Investigating shape coexistence in ^{74}Se using Coulomb excitation

R. Kjus[1], M. Zielińska[1], W. Korten[1], P. Aguilera[2,3], F. Angelini[3,4], M. Balogh[4], J. Benito Garcia[2], D. Brugnara[4], E. Clément[5], A. Ertoprak[4], R. Escudeiro[2], D. Freire Fernandez[6,7], F. Galtarossa[2], N. Gelli[8], A. Goasduff[4], A. Gozzelino[4], B. Góngora-Servín[4,9], K. Hadyńska-Klęk[10], D. Kalaydjieva[12], N. Marchini[8], A. Nannini[8], D.R. Napoli[4], R. Nicolás del Álamo[4], J. Pellumaj[4,9], R.M. Pérez-Vidal[4,11], S. Pigliapoco[2,3], E. Pilotto[2,3], K. Rezynkina[2,3], M. Rocchini[7,12], M. Sedlák[4], D. Stramaccioni[4], J.J. Valiente-Dobón[4], K. Wrzosek-Lipska[10], L. Zago[3,4], I. Zanon[4], G. Zhang[2], and T. Zidar[12]

[1]*IRFU, CEA, Université Paris-Saclay, France;* [2]*INFN, Sezione de Padova, Italy;* [3]*Dipartimento di Fisica, Università de Padova, Italy;* [4]*INFN Laboratori Nazionali di Legnaro, Italy;* [5]*GANIL, Caen, France;* [6]*MPI, Heidelberg, Germany;* [7]*GSI, Darmstadt, Germany;* [8]*INFN, Sezione di Firenze, Italy;* [9]*Dipartimento di Fisica e Scienze della Terra, Università di Ferrara, Italy;* [10]*HIL, University of Warsaw, Poland;* [11]*IFIC, CSIC - Universitat de València, Spain;* [12]*Department of Physics, University of Guelph, Canada*

The neutron-deficient selenium and krypton nuclei have been observed to exhibit a wide range of shapes at low excitation energy [1]. Typically, for even-even nuclei in this region, the ground states are of prolate deformation with oblate states built on a deformed 0^+ state. However, certain nuclei, such as ^{72}Kr and ^{68}Se, are suggested to have the reverse configuration [2, 3], i.e. an oblate ground state with a prolate band built on the excited 0^+ level. Our investigation focuses on ^{74}Se (Z=34, N=40), which from existing spectroscopic data has been thought to exhibit strong configuration mixing at low spin [1]. A recent β-decay measurement [4] provided for the first time firm spin assignments of multiple low-lying states in ^{74}Se and proposed an alternative interpretation, namely that the states typically believed to be of either oblate or prolate shape are of a vibrational quasi-spherical character, and that a deformed structure built on the 0^+_3 state is present at a higher excitation energy.

To study deformation of the collective structures observed at low excitation energy in ^{74}Se, a Coulomb-excitation experiment was performed at Legnaro National Laboratories, Italy, using a 240-MeV ^{74}Se beam on two different targets, ^{120}Sn and ^{208}Pb. For γ-ray detection 23 triple clusters of AGATA were used, with SPIDER [5] positioned at backward angles to detect scattered beam ions. A total of 18 excited states were populated up to 3.2 MeV excitation energy, including the ground-state band up to spin 8, the presumed oblate structure up to spin 6, as well as the 0^+_3 and 2^+_4 states, postulated by Ref. [4] to be strongly deformed. Moreover, an intense transition from a state at 2146 keV, that has never been observed before in γ-ray spectroscopy, is present in the spectra, indicating a collective character of this level.

The ongoing analysis focuses on the extraction of the γ-ray intensities, from which a set of electromagnetic matrix elements in ^{74}Se will be determined, including quadrupole moments of excited states. The sensitivity to those will be enhanced by the use of two targets strongly differing in atomic number Z. From the obtained $E2$ matrix elements, quadrupole deformation parameters for the 0^+_1 and 0^+_2 states will be determined, including the non-axiality parameter γ. Details of the performed experiment and selected aspects of the Coulomb-excitation data analysis will be presented along with the preliminary results.

[1] P.E. Garrett, M. Zielińska and E. Clément, Prog. Part. Nucl. Phys. **124** (2022) 103931.
[2] S.M. Fischer *et al.*, Phys. Rev. Lett. **84** (2014) 4064.
[3] H. Iwasaki *et al.*, Phys. Rev. Lett. **112** (2014) 142502
[3] E.A. McCutchan *et al.*, Phys. Rev. C **87** (2013) 014307.
[4] M. Rocchini *et al.*, Nucl. Instrum. Methods Phys. Res. A **971** (2020) 164030.