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Observation of 28O – Evolution of shell structure and multi-neutron correlations beyond the neutron dripline

How does nuclear shell structure evolve towards the highly neutron-rich nuclei? How do neutrons arrange themselves when they significantly outnumber protons in a nucleus? Addressing these questions, we present our recent observation of the doubly magic candidate nucleus, 28O, which has 20 neutrons and 8 protons, at RIBF at RIKEN. This nucleus provides a key benchmark for testing modern nuclear theories, including abinitio approaches, large-scale shell models, and continuum shell models. Additionally, 28O provides critical insights into the role of three-nucleon forces beyond the neutron dripline, which may elucidate the oxygen anomaly: the abrupt shift of the neutron dripline between Z=8 (O) and Z=9 (F). We also consider that this nucleus should have some multi-neutron correlation, such as dineutron-dineutron and tetra-neutron inside a nucleus. The talk also covers the observation of 27O and 30F, exploring possible many-body effects such as superfluidity in neutron-rich nuclei. Finally, we will discuss the near-future experiments along the neutron dripline, which aim further to advance our understanding of these exotic many-body systems.

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