Continuum QRPA analysis of Di-neutron correlation in the soft-dipole excitation

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We have analyzed the soft-dipole excitation in medium mass neutron-rich nuclei by means of the continuum quasiparticle random phase approximation (the continuum QRPA)[1]. The continuum QRPA utilizes the exact quasiparticle Green function satisfying the proper out-going boundary condition for neutrons and it includes the pairing interaction for the particle-particle channel self-consistently.

We calculate the E1 strength functions $S_{E1}(E) = dB(E1)/dE$ for even-even isotopes $^{18-24}$O,^{50,54,58}Ca,$^{80-86}$Ni near the neutron drip-line[2]. As an example of our calculations, we show the E1 strength for ^{84}Ni of the low energy region in Fig.1. The soft E1 strength arises just above the threshold energy of one (or two) neutron(s) escaping and it shows a smooth profile as a function of the excitation energy. The smooth profile implies that neutron escaping has a large influence on the soft E1 strength. To analyze the pair correlation effect, we decomposed it into the *static* and the *dynamical* mechanisms. The *static* pair correlation caused by the pair potenstial $\Delta(r)$ modifies the ground state configuration and the single-particle excitation. On the other hand, the *dynamical* pair correlation originates from the dynamical variation in the pair potential $\delta\Delta(r)$ on the excitation. By compairing the solid line (full pairing) and the dashed line(no dynamical) in Fig.1, we can see that the dynamical pairing effect has a tendency to increase the dipole strength.

We evaluate the particle-hole transition density $\rho^{ph}(r)$, the particle-pair transition density $P^{pp}(r)$, the hole-pair transition density $P^{hh}(r)$ to investigate the characters of the soft-dipole excitation. The relation $|P^{pp}(r)| > |\rho^{ph}(r)| > |P^{hh}(r)|$ is seen in the external region(left pannel of Fig.2). This relation indicates that the soft-dipole excitation has a character of a particle-particle excitation. This large enhancement of $P^{pp}(r)$ originates from a coherent superposition of two-quasiparticle configurations $[l \times (l+1)]_{L=1}$ consisting of continuum states with high angular momenta l reaching an order of $l \sim 10$ by the effect of the dynamical pairing(the right pannel of Fig.2). This result implies that the soft-dipole excitation is characterized by motion of a spin-singlet di-neutron in the nuclear exterior against A-2 subsystem.

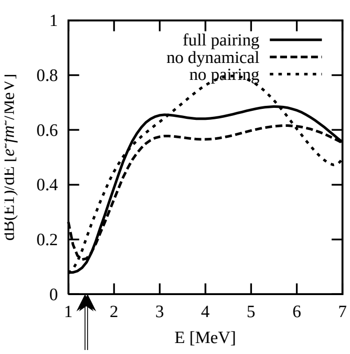

Figure 1: The E1 strength function for ^{84}Ni in the low energy region. The solid line is the result with the full pairing. The dotted line is obtained by neglecting all pairing correlations. The dashed line is obtained by neglecting the *dynamical* pairing(*static* pairing only). An arrow indicates the threshold energy of two neutrons.

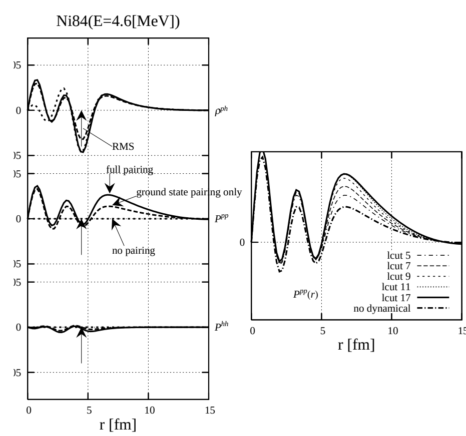

Figure 2: (Left pannel): The particle-hole transition density ρ^{ph}, the particle-pair transition density P^{pp} and the hole-pair transition density P^{hh} for ^{84}Ni. (Right pannel):The dependence of $P^{pp}(r)$) of neutrons on the cut-off orbital angular momentum $l_{cut}(= 5, 7, 9, 11, 17)$ of the neutron quasiparticle states.

Aknowledgments The numerical calculations were performed on the NEC SX-5 supercomputer systems at Research Center for Nuclear Physics, Osaka University.

References

[1] M.Matsuo, Nucl. Phys. A696, 371 (2001)

[2] M. Matsuo, K. Mizuyama, Y. Serizawa, Phys. Rev. C, to be published [arViv:nucl-th/0408052]