Heavy Quark Energy Loss in Medium

Elastic energy loss is not negligible?
Andrea Dainese, Simon Wicks, JHEP 01 (2012) 128

Proton-proton collisions: provide important test of pQCD in a new energy domain and heavy ion reference

Radiative energy loss via gluon radiation

Dead Cone Effect
- In vacuum, gluon radiation is suppressed at angles smaller than $R_{AA}$ (ratio of the quark mass to its energy)
- In medium, this implies lower energy loss for massive partons

Transverse momentum spectra, which leads to larger impact parameter of decay electrons than from backgrounds

Analysis approach is based on:
- High rate of electron production via semi-leptonic decay (-11%(-5)-10%-6%)
- Beauty hadrons have $cT > 500$ µm and a hard momentum spectrum, which leads to larger impact parameter of decay electrons than from those backgrounds

Electron identification

- Time Of Flight: Kaon & Proton Rejection with time of flight for electron hypothesis (99% from the expectation)
- Cut on minimum impact parameter $d_0$ (defined in the right) removes hadrons originating from primary vertices

Correction

Electron yield from beauty hadron decays ($\sigma_{EB}$) was corrected for efficiency $\epsilon$ and number of minimum bias collisions $R_{AA}$ and cross section $\sigma_{EB}$ (6 - geometrical acceptance $\times$ track reconstruction efficiency $\times$ electron identification efficiency $\times$ efficiency of the $d_0$ cut)

Systematic uncertainties are detailed in arXiv:

$$\sigma_{EB} = \frac{N_{E}}{L \times \epsilon \times R_{AA} \times \sigma_{EB}}$$

Total cross section determined by extrapolation procedure based on FONLL:

$$\sigma_{EB} = 280 \pm 23 \times \text{Stat} \times \text{Syst} \times 10^{(BR)} \mu \text{b}$$

Two complementary approaches ongoing

- Impact parameter $(d_0)$ cut, as shown for pp
- Impact parameter fit with Monte Carlo templates

Outlook: Analysis on Pb-Pb Data

- Differences between fit and data consistent with statistical variations.
- In pp collisions, cross section of electrons from beauty hadron decays obtained via fit is consistent with result from cut method.
- Peripheral Pb-Pb data described by fit within statistical variation.
- Pb-Pb fits suffer from lower MC statistics.
- Higher statistics being analyzed for both peripheral and central collisions.

Summary and Outlook

- The ALICE electron identification and vertexing capability allow one to measure charm and beauty production via electrons from heavy flavour hadron decays.
- In $p_T > 7$ TeV pp data, electron transverse momentum spectrum from charm and beauty hadron decays has been measured and is well described by pQCD calculations.
- The analysis to study the suppression of beauty hadrons via decay electrons in Pb-Pb collisions is ongoing, so STAY TUNED!