Intermediate-energy Coulomb excitation of ^{136}Te

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Based on the experience from the first intermediate-energy Coulomb excitation experiment performed at RIKEN with a heavy (A>100) ion beam, namely ^{104}Sn[1)], a similar experiment was realized in 2015 to study the nucleus ^{136}Te. The main objectives have been i) to determine a reliable value of the reduced transition probability, $B(E2)$, to the first excited 2^+ state based on the measurement of differential cross sections as a function of the scattering angle with both gold and carbon targets, ii) to search for discrete feeding transitions from higher-lying excited states and to study the influence of the feeding on the γ-ray angular correlation, and finally to search for a second 2^+ state, one with mixed-symmetry character.

A primary beam of ^{238}U at 345 MeV/u with an average intensity of 15 pnA bombarded a 4-mm thick beryllium production target located at the F0 focus of the BigRIPS fragment separator. The fission products around ^{136}Te were selected and purified by employing two wedge-shaped aluminium degraders. The secondary beam was identified event by event using the ΔE-TOF-B_ρ method, where the energy loss ΔE was measured by an ionization chamber located at the focal plane F7, B_ρ was determined from position measurements using PPACs and the TOF was measured with two plastic scintillators located at the focal points F3 and F7[2)]. After the selection and identification, the secondary beams were transported to the focal point F8 where they impinged on a 950 mg/cm^2 gold target with energies around 165 MeV/u. To detect the γ radiation emitted in the decay of the excited states, the reaction target was surrounded by the DALI2 spectrometer. The reaction products left the target with energies around 110 MeV/u and were identified by the ZeroDegree spectrometer using again the previously described ΔE-TOF-B_ρ method.

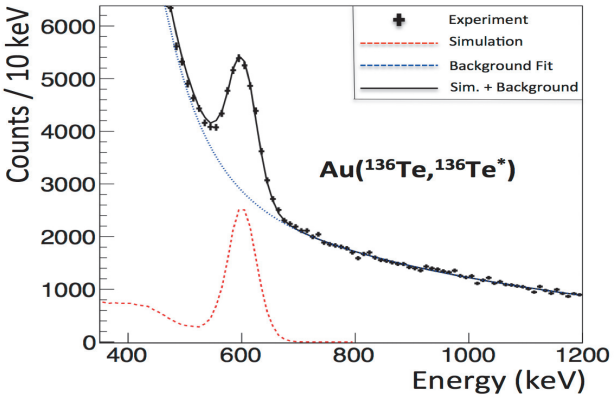

Fig. 1. Doppler-corrected γ-ray spectrum following Coulomb excitation of ^{136}Te. The observed line corresponds to the 606 keV, $2_1^+ \rightarrow 0_{gs}^+$ transition.

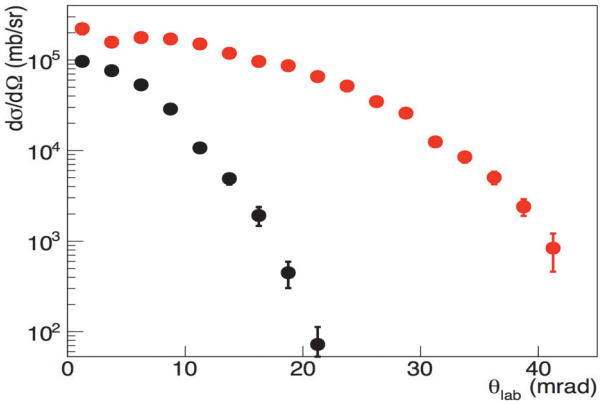

Fig. 2. The experimental differential cross sections as function of the scattering angle for inelastic excitation of the 2_1^+ state in ^{136}Te on a gold (red) and on a carbon (black) target.

The Doppler-corrected γ-ray spectrum, after selection on ^{136}Te ions in BigRIPS and ZD, is shown in Fig. 1. The fit to the experimental spectrum is shown by the thick black line which is composed of a two-exponential function describing the background (blue dotted line) and individual simulated responses (red dashed line). The line visible in the spectrum corresponds to the 606 keV, $2_1^+ \rightarrow 0_{gs}^+$ transition in ^{136}Te. The high statistics accumulated in this experiment is needed to study in detail the systematic uncertainties inherent in the determination of $B(E2)$ values using Coulomb excitation at relativistic energies. The differential cross sections measured for both the gold and the carbon target are shown in Fig. 2. The latter is used to determine the nuclear contribution to the cross section measured with the gold target. The data analysis is ongoing and the results will be presented soon.

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