**Study of Isolated-photon and Jet Momentum Imbalance in pp and PbPb Collisions** - [arXiv:1803.10533]

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**Sudakov Resummation**

Isolated-photon jet correlations have been widely regarded as the "Golden Probe" to understand the properties of the Quark-Gluon Plasma. In this study, we employed the Sudakov resummation formalism:

\[
\frac{d\sigma}{d\Delta\phi} = \sum_{\Delta x_{ij}} p_{ij} \delta p_{ij} \int dp_{i} \int dp_{j} \int db \times x_{i} f(x_{i}, \mu_{i}) x_{j} f(x_{j}, \mu_{j}) \frac{1}{2} \frac{d\sigma}{d\Delta\phi} = \frac{1}{2} \delta(\vec{q}_{0}^{2}) \delta(\phi) e^{-\Delta(k_{T})} \]

To study the angular correlation and transverse momentum imbalance between direct photons and jets, which is complementary to our previous study on dijet, dihadron and hadron-jets. We begin by comparing the normalized angular distribution with CMS and ATLAS data. Notice that the leading-order perturbative calculation diverges near \(\Delta\phi \approx \pi\) due to the large Sudakov logarithms, which were effectively resummed in the resummation formalism. Although pQCD can describe data at \(\Delta\phi < \pi\). Thus both frameworks are required in order to study the entire phase-space.

**Momentum Imbalance**

We then implemented the Sudakov resummation improved pQCD approach developed in our previous study

\[
\frac{1}{\sigma} \frac{d\sigma}{dz_{f}} \text{[predicted]} = \frac{1}{\sigma} \frac{d\sigma_{QCD}}{dz_{f}} \text{[pT]} + \frac{1}{\sigma} \frac{d\sigma_{Resummed}}{dz_{f}} \text{[pT]}
\]

to compare with the experimental data where the cuts are imposed on \(\Delta\phi\) and \(q_{T}^{2}\) to switch between perturbative calculation and resummation. Note that we have used a Gaussian smearing to account for the asymmetry caused by detector responses in experimental measurements.

\[
\frac{d\sigma_{Resummed}}{dz_{f}} \int \frac{dE}{\sqrt{2z_{f}}} \Delta \frac{d\sigma}{dz_{f}} = \frac{d\sigma_{Resummed}}{dz_{f}} \int \frac{dE}{\sqrt{2z_{f}}} \Delta \frac{d\sigma}{dz_{f}}
\]

Our result agreed with both ATLAS data and POWHEG+PYTHIA monte-carlo simulations. However, we cannot reproduce CMS pp data, and it is left as a future study.

**Transport parameter**

Once we have fixed our baseline calculation, we parameterized the QGP transport coefficient in the BDMPS energy-loss formalism:

\[
\epsilon D_{ij} = \sqrt{\frac{\pi}{2x_{j}}} \exp \left(-\frac{\pi x_{j}}{2z_{j}}\right)
\]

then simulated the jet propagation in the OSU 3-D viscous hydrodynamic evolution to take into account the geometric effects of the medium. We also compare our calculation with the unfolded data from the ATLAS collaboration at \(\sqrt{s} = 2.76\) TeV. We find that our results for pp collisions qualitatively agree with the results obtained from PYTHIA plus data overlay. The suppression in the \(x_{j}\) distributions in PbPb collisions also suggests a similar range for the transport coefficient \(\epsilon\).

**Future predictions**

Here we have provided our predictions for the \(x_{j}\) distributions in both pp and PbPb collisions, which can be compared directly with the unfolded ATLAS data once it becomes available. The importance of unfolding of data is that it gets rid of a lot of detector effects and make the difference between pp and PbPb collisions more prominent. This can lead us to a more profound and precise understanding of the energy loss mechanisms in QGP.

Please see poster for DiJet, Dihadron and Hadron-jet correlations in resummation improved pQCD approach.