Measurement of the ^{53}Mn (n, γ) cross-section at stellar energies

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^{53}Mn ($t_{1/2} \approx 3.7$ Ma) is expected to be one of the major short-lived radioisotopes produced during type II supernovae explosions [1, 2]. It can undergo further nuclear reactions due to its long half-life, which may influence the isotopic abundances of neighboring stable isotopes. Additionally, it can serve as a sensitive chronometer to date processes in the early solar system [3] and to determine the exposure time of terrestrial material to high energetic cosmic radiation [4].

We report here on the first measurement of the Maxwellian Averaged Cross-Section (MACS) of ^{53}Mn at stellar neutron energies performed at the Soreq Applied Research Accelerator Facility (SARAF) facility at the Soreq nuclear research center.

The target containing ~10^{18} atoms ^{53}Mn was prepared using a stock solution previously extracted and purified from activated accelerator waste in the course of the ERAWAST initiative [5] at PSI. The total number of ^{53}Mn atoms in the target was deduced from a retained sample via multi-collector ICP-MS measurements at PSI.

The activation of ^{53}Mn with neutrons of a quasi-Maxwellian spectrum of about 40 keV was performed using the Liquid-Lithium Target LiLiT) installation at the Soreq Applied Research Accelerator Facility (SARAF-) [6]. The ^{53}Mn target was encapsulated in an aluminum holder and introduced into a vacuum chamber in close proximity to the neutron entrance window immediately behind the liquid Lithum film.

The total accumulated neutron fluence was deduced from γ-measurements of co-activated gold foils mounted externally on the target holder and of natural cobalt added to the target material as an internal flux monitor. The ^{54}Mn, ^{60}Co and ^{198}Au activities were measured before and after the irradiation using high-resolution γ-spectroscopy.

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