Doublet channel neutron-deuteron scattering in EFT

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Generalisation of the effective field theory (EFT) program to the three-body problem is not straightforward. In bosonic systems and in some fermionic channels (in particular the $J = 1/2$ channel nucleon-deuteron scattering) one encounters a non-trivial problem. While each leading order three-body diagram with re-summed two-body interactions is individually finite, the whole amplitude shows sensitivity to the ultraviolet cutoff. In ref. [1] it was argued that the addition of an one-parameter three-body force counter-term at leading order is *necessary and sufficient* to eliminate this cut-off dependence.

We solve the problem without introducing three-body force by realizing that the relevant system of integral equations originally derived in ref. [2] has an infinite number of solutions [3] and the physical scattering amplitude is only one of these solutions. The physical amplitude is uniquely singled out by an additional boundary condition which is also provided by EFT.

Solving the system of equations and implying the boundary condition we calculate phase shifts for doublet channel neutron-deuteron scattering below break-up. As we do not introduce three-body force we do not have any additional free parameters which can be adjusted to data. The agreement of our calculations with available data is quite good for leading order calculations.

References

[1] P.F. Bedaque, H.-W. Hammer, and U. van Kolck, *Phys.Rev.Lett.* **82** (1999) 463;

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[3] G.S. Danilov, *Sov. Phys. JETP* **13** (1961) 349;