Realistic spectral function model for charged-current quasielastic-like (anti)neutrino scattering cross sections on ^{12}C

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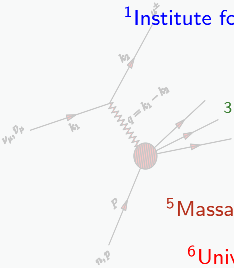


Theoretical scheme

In this work [1] we present a detailed study of charged current quasielastic neutrino and antineutrino scattering cross sections on a ^{12}C target with no pions in the final state.

The initial nucleus is described by means of a realistic spectral function $S(p, \mathcal{E})$ [2]:

$$S(p, \mathcal{E}) = \sum_i 2(2j_i + 1) n_i(p) L_{\Gamma_i}(\mathcal{E} - \mathcal{E}_i)$$

in which nucleon-nucleon (NN) correlations are implemented in $n_i(p)$ by using natural orbitals [3] through the Jastrow method [4].

[1] M.V. Ivanov *et al.*, *Phys. Rev. C* **99**, 014610 (2019); arXiv:1812.09435 [nucl-th].

[2] M.V. Ivanov *et al.*, *Phys. Rev. C* **89**, 014607 (2014); *Phys. Rev. C* **91**, 034607 (2015); A.N. Antonov *et al.*, *Phys. Rev. C* **83**, 045504 (2011).

[3] P.-O. Löwdin, *Phys. Rev.* **97**, 1474 (1955).

[4] M.V. Stoitsov *et al.*, *Phys. Rev. C* **48**, 74 (1993).

Theoretical scheme

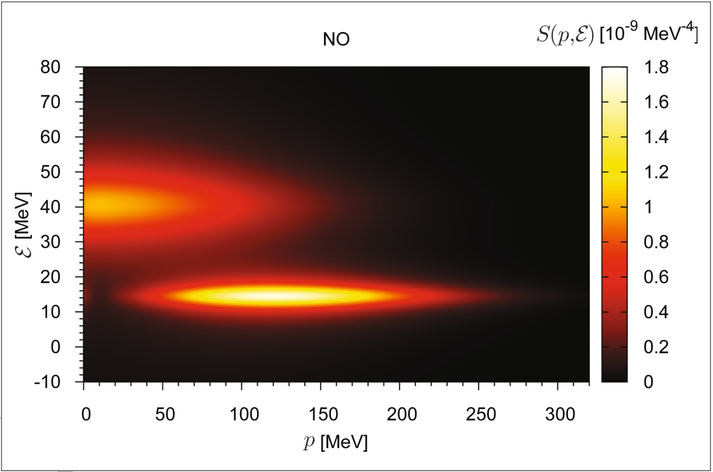


Figure: The ^{12}C realistic $S(p,\mathcal{E})$ using natural orbitals single-particle $n_i(p)$ from the Jastrow correlation method and Lorentzian function for the energy dependence. Two shells $1p$ and $1s$ are clearly visible.

Neutrino scattering

The model also includes the contribution of the weak two-body currents in the 2p-2h sector, evaluated within a fully relativistic Fermi gas [1]. The theoretical predictions are compared with a large set of experimental data measured by the MiniBooNE [2], MINERνA [3] and T2K [4] experiments.

Good agreement with the experimental data is found.

[1] I. Ruiz Simo *et al.*, *Phys. Rev. D* **90**, 033012 (2014); *J. Phys. G* **44**, 065105 (2017); *Phys. Rev. C* **94**, 054610 (2016).

[2] A. A. Aguilar-Arevalo *et al.* (MiniBooNE Collaboration), *Phys. Rev. D* **81**, 092005 (2010); *Phys. Rev. D* **88**, 032001 (2013).

[3] C. Patrick, "Measurement of the Antineutrino Double-Differential Charged-Current Quasi-Elastic Scattering Cross Section at MINERνA", Ph.D. thesis, Northwestern University 2016.

[4] K. Abe *et al.* (T2K Collaboration), *Phys. Rev. D* **93**, 112012 (2016).

Neutrino scattering

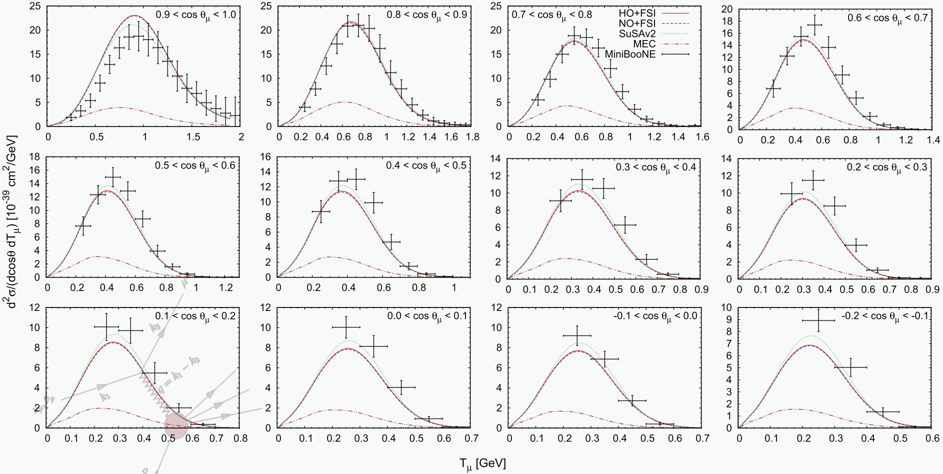


Figure: Flux-integrated double-differential cross section $\nu_\mu + ^{12}\mathrm{C}$ versus muon kinetic energy T_μ for various bins of $\cos\theta_\mu$; data (Aguilar-Arevalo *et al.*, MiniBooNE, 2010).

Neutrino scattering

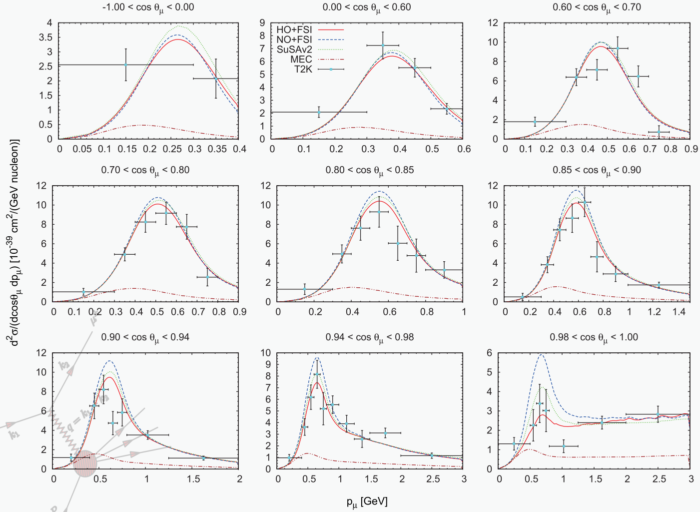
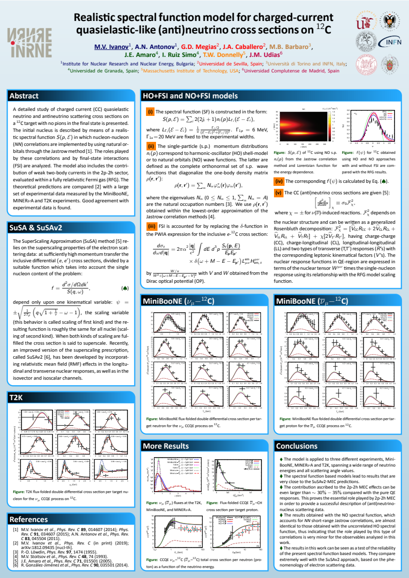


Figure: Flux-integrated double-differential cross section $\nu_\mu + {}^{12}\mathrm{C}$ versus muon momentum p_μ for various bins of $\cos\theta_\mu$; data (T2K Collaboration, 2016).

Poster



Realistic spectral function model for charged-current quasielastic-like (anti)neutrino cross sections on 12C
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Abstract
A detailed study of charged current (CC) quasielastic neutrino and antineutrino scattering cross sections on a 12C target with no pions in the final state is presented. The initial nucleus is described by means of a realistic spectral function S(p, E) in which nucleon-nucleon (NN) correlations are implemented by using natural orbitals through the Jastrow method [1]. The roles played by these correlations and by final-state interactions (FSI) are analyzed. The model also includes the contribution of weak two-body currents in the 2p-2h sector, evaluated within a fully relativistic Fermi gas (RFG). The theoretical predictions are compared [2] with a large set of experimental data measured by the MiniBooNE, MINERνA and T2K experiments. Good agreement with experimental data is found.
SuSA & SuSAv2
HO+FSI and NO+FSI models
MiniBooNE (νμ−12C)
MiniBooNE (ν̄μ−12C)
T2K
More Results
Conclusions
References

Thank You!