

ηN INTERACTIONS IN THE NUCLEAR MEDIUM AND η -NUCLEAR BOUND STATES

Jiří Mareš¹, Nir Barnea², Aleš Cieplý¹, Eliahu Friedman², Avraham Gal²

¹ Nuclear Physics Institute, 250 68 Řež, Czech Republic

² Racah Institute of Physics, The Hebrew University, 91904 Jerusalem, Israel

Our recent calculations of η -nuclear bound states in few-body, as well as many-body systems are reviewed. Underlying energy-dependent ηN interactions are derived from coupled-channel models that incorporate the $S_{11} N^*(1535)$ nucleon resonance.

The role of self-consistent handling of the subthreshold, strongly energy-dependent ηN interactions is thoroughly discussed. Our approach is found to impose stronger constraints than ever on the onset of η -nuclear binding. Binding energies and widths of η -nuclear bound states were calculated within several ηN interaction models for nuclei across the periodic table.

No ηNN bound states were found in models where $\text{Re}a_{\eta N} \leq 1$ fm ($a_{\eta N}$ is the ηN scattering length), i.e., in the majority of coupled-channel models of the $N^*(1535)$ resonance. For ηNNN , a weakly bound and relatively broad state was found within the model of Green and Wycech where $\text{Re}a_{\eta N} \approx 1$ fm.

The ${}^{12}_\eta\text{C}$ bound states are unlikely in models with $\text{Re}a_{\eta N} \leq 0.5$ fm, and as large value as $\text{Re}a_{\eta N} \approx 0.9$ fm is required to reproduce the ${}^{25}_\eta\text{Mg}$ bound-state candidate from the COSY-GEM experiment.