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Beta delayed fission studies of the neutron deficient Tl, At and Fr nuclei

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`Beta delayed  ssion (  DF) is a rare nuclear decay process which couples   decay`

and fission. In this two-step process, a parent nucleus first undergoes β decay, possibly populating states in the daughter nucleus close to the top of the fission barrier, thus allowing the fission of the daughter to be competitive with other decay modes.
The occurrence of this process has been previously observed in several heavy nuclei in the actinides region (N/Z ~ 1.5-1.6) due to the relatively large Qec value of the parent nucleus and the small fission barrier of the daughter.
According to semiempirical estimates, β DF is also likely to happen in the neutron-deficient region from Tl(Z=81) to Fr(Z=87), where high Qec values of up to 12 MeV are expected. The uniqueness of β DF in the lead region lies in the possibility of reaching exotic nuclei with an unusual N/Z ratio, e.g. N/Z=1.25 for 180 Hg, the β decay product of 180 Tl, which do not undergo spontaneous fission, and thus, it allows the investigation of their low-energy fission properties.
This talk reviews the results of an experimental campaign carried out at the ISOLDE mass-separator at CERN, in which a search for the β DF decay of isotopes 178–184 Tl, 193–196 At and 200–202 Fr has been performed. A novel and key feature of this work was the production of pure sources of the Tl and At isotopes using resonant laser ionization followed by mass separation.
A surprising outcome resulted from the β DF study of 180 Tl, where a completely unexpected asymmetrical mass split of the fission products of 180 Hg was observed([1]). Furthermore, evidence for the β DF of 178 Tl, 194,196 At and 202 Fr was obtained and an asymmetrical mass split of the fission products of 178 Tl is suggested. Together with the data for 180 Tl, this has established a new island of asymmetric fission, in addition to the previously known one in the heavy actinides nuclei. The experimental details and the results will be discussed in this contribution.

References
[1] A. N. Andreyev et al. Phys. Rev. Lett.,105 252502 (2010).

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