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Semi-inclusive charged-current neutrino-nucleus reactions: analysis of data in the relativistic impulse approximation

Nuclear effects in neutrino-nucleus scattering is one of the main sources of uncertainty in the analysis of neutrino oscillation experiments. At present most of these studies have been focused on inclusive scattering processes where only the scattered lepton is detected in the final state. This implies, due to the extended neutrino energy distribution (flux), that very different reaction mechanisms can contribute to the cross section. Hence the determination of the neutrino energy, required in the analysis of neutrino oscillations, presents a high uncertainty due to effects associated to the nuclear dynamics. This difficulty can be solved significantly by considering semi-inclusive scattering processes in which, in addition to the charged lepton, one hadron is also detected in the final state. We have presented a detailed description of this process using different nuclear models in [1]. Moreover, in the last years different neutrino collaborations have provided semi-inclusive data given in terms of several different kinematical variables linked to the detection of an ejected nucleon from the nucleus. In this work we provide a systematic study comparing our theoretical predictions with all available semi-inclusive data measured by the T2K, Minerνa and MicrooBooNE collaborations. Although being aware of the important limitations of the model, we are confident that the present results will help to better understand the nuclear dynamics, providing a more precise knowledge of neutrino oscillation parameters.

[1] "Semi-inclusive charged-current neutrino-nucleus cross sections in the relativistic plane wave impulse approximation". J.M. Franco-Patino, J. Gonzalez-Rosa, J.A. Caballero, M.B. Barbaro. Phys.Rev. C102 6, 064626 (2020)

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