

APPENDIX 1 - The funding application (to be completed in English)

B. Phase I – Short description of the research project and the scientific profile of the project leader

B1. Abstract of the project proposal (*maximum 2 pages*)

The deuteron-induced reactions at low and medium energies are of great importance for several on-going strategic research programmes at large-scale international level, as the [International Thermonuclear Experimental Reactor](#)¹ (ITER), the [International Fusion Material Irradiation Facility](#)² (IFMIF), related to the ITER fusion program, and the [Neutron For Science](#) (NFS) project at [SPIRAL-2](#) facility³. Thus, the [European Commission](#) (EC) domestic agency [Fusion for Energy](#)¹ (F4E) for ITER has assigned a top priority to the task of selecting and validating the best materials for constructing ITER, while IFMIF will use a deuteron beam from a particle accelerator to produce a large neutron flux for material studies. The NFS project involves deuteron beams too, being focused on both academic research and applied physics. However, there are significant discrepancies between the existing experimental data and even the latest version of the evaluated data library⁴ TENDL-2015 based on calculations with the widely-used computer code TALYS⁵. This is why a large attention has more recently paid to further measurements as well as to improved model calculations which should become finally able to describe the experimental data so that the deuteron data libraries³ may approach the standard of the current neutron libraries.

The high complexity of the deuteron-nucleus interaction due to the deuteron weak binding energy of 2.224 MeV is also related to a variety of reactions induced by the deuteron-breakup nucleons. Thus, specific noncompound processes as the breakup (BU) and direct reactions (DR) make the deuteron-induced reactions so different from reactions with other incident particles. Since the scarce consideration of only the pre-equilibrium emission (PE) and compound-nucleus (CN) mechanisms, as within TALYS, led to significant discrepancies with experimental results, recommended reaction cross sections of high-priority elements have mainly been obtained by fit of the data. This has been the reason hampering so far the comprehensive analysis involving large A-range of targets and incident-energy domain.

On the other hand, recent basic studies⁶ of deuteron-induced reactions around the Coulomb barrier pointed out that numerical calculations for these reactions are beyond current capabilities while their case might contain interesting physics. However, it was not paid the due attention to the specific noncompound processes which should be considered for the deuteron-induced reactions, i.e. the deuteron breakup which is also followed by various reactions induced by the BU nucleons. Thus, the IFIN-HH team has just shown⁷, in addition to previous basic studies⁸, that there is a significant difference between the larger CN contribution obtained from measured neutron angular

distributions, and decreased results of an unitary analysis of every deuteron-interaction mechanism due to the BU component. Moreover, it has been proved that use of the more realistic CN cross sections following the deuteron-interaction unitary and consistent analysis could improve the nuclear level densities which result from statistical neutron evaporation spectra⁶, as well as the results of the surrogate-reaction method⁸. It is worthwhile to note that the above-mentioned IFIN-HH team's results since 2011 were also supported by a grant of the Romanian National Authority for Scientific Research, CNCS – UEFISCDI, project number [PN-II-ID-PCE-2011-3-0450](#)⁹.

Overall, this proposal aims, in addition to the results of the above-mentioned UEFISCDI project⁹ coordinated by the present applicant, at further improvements of the theoretical description of deuteron interactions with nuclei that could be validated only by suitable description of experimental data. Thus, we plan to continue the series of recent studies^{10,11,12,13,14} looking for consistent inclusion of the deuteron BU contribution within activation cross-section calculations by using (i) consistent input parameters determined by analysis of various independent data, and (ii) systematic account of whole body of related data for isotope chains and/or nearby atomic elements.

¹ <https://www.iter.org/>, <http://fusionforenergy.europa.eu/>

² <http://www.ifmif.org/>

³ <http://pro.ganil-spiral2.eu/spiral2/instrumentation/nfs/lois/proton-and-deuteron-induced-activation-reactions/view>

⁴ A.J. Koning *et al.*, TENDL-2015, Dec. 2015, <http://www.talys.eu/TENDL-2015/>

⁵ A.J. Koning, S. Hilaire, and S. Goriely, v. TALYS-1.8, Jan. 2016; <http://www.talys.eu>

⁶ A.P.D. Ramirez *et al.*, Phys. Rev C **88**, 064324 (2013); Y. Byun *et al.*, *ibid.* **90**, 044303 (2014).

⁷ M. Avrigeanu and V. Avrigeanu, Phys. Rev. C **92**, 021601(R) (2015).

⁸ M. Avrigeanu and A. M. Moro, Phys. Rev. C **82**, 054605 (2010); M. Avrigeanu, V. Avrigeanu, and A.J. Koning, Phys. Rev. C **85**, 034603 (2012).

⁹ M. Avrigeanu, http://tandem.nipne.ro/~dante/projects/PN2P3_0450/index.html

¹⁰ M. Avrigeanu *et al.*, Fusion Eng. Design **84**, 418 (2009).

¹¹ P. Bem, E. Simeckova, M. Honusek, U. Fischer, S. P. Simakov, R.A. Forrest, M. Avrigeanu, A.C. Obreja, F.L. Roman, and V. Avrigeanu, Phys. Rev. C **79**, 044610(2009).

¹² E. Simeckova, P. Bem, M. Honusek, M. Stefanik, U. Fischer, S.P. Simakov, R.A. Forrest, A.J. Koning, J-C. Sublet, M. Avrigeanu, F.L. Roman, and V. Avrigeanu, Phys. Rev. C **84**, 014605(2011).

¹³ M. Avrigeanu, V. Avrigeanu, P. Bem, U. Fischer, M. Honusek, A.J. Koning, J. Mrazek, E. Simeckova, M. Stefanik, and L. Zavorka, Phys. Rev. C **88**, 014612 (2013).

¹⁴ M. Avrigeanu, V. Avrigeanu, P. Bem, U. Fischer, M. Honusek, K. Katovsky, C. Manailescu, J. Mrazek, E. Simeckova, and L. Zavorka, Phys. Rev. C **89**, 044613 (2014).

B2. Curriculum Vitae of the Project leader (*maximum 2 pages*)

Personal information: First name / Surname: Marilena Avrigeanu

Affiliation: [Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering \(IFIN-HH\)](#), 30 Reactorului, P.O. Box MG-6, 077125 Magurele, Ilfov, Romania.

Telephone number: +(4) 021 404 6125 **Mobile:** (+4) 0732 64 19 85

E-mail: marilena.avrigeanu@nipne.ro **URL:** <http://tandem.nipne.ro/~mavrig/>

Gender: Female **Date of birth:** 20/07/1949 **Nationality:** Romanian

Position within the project: leader

Work experience

From July 2000 – on: [Associate Professor](#), [Faculty of Physics](#), [Bucharest University](#); <http://www.fizica.unibuc.ro/Fizica/Studii/Doctorat/Docs/>. Activities: PhD lectures and theses conduction.

From Oct. 1999 – on: [Senior Researcher I](#), [Department of Nuclear Physics](#), IFIN-HH. Activities: Applied nuclear reaction model studies and development, nuclear data evaluation for fusion technology, [CEEX](#) & [NP-II](#) projects leadership, co-operation within [European Fusion Development Agreement](#) (EFDA) and [F4E](#) tasks.

From 1993 – to Sept. 1999: [Senior Researcher II](#), [Department of Nuclear Physics](#), IFIN-HH. Activities: applied nuclear model studies and nuclear data evaluation for nuclear fusion technology under Research Contracts (RC) with the [Nuclear Data Section/IAEA-Vienna](#)

From 1990 - to 1993: [Senior Researcher III](#), [Department of Nuclear Physics](#), [Institute for Physics and Nuclear Engineering \(IFIN\)](#), P.O. Box MG-6, 077125 Magurele, Ilfov, Romania. Activities: nuclear model analysis, input parameter systematics, nuclear data evaluation under RCs with the [Nuclear Data Section/IAEA-Vienna](#).

From 1977 - to 1990: Scientific Researcher, [Department of Applied Nuclear Physics](#), IFIN. Activities: applied nuclear model studies and fast-neutron induced nuclear data evaluation under RCs with the [Nuclear Data Section/IAEA-Vienna](#).

From 1975 - to 1977: Physicist, Cyclotron Laboratory, [Institute of Atomic Physics](#) (IFA), P.O. Box MG-6, 077125 Magurele, Ilfov, Romania. Activities: nuclear spectroscopy in Heavy-Ion induced reactions at the Institute of Atomic Physics Cyclotron U-120 and Van de Graaff Tandem accelerators.

From 1972 - to 1975: Physicist, Centrul de Pregatire si Specializare a Cadrelor în Domeniul Nuclear (CPSCDN, 1970-1990; presently: [Centrul de Pregatire si Specializare în Domeniul](#)

[Nuclear – CPSDN/IFIN-HH](#)), P.O. Box MG-6, 077125 Magurele, Ilfov, Romania. Activities:
Post-graduate courses Lecturer.

Education and Training

From 1976 - to 1982: Doctoral program, [Institute for Physics and Nuclear Engineering](#) Bucharest-Magurele, Romania. Ph.D (Physics) degree awarded on 12 August 1983. Principal subjects: nuclear spectroscopy and reaction mechanisms studies.

From 1967 – to 1972: Physics license at Bucharest University, Physics Department. Licensed in physics (Bachelor of Science). Principal subjects: general and atomic physics basic principles and applications; nuclear reactor physics and nuclear reaction research.

Personal skills and competences

Mother tongue(s): Romanian

Other language(s): English, French

Self-assessment	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
French	A1	A1	A1	A1	A1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user

* [Common European Framework of Reference for Languages](#)

Communication skills: Team spirit, gained through my work experience within advanced research groups; good communication skills gained through my experience as lecturer and PhD theses conductor.

Organisational skills: Good experience in team and project management; leadership of scientific research international cooperation and management of training and documentation.

Computer skills: Good command of Microsoft Office tools and graphic design applications (Origin™).

Scientometrics indicators according to Web of Science: Hirsch index: 18

List of publications: <http://www.nipne.ro/research/publications/27-publications.html>
<http://www.researcherid.com/rid/B-6068-2011>

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B3. The list of maximum 5 representative publications of the project leader, within last 10 years (2006 – present).

1. M. Avrigeanu^{*} and V. Avrigeanu, *Role of breakup and direct processes in deuteron-induced reactions at low energies*, [Phys. Rev. C **92**, 021601 \(R\) \(2015\)](#). [A[§], Q1[¶]]
2. M. Avrigeanu^{*}, V. Avrigeanu, P. Bem, U. Fischer, M. Honusek, K. Katovsky, C. Manailescu, J. Mrazek, E. Simeckova, and L. Zavorka, *Low energy deuteron-induced reactions on Fe isotopes*, [Phys. Rev. C **89**, 044613 \(2014\)](#). [A[§], Q1[¶]]
3. M. Avrigeanu^{*}, V. Avrigeanu, P. Bem, U. Fischer, M. Honusek, A.J. Koning, J. Mrazek, E. Simeckova, M. Stefanik, and L. Zavorka, *Low energy deuteron-induced reactions on ⁹³Nb*, [Phys. Rev. C **88**, 014612 \(2013\)](#). [A[§], Q1[¶]]
4. M. Avrigeanu^{*}, V. Avrigeanu, and A.J. Koning, *Investigation of deuteron breakup and deuteron-induced fission on actinide nuclei at low incident energies*, [Phys. Rev. C **85**, 034603 \(2012\)](#). [A[§], Q1[¶]]
5. M. Avrigeanu^{*} and A.M. Moro, *Improved deuteron elastic breakup energy dependence via the continuum-discretized coupled-channels method*, [Phys. Rev. C **82**, 037601 \(2010\)](#). [A[§], Q1[¶]]

* Corresponding author

[§]Article (WoS)

[¶]AIS-Q1 (WoS)