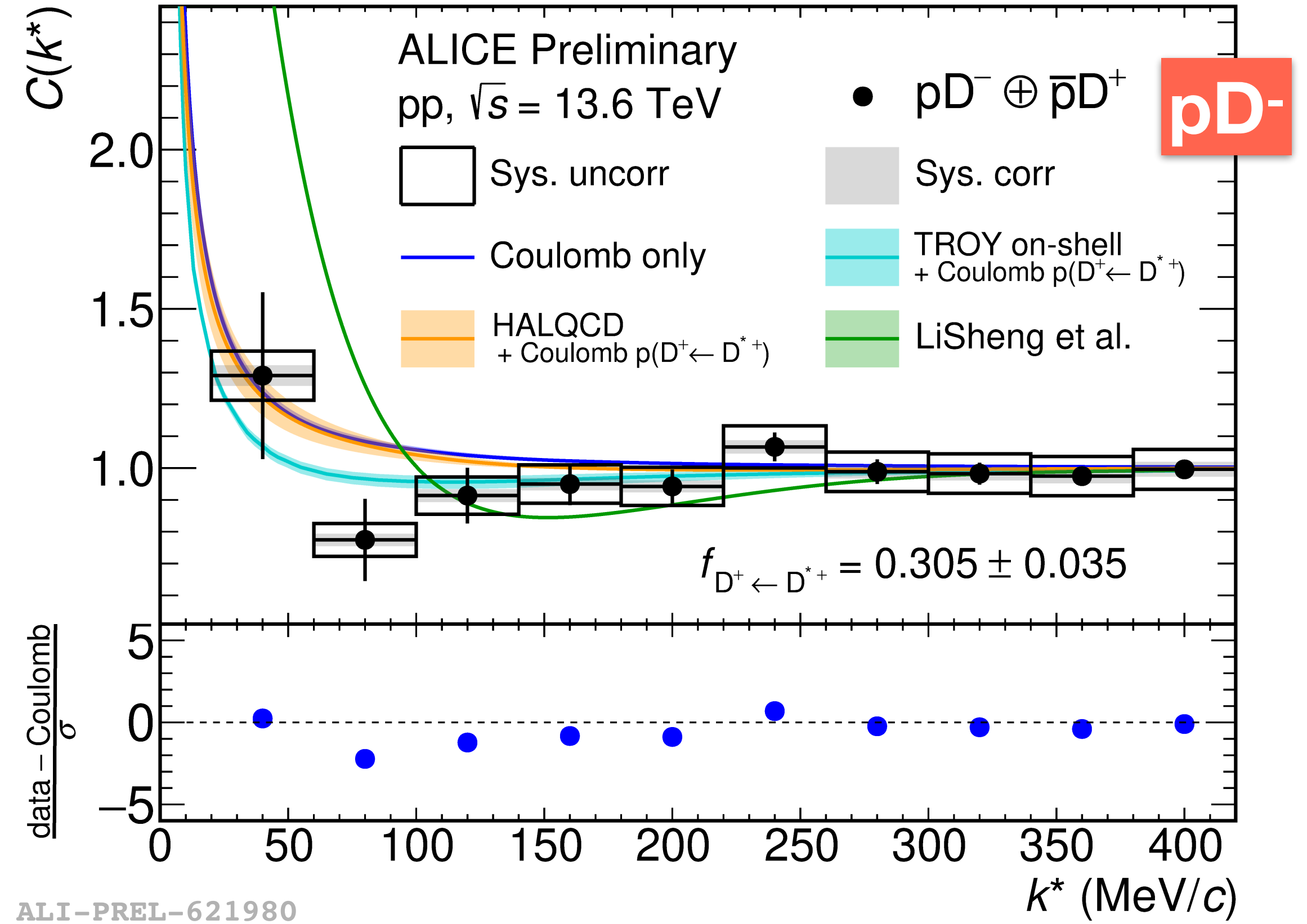
See also ALICE *Phys. Rev. D* **110** (2024) 032004
Phys. Rev. D **106** (2022) 052010



pD⁺ Clear deviation from Coulomb-only model

➔ Models include bound state $\Sigma_c^{++}(2800)$

➔ Disfavored by data



pD⁻ Compatible with Coulomb-only interaction or shallow repulsive strong interactions

ALICE in LHC Run 4



2010-2013

2015-2018

2022-2026

2030-2033

Run 1

LS1

Run 2

LS2

Run 3

LS3

Run 4

ALICE 1

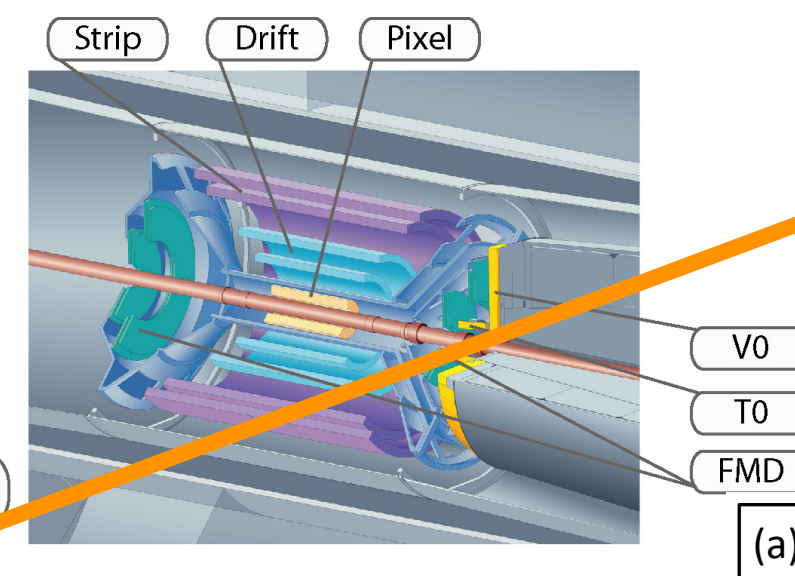
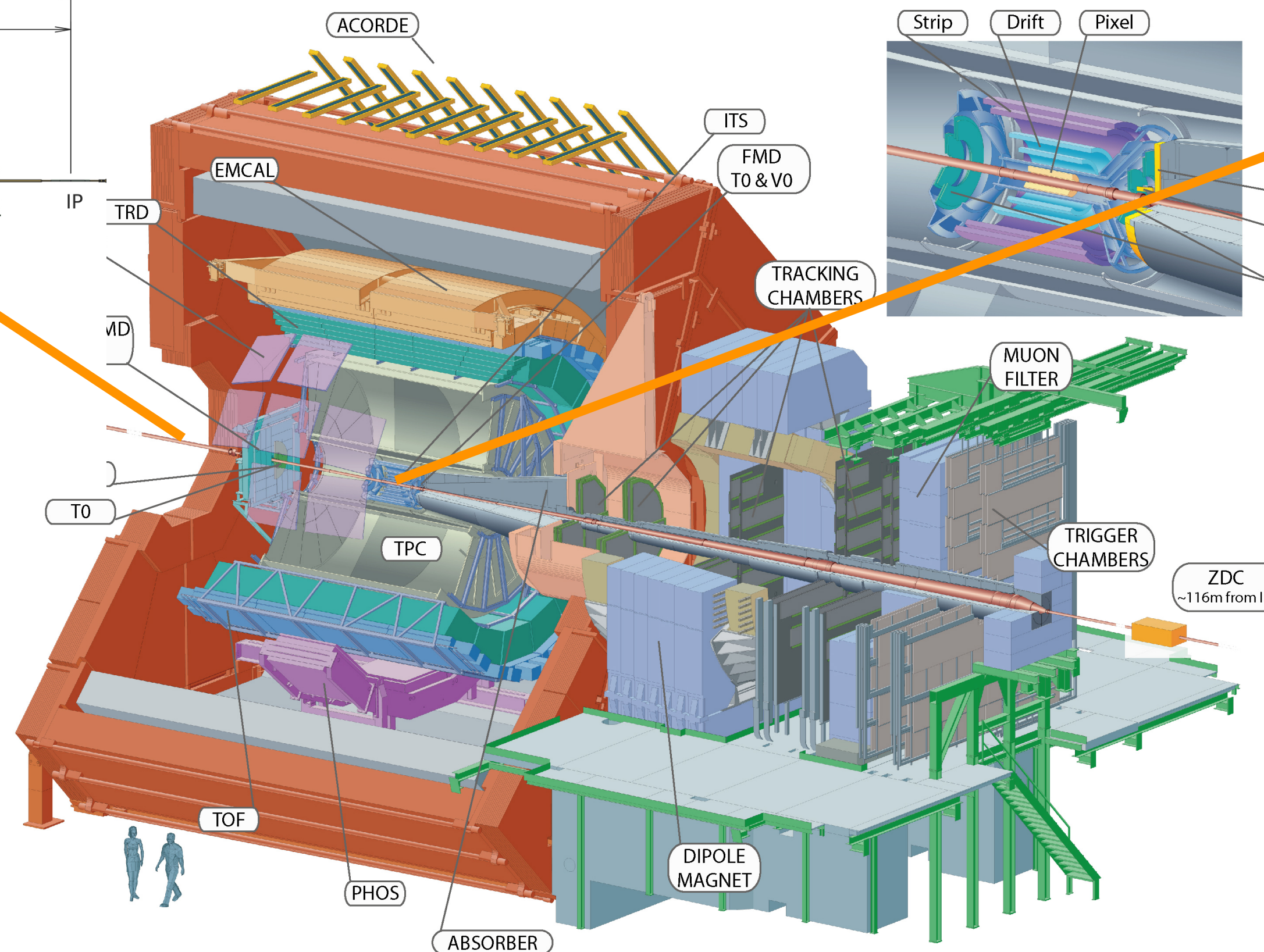
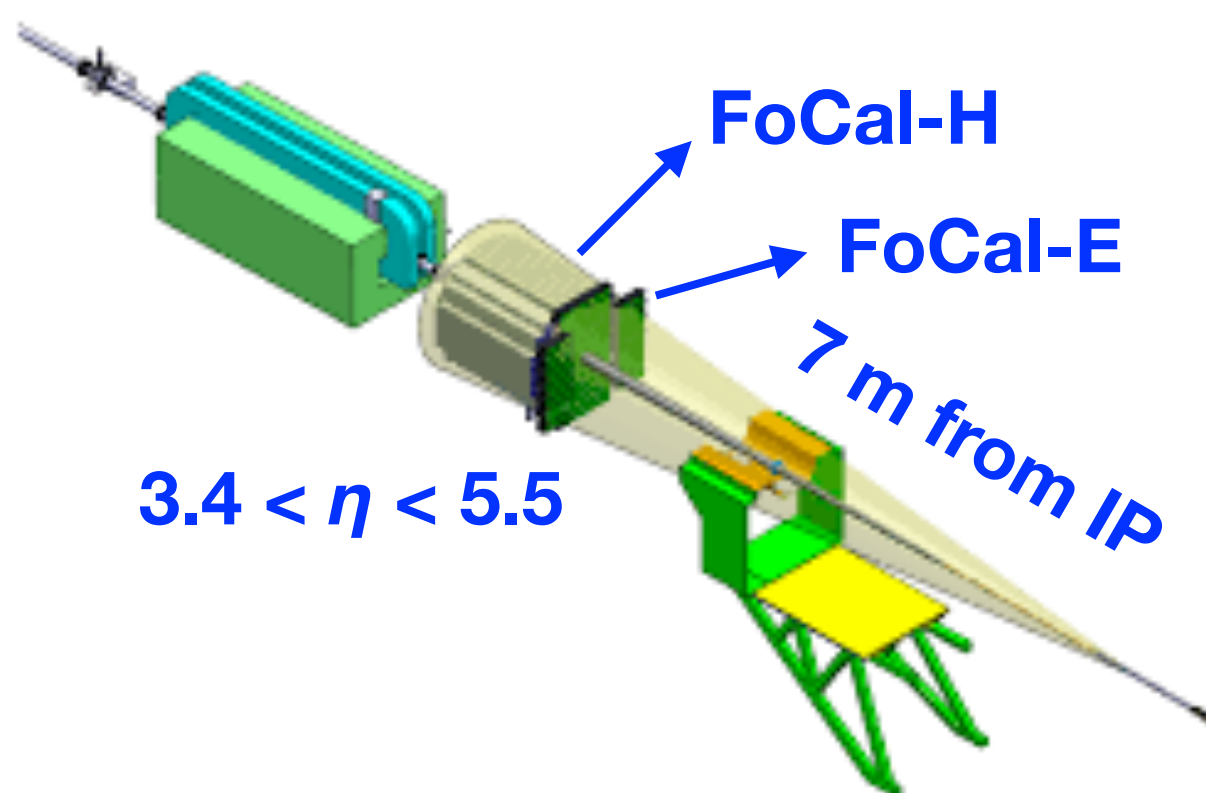
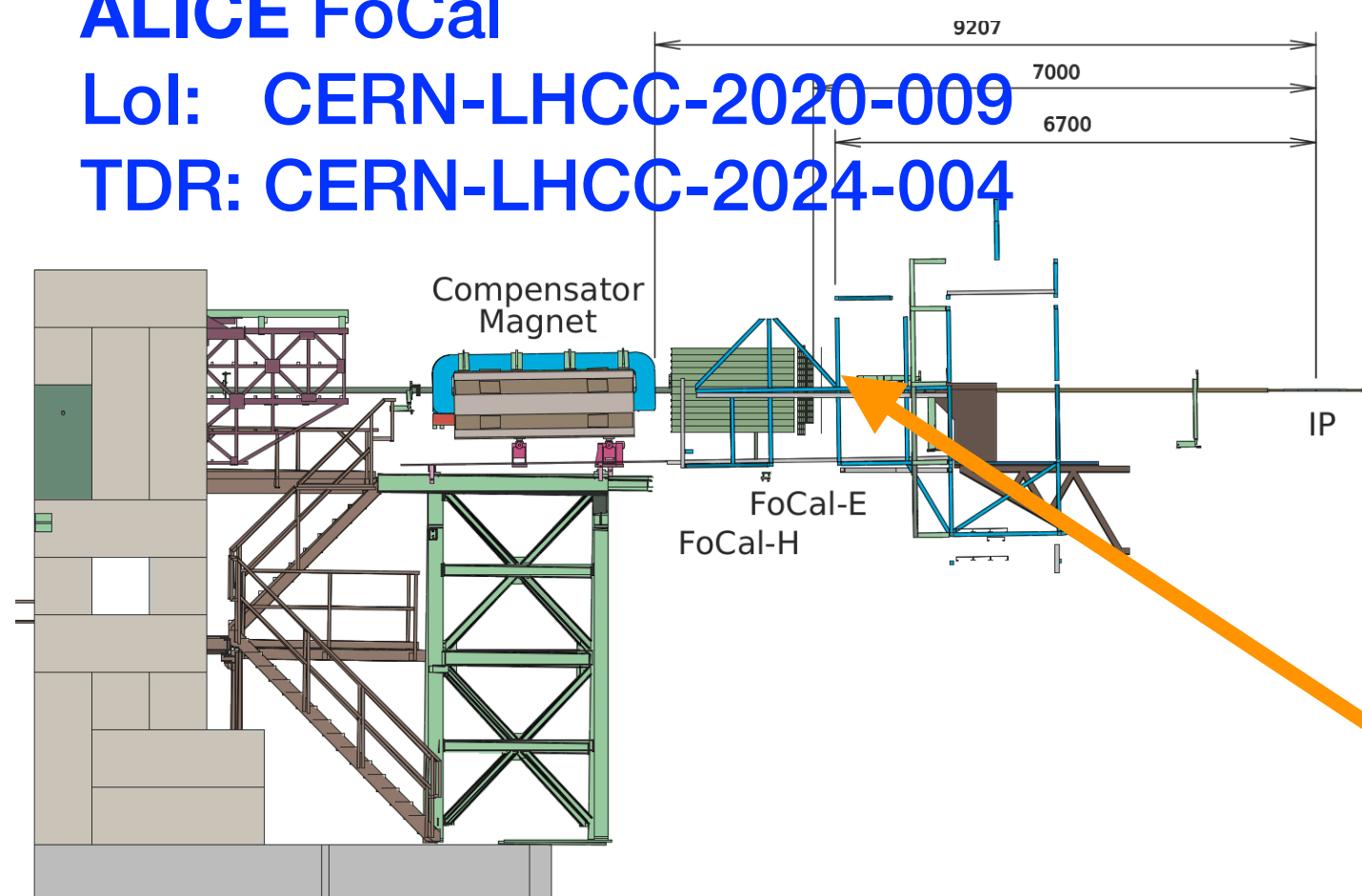
ALICE 2

ALICE 2.1

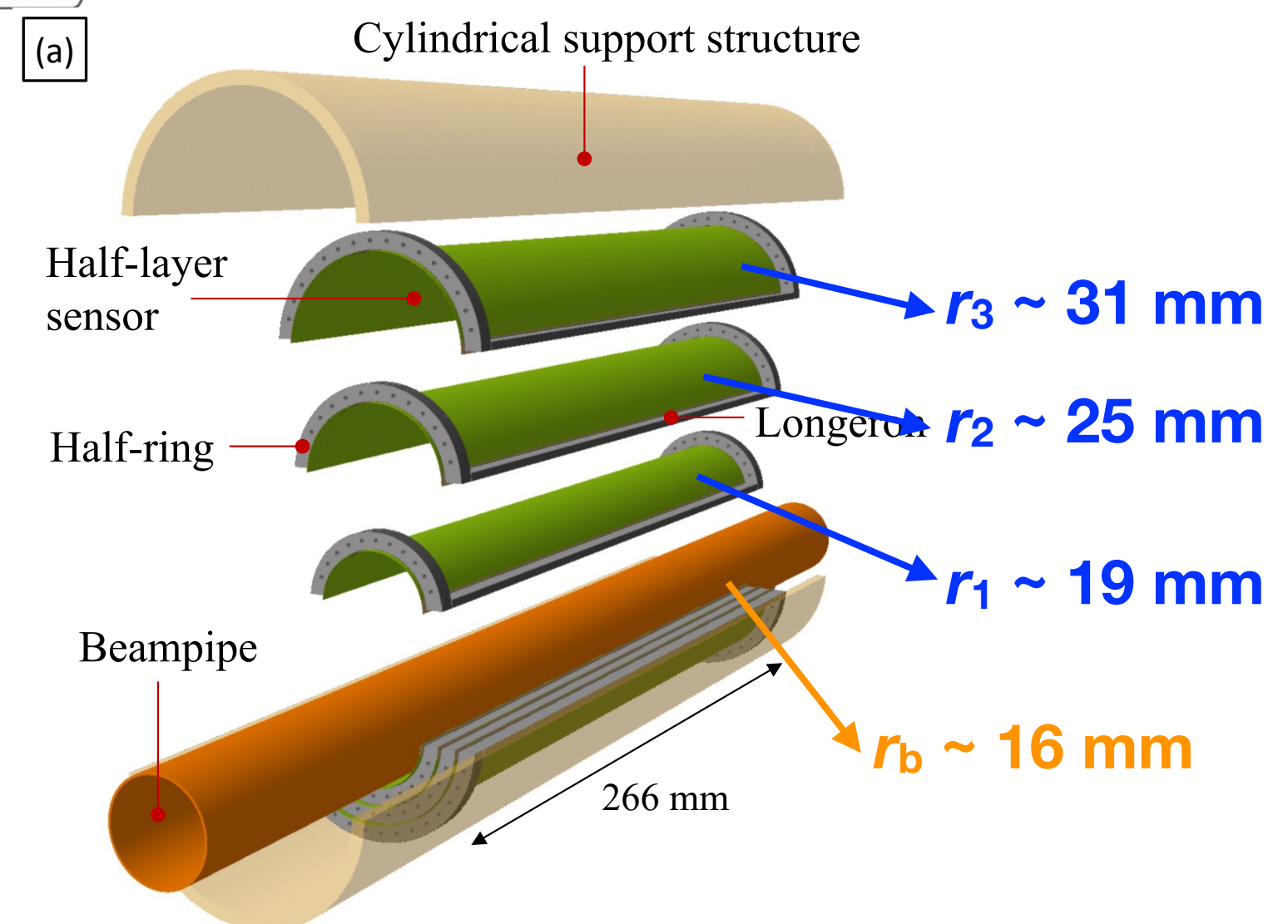
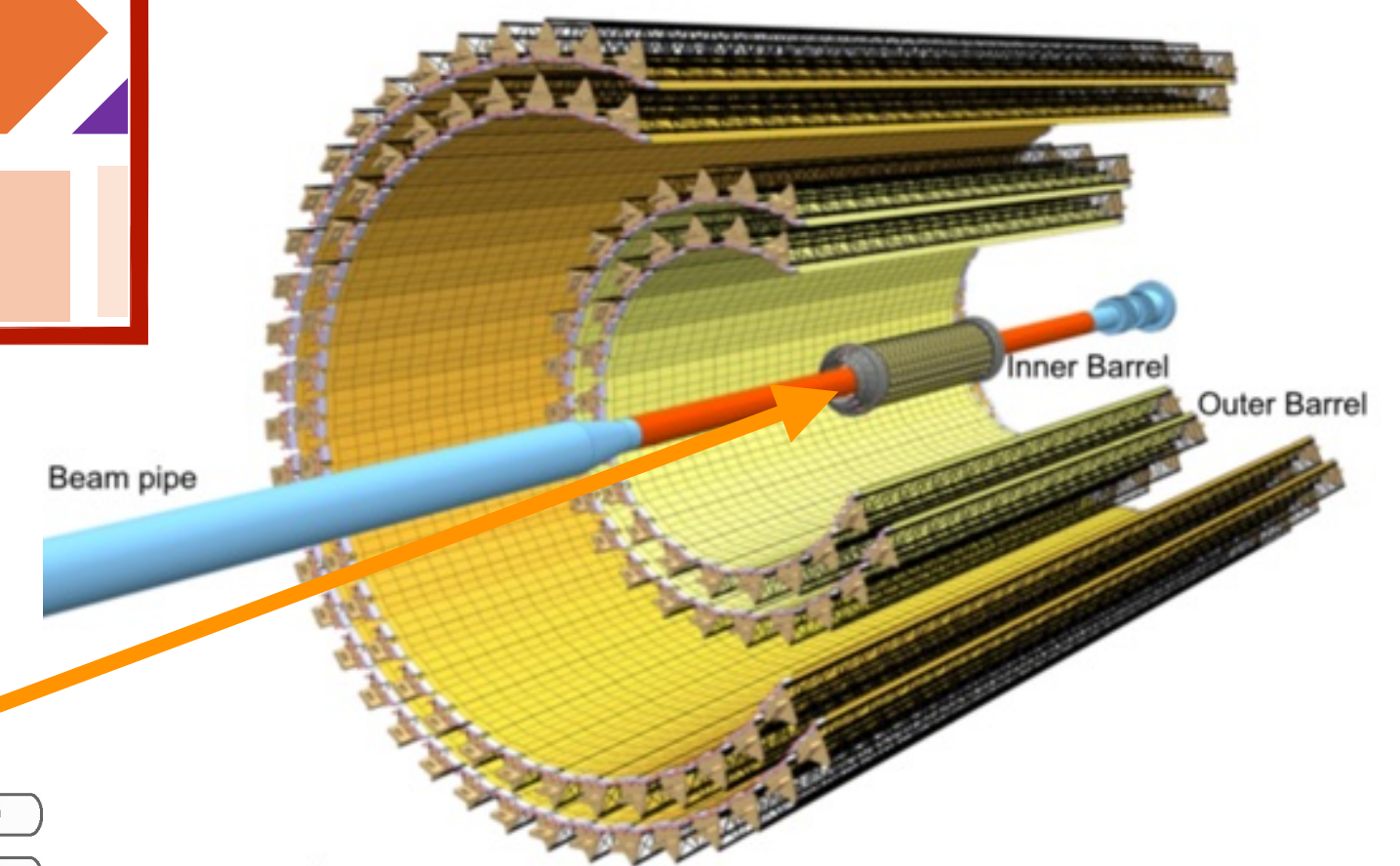
ALICE FoCal

LoI: CERN-LHCC-2020-009

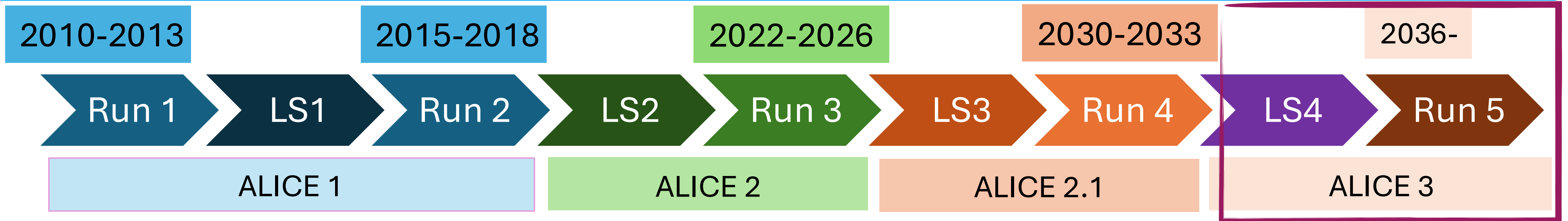
TDR: CERN-LHCC-2024-004



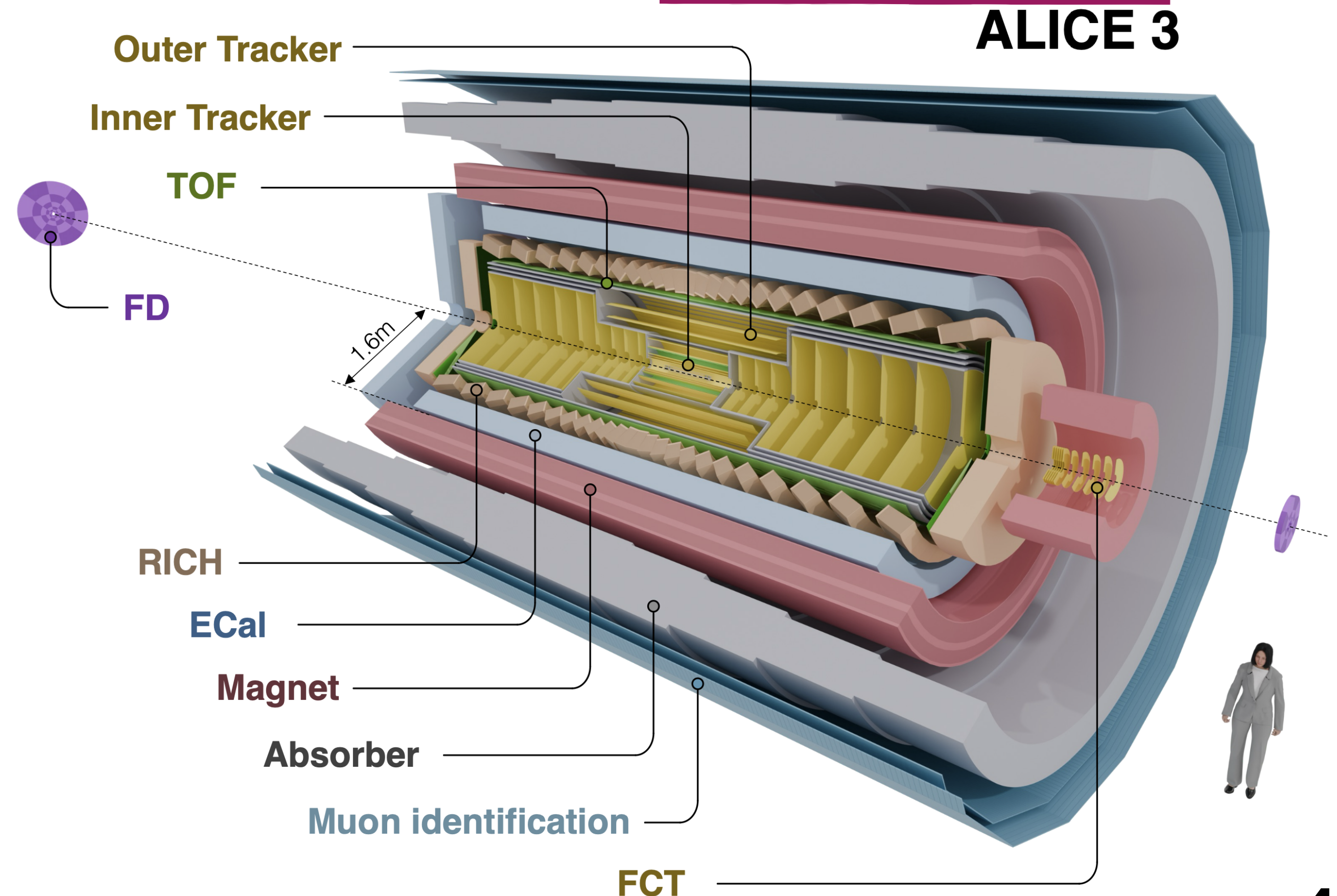
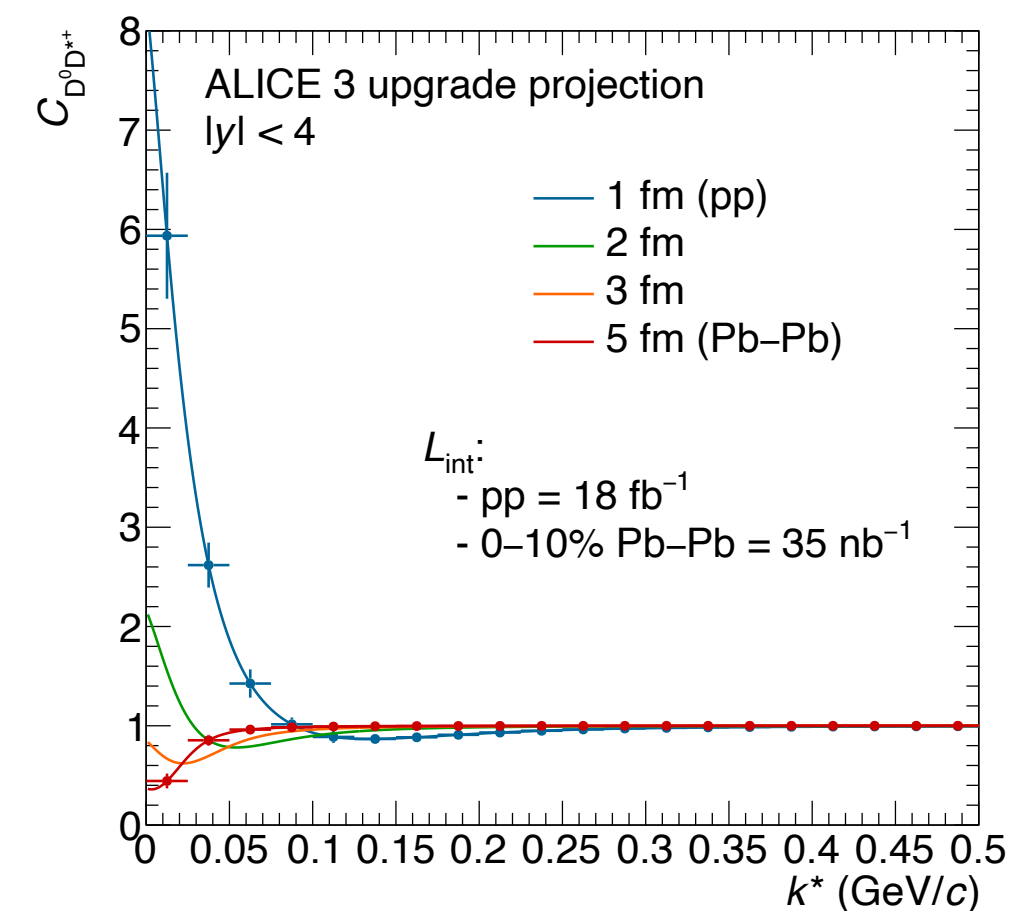
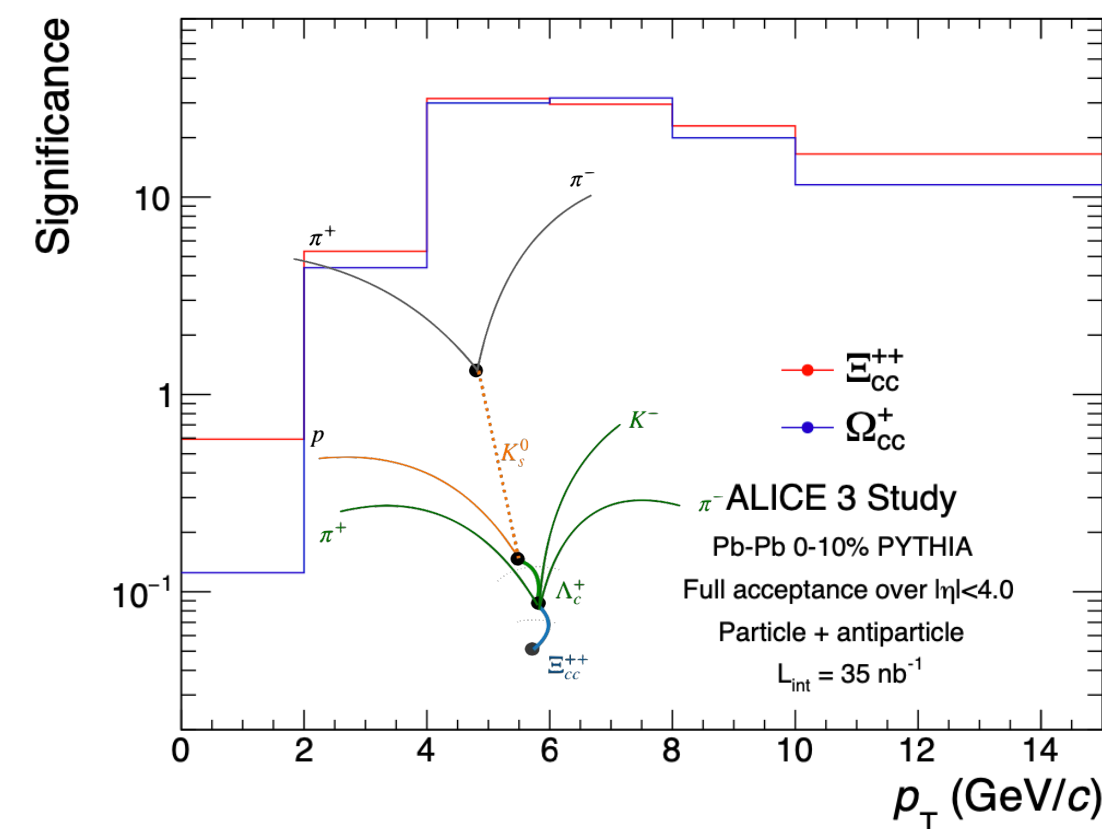
ALICE ITS3 TDR
CERN-LHCC-2024-003



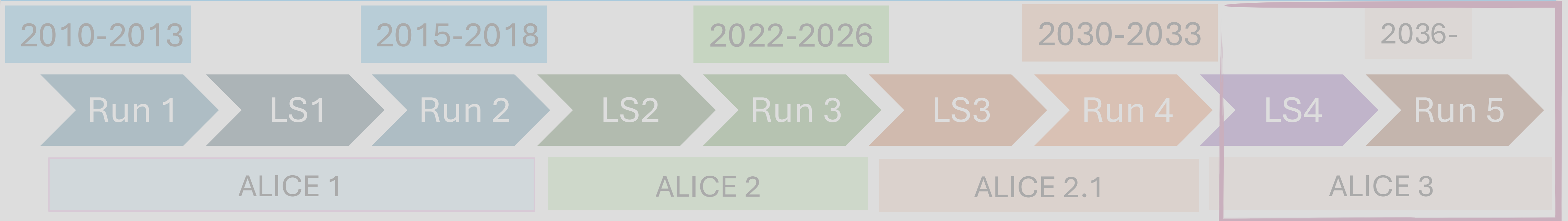
ALICE3 upgrade project



ALICE3 Lol:
CERN-LHCC-2022-009
Scoping document:
CERN-LHCC-2025-002

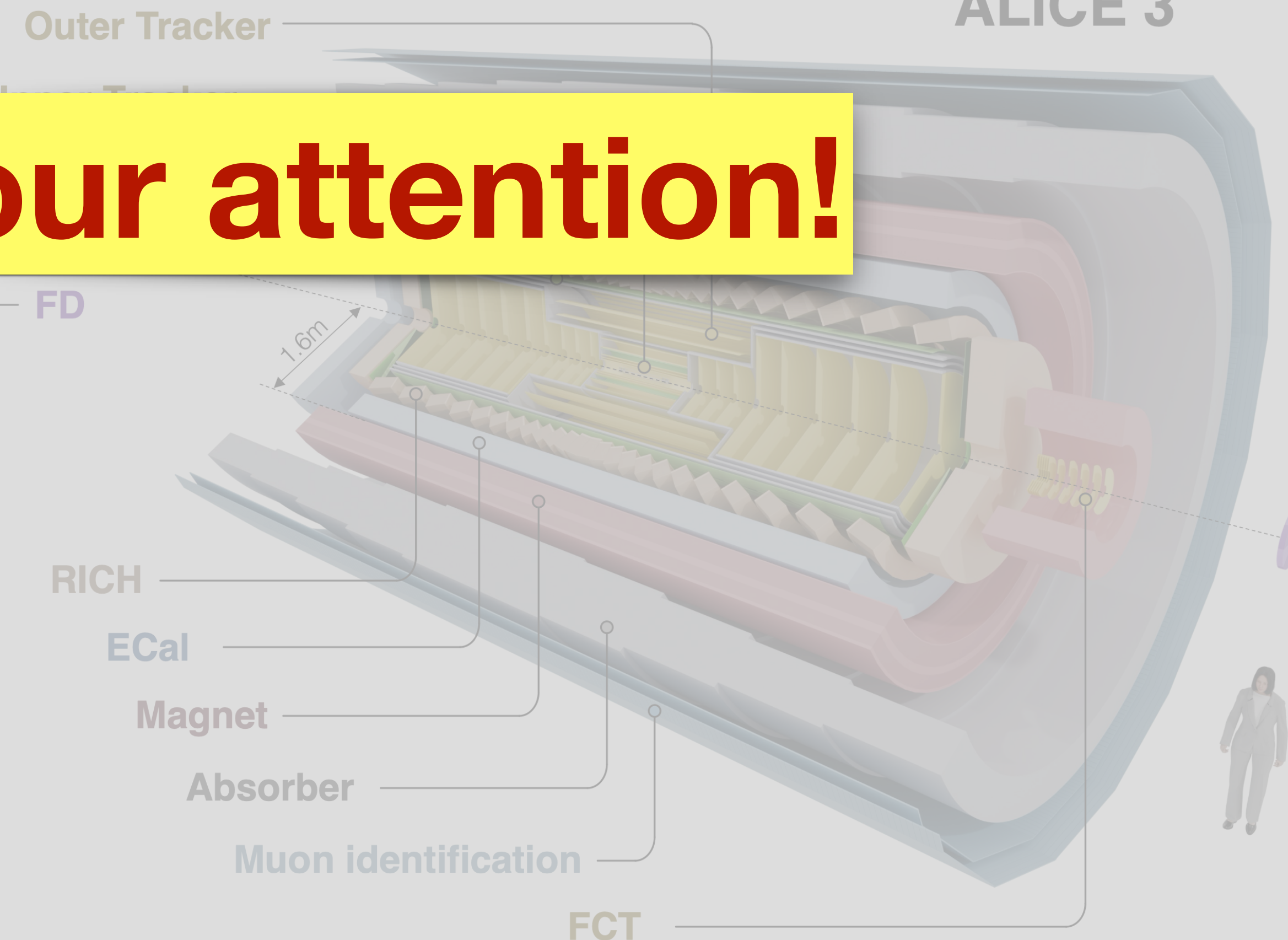
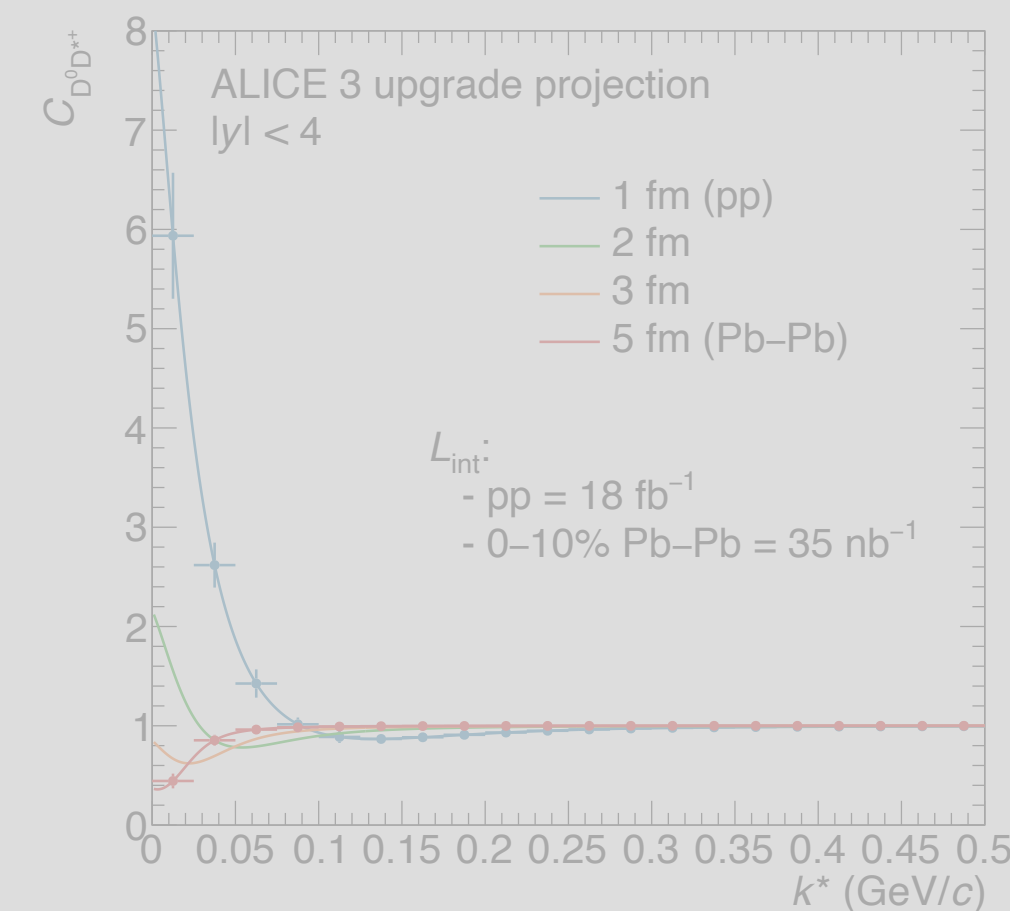
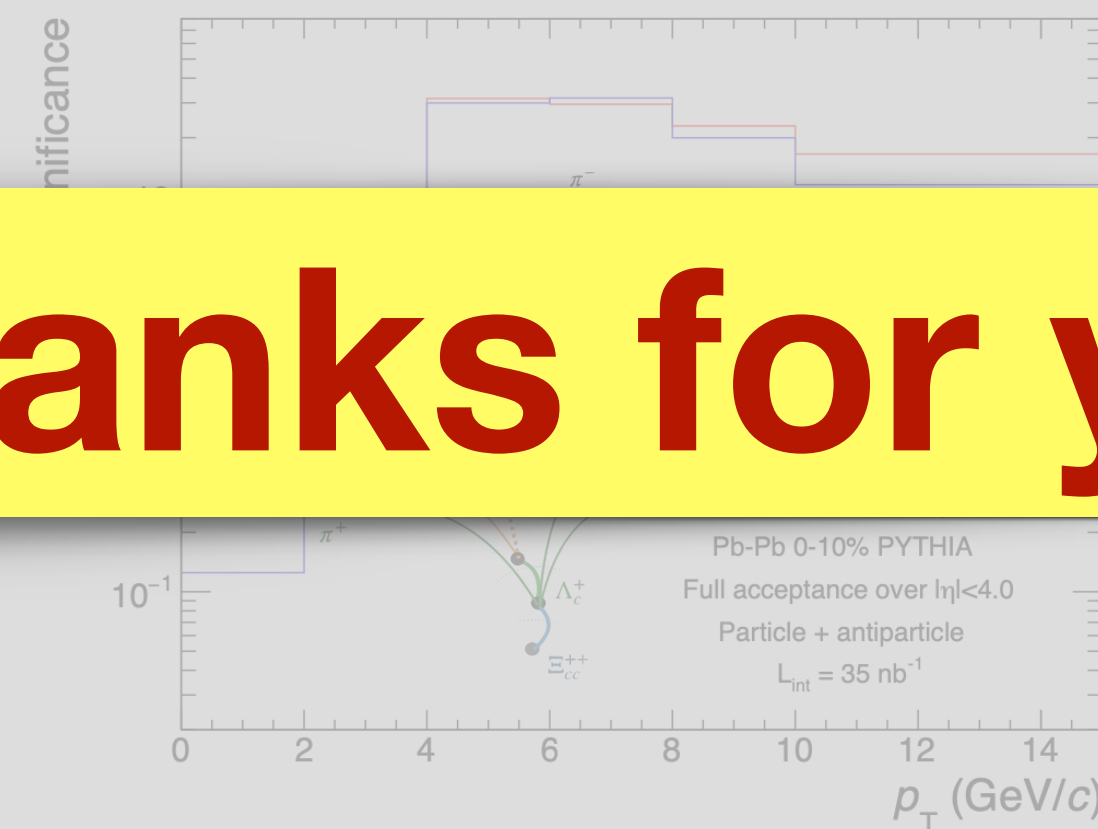


ALICE3 upgrade project



ALICE3 Lol:
CERN-LHCC-2022-009
Scoping document:
CERN-LHCC-2025-002

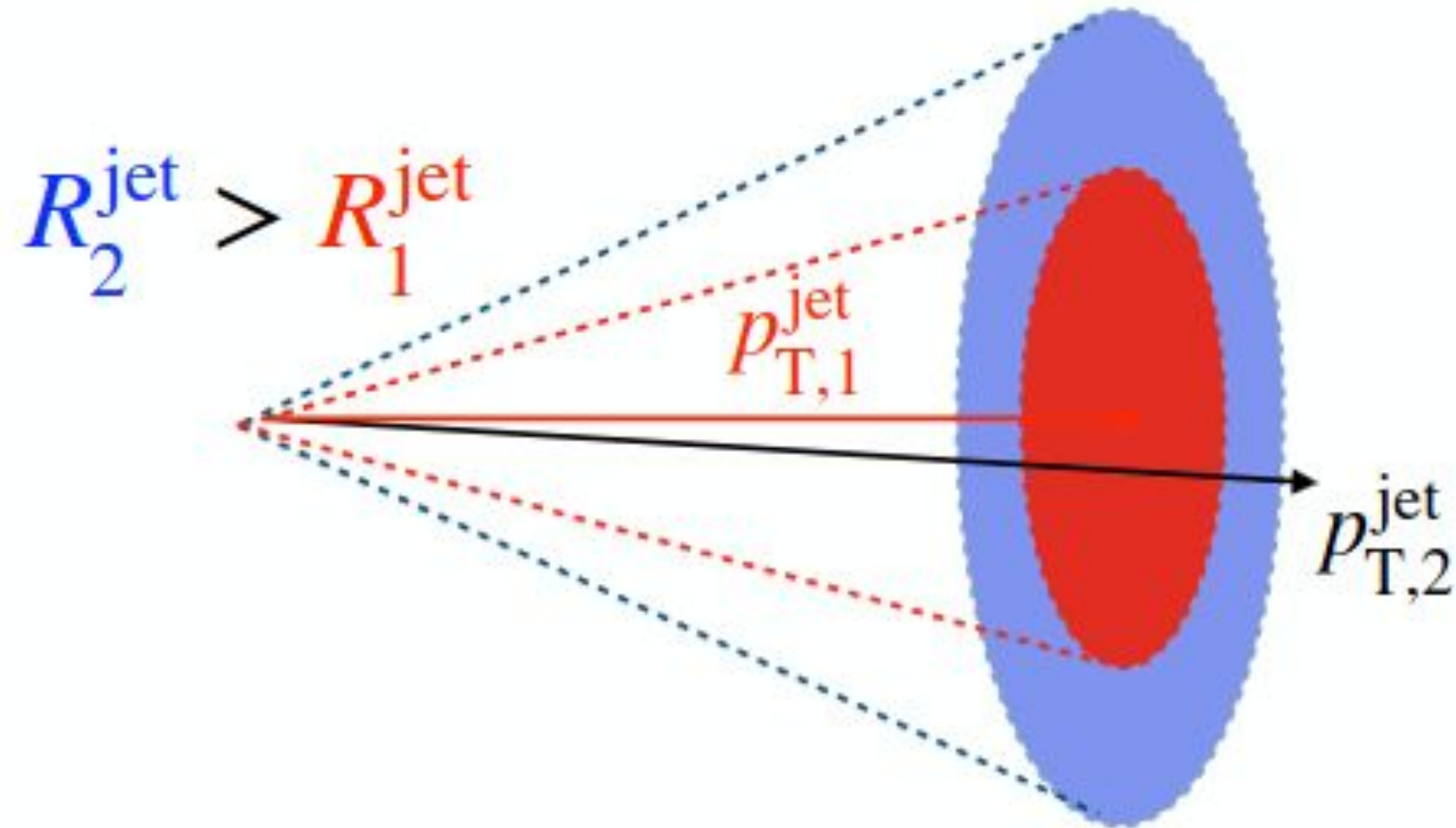
Thanks for your attention!



Backup



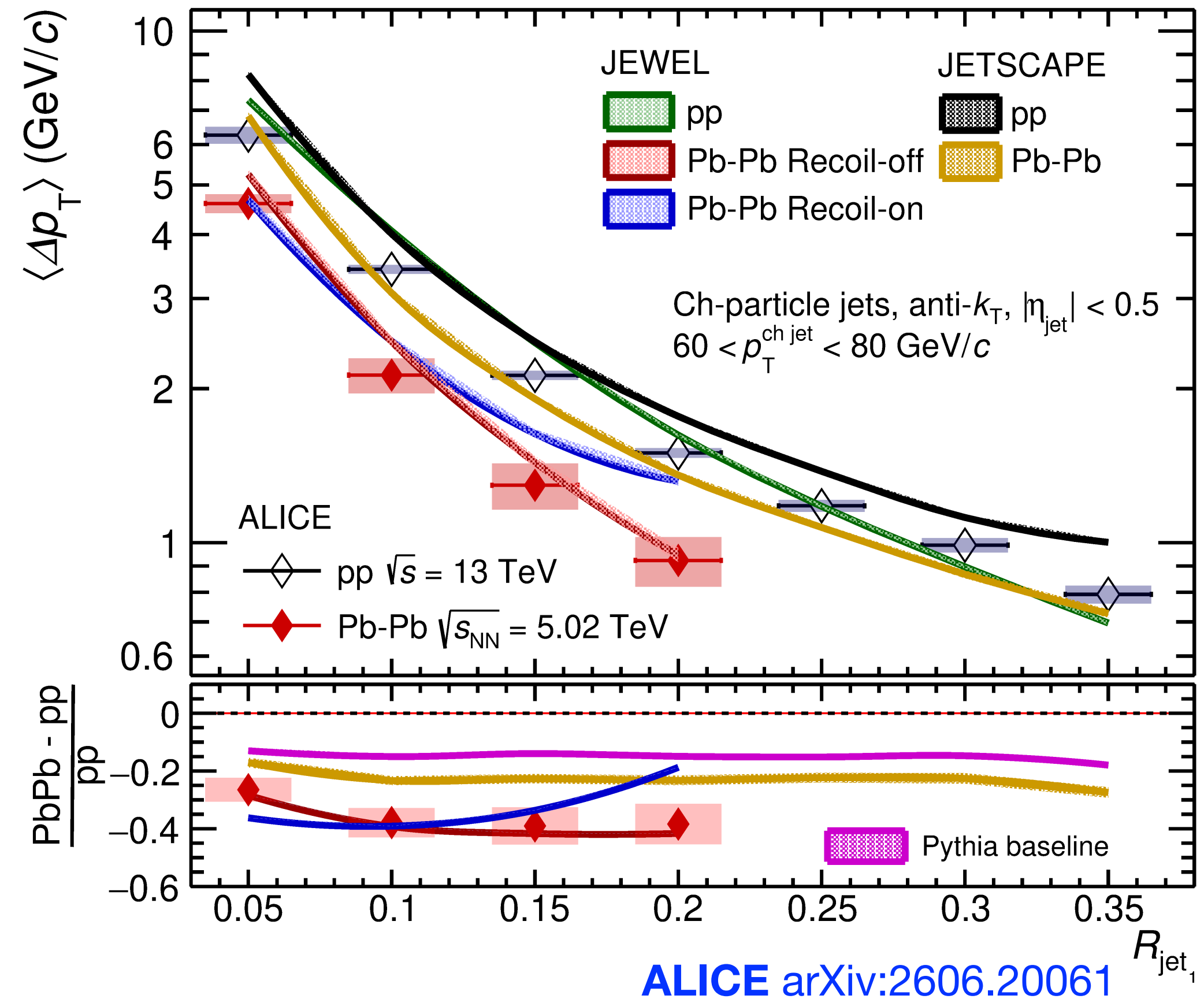
Jet energy redistribution



Proxy for the jet energy in $R_2 - R_1$:

$$\Delta p_T = p_{T,2}^{\text{jet}} - p_{T,1}^{\text{jet}}$$

- Jets are highly collimated at the LHC
- **Pb-Pb** jets contain less energy in ΔR than pp
 - ➔ Out-of-cone redistribution of particles
 - ➔ Narrowing of surviving jet cores



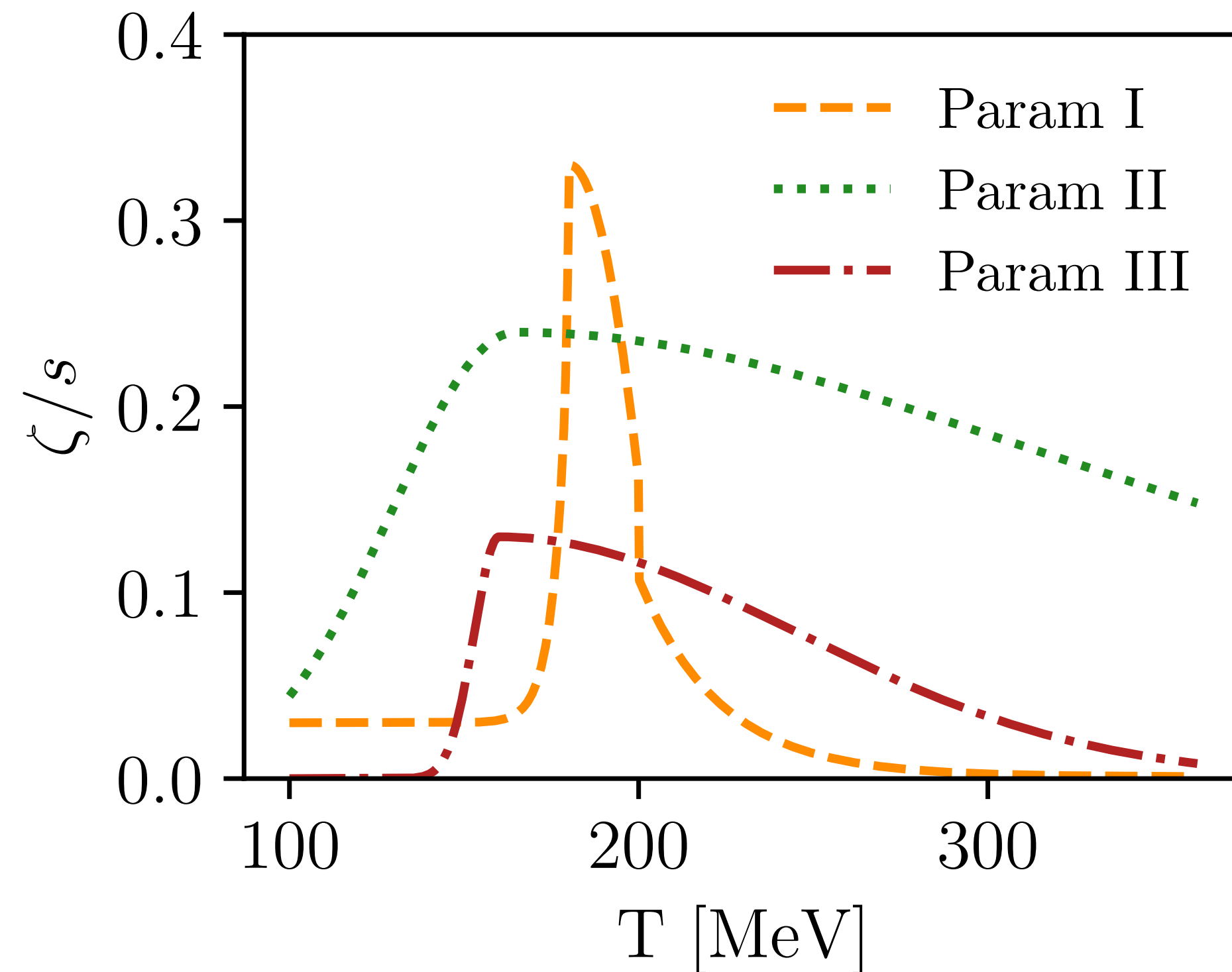
ALI-PUB-638251



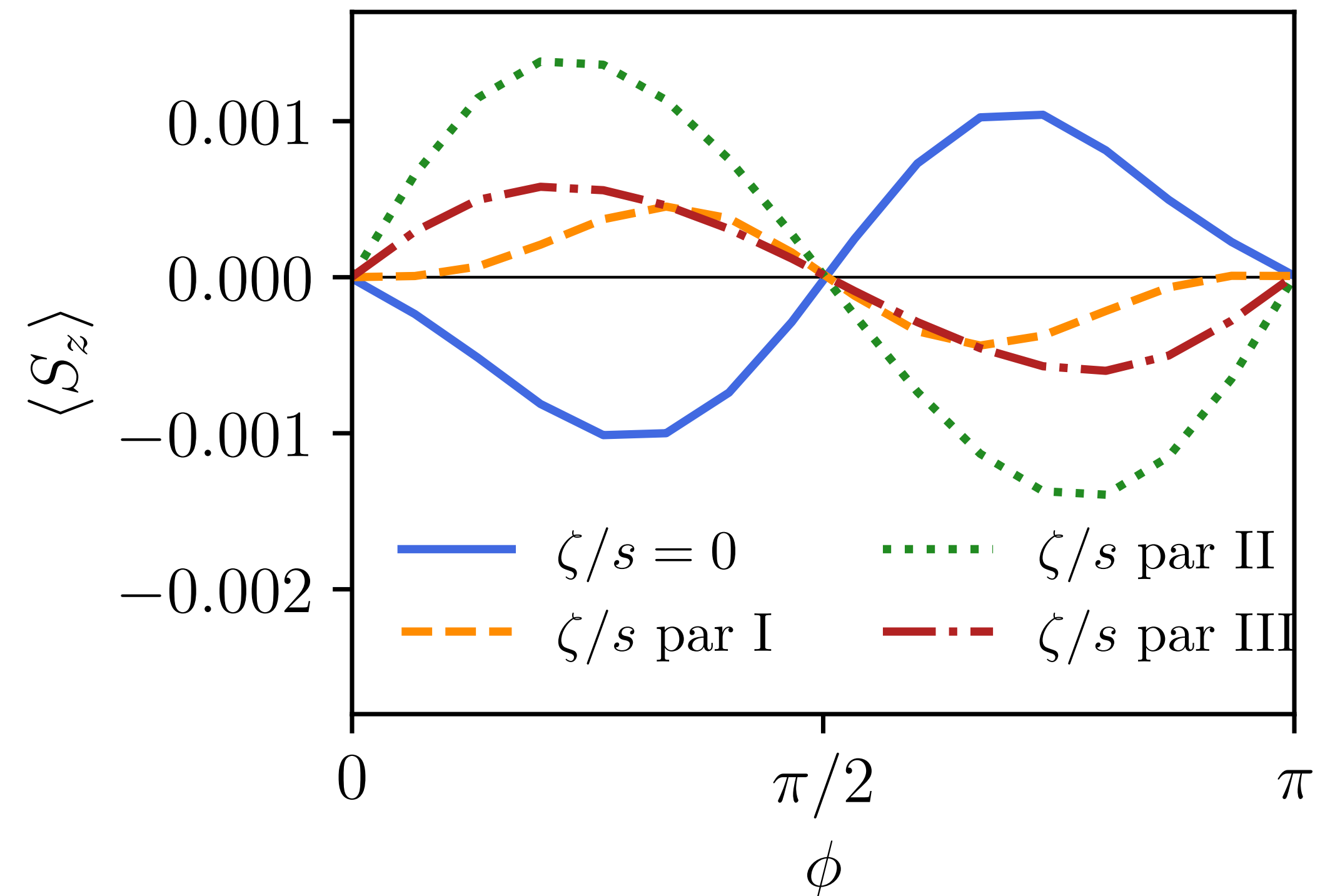
QGP property with local polarization



Bulk Viscosity Parametrizations



LHC PbPb 5020 GeV



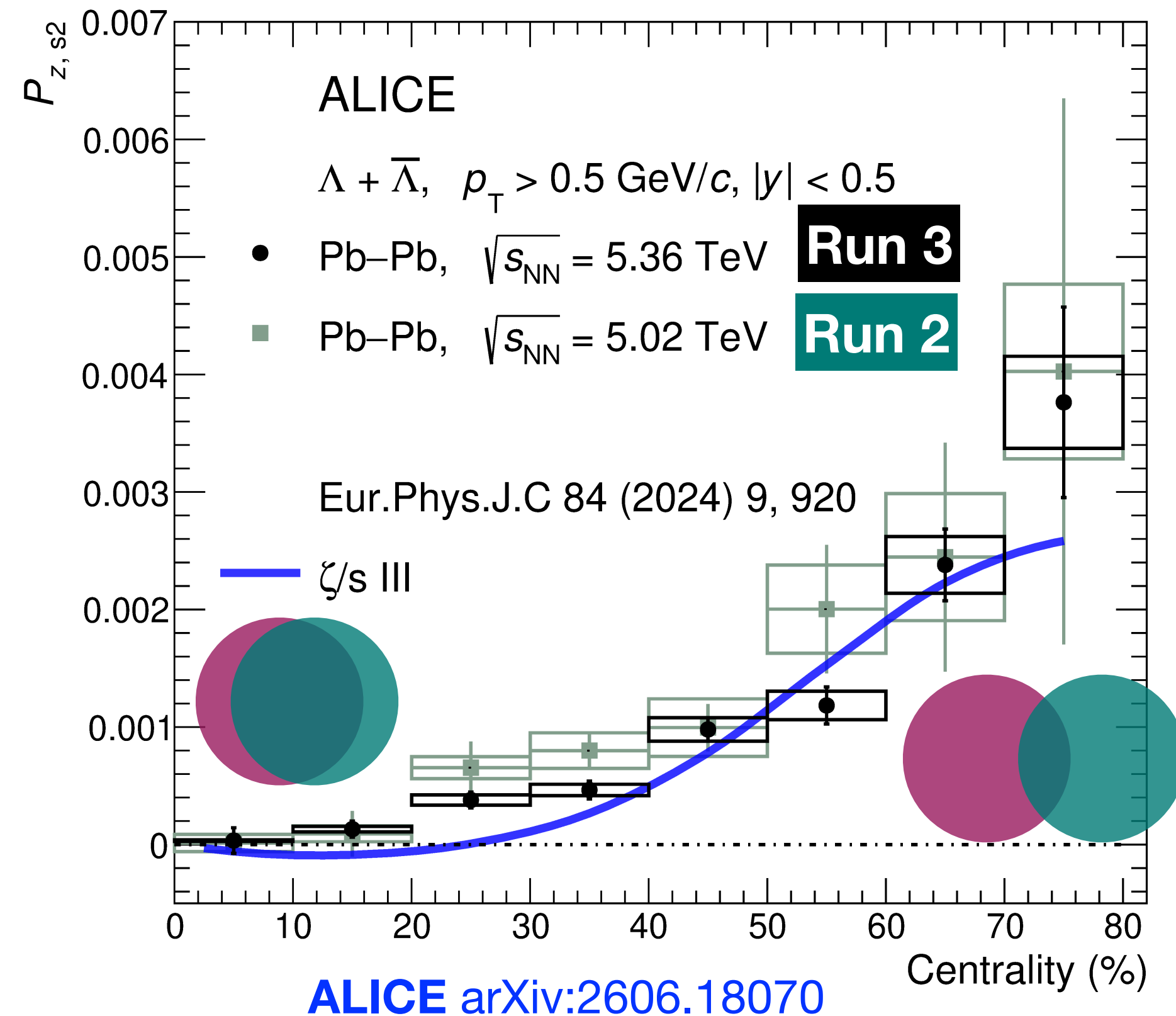
At LHC P_z is sensitive to

- Bulk viscosity ζ/s of the QGP at LHC energies $\Rightarrow$ change the sign of P_z
- Shear-induced polarization $\Rightarrow$ competes with the thermal vorticity

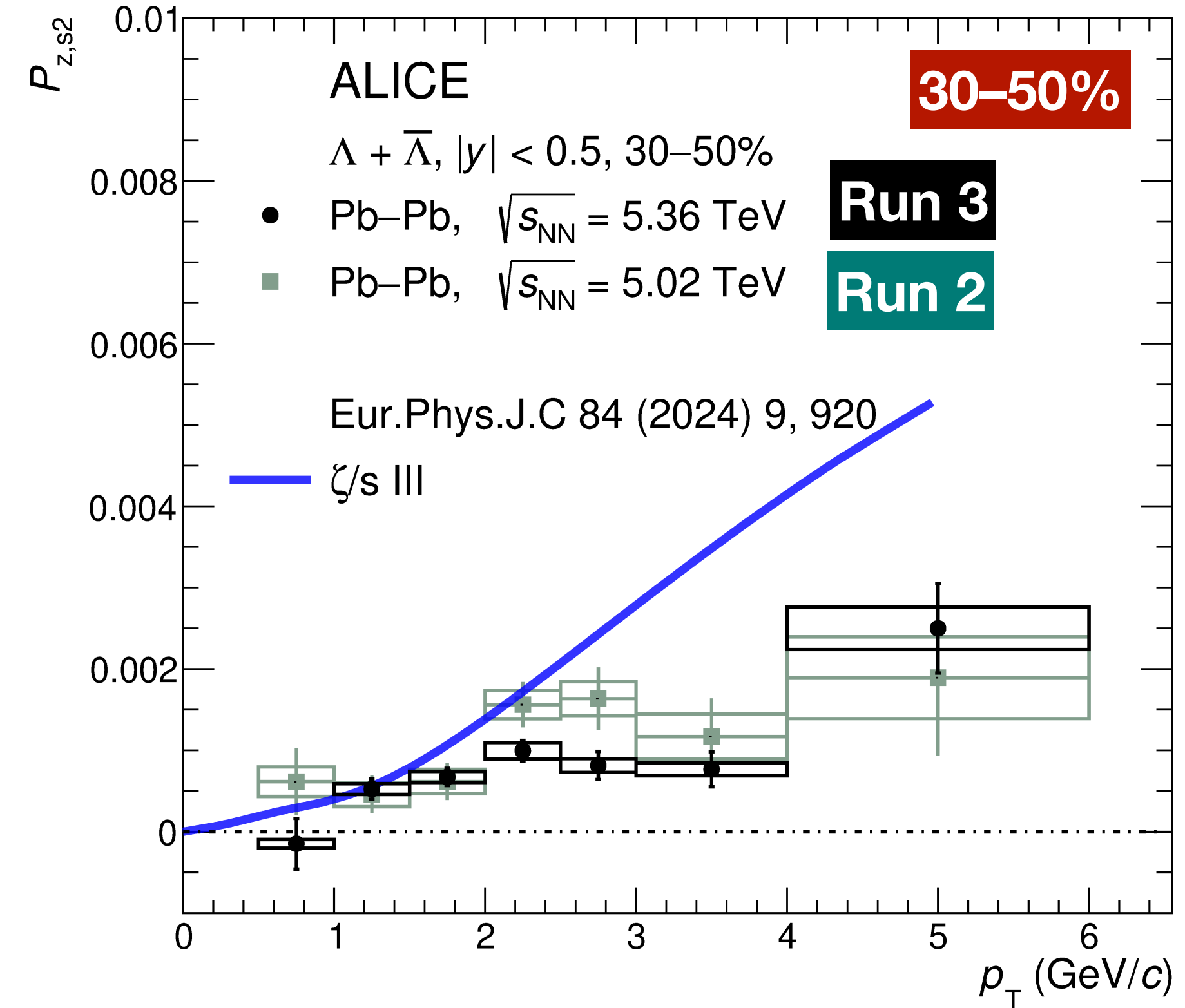
A. Palermo et al., *Eur. Phys. J.* **C84** (2024) 920

B. Fu et al., *Phys. Rev. Lett.* **127** (2021) 142301

New Run 3 results p_T -dependence



ALI-PUB-635108



ALI-PUB-635113

The measured p_T dependence is not fully described by the model, which predicts a steeper increase with p_T , indicating the need for further model development

➡ Only 2023 Pb-Pb data is used, to be improved with full Pb-Pb sample

Possible mechanisms



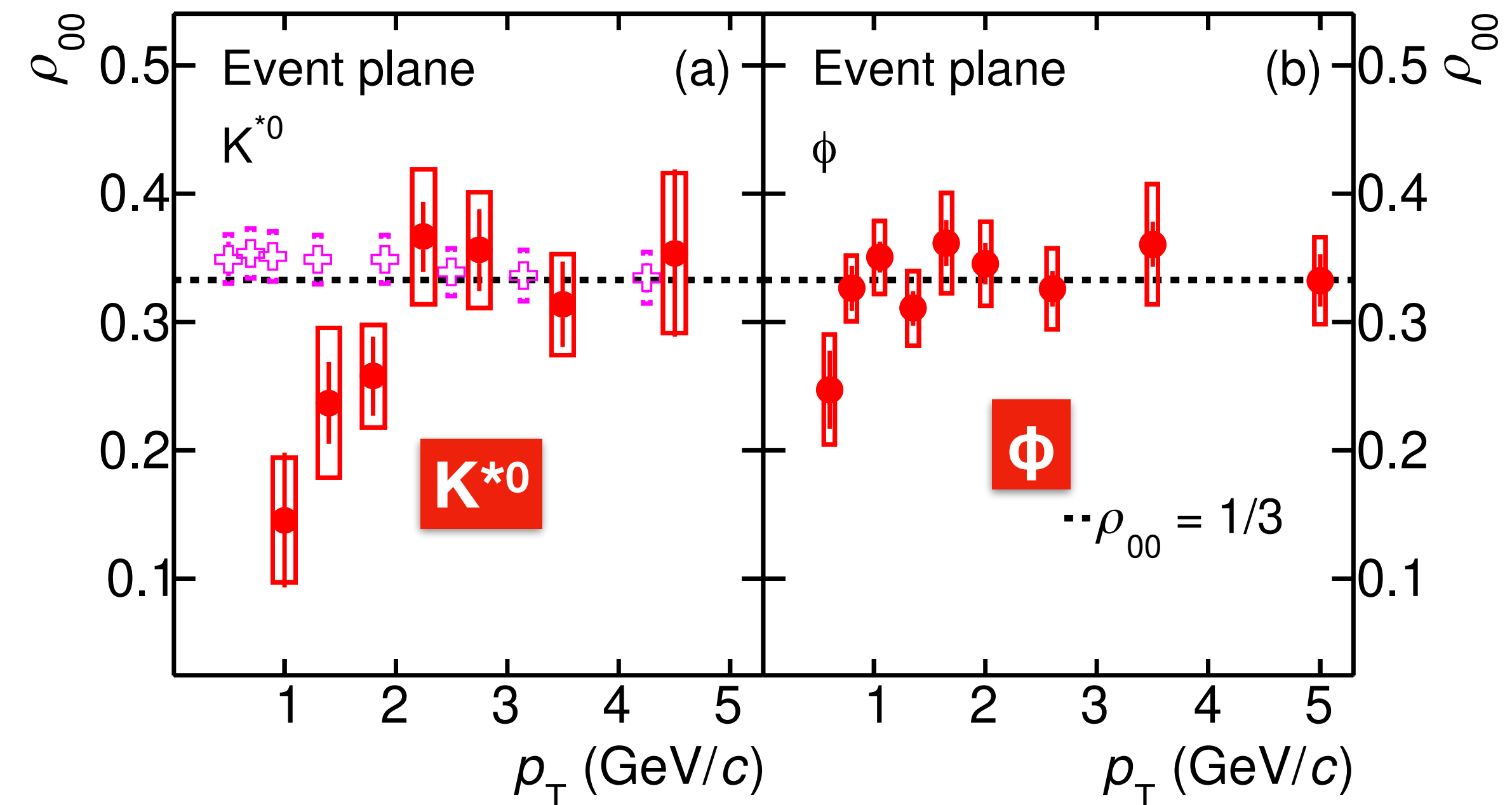
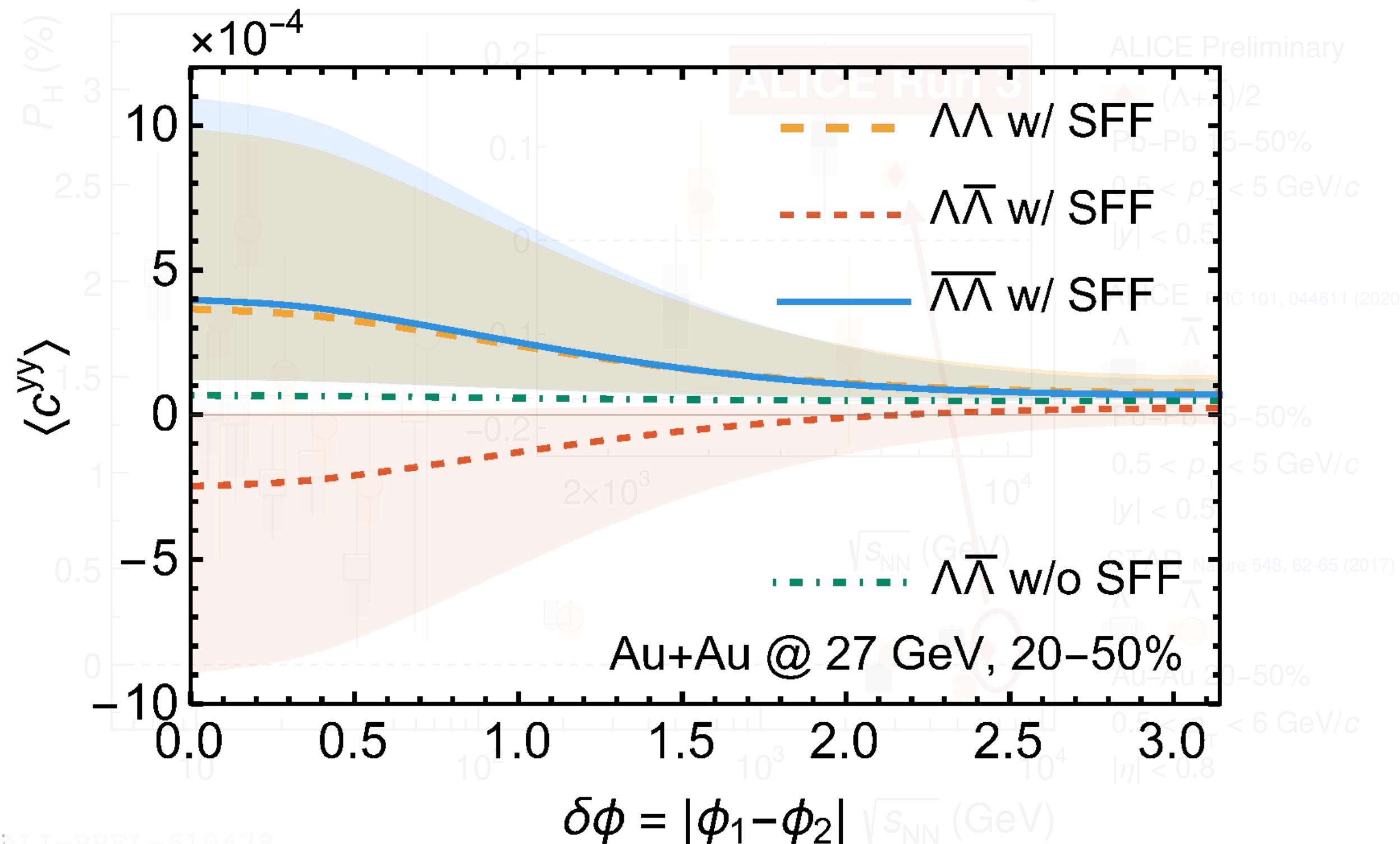
D. Hou et al., *Phys. Rev.* **D110** (2024) 056047
 A. Kumar et al., *Phys. Rev.* **D109** (2024) 054038
 Z.-T. Liang, Q. Wang, and X.-N. Wang et al., *Phys. Rev.* **D109** (2024) 114003
 A. Kumar et al., *Phys. Rev.* **D108** (2023) 016020
 B. Muller et al., *Phys. Rev.* **D105** (2022) L011901
 Q. Wang et al., *Phys. Rev.* **D105** (2022) 099903
 X.-G. Huang et al., *Phys. Lett.* **B817** (2021) 136325

Uncompleted list

Thermal estimation

$$\rho_{00} - 1/3 \sim \mathcal{O}(P_H^2)$$

$$P_H < 0.1 \% \rightarrow \rho_{00} - 1/3 \sim 0$$



ALI-PUB-520388

ALICE *Phys. Rev. Lett.* **125** (2020) 012301

X.-N. Wang et al., *Phys. Rev. Lett.* **136** (2026) 082301

ALICE ITS3 – Material budget



2010-2013

2015-2018

2022-2026

2030-2033

ALICE ITS3 TDR
CERN-LHCC-2024-003

Run 1

LS1

Run 2

LS2

Run 3

LS3

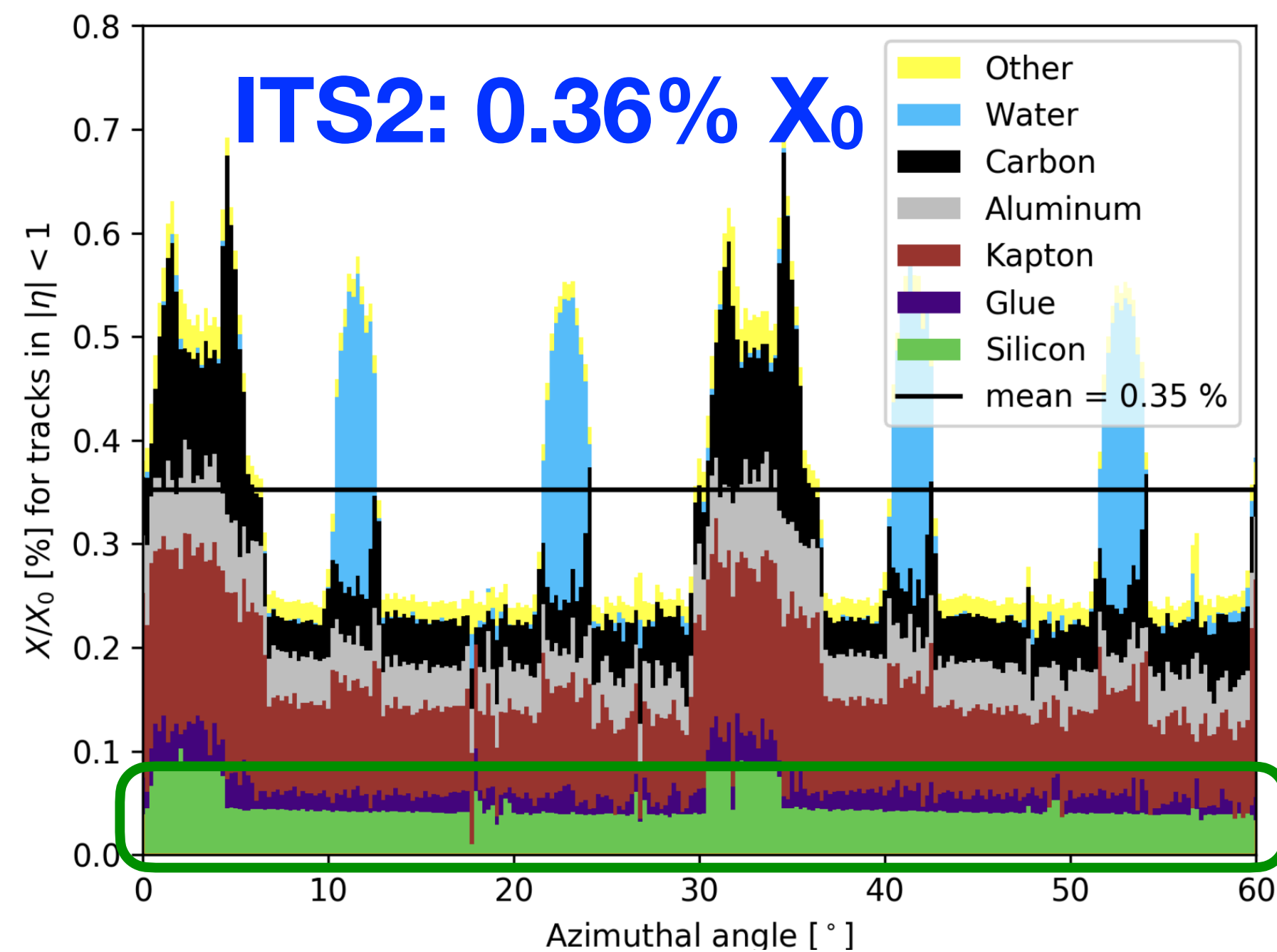
Run 4

ALICE 1

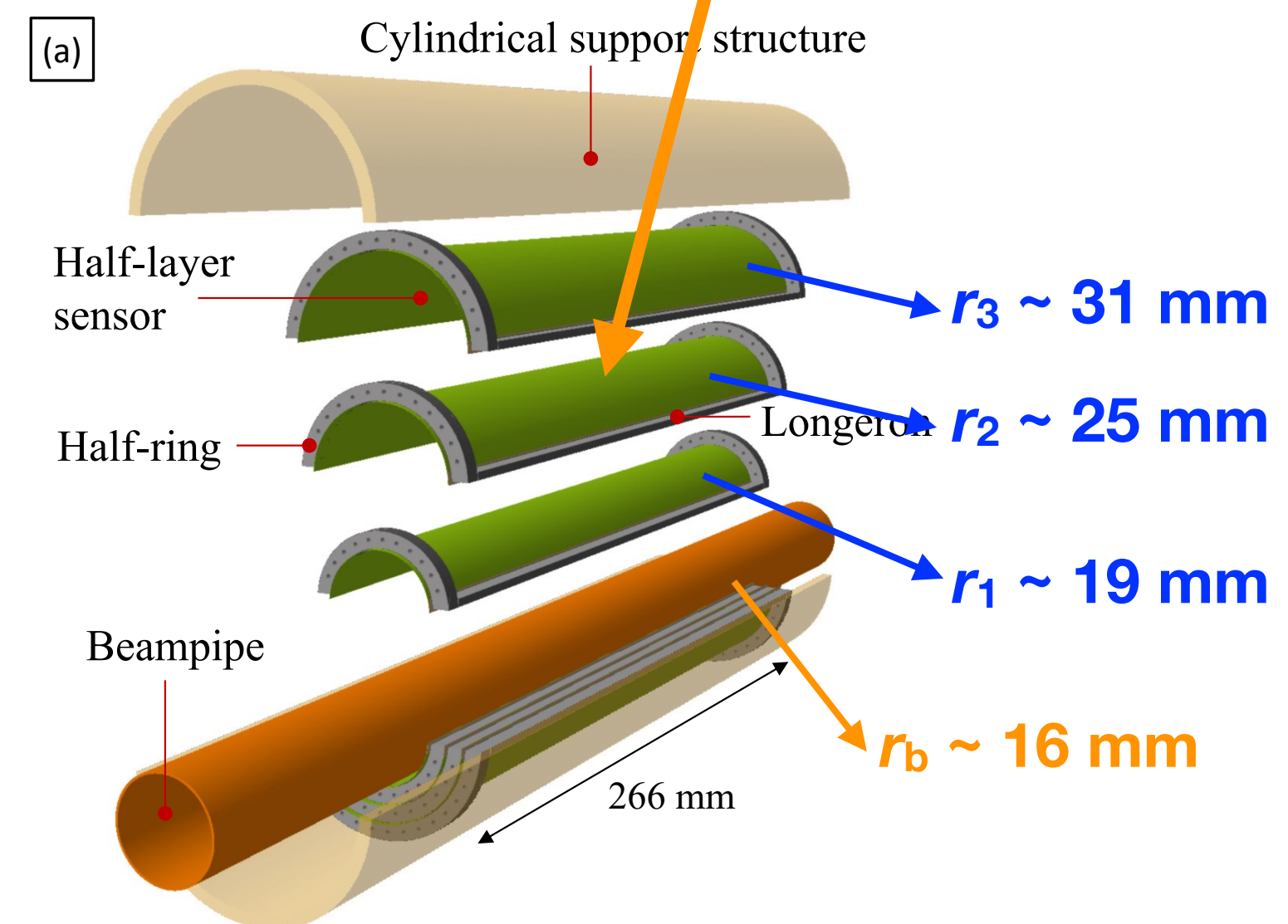
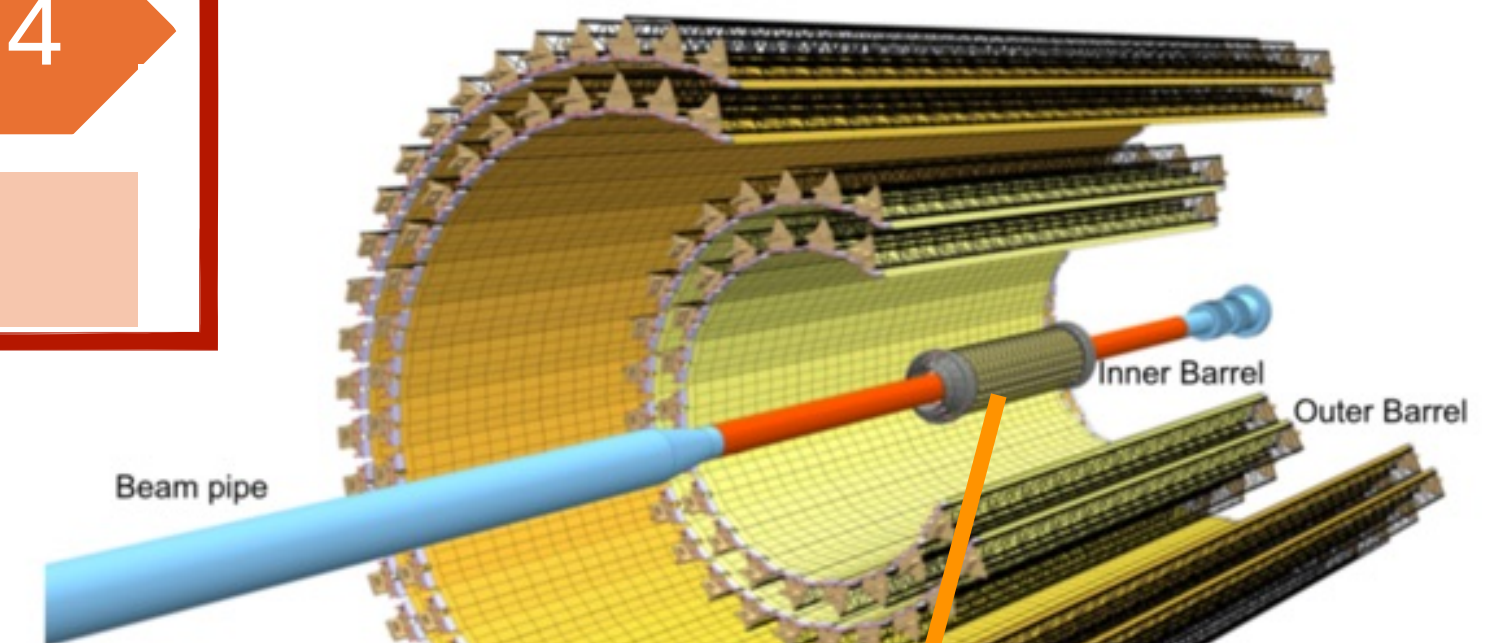
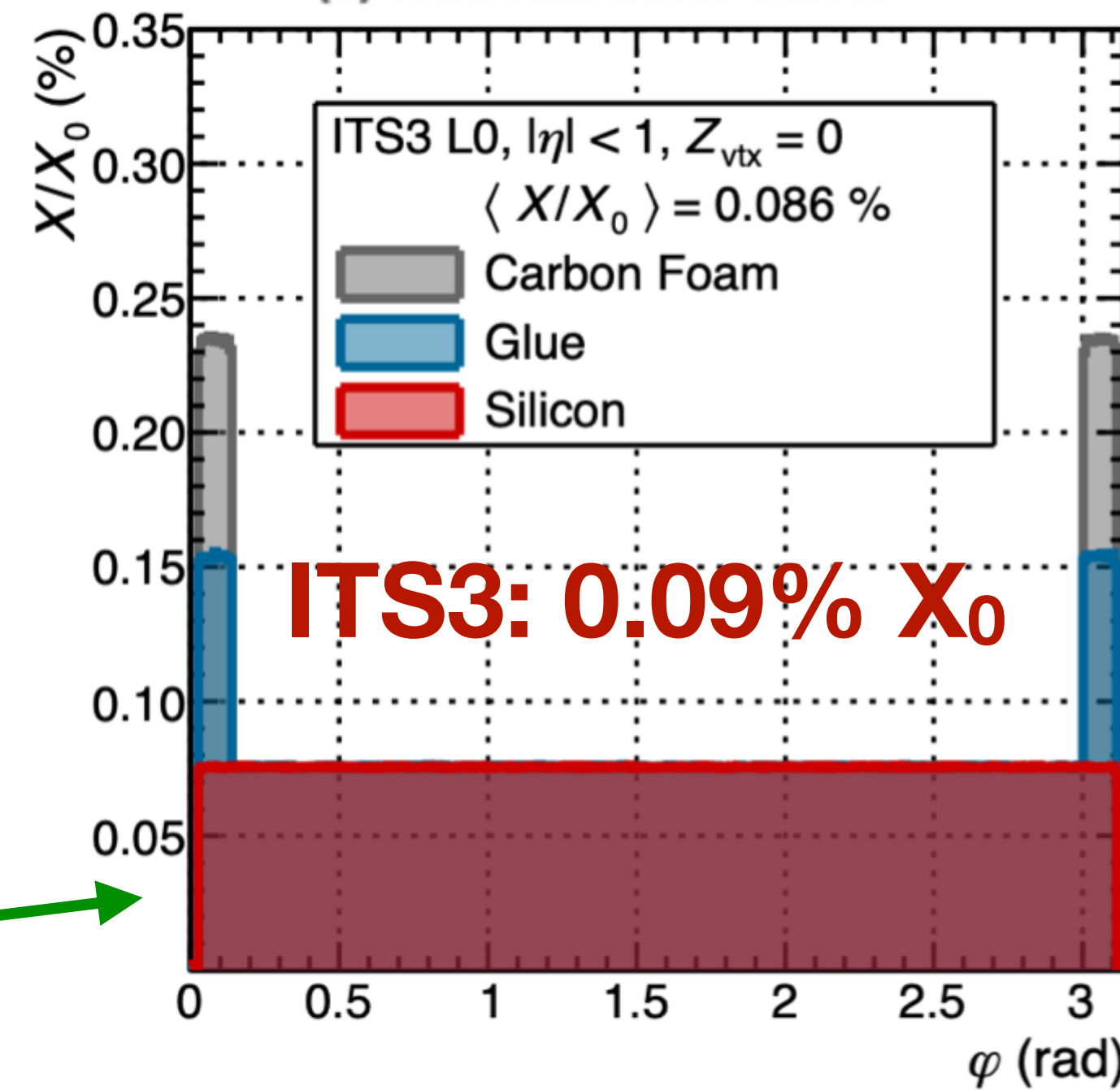
ALICE 2

ALICE 2.1

(a) ITS2 half inner barrel



(b) ITS3 half inner barrel



ALICE ITS3 – Open heavy flavors



2010-2013

2015-2018

2022-2026

2030-2033

ALICE ITS3 TDR
CERN-LHCC-2024-003

Run 1

LS1

Run 2

LS2

Run 3

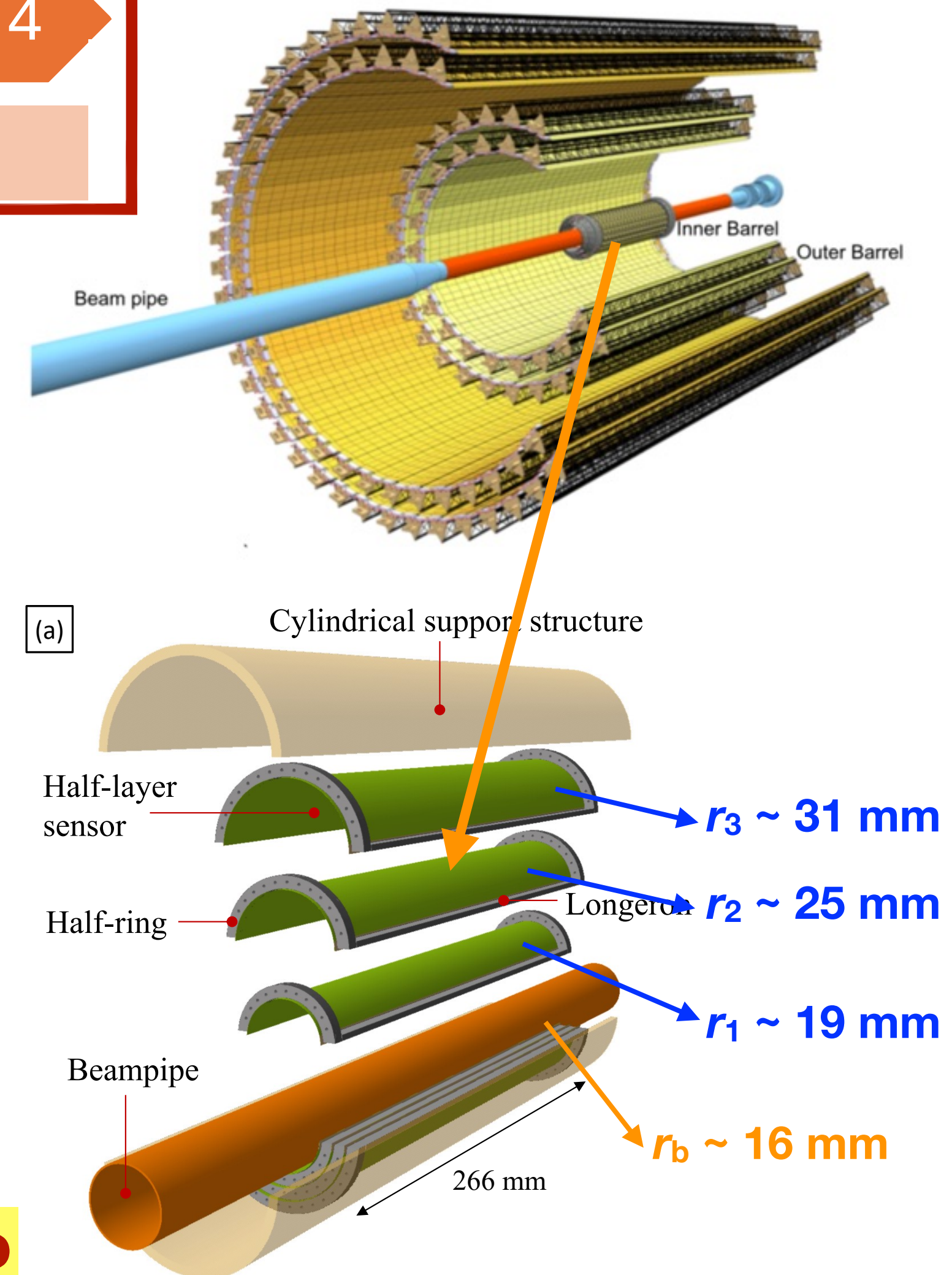
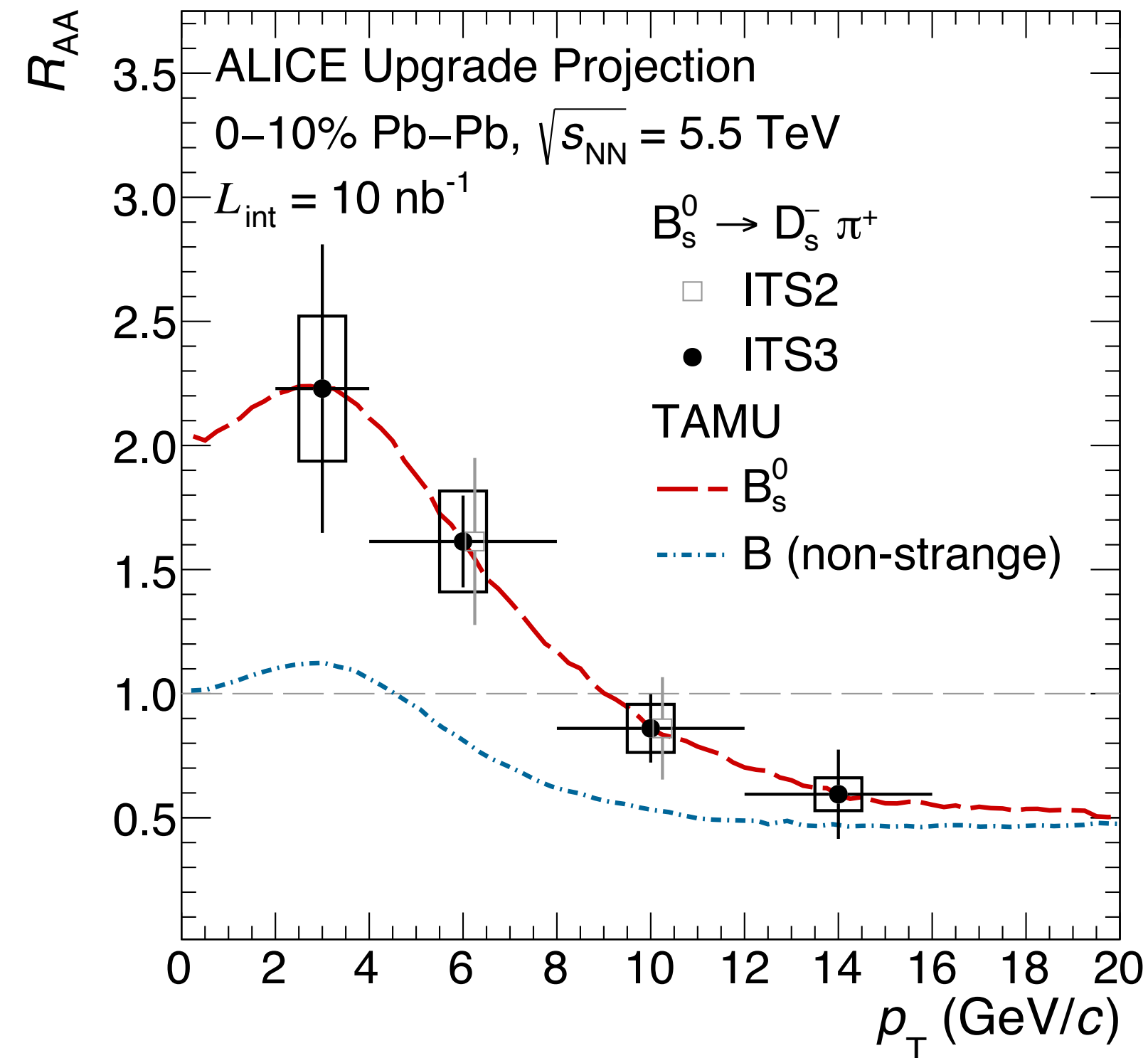
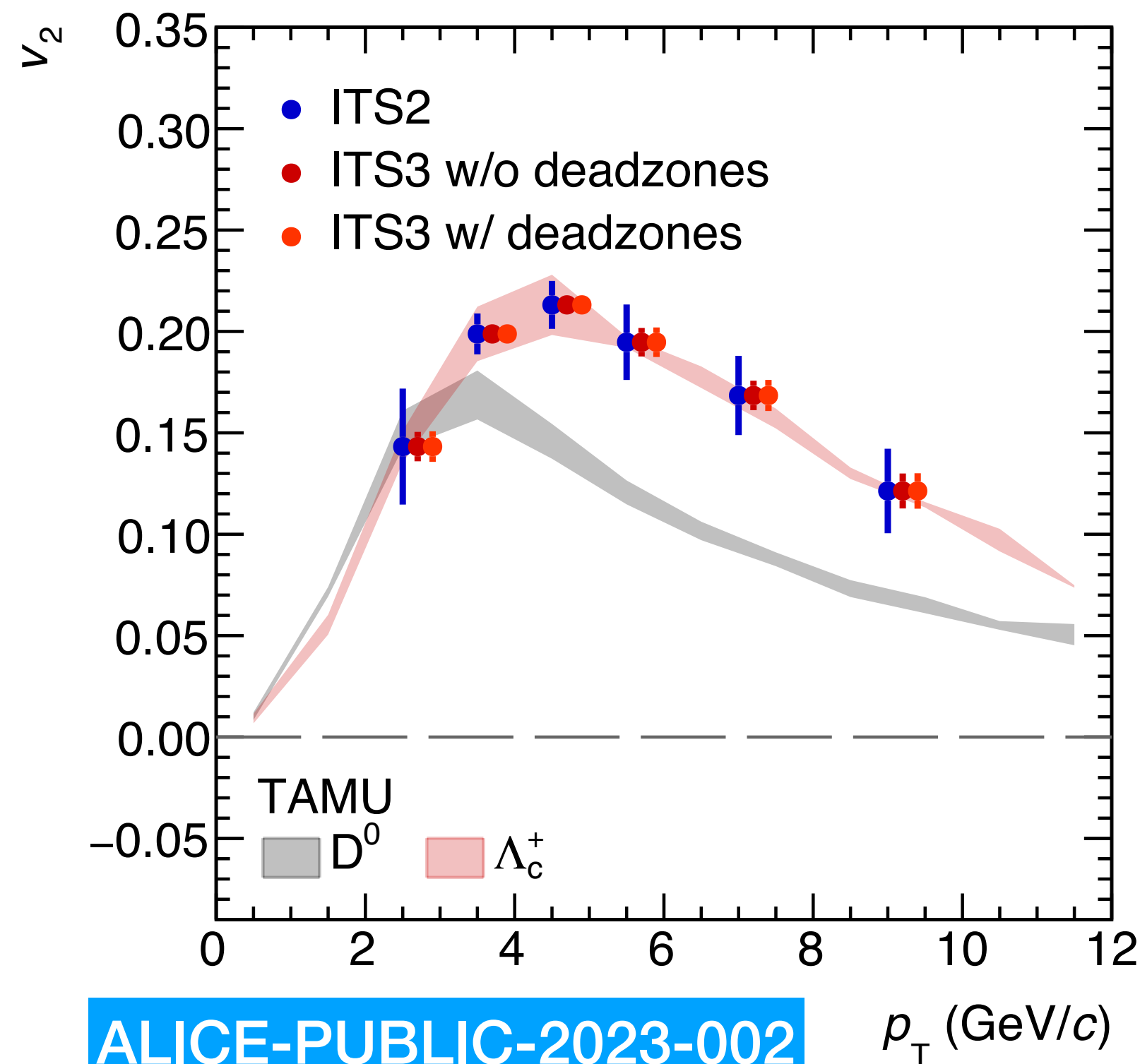
LS3

Run 4

ALICE 1

ALICE 2

ALICE 2.1



Precisely constrain on c, b transport properties in QGP

ALICE FoCal — Prototype



2010-2013

2015-2018

2022-2026

2030-2033

Run 1

LS1

Run 2

LS2

Run 3

LS3

Run 4

ALICE 1

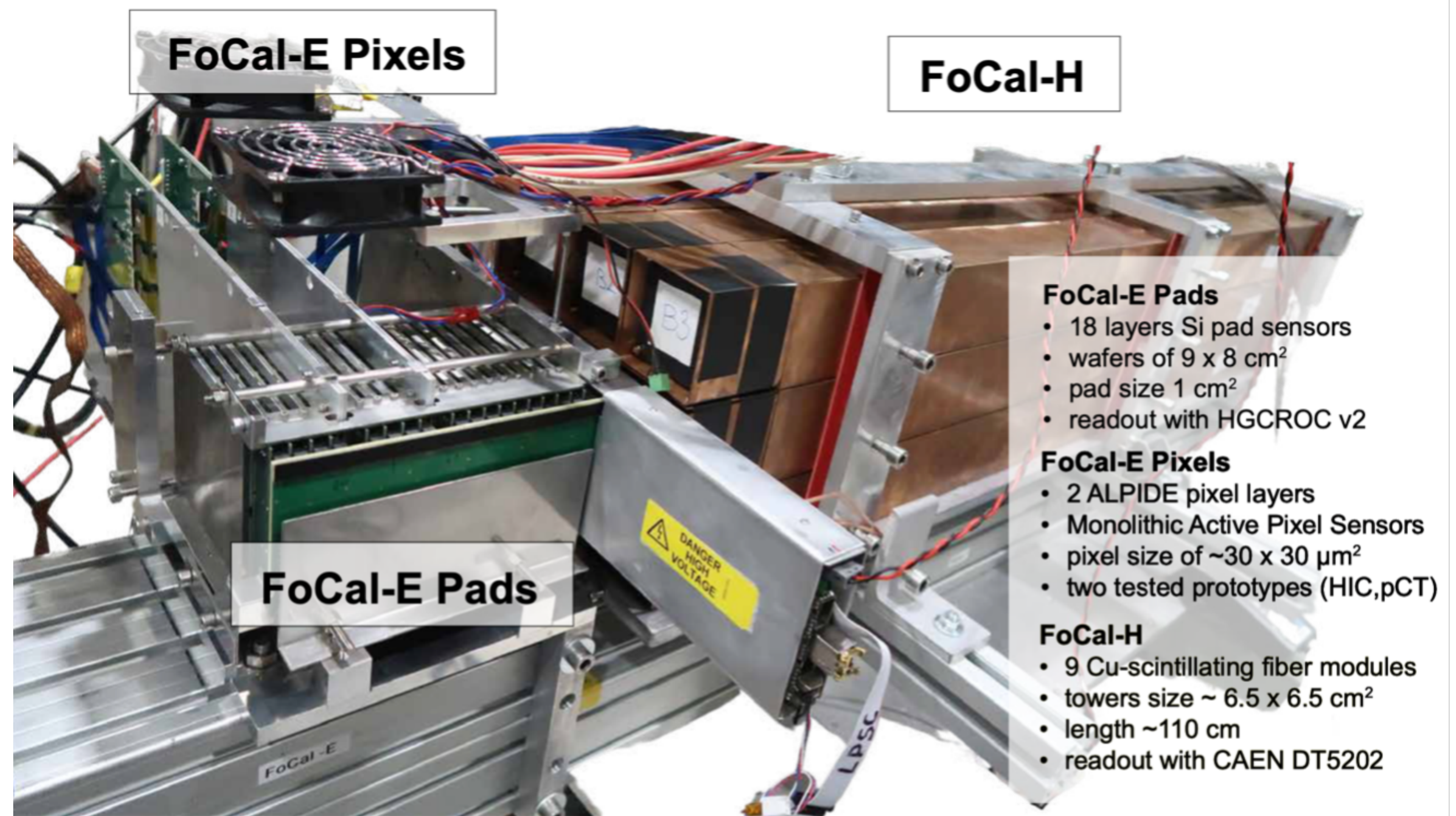
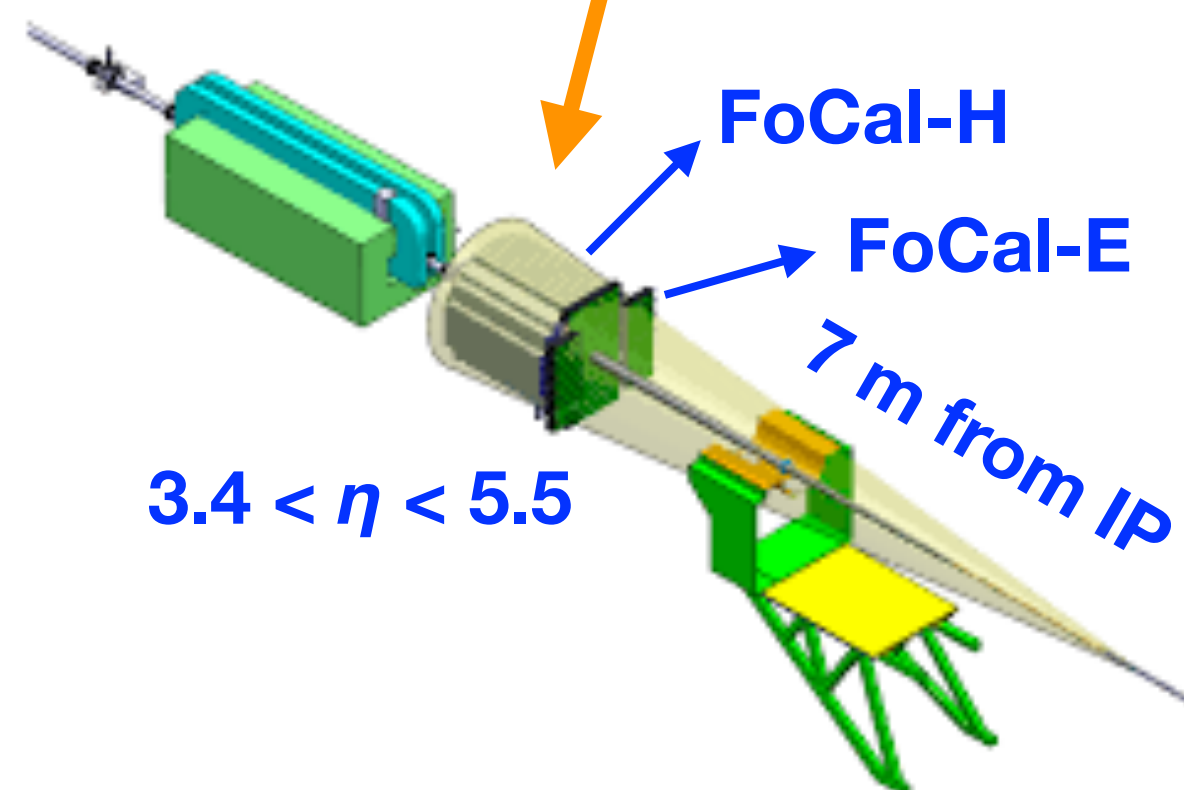
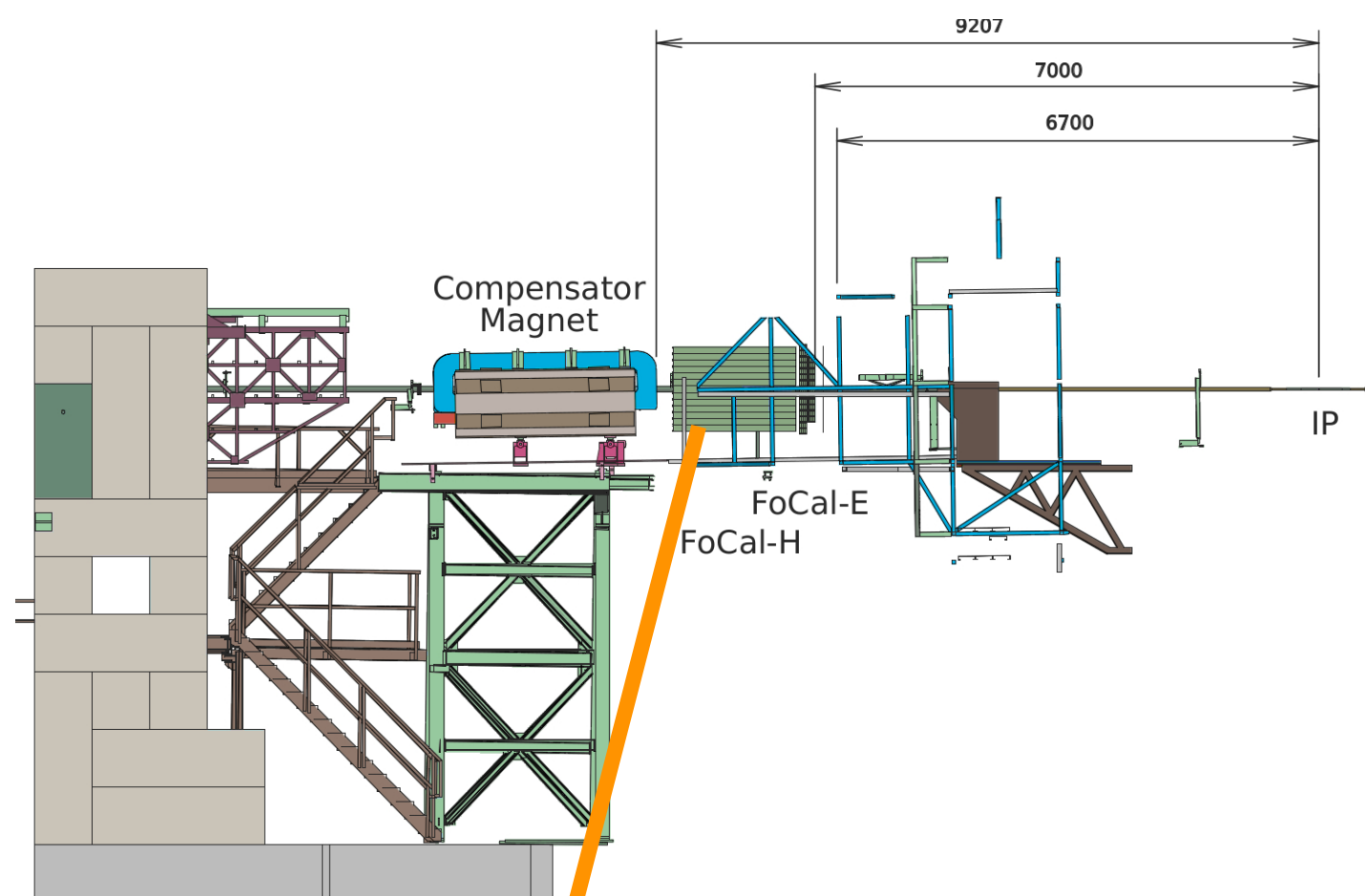
ALICE 2

ALICE 2.1

ALICE FoCal

LoI: CERN-LHCC-2020-009

TDR: CERN-LHCC-2024-004



FoCal-E Pads

- 18 layers Si pad sensors
- wafers of $9 \times 8 \text{ cm}^2$
- pad size 1 cm^2
- readout with HGCROC v2

FoCal-E Pixels

- 2 ALPIDE pixel layers
- Monolithic Active Pixel Sensors
- pixel size of $\sim 30 \times 30 \mu\text{m}^2$
- two tested prototypes (HIC, pCT)

FoCal-H

- 9 Cu-scintillating fiber modules
- towers size $\sim 6.5 \times 6.5 \text{ cm}^2$
- length $\sim 110 \text{ cm}$
- readout with CAEN DT5202

ALICE FoCal — Performance



2010-2013

2015-2018

2022-2026

2030-2033

Run 1

LS1

Run 2

LS2

Run 3

LS3

Run 4

ALICE 1

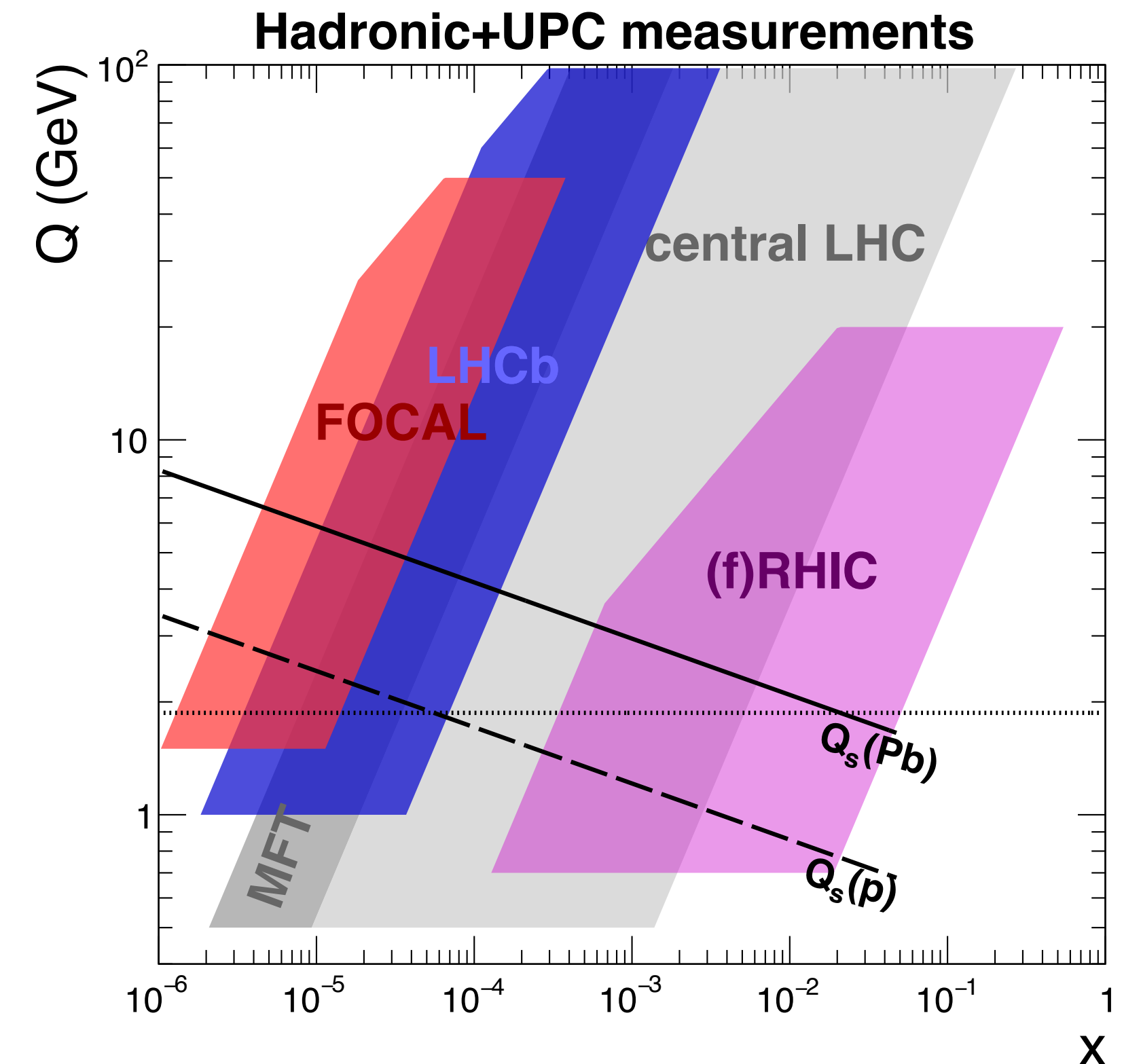
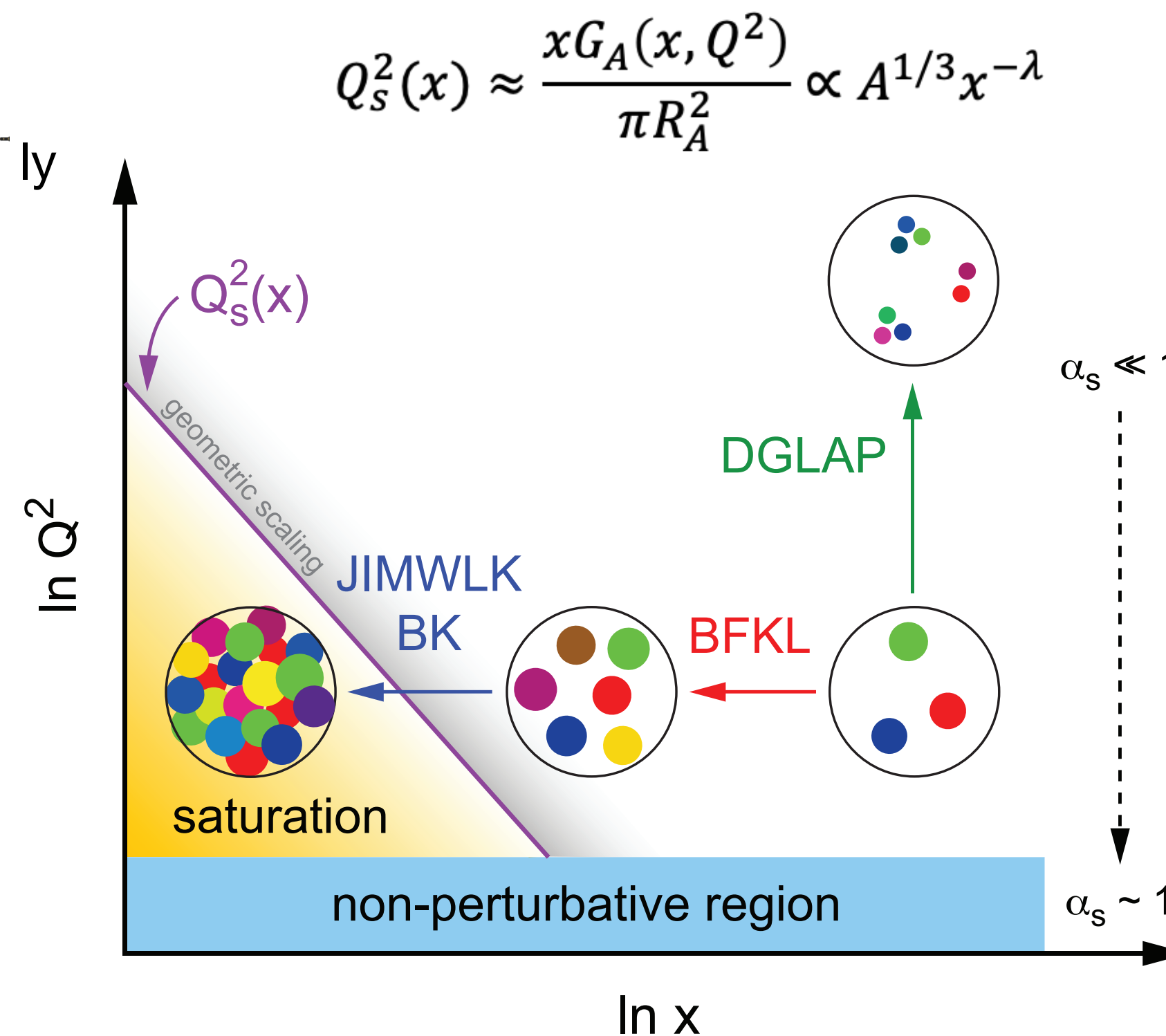
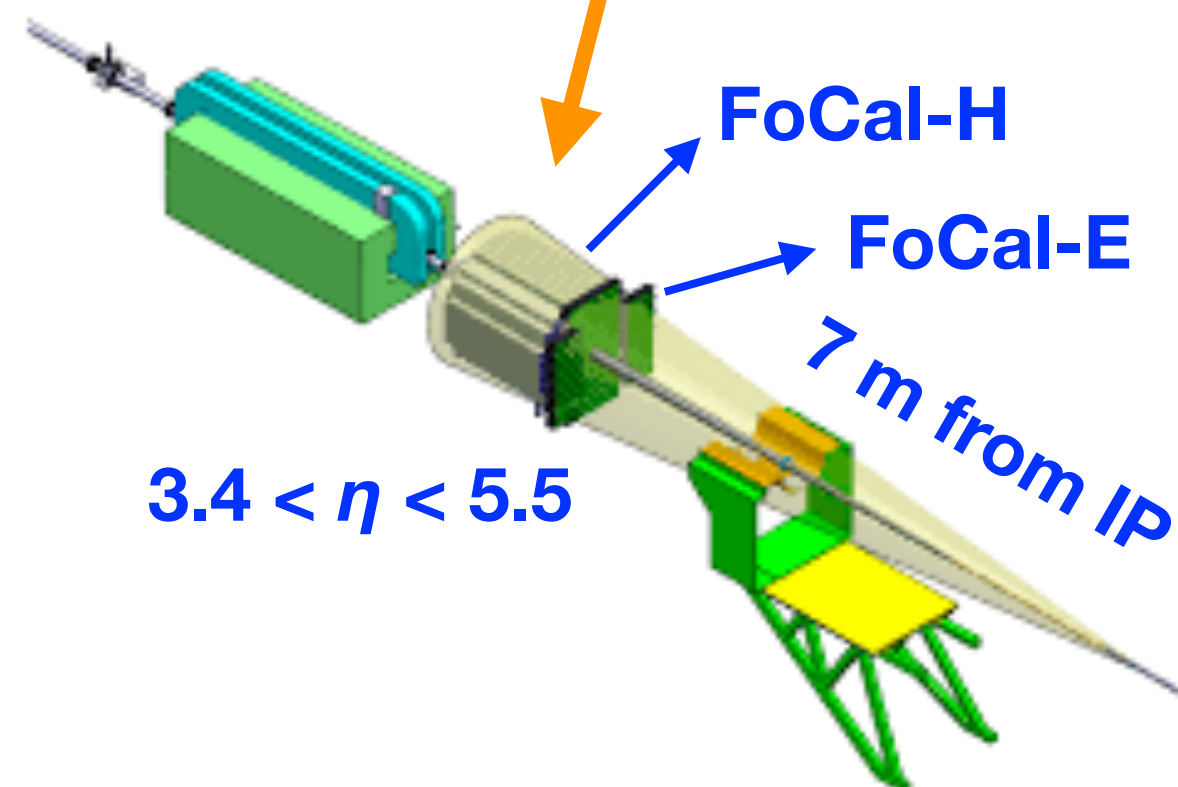
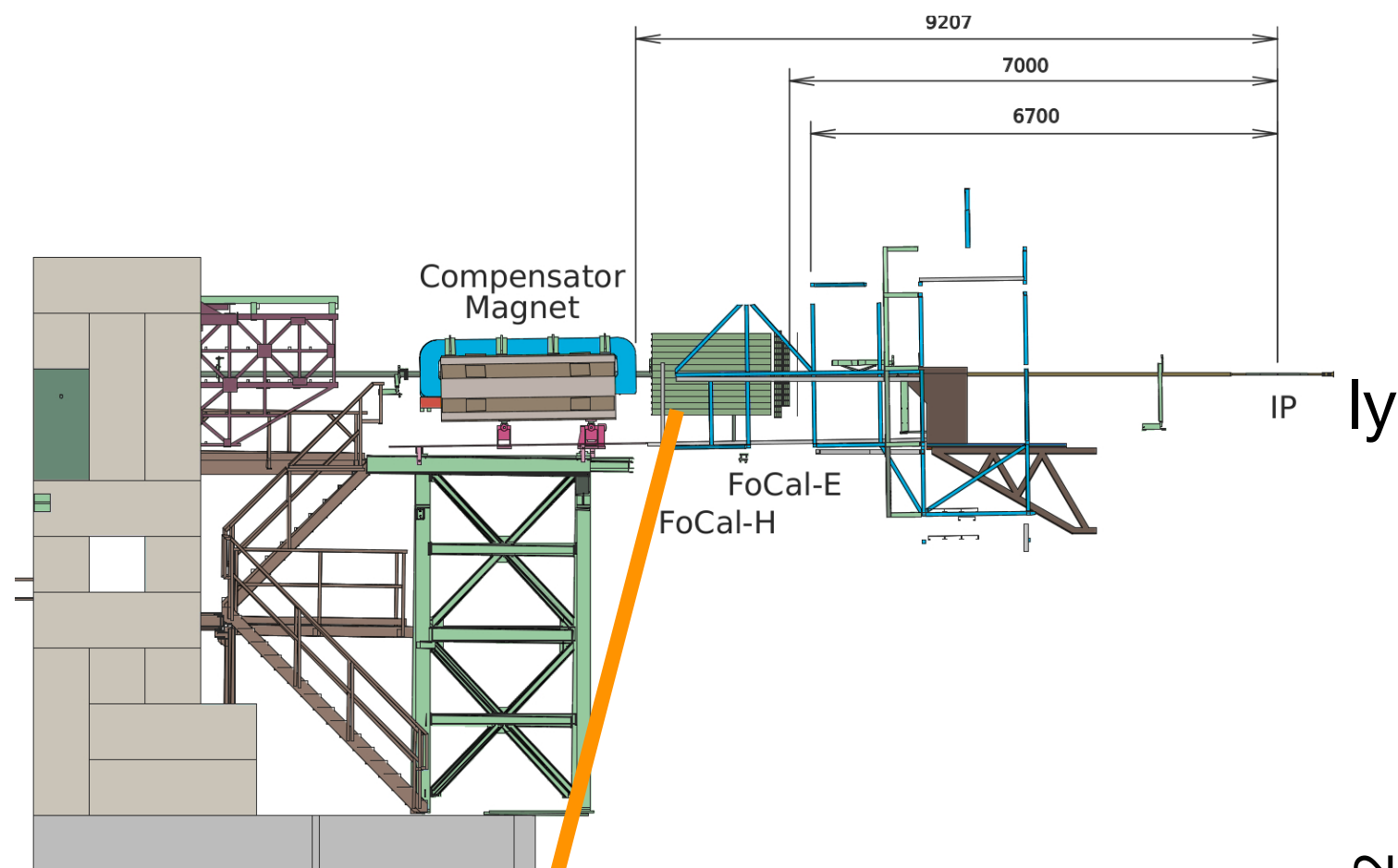
ALICE 2

ALICE 2.1

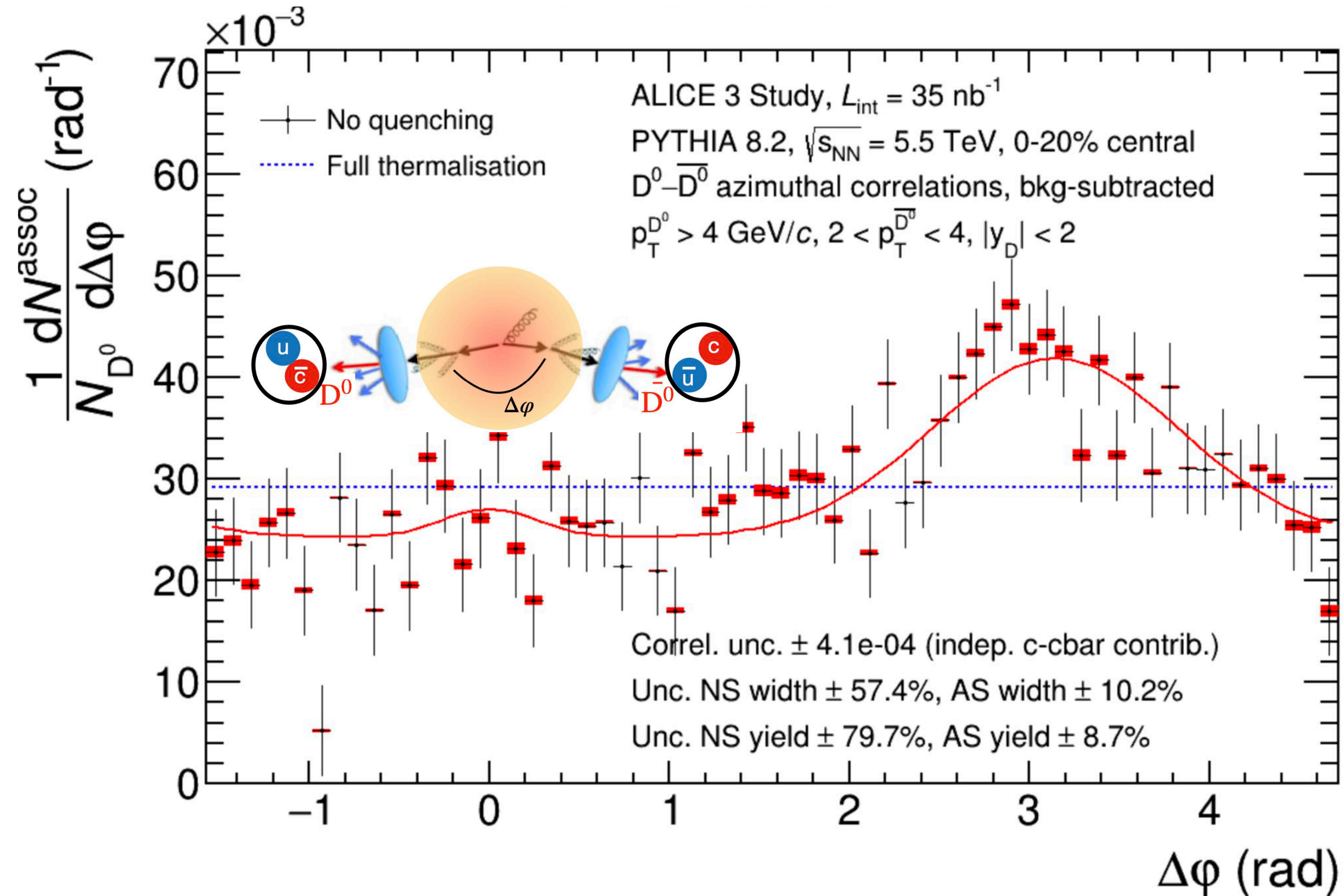
ALICE FoCal

LoI: CERN-LHCC-2020-009

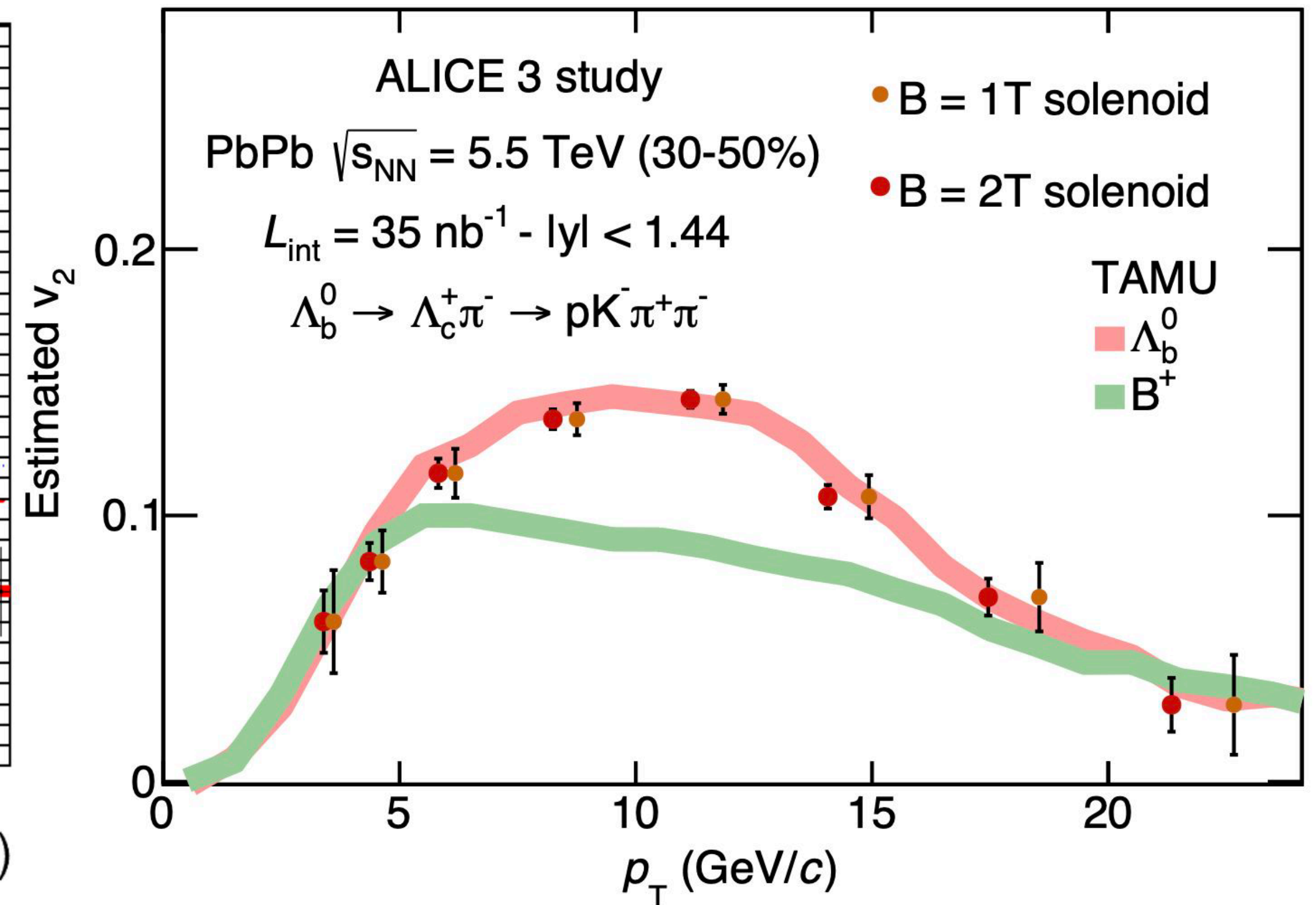
TDR: CERN-LHCC-2024-004



Heavy quark correlation and flow



D-meson pair azimuthal de-correlation
 is sensitive to the thermalization
 degree and to the energy loss

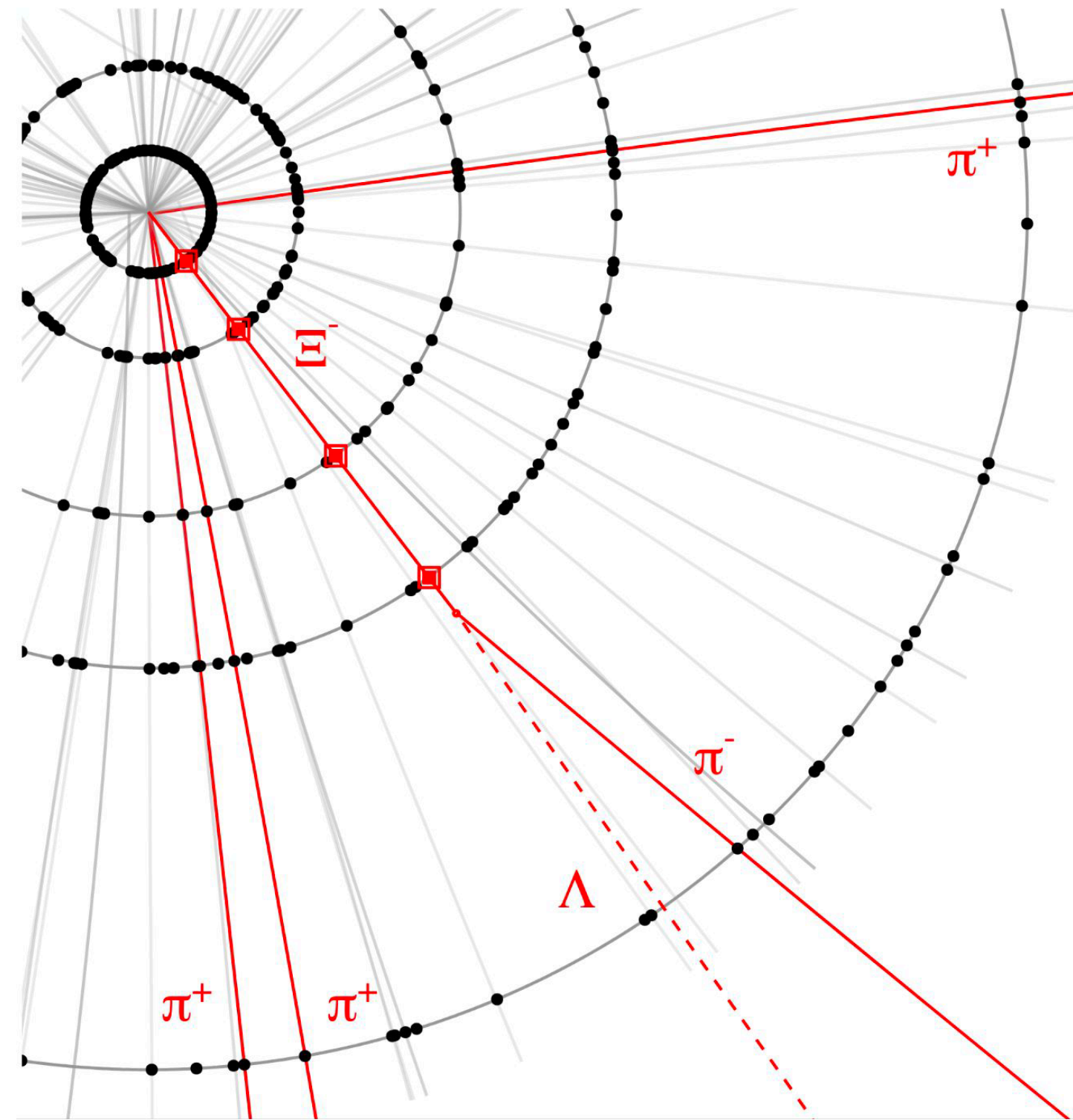


Direct reconstruction of beauty hadrons
 allows us to test beauty quark
 thermalization and hadronization

HF-tracker of multicharm baryons

$$\Xi_{cc}^{++} \rightarrow \Xi_c^+ + \pi^+ \rightarrow \Xi^- + 3\pi^+$$

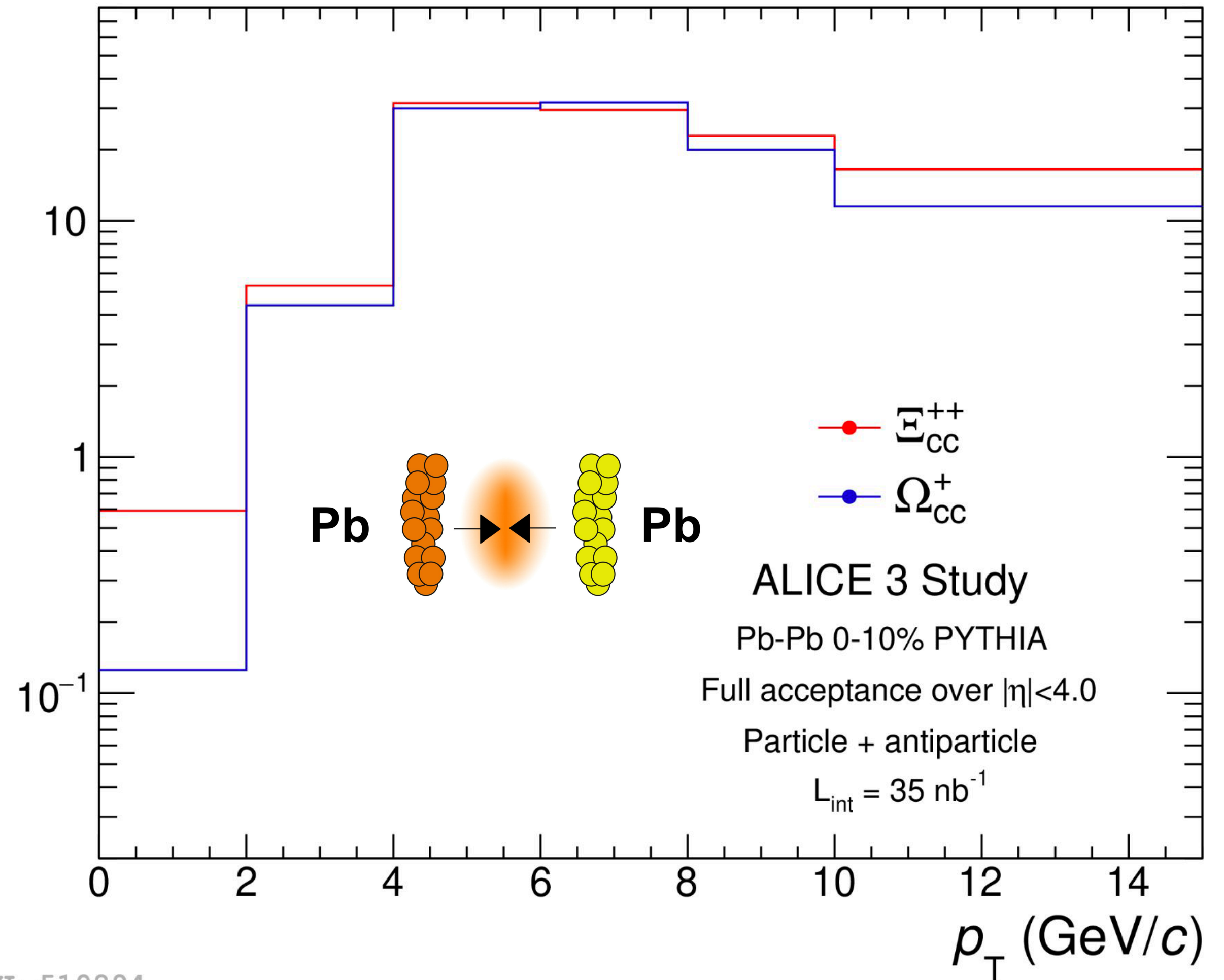
$$\Xi^- \rightarrow \Lambda + \pi^- \rightarrow p + 2\pi^-$$



Match hits to topologically reconstructed candidate to greatly improve precision

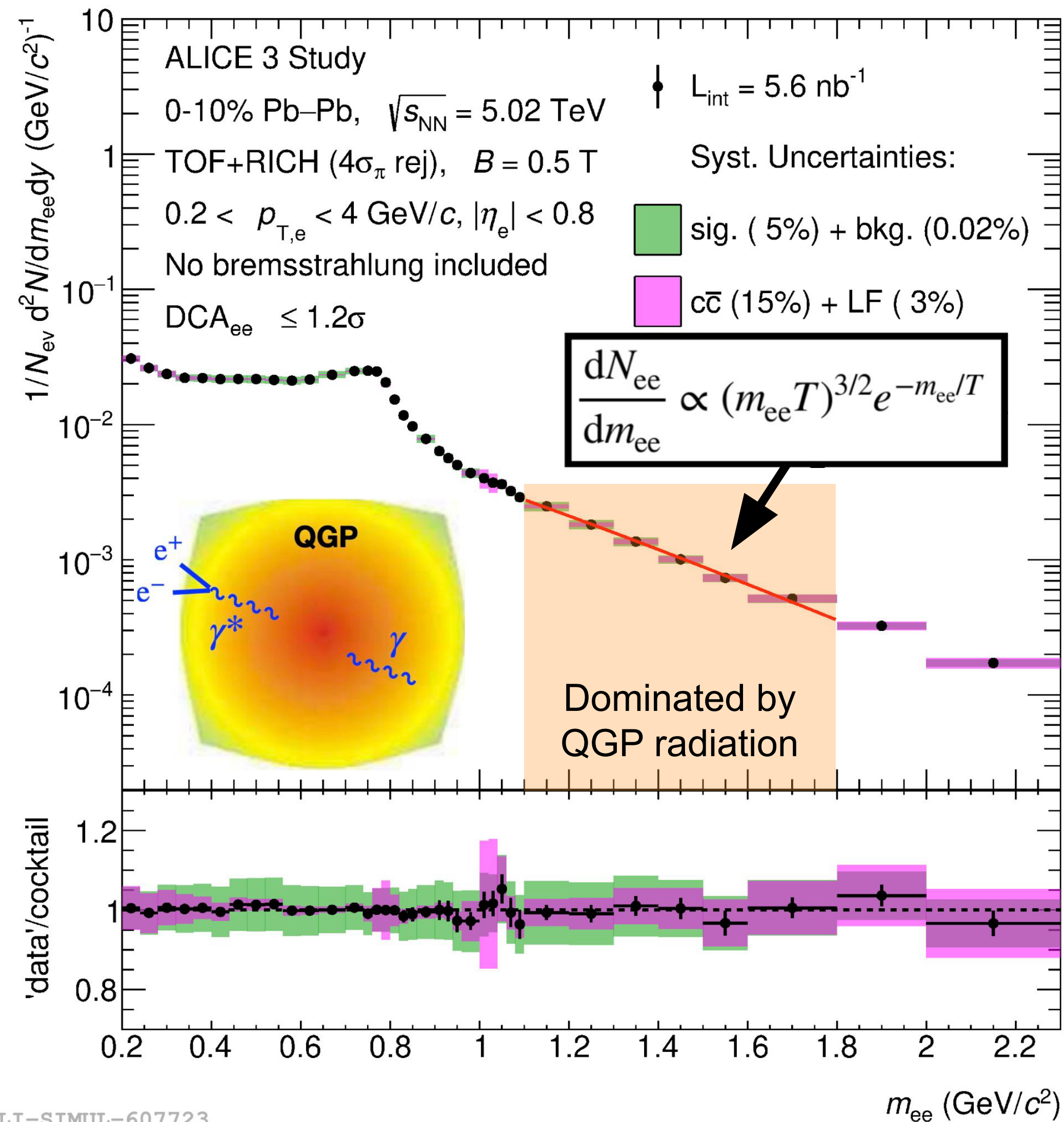
ALI-SIMUL-510894

Significance

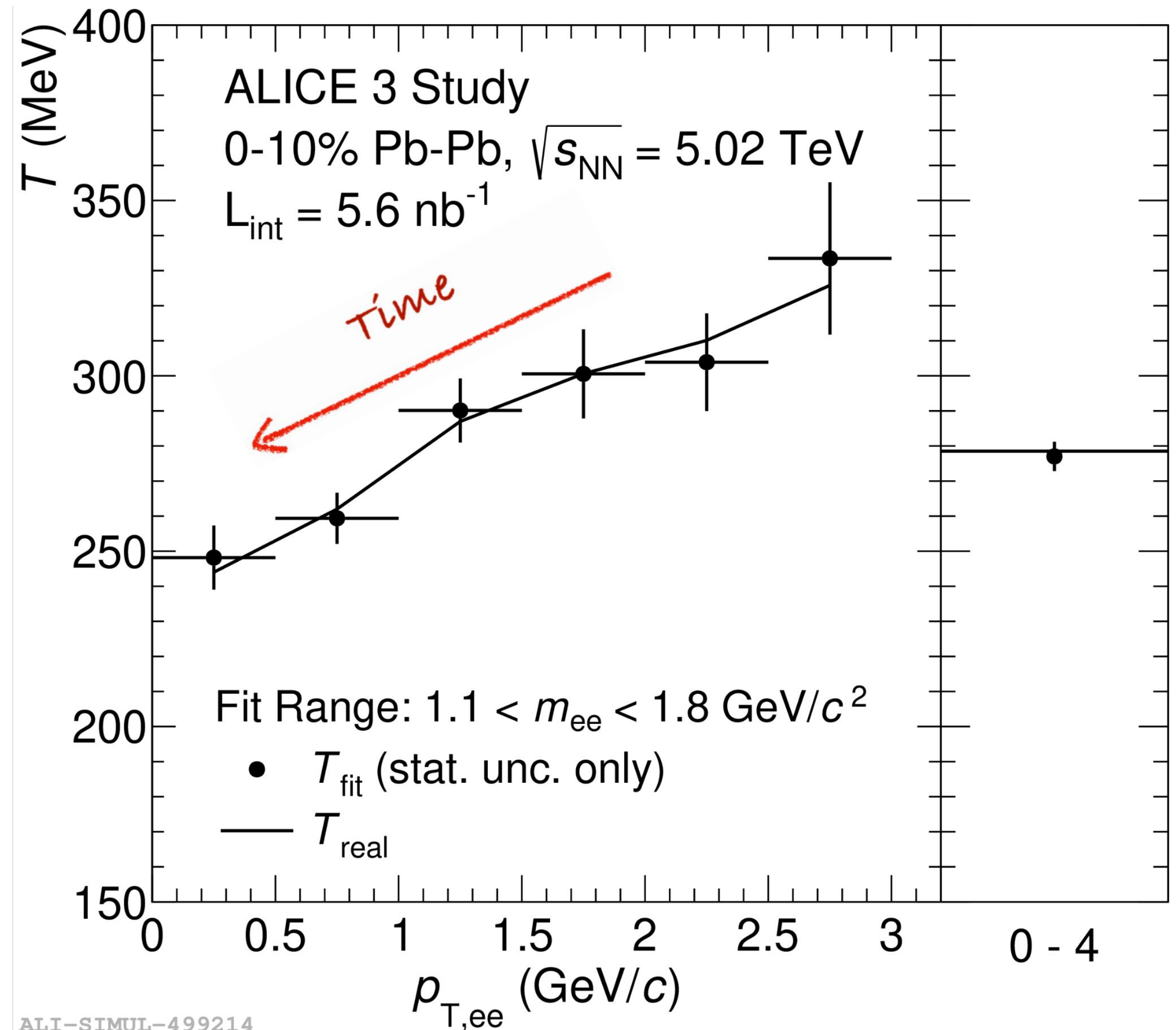


Highly efficient reduction of background from primary hyperons thanks to the pointing resolution!

QGP time evolution



ALI-SIMUL-607723



ALI-SIMUL-499214