Di-Neutron Correlation in Soft Octupole Excitations of Medium-Mass Nuclei near Drip-Line

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The pairing correlation in nuclei near the neutron drip-line is a very interesting issue. By means of the continuum QRPA method [1], we have already found that the di-neutron correlation appears in the ground state and the soft dipole excitation in the medium-mass nuclei near the neutron drip-line [2]. It is interesting that whether the di-neutron correlation appears in the other multipole excitations. In this report, we will discuss the pairing effect on the soft octupole excitations of medium-mass nuclei near the neutron drip-line.

In description of the excited state, we use the continuum QRPA method. The ground state is calculated by the coordinate-space Hartree-Fock-Bogoliubov (HFB) method with the Skyrme effective interaction [3]. We use the SLy4 parameter set [4] for the Skyrme force. The Skyrme force is used as the QRPA residual interaction in the particle-hole channel. However, the treatment of the momentum-dependent terms in the residual interaction is difficult so that we apply the Landau-Migdal approximation to these terms. In the particle-particle channel, we use the density-dependent delta interaction both for description of the ground state and for the QRPA residual interaction.

In Fig. 1(a), we show the strength function for the isoscalar octupole excitation of ^{84}Ni. There are two modes just above the neutron threshold: (i) the low-energy octupole state appears as the sharp-peak strength where both neutron and proton contribute to the strength. (ii) the neutron mode appears as the broad-bump strength. In order to investigate the character of these modes, we have evaluated the transition density. We found that the low-energy state is the particle-hole type surface vibrational mode as well known in stable nuclei. In the neutron mode, the particle-pair transition density has the significant tail (Fig. 1(b)). In the tail region, the large effect of the dynamical pairing can be seen. Furthermore, the states having the higher orbital angular momentum l (where the largest l of the bound state is 4, i.e. $1g_{9/2}$-orbit) contribute to the particle-pair transition density. This indicates that the di-neutron correlation plays an important role in the neutron mode. We conclude that the di-neutron correlation is general in nuclei near the neutron drip-line.

The numerical calculations have carried out on the NEC SX-5 supercomputer system at the Research Center for Nuclear Physics, Osaka University.

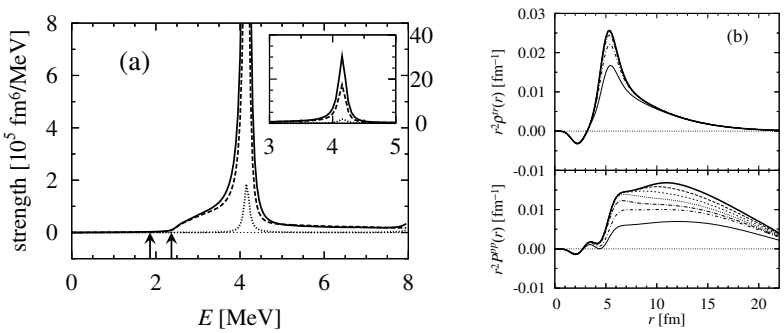

Figure 1: (a) The isoscalar octupole strength function of ^{84}Ni. The dashed and dotted line is the neutron and proton strength function. The arrows indicate the one- and two-neutron thresholds. (b) The particle-hole (the top panel) and particle-pair (the bottom panel) transition densities of the isoscalar octupole excitations of ^{84}Ni. The definitions of these transition densities is given by [2]. The thick and thin solid lines represent the full and the no dynamical pairing, respectively. The lines between the solid lines are in the case of l_{cut} = 7,9,11,13,15 where l_{cut} is the cut-off for the orbital angular momenta in description of the excited state.

References

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