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Implications of $^{151}Sm(n,\gamma)$ Cross Section at n_TOF

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HTML ABSTRACT + LINKS

Implications of ^{151}Sm(n,γ) Cross Section at n_TOF

S. Marrone[13 a], U. Abbondanno[14], G. Aerts[7], H. Álvarez[24], F. Alvarez-Velarde[20], S. Andriamonje[7], J. Andrzejewski[33], P. Assimakopoulos[9], L. Audouin[5], G. Badurek[1], P. Baumann[6], F. Bečvář[31], E. Berthoumieux[7], F. Calviño[25], D. Cano-Ott[20], R. Capote[23], A. Carrillo de Albornoz[30], P. Cennini[4], V. Chepel1[7], E. Chiaveri[4], N. Colonna[13], G. Cortes[25], A. Couture[29], J. Cox[29], S. David[5], R. Dolfini[15], C. Domingo-Pardo[21], M. Dahlfors[4], W. Dridi[7], I. Duran[24], C. Eleftheriadis[10], M. Embid-Segura[20], L. Ferrant[5], A. Ferrari[4], R. Ferreira-Marques[17], L. Fitzpatrick[4], H. Frais-Koelb[13], K. Fujii[13], W. Furman[18], C. Guerrero[20], I. Goncalves[30], R. Gallino[36], E. Gonzalez-Romero[20], A .Goverdovski[19], F. Gramegna[12], E. Griesmayer[3], F. Gunsing[7], B. Haas[32], R. Haight[27], M. Heil[8], A. Herrera-Martinez[4], M. Igashira[37], S. Isaev[5], E. Jericha[1], Y. Kadi[4], F. Käppeler[8], D. Karamanis[9], D. Karadimos[9], M. Kerveno[6], V. Ketlerov[19], P. Koehler[28], V. Konovalov[18], E. Kossionides[39], M. Krtička[31], C. Lamboudis[10], H. Leeb[1], A. Lindote[17], I. Lopes[17], M. Lozano[23], S. Lukic[6], J. Marganiec[33], L. Marques[30], P. Mastinu[12], A. Mengoni[4], P. M. Milazzo[14], C. Moreau[14], M. Mosconi[8], F. Neves[17], H. Oberhummer[1], S. O'Brien[29], M. Oshima[38], J. Pancin[7], C. Papachristodoulou[9], C. T. Papadopoulos[40], C. Paradela[24], N. Patronis[9], A. Pavlik[2], P. Pavlopoulos[34], L. Perrot[7], R. Plag[8], A. Plompen[16], A. Plukis[7], A. Poch[25], C. Pretel[25], J. Quesada[23], T. Rauscher[26], R. Reifarth[27], M. Rosetti[11], C. Rubbia[15], G. Rudolf[6], P. Rullhusen[16], J. Salgado[30], L. Sarchiapone[4], I. Savvidis[10], C. Stephan[5], G. Tagliente[13], J. L. Tain[21], L. Tassan-Got[5], L. Tavora[30], R. Terlizzi[13], I. Dillmann[8], G. Vannini[35], P. Vaz[30], A. Ventura[11], D. Villamarin[20], M. C. Vincente[20], V. Vlachoudis[4], R. Vlastou[40], F. Voss[8], S. Walter[8], H. Wendler[4], M. Wiescher[29] and K. Wisshak[8]

[1]Atominstitut der Österreichischen Universitäten,Technische Universität Wien, Austria, [2]Institut für Isotopenforschung und Kernphysik, Universität Wien, Austria, [3]Fachhochschule Wiener Neustadt, W iener Neustadt, Austria, [4]CERN, Geneva, Switzerland, [5]Centre National de la R echerche Scientifique/IN2P3 - IPN, Orsay, France, [6]Centre National de la Recherche Scientifique/IN2P3 - IReS, Strasbourg, France, [7]CEA/Saclay - DSM, Gif-sur-Yvette, France, [8]Forschungszentrum Karlsruhe

[a] Corresponding author: e-mail: stefano.marrone@ba.infn.it .

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GmbH (FZK), Institut für Kernphysik, Germany, [9]University of Ioannina, Greece, [10]Aristotle University of Thessaloniki, Greece, [11]ENEA, Bologna, Italy, [12]Laboratori Nazionali di Legnaro, Italy, [13]Dipartimento di Fisica and INFN, Bari, Italy, [14]Istituto Nazionale di Fisica Nucleare, Trieste, Italy, [15]Università degli Studi Pavia, Pavia, Italy, [16]CEC-JRC-IRMM, Geel, Belgium, [17]LIP - Coimbra & Departamento de Fisica da Universidade de Coimbra, Portugal, [18]Joint Institute for Nuclear Research, Frank Laboratory of Neutron Physics, Dubna, Russia, [19]Institute of Physics and Power Engineering, Kaluga region, Obninsk, Russia, [20]Centro de Investigaciones Energeticas Medioambientales y Technologicas, Madrid, Spain, [21]Consejo Superior de Investigaciones Cientificas - University of Valencia, Spain, [22]Universidad Politecnica de Madrid, Spain, [23]Universidad de Sevilla, Spain, [24]Universidade de Santiago de Compostela, Spain, [25]Universitat Politecnica de Catalunya, Barcelona, Spain, [26]Department of Physics and Astronomy - University of Basel, Basel, Switzerland, [27]Los Alamos National Laboratory, New Mexico, USA, [28]Oak Ridge National Laboratory, Physics Division, Oak Ridge, USA, [29]University of Notre Dame, Notre Dame, USA, [30]Instituto Tecnológico e Nuclear, Lisbon, Portugal, [31]Charles University, Prague, Czech Republic, [32]Centre National de la Recherche Scientifique/IN2P3 - CENBG, Bordeaux, France, [33]University of Lodz, Lodz, Poland, [34]Pôle Universitaire Léonard de Vinci, Paris La Défense, France, [35]Dipartimento di Fisica, Università di Bologna, and Sezione INFN di Bologna, Italy, [36]Dipartimento di Fisica Generale, Università di Torino INFN di Torino, I-10125 Torino, Italy, [37]Tokyo Institute of Technology, Tokyo, Japan, [38]Japan Atomic Energy Research Institute, Tokai-mura, Japan, [39]NCSR, Athens, Greece, [40]National Technical University of Athens, Greece.

Abstract. The accurate knowledge of the ^{151}Sm(n,γ) cross section has important implications for the nuclear technologies as well as for fundamental studies. Due to its radioactivity, the only experimental data available on ^{151}Sm were derived from a transmission measurement [1]. Nowadays thanks to the innovative features of neutron time-of-flight facility (n_TOF), it was possible to measure ^{151}Sm(n,γ) cross section in a wide energy range and with good accuracy [2]. We present, here, the main experimental results together with the implications concerning the nuclear astrophysical part.

Keywords: ^{151}Sm, neutron capture, level density, neutron strength function, nucleosynthesis, s process

PACS: 25.40.Lw, 26.20.+f, 27.60.+j, 97.10.Cv

OUTLOOK

The ^{151}Sm(n,γ) cross section is recently measured at innovative neutron time-of-flight facility (n_TOF) set in operation at CERN. Due to its radioactivity, up to date, the only data available on this isotope were derived from a transmission measurement [1]. Nowadays thanks to the innovative features of n_TOF such as high neutron flux, long flight path and low background, it was possible to measure ^{151}Sm(n,γ) cross section in a wide energy range (0.6 eV-1 MeV) and with good accuracy (6%) [2]. Neutrons at n_TOF are produced by spallation of the PS proton beam onto a massive Pb target, while the γ-rays, from capture events, are detected with liquid organic scintillators (C6D6)-based detectors. A detailed description of the facility, of the experimental set-up and of the data analysis is reported in the reference [2].

In the resolved resonance region (0.6 eV-1 keV), the capture cross section is represented in terms of R-matrix resonance parameters. The systematical analysis of the resonances has indicated that the most part of the detected levels are s-wave. Using the resonance parameter values, we have calculated, with better accuracy than in the past [1] see Figure 1, the main nuclear quantities such as: average spacing $<D>_{l=0}$ = 1.48 ± 0.04 eV, the neutron strength function S_0 = (3.87 ± 0.2)×10–4, and the resonance integral RI = 3,575 ± 120 b. These results assume particular relevance for the nuclear technologies. In fact, 151Sm is produced abundantly during nuclear reactor operation and although its half-life (~ 93 yr) is relatively short, it is often included in advanced incineration schemes. Moreover, due to its position in between the neutron magic ^{144}Sm and the deformed rotators 154Sm isotopes, the study of the ^{152}Sm provides important information about the nuclear structures in this mass region.

In the unresolved resonance region (1 keV-1 MeV), the capture yield is used to calculate the capture cross section, see Figure 1, and to derive the Maxwellian-averaged cross section (MACS) which has been found much higher than the theoretical predictions. This result has a great relevance in nuclear astrophysics. In fact, the relative probability of two processes (beta decay and neutron capture) of the ^{151}Sm branching-isotope, strongly varies the s abundances of the isotopes in the Sm-Eu-Gd region and particularly of the ^{152}Gd [2].

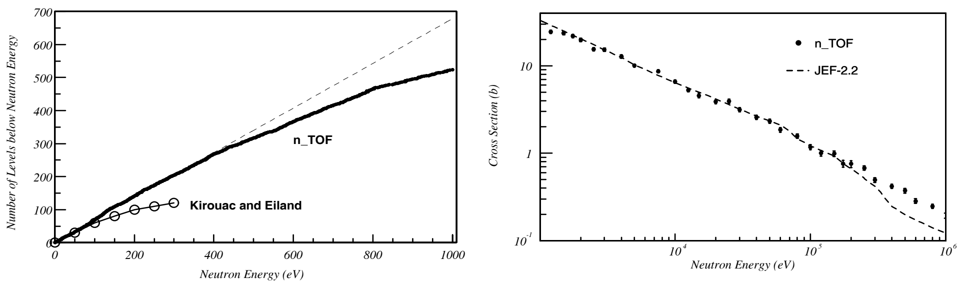

FIGURE 1. In left panel, the cumulative number of levels is represented together with previous experimental data (open circles [1]) and an interpolation of the new data (dashed line). Right panel illustrates the experimental ^{151}Sm(n,γ) cross section compared with JEF-2.2 evaluated data (dashed line).

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REFERENCES

1. G.J. Kirouac and H.M. Eiland, *Physical Review C*, **11**, 895 (1975).
2. U. Abbondanno *et al.*, *Physical Review Letters*, **63**, 161103 (2004).