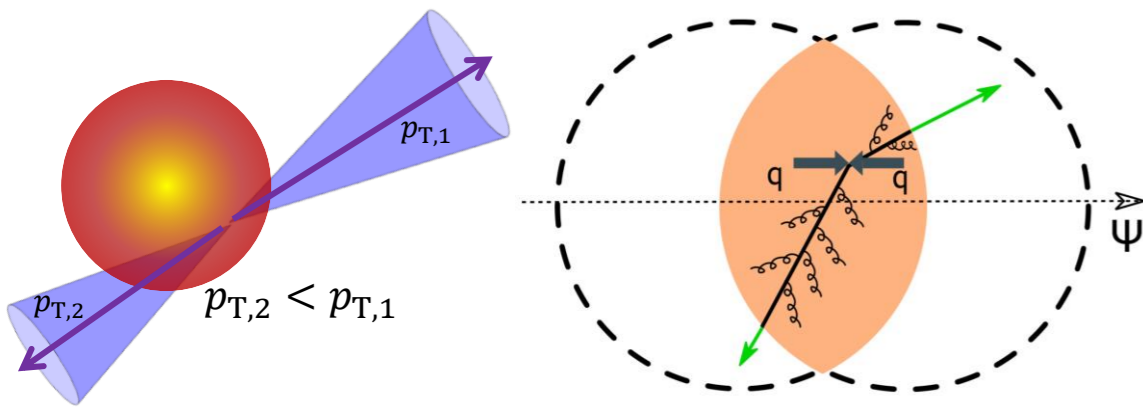


Motivation:

- Jets are known to lose energy while traversing the Quark Gluon Plasma in ways sensitive to the initial state geometry
- The transverse momentum balance of di-jet pairs in Pb+Pb can provide direct insight on the path-length dependence to energy loss
- Path-length dependent energy loss can cause higher jet yield in-plane vs. out-of-plane, creating a positive v_2
- Jet $v_{n>2}$ can give insight into the role of initial state fluctuations



Di-jet Measurement[1]:

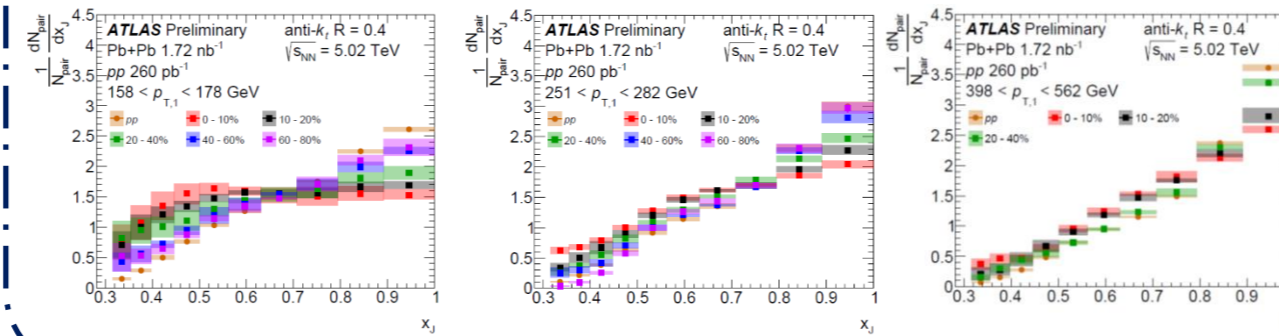
- Directly measure the two-dimensional leading, subleading transverse momentum ($p_{T,1}, p_{T,2}$) distribution of the leading di-jet pair with $\Delta\phi_{12} > 7\pi/8$ and both $|\eta_1|$ and $|\eta_2| < 2.1$
 - Two dimensional Bayesian unfolding accounts for migration in both the leading and sub-leading jet p_T
- The unfolded ($p_{T,1}, p_{T,2}$) distribution projected to the di-jet momentum balance: $x_j = \frac{p_{T,2}}{p_{T,1}}$

Jet v_n measurement[2]:

- Measure the $R = 0.2$ jet yield as a function of $\eta\Delta\phi_n = n |\Psi_n - \phi|$ in bins of centrality and jet p_T
 - For $n = 2, 3, 4$
- Yields are unfolded in p_T and $\Delta\phi_n$, and fit to extract v_n

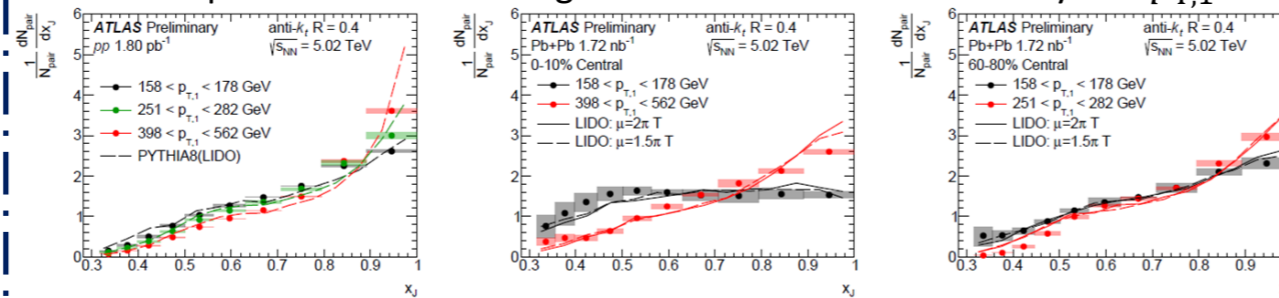
Di-jet Momentum Balance: Centrality Dependence

- $158 < p_{T,1} < 178$ GeV in central Pb+Pb is consistent with flat $x_j > 0.5$
- Peripheral Pb+Pb is consistent with pp above $p_{T,1} = 251$ GeV
- Central Pb+Pb has clear modification from pp out to $p_{T,1} = 562$ GeV



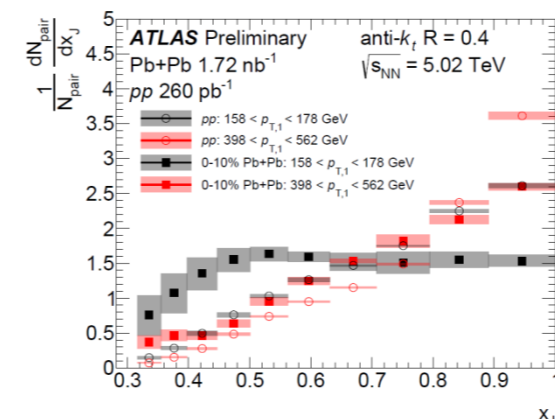
Di-jet Momentum Balance: Theory Comparison

- PYTHIA8 tune used in LIDO[3] over-predicts symmetric jets in pp collisions
- LIDO predictions observe agreement across both centrality and $p_{T,1}$



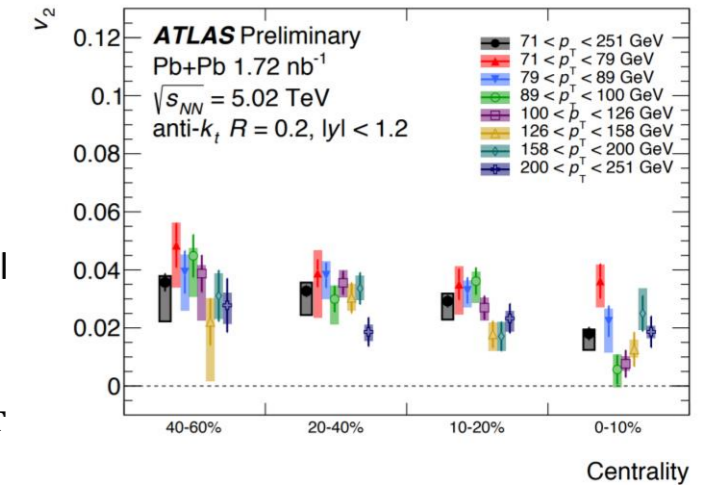
Di-jet Momentum Balance:

- Significant modification in central Pb+Pb compared to pp collisions extends through $p_{T,1} = 562$ GeV
- New, high p_T , information to constrain the role of fluctuations and path-length dependence in energy loss



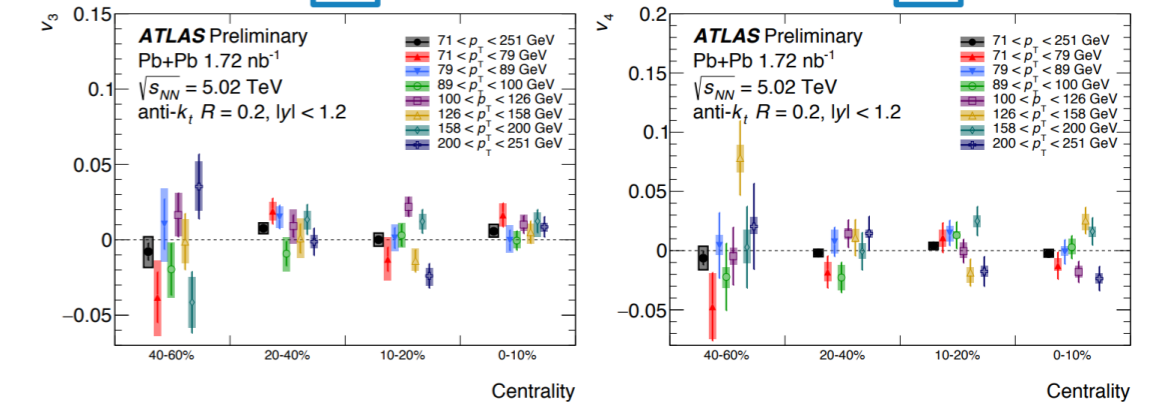
Jet v_2

- Observe positive v_2 on the order of 3-4% for $R=0.2$ jets with $71 < p_T < 251$ GeV in 40-60% events
 - Decreases to order 1% for 0-10% central events
- No observation of significant p_T dependence



Jet v_3 and v_4

- No evidence for non-zero v_3 and v_4 in Pb+Pb collisions



Conclusions

- ATLAS sees significant modification of the momentum balance of di-jet pairs in Pb+Pb collisions compared to pp collisions for leading jet p_T up to 562 GeV, evidence of path-length dependent energy loss within the QGP.
- A strong non-zero v_2 is observed for $R = 0.2$ jets which decreases to $\sim 1\%$ for central Pb+Pb, and is independent of p_T between 71 and 251 GeV
- ATLAS first measurement of v_3 and v_4 are consistent with zero

[1] ATLAS-CONF-2020-017

[2] ATLAS-CONF-2020-019

[3] Phys. Rev. C **100** (2019) 064911