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Enhanced Monopole Strength and Clustering in 12Be

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Many theoretical and experimental studies have been devoted to the cluster structure in nuclei in the past decades. But the detailed mechanism of clustering in nuclei is still an open question and is of fundamental importance in 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. Nevertheless, when approaching the neutron drip line some compact cluster cores may be favored in exotic nuclei even in the ground state. Neutron rich Be isotopes are obvious good candidates of clustering studies, for the richness of their cluster structures built on a well established α+α rotor, and the N = 8 shell quenching in 12Be was proposed as a signal of α clustering.
We have carried out a new breakup reaction experiment for 12Be at 29 MeV/nucleon at HIRFL-RIBLL in Lanzhou, China. A specially arranged detection system around zero degrees with high detection efficiency for states near the threshold was applied in this experiment. For the first time a strong resonance at around 10.3 MeV with a spin parity of 0+ was identified. And an enhanced monopole matrix element of about 7 fm2 and a large cluster decay width were also determined, in agreement with the GTCM calculation. These results reveal a strong clustering in the near threshold 10.3 MeV resonance in 12Be. Some other resonances were also observed in both 4He +8He and 6He+6He decay channels which are complementary to the previously suggested MR bands.

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