Nuclear effects in neutrino interactions and their implementation in the FLUKA Monte Carlo code

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The successful results obtained with atmospheric neutrinos and the future experimental programs on neutrino beams stimulated a renewed interest in the study of neutrino-nucleus interactions, with a particular attention to the few GeV energy region. In order to minimize the systematic error in the analysis of data due to theoretical uncertainties, a better understanding of nuclear effects is of fundamental importance. Furthermore, the implementation of these models within an event by event Monte Carlo code turns out to be an essential task. The FLUKA Monte Carlo code can be coupled to neutrino interaction generators so to provide a detailed and consistent description of nuclear environment. It includes a generalized intra-nuclear cascade approach and models for the pre-equilibrium and equilibrium phases. These take into account both re-interactions of hadrons inside the nucleus and the later stages of particle emission from the nuclear matter together with the production of residual nuclei. Such models, originally developed for nuclear physics applications, and whose validity is checked by means of the comparison with different data sets, can be used in the context of neutrino interactions in different regimes: from quasi-elastic to deep inelastic scattering. The FLUKA predictions for neutrino interactions can be benchmarked with data from liquid argon or emulsion detectors.