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Theoretical study of the $3\text{H}(p, e+e^-)4\text{He}$ and $3\text{He}(n, e+e^-)4\text{He}$ processes and the X17 anomaly

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A rather puzzling anomaly has been recently observed in the emission of electron-positron pairs in the $7\text{Li}(p, e+e^-)8\text{Be}$ and $3\text{H}(p, e+e^-)4\text{He}$ reactions [1,2]. This anomaly has been interpreted as the signature of a particle not foreseen in the standard model of particle physics (hereafter X17 boson) with mass $M=16.8$ MeV. The X17 boson could be a mediator of a fifth force, characterized by a strong coupling suppression of protons compared to neutrons [3]. This scenario can explain, at least partially, the long standing anomaly of the magnetic moment of muon found experimentally. In this contribution, we present an ab-initio study of the $3\text{H}(p, e+e^-)4\text{He}$ and $3\text{He}(n, e+e^-)4\text{He}$ processes [4]. We first analyze the pair production as a purely electromagnetic process in the context of a state-of-the-art approach to nuclear strong-interaction dynamics and nuclear electromagnetic currents, derived from chiral effective field theory (chiEFT). Next, we examine how the exchange of a hypothetical low-mass boson would impact the cross section for such a process. We consider several possibilities, that this boson is either a scalar, pseudoscalar, vector, or axial particle.

We also provide an overview of an experiment probing pair production in the $3\text{He}(n, e+e^-)4\text{He}$ at the n_TOF facility at CERN, currently in preparation [5]. We discuss also of other experimental searches of the X17 boson in nuclear reactions, as that performed by the MEG collaboration at PSI (Switzerland), which are currently repeating the $7\text{Li}(p, e+e^-)8\text{Be}$ experiment, or as in the $2\text{H}(p, e+e^-)3\text{He}$ and $2\text{H}(n, e+e^-)3\text{H}$ reactions, proposed in order to test the “protophobicity” of X17.

- [1] A. J. Krasznahorkay et al., Phys. Rev. Lett. 116, 042501 (2016)
- [2] A. J. Krasznahorkay et al., Phys. Rev. C 104, 044003 (2021)
- [3] J. L. Feng et al., Phys. Rev. Lett. 117, 071803 (2016)
- [4] M. Viviani et al., Phys. Rev. C 105, 014001 (2022)
- [5] E. Cisbani et al. CERN-INTC-2021-041 (2021) [<https://cds.cern.ch/record/2766541>]

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Scheduling Constraints

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