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Search for neutrinoless double-beta decay and measurement of double beta decay with two neutrinos with the NEMO-3 detector (15' + 5')

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The NEMO-3 detector, which had been operating in the Modane Underground Laboratory from 2003 to 2010, was designed to search for neutrinoless double-β (0νββ) decay. The double-beta decay with neutrino emission was observed for several isotopes (100Mo, 82Se, 116Cd, 130Te, 150Nd, 96Zr and 48Ca) and limits sets for 0νββ decay lepton-number violating mechanisms . Multivariate analysis were developed to use the full information on the events from this tracko-calo detector. The most sensitive search was performed on 100Mo due to the larger available mass (6.914 kg). For this isotope, the level of observed background in the 0νββ signal region [2.8–3.2] MeV is 0.44±0.13 counts/yr/kg, and no events are observed in the interval [3.2–10] MeV. With an exposure of 34.3 kg.yr, we derive a lower limit on the half-life of 0νββ decays in Mo100 of T1/2(0νββ)>1.1×1024 yr at the 90% confidence level, under the hypothesis of decay kinematics similar to that for light Majorana neutrino exchange. Depending on the model used for calculating nuclear matrix elements, the limit for the effective Majorana neutrino mass lies in the range ⟨mν⟩<0.33–0.62 eV.

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