



PhD position in theoretical nuclear physics

Structure and reactions of light and medium mass nuclei with the Gamow Shell Model with Coupled Channels

Description:

This project investigates the structure and reactions of exotic atomic nuclei near the limits of stability, where nuclei may be weakly bound or unbound. Recent advances in radioactive-ion-beam technology enable experimental study of these rare systems, which often exhibit unusual features such as extended “halo” structures. Traditional nuclear models, effective for stable nuclei, fail to capture the complexities of these open quantum systems. To address this, the project develops and applies the Gamow Shell Model (GSM) and its extension to coupled-channel (GSM-CC) approaches, which treat nuclei as open systems able to exchange particles and energy with their environment. This enables a unified description of both nuclear structure and reactions, including the effects of the quantum continuum that become significant near the driplines. These models yield accurate predictions that align with experimental data, guide future research, and remain flexible enough to apply to areas such as hypernuclei, atomic anions, and engineered quantum systems. A key innovation is integrating structure and reaction theories, overcoming traditional divisions in the field. The frameworks are designed for computational efficiency and scalability, leveraging supercomputing resources and incorporating uncertainty quantification for reliable predictions. By bridging gaps between theory and experiment, structure and reactions, and across quantum sciences, this research advances understanding of matter under extreme conditions, with broad implications for fundamental science and emerging technologies.

Expected skills:

Good knowledge of quantum mechanics, nuclear physics and computational aspects of the nuclear many-body problem. Excellent skills in computing and numerical analysis.

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