RECENT PROGRESS IN HYPERNUCLEAR PHYSICS

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Recent experimental results and future prospect in hypernuclear physics are presented.

Charge symmetry breaking (CSB) has become a recent hot topic in Λ hypernuclei. Old emulsion experiments suggested a large CSB effect in ΛN interaction from a large difference (~350 keV) of Λ's binding energy (B_Λ) between ${}^{4}_{\Lambda}\mathrm{H}(0^+)$ and ${}^{4}_{\Lambda}\mathrm{He}(0^+)$, and experimental confirmation has been long awaited. A recent experiment at Mainz precisely measured the π^- momentum of ${}^{4}_{\Lambda}\mathrm{H} \to {}^{4}\mathrm{He} + \pi^-$ weak decay and confirmed the ${}^{4}_{\Lambda}\mathrm{H}(0^+)$ B_Λ value. A recent J-PARC experiment observed a γ-transition for ${}^{4}_{\Lambda}\mathrm{He}(1^+ \to 0^+)$ at 1.41 MeV, much larger than the corresponding ${}^{4}_{\Lambda}\mathrm{H}(1^+ \to 0^+)$ energy (1.09 MeV), indicating a large CSB effect. Those results cannot be reproduced by the Nijmegen one-boson-exchange baryon-baryon (BB) interaction models and provide a strong constraint to theoretical models. CSB effects in *p*-shell Λ hypernuclei are also being studied via high-resolution $(e, e'K^+)$ spectroscopy at JLab.

Another topic is the first observation of a Ξ-nuclear deeply bound state (Kiso event) via re-scanning of the emulsion previously exposed to K^- beams at KEK-PS. They found an event of $\Xi^- + {}^{14}\mathrm{N}$ system decaying to ${}^{10}_{\Lambda}\mathrm{Be}$ and ${}^{5}_{\Lambda}\mathrm{He}$, and the Ξ^- binding energy of the initial state was derived to be 1.1–4.4 MeV. It is an evidence for attractive Ξ-*N* interaction and suggests that Ξ^- hyperons appear in the inner core of neutron stars. At J-PARC, more experiments for double strangeness systems (ΛΛ hypernuclei, Ξ^- atomic X-rays, Ξ hypernuclear spectroscopy) are running and being prepared.

In addition, high-resolution Λ hypernuclear spectroscopy with 0.1 MeV accuracy is planned at JLab and J-PARC to investigate density dependence of Λ*N* interaction, which provides a clue to reveal 3-body BBB repulsive forces and to solve the "hyperon puzzle" in heavy neutron stars.