Study of J/ψ v_2 in pp collisions with ALICE and MCH commissioning

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Analysis work

Studying proton-proton collisions at 13 TeV, looking for J/ψ flow

Quark-gluon plasma (QGP)

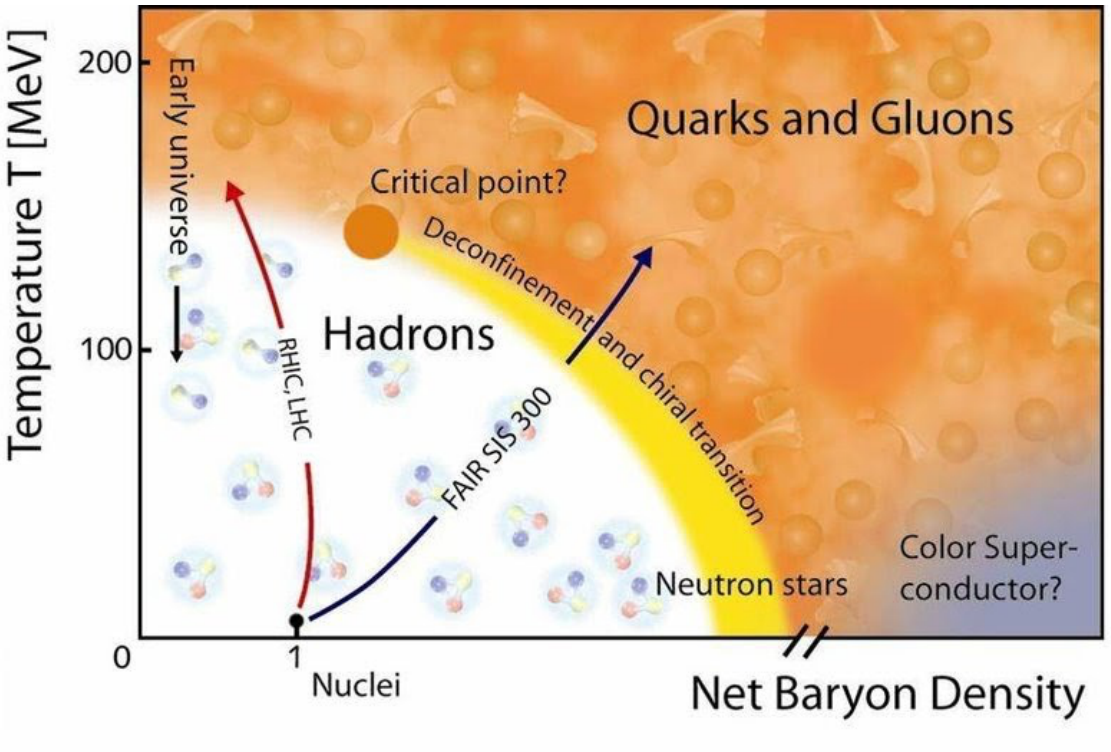
Study of Quark-Gluon Plasma (QGP)

- Deconfined state of matter
- Freely-roaming color charges

Primordial state of matter (~μs after Big Bang)
Core of Neutron stars

Scientific interest

Understanding of the strong force
Cosmological and astrophysical models

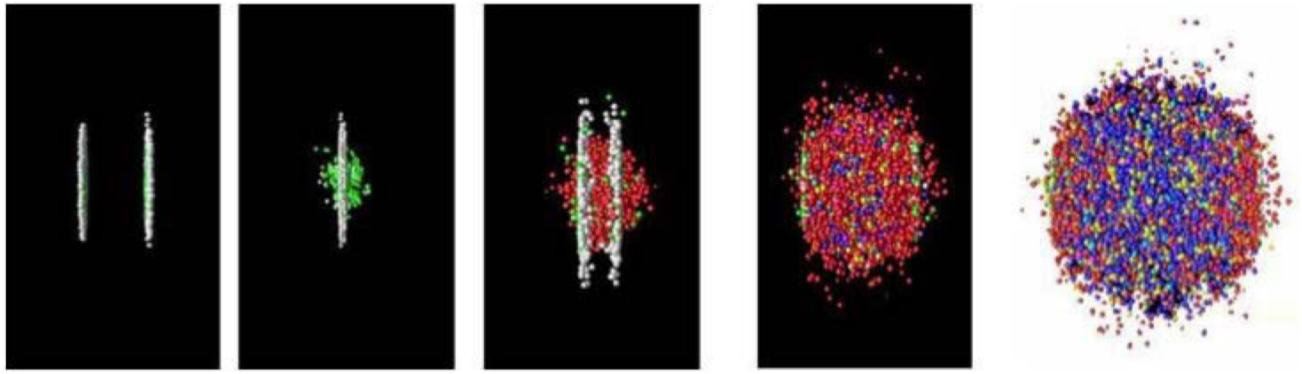


(GSI)

Forming the QGP and studying it

Formation through Heavy-ion collisions

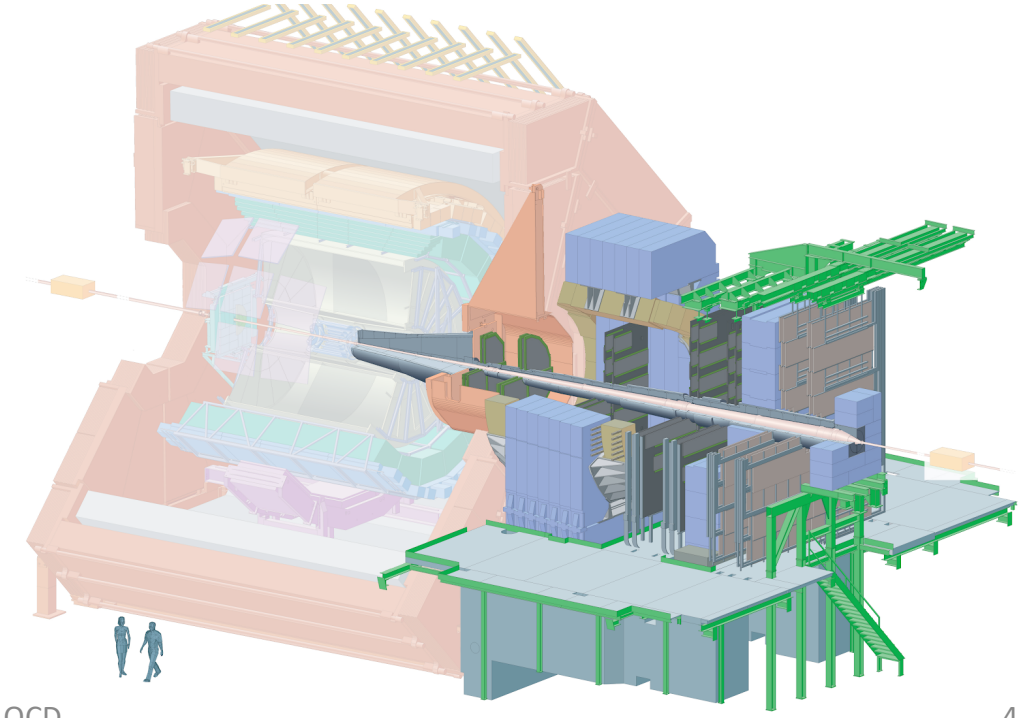
Pb-Pb ⇒ Formation of QGP
Pb-p, p-p ⇒ Reference (Cold Nuclear Matter (CNM) effects, not related to QGP formation)



What to look at ?

Production of hadrons in the QGP
Focus on quarkonium ($Q\bar{Q}$)

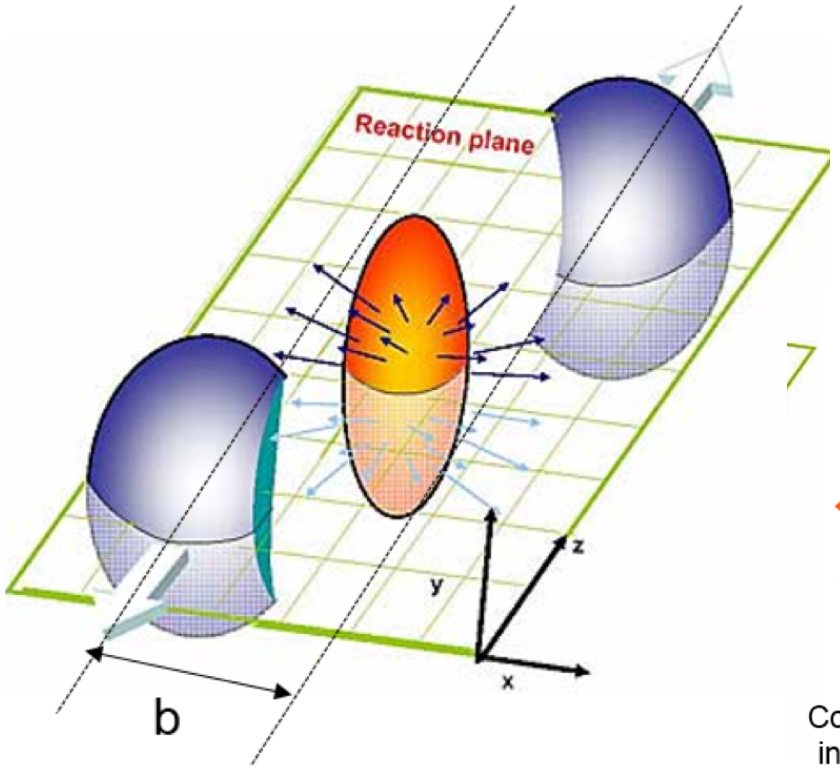
Influenced by color charges
Insight on QGP properties (e.g. Temperature)

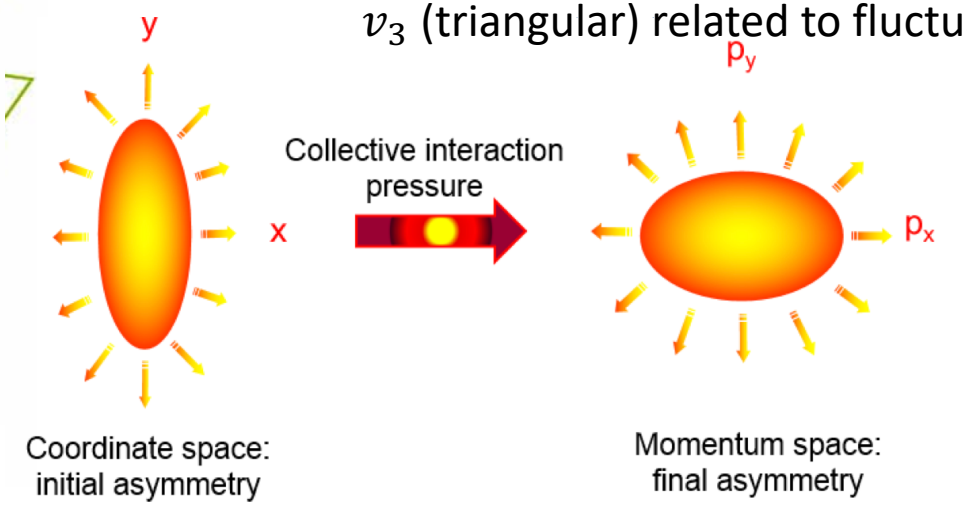


Elliptic flow

In Heavy-ion collisions, anisotropic collision region

- Anisotropies in momentum distribution
- Long-range correlations of produced particles





Azimuthal correlations of particles quantified by Fourier coefficients in ϕ angle distribution

$$\frac{dN}{d\phi} = \left\langle \frac{dN}{d\phi} \right\rangle \left(1 + \sum_n 2v_n \cos[n(\phi - \Psi_n)] \right)$$

v_2 (elliptic) related to the initial geometry of the collision

v_3 (triangular) related to fluctuations

Flow is a signature of QGP formation as it shows collective behaviours

Constrains theoretical models

Taken from Universe, 2017

Basis of the analysis in pp

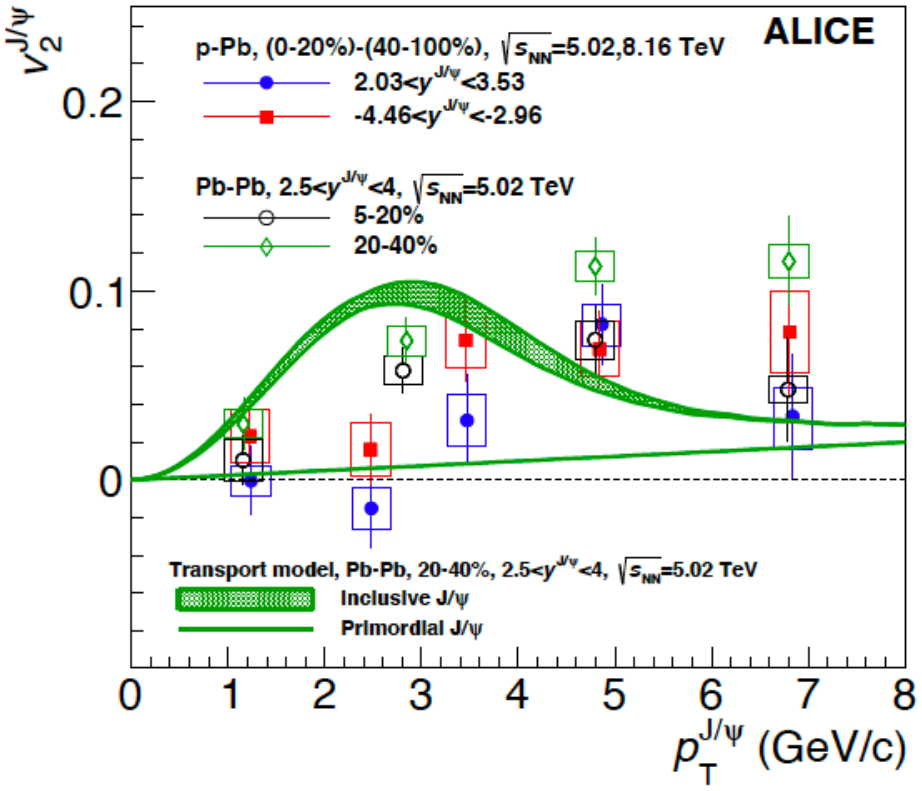
Non-zero v_2 measured in PbPb and in pPb

Measured v_2 in pp for other observables

Objective: Find if there is indeed a significant non-zero v_2 for the J/ψ in pp, the smallest system

Apply established **procedure from p-Pb** (based on 2-particle correlations)

ALICE, p-Pb publication [arXiv:1709.06807]



Analysis description

- Separate high and low multiplicity collisions (“central” and “peripheral”)
  - Make pairs of particles: dimuon-tracklet or tracklet-tracklet

(tracklet: charged particle track in the central barrel, whereas J/ψ observed through dimuon decay in forward spectrometer)

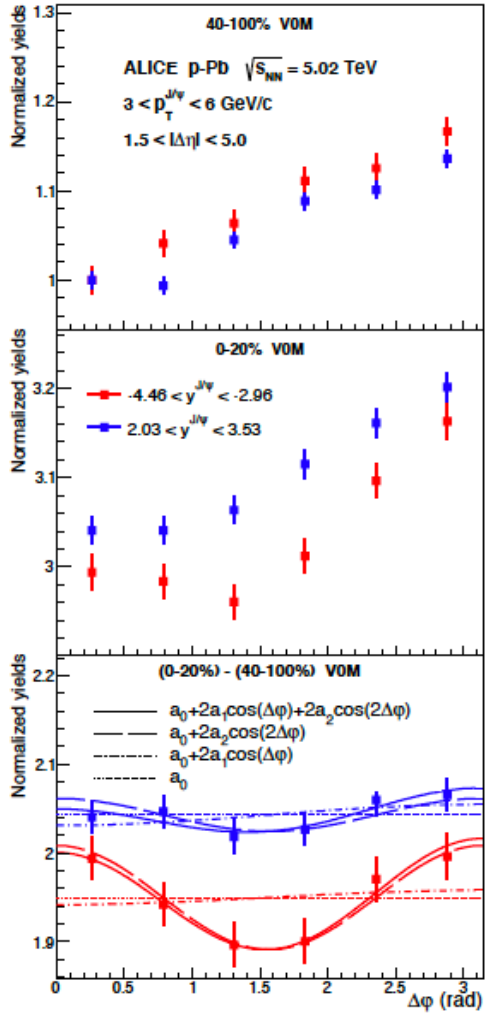
  - Measure particle correlations with respect to Δη (pseudorapidity) and $\Delta\phi$ (azimuthal angle)
  - Compute “per trigger yields”*
  - Subtract Central and Peripheral yields to get rid of non flow-effects
  - Measure $V_{2,tracklet-J/\psi}, V_{2,tracklets}$ $and\ deduce\ v_{2,J/\psi}$

* $$Y^i(z_{\mathrm{vtx}}, M_{\mu\mu}, p_{\mathrm{T}}^{\mu\mu}, \Delta\varphi, \Delta\eta) = \frac{1}{N^i_{\mathrm{trig}}(z_{\mathrm{vtx}}, M_{\mu\mu}, p_{\mathrm{T}}^{\mu\mu})} \frac{\mathrm{d}^2 N^i_{\mathrm{assoc}}(z_{\mathrm{vtx}}, M_{\mu\mu}, p_{\mathrm{T}}^{\mu\mu})}{\mathrm{d}\Delta\varphi \mathrm{d}\Delta\eta}$$

$$= \frac{1}{N^i_{\mathrm{trig}}(z_{\mathrm{vtx}}, M_{\mu\mu}, p_{\mathrm{T}}^{\mu\mu})} \frac{SE^i(z_{\mathrm{vtx}}, M_{\mu\mu}, p_{\mathrm{T}}^{\mu\mu}, \Delta\varphi, \Delta\eta)}{ME^i(z_{\mathrm{vtx}}, M_{\mu\mu}, p_{\mathrm{T}}^{\mu\mu}, \Delta\varphi, \Delta\eta)},$$

Number of associated particle pairs found in a bin of Δη, $\Delta\phi$, z_{vertex}, invariant mass, p_t, centrality

Number of reference particles triggered on in a bin of z_{vertex}, invariant mass, p_t, centrality

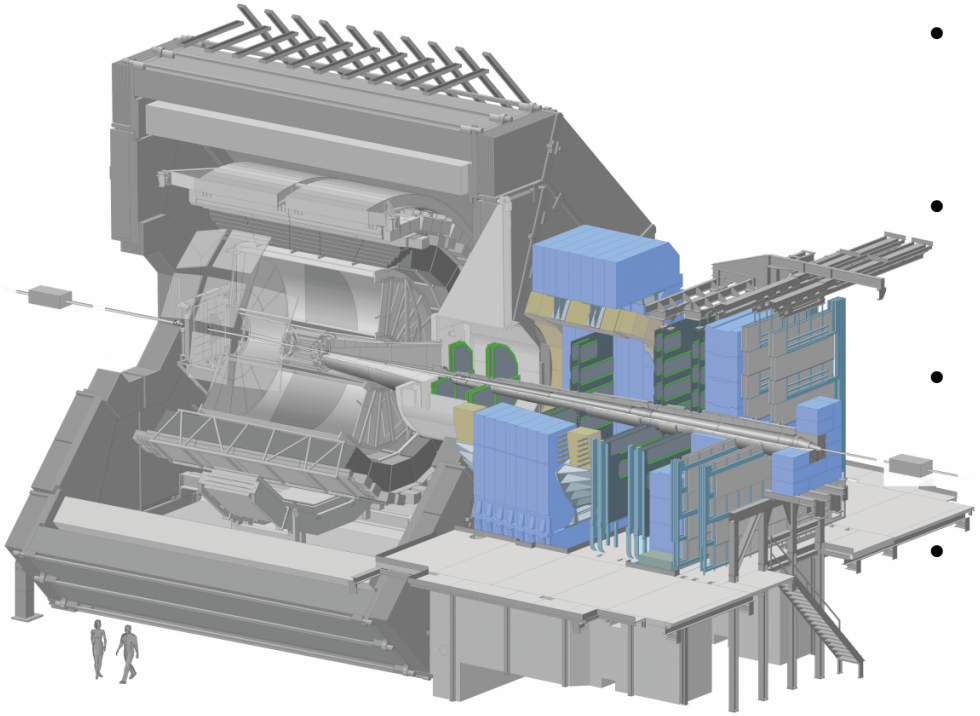


ALICE, p-Pb publication [arXiv:1709.06807]

MCH commissioning

Quality Control development

Muon Spectrometer



- Forward detector
  (-4 < y < -2.5)
- Front absorber and trigger chambers
- 5 stations of 2 detection chambers each
- A dipole magnet (3 T.m) for p_T identification

Electronics and readout being upgraded within ALICE Upgrade during LS2 (up until next year)
MCH needs to be commissioned (installation and quality control of the detectors)

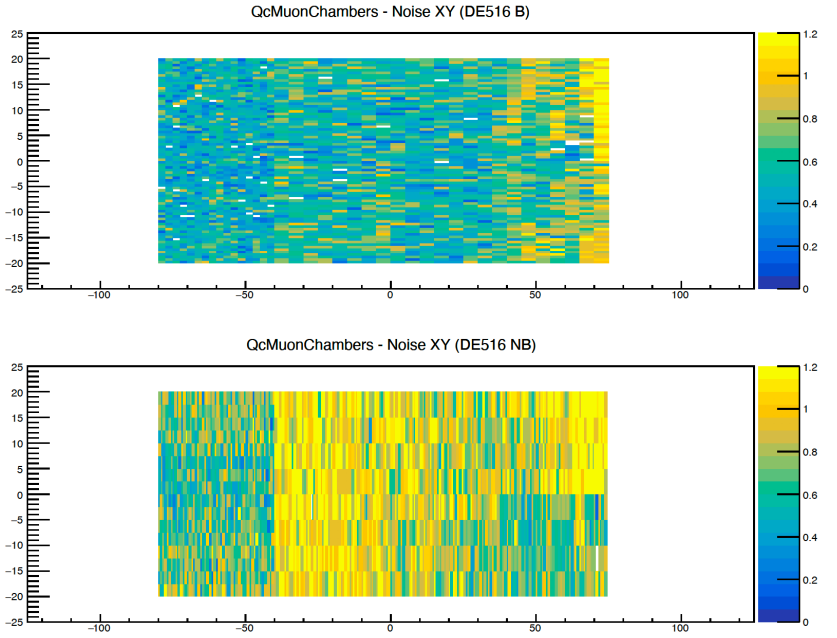
Quality Control

- During commissioning: Checking noise and pedestals levels of the detectors
- During Run 3: Monitoring various observables to ensure proper functionning of the detectors

Interesting observables to monitor

During commissioning:

- Runs on noise data
- Displays the noise and pedestal values of each channel
- Check: identification of noisy channels (info to be sent to mask them)



During Run 3:

- Error checker (check readout errors on raw data)
- Monitor detector occupancy, efficiency, deposited charge
- Trending of values over time

Conclusion

Analysis (J/ψ v_2 in pp)

Searching for collective behaviour in small systems
Ongoing work

MCH Commissioning

Ongoing work on Quality Control development

- Development of tasks and tools to monitor the detectors
- Used for noise and pedestal studies and for Run 3 data taking

Work on clustering algorithms

- Porting of simple algorithms
- Checks on Test Beam data
- Ongoing work in the collaboration to develop more complex clusterings and improve the results

Thank you for your attention !