

Progress Report 2015-2016

NRDC Meeting, June 7-10, 2016, Peking, China

NUCLEAR REACTION DATA GROUP at ATOMKI
(S. Takács)

General

The main task of the Atomki Nuclear Reaction Data Group is systematic investigation of the excitation functions of light charged particle induced nuclear reactions on series of target materials. This experimental work covers measurement of cross section data and/or reaction yield for the nuclear reactions induced by protons, deuterons and helium particles ^3He , ^4He . Besides measuring new activation cross section data compilation and evaluation of the available experimental data of the actual investigated reactions also considered. Some of the experimentally determined or evaluated cross section data are directly applied in isotope production, in Thin Layer Activation (TLA) investigations or in other applications in our laboratory. The measurements are done as part of an extensive international collaboration. Our partners in 2015 and 2016 were:

- VUB Cyclotron laboratory, Brussels, Belgium,
- Nishina Center for Accelerator-Based Science, RIKEN, Wako, Saitama, Japan,
- Faculty of Science, Hokkaido University, Sapporo, Japan,
- Molecular Imaging Center, NIRS, Chiba, Japan
- Forschungszentrum Jülich Germany,
- Cyclotron Facility, Nuclear Research Centre, Atomic Energy Authority, Cairo, Egypt,
- Institute of Physics and Power Engineering (IPPE), Obninsk, Russia.

The experimental activation cross section data were measured for proton beams up to 65 MeV, deuteron beams up to 50 MeV, alpha particle beams up to 50 MeV and ^3He particles up to 28 MeV. Data compilation and data evaluation are mainly connected to running international projects. Systematic investigations of excitation functions of charged particle induced nuclear reactions needed for optimizing production routes of radioisotopes for use in diagnostic and radiotherapy treatments are continued during the last period. Irradiations are performed in the frame of different collaborations at cyclotrons of Atomki, Hungary, VUB and LLN, Belgium and RIKEN, Japan.

Staff

The number of permanent staff members of the Atomki Nuclear Reaction Data Group is decreasing. The group consists of physicists, radio-chemist and technical staff. Since 2016 there are four experimental physicists working on cross section measurements of mainly charged particle induced reactions and in minor part also on neutron induced reactions. The only radio chemist is working on separation of reaction products, target preparation and isotope production. The group consists of four physicist, one radiochemist and 3 technical staff members.

Data compilations and evaluation

The newly measured data are compiled in EXFOR database. Our responsibility to compile experimental data of charged particle induced nuclear reactions reported from Debrecen, Brussels and Jülich. Due to lack of manpower effective EXFOR compilation work is done only by one physicist. Although all the published experimental works are compiled in EXFOR from our responsibility area, there is sometimes delay in the compilation work. Since January 2015 a PhD student joined to the EXFOR compilation work on voluntary base.

In 2015 a total of 27 papers in 2016 a total of 22 papers were compiled in EXFOR.

Beside data measurements compilation and evaluation of earlier measured data are also performed for selected nuclear reactions. Results of these compilation works are part of larger international projects (CRP) and/or published in international scientific journals.

EXFOR statistics: compiled in 2016

Number of new entries:	22
Number of subentries with new data:	181
Number of data lines:	3819

Participations in CRPs

- Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production (2012–2016)
- Therapeutic Radiopharmaceuticals Labeled with New Emerging Radionuclides (^{67}Cu , ^{186}Re , ^{47}Sc), (2016-2019)

Publications in 2016

Papers published in 2016 containing experimental cross section data measured on different target materials bombarded by proton, deuteron, helium-3 and/or alpha particles are listed here and are compiled in EXFOR database.

1. Ali B. M., Al-Abyad M., Seddik U., El-Kameesy S. U., Ditrói F., Takács S., Tárkányi F.: *Experimental investigation and theoretical calculation for ^3He induced nuclear reactions on vanadium*. NIM/B 373 (2016)76
2. Amjed N, Hussain M., Aslam M. N., Tárkányi F., Qaim S. M.: *Evaluation of nuclear reaction cross sections for optimization of production of the emerging diagnostic radionuclide ^{55}Co* . ARI 108 (2016)38-48.
3. Ditrói F., Tárkányi F., Takács S., Hermanne A.: *Activation cross sections of proton induced nuclear reactions on gold up to 65 MeV*. ARI 113 (2016)96

4. Ditrói F., Tárkányi F., Takács S., Hermanne A., Ignatyuk A. V.: *Activation cross sections of deuteron induced reactions on niobium in the 30-50 MeV energy range.* NIM/B 373 (2016)17-27
5. Hermanne A., Tárkányi F., Takács S., Ditrói F., Szûcs Z. : *Activation cross sections of deuteron-induced nuclear reactions on mercury up to 50 MeV.* JRN 308 (2016)221
6. Hermanne A., Tárkányi F., Takács S., Ditrói F., Szûcs Z., Brezovcsik K. : *Experimental cross-sections for proton induced nuclear reactions on mercury up to 65 MeV.* NIM/B 378 (2016)12
7. Tárkányi F., Ditrói F., Hermanne A., Takács S., Baba M.: *Investigation of activation cross sections of proton induced reactions on indium up to 70 MeV for practical applications.* ARI 107 (2016)391-400.
8. Tárkányi F., Ditrói F., Takács S., Hermanne A., Baba M., Ignatyuk A. V.: *Excitation functions for (d,x) reactions on ^{133}Cs up to $E_d=40$ MeV.* ARI 110 (2016)1:109-117.
9. Takács S., Ditrói F., Aikawa M., Haba H., Otuka N.: *Benchmark experiment for the cross section of the $^{100}\text{Mo}(p,2n)^{99m}\text{Tc}$ and $^{100}\text{Mo}(p,pn)^{99}\text{Mo}$ reactions.* NIM/B 375 (2016)60-
10. Kovács Z., Szelecsényi F., Brezovcsik K. : *Preparation of thin gadolinium samples via electrodeposition for excitation function studies.* JRN 307 (2016)3:1861-1864
11. Szelecsényi F., Steyn G. F., Kovács Z. : *On the formation of non-radioactive copper during the production of ^{64}Cu via proton and deuteron-induced nuclear reactions on enriched ^{64}Ni targets.* JRN 307 (2016)3:1841-1846.
12. Szelecsényi F., Kovács Z., Kotaro Nagatsu., Ming-Rong Zhang., Kazutosi Suzuki.: *Investigation of deuteron-induced reactions on ^{nat}Gd up to 30 MeV: Possibility of production of medically relevant ^{155}Tb and ^{161}Tb radioisotopes.* JRN 307 (2016)3:1877-1881.
13. Alaa Elbinawi., Al-Abyad M., Abd-Elmageed K. E., Hassan K. F., Ditrói F. : *Proton induced nuclear reactions on natural antimony up to 7 MeV.* RCA 104 (2016)221
14. Solieman A. H. M., Al-Abyad M., Ditrói F., Saleh Z. A.: *Experimental and theoretical study for the production of ^{51}Cr using p, d, ^3He and ^4He projectiles on V, Ti and Cr targets.* NIM/B 366 (2016)19(27)