

# Double- $\Lambda$ ; and $\Xi$ ; hypernuclei : Findings and Prospects

Wednesday, 7 June 2023 14:28 (28 minutes)

## Double- $\Lambda$ ; and $\Xi$ ; hypernuclei : Findings and Prospects

Kazuma Nakazawa <sup>1, 2</sup>

<sup>1</sup> High Energy Nuclear Physics Laboratory, RIKEN

<sup>2</sup> Faculty of education, Gifu University, Japan

Since the discovery of the doubly-strange hypernucleus in 1963, many efforts have been made but no new discoveries have been made. In the 1980s, we introduced the Emulsion-Counter “Hybrid-method” combining real-time detectors and nuclear emulsion, which led to the discovery of the charn and beauty particles, to our experiment to search for doubly-strange hypernucleus. As a result, we confirmed the existence of double- $\Lambda$ ; hypernucleus, which decayed sequentially, at an absorption point of a  $\Xi$ ;  $\Xi$  particle in the KEK-E176 experiment. With developed hybrid method, the E373 (KEK) experiment succeeded in the unique identification of  $\Lambda\Lambda$ - $\Lambda\Lambda$ -He, where the interaction between  $\Lambda$ ; and  $\Lambda$ ; particles was understood to be weakly attractive. In the further improved E07 (J-PARC) experiment, we succeeded in detecting 33 cases of doubly-strange hypernuclei and the ground state of  $\Xi$ ; hypernuclei. From the 47 cases we have detected so far and one case in 1963, we found that the interaction between two  $\Lambda$ ; particles is a weak attraction and that the energy at which two  $\Lambda$ ; particles bind to a nucleus seems to depend linearly on the nuclear mass number. Additionally, the existence of the  $\Xi$ ; hypernucleus was confirmed, then the interaction between the  $\Xi$ ; and nucleon works attractively. Regarding the  $\Xi$ - $\Xi$ -C hypernuclei, the level structure can be seen. We are currently developing an efficient detection method for the production and decay of doubly-strange hypernuclei by probing the entire volume of the emulsion and applying a machine learning model, without relying on information from real-time detectors. This development is expected to detect a large number of double- $\Lambda$ ; hypernuclei emitted from the  $K$ - $\Lambda$  reaction point as well as the  $\Xi$ - $\Xi$  absorption, which shall conduce to very important and more reliable information for understanding baryons in a unified manner under SU(3) $_f$  symmetry.

**Primary author:** Prof. NAKAZAWA, Kazuma (High Energy Nuclear Physics Lab./ Faculty of education, Gifu Univ.)

**Presenter:** Prof. NAKAZAWA, Kazuma (High Energy Nuclear Physics Lab./ Faculty of education, Gifu Univ.)

**Session Classification:** Hypernuclei and kaonic atoms

**Track Classification:** Hypernuclei and kaonic atoms