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Current situation on Pygmy Dipole Resonance and related topics

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Sizable $E1$ strengths around the neutron threshold energy have been observed in a number of $N > Z$ nuclei, as are called the pygmy dipole resonance (PDR), while the $E1$ excitations are predominantly concentrated in the giant dipole resonance (GDR). Although the PDR has been suggested to be an $E1$ oscillation of the neutron skin against the inner core, its physical content yet remains obscure. A systematic calculation using the random-phase approximation (RPA) [1] shows that the low-energy $E1$ strengths correlate to the neutron skin thickness in some regions of nuclear chart, supporting the skin-core oscillation interpretation, but not in other regions. Simultaneously, it is also shown that the low-energy $E1$ strengths develop when the neutron Fermi level occupy low-angular-momentum orbit in neutron-rich nuclei, implying that the low-energy $E1$ mode is a neutron emission mode. In this talk, we will present a current situation of the interpretation of the PDR. We emphasize systematic calculations and experiments is needed in order to pin down nature of the PDR. It is important to investigate character of the low-energy $E1$ excitations, since they are relevant to reaction rates in nucleosynthesis. Moreover, if the low-energy $E1$ excitation is really connected the neutron skin properties, we can extract from the low-energy $E1$ strengths, the neutron matter properties. Especially, it is expected to clarify density-dependence of the nuclear symmetry energy, L, which is key to structure of neutron stars. We also show the some related topics of the low-energy $E1$ mode (PDR) in the talk.

[1] T. Inakura, T. Nakatsukasa, and K. Yabana, Phys. Rev. C 84, 021302 (2011).