

## **C. Phase II – The scientific profile of the project leader**

### **C1. Significant and representative scientific achievements (maximum 2 pages)**

The most important contributions of the project leader in his research field in the latest 10 years (2006-2016), as findings or results that have led significantly to a better knowledge in the field of **nuclear-data evaluation**, followed the experience and results obtained within two previous distinct time periods of the applicant, as (i) experimental work in direct reactions and gamma-ray spectroscopy in heavy-ion reactions at Cyclotron and Tandem accelerators of IFA-Bucharest (1970-1977), and (ii) nuclear-model analysis for evaluation of neutron induced reactions at [IFIN-HH](#), also under research contracts with [NDS/IAEA](#) and [Euratom-EFDA](#) since 1980 and 2000, respectively. Thus, while the experimental work provided useful experience for the nuclear-data evaluation work, there were several former publications (e.g., Refs.<sup>1,2,3,4,5</sup>) and projects conducted<sup>6,7</sup> which provided a sound base for the latest period of 10 years which is concerned below.

#### **(1) Relation of project leader's most important contributions to the topic of this project**

The topic of this project proposal – deuteron-induced reactions at low and medium energies – became the object of the applicant's work since 2004, under the particular [Euratom-EFDA](#) pointing out of the corresponding need for the ITER/IFMIF objectives. Since until then the applicant was involved within the [Euratom-EFDA](#) program with respect to the fusion-neutron activation assessment by the same [IFIN-HH group of nuclear-data evaluation](#), the applicant has been able to apply also in this respect nuclear-theory methods proved formerly successful (e.g., Refs.<sup>1-5</sup>). However, beyond the completion of several studies already initiated at that time (e.g. Refs. C2.1.9-10, C2.2.1, C2.4.3, C2.5.4), the high complexity of the deuteron-nucleus interactions made vital her focusing on this subject. Thus, her main contributions in the latest seven years concern only this topic, with the positive consideration of the corresponding results (Refs. C2.1.1-8, C2.4.1-2, C2.4.4-11) within valuable large-scale projects (C2.5.1-3, C2.5.5) as well as proving suitable the powerful support received at the national level (C2.5.6-7). Moreover, due consideration of these results led to the inclusion of the particular formalism developed at IFIN-HH within the latest version of the computer code [TALYS-1.8](#)<sup>8</sup> which is presently world-wide used for nuclear-data evaluation.

#### **(2) Reflecting of project leader's most important contributions in its main publications**

The above-mentioned contributions of the project leader form the object - as the corresponding author – of the publications given within this funding application as:

- Refs. C2.1.1-8, and
- Refs. C2.4.1-2, C2.4.4-11.

### (3) Illustration of applicant's independent activity and its international visibility

While most of the references either given in Sec. C2 or cited in Sec. D of the present funding application are results of the cooperation of 2-9 co-workers, the independent research activity of the applicant is illustrated actually by

- (i) the attribute of corresponding author for all Refs. C2.1.1-10, including larger authors' lists of whom the applicant has been the only one from its own department,
- (ii) invited lecturer (C2.4.5-6, C2.4.10)
- (iii) oral presentations of all other presentations given in Sec. C2.4, and
- (iv) the research projects C2.5.1-7 initiated and conducted in addition to Refs.<sup>5,6</sup>.

The international visibility is shown in addition to the above items (ii)-(iii) by the following issues:

- [Senior Associate, The Abdus Salam International Centre for Theoretical Physics \(ICTP\), Trieste, Italy \(2002 – 2007\),](#)
- [Liaison officer](#) between [IFIN-HH](#) and [OECD/NEA-Data Bank](#), Paris, since 1992, on the basis of own contributions to OECD/NEA Data Bank (Paris), making thus possible **the IFIN access** to the full NEA-DB computer code collection (25 code packages requested/obtained from NEA-DB for whole IFIN between 1992-1998) in various IFIN-HH areas,
- inclusion of the results of Ref. C2.1.9 within the former version of the largest actual data basis for nuclear-data evaluation [RIPL-3](#) (<http://www-nds.iaea.org/RIPL-3/>),
- inclusion of the results of Ref. C2.4.11, under the [F4E-FPA-168](#) (2011-2016) request, among the options of the latest version (January 2016) of the widely-used computer code [TALYS-1.8](#),
- inclusion of the results of Ref. C2.1.2-6, under the [F4E-FPA-168](#) (2011-2016) request, within a version of TALYS-1.8 provided to the TALYS team for coming update.

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<sup>1</sup> [M. Avrigeanu\\*](#) *et al.*, Z. Phys. A **329**, 177 (1988); *ibid.* **335**, 299 (1990).

<sup>2</sup> [M. Avrigeanu\\*](#), P.E. Hodgson, and A.J. Koning, J. Phys. G **19**, 745 (1993).

<sup>3</sup> [M. Avrigeanu\\*](#) *et al.*, Phys. Rev. C **54**, 2538 (1996); *ibid.* **56**, 1633 (1997); *ibid.* **58**, 295 (1998).

<sup>4</sup> [M. Avrigeanu\\*](#) and V. Avrigeanu, Comp. Phys. Comm. **112**, 191 (1998); [NDS/IAEA](#)-Vienna, [RIPL-1](#), <http://www-nds.iaea.or.at/ripl/optical/recommended/>

<sup>5</sup> [M. Avrigeanu\\*](#) *et al.*, Nucl. Phys. A **693**, 616 (2001); *ibid.* **723**, 104 (2003), *ibid.* **764**, 246 (2006).

<sup>6</sup> *Calculations of fast neutron cross sections for structural materials*, [IAEA](#) Research Contract Nos. **2983,3802/R0-R4,7408,8886/R0-R1,12422/R0-R2** (1982,1985-'9,1993,1995,2002-'5; 51kUSD).

<sup>7</sup> *Evaluation and validation of D-Li cross-section data*, [EFDA](#) **TW4-TTMI-003/D4** (2004, 40 k€).

<sup>8</sup> <http://www.talys.eu/fileadmin/talys/user/docs/talys1.8.pdf>

## C2. Defining elements of the outstanding scientific achievements of the project leader in the last 10 years, 2006 – present (maximum 3 pages)

### 1. Articles

- 1.1. 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<sup>§</sup>, Q1<sup>¶</sup>]
- 1.2. 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<sup>§</sup>, Q1<sup>¶</sup>]
- 1.3. M. Avrigeanu\* and V. Avrigeanu, *Consistent analysis of the nuclear reaction mechanisms involved in the deuteron-induced activations at low and medium energies*, [Nucl. Data Sheets \*\*118\*\*, 301 \(2014\)](#). [A<sup>§</sup>, Q1<sup>¶</sup>]
- 1.4. 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 <sup>93</sup>Nb*, [Phys. Rev. C \*\*88\*\*, 014612 \(2013\)](#). [A<sup>§</sup>, Q1<sup>¶</sup>]
- 1.5. 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<sup>§</sup>, Q1<sup>¶</sup>]
- 1.6. 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, *Low and medium energy deuteron-induced reactions on <sup>63,65</sup>Cu nuclei*, [Phys. Rev. C \*\*84\*\*, 014605 \(2011\)](#). [A<sup>§</sup>, Q1<sup>¶</sup>]
- 1.7. 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<sup>§</sup>, Q1<sup>¶</sup>]
- 1.8. 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, *Low and medium energy deuteron-induced reactions on <sup>27</sup>Al*, [Phys. Rev. C \*\*79\*\*, 044610 \(2009\)](#). [A<sup>§</sup>, Q1<sup>¶</sup>]
- 1.9. M. Avrigeanu\*, W. von Oertzen, R.A. Forrest, A. Obreja, F.L. Roman, and V. Avrig-eanu, *Complementary optical-potential analysis of  $\alpha$ -particle elastic scattering and induced reactions at low energies*, [At. Data Nucl. Data Tables \*\*95\*\*, 501 \(2009\)](#). [R, Q2]
- 1.10. M. Avrigeanu\* and V. Avrigeanu, *Addendum to "Elastic  $\alpha$ -scattering on <sup>112</sup>Sn and <sup>124</sup>Sn at astrophysically relevant energies"*, [Phys. Rev. C \*\*73\*\*, 038801 \(2006\)](#). [A, Q1]

### 2. Books/ chapters (including monographs):

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\* Corresponding author

§ Article/Review (WoS)

¶ AIS-Q1/Q2 (WoS)

2.1. R. Capote\*, M. Herman, P. Oblozinsky, P.G. Young, S. Goriely, T. Belgya, A.V. Ignatyuk, A.J. Koning, S. Hilaire, V.A. Plujko, M. Avrigeanu, O. Bersillon, M.B. Chadwick, T. Fukahori, Zhigang Ge, Yinlu Han, S. Kailas, J. Kopecky, V.M. Maslov, G. Reffo, M. Sin, E.Sh. Soukhovitskii, and P. Talou, *R IPL - Reference Input Parameter Library for Calculation of Nuclear Reactions and Nuclear Data Evaluations*, [Nucl. Data Sheets \*\*110\*\* \(2009\) 3107-3214](#). [A<sup>§</sup>, Q1<sup>¶</sup>]

### 3. Patents

### 4. Scientific presentations

4.1. M. Avrigeanu\* and V. Avrigeanu, *Role of the direct mechanisms in the deuteron-induced surrogate reactions*, Proc. **14th** Int. Conf. on **Nuclear Reaction Mechanisms**, 15 - 19 June **2015**, **Varenna**, Italy, CERN-Proceedings-2015-001, p.203.

4.2. M. Avrigeanu\* and V. Avrigeanu, *Consistent analysis of all-inclusive deuteron-induced reactions at low energies*, Proc. **13th** Int. Conf. on **Nuclear Reaction Mechanisms**, 11-15 June **2012**, **Varenna**, Italy, CERN-Proceedings-2012-002, p.187.

4.3. M. Avrigeanu\*, W. von Oertzen, A.C. Obreja, F.L. Roman, and V. Avrigeanu, *Optical potentials for alpha particles on heavy nuclei around the Coulomb barrier*, Proc. **12th** Int. Conf. on **Nuclear Reaction Mechanisms**, 15-19 June **2009**, **Varenna**, Italy, CERN-Proceedings-2010-001-V-1 (CERN, Geneva, 2010), p. 159.

4.4. M. Avrigeanu\*, H. Leeb, W. Von Oertzen, F.L. Roman and V. Avrigeanu, *Deuteron and  $\alpha$ -particle semi-microscopic optical potential*, Proc. **11th** Int. Conf. on **Nuclear Reaction Mechanisms**, June 12-16, **2006**, **Varenna**, Italy, edited by E. Gadioli (Ricerca Scientifica ed Educazione Permanente), Suppl. 126, Milano, 2006, p. 123.

4.5. M. Avrigeanu\* and V. Avrigeanu, *On deuteron interactions within surrogate reactions and nuclear level density studies*, XXI Int. School on Nuclear Physics, Neutron Physics and Applications, 6-12 Sept. 2015, Varna, Bulgaria.

4.6. M. Avrigeanu\* and V. Avrigeanu, *Direct processes effects on deuteron activation cross sections*, XX Int. School on Nuclear Physics, Neutron Physics and Applications, 16-22 Sept. 2013, Varna, Bulgaria; [J. Phys. Conf. Ser. \*\*533\*\*, 012004 \(2014\)](#).

4.7. M. Avrigeanu\*, V. Avrigeanu, and C. Manailescu, *On reaction mechanism involved in the deuteron-induced surrogate reactions on actinides*, Carpathian Summer School of Physics 2014: Exotic Nuclei and Nuclear/Particle Astrophysics (V), 13-26 July, 2014, Sinaia, Romania; [AIP Conf. Proc. \*\*1645\*\*, 139 \(2015\)](#).

4.8. M. Avrigeanu\*, V. Avrigeanu and F.L. Roman, *Deuteron-induced reaction mechanisms at low energies*, Third Int. Workshop on Compound Nuclear Reactions and Related Topics

(CNR\*11), 19-23 Sept. 2011, Prague, Czech Republic; [EPJ Web of Conf. 21, 07003 \(2012\)](#).

4.9. [M. Avrigeanu\\*](#) and V. Avrigeanu, *Assessment of deuteron-induced reaction mechanisms at low and medium energies*, 2nd Int. Workshop on Compound Nuclear Reactions and Related Topics (CNR\*09), 5-8 October 2009, Bordeaux; [EPJ Web of Conf. 2, 01004 \(2010\)](#).

4.10. [M. Avrigeanu\\*](#) and V. Avrigeanu, *Deuteron breakup effects on activation cross sections at low and medium energies*, XVIII Int. School on Nuclear Physics, Neutron Physics and Applications, 16-22 Sept. 2013, Varna, Bulgaria; [J. Phys. Conf. Ser. 205, 012014 \(2010\)](#).

4.11. [M. Avrigeanu\\*](#), W. von Oertzen, R.A. Forrest, A. Obreja, F.L. Roman, and V. Avrigeanu, *Analysis of deuteron elastic scattering and induced activation on light and medium nuclei for IFMIF EVEDA*, 25th Symp. on **Fusion Technology** (SOFT-2008), 15-19 Sept. 2008, Rostock, Germany; [Fusion Eng. Des. 84, 418 \(2009\)](#). [A<sup>§</sup>, Q2<sup>¶</sup>]

5. Research projects (where the project leader was coordinator or IFIN-HH responsible)

5.1. [F4E-GRT-168.02](#) Tasks 5.1/8.2 (Ctr. F4E-RO-1F4E), *Deuteron break-up models in TALYS code/Ni deuteron cross-section data evaluation*, 2014-2016 (40 k€); Results/Acknowledgments ([R/A](#)): Refs. [C2.1.1, C2.4.1, C2.4.7], MS PRC Jun2016.

5.2. [F4E-GRT-168.01](#) Task 5, (Ctr. F4E-RO-13-02), *Development of alpha-particle optical model potential / Analysis of deuteron activation cross sections for major EUROFER constituents*, 2012-2014 (55 k€); [R/A](#): [C2.1.2-4, C2.4.6].

5.3. [NDS/IAEA-Vienna \(FENDL\)](#) Research Agreement No. **14996**, *Theoretical Modeling of Deuteron Elastic Scattering and Induced Activation on Light and medium Nuclei for IFMIF EVEDA*, 2008-2011 (~5k€); [R/A](#): [C2.4.11].

5.4. [NDS/IAEA-Vienna \(RIPL3\)](#) Research Contract No. **12422**, *Microscopic optical potential for alpha-particles at low energies*, 2003-2007 (15 kUSD); [R/A](#): [C2.1.10, C2.2.1, C2.4.2].

5.5. [Association EURATOM/MEdC](#) Task TW5-TTMI-004/D6, *IFMIF Design Integration. Deuteron-induced activation cross-section evaluation for accelerator materials (Cu, Al, Nb)*, 2006 (50 k€); [R/A](#): [C2.1.6, C2.1.10, C2.4.4, C2.4.10].

5.6. [UEFISCDI PN-II-ID-PCE-2011-3-0450](#), *Deuteron-induced reactions at low and medium energies: Consistent direct and statistical model analyses*, 2011-2016 (1.5 Mlei); [C2.1.1-5, C2.4.1-2,6-7], [Phys. Rev. C 85, 044618 \(2012\)](#), MS PRC.

5.7. [UEFISCDI PN-II-ID-PCE-2007-1-885](#), *Setting up the temperature dependence of the nuclear matter density in nuclei*, 2007-2010 (1 Mlei); [R/A](#): [C2.1.8, C2.4.10-11], [Phys. Rev. C 79, 027601 \(2010\)](#), *ibid.* **81**, 038801 (2010), *ibid.* **82**, 014606 (2010).