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Pion radiative capture on 2H, 3H and 3He

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Collaboration

Abstract content

Radiative pion capture has been studied theoretically and experimentally for many years and for information on earlier achievements see Ref. [1]. In particular, the $\pi^- + d \to \gamma + n + n$ reaction has attracted a lot of attention, because this process can be used to extract the neutron-neutron scattering length. This issue is discussed in detail in Ref. [2], where also important references to earlier and more recent theoretical calculations can be found.
Recently, we have calculated capture rates for the $\mu^- + d \to \nu + n + n$, $\mu^- + {}^3\mathrm{He} \to \nu + {}^3\mathrm{H}$, $\mu^- + {}^3\mathrm{He} \to \nu + n + d$, $\mu^- + {}^3\mathrm{He} \to \nu + n + n + p$ [3] and $\mu^- + {}^3\mathrm{H} \to \nu + n + n + n$ [4] reactions. It is clear that the pion radiative capture can also be treated within our momentum space framework. In this contribution, the $\pi^- + {}^2\mathrm{H} \to \gamma + n + n$, $\pi^- + {}^3\mathrm{H} \to \gamma + n + n + n$, $pi^- + {}^3\mathrm{He} \to \gamma + n + d$ and $\pi^- + {}^3\mathrm{He} \to \gamma + n + n + p$ capture reactions are studied with realistic nucleon-nucleon and three-nucleon potentials under full inclusion of final-state interactions. We assume that the full initial state consists of the atomic K-shell pion wave function and the initial nucleus state. Our calculations are performed with traditional nuclear forces and a simple single-nucleon transition operator but they represent a solid base for future calculations with input from chiral effective field theory. We plan further investigations of pion radiative capture processes using the transition operator from Ref. [5].
References:
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