Matter with strangeness

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A recent experimental progress of strangeness nuclear physics is reviewed. In particular, the following three items are discussed, in which new hypernuclear data have revealed important properties of the ΛN, $\Lambda\Lambda$ and ΣN interactions.

- γ-ray spectroscopy technique has been successfully applied to Λ hypernuclei using a germanium detector array (Hyperball) as well as an NaI counter array. The level structure of ${}^{7}_{\Lambda}$Li [1], ${}^{9}_{\Lambda}$Be [2], and ${}^{13}_{\Lambda}$C [3] were investigated at KEK (E419) and BNL (E930, E929), and the strengths of the spin-spin and the spin-orbit interactions between a Λ and a nucleon were derived. In a recent BNL experiment (E930), γ rays in ${}^{16}_{\Lambda}$O and ${}^{15}_{\Lambda}$N have also been observed with Hyperball, and the ΛN tensor interaction is being investigated from their level structure.

- A beautiful event of a double Λ hypernucleus ${}^{6}_{\Lambda\Lambda}$He was observed in the emulsion-counter hybrid experiment at KEK (E373) [4]. It was produced by Ξ^- absorption at rest in emulsion and uniquely identified from its sequential weak decay. From the measured binding energy, the strength of the $\Lambda\Lambda$ interaction was unambiguously derived to be $-1.01 \pm 0.2^{+0.18}_{-0.11}$ MeV. This value is much smaller than the one previously believed from old emulsion data (-4 MeV).

- The Σ-nucleus potential was studied at KEK (E438) by the ^{28}Si(π^-, K^+) reaction at 1.2 GeV/c. Within a framework of the distorted wave impulse approximation, a strongly ($\sim$150 MeV) repulsive Σ potential is necessary to explain the measured continuum shape of the inclusive spectrum [5]. This result suggests that the spin-isospin-averaged central ΣN force is strongly repulsive.

These results will give great contributions to our unified understanding of the baryon-baryon interactions and the baryonic matter with strangeness, combined with theoretical studies based on meson-exchange and quark pictures.

References

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