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Double-beta decay Q-value measurements with the JYFLTRAP Penning trap

The observation of double-beta decays and double-electron captures have become an important tool in the search for physics beyond the Standard Model (SM). These decays have been proposed to decay by emitting either two neutrinos or no neutrinos. While the two neutrino mode has been observed [1], the proposed neutrinoless decay mode requires the neutrino to be its own antiparticle (a Majorana particle), which would be a violation of the SM. To determine the suitability of an isotope for these observations, the energy released in the decay (Q-value) needs to be known precisely in order to calculate its half-life (generally $\geq 10^{25}$ a [1]), and thus the feasibility of observing the neutrinoless decay mode and to separate the decay signal from background.

In three recent measurements at the Ion Guide Isotope Separator On-Line (IGISOL) facility [2] in the University of Jyväskylä, the JYFLTRAP double Penning trap [3] employing the Phase-Imaging Ion-Cyclotron Resonance (PI-ICR) method [4] was used to determine the $Q_{\beta^-\beta^-}$ of ^{104}Ru [5], ^{122}Sn, ^{142}Ce and ^{148}Nd, and Q_{ECEC} of ^{120}Te. In addition, the precisely known Q_{ECEC} of ^{102}Pd [5] and ^{150}Nd, and $Q_{\beta^-\beta^-}$ of ^{124}Sn were re-measured. The ions were produced using two electric discharge ion sources. A precision of $\sim$100 eVs was reached for the Q-values. Most of our measurements are in agreement with their literature values in the Atomic Mass Evaluation [6]. In my contribution, I will present the JYFLTRAP measurement setup, the PI-ICR measurement technique and the results of our measurements.

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