# Heavy Flavor Tracker (HFT) : A new inner tracking device at STAR

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**Abstract**

The HFT, a new inner tracking detector for STAR, aims to measure the charmed hadron nuclear modification factor as well as their elliptic flow to the low $p_T$ region (~0.5 GeV/c) by measuring the displaced vertices of charmed particles.

## 1. Introduction

Due to their large masses, heavy flavor (*c* and *b*) quarks are produced in the early stages of heavy ion collisions [? ]. A precise measurement of heavy flavor production could be achieved by identifying the decay of charmed mesons using direct topological reconstruction and thus disentangling the *c* and *b* contributions. The HFT has the necessary resolution for such a measurement that requires high precision. It is the assembly of the existing Silicon Strip Detector (SSD) and 2 new detecting devices: the Intermediate Silicon Tracker (IST) and the PIXEL detector. The PIXEL is composed by 2 layers of monolithic CMOS Active Pixel sensors [? ] which measure with great accuracy the position of a particle within a few centimeters of the interaction region. These very thin layers minimize the multiple coulomb scaterring. The intermediate tracking system is made by the IST and the existing SSD (Table **??**). The purpose of the IST and the SSD is to link tracks found in the STAR Time Projection Chamber (TPC) to the PIXEL detector.

Table 1: Characteristics of each silicon layer of the HFT

| Detector | Radius | Technology | Si thickness | Hit resolution $R/\phi - Z$ | Material Budget in radiation length $X_0$ |
|---|---|---|---|---|---|
| | (cm) | | ($\mu$m) | ($\mu$m - $\mu$m) | |
| SSD | 23 | double sided strips | 300 | 30 - 857 | 1% |
| IST | 14 | Si Strip Pad sensors | 300 | 170 -1700 | 1.2% |
| PIXEL | 2.5, 8 | Active Pixels | 50 | 8.6 - 8.6 | 0.37% |

## 2. Simulation details

Simulations presented in this proceedings were performed using the full STAR geometry package with 10k AuAu HIJING central events at $\sqrt{s_{NN}} = 200$ GeV embedded with $D^0$ and $\Lambda_c$ particles, forced to decay to their hadronic channels ($D^0 \rightarrow K^-\pi^+$, $\Lambda_c \rightarrow K^-\pi^+ p$). Their reconstruction efficiencies are based on particle identification of daughter particles provided by the TPC and extended to higher $p_T$ with the Time of Flight detector (TOF) : $K$-$\pi$ and ($K$+$\pi$)-$p$ separations were done up to $p_T \leq 1.6$ GeV/c and $p_T \leq 3$ GeV/c, respectively. Topological cuts have been also applied to the $D^0$ candidates. The effect of *out of time* events is included in the PIXEL simulation at a rate corresponding to RHIC-II luminosity.

## 3. Estimated $D^0$ and $\Lambda_c$ reconstruction performances
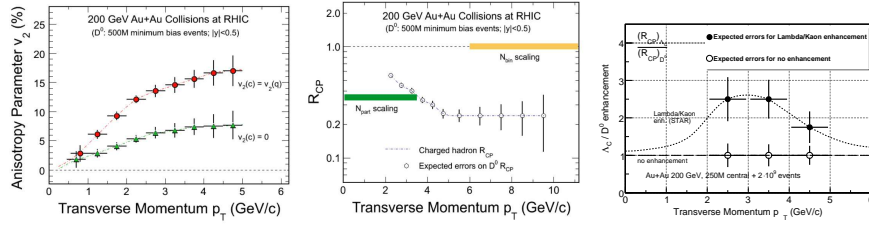


Figure 1: Projections of key measurements with HFT

Figures **??** show the statistical error projections for the key measurements with the HFT in 500 M minimum bias AuAu collisions. Fig. **??**(left) is the flow parameter $v_2$, shown for two extreme scenarios [charm quark flow equal to light quark flow (red circles) and charm quark does not flow (green triangles)]. The HFT will be able to distinguish with great accuracy these 2 cases. Figure **??**(middle) shows the suppression factor $R_{CP}$ of $D^0$: the HFT will be able to measure it directly for $p_T \leq 10$ GeV/c via the hadronic channel thus avoiding the indirect method using non-photonic electrons. A measurement of $\Lambda_c$ is important to perform since the $\Lambda_c/D^0$ ratio may be enhanced, indicating a similar pattern to the baryon/meson ratio involving light quarks in the intermediate $p_T$ region [**?** ]. Two scenarios are investigated for the $\Lambda_c/D^0$ ratio [**?** ] : no enhancement and same enhancement as $\Lambda/K_s^0$. We see from Fig. **??**(right) that the statistical errors are sufficiently small, making a measurement of baryon/meson ratio in charm sector with good precision in heavy ion collisions.

## 4. Summary

The HFT, by using low mass CMOS sensors, will be able to directly reconstruct charm hadrons over a large momentum range and, thus, study flow and energy loss of heavy flavor particles. Several physics capabilities such as baryon/meson ratio in the charm sector have been studied.

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