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Role of neutron pairing in alpha-knockout amplitude

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The formation of alpha particles in the surface region of medium and heavy nuclei is related to the alpha-particle correlation and formation in low-density nuclear matter and the microscopic description of alpha decay. Recently measured alpha knock-out cross section in a series of Sn isotopes is reported to be correlated with the number of alpha particles in the nuclear surface evaluated with the effective model based on the relativistic mean-field theory [1,2].
In this presentation, we intend to describe the alpha knock-out amplitude based on the nuclear density functional theory that does not treat the explicit alpha-particle degree of freedom. We evaluate the transition matrix elements of the four-nucleon annihilation operator as a function of the coordinate. Within the nuclear density functional theory without neutron-proton mixing, the transition matrix element is a product of the neutron part and proton part,
and the neutron pairing in the initial nucleus of the decay plays a dominant role. In the case of the Sn isotope, the pairing is present only in the neutrons, and the transition matrix element shows a strong correlation with the neutron pairing gap. The square of the transition matrix element explains the relative trend of the experimentally measured alpha knock-out cross-section in 112-124Sn.

[1] J. Tanaka, et al., Science 371, 2360 (2021).
[2] S. Typel, Phys. Rev. C 89, 064321 (2014).

Experimental study on nuclear physics

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