Thesis title and abstract

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Thesis title: Studies of tensor interactions and reaction mechanism of short-range correlated-nucleon pairs through ^{16}O(p,pd) reactions

Abstract:

We investigate short-range correlated-nucleon pairs in ^{16}O induced by tensor interactions by measuring pick-up reactions of high-momentum neutrons, in coincidence with high-momentum protons emitted at opposite angles. The nuclear tensor interaction is a major part of nucleon-nucleon interactions, and it was originally found in understanding the properties of deuteron, such as binding energy and non-zero quadrupole moment. However, its role in heavier nuclei is elusive, because explicit treatment of tensor interactions is difficult in nuclear structure models and the effect of tensor interactions is not easy to isolate experimentally from others. Recently theoretical and experimental studies have shown the necessity of tensor interactions in inducing high-relative-momentum nucleon pairs, which are formerly considered due to short-range central interactions. Pioneering work has shown the existence of high-momentum nucleon pairs induced by tensor interactions, by comparing the cross sections to different final states in ^{16}O(p,pd) reactions. However, the discussion in this work suffered from the influence of competing reaction mechanism. Therefore, we performed systematical measurements on ^{16}O(p,pd) reactions at various incident energies and scattering angles to study effects of tensor interactions without ambiguity of reaction mechanisms.

In this thesis, we present a systematic study on the high-relative-momentum p-n pairs with specific spin and isospin configurations. We measured the pick-up domain ^{16}O(p,pd) reactions at 230 and 392 MeV incident energies and several scattering angles at Research Center for Nuclear Physics, Osaka. We measured deuterons by the Grand Raiden spectrometer and protons in coincidence by a plastic scintillator array. From the energies and scattering angles of deuterons and protons, we constructed the missing mass spectrum of ^{14}N and obtained the cross section of reactions populating to the 3.95 MeV state ($J^\pi = 1^+,\ T = 0$) and 2.31 MeV state ($J^\pi = 0^+,\ T = 1$) in ^{14}N. We deduced the cross section ratio between reactions populating to two final states, corresponding to the removal of $(S,T) = (0,1)$ and $(1,0)$ p-n pairs from ^{16}O. We discuss the dependence of the cross section ratio on the relative-momentum of the correlated nucleon pairs from the data at different incident energies but the same scattering angle, where the effect of competing reaction mechanism cancel. Observed ratio difference shows an effect of tensor interactions clearly. We also discuss effects of other reaction mechanism, which is confirmed to reduce the observed effects of tensor interactions.