Application of chiral NN and NNN interactions to the $^4$He photo-disintegration

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We present an ab initio calculation [1] of the $^4$He total photo-absorption cross section using two- (NN) plus three-nucleon (NNN) interactions based upon chiral effective field theory (χEFT) [2]: the high quality NN potential at the fourth order (N$^3$LO) in the χEFT expansion of Ref. [3], and the NNN interaction at the highest order presently available (N$^2$LO) [4, 5]. The two low-energy constants of the NNN contact terms are constrained according to the preferred choice suggested in Ref. [6]. The microscopic treatment of the continuum problem is achieved by means of the Lorentz integral transform method [7], applied within the NCSM [8, 9] approach. Our results show a peak around the excitation energy of $\omega = 27.8$ MeV, with a cross section of 3 mb. The inclusion of the NNN force in the Hamiltonian induces a reduction of the peak at low energies and the enhancement of the high-energy tail of the cross section. We compare to calculations obtained using different interaction models and to representative experiments.

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