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Beam Energy Scan on Hypertriton Production and Lifetime Measurement at STAR

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The hyperon-nucleon(Y-N) interaction is of great physical interest because it introduces a new quantum number strangeness in nuclear matter. It is predicted to be the decisive interaction in some high-density matter systems, such as neutron stars [1]. RHIC, the Relativistic Heavy Ion Collider, provides an ideal laboratory to study Y-N interaction because hyperons and nucleons are abundantly produced at high energy nucleus-nucleus collisions. The lifetime and decay modes of the hypertriton, the lightest hypernucleus, which consists of a proton, a neutron and the lightest hyperon Lambda, and the antimatter hypertriton discovered at RHIC[2], provide valuable insights into the Y-N interaction.

The strangeness population factor S3, defined as $\frac{^3_\Lambda H/^3 He}{\Lambda/p}$, is a good representation of the local correlation between baryon number and strangeness[2]. It is predicted that S3 has a different behavior in QGP and pure hadron gas[3,4] thus can be used as a tool to distinguish Quark-Gluon Plasma (QGP) from a pure hadronic phase.

The RHIC beam energy scan program in 2010-2011 allowed STAR to collecte data from Au+Au collisions over a broad range of energies. This provides an opportunity to study the beam energy dependence of S3. In addition, due to the beam energy independence of our lifetime measurement method, with increased statistics of present datasets, an improved result of lifetime measurement of hypertriton can be obtained.

In this talk, the hypertriton analysis results for Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7, 11.5, 19.6, 27, 39 and 200 GeV will be presented. With the excellent particle identification of Time Projection Chamber, we are able to reconstruct $^3_\Lambda H(^3_\Lambda \bar{H})$ via its two-body decay channel to ^3He and $\pi^-(\overline{^3He}$ and $\pi^+)$. The combined $^3_\Lambda H$ plus $^3_\Lambda \bar{H}$ raw yield is about 600 and its significance can reach 9.6σ. With this increased statistics, our lifetime measurement will be presented and the beam energy dependence of S3 will also be discussed.

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