

## Observation of two-neutrino double electron capture in Xe-124 with XENON1T

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Two-neutrino double electron capture (2νECEC) is a second-order weak-interaction process with a predicted half-life that surpasses the age of the Universe by many orders of magnitude. Here we report the direct observation of 2νECEC in Xe-124 with the XENON1T dark-matter detector. The significance of the signal is 4.4 standard deviations and the corresponding half-life of  $1.8 \times 10^{22}$  years is the longest measured directly so far.

**Primary author:** Dr LINDEMANN, Sebastian (Universität Freiburg)

**Presenter:** Dr LINDEMANN, Sebastian (Universität Freiburg)

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