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Search for Electron Capture in 176Lu with a LYSO scintillator

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Naturally occurring ^{176}Lu decays by β- decay to ^{176}Hf with a half-life of 37.8 Gyr.
This radioactive decay provides an important isotopic clock (Lu/Hf) to date meteorites and minerals, furthermore ^{176}Lu/^{176}Hf can be used as an s-process thermometer in studies of stellar nucleosynthesis.
It has been suggested that some discrepancies involving Lu/Hf age comparisons in different samples could be reconciled if ^{176}Lu also underwent significant electron capture (EC) decay.
In particular, besides the well known β- decay to ^{176}Hf, the ^{176}Lu is also expected to be unstable with respect to electron capture decay to ^{176}Yb. The Q_{EC} for decay to the ^{176}Yb ground state is 106.2 keV. Thus, EC decays to both the $J^p = 0^+$ ground state and the $J^p = 2^+$ 82 keV first excited state of ^{176}Yb are both possible. These EC decay branches would be 7^{th} and 5^{th} forbidden transitions, respectively, and thus are expected to be negligibly small.
Previous searches of the ^{176}Lu EC decay were performed by using a passive Lutetium sources and looking for the ^{176}Yb* 82 keV gamma or the characteristic Yb X-rays in a HP-Ge detector.
Our new approach uses a LYSO crystal scintillator coupled to a PMT as an active Lutetium source, acquired in coincidence with an HP-Ge; this allows a powerful reduction of the background provided by the known ^{176}Lu β- decay branch.
The preliminary results of the measurement on a detector prototype arranged in the INFN-TIFPA laboratory will be summarized, the upper limits to the EC branching ratio of ^{176}Lu decay has been improved by a factor 3-20 (depending on the considered EC channel) with respect to previous measurements.

Primary authors: NOZZOLI, Francesco (Universita degli Studi di Trento and INFN (IT)); Mr GHEZZER, Luigi Ernesto (Phys. Dep. University of Trento); IUPPA, Roberto (Universita degli Studi di Trento and INFN (IT)); ZUCCON, Paolo (Universita degli Studi di Trento and INFN (IT))

Presenter: NOZZOLI, Francesco (Universita degli Studi di Trento and INFN (IT))

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