Strangeness production in U+U collisions at RHIC

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- Motivation
- STAR experiment at RHIC
- Analysis technique
- Results
- Summary & Outlook

Motivation

Strange quark production and its thermalization in the medium created aftermath in HIC, is an interesting probe to understand the medium properties, since net strangeness is zero in colliding nuclei.

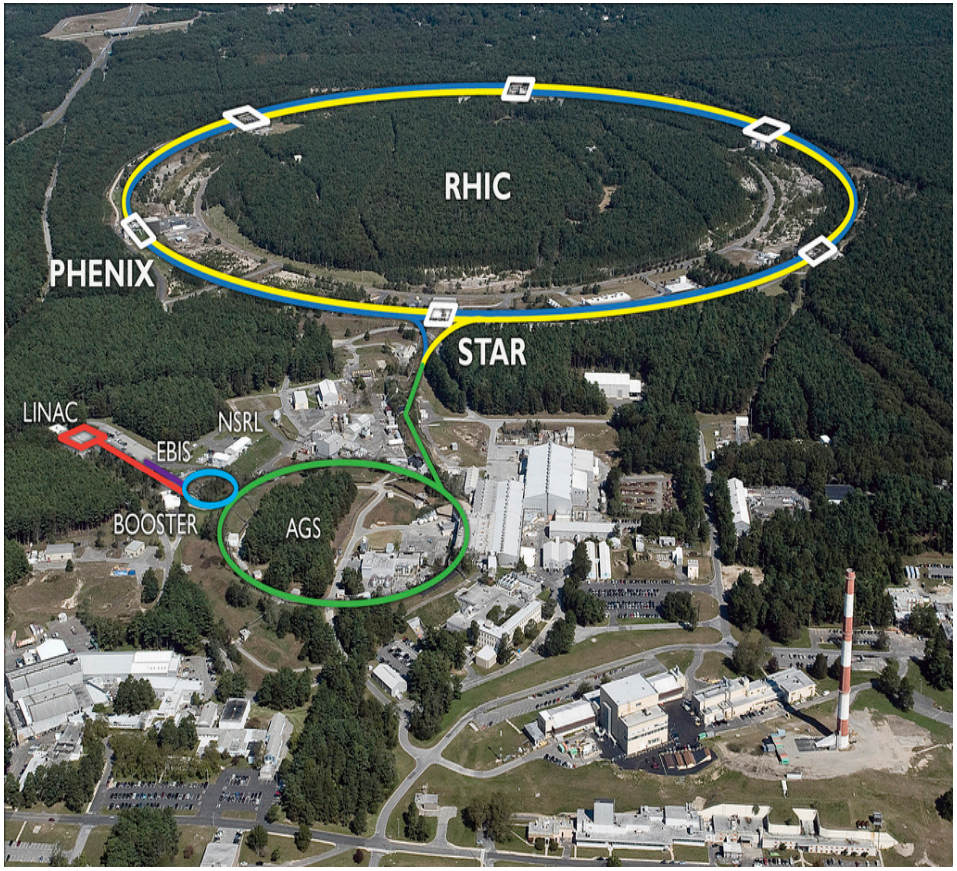
Advantages over Au+Au:

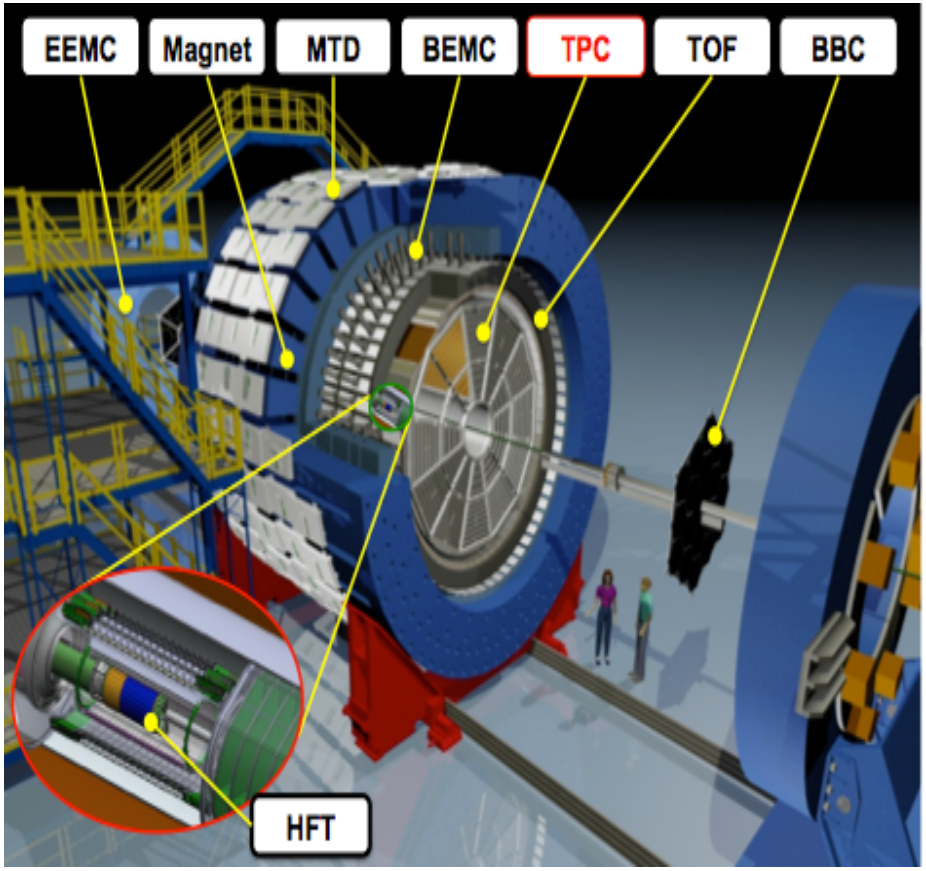
- Different Geometrical orientation in same nuclei
(R. Haque, Z. Lin and B.Mohanty, Phys.Rev.C 85,034905,2012)

- Larger energy density than Au+Au system
(D. Kikola, G.Odyniec, and R.Vogt, Phys.Rev.C 84,054907,2011)

- Larger life time of fireball
(John Campbell,QM -2014 Poster,I-08)

STAR experiment at RHIC





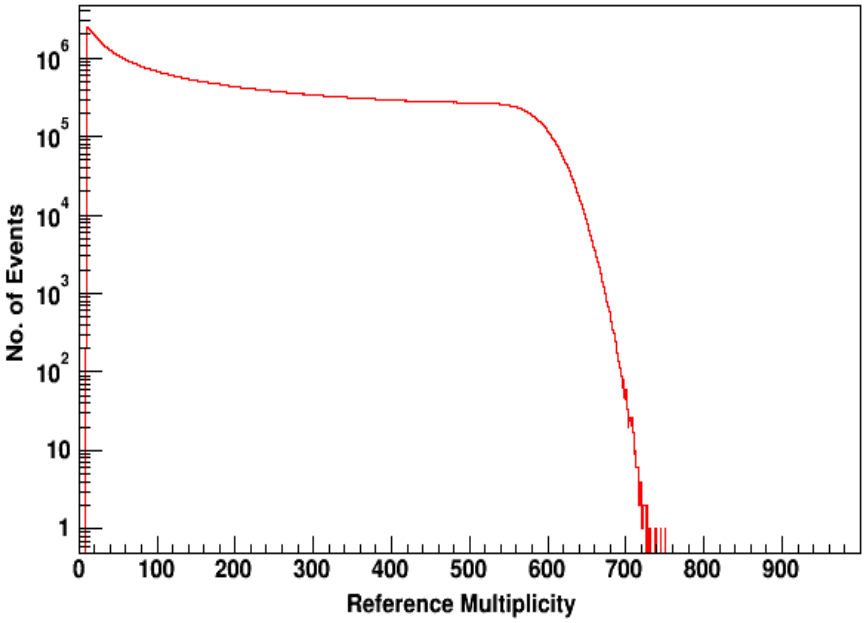
Colliding systems:
Au+Au, Cu+Cu, Cu+Au, U+U, d+Au, h+Au, p+p

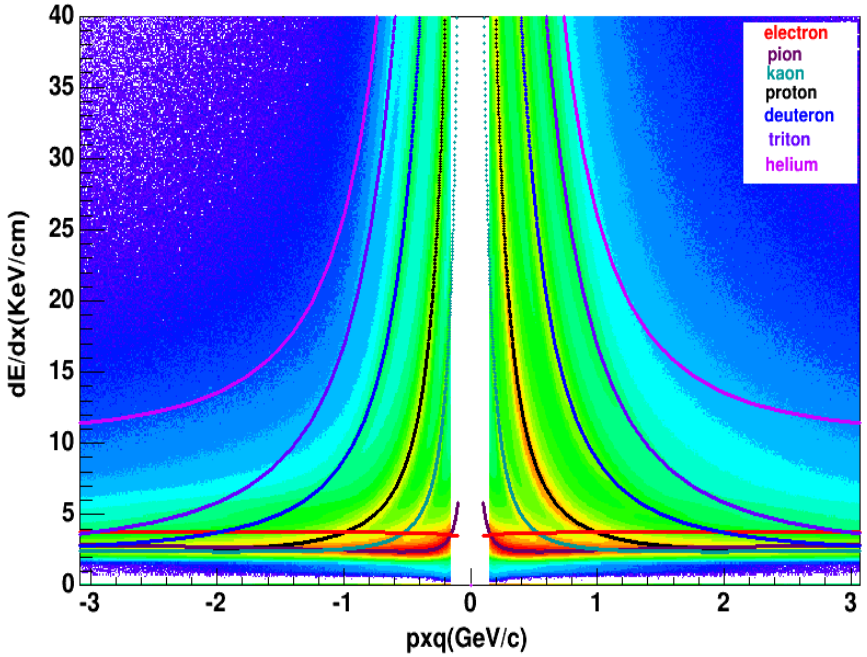
Center of mass energy:
$\sqrt{s_{NN}}$ = 7.7GeV to 500GeV

- Magnetic field: 0.5T
- Large acceptance: $|\eta|<1.8$, $0<\phi<2\pi$
- Excellent particle identification capabilities (Using Time Of Fight and Time Projection Chamber)

Dataset & track Cuts

System	U+U
Energy	193GeV
Event cuts	$\|V_z\|<40$cm, $V_r<2$cm
Statistics	~ 300 Million





p_T	≥0.15 GeV/c
$\|\eta\|$	≤1.0
nHits	>15
$\|n\sigma\|$	<4.0

Reference multiplicity:
No. of charged particles with $|\eta|<0.5$

$$\eta = \frac{1}{2}\ln\left(\frac{|\vec{p}|+p_z}{|\vec{p}|-p_z}\right) = -\ln\left[\tan\left(\frac{\theta}{2}\right)\right]$$

$$-\left\langle \frac{dE}{dx} \right\rangle \sim A\left(1+\frac{m^2}{p^2}\right)$$

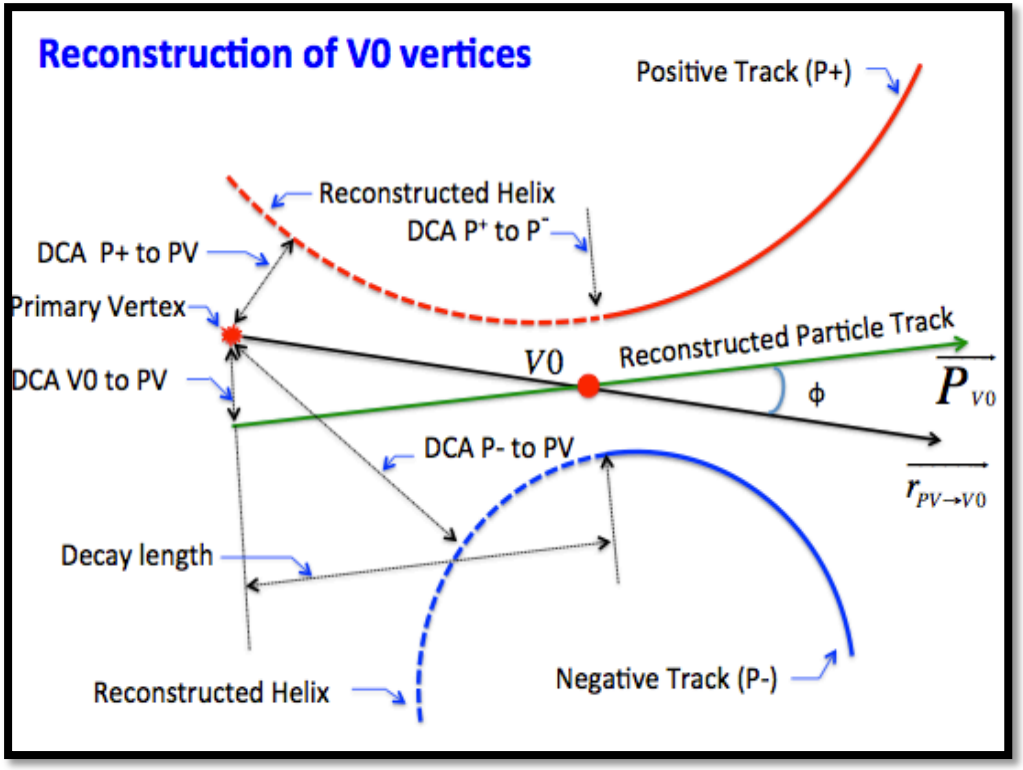
$$N\sigma = \frac{1}{R}\times\log\left(\frac{dE/dx_{measured}}{dE/dx_{theory}}\right)$$

Topological cuts:

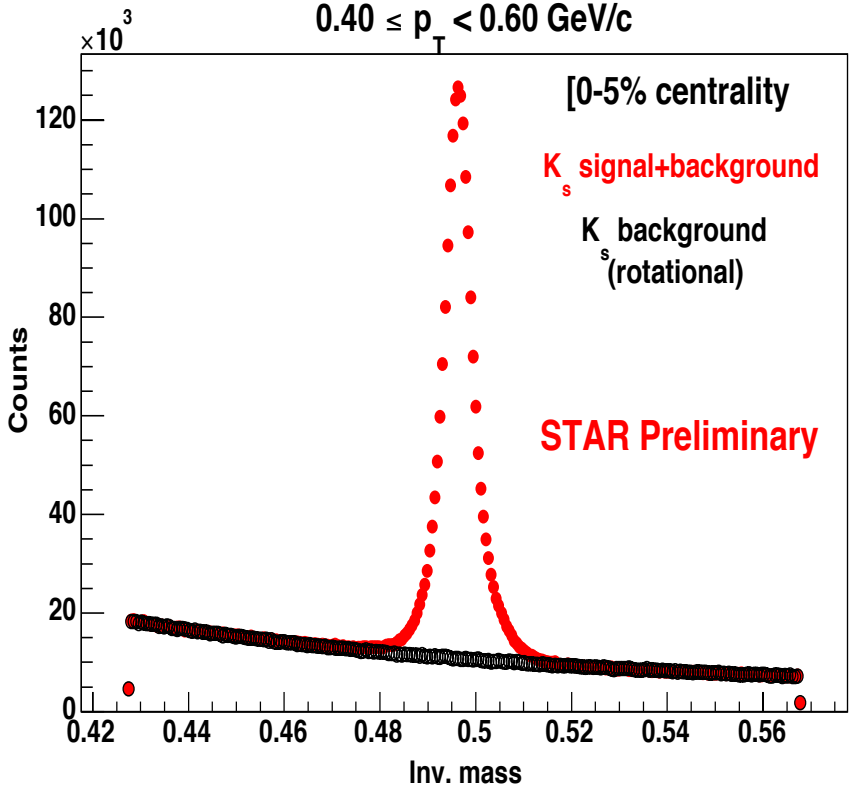
Strange particles are reconstructed via their dominant hadronic decay channels as listed below:

	Dominant decay mode, branching ratio(in %)	Mass (in MeV)	Decay length (in cm)	Mean Life time
K^0_s	$\pi^+\pi^-$,69.2±0.5	497.614±0.024	2.68	(0.8954±0.0004)×10^{-10}s
Λ	pπ,63.9±0.5	1115.683±0.006	7.89	(2.632±0.020)×10^{-10}s

	K^0_s	Λ
Dca dau1	≥2.0 cm	≥1.0 cm
Dca dau2	≥2.0 cm	≥2.0 cm
Dca dau1 to dau2	≤0.8 cm	≤0.8 cm
Pointing away cut	>0.0	>0.0
V_0 dca	≤0.8 cm	≤0.7 cm
V_0 decay length	≥6.0 cm	≥6.0 cm
$\lvert V_0$ rapidity$\rvert$	≤0.5	≤0.5

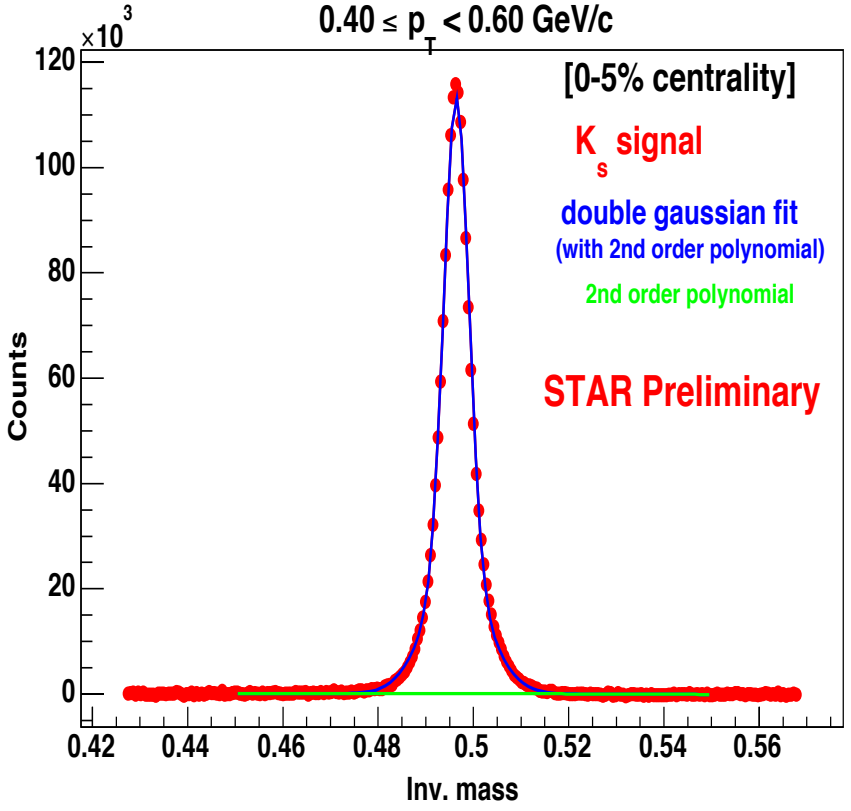


Signal extraction



- Fitting function:

$$ae^{-\frac{(x-b)^2}{2c^2}} + de^{-\frac{(x-b)^2}{2f^2}} + p_1 + p_2 x + p_3 x^2$$

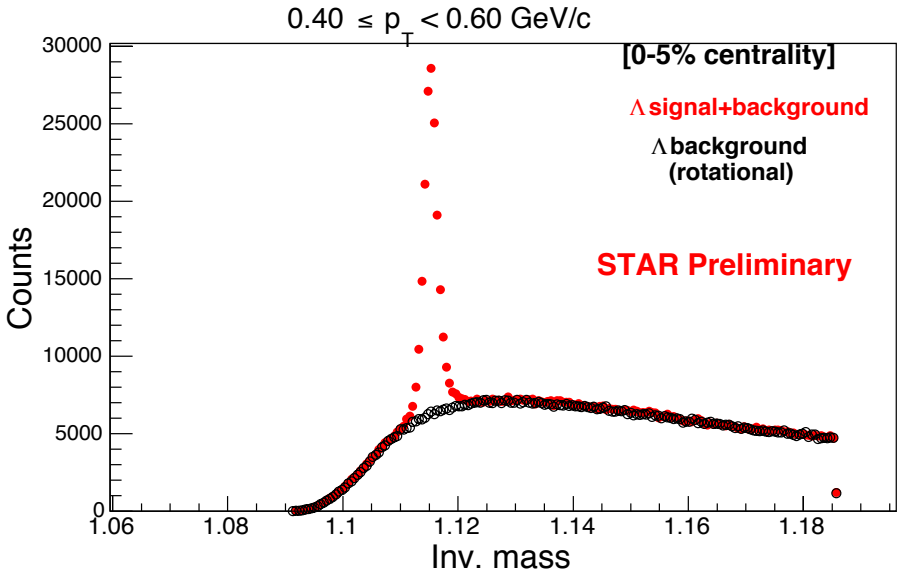


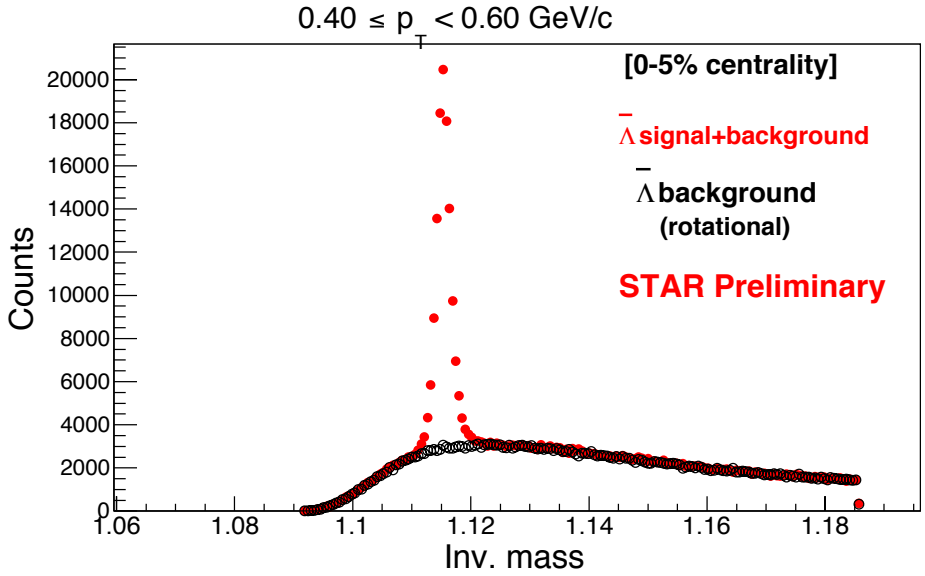
- Invariant mass formula:

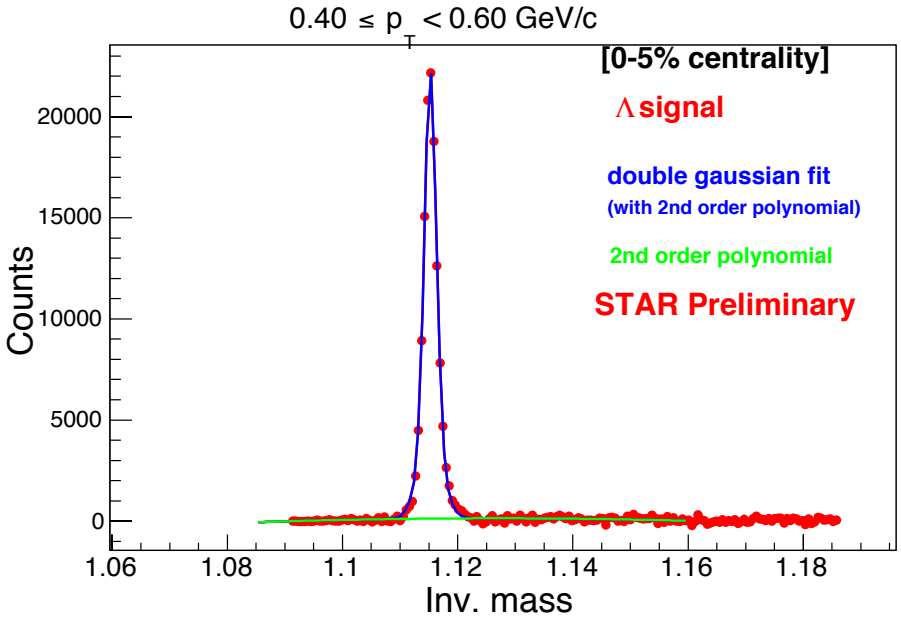
$$\sqrt{\left(E_1+E_2\right)^2-\left(\vec{p}_1+\vec{p}_2\right)^2}$$

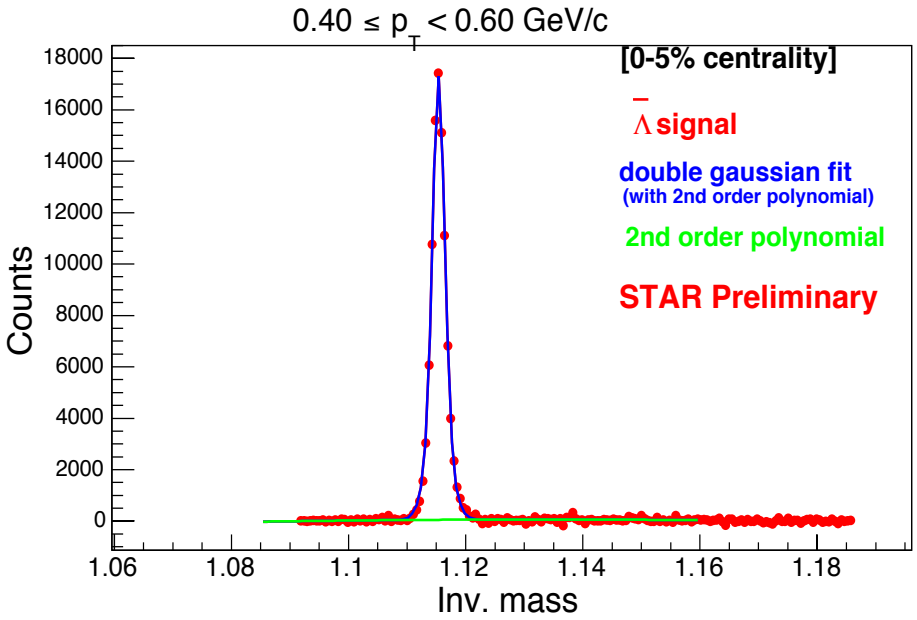
  - Background method: Rotational

Signal extraction

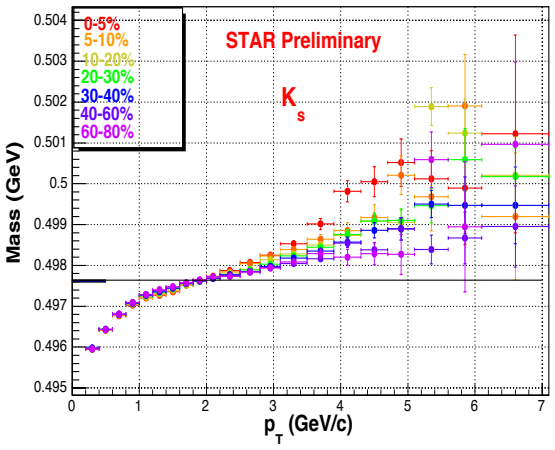


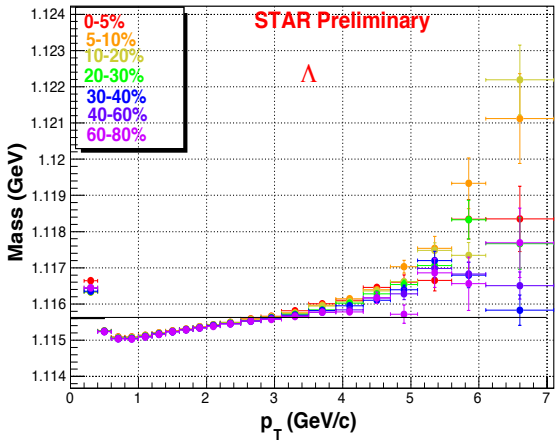


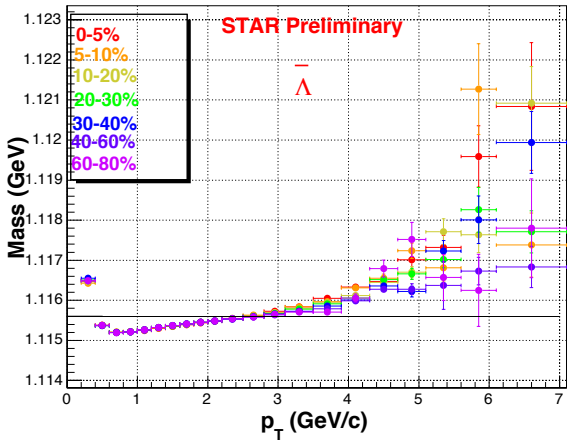


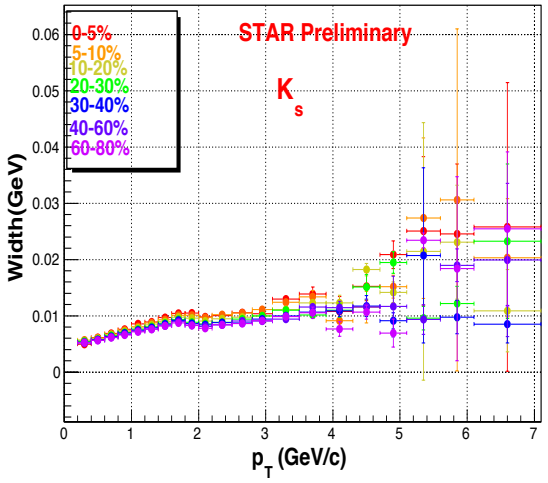


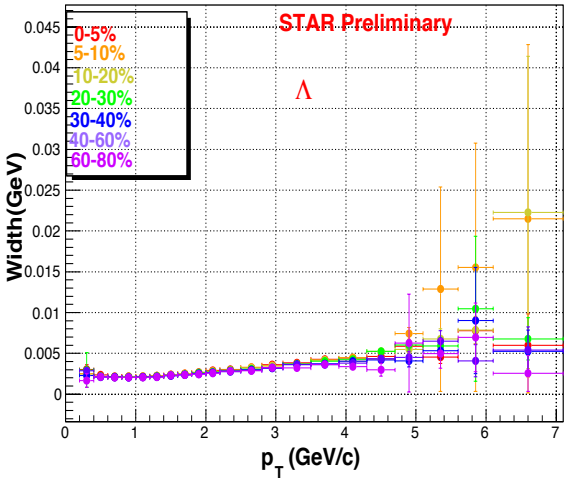
Mass & Width variation

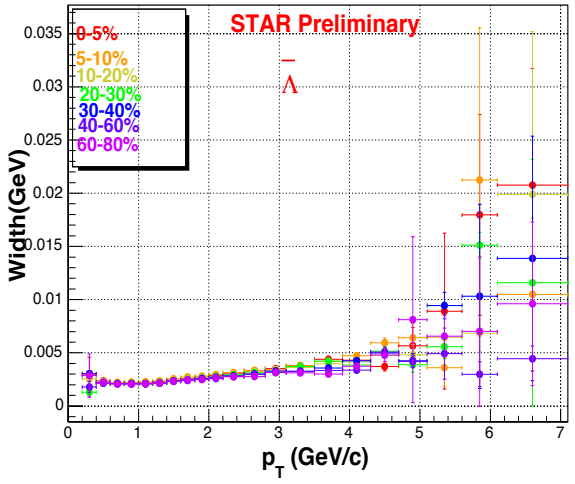






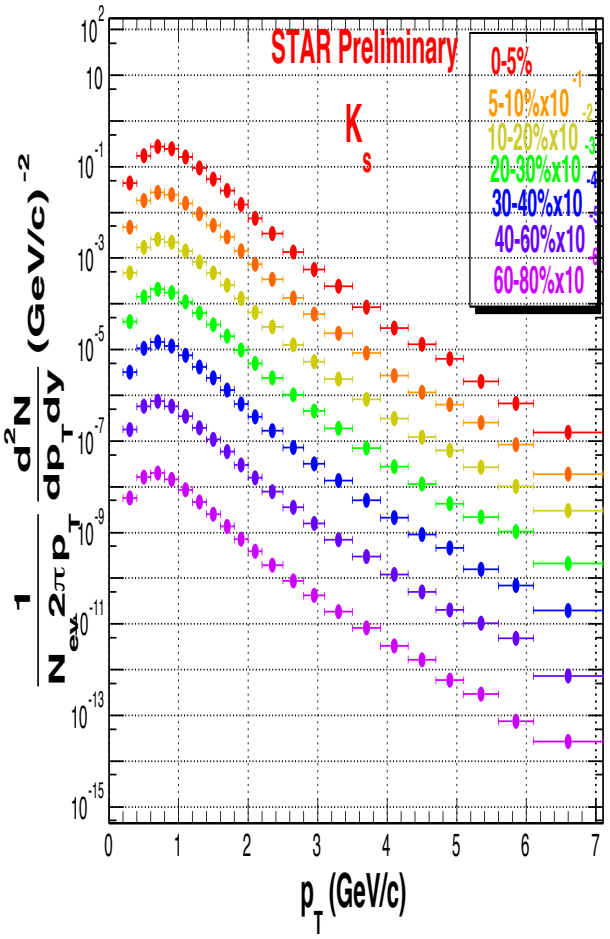


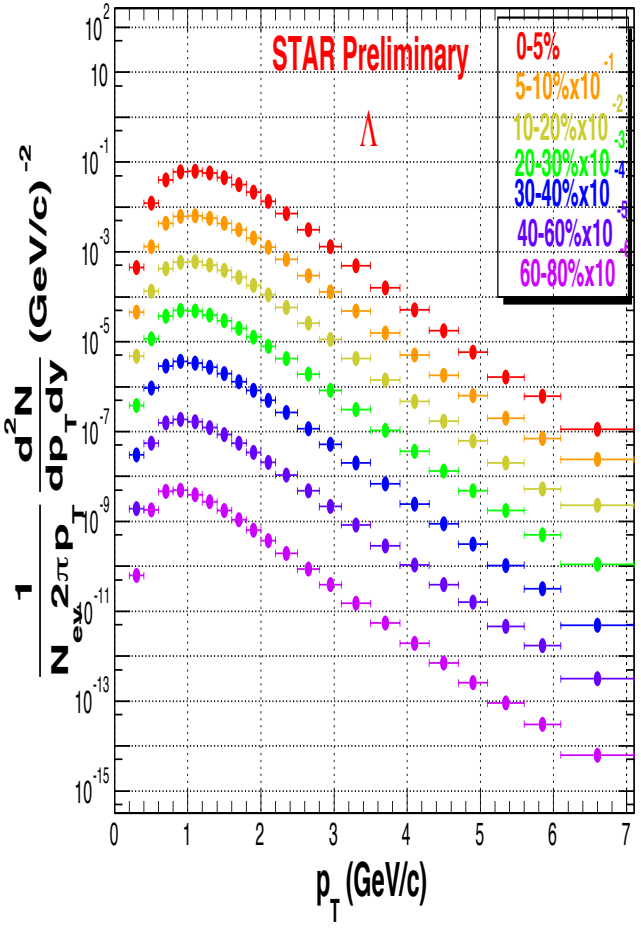


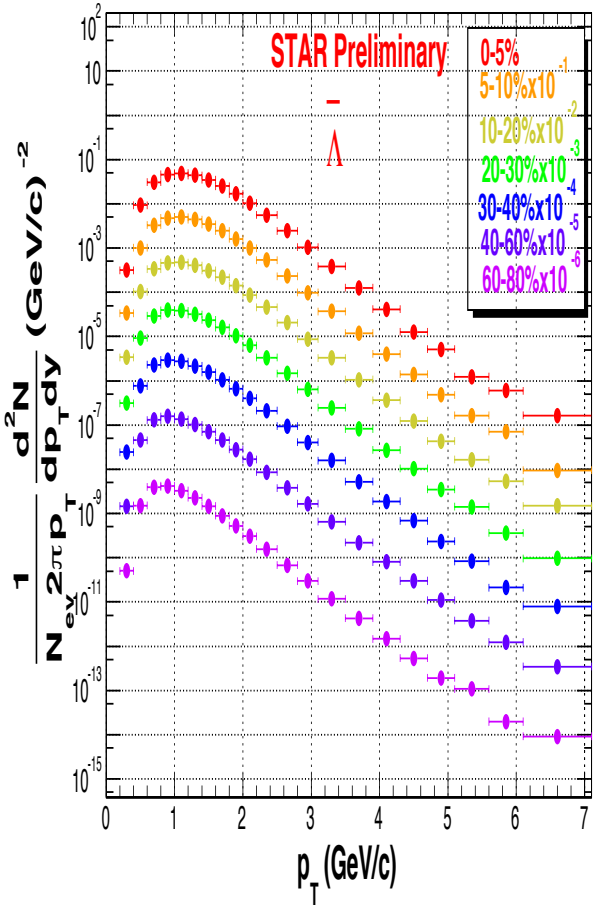


particle	Mass PDG value	Mass variation	Width measured
K^0_s	497.614±0.024 MeV	4.2 MeV(~ 0.9%)	10 MeV
Λ	1115.683±0.006 MeV	7.4 MeV(~ 0.7%)	5 MeV
$\bar{\Lambda}$		6.9MeV(~0.6%)	5 MeV

Uncorrected p_T spectra







- First measurement of K^0_s, Λ & $\bar{\Lambda}$ in U+U collisions
- p_T reach upto 7GeV/c

Summary

- First measurement of single-strange hadrons(K^0_s, $\Lambda(\bar{\Lambda})$) in U+U $\sqrt{s_{NN}}$ =193GeV data via their hadronic decay channels.
- Measured mass of these particles are consistent with PDG value(less than 1% deviation).

Outlook

- To correct spectra for detector acceptance and efficiency.
- To look for multi-strange hadrons

Thank you