Search for the E0 Decay of the ^{236}U Fission Isomer ◇

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Transitions between nuclear states with a large deformation difference may have large transition probabilities for E0 decays. Such an E0 decay has been found in the decay of the ^{238}U fission isomer back into the normal-deformed states [1]. However, a search for the E0 back-decay in ^{236}U showed no result [2].

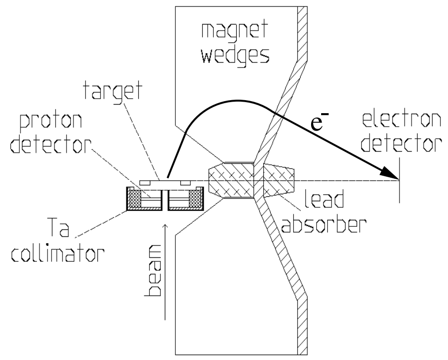

Fig. 1: Schematic drawing of the experimental set-up used for the test experiment. For clarity only one mini-orange spectrometer is shown.

Using a new set-up (fig. 1) with two mini-orange spectrometers (MOS) to measure conversion electrons we want to search for the E0 back-decay in ^{236}U. The fission isomer will be populated in the ^{235}U(d,p)^{236}U reaction. Due to the small cross section for the E0-decay a highly efficient and selective electron detection system had to be designed. The MOS (fig. 2) consist of six $Nd_2Fe_{14}B$ permanent magnet wedges with a central lead absorber.

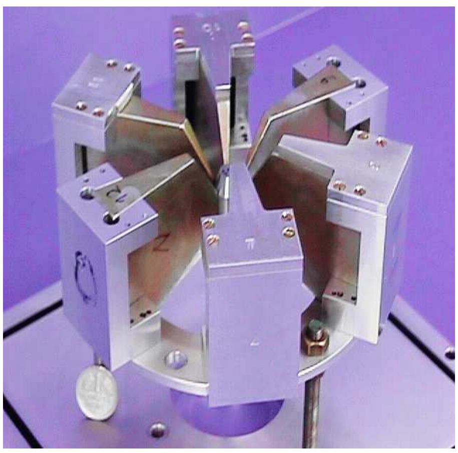

Fig. 2: Mini orange spectrometer optimized for the transmission of electrons in the energy range between 2.6 and 2.8 MeV.

The toroidal magnetic field has been optimized for a transmission of electrons in the energy range of the E0 back-decay. From the investigation of the γ-branch in the back decay to the first minimum [3] the excitation energy of the fission isomer has been determined as 2.81MeV. The expected electron energy of the E0 decay is therefore 2.69MeV. The MOS mounted in a close geometry around the target have a transmission of about 8% at an electron energy of 2.6-2.7 MeV. Si(Li) detectors of 6mm thickness and an active area of 500mm^2 are used. In order to suppress background coincidences will be measured between the protons from the reaction and conversion electrons. As shown in fig. 1, in first tests the protons have been detected in an annular Si counter with an active area of 450mm^2, positioned at backward angles. The proton detector had a distance of 5.6mm to the target and covered a solid angle of 26.5% of 4π. A Ta collimator protected the proton detector from the beam. Between detector and target a 40μm thick polycarbonate foil was mounted to prevent the fission fragments from reaching the detector and causing radiation damage.

This set-up was tested in beam at the Tandem accelerator of the Garching accelerator laboratory [4]. The test experiment showed that the beam current had to be limited due to high count rate in the proton detector. For the following experiments the ring detector for the protons will be replaced by two double sided Si strip-detectors with an area of 4×4cm each.

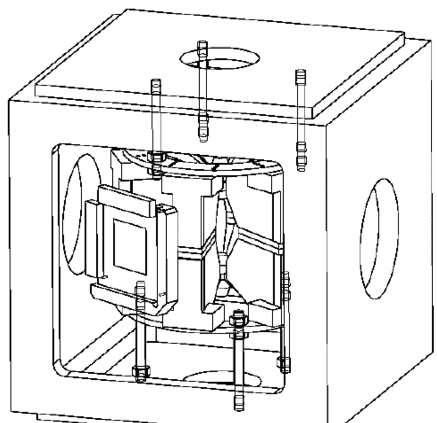

Fig. 3: Schematic drawing of the optimized experimental set-up. Two double sided silicon strip detectors will be used for the proton detection.

They will be mounted at a larger distance (9cm) to the target which results an a smaller solid angle of 3.14% of 4π. The loss of count rate can be compensated by higher beam currents. Fig. 3 shows the scattering chamber with two MOS and one of the strip detectors. In addition, the effective solid angle of the MOS is increased by a factor of two since the electron paths will no longer be blocked by the proton detector.

References

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