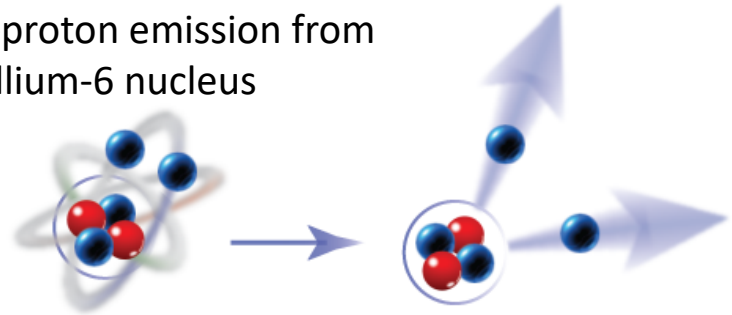
Caught in flight: fermion pair dynamics in open quantum systems

Objectives

- Three-body decay is a rare decay mode observed in a handful of unbound rare isotopes.
- We developed a realistic time-dependent framework that allows for a full control of the nuclear structure inside the nucleus, where nucleonic pairs are formed, and the dynamics of escaping nucleons.
- Using this new approach, we study the angular and energy correlations between emitted nucleons in a 3-body decay.

Two-proton emission from beryllium-6 nucleus



Video : Density evolution for the two-proton decay of the ground state of beryllium-6 for different strengths of pairing interaction V_{pp}.

Impact

- To study the mechanism of two-nucleon decay, theoretical models must fully control the behavior of the decaying system at large distances and long propagation times. To this end, we developed a realistic time-dependent framework that allows for precise three- body solutions asymptotically.
- By comparing the dynamics of two-proton and two-neutron decays, we demonstrated that while the two-proton emission is largely affected by the electrostatic repulsion, some fingerprints of nucleonic pairing remain.
- Our results indicate that the anticipated high-resolution data on energy and angular nucleon-nucleon correlations from FRIB will provide unique insights into the structure of proton and neutron pairs in rare isotopes.

Accomplishments

- Publication: S. M. Wang and W. Nazarewicz, Phys. Rev. Lett 126, 142501 (2021)
- Featured by MSU and several news outlets.