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Consistent, high-quality two-nucleon potentials up to fifth order of the chiral expansion¹

RUPRECHT MACHLEIDT, Univ of Idaho

We present NN potentials through five orders of chiral effective field theory ranging from leading order (LO) to next-to-next-to-next-to-next-to-leading order (N⁴LO). The construction is consistent in the sense that the same power counting scheme as well as the same cutoff procedures are applied in all orders. Moreover, the long-range parts of these potentials are fixed by the very accurate πN LECs as determined in the Roy-Steiner equations analysis by Hoferichter, Ruiz de Elvira and coworkers. In fact, the uncertainties of these LECs are so small that a variation within the errors leads to effects that are essentially negligible, reducing the error budget of predictions considerably. The NN potentials are fit to the world NN data below pion-production threshold of the year of 2016. The potential of the highest order (N⁴LO) reproduces the world NN data with the outstanding χ^2/datum of 1.15, which is the highest precision ever accomplished for any chiral NN potential to date. The NN potentials presented may serve as a solid basis for systematic *ab initio* calculations of nuclear structure and reactions that allow for a comprehensive error analysis.

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