Observation of the Antimatter Hypernucleus

Junlin Wu
(for the STAR Collaboration)

University of Chinese Academy of Sciences

Abstract

Matter-antimatter asymmetry is a research topic of fundamental interest, as it is the basis for the existence of the matter world, which survived annihilation with antimatter in the early Universe. High energy nuclear collisions create conditions similar to the Universe microseconds after the Big Bang, with comparable amounts of matter and antimatter. Much of the antimatter created escapes the rapidly expanding fireball without annihilation, making such collisions an effective experimental tool to create heavy antimatter nuclear objects and study their properties.

In this presentation, we give a brief review of the history of antimatter hypernuclear research, then we report the first discovery of the heaviest antimatter particle (${}^{4}_{\bar{\Lambda}}\overline{\mathrm{H}}$) ever seen on Earth, composed of an anti-Lambda ($\bar{\Lambda}$), an antiproton and two antineutrons. ${}^{4}_{\bar{\Lambda}}\overline{\mathrm{H}}$ is reconstructed through its two-body decay in ultrarelativistic heavy ion collisions at the STAR experiment at the Relativistic Heavy Ion Collider. A total of about 6.4 billion U+U, Au+Au, Ru+Ru, and Zr+Zr collision events with center-of-mass energy per colliding nucleon-nucleon pair $\sqrt{s_{NN}}$=193 GeV (U+U) or 200 GeV (other systems) are used in this analysis. The measurement of antihypernuclei ${}^{4}_{\bar{\Lambda}}\overline{\mathrm{H}}$ lifetime is achieved for the first time and compared with lifetime of their corresponding hypernuclei ${}^{4}_{\Lambda}\mathrm{H}$, which allows for further tests of the CPT symmetry. Production yield ratios among (anti)hypernuclei and (anti)nuclei are also measured and compared with theoretical model predictions, shedding light on their production mechanism.