# Composition and properties of multi-strange hypernuclear systems

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We address multi-strange hypernuclear matter using a nonrelativistic effective potential approach as well as relativistic mean-field theory. According to Schaffner *et al.* [**?**], multi-strange hypernuclear systems stable with respect to the strong interaction contain in general not only $\Lambda$, but also $\Xi$ hyperons equilibrated against the $\Lambda\Lambda \longleftrightarrow \Xi N$ conversion. Whereas earlier studies were restricted to the isosymmetric matter or some certain nucleonic cores, we cover the whole ranges of strangeness $s$ and electric charge $q$ per baryon and deduce the region of $s$ and $q$, in which the infinite matter is stable with respect to the conversion and single-baryon emission. The region is enveloped by nucleon and $\Xi$ drip lines and includes subregions of different baryonic compositions (like $pn\Lambda$, $pn\Lambda\Xi^-$, $pn\Lambda\Xi^0\Xi^-$, $n\Lambda\Xi^0\Xi^-$, $\Lambda\Xi^0\Xi^-$) [**?**]. At some conditions, more exotic compositions (e.g., $n\Lambda\Xi^-$, $n\Xi^0\Xi^-$) are possible. We calculate energy per baryon, density, baryonic fractions, chemical potentials at saturation at various $s$ and $q$.

As available knowledge of relevant baryonic interactions is so far rather scarce, we employ the different models with various parameter sets. Naturally, the overall picture is particularly sensitive to isospin symmetry properties, which are driven by coupling of the baryons to isovector mesons in the relativistic mean-field framework and by some phenomenological parameters in the effective potential approach. We consider not only $\Xi\Xi\rho$, but also $\Xi\Xi\delta$ coupling (where $\delta$ is the scalar isovector meson). Implications of $\delta$ field are nontrivial and cannot be simulated by an effective readjustment of the $\Xi\Xi\rho$ coupling.

We consider also a new channel of strong decay of finite multi-strange hypernuclear systems: multiple (simultaneous) conversion of all the $\Xi$ hyperons. Some systems suggested earlier as candidates for the lightest multi-strange hypernuclei are most probably unstable with respect to this channel (e.g., ${}^{6}_{\Xi^0\Xi^0}\mathrm{He} \rightarrow 2p + 4\Lambda$). On the other hand, we prove that the multiple conversion is forbidden in the infinite uniform hypernuclear matter.

## References

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[2] D.E. Lanskoy, In *Strangeness Nuclear Physics*, Proc. of the APCTP Workshop, Seoul, 1999, Il.-T. Cheon, S.W. Hong, T. Motoba (eds), World Scientific, 2000, p.347.