$N^*(1535)$ **Dynamics in η-Mesic Nuclei**

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One exciting subject of modern hadron and electron factories is the investigation of new types of nuclei. Besides the formation of deeply bound pionic atoms the most promising candidate is the investigation of η-mesic nuclei [1]. For Goldstone bosons as fundamental objects of QCD, nuclear medium modfies the basic meson-baryon interaction or the mesonic properties itself are of fundamental interest. As recently, there has been evidence for a partial restoration of chiral symmetry in pionic nuclei (as also supported from double pion production of the CHAOS coll.[2]), a similar question might be raised for the whole Goldstone-octet. Beyond that, η-mesic nuclei offer the additional advantage that their dynamics around threshold is strongly dominated by the excitation of the $N^*(1535)$ odd parity resonance [3], providing a unique possibility to study the formation and propagation of excited baryonic states in nuclear matter.
Our present investigations focus on two aspects of η mesic nuclei:
- Formation: The starting point of this study is a crossing symmetric meson-exchange model, dominated by π, η, ρ and ω exchange, with corrections for off-shell effects both in the s,t and u channels; background contributions are estimated from the coupling to the intermediate N and Roper resonances. The model is applied for a comparative study of quasi-free and recoilless production in the range of 50 MeV below and above the η threshold on He and C nuclei;
- N^* dynamics: For the N^* propgation we treat the large non-localities of the resonance dynamics in the framwork of the isobar doorway approach (extending the fromalism from the Δ-hole model in pion scattering [4]). Particularly, we focus on medium effects of the N^*, including in the framework of effective Lagrangians the coupling to single-meson (π, η) states via the N^* one-loop self energy and the nonstatic OBE, and to the nucleonic and the π, π contiuum noncrossed and crossed box diagrams (together with a localization of the box appropriate for near-threshold kinematics). For fast convergence doorway states are finally constructed within the projector formalism.
With the calculations still in an exploratory stage, we presently investigate the interplay of the appropriate kinematics, target nuclei and characteristics from specific final states as detailed signatures of the N^* dynamics.

References

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