Direct Lifetime Measurement of ${}^{3,4}_{\Lambda}$H Hypernuclei using the (K^-, π^0) Reaction

Abstract

The lifetimes of light hypernuclei, particularly the hypertriton ${}^{3}_{\Lambda}$H, have been subjects of intense study due to conflicting measurements from recent heavy-ion collision experiments. Some measurements report lifetimes significantly shorter than the free Λ lifetime (HypHI 2013, STAR 2018 and ALICE 2016), while others find consistency with it (STAR 2021 and ALICE 2023). To address this discrepancy, our J-PARC E73 experiment employs the (K^-, π^0) strangeness exchange reaction with a high-intensity K^- beam at the J-PARC K1.8BR beam line, enabling direct lifetime measurements of both ${}^{3}_{\Lambda}$H and ${}^{4}_{\Lambda}$H hypernuclei in the time domain.

In a pilot run, we measured the lifetime of ${}^{4}_{\Lambda}$H with unprecedented precision, as published in Physics Letters B 845 (2023) 138128. For ${}^{3}_{\Lambda}$H, data collection was completed by February 2025, and we are currently analyzing the data. At the conference, we will present the recent progress of the hypertriton lifetime using this method, along with determinations of its production cross-section and binding energy. These measurements are essential for advancing our understanding of hyperon-nucleon interactions.