Coulomb excitation of ^{136}Te studied with the DALI2 spectrometer

V. Vaquero,[*1] A. Jungclaus,[*1] P. Doornenbal,[*2] E. Sahin,[*3] Z.Y. Xu,[*4] S. Chen,[*2,*5] Y. Shiga,[*6] D. Steppenbeck,[*2] R. Taniuchi,[*2,*7] and the NP1306-RIBF98R1 collaboration

In April 2015 an experiment was performed at the RIBF of the RIKEN Nishina Center to study the excitation and decay of a second excited 2^+ state at an excitation energy around 1.5-1.6 MeV in the nucleus ^{136}Te which is predicted by theoretical calculations to be of mixed-symmetry character. The aim was to explore for the first time the potential of the Coulomb excitation technique at relativistic energies for the study of mixed-symmetry states (MSS) in radioactive nuclei. A second aspect of the experiment was to perform a model analysis with exceptional high statistics for the determination of the B(E2; $2_1^+ \rightarrow 0_1^+$) value from measured differential cross sections after Coulomb excitation at relativistic energies. Based on our recent experiences with the analysis of the first Coulex experiments with heavy beams at energies around 130-150 MeV/u performed at RIKEN[1] it became highly desirable to study in detail all systematic uncertainties involved in such an analysis to set the standards for the routinely use of this technique in the future.

The ^{136}Te ions were produced in the projectile fission of a 345-MeV/u ^{238}U beam on a 4-mm ^{9}Be target. The nuclei of interest were separated and identified during their flight through BigRIPS and hit a secondary gold target at the F8 focal plane in which the Coulomb excitation took place. The γ radiation emitted in the decay of the excited states was detected in the DALI2 spectrometer in coincidence with ^{136}Te ions identified in the ZeroDegree (ZD) spectrometer. Over the last months work has been devoted to improve the particle identification (PID) in both the BigRIPS and ZD spectrometer. Preliminary PID plots are shown in Fig.1 while a γ-ray spectrum measured in coincidence with ^{136}Te ions detected in both BigRIPS and ZD is shown in Fig. 2. From the latter figure it is evident that indeed high statistics was accumulated for the Coulomb excitation of the first 2^+ state in ^{136}Te which will allow for a detailed study of the procedure employed to deduce B(E2) values in this type of experiment. Different theoretical calculations[2,3] predict a significant probability for the Coulomb excitation of a second 2^+ state. Therefore, a thorough search for additional lines in the γ-ray spectra obtained in the present experiment will be performed in the near future.

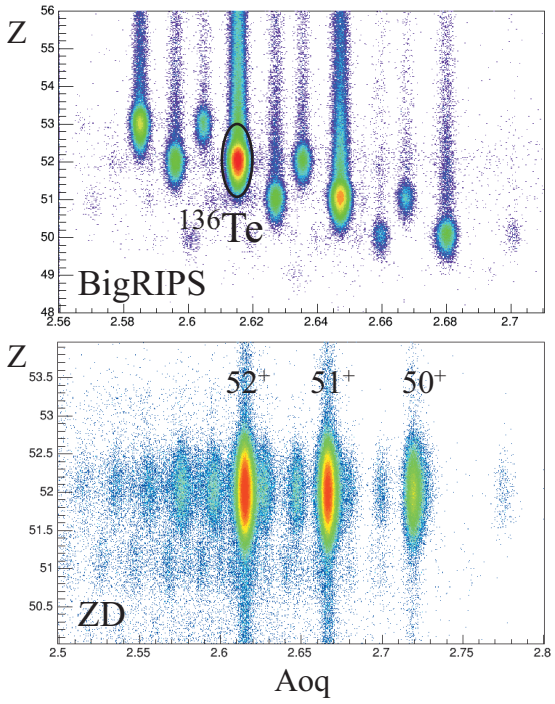

Fig. 1. PID obtained for the BigRIPS and the ZD spectrometer. The ZD plot was obtained requiring the identification of ^{136}Te ions in BigRIPS. Note that the ^{136}Te ions are observed in different charge states in ZD.

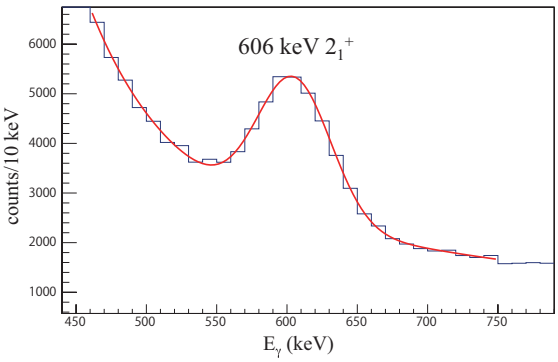

Fig. 2. Gamma-ray spectrum in coincidence with the ^{136}Te ions detected in the ZD spectrometer.

*1 Instituto de Estructura de la Materia, CSIC
*2 RIKEN Nishina Center
*3 Department of Physics, University of Oslo
*4 Department of Physics, University of Hong Kong
*5 State Key Laboratory of Nuclear Physics and Technology, Peking University
*6 Department of Physics, Rikkyo University, Tokyo
*7 Department of Physics, University of Tokyo

References

1) P. Doornenbal et al.: Phys. Rev. C **90**, 061302(R) (2014).
2) N. Shimizu et al.: Phys. Rev. C **70**, 054313 (2004).
3) A.P. Severyukhin et al.: Phys. Rev. C **90**, 011306(R) (2014).