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The astrophysical ^{140}Ce(n,γ)^{141}Ce reaction: present and future

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The ^{140}Ce(n,γ)^{141}Ce is recognized as an important reaction in the flow of neutron-capture nucleosynthesis due to the neutron-magic character of ^{140}Ce and a corresponding small neutron capture cross section. We present here [1] measurements of the neutron-capture Maxwellian-averaged cross section (MACS) of stable cerium isotopes performed by activation in the quasi-Maxwellian ^{7}Li(p,n) neutron field ($kT \sim 34\,\mathrm{keV}$) produced by the Liquid-Lithium Target (LiLiT) at Soreq Applied Research Accelerator Facility (SARAF). The MACS values ($kT = 30\,\mathrm{keV}$) are generally consistent with previous measurements and for ^{140}Ce smaller by approximately 15-20%. In contrast a recent study of the ^{140}Ce(n,γ)^{141}Ce cross section measured via time of flight [2] leads to MACS values larger by ~20-40% than quoted in the experimental database KADoNIS [3] in the $kT \sim 5 - 10\,\mathrm{keV}$ (see also [4]). We note here that the the activation and time-of-flight experiments were focused on different kT regions ($\sim 30\,\mathrm{keV}$ and $\sim 10\,\mathrm{keV}$, respectively), possibly affecting the MACS determinations for kT values out of their respective regions. In order to contribute to the understanding of neutron-capture nucleosynthesis in this region of nuclides, an independent experiment is being planned, based on activation in the quasi-Maxwellian neutron field ($kT \sim 5\,\mathrm{keV}$) of the ^{18}O(p,n) reaction close to threshold. This experiment will enable direct comparison between a quasi-Maxwellian activation and the time-of-flight measurement without the need of extrapolation and hence has the potential to resolve the discrepancy. The ^{18}O(p,n) reaction was originally proposed by Heil et al. [5] for astrophysical MACS determinations and its study was recently revisited [6] for our experiments. With a proton beam of $2581\,\mathrm{keV}$ incident on a $^{18}OTa_2O_5$ target at the PTB-PIAF facility, the outgoing neutron energy distribution was measured by means of time of flight with a thin ^{6}Li detector at angles of $0^\circ - 60^\circ$. The angle-integrated neutron spectrum closely resembles a thermal flux distribution at $kT = 5\,\mathrm{keV}$. The results, under final analysis stages, will be presented.

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