Seminář

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Pionless EFT theory revealing the onset of ΛΛ hypernuclear binding

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The highly topical issue of the lightest ΛΛ hypernucleus remains still unresolved mainly due to the lack of ΛΛ scattering data as well as limited data on ΛΛ hypernuclear systems. Valuable information on the ΛΛ interaction has been provided recently by the analyses of ΛΛ correlations in relativistic heavy ion collisions, which put further experimental constraints on ΛΛ scattering length.

Pionless EFT theory, widely applied by the team of prof. Barnea (the Hebrew University), represents a very convenient tool with minimal set of low energy constants. They are fitted to available data, taking into account both experimental as well as theoretical uncertainties.
Binding energies of light, $A \leq 6$, ΛΛ hypernuclei are calculated using the Stochastic Variational Method.
The pionless EFT input in the strangeness $S = -2$ sector consists of (i) a ΛΛ contact term constrained by the ΛΛ scattering length $a_{\Lambda\Lambda}$, using a range of values compatible with ΛΛ correlations observed in relativistic heavy ion collisions, and (ii) a ΛΛN contact term constrained by the only available $A \leq 6$ ΛΛ hypernucler binding energy datum of ${}_{\Lambda\Lambda}{}^{6}\mathrm{He}$.

The recently debated neutral three-body and four-body systems ${}_{\Lambda\Lambda}{}^{3}\mathrm{n}$ and ${}_{\Lambda\Lambda}{}^{4}\mathrm{n}$ are found unbound by a wide margin. A relatively large value of $|a_{\Lambda\Lambda}|$ approx. 1.5 fm is needed to bind ${}_{\Lambda\Lambda}{}^{4}\mathrm{H}$, thereby questioning its particle stability. In contrast, the particle stability of the $A = 5$ ΛΛ hypernuclear isodoublet 5ΛΛH${}_{\Lambda\Lambda}{}^{5}\mathrm{H}$–${}_{\Lambda\Lambda}{}^{5}\mathrm{He}$ is robust, with Λ separation energy of order 1 MeV.

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