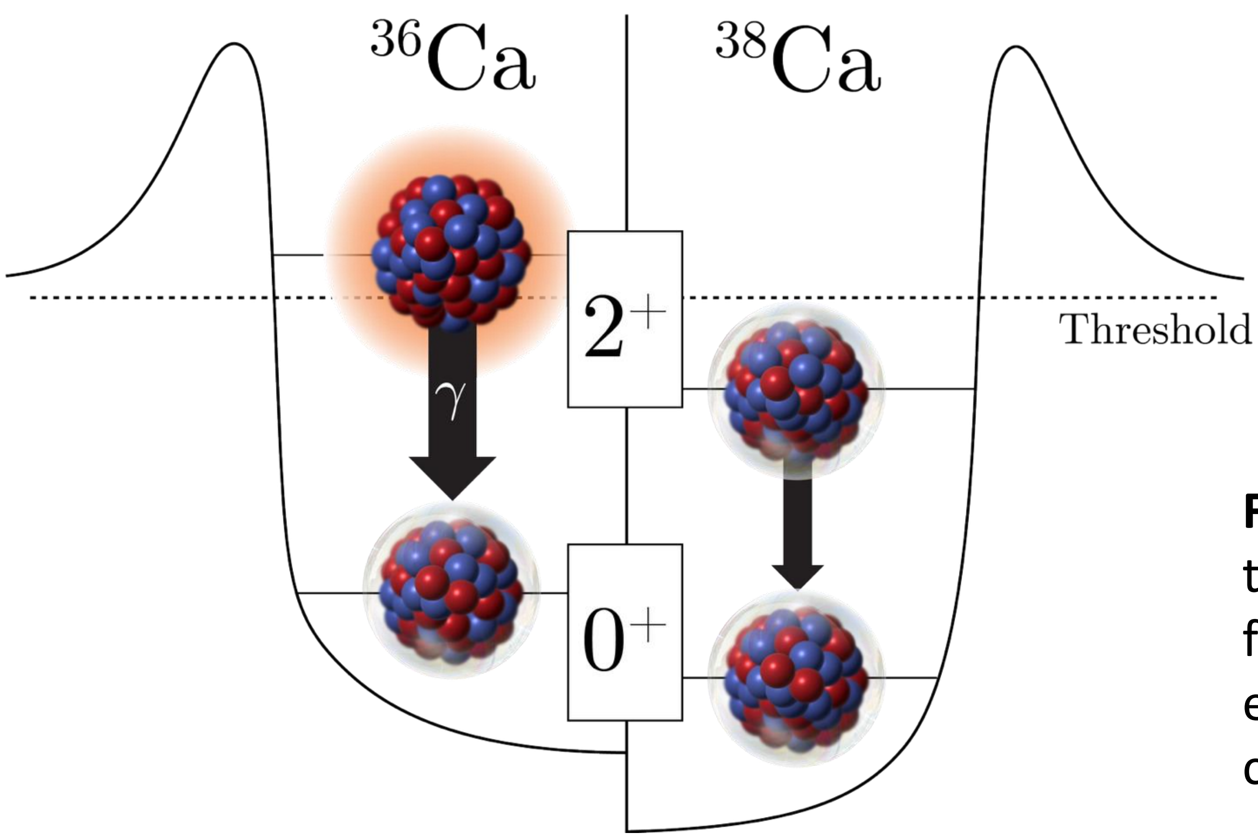
Loose binding of ^{36}Ca has been shown to solve a recent nuclear puzzle

Objectives

- A striking anomaly is observed in ^{36}Ca and ^{38}Ca near the proton dripline: despite its higher 2^+ excitation energy and smaller charge radius, ^{36}Ca exhibits a larger $B(E2; 0^+ \rightarrow 2^+)$ transition strength than ^{38}Ca.
- This observation suggests a complex interplay between structural evolution and continuum effects associated with proton excitations to unbound states across the $Z = 20$ magic gap.



Impact

- The puzzle was investigated using the Gamow shell model, a configuration-mixing approach that explicitly incorporates excitations to unbound states.
- We employed the chiral EFT Hamiltonian with two-nucleon and three-nucleon forces. The low-energy constants of the interaction were fine-tuned to reproduce experimental separation energies.
- The calculations reveal that the unbound 2^+ state of ^{36}Ca, a proton resonance, exhibits a spatially diffuse structure. This enhances the *B(E2)* transition strength, which explains the observed anomaly. In particular,
- Our analysis reveals that the proton sd→fp excitations strongly influence the *B(E2)* transition.

Accomplishments

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Figure caption: The exotic nuclei ^{36,38}Ca have fewer neutrons than protons, making the protons only weakly bound. The first excited state of ^{36}Ca lies above the proton separation energy. This appears to make it easier to excite than the corresponding state in ^{38}Ca