Intermediate-energy Coulomb excitation of ^{77}Cu

E. Sahin,[*1] V. Modamio,[*1] Z. Y. Xu,[*2] F. Bello,[*1] K. K. Hadyńska-Klęk,[*1] P. Doornenbal,[*3] S. Chen,[*3,*4] A. Jungclaus,[*5] R. Taniuchi,[*6] and the NP1406-RIBF126 collaboration

The present experimental study on ^{77}Cu has been carried out at RI Beam factory (RIBF) of the RIKEN Nishina Center[1]. It will complement our previous study of ^{77}Cu via beta decay of ^{77}Ni at RIKEN within the EURICA campaign. The low-lying states in ^{77}Cu were identified as particle-core excitations through the comparison to the large scale Monte Carlo Shell Model (MCSM) calculations[2,3]. An almost unique way to characterize the states predicted as collective in the calculations is to measure the transition probabilities, i.e. B(E2) strengths. Hence the following Coulomb excitation experiment was performed to study the collective properties of low-lying states in ^{77}Cu. The characterization of such states and in particular the mixing of both collective and single-particle configurations will provide significant information on the shell structure close to ^{78}Ni. A Coulomb excitation measurement of the states due to the proton-core excitations in the case of ^{77}Cu nucleus will also provide an estimation of the collectivity of the 2^+ state in th even-even ^{76}Ni "core".

Exotic secondary beam particles were produced by induced fission of the ^{238}U beam on a 3-mm thick ^{9}Be target. The uranium beam was accelerated to an energy of 345 MeV/nucleon with an average beam intensity of 20 pnA. Fission products were selected and transported by the BigRIPS fragment separator. Coulomb excitation of the fragments was performed on a 900-mg/cm^2 thick ^{197}Au target, mounted in front of the Zero Degree Spectrometer. The DALI2 NaI array was used to detect de-excitation γ ray measured in coincidence with beam-like particles identified in the Zero Degree Spectrometer (ZDS). Two different beam settings of the BigRIPS fragment separator have been employed during the beam time. In the first one the central trajectory was set at ^{73}Cu as a test case to perform the absolute cross-section measurement technique (See Ref.[4] for details). In the second setting, the momentum distribution of the incoming fragments were centered for ^{77}Cu. Figures 1 and 2 show the preliminary particle identification (PID) spectra for ZDS, i.e. after the Coulomb excitation target at F8 position. Note that ^{72}Ni was observed in the first setting which will allow us to obtain the transition strength of the 0_1^+ to 2_1^+ transition and to fill the gap in the seniority parabola of the Ni chain from N=40 to N=46. Data analysis in order to obtain doppler-corrected γ-ray spectra for the extraction of the Coulomb excitation cross sections is still ongoing.

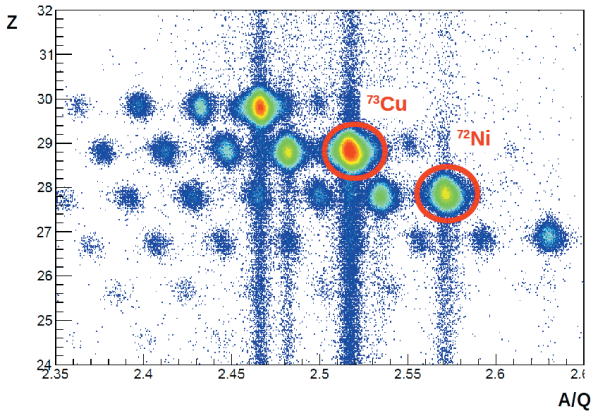

Fig. 1. Setting 1: ^{73}Cu and ^{72}Ni are identified in the Z (atomic number) versus A/Q (mass-to-charge number) plot for ZDS.

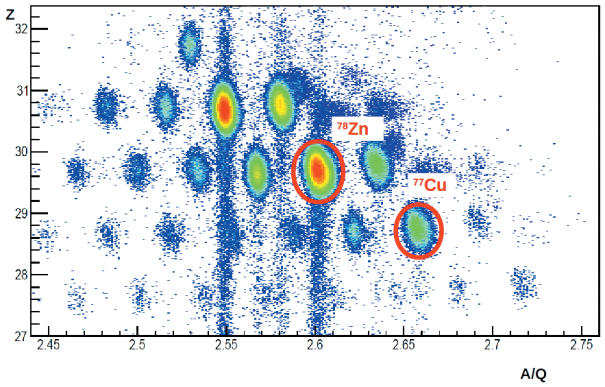

Fig. 2. Setting 2: ^{77}Cu and ^{78}Zn are identified in the Z (atomic number) versus A/Q (mass-to-charge number) plot for ZDS.

*1 University of Oslo, Department of Physics
*2 University of Hong Kong
*3 RIKEN Nishina Center
*4 Peking University
*5 Instituto de Estructura de la Materia, CSIC
*6 University of Tokyo

References

1) T. Onishi *et al.*, J. Phys. Soc. Jpn. **79**, 073201 (2010).
2) Y. Tsunoda, T. Otsuka, N. Shimizu, M. Honma, and Y. Utsuno, Phys. Rev. C **89**, 031301(R) (2014).
3) Y. Tsunoda et al., private communication.
4) P. Doornenbal et al., Phys. Rev. C **90**, 061302(R) (2014).