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Infinite-cutoff renormalization of the chiral NN potential up to N3LO RUPRECHT MACHLEIDT, CHRISTOPHER ZEOLI, University of Idaho — Naively, the "best" method of renormalization is the one where the momentum cutoff is taken to infinity while maintaining stable results due to a cutoff-dependent adjustment of counter terms. We have applied this renormalization method in the calculation of phase-shifts for nucleon-nucleon (NN) scattering using chiral NN potentials up to next-to-next-to-next-to-leading order (N3LO). For lower partial waves, we find that there is either no convergence with increasing order or, if convergence occurs, the results do not converge to the empirical values. For higher partial waves, we always observe convergence to the empirical phase shifts (except for the 3G5 state). Furthermore, no matter what the order is, one can use only one or no counter term per partial wave, creating a rather erratic scheme of power counting that does not allow for a systematic order-by-order improvement of the predictions. The conclusion is that infinite-cutoff renormalization is inappropriate for chiral NN potentials, which should not come as a surprise, since the chiral effective field theory these potentials are based upon is designed for momenta below the chiral-symmetry breaking scale of about 1 GeV. This value for the hard scale should be perceived as a reasonable upper limit for the cutoff.

Ruprecht Machleidt
University of Idaho

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