Charge symmetry breaking in Λ hypernuclei

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The large charge symmetry breaking (CSB) implied by the Λ binding energy difference $\Delta B_{\Lambda}(0_{\text{g.s.}}^+) = 0.35 \pm 0.06$ MeV of the A = 4 mirror hypernuclei ground states as deduced from past emulsion measurements, see Fig. 1, has defied theoretical attempts to reproduce it in terms of CSB in hyperon masses and in hyperon-nucleon interactions, including one pion exchange arising from $\Lambda - \Sigma^0$ mixing, as reviewed in HYP2012 by Nogga [1].



Figure 1: Level diagram of the A = 4 mirror Λ hypernuclei, taken from Tamura [2].

In this talk I will review a new evaluation of CSB in the $A = 4 \Lambda$ hypernuclei and its extension to *p*-shell mirror Λ hypernuclei using a schematic strong-interaction $\Lambda N \leftrightarrow \Sigma N$ coupling model developed by Akaishi and collaborators [3] for *s*-shell Λ hypernuclei and extended by Millener to the *p* shell [4]. The model yields values of $\Delta B_{\Lambda}(0_{g.s.}^+) \sim 0.25$ MeV [5]. Smaller size and mostly negative *p*-shell binding energy differences were found for the A = 7 - 10 mirror hypernuclei, in rough agreement with the few available data. CSB reduces by almost 30 keV the 110 keV ${}^{10}_{\Lambda}B$ g.s. doublet splitting anticipated in shell-model calculations that account for the hyperonnucleon strong-interaction spin dependence in the *p* shell [6] thereby explaining the persistent experimental failure to observe the $2_{exc}^- \rightarrow 1_{g.s.}^- \gamma$ -ray transition.

Finally, preliminary results of a new NCSM four-body calculation [7] of CSB splittings in the A = 4 hypernuclei, using LO chiral hyperon-nucleon interactions, will be briefly reported.

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- [3] Y. Akaishi, T. Harada, S. Shinmura and K.S. Myint, PRL 84 (2000) 3539;
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- [7] D. Gazda and A. Gal, in preparation.