Measurement of suppression of large-radius jets and its dependence on substructure in Pb+Pb with ATLAS

Martin Krivos for the ATLAS Collaboration

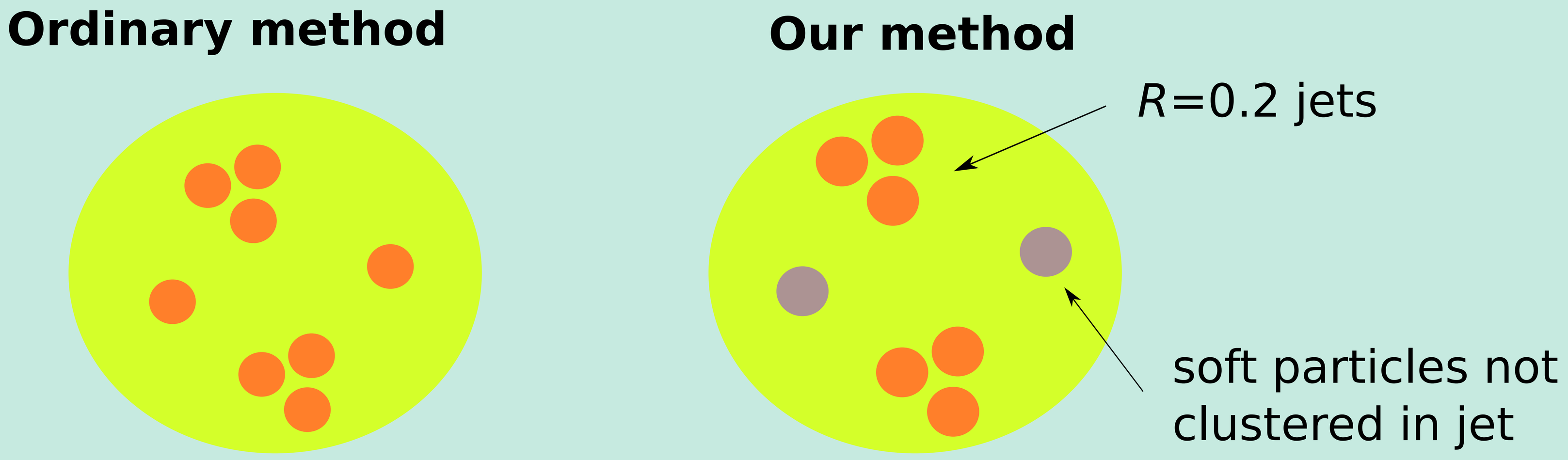
INTRODUCTION

- Measurements of the suppression of the jet yield in Pb+Pb compared to *pp* provide insight on the energy-loss process and the properties of the quark-gluon plasma (QGP).
- A new method was used to produce R=1.0 jets - see section JET RECONSTRUCTION for more details.
- We want to study if jet quenching (suppression of jets) depends on the jet substructure and if color coherence is present.
- Some models which describe the jet energy loss in the QGP, propose that the medium can only resolve partonic fragments at certain transverse resolution scale and below this scale, they act coherently as a single emitter.
- The transition from color coherence to decoherence not seen with the resolution power of this analysis.
- Data were collected during 2018 Pb+Pb (1.72 nb^{-1}) and 2017 *pp* (257 pb^{-1}) data, both at the center-of-mass energy of 5.02 TeV.

Conf. note: ATLAS-CONF-2019-09

JET RECONSTRUCTION

• R=1.0 Jets: R=0.2 Jets with p_T > 35GeV reclustered with anti-k_t algorithm within $|y|$ < 2.0.
• Difference with respect to ordinary R=1.0 jets - particles from the soft radiation and UE are removed.



• 2D(1D) Bayesian unfolding is applied in jet p_T and splitting scale (in jet p_T only).
• The unfolding removes the effects of the jet energy resolution, residual jet energy scale non-closure and the combinatorial contribution.

Splitting scale:

Characterizes jet substructue, it is a scale of the last clustering step and the harderst splitting. Is defined as:

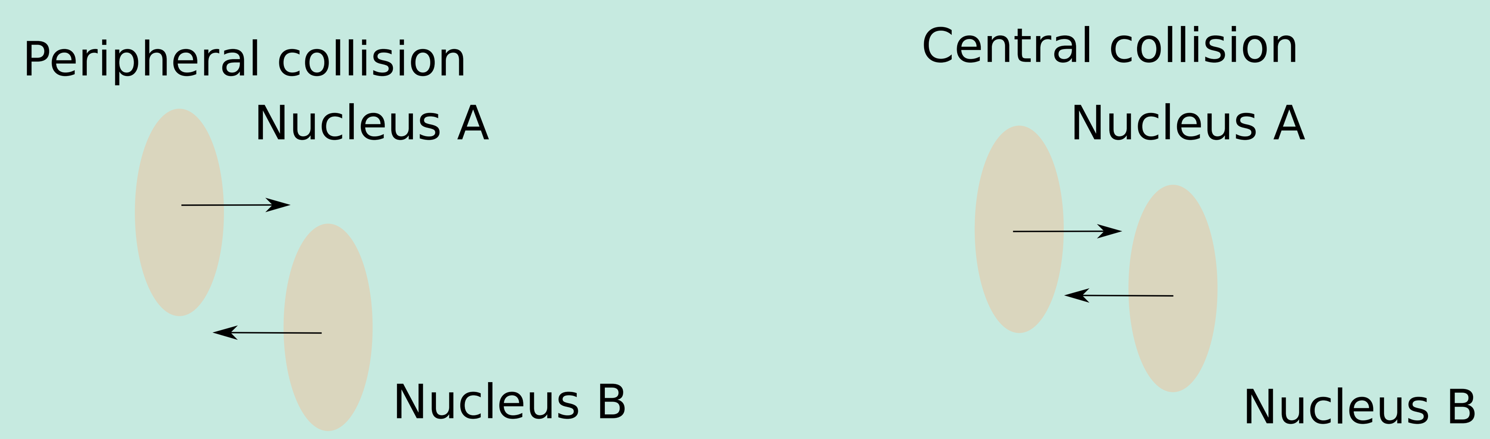
$$\sqrt{d_{12}} = min(p_{T1}, p_{T2}).\Delta R_{12}$$

where R_{12} is:

$$\Delta R_{12} = \sqrt{\Delta\phi^2 + \Delta y^2}$$

CENTRALITY

• Quantify how much colliding nulcei overlap



• We introduce <N_{part}> as average number of participating nucleons.
• 0-10% centrality: The most central collisions, large <N_{part}>.
• 60-80% centrality: Peripheral collisions.
• Measured by transverse energy deposited in forward calorimeter.

NUCLEAR MODIFICATION FACTOR

• Measures difference between *pp* and Pb+Pb collisions and how much jets are suppressed.

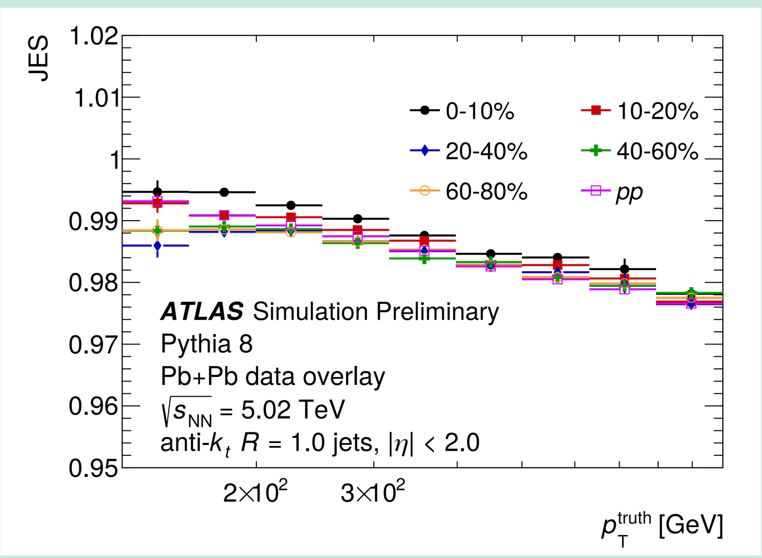
• Defined as:

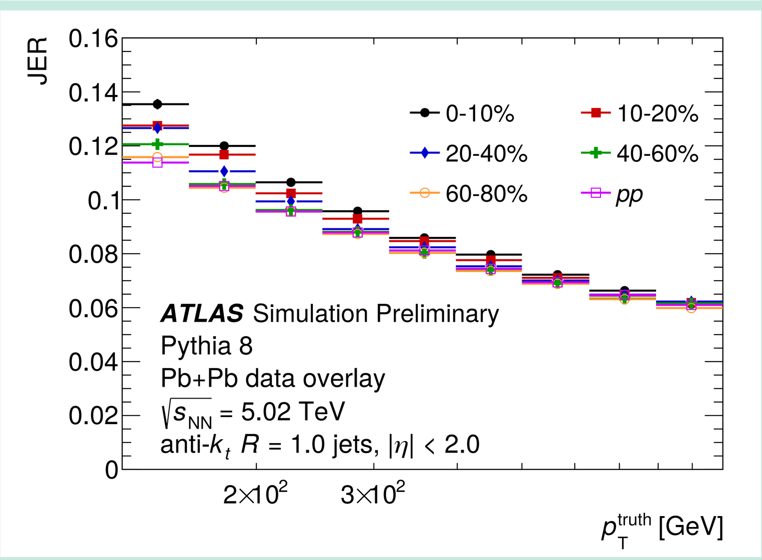
$$R_{AA} = \frac{\frac{1}{N_{evt}}\frac{d^3N^{AA}_{jet}}{dp_T d\sqrt{d_{12}}dy}}{\langle T_{AA}\rangle \frac{d^3\sigma^{pp}_{jet}}{dp_T d\sqrt{d_{12}}dy}}$$

where <T_{AA}> is nuclear thickness function.
• R_{AA} = 1 : no suppression
• R_{AA} = 0.5: yields suppressed by factor of 2 in Pb+Pb compared to *pp*.

JES AND JER

Our method results in good Jet energy scale (JES) and Jet energy resolution (JER).

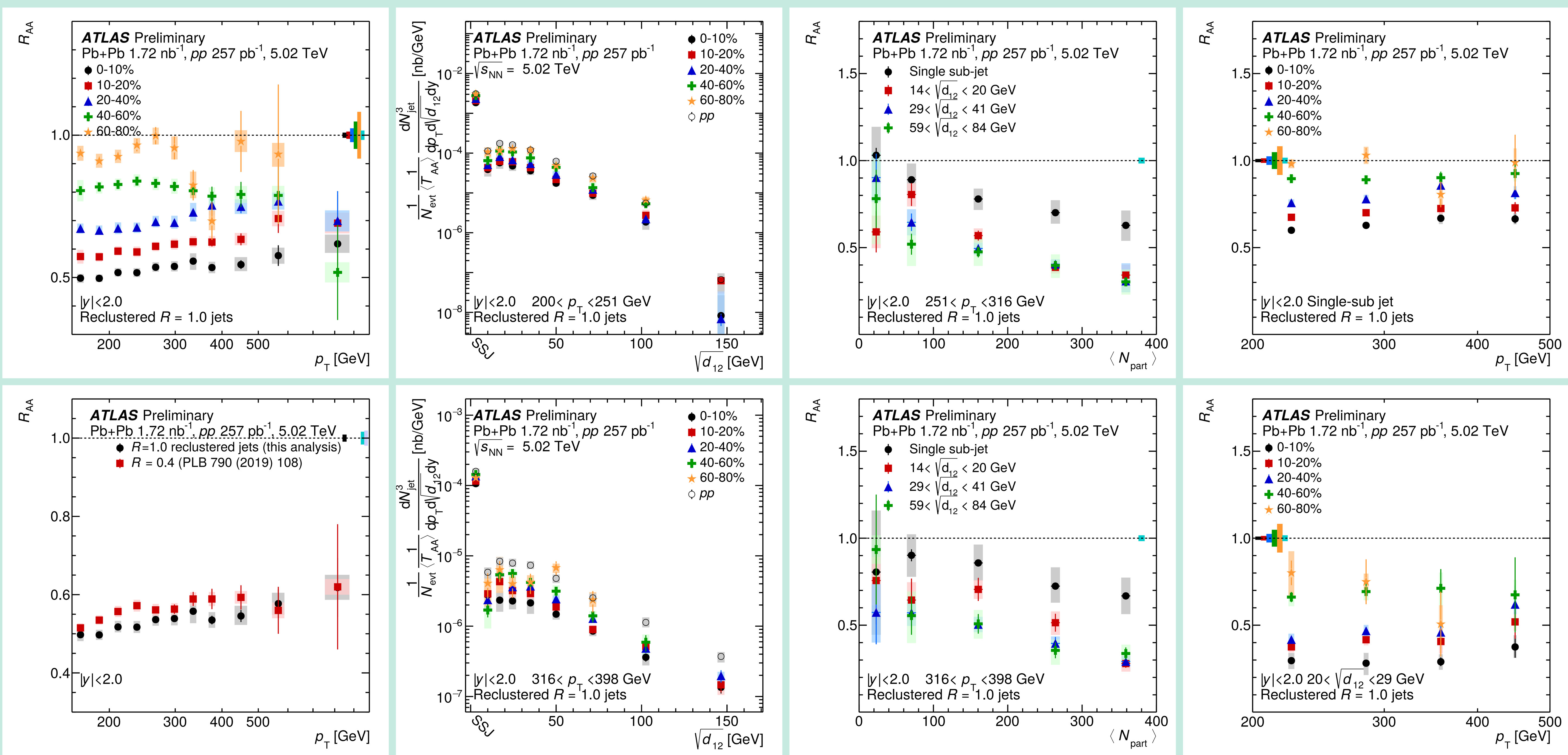




BOOST, 2020, Online

RESULTS

Inclusive R_{AA} | Yields with splitting scale | R_{AA} vs <N_{part}> | R_{AA} vs p_T



•R_{AA} is consistent with anti-k_t R=0.4 jets
•Suppression up to factor of 2 in the most central collisions.
•p_T dependence.

• R_{AA} drops significantly from single sub-jet to non-zero splitting scale (more complex substructure).

• R_{AA} decreases as <N_{part}>increases (more central collisions).

• R_{AA} increases as jet p_T increases for R=1.0 jets with a single sub-jet.

The jets with single sub-jet are less suppressed with respect to those with higher sub-jet multiplicity → color decoherence.