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Meson exchange currents in muon capture on the deuteron and ^{3}He

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Collaboration

Abstract content

We will investigate the role of meson exchange currents in the description of the μ^-+d $\rightarrow$ ν_μ+n+n and μ^-+^{3}He $\rightarrow$ ν_μ+^{3}H reactions. They both are treated as the decay of the corresponding muonic atoms, with the muon initially on the lowest K shell. The muon binding energy in these atoms can be safely neglected and in the initial state we deal essentially with the deuteron (or ^{3}He) and muon at rest. These two reactions are interesting for several reasons. First of all, they offer a testing ground for the nuclear wave functions, which for any nucleon-nucleon (NN) and three-nucleon (3N) forces can be constructed for such light systems with great accuracy. In these reactions few-nucleon weak current operators are an important dynamical ingredient. In the current operators apart from the relatively well known single nucleon contributions, two-nucleon parts (generated by various meson exchanges) play an important role. Their details are not well known and several models should be considered [1]. We will present our formalism for dealing with these reactions and a simple method for partial wave decomposition of the two-nucleon operators. The crucial nuclear matrix elements of the corresponding weak current operators will be calculated in the momentum space and using partial wave decomposition. The effect of meson exchanges will be investigated in the energy spectrum of the emitted neutrinos (in the deuteron case) and in the total decay rates for the two reactions. We will employ various models of NN and 3N forces, such as the Bonn B [2] or chiral NNLO potentials [3]. Our results with the single nucleon currents look already very promising and we hope for the improvement in the description of the experimental data, when dominant two-nucleon current operators are included in our framework.

1. L. Marcucci et al., Phys. Rev. C83, 014002 (2011).
2. R. Machleidt, Adv. Nucl. Phys. 19 (1989) 189.
3. E. Epelbaum, Prog. Part. Nucl. Phys. 57, 654 (2006).

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