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Dynamical Model Approach to Coherent Pion Production

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We report our recent study on the coherent pion production in the neutrino-nucleus scattering in the sub- and few-GeV region. In our approach, the transition amplitude is calculated by summing elementary amplitudes of a weak pion production off a single nucleon embedded in a nuclear environment. Therefore, it is of primary importance to start with a model which reasonably describes electroweak pion productions off a free single nucleon. The Sato-Lee (SL) model is such a model, and we employ it in our calculation. The SL model contains both resonant and non-resonant mechanisms. For a reaction on a nuclear target, we need to consider medium effects such as the change of the delta-propagation (shifts of the mass and width) and the final-state interactions between the outgoing pion and nucleus. In the energy region of our interest, we may take care of these important medium effects using the delta-hole model. Thus our model is based on a combination of the SL model and the delta-hole model. Our model takes care of non-local effects of the delta propagation in nuclei. All free parameters in our model are optimally fitted to both elastic and total cross sections of the pion-nucleus scattering. First, we calculate the coherent pion photo-production off a nucleus, and then compare the result with data to test the reliability of our approach. We find a reasonable agreement with data, and have a good basis to proceed to the neutrino process. In our presentation, we explain our model and show new numerical results for the charged-current and neutral-current reactions, and the neutrino and antineutrino reactions. We also make a comparison of our result with recent data and other theoretical calculations.

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