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D_s meson reconstruction via $K^+K^-\pi$ decays

The proposed HFT will significantly extend the physics reach of the STAR experiment for precision measurement of the yields and spectra of particles containing heavy quarks. This will be accomplished through topological identification of mesons and baryons containing charm or bottom quarks, such as the D^0 and the D_s by reconstruction of their displaced decay vertices with a precision of approximately 50 μm in p+p, d+A, and A+A collisions.

The enhancement of strangeness production in heavy ion collisions relative to that in p+p collisions at the same energy were originally conceived to be a smoking gun of Quark Gluon Plasma (QGP) formation [1, 2]. However, the strangeness enhancement in nuclear collisions relative to p+p could also be attributed to the canonical suppression of strangeness production in p+p collisions [3]. The study of the coalescence of strangeness and heavy flavor will provide a better understanding of strangeness enhancement in nuclear collisions. D_s is the lightest meson of such a combination.

D_s can be reconstructed through their hadronic $D_s \to \phi + \pi \to K^+ + K^- + \pi$ (BR 2.18%), with a decay length of $c\tau = 149.9\mu m$. By selecting the well-reconstructed secondary vertice with a distance ($> 100\mu m$) to the event primary vertex, a large portion of the background is rejected. A well-reconstructed D_s vertex requires the DCA between daughter tracks $< 100\mu m$, the DCA between any daughter track and the D_s vertex $< 100\mu m$, and the distance between any two secondary vertice of daughter pairs $< 200\mu m$. To select 3-track combinations coming from D_s decays, a further topological cut is used: a D_s momentum pointing back to the primary vertex. Furthermore, there is an extra constraint on the $K^+ + K^-$ invariant mass (3σ around ϕ mass peak). This cut reduces the signal to half, but reduces the background by a factor of a few hundred.

10K central Au+Au HIJING events have been used to estimate the combinatorial background. In order to enhance statistics at high p_T, 30 D_s with a power-law p_T spectrum (with $\langle p_T \rangle = 1.0$ GeV/c, and $n = 11$) have been embeded into each event. The D_s were required to decay through the $\phi + \pi \to K^+K^-\pi$ channel. The events were simulated with a vertex position within $\pm 5cm$ from the detector center. The expected D_s yield is 0.9 per event, which will yield low signal significance.

The left panel of Fig. 1 shows the significance of the D_s reconstruction, and the right panel of Fig. 1 estimates the statistical errors on the measured D_s invariant yield, based on 500M events. The significance increases with p_T.

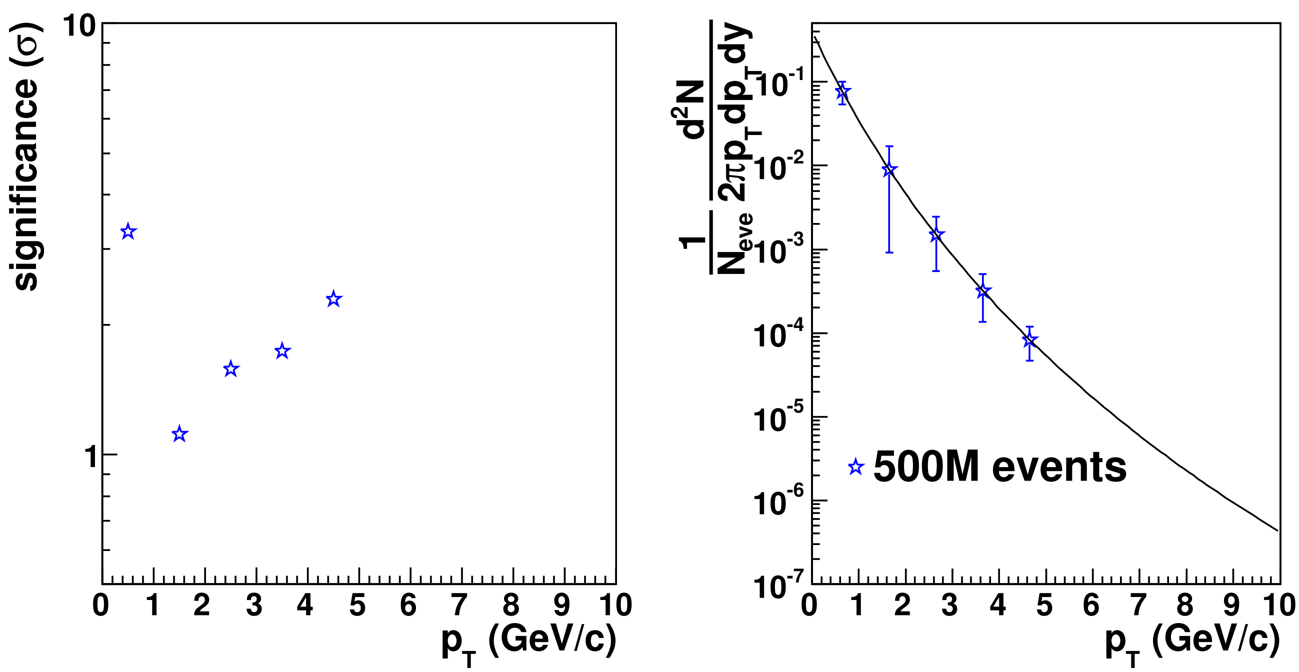

FIG. 1: The simulation results of the D_s reconstruction from $D_s \to \phi + \pi \to K^+ + K^- + \pi$ decay channel.

However, the current simulation production runs out of statistics at high p_T due to the power-law spectrum.

In the near future, we will increase statistics for high p_T, implement the PID selectron from TOF, and estimate the significance the D_s reconstruction in a more realistic scenario.

[1] J. Rafelski and B. Muller *Phys. Rev. Lett.* **48** (1982) 1066.
[2] J. Adams *et al.* [STAR Collaboration], *Phys. Rev. Lett.* **92** (2004) 182301.
[3] K. Redlich and A. Tounsi *Eur. Phys. J.* **C24** (2002) 589.