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Study on the cluster structure related to neutron-rich Carbon isotope beams

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Nucleon clustering inside a nucleus is an intriguing phenomenon observed since the early time of nuclear physics. For stable nuclei, the cluster structure is generally developed at excited states close to the corresponding particle decay threshold as illustrated in the Ikeda diagram. When approaching the neutron drip line, a large number of cluster configurations are expected both in the excited and ground states. Many theoretical and experimental efforts have been devoted to this topic, but the detailed mechanism of cluster formation in nuclei is still an open question, which is of fundamental importance not only for nuclear physics but also for astrophysics.

We propose to study the cluster structure of neutron-rich carbon isotopes with Quasi-Free Scattering (QFS) method at RIBF. High-intensity secondary beams of carbon isotopes can be provided by BigRIPS. To reduce complex target effect from heavier targets, a solid hydrogen target will be used in this research, which will also increase the reaction luminosity. The proposed study will be a kinematically complete measurement, with the outgoing particles detected by high-performance SAMURAI spectrometer, Recoil Protons Spectrometer (ESPRI-RPS) detector, NEBULA array, and silicon-CsI(Tl) telescope. The cluster spectroscopic factors of the carbon isotope chain can then be extracted by employing DWIA calculations, and this will further allow to systematically investigate the behavior of clustering when approaching the drip line. We will also study he cluster structure in the excited states of neutron-rich beryllium isotopes and the neutron-neutron correlation in the multi-neutron clusters, as they will be produced after the QFS alpha knockout from carbon isotopes.

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