SATURNE: CURRENT STATUS AND PHYSICS POTENTIAL

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The Sarov tritium neutrino experiment (SATURNE) is part of the scientific program of the National Center for Physics and Mathematics (NCPM) [1] that was founded in Sarov in 2021. The experiment is under preparation, with the first taking of data expected for 2025 and the data collection expected to be completed by 2032.

SATURNE is motivated by fundamental problems in neutrino physics. Specifically, it will primarily search for neutrino electromagnetic interactions [2,3] in elastic and ionizing neutrino-atom collisions. The experiment will employ a high-intensity tritium neutrino source, with an initial activity of at least 10 MCi and possibly up to 40 MCi. The tritium source will be used in combination with the He-4, Si and SrI_2(Eu) targets in order to study the elastic and ionization channels of neutrino-atom collisions at unprecedentedly low energies.

The Si and SrI_2(Eu) detectors with record low-energy thresholds for such detector types will measure the ionization channel of neutrino-atom collisions. With the 1-year data from either detector, one may expect to achieve a sensitivity on the order of $\sim 10^{-12}\,\mu_B$ at 90% C.L. to the neutrino magnetic moment μ_ν, which is the most studied theoretically and actively searched experimentally among the neutrino electromagnetic properties.

The measurements with the liquid He-4 detector in a superfluid state are expected to provide the first observation of coherent elastic neutrino-atom scattering (CEνAS) [4,5]. This will bring the experimental studies of coherent elastic neutrino-nucleus scattering (CEνNS) [6] to a qualitatively new level, namely when one will be able to explore the neutrino elastic scattering not only on a nucleus as a whole, but also on an atom as a whole. With the 5-year data using the liquid He-4 detector, it is also expected to achieve a record-high μ_ν-sensitivity of $\sim 10^{-13}\,\mu_B$ at 90% C.L.

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