Projections for jet quenching measurements in OO collisions at $\sqrt{s_{NN}}$ = 6.37 TeV during the LHC Run3

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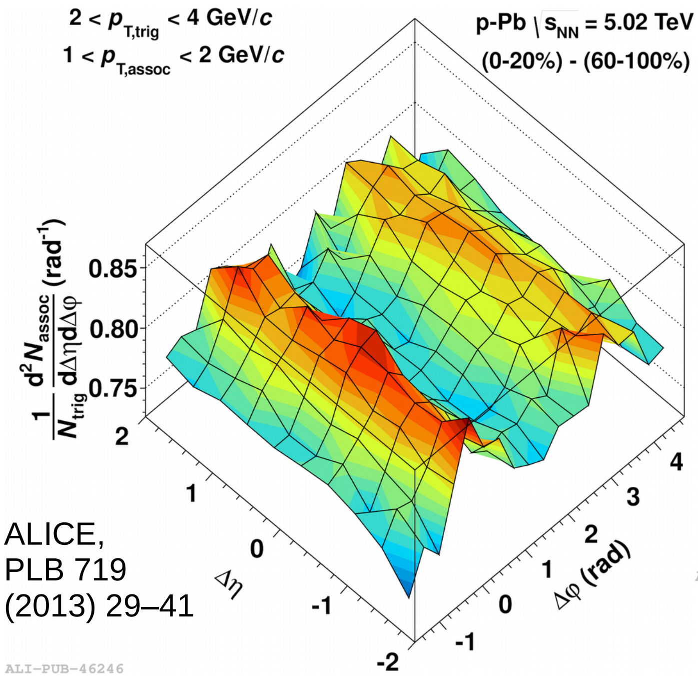
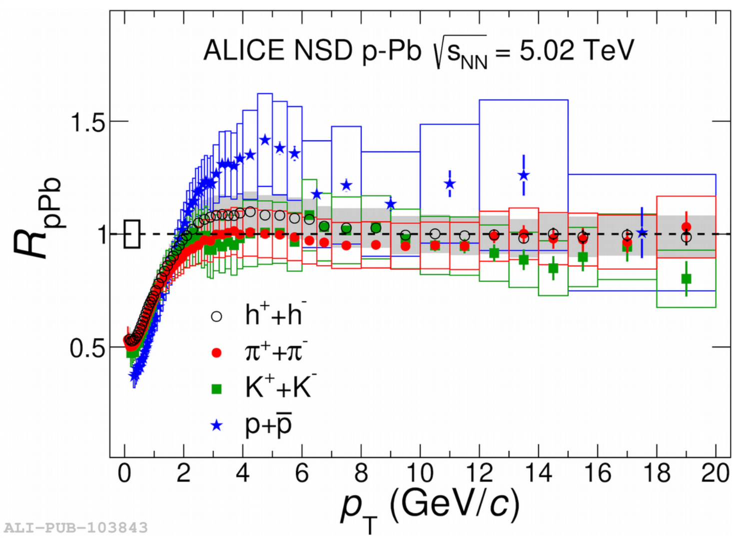
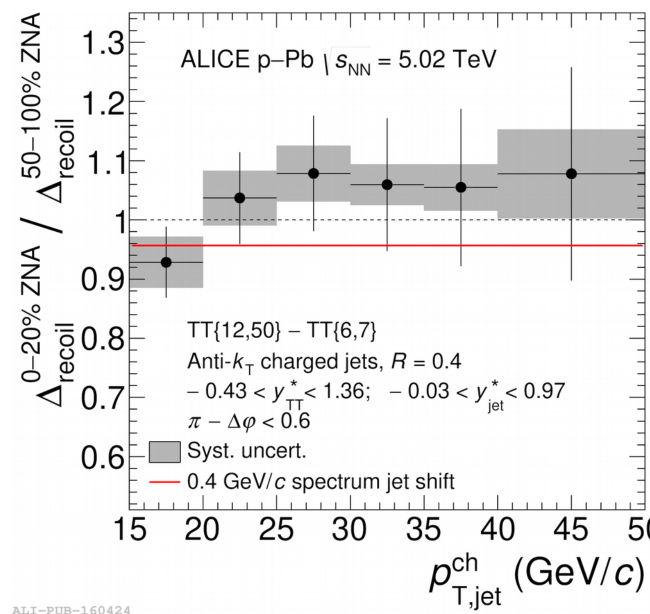


ALICE, PLB 719 (2013) 29–41



ALICE, PLB 760 (2016) 720



ALICE, PLB 783 (2018) 95-113

- Small systems: evidence of collectivity but no evidence of jet quenching signal within current experimental resolution. Is the QGP produced?
- OO at $\sqrt{s_{NN}}$ = 6.37 TeV, system size is between p–Pb a Pb–Pb
- $\mathcal{L} \approx 0.5 - 1\ \text{nb}^{-1}$ provides sufficient precision for jet quenching detection in minimum bias OO [Huss et al. arXiv hep-ph 2007.13754]
- ALICE has multiple, systematically independent approaches, which is essential for data driven discovery of a small effect

Projection for R_{AA} for inclusive hadrons in min. bias events

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Nuclear modification factor for minimum bias cross sections

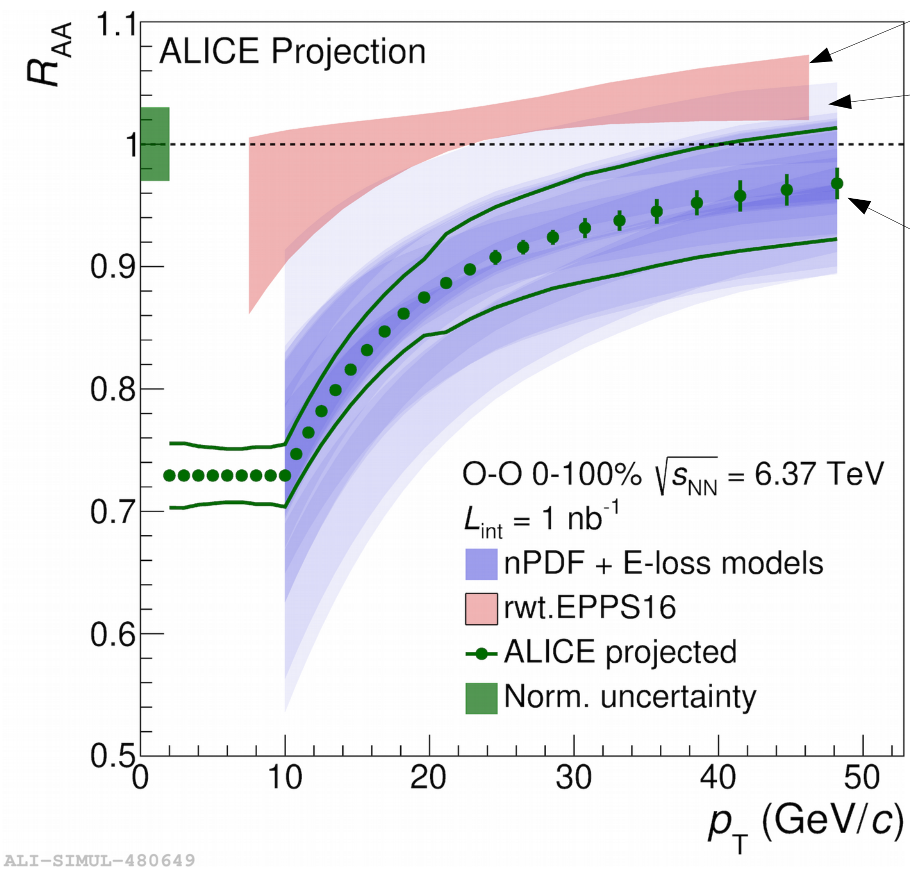
$$R_{AA} = \frac{1}{A^2} \frac{d\sigma^h_{OO}/dp_T}{d\sigma^h_{pp}/dp_T}$$

Scaling factor of   of pp reference from the Glauber theory is A^2

Luminosities used in the projection :

OO $\sqrt{s_{NN}}$ = 6.37 TeV $\mathcal{L}_{OO}$ = 1 nb^{-1}

pp $\sqrt{s}$ = 5.02 TeV $\mathcal{L}_{pp}$ = 3 pb^{-1}



Calculation which assumes no energy loss and which accounts just for nuclear PDFs

Calculations which assume energy loss models together with nuclear PDFs
[Huss et al. arXiv hep-ph 2007.13754]

ALICE projection:
data points follow a mean energy loss model
In the range up to 50 GeV/c:
- statistical precision < 1.5%
- systematic precision 4–6%
  - interpolation error ≤ 3%
  - cross section normalization 3%
  - other systematics 2–4%

Planned OO run will have sufficient precision to measure jet quenching from this projection

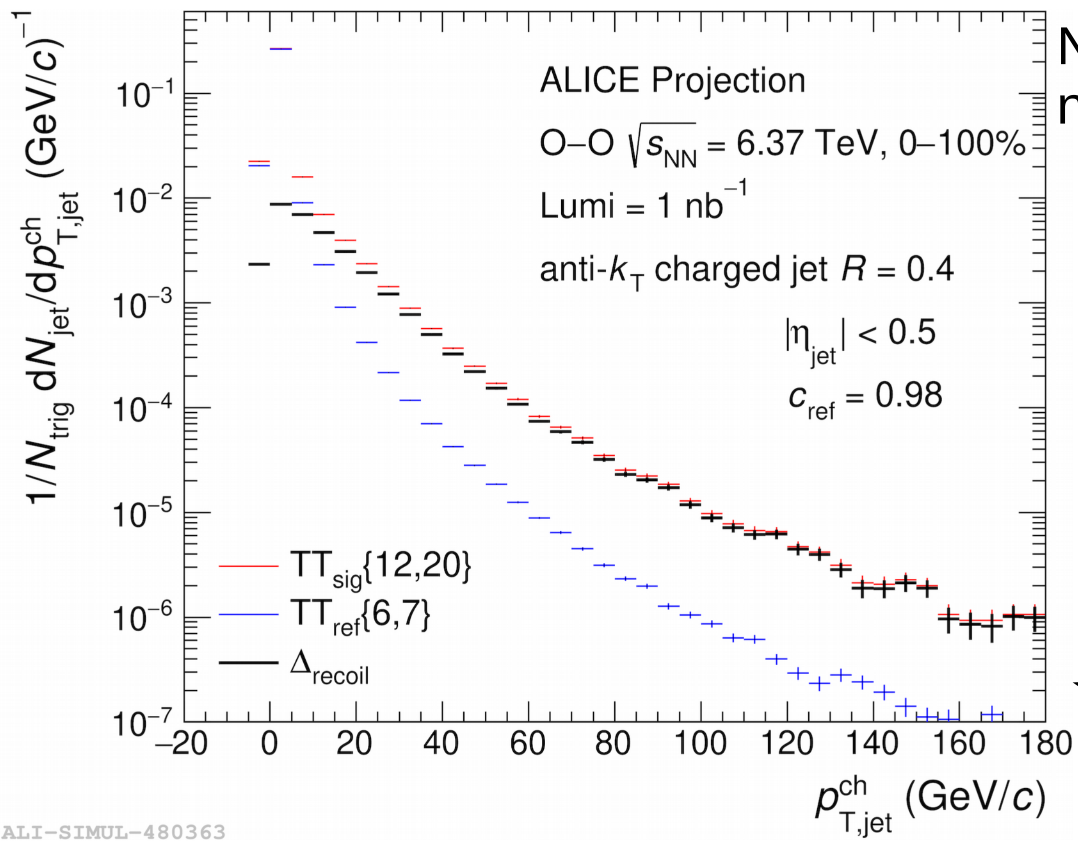
Jet quenching measurements with semi-inclusive hadron+jet observable

Observable: p_T spectrum of charged-particle jets which recoil in azimuth from a high-p_T hadron

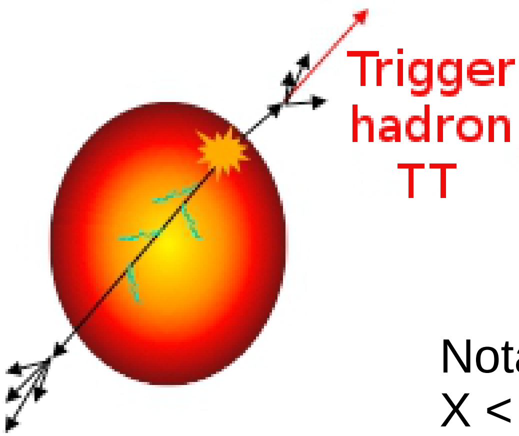
Jet p_T is corrected for the expected underlying event contribution

Data driven approach to suppress combinatorial jets including multi-parton interactions

$$\Delta_{\mathrm{recoil}} = \frac{1}{N_{\mathrm{trig}}} \frac{\mathrm{d}N_{\mathrm{jet}}}{\mathrm{d}p^{\mathrm{ch}}_{\mathrm{T,jet}}}\bigg|_{\mathrm{TT_{Sig}}} - c_{\mathrm{ref}} \cdot \frac{1}{N_{\mathrm{trig}}} \frac{\mathrm{d}N_{\mathrm{jet}}}{\mathrm{d}p^{\mathrm{ch}}_{\mathrm{T,jet}}}\bigg|_{\mathrm{TT_{Ref}}}$$



No assumption about collision geometry needed since we measure per trigger yields



Notation: TT{X,Y}
X < $p_{T,trig}$ < Y GeV/c

Simulations for projected integrated lumi.

Limits on E transport out of R=0.4 cone

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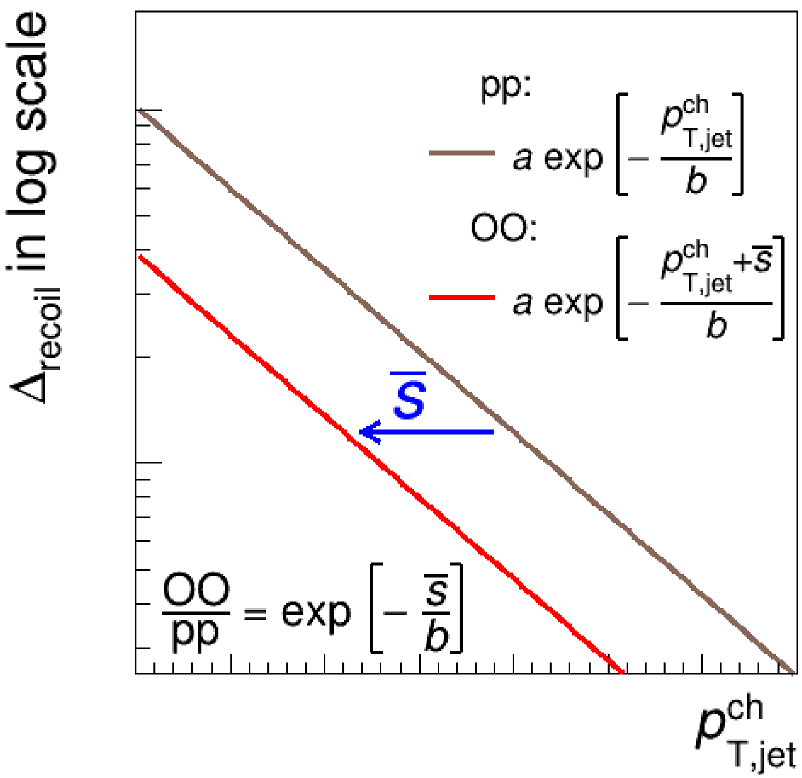
$\Delta^{OO}_{recoil} / \Delta^{pp}_{recoil}$ is a constant depending on pp spectrum slope b and shift $\bar{s}$

Projection for the spectrum shift measurement ($\mathcal{L}_{OO}$ = 1 nb^{-1}, $\mathcal{L}_{pp}$ = 3 pb^{-1}) :

OO/pp : $\bar{s}$ > 0.16 GeV/c (90% CL)

$OO_{0\text{-}20\%}/OO_{50\text{-}100\%}$: $\bar{s}$ > 0.14 GeV/c (90% CL)

The shifts correspond to R_{AA}~0.98 → sensitive to smaller effects than inclusive hadrons



Δ_{recoil} ~ exponential in 15–55 GeV/c