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CEνAS processes in He-II: Beyond the model of ideal BEC

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Superfluid helium-4 (He-II) is being considered as a detector material for light dark matter searches [1,2] and the observation of coherent elastic neutrino-atom scattering (CEνAS) [3]. It has extreme intrinsic radiopurity, high impedance to external vibration noise, and a unique quantum evaporation signal channel enabling the detection of phonon- and rotonlike modes via liberation of He-4 atoms into a vacuum. Detecting the liberated atoms using atomic adsorption onto a calorimeter suspended in vacuum above the free surface of the target He-II, in principle, can make it possible to measure unprecedentedly low recoil energies (on a meV scale).

In this contribution we address the issue of the He-II response to low-energy elastic neutrino-atom scattering. Specifically, we focus on how the effects of the real medium alter the atomic recoil spectra calculated in the simplified model of ideal Bose-Einstein condensate (BEC) for He-II. We present calculations for scattering of tritium electron antineutrinos on atoms in He-II, which case is relevant to the SArov Tritium-Ultra-Rich Neutrino Experiment (SATURNE) [4] that aims at the first ever observation of CEνAS and the search of neutrino magnetic moment with a world-leading sensitivity. We show that taking into account the realistic atomic momentum distribution in He-II [5] leads to quantitative and qualitative differences with respect to the ideal BEC model. We outline the risks to misinterpret the future SATURNE data as a signal of new physics, in particular, such as the neutrino magnetic moment, if ignoring the effects of the real He-II medium.

[1] S. A. Hertel, A. Biekert, J. Lin, V. Velan, and D. N. McKinsey, Phys. Rev. D **100**, 092007 (2019)

[2] B. von Krosigk et al., SciPost Phys. Proc. **12**, 016 (2023)

[3] M. Cadeddu, F. Dordei, C. Giunti, K. A. Kouzakov, E. Picciau, and A. I. Studenikin, Phys. Rev. D **100**, 073014 (2019)

[4] K. A. Kouzakov, I. S. Stepantsov, and A. I. Studenikin, Phys. Atom. Nucl. **88**, 275 (2025)

[5] P.E. Sokol and W.M. Snow, in *Excitations in Two-Dimensional and Three-Dimensional Quantum Fluids*, ed. by A.G.F. Wyatt and H.J. Lauter (Plenum Press, New York, 1991), p. 47

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