Search for Hypernuclei using STAR Express Stream Data with KF Particle Package

I. Kisel
(for the STAR Collaboration)

Within the FAIR Phase-0 program the algorithms of the FLES (First-Level Event Selection) package developed for the CBM experiment (FAIR/GSI, Germany) are adapted for online and offline processing in the STAR experiment (BNL, USA).

Long-lived charged particles are reconstructed in the Time Projection Chamber using the CA track finder algorithm based on the Cellular Automaton. The search for short-lived particles is performed by the KF Particle package based on the Kalman Filter using the reconstructed long-lived daughter particles produced in the decays of the searched short-lived mother particles.

As a result of adapting the algorithms to work online, an express data production chain was created on the STAR High Level Trigger (HLT) farm, that extends the HLT functionality in real time up to the physics analysis. An important advantage of the express analysis is that it allows to start calibration, production and analysis of the data as soon as they are received.

The STAR Beam Energy Scan II program, including fixed target Au+Au collisions taken in 2018–2021, is particularly suited to study hypernuclei. Light hypernuclei are expected to be abundantly produced in low energy heavy-ion collisions. Measurements of hypernuclei production and their properties will provide information on the hyperon-nucleon interactions, which are essential ingredients for understanding of nuclear matter equation-of-state at high net-baryon densities, and, hence, the structure of neutron stars.

With the heavy fragment trigger introduced for the 2021 data taking, we were able to run the express stream production at the STAR HLT farm to search for hypernuclei. The collected data were sufficient to observe the decay process of ${}^{5}_{\Lambda}\mathrm{He} \rightarrow {}^{4}\mathrm{He}p\pi^{-}$ with more than 11σ significance.