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Measurement of two-neutrino double electron capture in ^{124}Xe

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Two-neutrino double electron capture (2νECEC) is a second-order weak process with predicted nuclear half-lives that surpass the age of the Universe by many orders of magnitude. Indications for 2νECEC decays have only been seen for two isotopes, ^{78}Kr and ^{130}Ba, and instruments with very low background levels are needed to detect them directly with high statistical significance. The 2νECEC half-life provides an important input for nuclear structure models and its measurement represents a first step in the search for neutrinoless double electron capture (0νECEC). A detection of the latter would imply the existence of lepton number violation and the Majorana nature of neutrinos. The XENON1T dark matter experiment recently reported the first direct observation of the 2νECEC in ^{124}Xe. The significance of the signal is 4.4 standard deviations, and the measured half-life, $(1.8 \pm 0.5_{\mathrm{stat} \pm 0.1_{\mathrm{syst}}) \times 10^{22}}$ yr, is the longest ever measured directly . This highlights the broad physics reach for the next experiment in the XENON family, XENONnT, which will start data-taking in 2020.
This talk is based on *Observation of two-neutrino double electron capture in ^{124}Xe with XENON1T*, [XENON Collaboration. Nature 568, 532-535 (2019)]