

Search for Alpha Cluster Condensation in ^{16}O

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Recently Tohsaki, Horiuchi *et al.* [1] proposed a new α cluster wave function in order to investigate α -particle Bose condensed states in ^{16}O . The calculation suggests that there would be a 4α -cluster condensed 0^+ state at $E_x \simeq 14.0$ MeV. This α -cluster condensed state has a large root-mean-square (rms) radius of 3.97 fm compared with 2.73 fm for the ground state in ^{16}O . A large rms value indicates that this 0^+ state corresponds to a very dilute system which is only about a fifth of the experimental ground state density. The fact that the α -cluster condensed 0^+ state is of the dilute density is in agreement with nuclear matter calculations where it was shown that a condensate of α -like particles is possible only in matter with $\rho \leq 0.03 \text{ fm}^{-3}$.

We searched this 4α -cluster condensed state in ^{16}O via the $^{16}\text{O}(\alpha, \alpha')$ scattering at $E_\alpha = 400$ MeV. We have found a new resonance-like state at $E_x \simeq 13.5$ MeV with $\Gamma \simeq 800$ keV. The measured angular distribution is consistent with that for $J^+ = 0^+$. Thus this new state can be considered as a theoretically predicted 4α -cluster condensed 0^+ state.

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References

- [1] A. Tohsaki, H. Horiuchi, P. Schuck, and G. Röpke, Phys. Rev. Lett. **87**, 192501 (2001).