Study of Astrophysical *s*-Process Neutron Capture Reactions at the High-Intensity SARAF-LiLiT Neutron Source

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We report on recent experiments at the Soreq Applied Research Accelerator Facility - Liquid-Lithium Target (SARAF-LiLiT) laboratory dedicated to the study of s-process neutron capture reactions. The mA-proton beam at 1.92 MeV (2–3 kW) from SARAF Phase I yields high-intensity 30 keV quasi-Maxwellian neutrons (3–5×10^{10} n/s). The high neutron intensity enables Maxwellian averaged cross sections (MACS) measurements of low-abundance or radioactive targets. Neutron capture reactions on the important *s*-process branching points ^{147}Pm and ^{171}Tm were investigated by activation in the LiLiT neutron beam and γ-measurements of their decay products. MACS values at 30 keV extracted from the experimental spectrum-averaged cross sections are obtained and will be discussed. The Kr region, at the border between the so-called weak and strong s-process was also investigated. Atom Trap Trace Analysis (ATTA) was used for the first time for the measurement of a nuclear reaction cross section and the MACS(30 keV) of the ^{80}Kr(n,γ)^{81}Kr($t_{1/2}$= 230 ky) and ^{84}Kr(n,γ)^{85g}Kr(10.8 y) were determined. The latter determination was confirmed both by low-level β counting and γ spectrometry while the shorter capture products ^{79,85m,87}Kr were detected by γ-spectrometry only. The partial MACS leading to ^{85m}Kr(4.5 h) measured in this experiment has interesting implications since this state decays preferentially by β decay (79%) to ^{85}Rb on a faster time scale than does ^{85g}Kr and behaves thus as an *s*-process branching point. This work was supported in part by Pazy Foundation (Israel) and Israel Science Foundation.