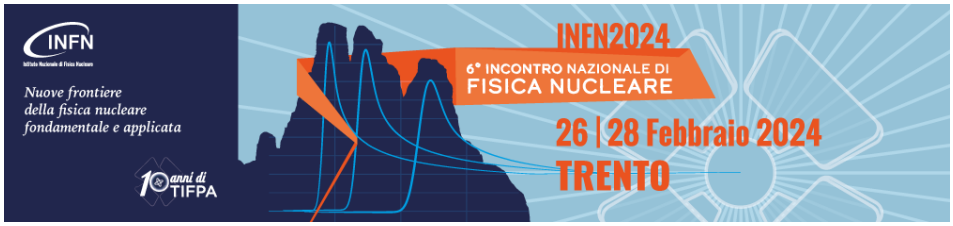

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LYSO calorimeters for searching ^{176}Lu electron capture decay

Monday, 26 February 2024 16:30 (5 minutes)

The decay of ^{176}Lu to ^{176}Hf through β^- decay occurs naturally and has a half-life of 37.8 Gyr. This decay is a valuable isotopic clock (Lu/Hf) used for dating meteorites and minerals, and can also serve as an s-process thermometer in the study of stellar nucleosynthesis.
Apart from undergoing β^- decay to form ^{176}Hf, the radioisotope ^{176}Lu can also become unstable through electron capture decay, leading to the formation of 176Yb. The Q_{EC} value for this decay to the ^{176}Yb ground state is 106.2 keV. As a result, the decay can occur to both the $J^p = 0^+$ ground state and the $J^p = 2^+$ 82 keV first excited state of ^{176}Yb. These EC decay branches would be 7th and 5th forbidden transitions respectively, and, thus, are expected to be negligibly small. Previous searches of the 176Lu EC decay were performed using passive Lutetium sources and looking for the ^{176}Yb* 82 keV gamma or the characteristic Yb X-rays in an HP-Ge detector. We have developed a new method utilizing an LYSO crystal scintillator and PMT to act as an active Lutetium source. This is combined with an HP-Ge to significantly decrease the background from the known ^{176}Lu β^- decay branch. Our preliminary results from testing a detector prototype in the INFN-TIFPA laboratory have led to improved upper limits on the EC branching ratio of ^{176}Lu decay, surpassing previous measurements by a factor of 3-20 depending on the specific EC channel being considered.

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