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Observation of ^{28}O –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, ^{28}O , which has 20 neutrons and 8 protons, at RIBF at RIKEN. This nucleus provides a key benchmark for testing modern nuclear theories, including ab-initio approaches, large-scale shell models, and continuum shell models. Additionally, ^{28}O 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 ^{27}O and ^{30}F , 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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