Coulomb excitation of ^{68m,70g}Cu using laser ionized and post-accelerated isomeric beams

I. Stefanescu[1], G. Georgiev[2], P. Van Duppen[1], M. Huyse[1], O. Ivanov[1], J. Van De Walle[1], Th. Kröll[3], T. Sieber[4], J. Iwanicki[5], N. Warr[6], S. Franchoo[7], P. Butler[8], D. Balabanski[9], G. Lo Bianco[9], K. Gladnishki[9], A. Saltarelli[9], A. Lagoyannis[10], L. Fraile[11], U. Köster[11], F. Wenander[11], P. Delahaye[11], J. Cederkäll[11] and the MINIBALL and REX-ISOLDE collaboration

[1] *IKS, Katholieke Universiteit Leuven, Belgium*
[2] *CSNSM, Orsay, France*
[3] *TU München, Germany*
[4] *LMU München, Germany*
[5] *Warsaw University, Poland*
[6] *IKP, Universität zu Köln, Germany*
[7] *IPN Orsay, France*
[8] *University of Liverpool, Great Britain*
[9] *University of Camerino, Italy*
[10] *NCSR Athens, Greece*
[11] *Cern, Switzerland*

The study of the structure of nuclei located in the vicinity of ^{68}Ni has attracted much interest lately. Experimental investigations were focussed to find empirical evidence for the confirmation of the magicity of the $N = 40$ subshell closure and its influence on the single-particle and collective properties of the neighboring nuclei. The existing experimental information about the structure of the neutron-rich nuclei around ^{68}Ni has been mostly obtained in beta-decay, mass and moments measurements as well as in coulomb excitation experiments with radioactive beams of even-even isotopes.

Crucial information about the existence and strength of the $N = 40$ gap can be obtained from the investigation of the odd-odd isotopes ^{68,70}Cu. The low-energy structure of these nuclei is expected to be very sensitive to the single-particle spacing between the valence orbitals and to the specific residual interaction acting among the valence particles. In both nuclei, the specific shell-model states involved give rise to multiplets of states. Among them, the multiplet of states (6^-, 4^-, 5^-, 3^-), originating from the configuration $\pi p_{3/2}\nu g_{9/2}$ is extremely important for the discussion about the $N = 40$ subshell closure. The existing experimental information about these specific states indicated that 6^- is an isomeric state in both nuclei and it is the lowest in energy. Candidates for the other states of the multiplet were proposed at higher energies [1,2,3].

In order to determine experimentally the energies, spins and reduced transition probabilities between the states of the $\pi p_{3/2}\nu g_{9/2}$ multiplet in both nuclei, we performed a coulomb excitation experiment by using 6^- isomeric beams. The beams were produced by ISOLDE-CERN by using narrow band laser ionization and post-accelerated by REX to 2.9 MeV/u. This was for the first time when isomeric beams were post-accelerated and used for nuclear structure investigations by coulomb excitation. De-excitation gamma-rays were detected by the highly-efficient MINIBALL array. The energies and spins of the 4^- and 3^- states were firmly identified and the $B(E2; 6^- \rightarrow 4^-)$ values were experimentally determined in both nuclei. The measured B(E2) values were found to be of the order or few W.u., suggesting a single-particle-like structure for the states of this multiplet. Large scale shell-model calculations using a realistic effective interaction within the *pfg* valence space outside the ^{56}Ni core account very well for the observed properties in both nuclei [4].

[1] J. Van Roosbroeck et al., Phys. Rev. C 69, 034313 (2004);
[2] J. Van Roosbroeck et al., Phys. Rev. Lett. 92, 112501 (2004);
[3] J. D. Sherman et al., Phys. Lett. B 67, 257 (1977);
[4] N. Smirnova, Private Communications.