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Indirect study of 17O(a,n)20Ne and 17O(a,g)21Ne reactions via 17O(7Li,t)21Ne alpha-transfer reaction and its impact on the s-process in rotating poor-metal massive stars

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F. Hammache[1], P. Adsley[2,3,*], L. Lamia[4,5,6], D.˜S. Harrouz[1], N. de Séréville[1], B. Bastin[7], T. Faestermann[8], C. Fougères[7], R. Hertenberger[9], M. La Cognata[5], A. Meyer[1], S. Palmerini[10,11], R.G. Pizzone[5], F. de Oliveira[7], S. Romano[4,5,6], A. Tumino[12,5], H.-F. Wirth[9]

[1] Université Paris-Saclay, CNRS/IN2P3, IJCLab, 91405 Orsay, France
[2] School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa
[3] iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa
[4] Dipartimento di Fisica e Astronomia "E. Majorana", Univ. di Catania,95123 Catania, Italy
[5] Laboratori Nazionali del Sud - Istituto Nazionale di Fisica Nucleare, 95123 Catania, Italy
[6]Centro Siciliano di Fisica Nucleare e Struttura della Materia CSFNSM, Catania, Italy
[7] GANIL, CEA/DRF-CNRS/IN2P3, 14076 Caen, France
[8] Physik Department E12, Technische Universität München, D-85748 Garching, Germany
[9] Fakultät für Physik, Ludwig-Maximilians-Universität München, D-85748 Garching, Germany
[10] Dipartimento di Fisica e Geologia, Università degli Studi di Perugia, 06123 Perugia, Italy
[11] Istituto Nazionale di Fisica Nucleare, Sezione di Perugia, 06123 Perugia, Italy
[12] Facoltà di Ingegneria e Architectura, Università degli Studi "Kore", 94100 Enna, Italy

[*] Present address:Cyclotron Institute and Department of Physics & Astronomy, Texas A&M University, College Station, Texas 77843, USA

Recent models of low metallicity rotating massive stars show the possibility of a large production of *s*-elements between strontium and barium. The efficiency of the *s*-process in these stars depends strongly on the ratio of the reaction rates of the two competing ^{17}O(α,n)^{20}Ne and ^{17}O(α, γ)^{21}Ne reactions [1]. This ratio determines the influence of the poisoning effect of ^{16}O which consumes the neutrons released by the ^{22}Ne(α,n)^{25}Mg reaction, the main neutron source for the weak component of the s-process in massive stars. Indeed, the neutrons consumed by ^{16}O(n,γ)^{17}O may either be released by ^{17}O(α,n)^{20}Ne or lost for good via ^{17}O(α, γ)^{21}Ne. However, the reaction rates of these two competing reactions are poorly known because of the lack of spectroscopic information (Γ_α, J$^\pi$, Γ_n, Γ_γ,...) of the astrophysical relevant states in the compound nucleus ^{21}Ne. To have a better determination of ^{17}O(α,n)^{20}Ne and ^{17}O(α, γ)^{21}Ne reaction rates, the α-widths of the states of interest were determined experimentaly for the first time through the measurement of their α-spectroscopic factors. The latter were determined from the α-transfer reaction ^{17}O(^{7}Li,t)^{21}Ne measurement [2] performed at MLL-Munich, using the high-energy resolution magnetic spectrometer Q3D. The measured and calculated DWBA differential cross sections of the different populated states will be presented as well as the obtained α-spectroscopic factors and the α-widths of the relevant states in ^{21}Ne. Finally, the ^{17}O(α,n)^{20}Ne and ^{17}O(α, γ)^{21}Ne reactions rates calculations and their corresponding uncertainties using our obtained α-widths and the most recent measured neutron widths [3] will be presented. Our rates favour the neutron recycling via ^{17}O(α,n)^{20}Ne reaction instead of losing them via ^{17}O(α, γ)^{21}Ne reaction and suggest an enhancement by a very large factor of the *s*-elements between Ba and Sr.

[1] U. Frischknecht, R. Hirschi et al., MNRAS 456, 1803 (2016), arXiv:1511.05730 [astro-ph.SR].

[2] F. Hammache, P. Adsley, L. Lamia et al., to be submitted soon

[3] J.Frost-Schenk, P. Adsley, A. M. Laird, R. Longland et al. submitted to MNRAS (private communication)

Primary author: Dr HAMMACHE, Faïrouz (IJCLab Orsay)

Presenter: Dr HAMMACHE, Faïrouz (IJCLab Orsay)

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