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Study of the Molecular States in Oxygen 20

It is well established that clustering is an essential aspect of nuclear many-body system. In neutron-rich domains, the valence neutrons in nuclei can exist in molecular orbitals, their role is similar to that of electrons in covalent bonds in atomic molecules, which help to stabilize the unstable multi-cluster states. The AMD plus GCM calculation found that the valence neutrons give richer structures for 20O. It suggests that the second 0+ band is a mixture of the 12C+4He+4n and 14C+6He cluster structures, and the third 0+ band and the 0- band have prominent 16C+4He cluster structure, and these two bands are regarded to be parity doublet bands.
Our group has performed an inelastic breakup experiment with a 30MeV/A 20O beam off a plastic target in Lanzhou to study the cluster states in 20O above 16C+α breakup threshold. With both the invariant mass and missing mass methods, we have detected the breakup fragments and the recoiled protons to reconstruct the two interest rotational bands. Thanks to the excellent energy calibration results and particle identification, 7 excited states of Oxygen 20 from this spectrum are in excellent agreement with those published in Bohlen's work. Besides, a new excited state is proposed to exist in Oxygen 20 with excitation energy of 17.16MeV, which decays predominantly in the way of cluster emission rather than neutron emission. And this state has not been observed by previous experiments.

Summary

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