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Systematic study of 3n and 3p Systems

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Recent observations of peak structures in the excitation spectra of the four-neutron system have brought new attention to multineutron systems from both experimental and theoretical perspectives. A key challenge lies in identifying the mechanisms behind these peaks and exploring systematics as neutron number changes. Addressing these issues is important for deepening our grasp of neutron-rich few-body dynamics and the underlying nuclear forces in extreme environments.

Among such systems, the three-neutron (3n) system is one of the simplest multineutron configurations and provides a useful starting point for studying neutron correlations. It is generally thought that such delicate systems are optimally accessed through reactions with minimal momentum transfer. However, prior investigations of the 3n system have not explored this low-momentum transfer domain. To address this, we conducted a measurement of the 3H(t, 3He)3n reaction at 170 MeV/u using the SHARAQ spectrometer at RIKEN RIBF —a pioneering example of intermediate-energy RI-RI scattering employing a triton beam and tritium target. A specially developed high-density tritiated titanium target was employed to ensure sufficient statistics.

Additionally, we carried out a parallel study of the three-proton system (3p) via the isospin-symmetric 3He(3He, t)3p reaction at RCNP. Together, these experiments offer complementary insights into the T = 3/2 sector of the three-nucleon system.

In this talk, we will present the detailed results of these studies, as well as our plans for future experimental investigations of multineutron systems using new approaches.

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