Pairing effects on low-energy single-neutron resonances in neutron drip-line nuclei

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Single-particle motion in a drip-line nucleus may emerge as a resonance. Furthermore, low-energy one-neutron resonances may be governed by the pair correlation because neutron drip-line nuclei have very shallow Fermi surface.

We describe elastic neutron scattering on a neutron drip-line nucleus under the influence of the pair correlation. We solve the Hartree-Fock-Bogoliubov equation in the coordinate representation so that the quasiparticle wavefunction satisfies the scattering boundary condition [1-2]. We focus on single-particle resonances associated with weakly bound orbits with low orbital angular momentum.

We calculate phase shift, elastic cross section and width of resonance for $^{46}$Si which has weakly bound $2p_{1/2}$ orbit. When the pairing is switched on, this $2p_{1/2}$ state emerges as a resonance. The width of this $p_{1/2}$ resonance increases with increasing pairing strength $\Delta$ (Fig.a-b). If we compare it with that of single-particle potential resonance (dashed line in Fig.b) at the same resonance energy, we found that the width of these quasiparticle resonances is narrowed by the pairing. Another feature is that these resonances exist even above the centrifugal barrier (arrow in Fig.b).

![Fig.(a) elastic cross section and phase shift of $p_{1/2}$, (b) resonance width and energy.](image)