Motivation

The charged-particle nuclear modification factor in AA collisions, $R_{AA}$, was found to exhibit a large suppression at both RHIC and the LHC. This magnitude and shape of this suppression contains information about many competing processes in heavy ion collisions: initial state effects, flow effects, the Cronin effect, and jet quenching. In particular, measurements of the high-$p_T$ $R_{AA}$ help constrain models of energy loss in the hot medium created in heavy ion collisions. Similarly, an accurate measurement of the nuclear modification factor in pA collisions, $R_{pA}$, can help disentangle initial state effects from those caused by the presence of a quark-gluon plasma.

Charged-particle Spectra

- Combine min-bias and triggered data for large $p_T$ reach
- Spectra measured in $|\eta|<1$

![Graph showing CMS $R_{AA}$ at 2.76 TeV (Eur. Phys. J. C 72 (2012) 1945)]

![Graph showing CMS $R_{pA}$]

For $R_{AA}$: scale PbPb by $T_{AA}$ and normalize pp by luminosity

- Uncertainty peak at 3 GeV from strange-baryon composition
- pp luminosity uncertainty only 2.3% after VDM scan analysis

Charged-particle $R_{AA}$

In all 6 centrality bins measured, 5.02 TeV PbPb results are very close to 2.76 TeV results.

![Graph showing CMS $R_{AA}$ at 5.02 TeV vs. 2.76 TeV]

CMS $R_{AA}$ helps constrain models of energy loss in the hot medium created in heavy ion collisions. Similarly, an accurate measurement of the nuclear modification factor in pA collisions, $R_{pA}$, can help disentangle initial state effects from those caused by the presence of a quark-gluon plasma.

Charged-particle $R_{pA}$

Using CMS’s existing measured pPb spectrum from [1], we can calculate $R_{pA}$ and compare with $R_{AA}$. The difference between $R_{AA}$ and $R_{pA}$ indicates the significant suppression seen in $R_{AA}$ is not associated with cold nuclear matter effects.

![Graph showing CMS $R_{pA}$ vs. $R_{AA}$]

For $R_{pA}$: scale PbPb by $T_{AA}$ and normalize pp by luminosity

- Uncertainty peak at 3 GeV from strange-baryon composition
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