Nuclear axial currents in chiral effective field theory and applications to few-nucleon systems

Abstract

In this talk, I will present the derivation of the two-nucleon axial charge and current operators in chiral effective field theory (χEFT) up to one loop. We use a formalism based on time-ordered perturbation theory, in which, along with irreducible contributions, non-iterative terms in reducible contributions are identified and accounted for order-by-order in the power counting. The resulting axial current is found to be finite and conserved in the chiral limit, while the axial charge requires renormalization. The unknown low energy constant (LEC) z_0 entering the axial current is known to be related to c_D, *i.e.*, the LECs entering the three-nucleon chiral potential at N2LO. The LEC z_0, and therefore c_D, has been fitted in order to reproduce the Gamow-Teller (GT) matrix element in tritium β decay. With z_0 fixed, both the axial current and the N2LO chiral three-nucleon potential acquire predictive power. In particular, the N2LO chiral three-nucleon potential leads to an improvement in the description of the neutron-deuteron doublet scattering length and the A=3 binding energies. I will therefore discuss an application to low energy neutrino scattering off the deuteron. Preliminary results for the total cross section as a function of the incident neutrino energies will be presented.