

Complete next-to-next-to-leading order calculation of $NN \rightarrow NN\pi$ in chiral EFT

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Collaboration

Abstract content

Understanding of near-threshold pion production is of significant importance since it allows a direct test of chiral EFT, probes NN dynamics at intermediate energies and provides access to isospin violation in few-nucleon processes [1]. It has been known since years that neutral pion production in $pp \rightarrow pp\pi^0$ is the most challenging process since the experimental cross-section in this channel is suppressed by more than an order of magnitude, as compared to the charged channels near threshold. The experimental evidence is fully in line with the chiral suppression of the leading production operators in this channel and the important role of higher order effects, especially chiral loops. We present the results of the full pion production operator near threshold calculated up-to-and-including next-to-next-to-leading order (NNLO) in chiral effective field theory [2,3]. We include explicit Delta degrees of freedom and demonstrate that they provide essential contribution required to understand neutral pion production data. Analysis of chiral loops at NNLO reveals new mechanisms which are important, but have not been considered in phenomenological studies so far. The methods developed in this work can be helpful in the study of charge symmetry breaking in $pn \rightarrow d\pi^0$ and $dd \rightarrow \alpha\pi^0$. [1] V. Baru, C. Hanhart and F. Myhrer, arXiv:1310.3505 [nucl-th]. [2] A. A. Filin, V. Baru, E. Epelbaum, H. Krebs, C. Hanhart, A. E. Kudryavtsev and F. Myhrer, Phys. Rev. C 85 (2012) 054001. [3] A. A. Filin, V. Baru, E. Epelbaum, C. Hanhart, H. Krebs and F. Myhrer, Phys. Rev. C 88 (2013) 064003.

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