Journal Club: Measurements for Jet Fragmentation in 2015 PbPb at 5 TeV

https://inspirehep.net/literature/1749578

Xiaoning Wang

Procedure & quantities measured

$$D(p_{\mathrm{T}}, r) = \frac{1}{N_{\mathrm{jet}}} \frac{1}{2\pi r\, dr} \frac{dn_{\mathrm{ch}}(p_{\mathrm{T}}, r)}{dp_{\mathrm{T}}}$$

$$R_{D(p_{\mathrm{T}}, r)} = \frac{D(p_{\mathrm{T}}, r)_{\mathrm{Pb+Pb}}}{D(p_{\mathrm{T}}, r)_{pp}}$$

$$\Delta D(p_{\mathrm{T}}, r) = D(p_{\mathrm{T}}, r)_{\mathrm{Pb+Pb}} - D(p_{\mathrm{T}}, r)_{pp}$$

R = 0.4, 126 GeV < p_T^{jet} < 316 GeV, $|y^{jet}|$ < 1.7

0 < r < 0.8, $|\eta^{trk}|$ < 2.5, p_T^{trk} > 1 GeV

Ip requirements to suppress secondary tracks, etc. etc.

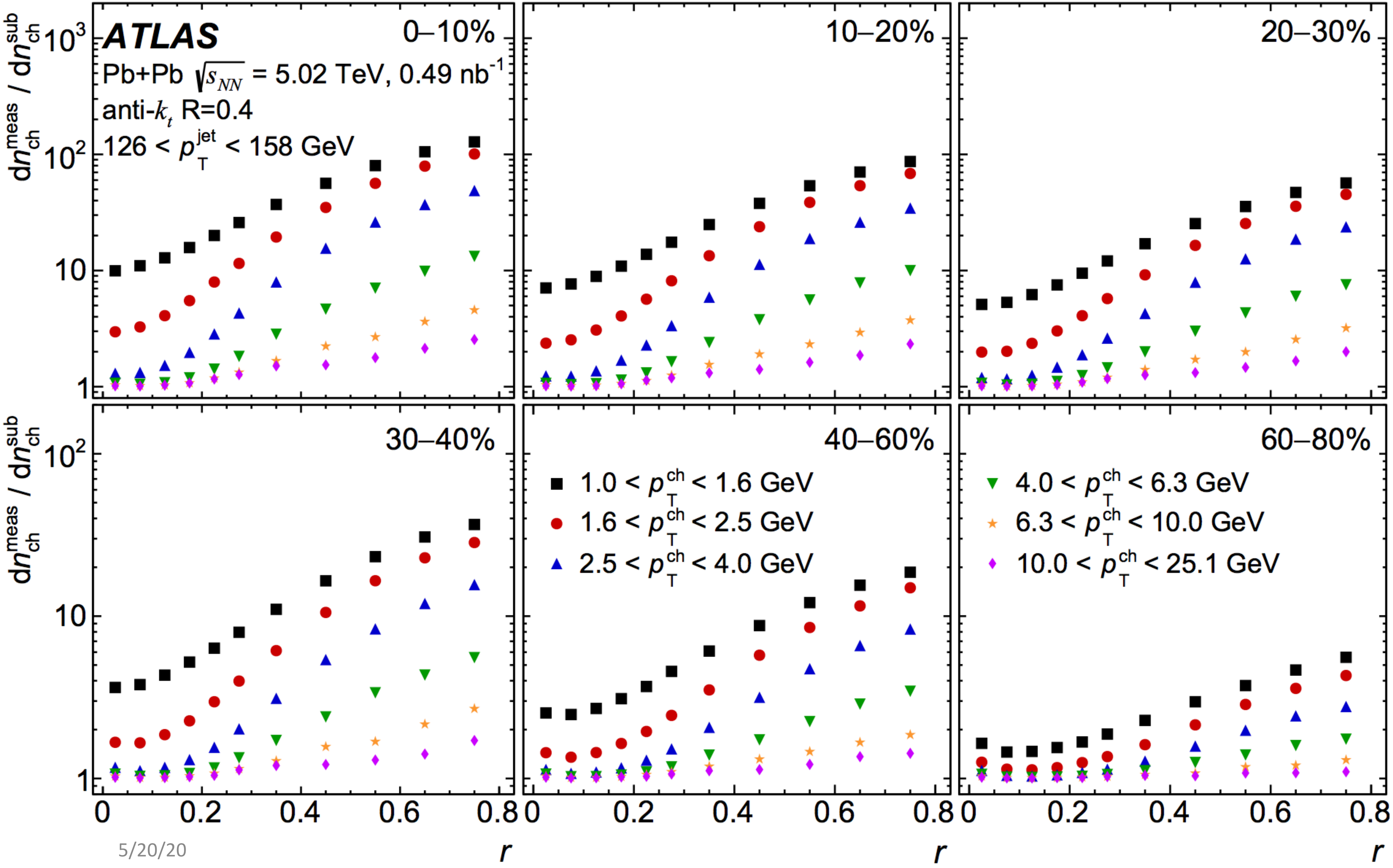
$$\frac{d^2 n_{\mathrm{ch}}^{\mathrm{meas}}(p_{\mathrm{T}}^{\mathrm{ch}}, r)}{dp_{\mathrm{T}}^{\mathrm{ch}}\, dr} = \frac{1}{\varepsilon(p_{\mathrm{T}}^{\mathrm{ch}}, \eta^{\mathrm{ch}})} \frac{\Delta n_{\mathrm{ch}}(p_{\mathrm{T}}^{\mathrm{ch}}, r)}{\Delta p_{\mathrm{T}}^{\mathrm{ch}} \Delta r}$$

Efficiency correction

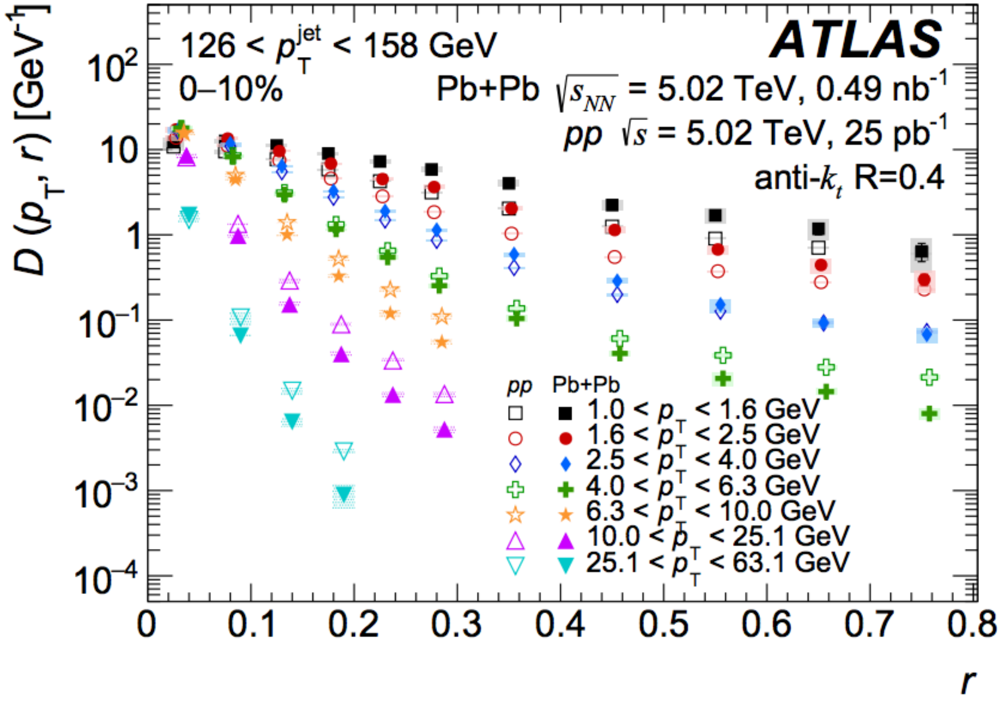
MC overlay subtract truth-linked particles

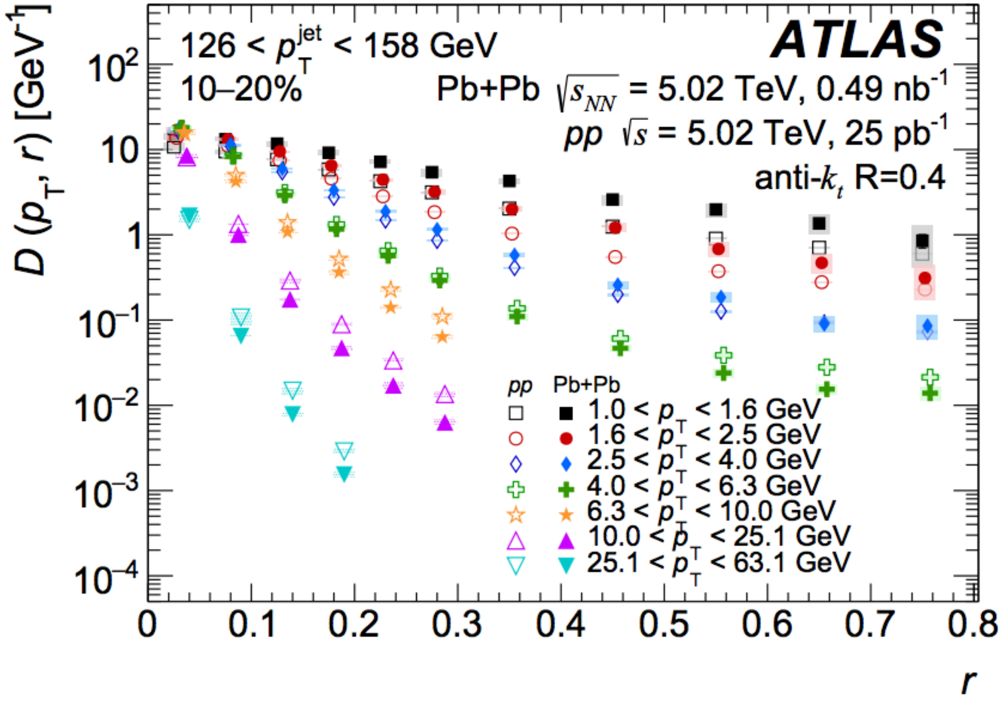
$$\frac{d^2 n_{\mathrm{ch}}^{\mathrm{sub}}(p_{\mathrm{T}}^{\mathrm{ch}}, r)}{dp_{\mathrm{T}}^{\mathrm{ch}}\, dr} = \frac{d^2 n_{\mathrm{ch}}^{\mathrm{meas}}(p_{\mathrm{T}}^{\mathrm{ch}}, r)}{dp_{\mathrm{T}}^{\mathrm{ch}}\, dr} - \frac{d^2 n_{\mathrm{ch}}{}^{\mathrm{UE+Fake}}(p_{\mathrm{T}}^{\mathrm{ch}}, r)}{dp_{\mathrm{T}}^{\mathrm{ch}}\, dr}$$

$$D(p_{\mathrm{T}}, r) = \frac{1}{N_{\mathrm{jet}}^{\mathrm{unfolded}}} \frac{1}{2\pi r\, dr} \frac{dn_{\mathrm{ch}}^{\mathrm{unfolded}}(p_{\mathrm{T}}^{\mathrm{ch}}, r)}{dp_{\mathrm{T}}}$$

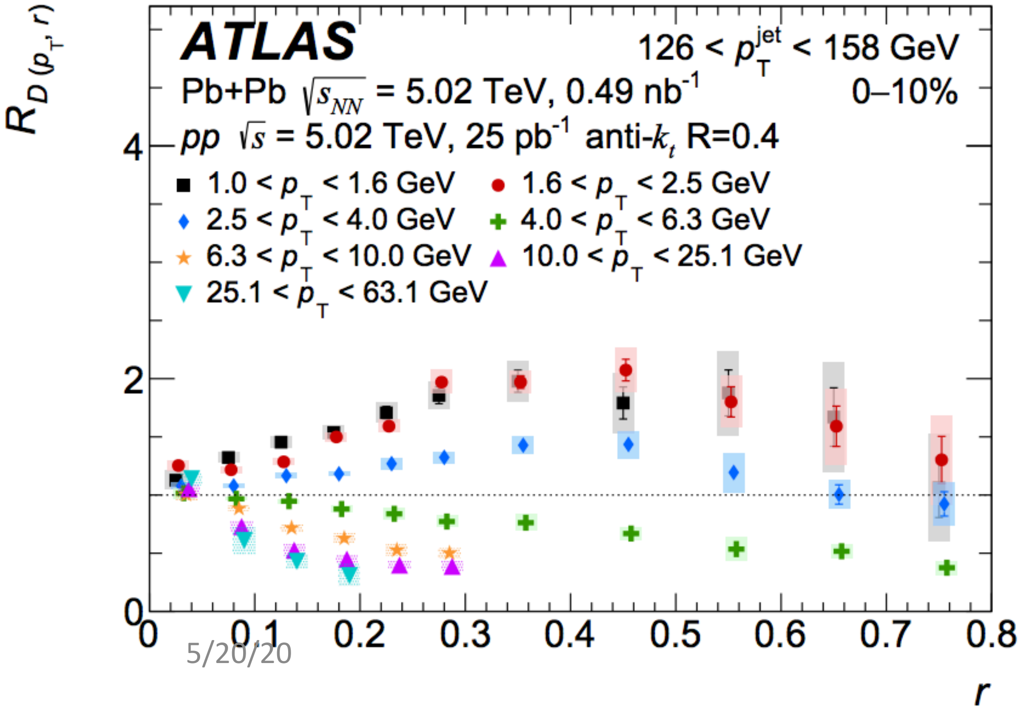


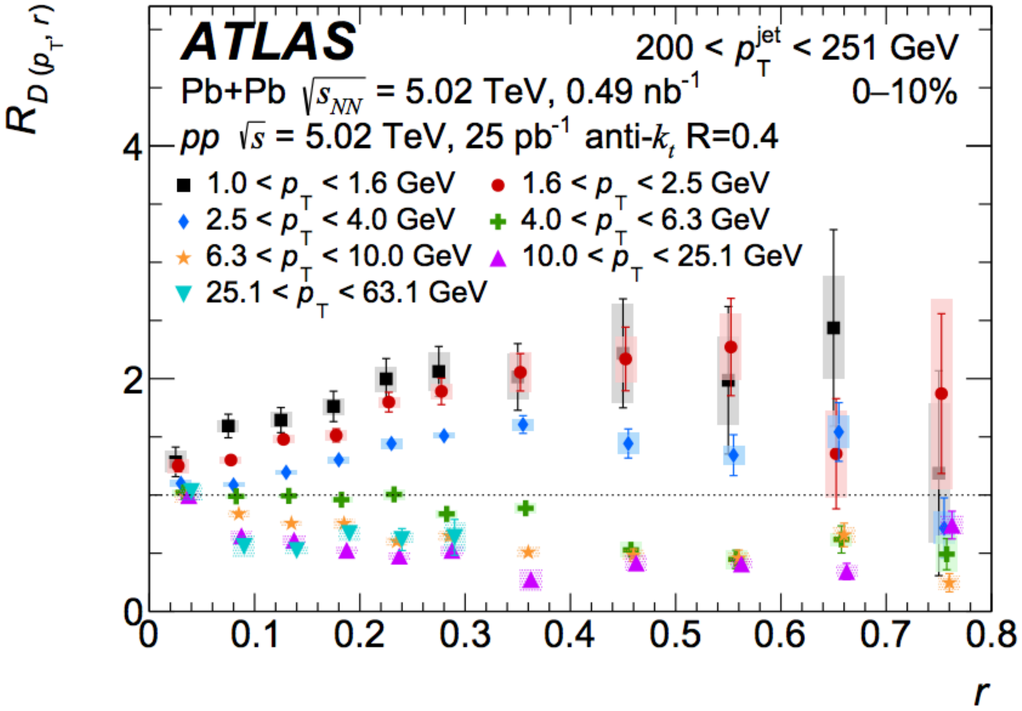
Bkg/signal ratio increases with
↓ p_T^{ch}
↑ centrality
↑ r (why?)



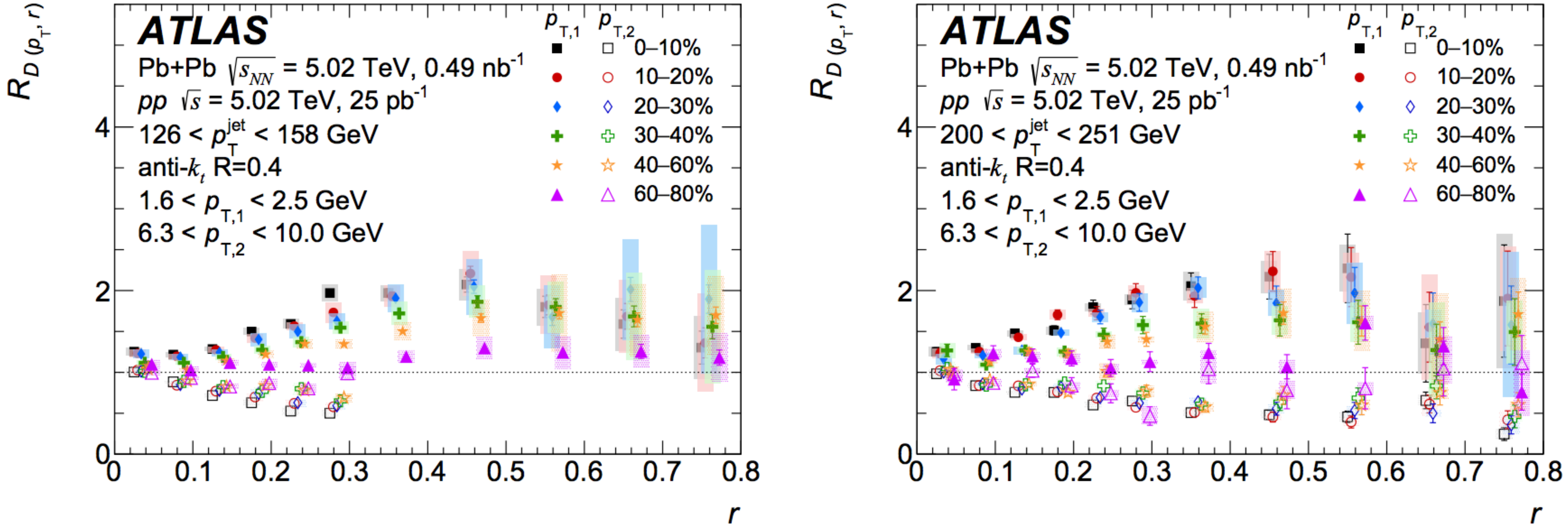


Low pT:
0 < r < 0.3: above unity and increasing modification
0.3 < r < 0.6: above unity ~ flat
0.6 < r < 0.8: above unity and decreasing



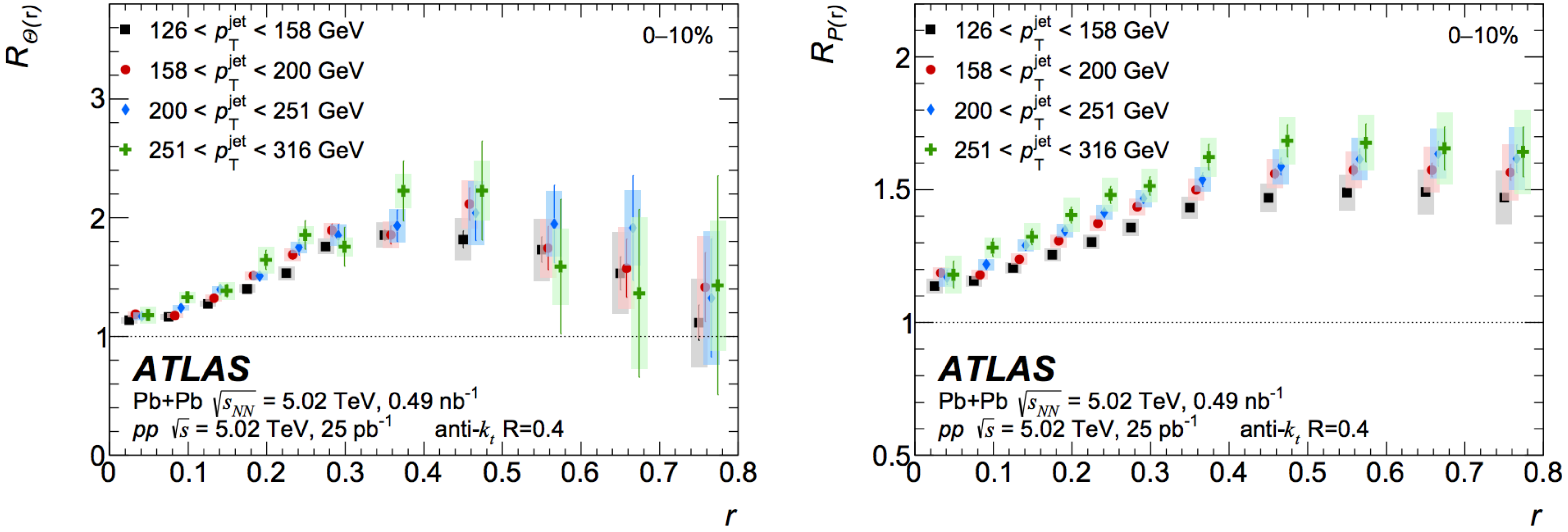


High pT:
0 < r < 0.3: below unity and increasing modification
0.3 < r < 0.8: below unity and flat (decreasing?)



Why less high pT tracks at larger r?

What creates the broadening of low pT tracks (especially in comparison to suppression of high pT tracks)?



$$\Theta(r) = \int_{1\text{ GeV}}^{4\text{ GeV}} D(p_{\mathrm{T}}, r)\,dp_{\mathrm{T}}$$

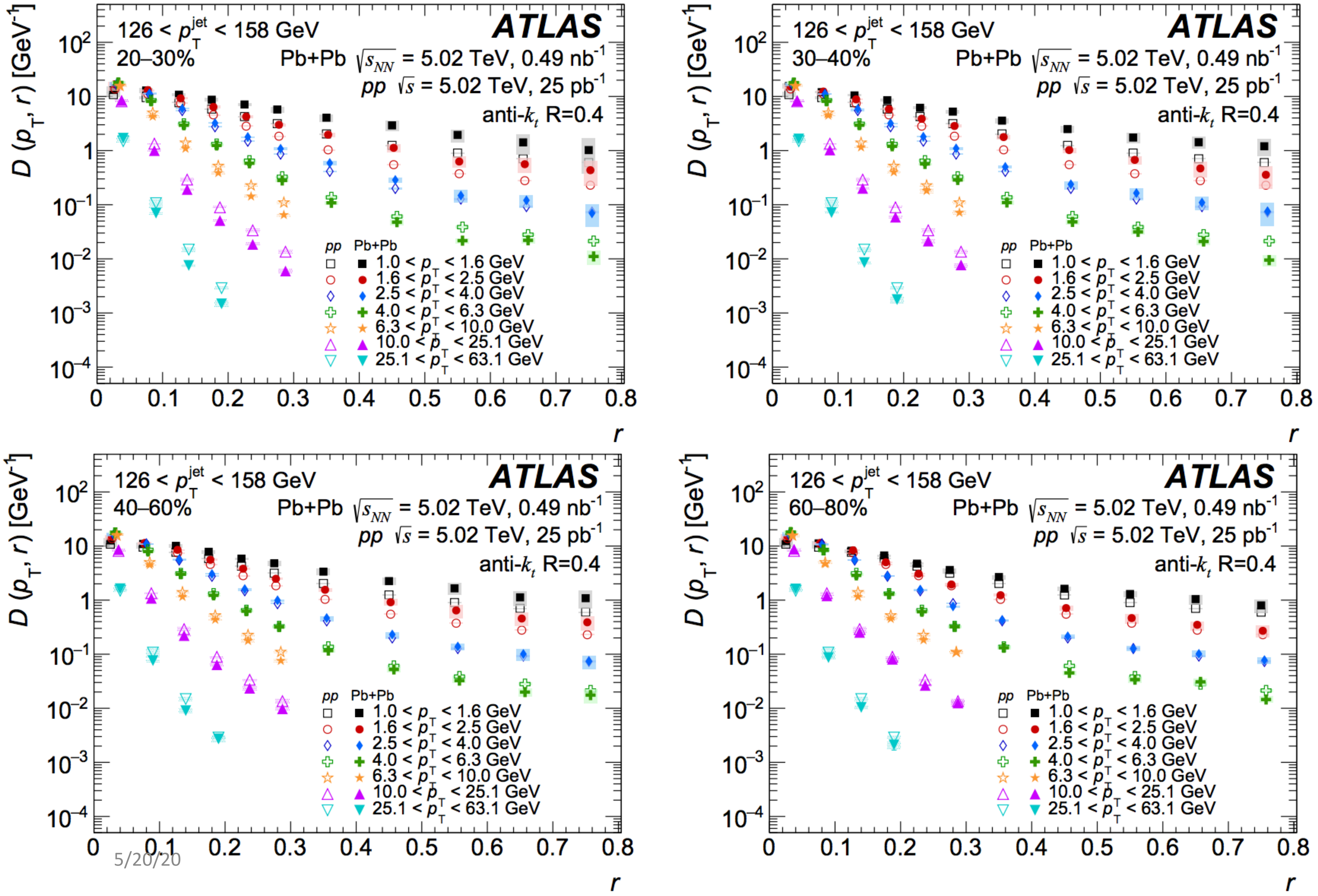
$$P(r) = \int_0^r \int_{1\text{ GeV}}^{4\text{ GeV}} D(p_{\mathrm{T}}, r')\,dp_{\mathrm{T}}\,dr'$$

$$R_{\Theta(r)} = \frac{\Theta(r)_{\mathrm{Pb+Pb}}}{\Theta(r)_{pp}}$$

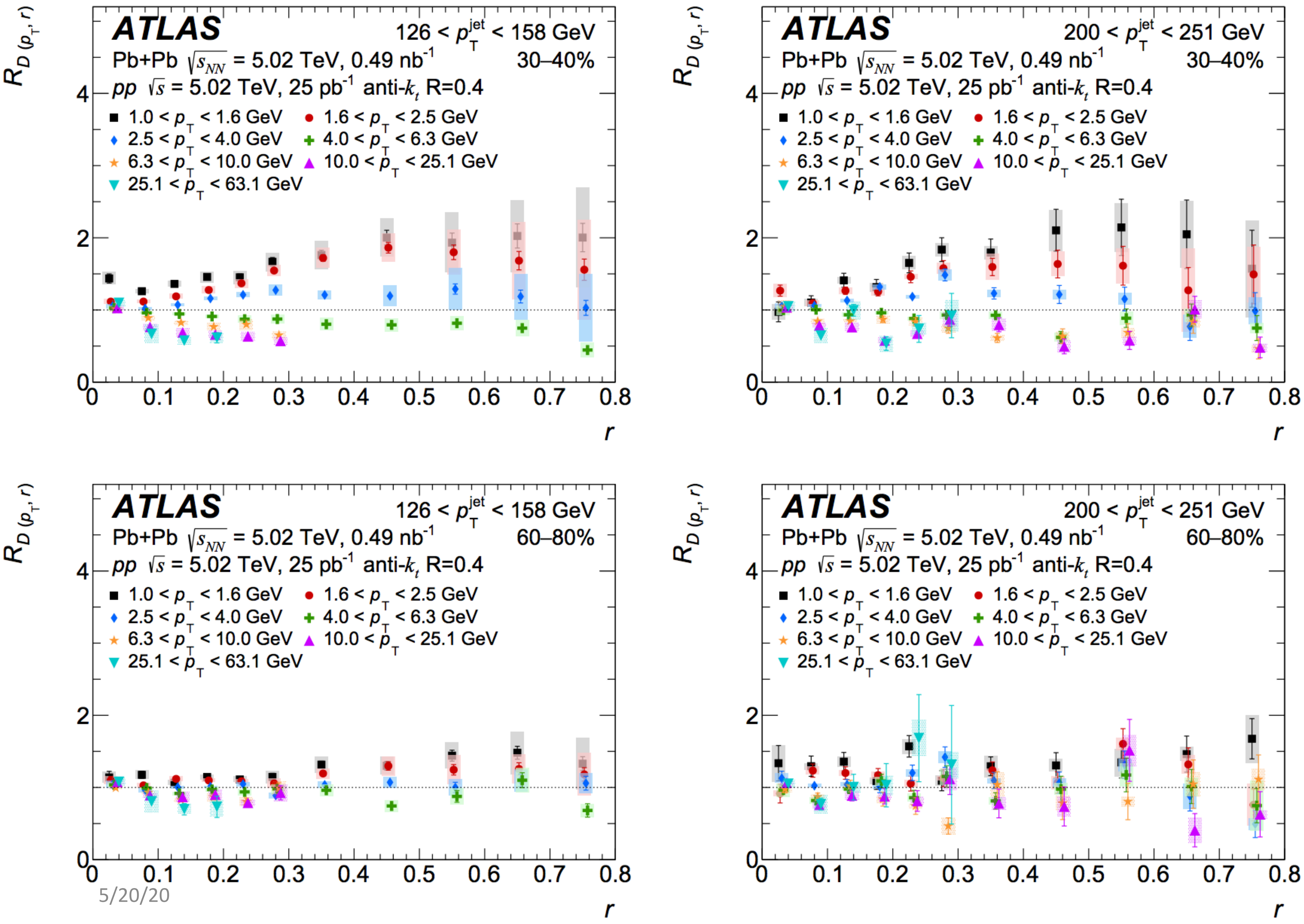
$$R_{P(r)} = \frac{P(r)_{\mathrm{Pb+Pb}}}{P(r)_{pp}}$$

Modification is enhanced with jet pT increases? (why? If particles are in general more collimated?)

More plots for peripheral events



126 < p_T^{jet} < 158 GeV
20–30%
30–40%
40–60%
60–80%
ATLAS
Pb+Pb $\sqrt{s_{NN}}$ = 5.02 TeV, 0.49 nb^{-1}
pp $\sqrt{s}$ = 5.02 TeV, 25 pb^{-1}
anti-k_t R=0.4
pp Pb+Pb
1.0 < p_T < 1.6 GeV
1.6 < p_T < 2.5 GeV
2.5 < p_T < 4.0 GeV
4.0 < p_T < 6.3 GeV
6.3 < p_T < 10.0 GeV
10.0 < p_T < 25.1 GeV
25.1 < p_T < 63.1 GeV
$D(p_T, r)$ [GeV^{-1}]
r


ATLAS
126 < p_T^{jet} < 158 GeV
Pb+Pb $\sqrt{s_{NN}}$ = 5.02 TeV, 0.49 nb^{-1}
30–40%
pp $\sqrt{s}$ = 5.02 TeV, 25 pb^{-1} anti-k_t R=0.4
1.0 < p_T < 1.6 GeV
1.6 < p_T < 2.5 GeV
2.5 < p_T < 4.0 GeV
4.0 < p_T < 6.3 GeV
6.3 < p_T < 10.0 GeV
10.0 < p_T < 25.1 GeV
25.1 < p_T < 63.1 GeV
$R_{D\,(p_T,\,r)}$
r
ATLAS
200 < p_T^{jet} < 251 GeV
Pb+Pb $\sqrt{s_{NN}}$ = 5.02 TeV, 0.49 nb^{-1}
30–40%
pp $\sqrt{s}$ = 5.02 TeV, 25 pb^{-1} anti-k_t R=0.4
ATLAS
126 < p_T^{jet} < 158 GeV
Pb+Pb $\sqrt{s_{NN}}$ = 5.02 TeV, 0.49 nb^{-1}
60–80%
pp $\sqrt{s}$ = 5.02 TeV, 25 pb^{-1} anti-k_t R=0.4
ATLAS
200 < p_T^{jet} < 251 GeV
Pb+Pb $\sqrt{s_{NN}}$ = 5.02 TeV, 0.49 nb^{-1}
60–80%
pp $\sqrt{s}$ = 5.02 TeV, 25 pb^{-1} anti-k_t R=0.4

in the measurement's phase space. For Pb+Pb collisions, the efficiency for $|\eta| < 0.3$ is $\sim 80\%$ at 1 GeV and rises to $\sim 85\%$ at 10 GeV. For $1.0 < |\eta| < 2.0$, the efficiency is $\sim 67\%$ to $\sim 72\%$ over the same p_{T} range, with the variation in efficiency between the most-central and most-peripheral Pb+Pb collisions being approximately 3% in both η ranges. For pp collisions, the efficiency for $|\eta| < 0.3$ is $\sim 85\%$ at 1 GeV, and rises to $\sim 88\%$ at 10 GeV, remaining relatively constant thereafter. For $1.0 < |\eta| < 2.0$, the efficiency is $\sim 82\%$ to $\sim 86\%$ over the same p_{T} range. Further details about the tracking efficiency can be found in