

# Double Beta Decay

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# TWO-NEUTRINO DECAY

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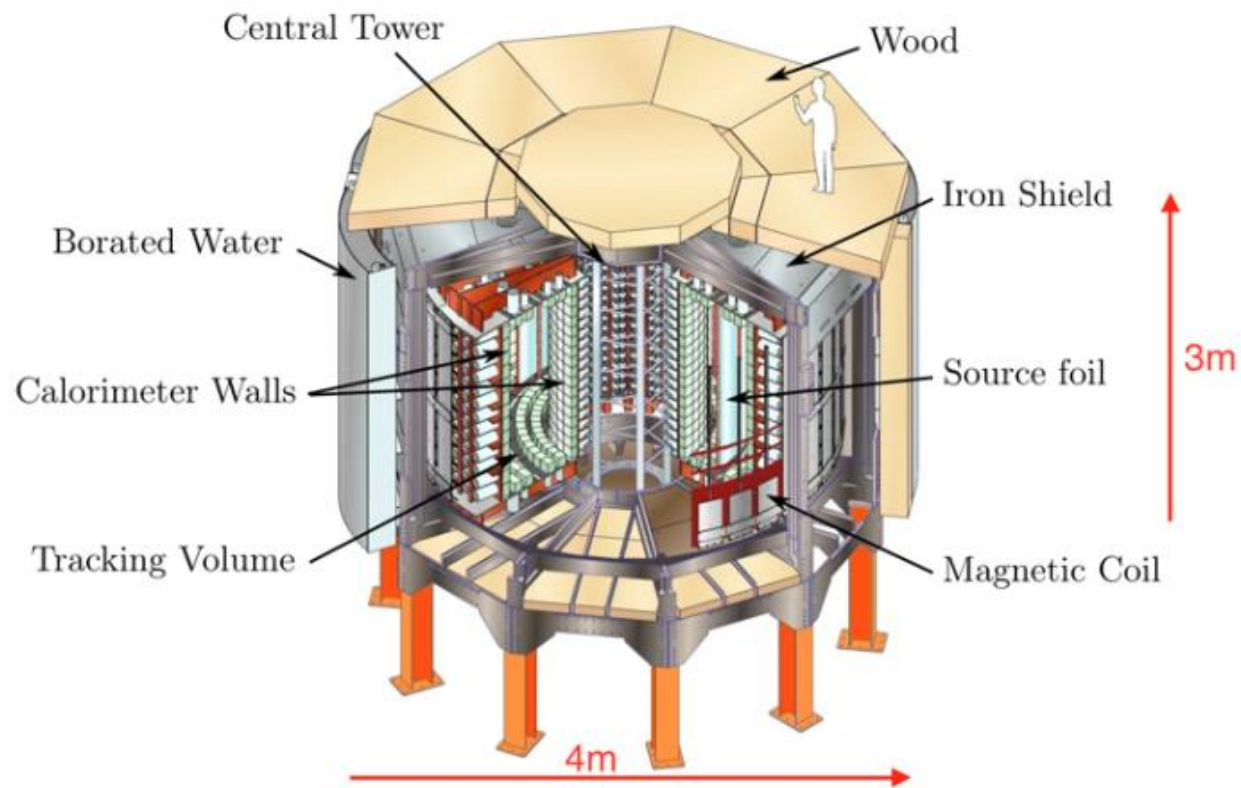
- $(Z, A) \rightarrow (Z + 2, A) + e^-_1 + e^-_2 + \bar{\nu}_{e1} + \bar{\nu}_{e2}$
- Transformation of two neutrons into protons
- Decays only if the initial nucleus is less bound than final one
  - Only fulfilled in nature for even-even nuclei
- Conserves electric charge and lepton number

# NEUTRINOLESS DECAY

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- $(Z, A) \rightarrow (Z + 2, A) + e^-_1 + e^-_2$
- Violates lepton number conservation
  - Forbidden in standard electroweak theory
  - Observation would indicate that neutrinos are massive Majorana particles
  - Could be used to measure neutrino mass

# NEMO-3



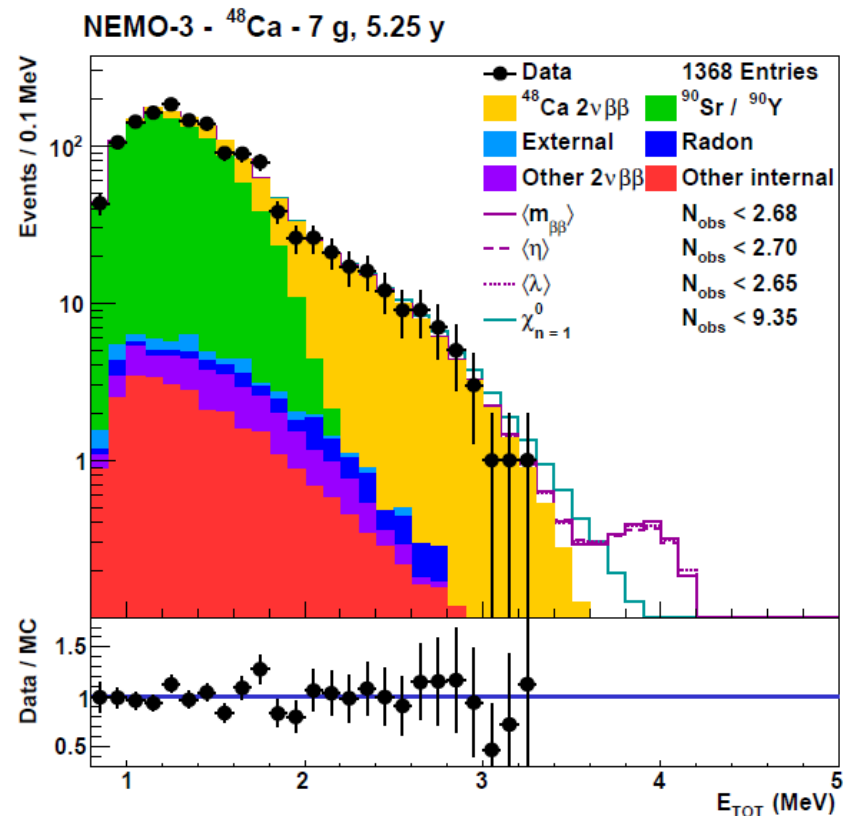
# EXPERIMENT

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- Search for  $0\nu\beta\beta$  is a search for a peak superimposed on a continuum
  - good energy resolution and therefore signal-to-background ratio is needed
  - Main background is the  $2\nu\beta\beta$  signal
- Four  $0\nu\beta\beta$  mechanism are investigated:
  - exchange of the light neutrinos
  - supersymmetric processes
  - through coupling of right and left-handed quarks and leptons
  - emission of a single Majorana particle

# NEMO-3 RESULTS

- Collected data between 2003 and 2011
- Low energies:  $^{90}\text{Sr}$  and  $^{90}\text{Y}$  background events dominate
- Higher energies: Signal of  $2\nu\beta\beta$  clearly visible



# SUMMARY

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- Investigation of the double-beta decay of  $^{48}\text{Ca}$  with a total expose time of more than five years
  - Larger and purer sample of  $\beta\beta$  events has been selected than before
- Half-life:  $T_{1/2}^{2\nu} = [6.4^{+0.7}_{-0.6} \text{ (stat)} \ ^{+1.2}_{-0.9} \text{ (syst.)}] \times 10^{19} \text{ yr}$
- Search for  $0\nu\beta\beta$  decays has been performed
  - No signal has been found, new limits for different processes has been determined