Heavy Flavour Jets Production in Pb+Pb Collisions with the ATLAS Detector

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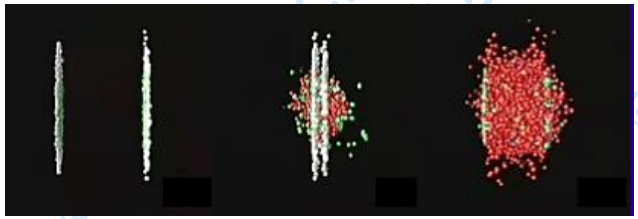
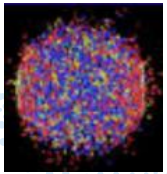
Heavy Ions and the Quark Gluon Plasma

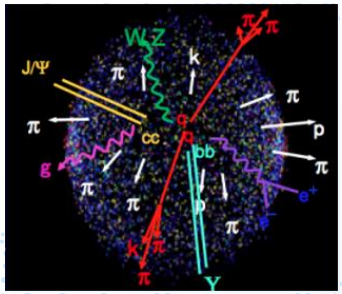
- Why study heavy ion collisions?



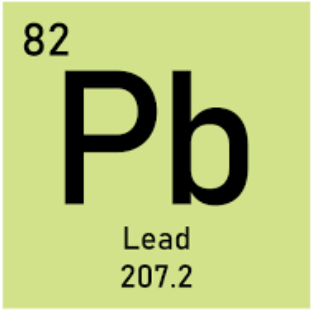
Incoming Nuclei Collison QGP



Mixed Phase

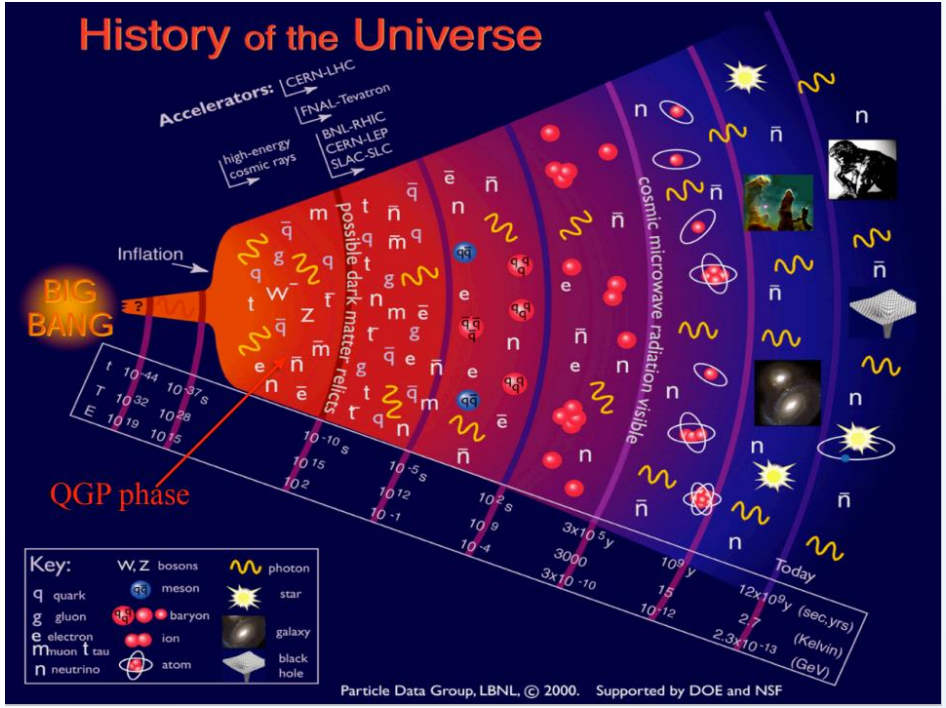


- Lead has 208 nucleons

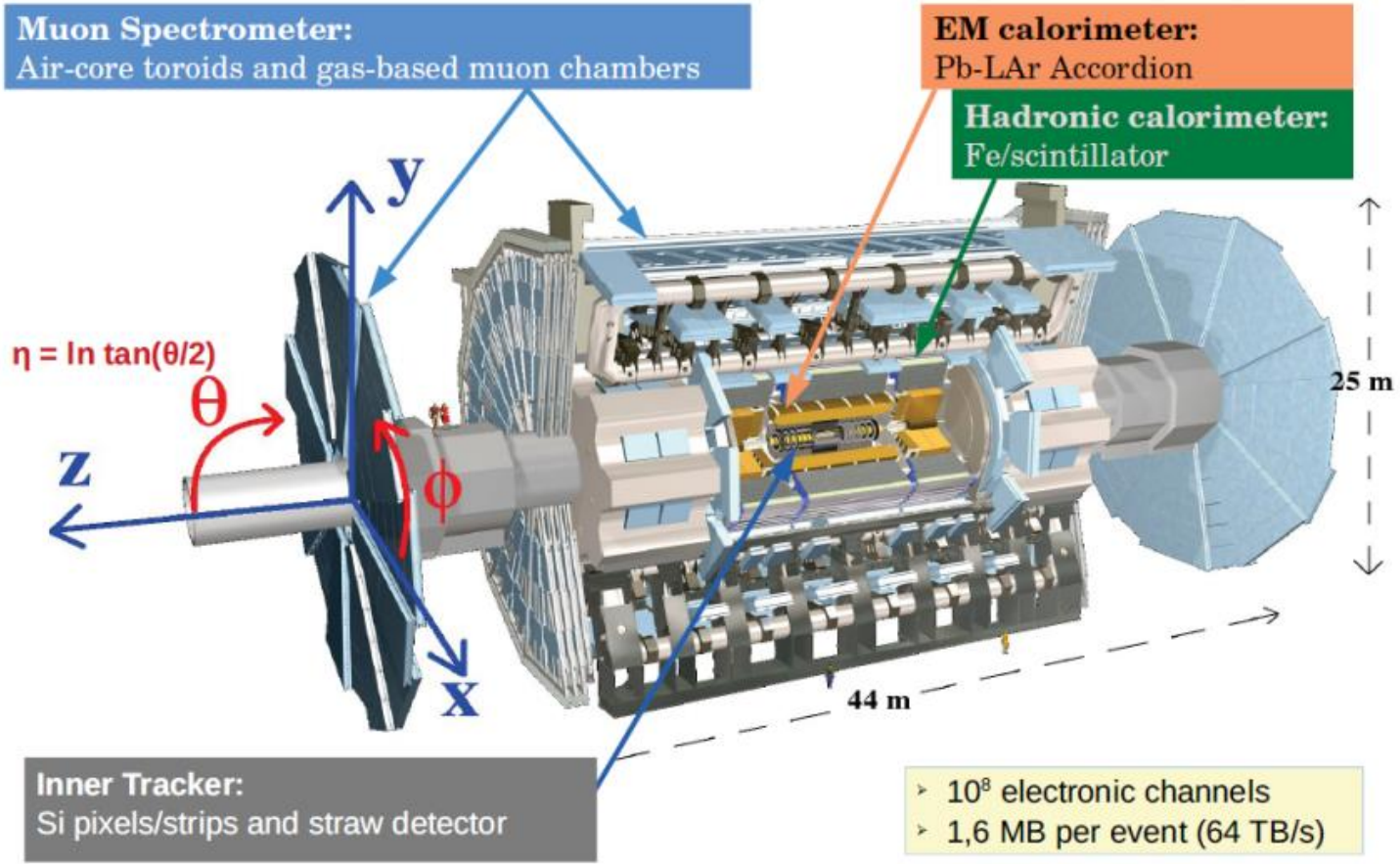


Heavy Ions and the QGP

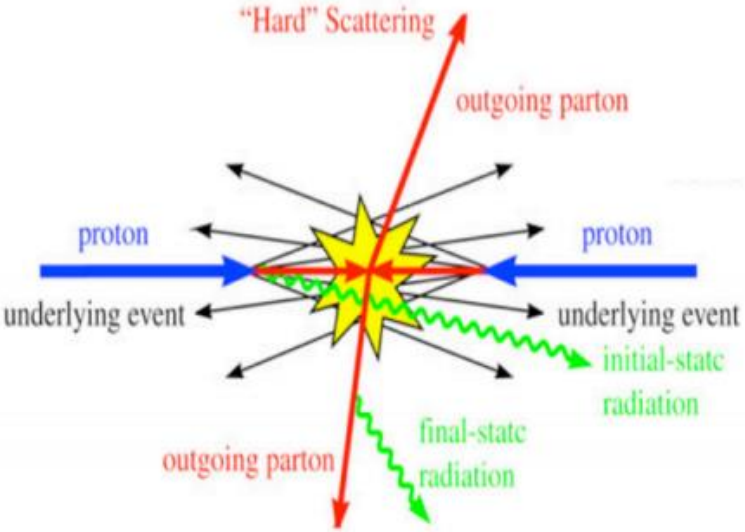
- Why study the Quark Gluon Plasma?



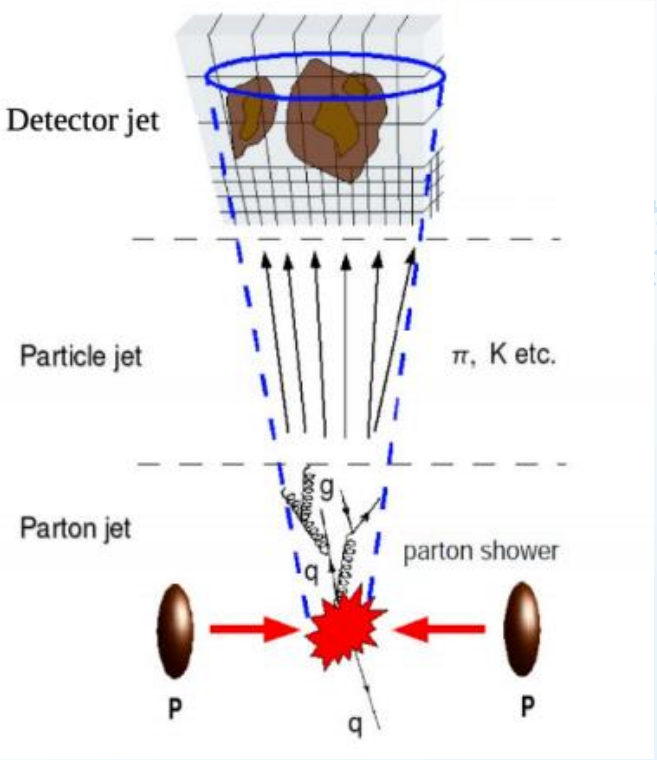
ATLAS Detector



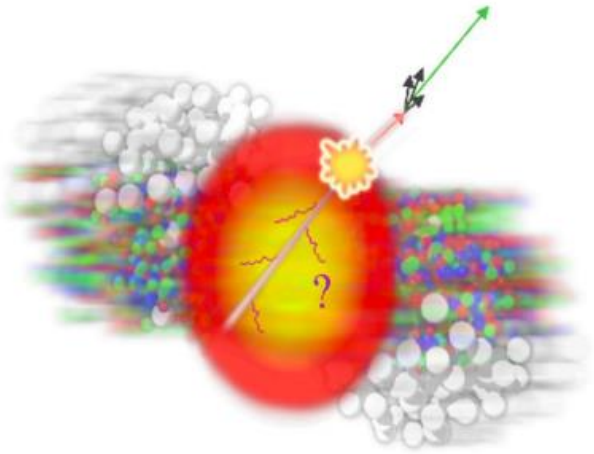
Jets as the golden probes of the QGP



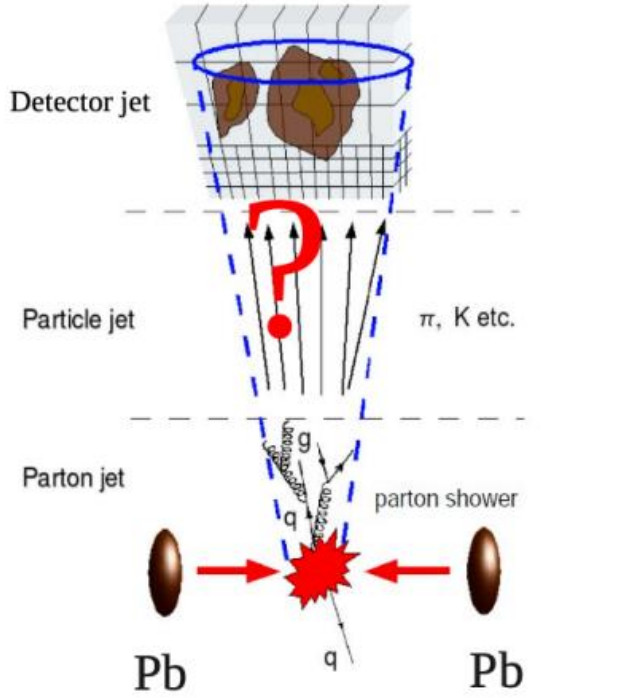
Proton-Proton Collisions



Jets as the golden probes of the QGP



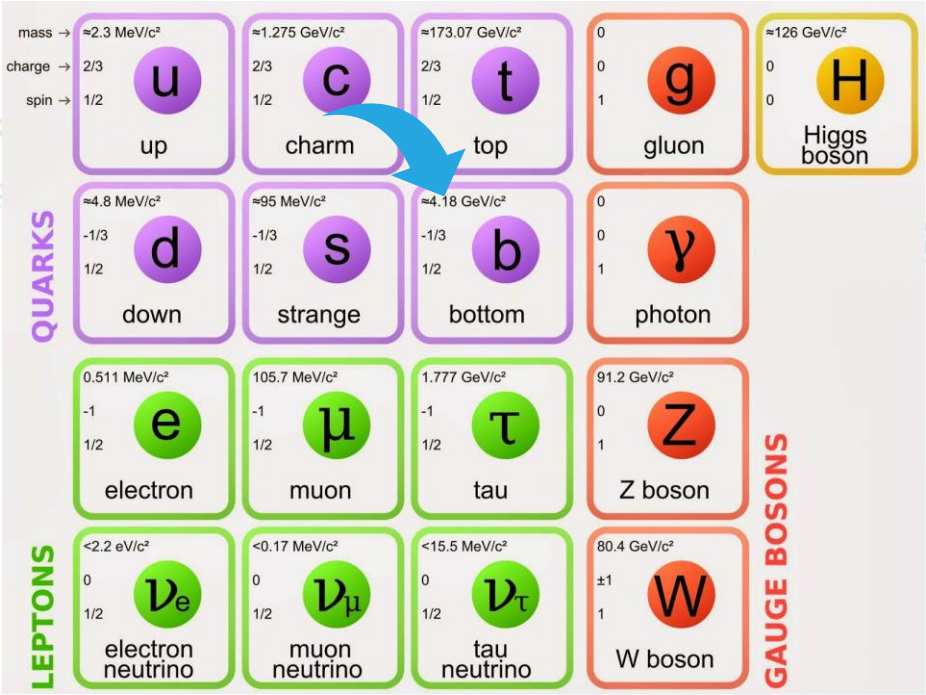
Lead-Lead Collisions



b-jets and the QGP

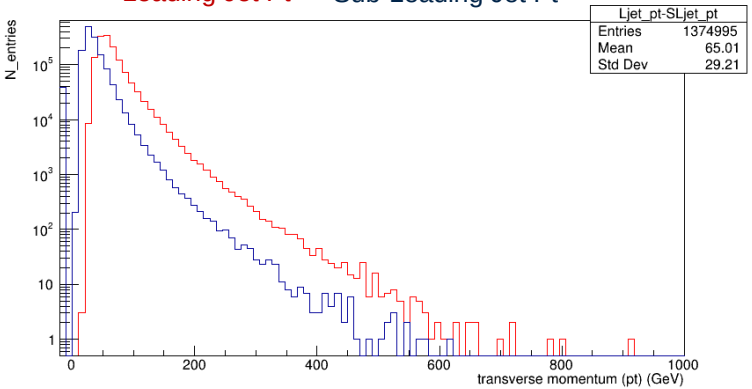
- Why study b-jets in the QGP?

- What is the expected behaviour of b-jets in the QGP?

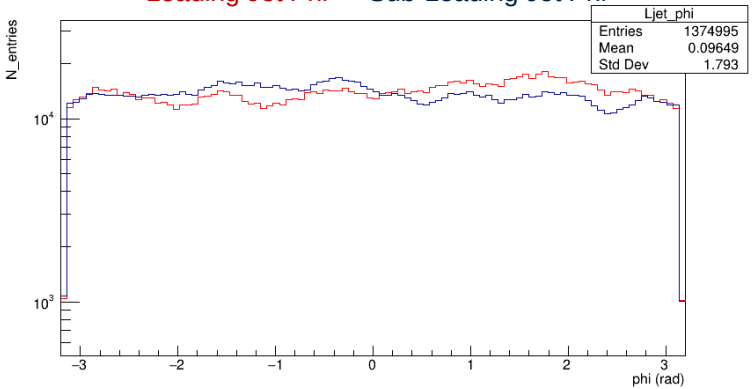


The sample used in this project

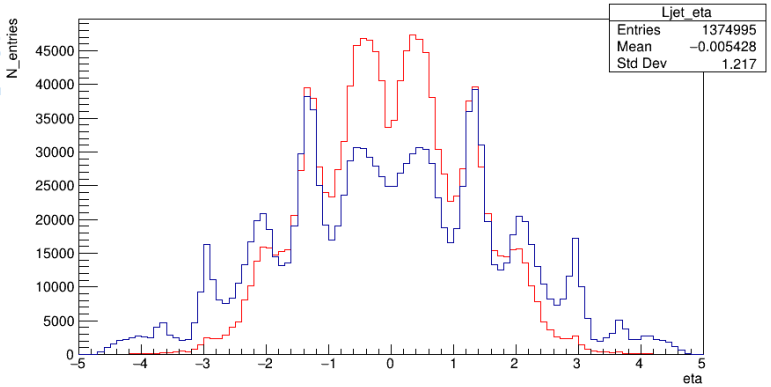
Leading Jet Pt Sub-Leading Jet Pt



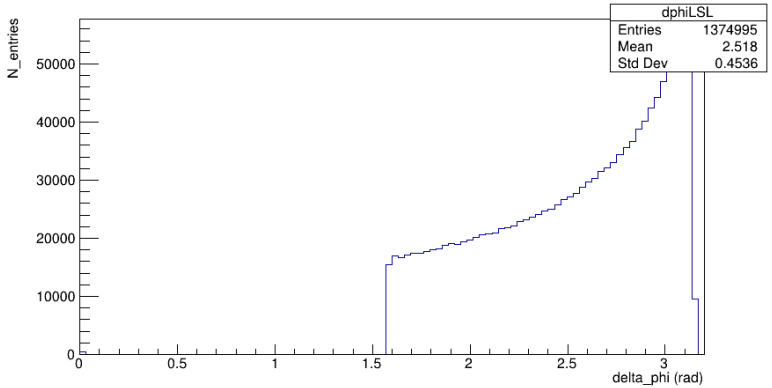
Leading Jet Phi Sub-Leading Jet Phi



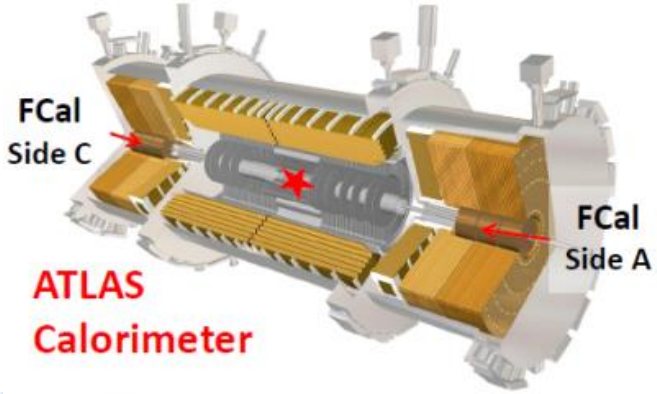
Leading Jet Eta Sub-Leading Jet Eta

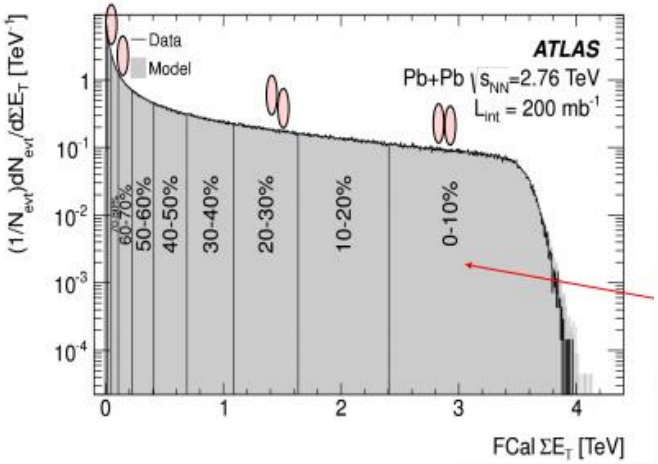


Delta Phi

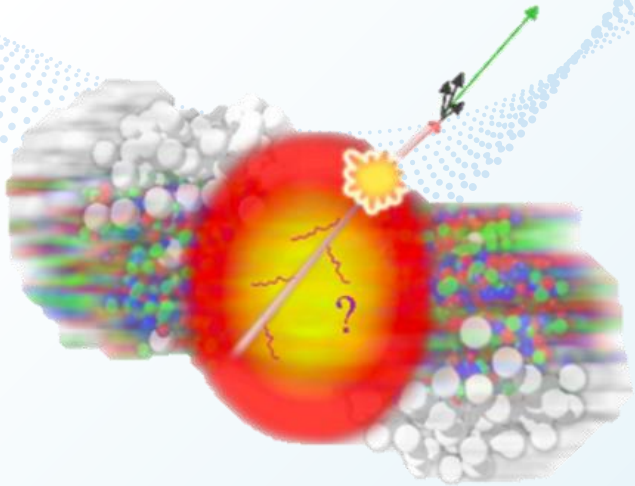


Collision centrality and the QGP





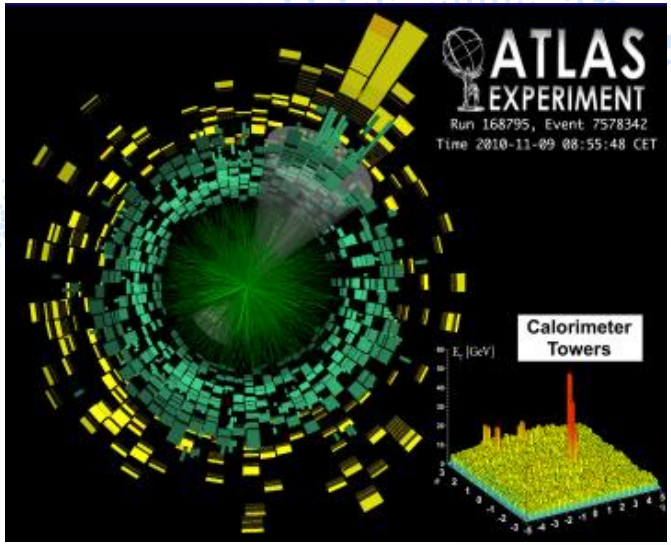
- QGP is formed only if the collision is central enough
- We can determine centrality with the energy deposited in the Forward Calorimeters

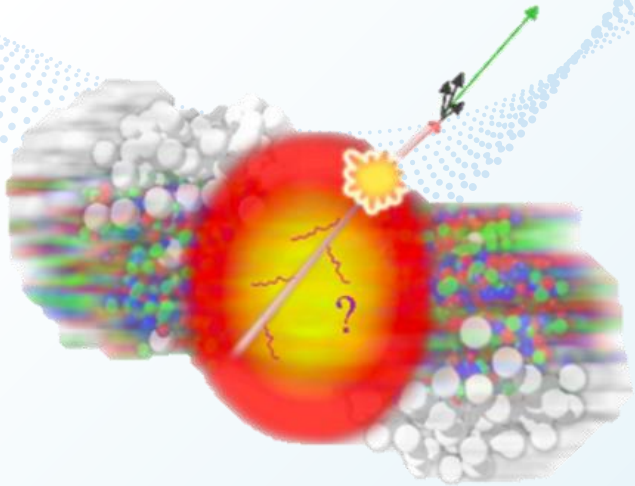


Di-jet asymmetry in heavy ion collisions

- The transverse momentum asymmetry observable is a great way to see the effect of the QGP on jets

$$A = \frac{Ljet\_pt - SLjet\_pt}{Ljet\_pt + SLjet\_pt} \quad (1)$$



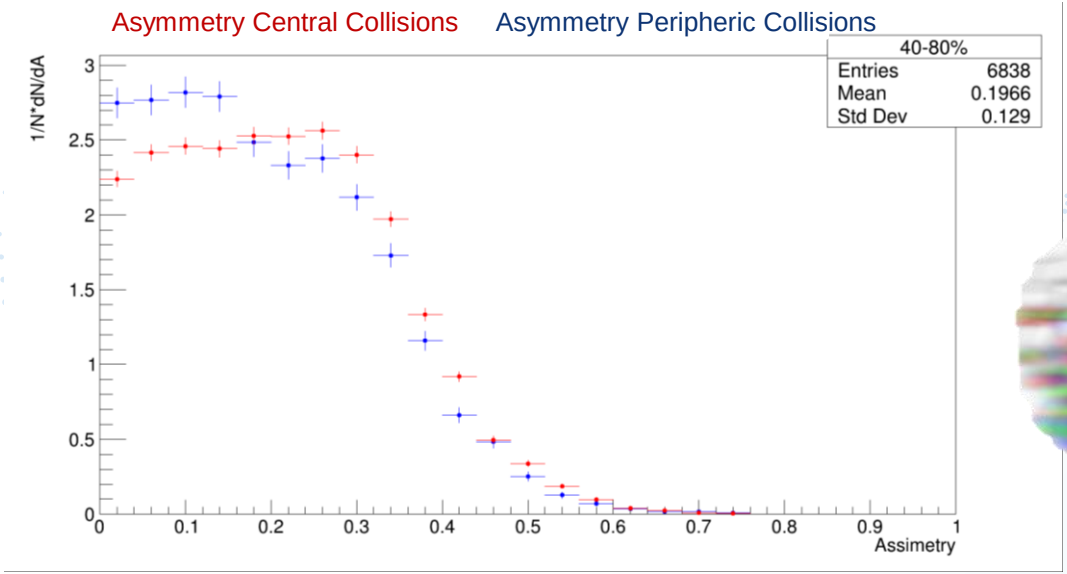


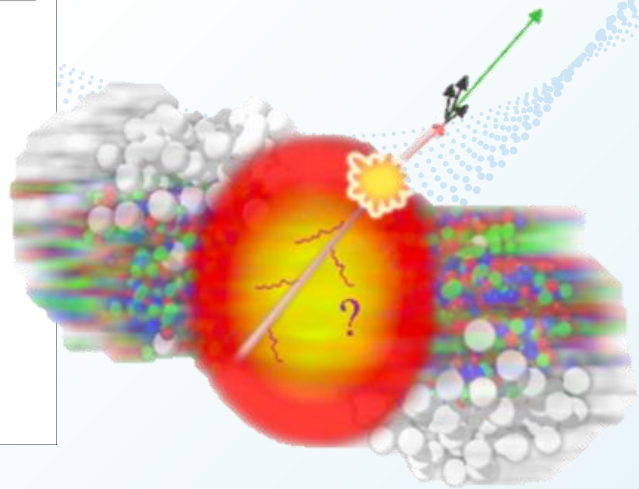
(1) https://arxiv.org/pdf/1011.6182.pdf

Di-jet asymmetry in heavy ion collisions

- Cuts used for this graph: SLjet_pt>50GeV, Ljet_pt>100GeV, |eta| < 2.8, dphi > 2.5

$$A = \frac{Ljet\_pt - SLjet\_pt}{Ljet\_pt + SLjet\_pt} \quad (1)$$





(1) https://arxiv.org/pdf/1011.6182.pdf

Di-jet asymmetry for b-jets

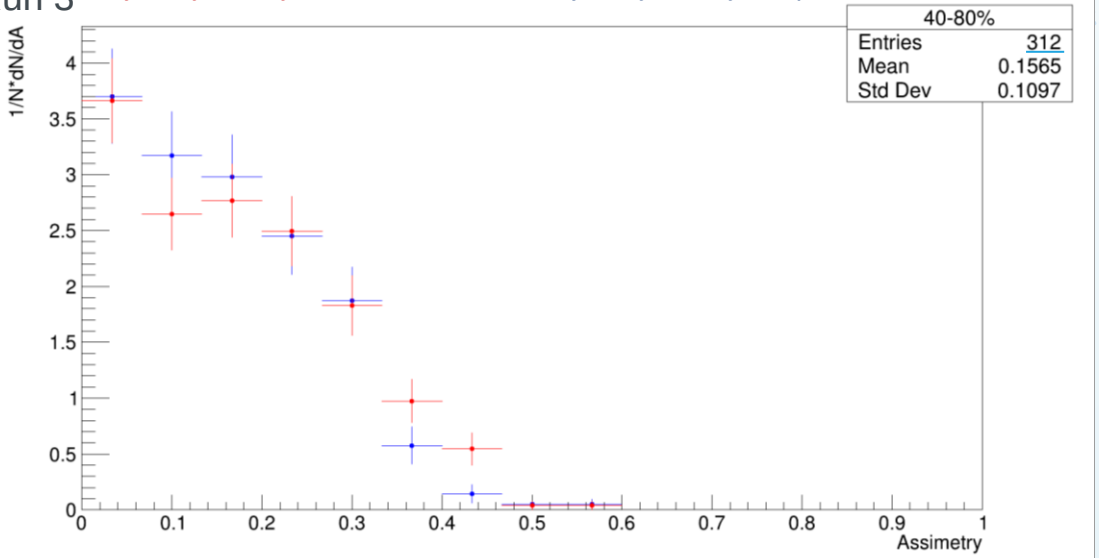
- To study the b-jet assymmetry, the ideal events are the back-to-back $b\bar{b}$
- However, there is too little statistic as these are only 0.6% of all events
- Something to be looked at in Run 3

$$A = \frac{Ljet\_pt - SLjet\_pt}{Ljet\_pt + SLjet\_pt}$$

BB – 0.6%
BU – 6%
BC – 0.5%

Inclusive di-jet production
“U” stands for all light jets (2)

b-jet Asymmetry Central Collisions b-jet Asymmetry Peripheric Collisions

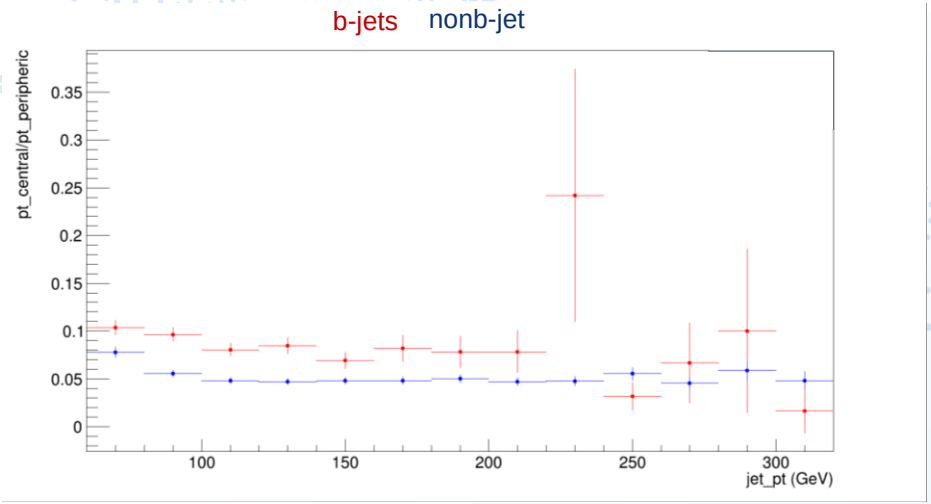


(2) https://arxiv.org/pdf/1210.0441.pdf

R_{cp}

- R_{cp} is the normalized ratio between the central pt histogram and peripheral pt histogram
- R_{cp} analysis requires only one b-jet per event, so we can use more statistic (7.1% of the events)

$$R_{\mathrm{CP}}^{\mathrm{meas}}(p_{\mathrm{T}})\big|_{\mathrm{cent}} = \frac{1}{R_{\mathrm{coll}}^{\mathrm{cent}}} \left(\frac{\frac{N_{\mathrm{jet}}^{\mathrm{cent}}(p_{\mathrm{T}})}{N_{\mathrm{evt}}^{\mathrm{cent}}}}{\frac{N_{\mathrm{jet}}^{60-80}(p_{\mathrm{T}})}{N_{\mathrm{evt}}^{60-80}}} \right) \quad (3)$$



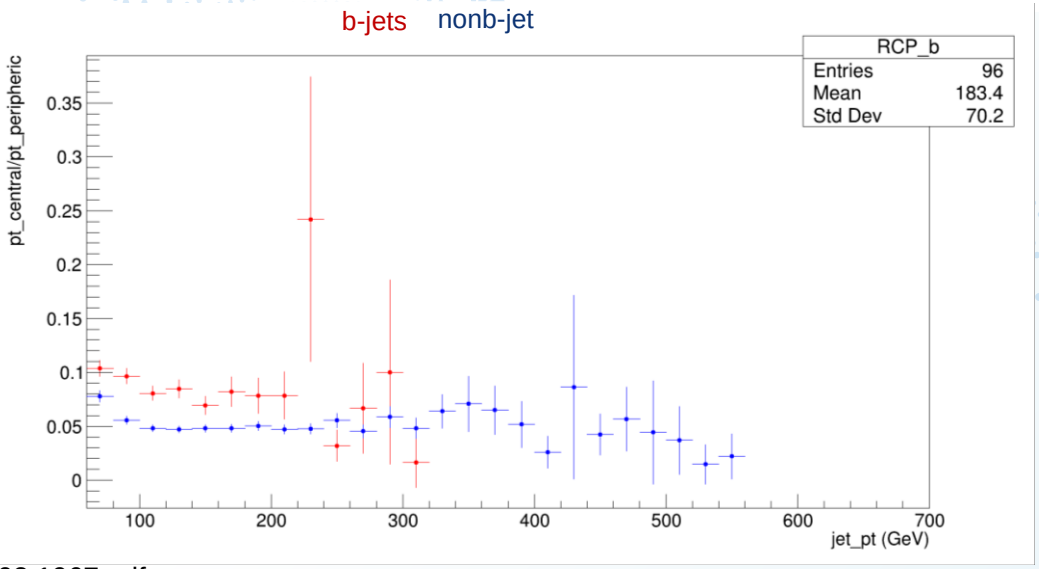
b-jets are less suppressed by the QGP

(3) https://arxiv.org/pdf/1208.1967.pdf

RCP

- However, more statistic is still needed to reach higher values of transverse momentum
- Bias in sample has affected normalization

$$R_{\mathrm{CP}}^{\mathrm{meas}}(p_{\mathrm{T}})|_{\mathrm{cent}} = \frac{1}{R_{\mathrm{coll}}^{\mathrm{cent}}} \left(\frac{\frac{N_{\mathrm{jet}}^{\mathrm{cent}}(p_{\mathrm{T}})}{N_{\mathrm{evt}}^{\mathrm{cent}}}}{\frac{N_{\mathrm{jet}}^{60-80}(p_{\mathrm{T}})}{N_{\mathrm{evt}}^{60-80}}} \right) \quad (2)$$



(2) https://arxiv.org/pdf/1208.1967.pdf

Conclusions

- Jets in central collisions are suppressed by the QGP, as shown by the di-jet asymmetry
- b-jets are shown to be less suppressed by the QGP
- More statistics are necessary to study the effects of the QGP on b-jets ➡ Run 3

Thank You!