Matter-Antimatter Mass Difference Measurement for (Anti) Triton, (Anti) Helium-3, and (Anti) Helium-4 with STAR

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(Dated: November 13, 2024)

PACS numbers:
Keywords:

The foundation of modern physics is built on our understanding of the symmetries of nature. Of these symmetries, the universal symmetry of CPT is one of the most fundamental, underpinning both Quantum Field Theory and the General Theory of Relativity. CPT symmetry requires that all systems are invariant under a simultaneous reversal of charge, parity and time direction. This symmetry further requires that the mass of every type of matter be exactly the same as its anti-matter counterpart. Using the data of Ru+Ru and Zr+Zr isobar collisions at $\sqrt{s_{NN}} = 200$ GeV collected by the STAR experiment in 2018, we report the mass difference between three nuclei and their anti-matter counterparts - ${}^3H$, ${}^3He$, and ${}^4He$ - to test CPT symmetry. These are the first measurements of the mass difference between ${}^3H$ and ${}^3\overline{H}$ and between ${}^4He$ and ${}^4\overline{He}$ providing a crucial CPT symmetry tests using the heaviest stable anti-nuclei observed to date.