

Light Ion Collisions at LHC in a QGP Context

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Topics

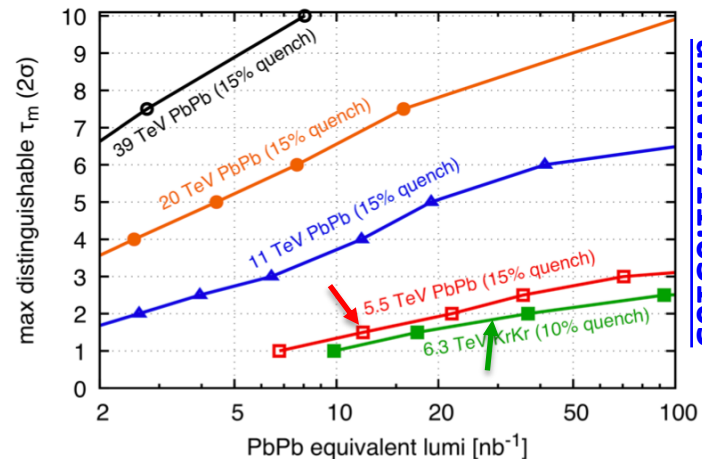
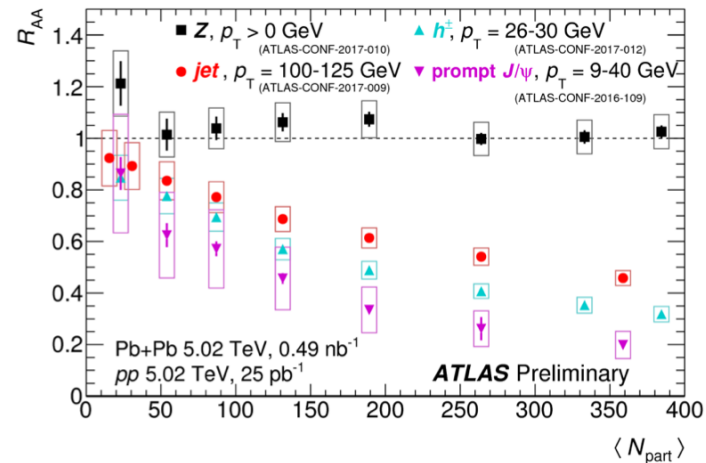
- Maximizing nucleonic luminosity for hard probes
 - Balance between instantaneous lumi and A
 - A large enough that QGP effects are non-trivial
- Geometry
 - Varying size and collision geometry independently
 - Future Glauber model use?
- Analysis prospects w/smaller underlying event

Gain in Nucleonic Luminosity

- Basic gain with Argon as example case (estimates from John Jowett):
 - Instantaneous nucleonic luminosity for Ar/Pb ≈ 5 :
 $40^2 \times 2E30 \text{ cm}^{-2} \text{ s}^{-1} / 208^2 \times 1.5E28 \text{ cm}^{-2} \text{ s}^{-1}$
 - Expect another factor of ~ 2 in integrated luminosity b/c EM cross sections that limit Pb are much smaller
 - Factor of **~ 10** total gain in integrated nucleonic luminosity and thus hard probe statistics
- Still to determine if there is some *best* choice for maximizing nucleonic luminosity by balancing peak lumi, lifetime, and A
 - Broad picture of luminosity vs A ideal
 - In the meantime Xe, Kr, and Ca are on the table
- “Technical” but important limitation: ALICE detector limit by total soft yield (\sim TPC), so would be difficult to take advantage of higher instantaneous luminosity

QGP Onset

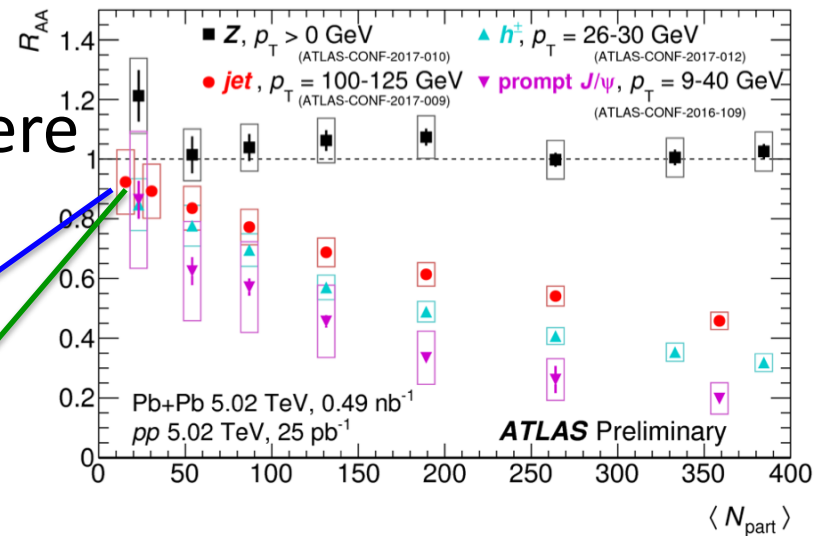
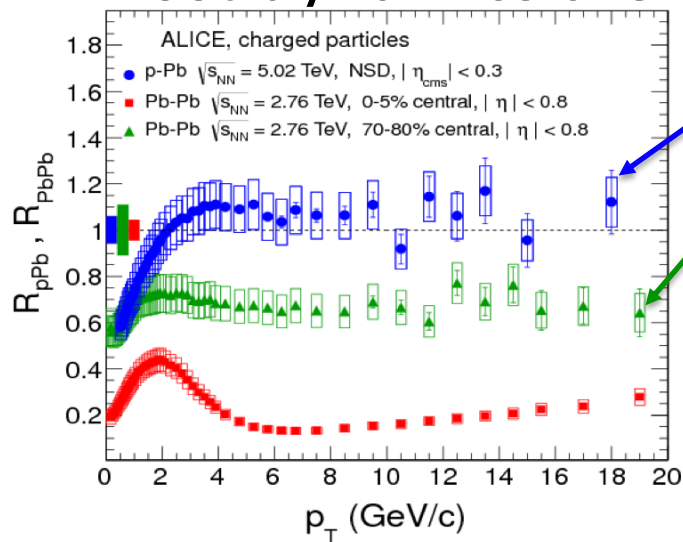
- Gain in number of hard probes is relevant (in this context) if QGP effects can be seen
- Generically, QGP signatures are 'on' (if not maximally) by $N_{\text{part}} \approx 70 \approx \text{central Ar+Ar}$
- Case by case different observables have different dynamics and uncertainties
 - (Inclusive R_{AA} wouldn't benefit much from statistical increase)
 - Something like top quark measurements might



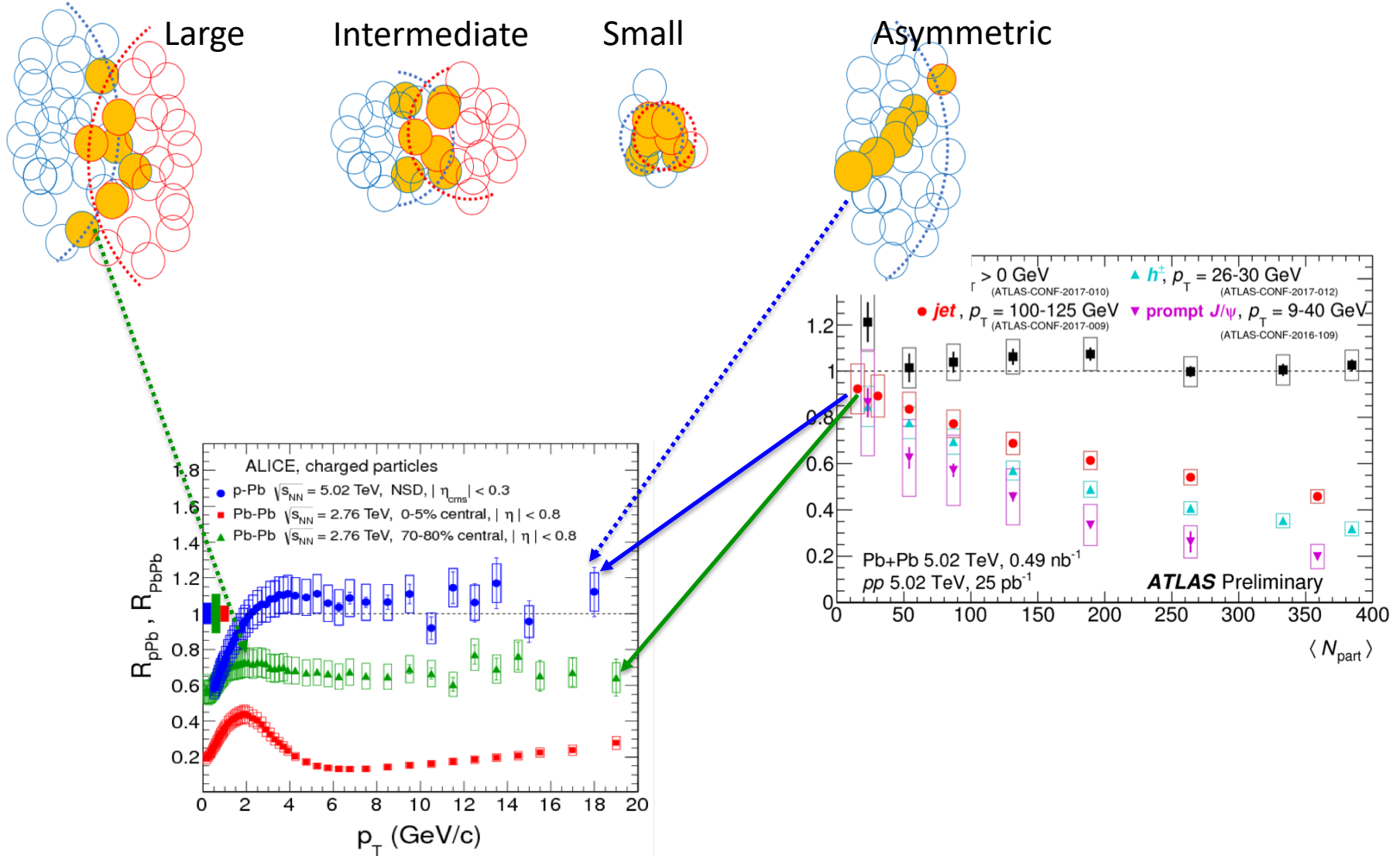
QGP Onset?

- Challenge of smaller QGP effects to measure may also be a physics opportunity

– More tools to study the QGP onset, data where most dynamics are

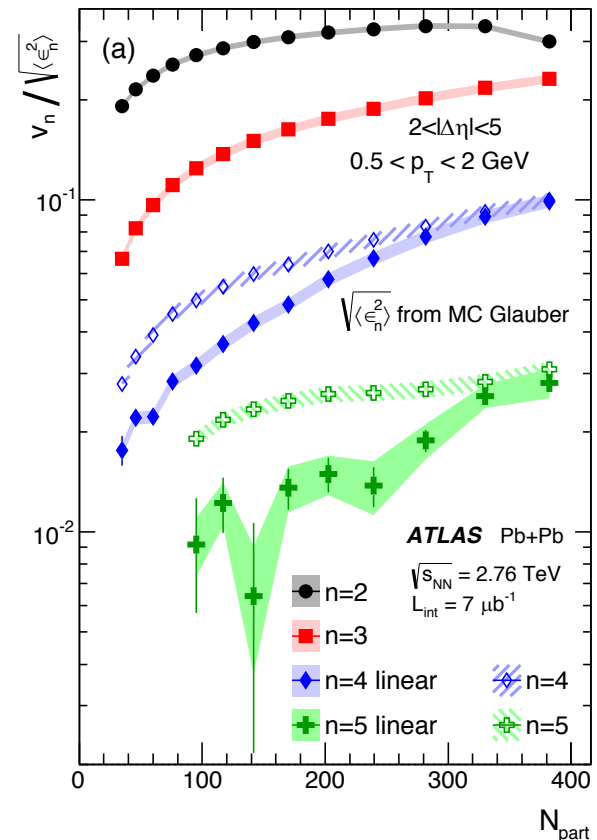


QGP Onset: Size vs Geometry



Changing Geometry

- Different A values also provide a way to vary eccentricity separately from size
- From energy loss point of view, opportunity to vary energy density separately from path length
- Could be relevant for J/Ψ regeneration: multiplicity vs volume



Use of Glauber Model

- Many atoms have measured nuclear charge radius but not diffusivity
- How important is having measured input for Glauber model of chosen A?
 - Can we trust models?
 - Can the measurements be made?

Analysis Gains From Smaller Underlying Event

- Smaller underlying event should have *direct* benefit for jet energy resolution, missing energy, etc
 - Could also improve low-mass dilepton, charm-charm, etc
- Improvement in statistical uncertainty should be accompanied by systematic uncertainty for many measurements
 - Specific performance estimates needed
- Enable new measurements?

To Go Forward

- Two central benefits to small A: maximizing luminosity and changing geometry
- General questions:
 - How best to optimize LHC running to physics?
 - Studies beyond Ar underway for luminosity
 - Theory input for physics questions
 - What outside input is needed?
 - Input to Glauber? Other?
- Specific questions:
 - Performance estimates for specific analyses
 - Learn from XeXe
- Changing A also touches nPDF, diffractive, and related studies