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Search for Hidden Neutrinos at the European Spallation Source

The upcoming European Spallation Source (ESS) will soon provide the most intense spallation neutron source in the world and represents a unique opportunity to probe unexplored parameter space for long-lived particles. In this context, we propose the Search for Hidden Neutrinos at the ESS (SHiNESS) experiment, highlighting its unique opportunities to search for the existence of sterile neutrinos across a wide range of scales: anomalous oscillations at short baselines; non-unitarity mixing in the active neutrino sector; or an excess of events with multiple leptons in the final state, produced in the decay of heavy neutrinos. The baseline design of the detector comprises an active volume filled with 42 ton of liquid scintillator, located 25 m far from the ESS beam target. We show that SHiNESS will be able to considerably improve current global limits for the three cases outlined above. Although in this work we focus on new physics in the neutrino sector, the proposed setup may also be used to search for signals from weakly interacting particles in a broader context.

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