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Few-body strangeness nuclei and their puzzles

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Nuclear spectroscopy with heavy ion beams and fixed nuclear targets has recently become a powerful tool to study sub-atomic nuclei with strangeness. The first HypHI experiment at GSI has demonstrated the feasibility of the method by reconstructing invariant masses and decay vertexes with 6Li beams at 2 A GeV bombarding a graphite target, and formation and mesonic weak-decay of light hypernuclei have been successfully observed. The results have revealed a significantly short lifetime of hypertriton. Furthermore, it has also revealed indications of signals in the d+pi- and t+pi- invariant mass distributions, that may indicate a possibility of a weakly bound state with a Lambda-hyperon together with two neutrons (n-n-Lambda). These observations are recently under debate. For the n-n-Lambda state, recent theoretical calculations have shown that such a state is unlikely bound.

The accuracy and the statistics of the developed method for the hypernuclear spectroscopy with heavy ion beams should yet be improved. The method also has to be further developed with different detection techniques and beams at higher energies. A new experimental project to study hypernuclei has been proposed at GSI, and it will introduce the WASA central detector, which has recently been transferred from COSY in Juelich to GSI, for pion measurement combined with the high resolution fragment separator, FRS, for measuring decay residues. The project has already been approved, and experiments with WASA+FRS will be performed in coming years. The project will be continued with the Super-FRS at FAIR. Another new development at higher energies is in progress for the future heavy ion accelerator facility in China, High Intensity heavy ion Accelerator Facility, HIAF. Both projects at FAIR and HIAF will open new possibilities to study double-strangeness hypernuclei with heavy ion beams and fixed targets as well as to measure directly magnetic moments of hypernuclei. The current situations to study the lifetime of hypernuclei and n-n-Lambda as well as these new projects will be discussed in the talk.

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