The Relativistic Green's Function Model and the Optical Potential

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The relativistic Green's function (RGF) model has been quite successfull in the description of Quasi-Elastic (QE) electron and neutrino-nucleus scattering data. In the model Final-State Interactions (FSI) are accounted for in the inclusive QE scattering by the complex Optical Potential (OP) derived from elastic proton-nucleus scattering data. The RGF formalism can translate the flux lost towards inelastic channels, represented in the imaginary part of the OP, into the strength observed in inclusive reactions. Inelastic channels are not included explicitly in RGF calculations, they can rather be incorporated from the imaginary part of the OP that can be extracted directly from the elastic nucleon-nucleus scattering phenomenology. In the model the OP is therefore a powerful tool to include important contributions not included in other models, based on the impulse approximation, which are usually adopted for QE lepton-nucleus scattering.

The availability of phenomenological OPs is essential to make RGF calculations feasible, but there are some caveats: 1) The use of a phenomenological OP does not allow us to disentangle the role of a specific inelastic channel and can therefore introduce uncertainties and ambiguities in the interpretation of the RGF results. 2) Elastic proton-scattering data do not completely constrain the size and the shape of the OP. Different phenomenological OPs are available, which are able to give equivalently good descriptions of elastic proton-nucleus scattering data, but which can produce different results and theoretical uncertainties in RGF calculations.

The theoretical uncertainties of the RGF model are discussed in this contribution. The comparison with the results of other relativistic descriptions of FSI and with experimental data in different kinematic conditions can be helpful to assess the relevance of specific nuclear effects and of inelastic contributions. Results obtained with a new Global Relativistic Folding Optical Potential (GFROP) are presented and discussed. Two basic ingredients underly the realization of this GFROP: a suitable analytical representation for the *NN* interaction and an appropriate model of nuclear densities. The advantage of the GRFOP is that it is, to some extent, less phenomenological, as the shapes of the potential are essentially derived from the proton and neutron densities, and these have been constrained by experimental data. The new GRFOP potential has been tested within the RGF model in inclusive QE electron scattering and for (anti)neutrino-nucleus scattering at MiniBooNE kinematics.