

RAPORT FINAL DE ACTIVITATE

Denumirea proiectului	Participarea Romaniei la EUROfusion WPBB si cercetari complementare (Romanian participation at EUROfusion WPBB and complementary research) / WPBB2-RO https://www.nipne.ro/proiecte/pn3/57-projects.html
Numar de contract	EU-01/ 03.01.2022
Conducator de proiect	Institutul Național de Cercetare Dezvoltare pentru Fizică și Inginerie Nucleară „Horia Hulubei”
Perioada raportata	Ianuarie 2022 – Septembrie 2024
Numar total de pagini	

*Numarul raportului intermediar va coincide cu nr. etapei/fazei de executie. Nu se atribuie niciun numar raportului final.

Raportul conține: Secțiunea 1 – **Raport științific final** (La predare, Raportul se prezinta și pe suport electronic.)

Subsemnatul Dr. MĂRGINEAN Nicolae Marius, in calitate de reprezentant legal autorizat al Insittutului Național de Cercetare Dezvoltare pentru Fizică și Inginerie Nucleară „Horia Hulubei”, declar, pe proprie raspundere, ca datele furnizate prin prezentul Raport de activitate sunt reale si ca toate cheltuielile s-au efectuat in mod exclusiv pentru realizarea si in conformitate cu prevederile contractului Nr. EU-01/ 03.01.2022 finantat prin PN III/Programul 5/Subprogramul 5.2/Modulul EURATOM-RO Fuziune

Reprezentant legal al Conducatorului de proiect,
Director General,

Dr. MĂRGINEAN Nicolae Marius

Director Proiect,

Dr. AVRIGEANU Vlad

Director Economic,

Ec. POPESCU Ion Alexandru

Data 24.10.2024

RAPORT ȘTIINȚIFIC FINAL

Raportul științific final va cuprinde următoarele documente:

1. Rezumat publicabil în limbile română și engleză (maxim 3 pagini) din care să rezulte principalele rezultate, activități, gradul de noutate și impactul preconizat asupra mediului științific, tehnic, economic, social și didactic;
2. Indicatori de realizare finală, conform modelului din Anexa 1.B – reprezintă suma tuturor indicatorilor din rapoartele intermediare;
3. Protocol de finalizare a proiectului, conform modelului din Anexa 1.D.

REZUMAT

(RO) Evaluarea datelor nucleare ale reactiilor induse de deuteroni sau pentru emisia de particule alfa precum si stadiul si aspectele de interes actual ale acestor subiecte din domeniul datelor nucleare pentru tehnologiile fuziunii nucleare impuse de proiectele ITER, DEMO, si IFMIF-DONES. Astel, fata de cercetarile corelate cu fisiunea nucleara, exista o necesitate majora pentru sectiuni eficiente precise ale reactiilor induse de neutroni si deuteroni intr-un domeniu extins de energii incidente de pana la 50 MeV. Cerintele actuale sunt indeplinite in cadrul "TALYS-base Evaluated Nuclear Data Library (TENDL)" realizata pe baza folosirii extinse a codului TALYS atat pentru cercetari fundamentale cat si pentru aplicatiile incluzand tehnologiile ale fuziunii nucleare. Cu toate acestea, dezvoltari ulterioare ale acestei biblioteci de date au fost conectate recent nu numai cu domeniul energetic mentionat mai sus dar si cu varietatea mai mare a datelor nucleare necesare pentru tehnologiile nucleare, fata de domeniul aplicatiilor fisiunii nucleare. In consecinta, evaluarea de date nucleare corelate mai recent cu reactiile induse de deuteroni si emisia de particule alfa in reactiile induse de neutroni, in cadrul "European Fusion Program", in continuarea realizarii programelor F4E si EUROfusion, este realizata in particular pentru deuteroni incidenti pe ^{93}Zr si izotopii stabili ai Mo [1,6,8] precum si evaluarea emisiei alfa indusa de neutroni rapizi pe nuclee cu $54 \leq A \leq 99$ [2,3-5,7,9].

Rolul major al seturilor consistente de parametri de model pentru rezultatele analizelor reactiilor induse de deuteroni [10,12,13] si de emisie a particulelor alfa [11,14], vizand posibila diferenta intre reactiile directe ale deuteronilor precum si intre potentialele de model optic (OMPs) ce descriu fie imprastierea elastica si reactiile induse de particulele alfa, fie emisia acestora din nucleele excitate in reactii nucleare, a fost de asemenea evidentiat. Utilizarea acestora este opusa implicarii oricaror factori empirici de scalare ale largimilor de stari nucleare pentru emisia gama si/sau de neutroni, sau combinatiilor tuturor optiunilor posibile pentru principalii parametri de model ale unui cod de calcul. Descrierea corespunzatoare a tuturor canalelor de reactie in competitie cu emisia alfa, confirmata printr-o analiza detaliata a incertitudinilor asociate, pentru a evita compensarea ambiguitatilor de model si/sau a erorilor diferitilor parametri, permite in final si luarea corecta in considerare a unor procese nucleare directe suplimentare. Rezultatele publicate [1-14] au fost initial prezentate in cadrul EUROfusion WPBB-S.05.02-T001/4/7 Monitoring Meetings [15-26].

(EN) The nuclear data evaluation for deuteron-induced reactions and α -particle emission by neutron interactions as well as the status and open questions related to these subjects are of real interest in the area of nuclear data for fusion technology, specifically for the nuclear design of the ITER fusion device, the European DEMO fusion reactor, and the IFMIF-DONES Irradiation Facility, are briefly reviewed. A firm demand for accurate cross-sections of reactions induced by neutrons and deuterons exists, in this respect, within a more enlarged energy range up to 50 MeV than for fission applications. The current requirements are closely met by the TENDL Evaluated Nuclear Data Library, settled using the TALYS nuclear model code, which is one of the most widely used codes in basic research and applications including nuclear fusion technology. However, further improvement of this data library has recently been suggested, while, with respect to fission applications, not only the aforementioned energy range but also the diversity of nuclear data for fusion technologies is plainly stretched.

Consequently, nuclear data evaluation related more recently on deuteron-induced reactions and α -emission by neutron interactions, throughout the European Fusion Program and subsequent to previous achievements within F4E and EUROfusion programs, is particularly carried on for deuterons incident on ^{93}Zr and Mo stable isotopes [1,6,8] as well as alpha-particle emission in neutron-induced reactions on $54 \leq A \leq 99$ nuclei [2,3-5,7,9].

The major role of consistent parameter sets within analysis of deuteron-induced reactions [10,12,13] and neutron-induced alpha-particle emission [11,14], for the assessment of a possible difference between deuteron direct interactions as well as the optical model potentials (OMPs) which describe either alpha-particle elastic scattering and induced reactions or alpha-emission from excited compound nuclei, is shown. They are involved at variance with use of either empirical rescaling factors of the gamma and/or neutron widths or even combinations of all options of a computer code for main input parameters. Suitable description of all competitive reaction channels, confirmed by a careful uncertainty analysis in order to avoid parameter ambiguities and/or error compensation, support further consideration of additional direct processes. All results already published [1-14] have formerly been presented in the EUROfusion WPBB-S.05.02-T001/4/7 Monitoring Meetings [15-26].

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ANEXA 1.B Indicatori de realizare finala

Tip indicator	Numar	Scurta descriere (daca este cazul)
Numar de articole stiintifice in reviste si volume indexate ISI	14	Phys. Lett. B 858 , 139078 (2024) Journal of Fusion Energy 43 , 15 (2024) Eur. Phys. J. A 58 , 3 (2022); <i>ibid.</i> 58 , 189(2022) Phys. Rev. C 106 , 024615 (2022), <i>ibid</i> 107 , 034613 (2023) Front. Phys. 11 , 1142436 (2023); <i>ibid.</i> 11 :1172697 (2023); <i>ibid.</i> 12 , 1247311 (2023) EPJ Web of Conf. 284 , 03006 (2023); <i>ibid.</i> 284 , 03007 (2023); <i>ibid.</i> 292 , 06001 (2024); (submitted, Oct. 2024): 2
Numar de articole stiintifice în reviste indexate în alte baze de date internaționale recunoscute	12	Reports NEA/DB JEFF: EFFDOC-1472, -1473, Apr.2022; JEFDOC-2137, -2138, Apr.2022; EFFDOC-1487, -1488, Nov.2022; EFFDOC-1503, -1504, Apr.2023; EFFDOC-1518, -1519, Nov.2023; EFFDOC-1538, -1539, Apr.2024
Numar articole publicate in top 10% cele mai citate publicatii	2	[top 25%: ISI/WoS/Q1]
Numar de brevete obtinute la nivel national si international		
Numar de brevete in curs de obtinere la nivel national si international		
Numar de tehnologii elaborate/transferate in urma Colaborarii la EUROfusion		
Numar de modele experimentale/prototitpuri		
Numarul de posturi de cercetatori echivalent norma intreaga (ENI) sustinute *	3.58	
Numarul de cercetatori cu doctorat sustinuti *	2	
Numarul de ingineri sustinuti *	1	
Numarul de tehnicieni sustinuti *		
Numarul personalului economic/administrativ sustinut *	1	
Numarul de doctoranzi sustinuti *		
Numar de masteranzi sustinuti *		
Numarul de participari la experimente EUROfusion efectuate*		
Numar de conferinte organizate*		
Numar de participari la Conferinte Internationale*	6	
Numar de prezentari la Conferinte Internationale	6	
Numar de postere prezentate la Conferinte Internationale*		
Numar de participanti la Workshopuri*	2	
Numar de prezentari orale la Workshopuri	8	
Numar de postere prezentate la Workshopuri		
Numărul participanților la întruniri de proiect în cadrul contractelor EUROfusion	12	
Numarul de proiecte Orizont 2020 (inclusiv cele ale partenerilor daca este cazul)		
Numarul de evenimente de comunicare si popularizare a stiintei sustinute*		
Numar de cursuri de instruire sau perfectionare realizate		
Altele (specificati)		

*) din Fondurile Programului

Director de proiect,
Dr. AVRIGEANU Vlad