Stellar ^{36,38}Ar$(n,\gamma)^{37,39}$Ar Reactions Studied at SARAF-LiLiT

M. Tessler[a], M. Paul[a], S. Halfon[b], B. S. Meyer[c], R. Pardo[d], R. Purtschert[e], K. E. Rehm[d], R. Scott[d], M. Weigand[f], L. Weissman[b], S. Almaraz-Calderon[d], M. L. Avila[d], D. Baggenstos[e], P. Collon[g], N. Hazenshprung[d], Y. Kashiv[g], D. Kijel[b], A. Kreisel[b], R. Reifarth[f], D. Santiago-Gonzalez[d,h], A. Shor[b], I. Silverman[b], R. Talwar[d], D. Veltum[f] and R. Vondrasek[d]

[a] *Racah Institute of Physics, Hebrew University, Jerusalem, Israel 91904,*
[b] *Soreq NRC, Yavne, Israel 81800,*
[c] *Dpt. of Physics and Astronomy, Clemson University, Clemson, South Carolina 29634, USA,*
[d] *Argonne National Laboratory, Argonne, IL, USA,*
[e] *Physics Institute, University of Bern, 3012 Bern, Switzerland,*
[f] *Goethe University Frankfurt, Frankfurt, Germany,*
[g] *Dept. of Physics, University of Notre Dame, Notre Dame, IN, USA,*
[h] *Dpt. of Physics and Astronomy, Louisiana State University, Baton Rouge, LA, USA,*

As part of a program of neutron-capture measurements in the regime of the weak s-process, we studied for the first time the ^{36,38}Ar(n,γ) reactions in the stellar neutron energy regime and their contribution to production of light neutron-rich nuclides. The experiments were performed with the Liquid-Lithium Target (LiLiT) and the mA-proton beam at 1.92 MeV (2-3 kW) from the Soreq Applied Research Accelerator Facility (SARAF). The facility yields high-intensity quasi-Maxwellian (kT $\sim$ 30-50 keV) neutrons (3-5$\times 10^{10}$ n/s). Gas samples were irradiated at the SARAF-LiLiT neutron source and the ^{37}Ar/^{36}Ar and ^{39}Ar/^{38}Ar ratios in the activated gas samples were determined by accelerator mass spectrometry at the ATLAS facility (Argonne National Laboratory). The ^{37}Ar activity was also measured by low-level counting at the University of Bern. The measured values of the Maxwellian Averaged Cross Sections (MACS) are significantly lower than theoretical and evaluated values published so far. Nucleosynthesis He-burning calculations using the ^{36,38}Ar(n,γ) experimental MACS show that the residual mass fraction of ^{36}Ar increases by a factor of $\sim$10 while the mass fraction of neutron-rich nuclides in the region A=36-48 during the weak s-process is lowered by 10 to 50%.

This work was supported in part by Israel Science Foundation (Grant Nr. 1387/15), Pazy Foundation (Israel), the US Department of Energy, Office of Nuclear Physics, under Contract NoDE-AC02-06CH11357. D.S.G. acknowledges the support by the U.S. Department of Energy, Office of Nuclear Physics, under grant No. DE-FG02-96ER40978. This research has received funding from the European Research Council under the European Unions's Seventh Framework Program (FP/2007-2013) /ERC Grant Agreement n. 615126.