

Advance in a field theoretic understanding of $NN \rightarrow NN\pi$

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We study the production amplitude for the reaction $NN \rightarrow NN\pi$ up to next-to-leading order in chiral perturbation theory using a counting scheme that takes into account the large scale introduced by the initial momentum.

We show that the irreducible chiral loops that arise at this order exactly cancel those terms that arise from the off-shell parts of the πN rescattering vertex. This cancellation is required for formal consistency of the whole scheme, since the mentioned diagrams show a linear growth with respect to the outgoing NN momentum. Such a growth would have led to a large sensitivity to the NN wave function, when the convolution with the final state, as demanded by the non-perturbative nature of the NN interaction, is performed. This, however, would have been in conflict with general arguments.

The net effect of the inclusion of all next-to-leading order loops is to enhance the leading rescattering amplitude by a factor of 4/3, bringing its contribution to the cross section for $pp \rightarrow d\pi^+$ close to the experimental value.

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