# Coulomb Excitation of $^{180}$Ta ◇

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Only 0.012% of natural Tantalum consists of $^{180}$Ta, the rest being $^{181}$Ta. The isotope $^{180}$Ta survives in nature in a $9^-$ isomeric state at an excitation energy of 75.3 keV. The halflife of this state is $T_{\frac{1}{2}} > 1.2 \times 10^{15}$ y because of the eight-times K-forbidden transition from the $9^-$ isomer to the unstable ground state ($T_{\frac{1}{2}}$=8.1 h) $1^+$. 86% of the ground state decays to $^{180}$Hf, the rest to $^{180}$W. The study of $^{180}$Ta is interesting from an astrophysical point of view because neither the production of the isomer nor its survival are so far satisfactorily explained. The survival is closely related to a possible depopulation of the isomeric state under stellar conditions with high photon fluxes. Earlier Coulomb-excitation experiments [1] indicated a depopulation via intermediate states.

To check these predictions $^{180}$Ta was Coulomb excited by 225 MeV $^{58}$Ni projectiles impinging on a $Ta_2O_5$-target enriched to 5.6% in $^{180}$Ta on a thin C-backing. For comparison a similar natural Ta-target was also irradiated. The detector array used was the standard NORDBALL equipment plus a newly developed PIN-diode particle-detector [2]. This setup allows $\gamma$-spectroscopy in coincidence with particles backscattered from $^{180/181}$Ta, important for cleaning the spectra from background caused by reactions of $^{58}$Ni on C or O. Cascade and crossover transitions, all belonging to the K=$9^-$ rotational band, could be observed up to spin I=$15^-$ (Fig.1). No $\gamma$-rays indicating the depopulation of the isomeric state could be seen in the online spectra. Offline analyses to clear up this point are in progress.

Another indicator for the depopulation of the isomeric state is the observation of the $^{180}$Ta ground state decay. It can be identified by the 93.3 KeV $2^+$ to $0^+$ transition in $^{180}$Hf and by the Hf x-rays. A planar Ge(HP)-detector was used for out-off-beam activation measurements to look for the ground-state decay of recoils caught on a catcher-foil. The intensities of the lines from recoils of the enriched and of the not enriched target are identical within the error bars. This means that $^{180}$Ta in its ground state was probably not produced by depopulation of the isomeric state, but via the $^{181}$Ta($^{58}$Ni,$^{59}$Ni)$^{180}$Ta subcoulomb pickup reaction.

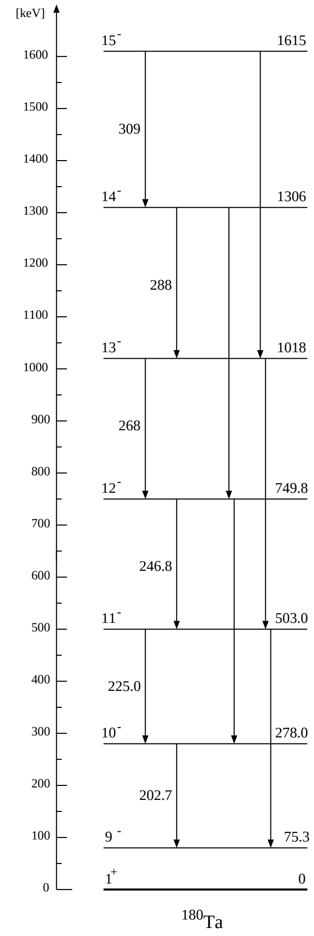


Fig. 1: The observed $\gamma$-transitions of $^{180}$Ta

## References

[1] Phys. Rev. **C50** (1994) 2198
[2] M. Würkner et al., "A new particle detector for gamma-coincidence experiments", this report p. 115

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