New measurement of the neutron capture cross section of the thallium isotopes ^{203}Tl, ^{204}Tl and ^{205}Tl

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Neutron capture cross sections are one of the key input parameters for an accurate description of the s-process of stellar nucleosynthesis, which is responsible for the production of about half of the elemental solar abundances between Fe and Bi in AGB stars. In this talk we will present the new measurement of the capture cross section of the thallium isotopes ^{203}Tl, ^{204}Tl, and ^{205}Tl, performed at the n_TOF facility (CERN) between 2015 and 2018.

During s-proces conditions, for a nucleus of radioactive ^{204}Tl ($T_{1/2} = 2.78\,y$, β-decays to ^{204}Pb), the probability of decaying is similar than that of capturing a neutron, thus acting as what is called a branching point. Concerning ^{205}Tl, this terrestrially stable nucleus becomes unstable by bound-state beta decay, decaying to ^{205}Pb. In the end, both cross sections play an important role in fixing the final abundances of the lead isotopes. What is more, they are necessary for and accurate determination of the primordial ratio ^{205}Pb/^{204}Pb, which has a potential use as an s-process cosmo-chronometer thanks to the long half-life ($T_{1/2} = 1.5\times10^{7}\,y$) of ^{205}Pb.

This is the first time the ^{204}Tl(n,γ) cross section has been measured, using a sample of 260 mg of ^{203}Tl enriched to 4% (9 mg) in ^{204}Tl and a detectopm setup of four C_6D_6 gamma detectors. The overall content of 96% of ^{203}Tl made an ancillary measurement of ^{203}Tl(n,γ) alone necessary, which has yielded updated cross section data for this reaction, as well.

The measuring technique, the stellar cross section calculation, and the implications for the s-process of the new nuclear data will all be covered in this talk.