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High-Precision Decay Pion Spectroscopy at MAMI – progress in mass calibration with novel beam energy measurement –

Friday, April 4, 2025 1:30 PM (20 minutes)

The hypertriton ($^{3}_{\Lambda}$H) is the lightest Lambda-Hypernucleus, consisting of one proton, one neutron, and a Lambda.
Its mass and lifetime have been measured using emulsion techniques and heavy-ion collision experiments.
Their relationship has been observed to deviate from theoretical predictions, which is known as the 'hypertriton puzzle'.
The accuracy of measured Lambda-binding energies remains approximately 100 keV, which is insufficient to resolve the puzzle.
An accurate and independent measurement is therefore crucial for understanding the 'hypertriton puzzle'.

In October 2022, we conducted decay pion spectroscopy experiments on s-shell hypernuclei at the Mainz Microtron MAMI in Germany, followed by spectrometer calibration in March 2024.
The method was originally established in the 2010s, and in 2016, the mass of $^{4}_{\Lambda}$H was successfully measured with an accuracy of approximately 80 keV .
To suppress the systematic error and achieve higher accuracy for hypertriton, we have been developing a new beam energy measurement technique called undulator radiation interferometry.
This technique achieved a beam energy precision of 20 keV in the 200 MeV region, and will reduce the systematic error in hypernuclear mass measurements to 10-20 keV.

In this talk, I will present our experimental methods, including calibration procedures, and report on the current analysis status.

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