

Progress Report
NUCLEAR REACTION DATA GROUP at ATOMKI
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Introduction

The research program of the Atomki Nuclear Reaction Data Group consists of measurement, compilation, evaluation and application of low and medium energy charged particle induced nuclear reaction data. The work is done in international collaborations (see below). The experiments, data compilation and data evaluation are mainly connected to running international projects. Every day applications at ATOMKI and collaborating institutes also initiate data measurements.

One initiative is the systematic experimental study of activation cross sections of proton and deuteron induced reactions for comparison with the results of modern theoretical codes to establish a more reliable experimental database and to prepare of a general use activation file up to 100 MeV protons and 50 MeV deuterons.

Second program is the systematic investigation of nuclear data for production of radioisotopes candidate for use in radiotherapy.

The staff members are active referrers of different journals and conference proceedings reporting nuclear data related works (Applied Radiation and Isotopes, Journal of Radioanalytical and nuclear Chemistry, Nuclear Instruments and Methods, Annals of Nuclear Energy, etc)

Experimental works

We have continued the systematic investigation of excitation functions of reactions for different applications. The investigated reactions are connected to the following main application areas

- Activation cross sections for accelerator and target technology and for radiation protection.
- Cross section data for production of medical radioisotopes for diagnostic investigations and for therapy.
- Activation cross sections for Thin Layer Activation technique (TLA).
- Preparation of a general use CP activation data file.

The experiments are done in Debrecen and at cyclotrons of foreign laboratories in the frame of well established long term collaboration, in :

- Institute of Nuclear Chemistry (FZ Jülich, Germany)
- Cyclotron Laboratory of the Vrije Universiteit Brussel (VUB, Brussels, Belgium)
- Cyclotron Radioisotope Centre of the Tohoku University (CYRIC, Sendai, Japan)
- Division of Advanced Technology for Medical Imaging of the National Institute of Radiological Sciences (Chiba, Japan)
- Radionuclide Production Laboratory of the iThemba Laboratory for Accelerator Based Sciences (Somerset West, South Africa).
- Centre de Ressources du Cyclotron, UCL, (Louvain-la-Neuve, Belgium)

Theoretical calculation of the measured data was done in collaboration with scientist from:
Institute of Theoretical Physics, IPPE, Obninsk, Russia

Results are reported in scientific journals or relevant conferences 30 new papers 15 conference lectures. In all papers significant effort is made for complete review and evaluation of the earlier experimental results and for comparison with results of different model codes (TALYS, EMPIRE, ALICE, etc)

Data compilations and evaluations

EXFOR compilations

In the last period all publications on charged particle induced nuclear reactions with experimental data reported from Debrecen, Brussels and Jülich were compiled in EXFOR format in collaboration with IAEA NDS.

In the last two years about 50 paper containing new experimental cross section data were published from the three institutes.

List of papers of missing EXFOR compilations were partly collected during data compilation for FENDL-3 and during preparation of our new experimental data.

In a few cases errors were discovered in the already compiled EXFOR files which were corrected.

CRP and TC participations

- Database for fusion evaluated nuclear data library (2009-2011)
- Development of TLA database (2011)
- Accelerator-based Production of Molybdenum/Technetium-99m(2012-2015)
- Development of a reference database for particle-induced gamma-ray emission (PIGE) (2011-2015)-(ATOMKI- Laboratory of Ion Beam Applications)

Nuclear data service

The ATOMKI group continues to distribute compiled or evaluated cross section/thick target yield data for low and medium energy charged particle nuclear reactions mainly for cyclotron applications according to the requirements.

Staff

The staffs connected to the experimental nuclear reaction data measurement consist of six physicists and two chemists. Out of them three (F. Tárkányi, S. Takács,) physicists are working in part time on data compilation and evaluation.

Publications in 2010-2012

Papers published in 2010-2012 in which our group was involved containing experimental cross section data measured on different target materials bombarded by proton, deuteron, helium-3 and/or alpha particles are around 44. The relevant papers are compiled in EXFOR database

Ditrói F., Tárkányi F., Takács S., Hermanne A., Baba M., Ignatyuk A. V.: *Investigation of deuteron-induced reactions on cobalt.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **268** (2010)17-18:2571-2577

Hermanne A.⁴, Tárkányi F., Takács S., Van den Winkel P., Adam-Rebeles R., Ignatyuk A., Kovalev S. F.: *Production of the therapeutic radioisotope ^{114m}In through the $^{116}\text{Cd}(p,3n)^{114m}\text{In}$ reaction.*

Applied Radiation and Isotopes **68** (2010)1:14-17

Hermanne A., Tárkányi F., Takács S., Adam-Rebeles R., Spellerberg S., Ignatyuk A., Schweickert H.: *Optimisation of the long lived ^{121}Te contaminant in production of ^{123}I through the $^{124}\text{Xe}(p,x)$ route.*

Chemické Listy **104** (2010)14:S198-S199.

Hermanne A., Daraban L., Adam-Rebeles R., Ignatyuk A., Tárkányi F., Takács S.: *Alpha induced reactions on ^{nat}Cd up to 38.5 MeV: Experimental and theoretical studies of the excitation functions.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **268** (2010)9:1376-1391.

Takács S., Hermanne A., Tárkányi F., Ignatyuk A.: *Cross-sections for alpha particle produced radionuclides on natural silver.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **268** (2010)1:2-12.

Takács S., Tárkányi F., Hermanne A., Adam-Rebeles R.: *Activation cross sections of deuteron-induced nuclear reactions on hafnium.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **268** (2010)22:3443-3451.

Tárkányi F., Hermanne A., Takács S., Ditrói F., Király B., Yamazaki H., Baba M., Mohammadi A., Ignatyuk A. V.: *New measurements and evaluation of excitation functions for (p,xn) , (p,pxn) and $(p,2pxn)$ reactions on ^{133}Cs up to 70 MeV proton energy.*

Applied Radiation and Isotopes **68** (2010)1:47-58.

Tárkányi F., Hermanne A., Takács S., Király B., Spahn I., Ignatyuk A. V.: *Experimental study of the excitation functions of proton induced nuclear reactions on ^{167}Er for production of medically relevant ^{167}Tm .*

Applied Radiation and Isotopes **68** (2010)2:250-255.

Tárkányi F., Hermanne A., Király B., Takács S., Ignatyuk A. V.: *Study of excitation functions of alpha-particle induced nuclear reactions on holmium for ^{167}Tm production.* Applied Radiation and Isotopes **68** (2010)3:404-411.

Tárkányi F., Ditrói F., Király B., Takács S., Hermanne A., Yamazaki H., Baba M., Mohammadi A. ⁴, Ignatyuk A. V. ⁴: *Study of activation cross sections of proton induced reactions on barium: Production of $^{131}\text{Ba} \rightarrow ^{131}\text{Cs}$.* Applied Radiation and Isotopes **68** (2010)1869-1877.

Tárkányi F., Takács S., Ditrói F., Király B., Hermanne A., Sonck M., Baba M., Yamazaki H., Uddin M. S., Ignatyuk A. V.: *Study of production of $^{99\text{m}}\text{Tc}$ radioisotope via charged particle induced reactions up to 100 MeV: New data and review.* European Nuclear Conference. ENC 2010. Barcelona, Spain, 30 May - 2 June. Proceedings. <http://euronuclear.org/events/enc/enc2010/transactions.htm> **0** (2010)5-1.

Adam-Rebeles R., Hermanne A., Van den Winkel P., Tárkányi F., Takács S.: *Activation cross section of deuteron induced reactions on natural thallium for the production of ^{203}Pb .* Journal of the Korean Physical Society **59** (2011)23:1975-1978.

Ditrói F., Takács S., Tárkányi F., Smith R. W., Baba M. *Investigation of proton and deuteron induced reactions on cobalt.* Journal of the Korean Physical Society **59** (2011)23:1697-1700.

Ditrói F., Tárkányi F., Takács S., Hermanne A., Yamazaki H., Baba M., Mohammadi A., Ignatyuk A. V.: *Activation cross-sections of deuteron induced nuclear reactions on manganese up to 40 MeV.* Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **269** (2011)1878-1883.

Ditrói F., Tárkányi F., Takács S., Hermanne A., Yamazaki H., Baba M., Mohammadi A., Ignatyuk A. V.: *Study of activation cross-sections of deuteron induced reactions on rhodium up to 40 MeV.* Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **269** (2011)18:1963-1972.

Hermanne A., Tárkányi F., Takács S., Adam-Rebeles R., Ignatyuk A., Spellerberg S., Schweikert R.: *Limitation of the long-lived ^{121}Te contaminant in production of ^{123}I through the $^{124}\text{Xe}(p,x)$ route.* Applied Radiation and Isotopes **69** (2011)2:358-368.

Hermanne A., Adam-Rebeles R., Tárkányi F., Takács S., Spahn I., Ignatyuk A. V.: *High yield production of the medical radioisotope ^{167}Tm by the $^{167}\text{Er}(d,2n)$ reaction.* Applied Radiation and Isotopes **69** (2011)2:475-481.

Hermanne A., Adam-Rebeles R., Tárkányi F., Takács S., Király B., Ignatyuk A. V.: *Cross sections for production of longer lived $^{170,168,167}\text{Tm}$ in 16 MeV proton irradiation of ^{nat}Er .* Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **269** (2011)7:695-699.

Hermanne A., Adam-Rebeles R., Tárkányi F., Takács S., Takács M., Ignatyuk A.: *Cross sections of deuteron induced reactions on ^{nat}Cr up to 50 MeV: Experiments and comparison with theoretical codes.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **269** (2011)21:2563-2571.

Takács S., Tárkányi F., Hermanne A., Adam-Rebeles R.: *Activation cross sections of proton induced nuclear reactions on natural hafnium.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **269** (2011)2824-2834.

Tárkányi F., Hermanne A., Takács S., Sonck M., Szûcs Z., Király B., Ignatyuk A. V.: *Investigation of alternative production routes of ^{99m}Tc : Deuteron induced reactions on ^{100}Mo .* Applied Radiation and Isotopes **69** (2011)1:18-25.

Tárkányi F., Hermanne A., Király B., Takács S., Ditrói F., Baba M., Ignatyuk A. V.: *Investigation of activation cross sections of deuteron induced reactions on indium up to 40 MeV for production of $^{113}Sn/^{113m}In$ generator.* Applied Radiation and Isotopes **69** (2011)1:26-36.

Tárkányi F., Ditrói F., Hermanne A., Takács S., Király B., Baba M., Ignatyuk A.: *Experimental study of the excitation functions of deuteron induced reactions on ^{nat}Sn up to 40 MeV.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **269** (2011)4:405-416.

Tárkányi F., Ditrói F., Hermanne A., Takács S., Király B., Yamazaki H., Baba M., Mohammadi A., Ignatyuk A. V.: *Activation cross-sections of deuteron induced nuclear reactions on gold up to 40 MeV.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **269** (2011)12:1389-1400.

Tárkányi F., Ditrói F., Takács S., Hermanne A., Baba M., Ignatyuk A. V.: *Investigation of activation cross-sections of deuteron induced reactions on vanadium up to 40 MeV.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **269** (2011)1792-1800.

Tárkányi F., Hermanne A., Ditrói F., Takács S., Király B., Csikai Gy., Baba M., Yamazaki H., Uddin M. S., Ignatyuk A. V., Qaim S. M.: *Systematic study of activation cross-sections of deuteron induced reactions used in accelerator applications.*

Workshop on Nuclear Measurements, Evaluations and Applications. NEMEA 6. Krakow, Poland, 25-28 Oct., 2010. Proceedings. Eds: OECD Nuclear Energy Agency, Nuclear Science. Paris, OECD Publ. (NEA/NSC/DOC(2011)4) **0** (2011)1:203-214.

Al-Abyad M., Abdel-Hamid A. S., Tárkányi F., Ditrói F., Takács S., Seddik U., Bashter I. I.: *Cross-section measurements and nuclear model calculation for proton induced nuclear reaction on zirconium.*

Applied Radiation and Isotopes **70** (2012)257-262.

Ditrói F., Tárkányi F., Takács S., Dóczy R., Hermanne A., Ignatyuk A. V.: *Study of excitation function of deuteron induced reactions on ^{nat}Kr up to 20 MeV.*
Applied Radiation and Isotopes **70** (2012)574-582.

Ditrói F., Tárkányi F., Takács S., Hermanne A., Ignatyuk A. V., Baba M.: *Activation cross-sections of deuteron induced reactions on natural palladium.*
Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **270** (2012)61-74.

Hermanne A., Adam-Rebeles R., Tárkányi F., Takács S., Takács M. P., Csikai Gy., Ignatyuk A.: *Cross sections of deuteron induced reactions on ⁴⁵Sc up to 50 MeV: Experiments and comparison with theoretical codes.*
Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **270** (2012)1:106-115.

Takács S., Takács M. P., Hermanne A., Tárkányi F., Adam-Rebeles R.: *Cross sections of deuteron-induced reactions on ^{nat}Sb up to 50 MeV.*
Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **287** (2012)1:93-105.

Tárkányi F., Hermanne A., Takács S., Ditrói F., Spahn I., Ignatyuk A. V.: *Activation cross-sections of proton induced nuclear reactions on thulium in the 20-45 MeV energy range.*
Applied Radiation and Isotopes **70** (2012)309-314.

Tárkányi F., Ditrói F., Takács S., Király B., Hermanne A., Sonck M., Baba M., Ignatyuk A. V.: *Investigation of activation cross-sections of deuteron induced nuclear reactions on natural Mo up to 50 MeV.*
Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **274** (2012)1:1-25.

Tárkányi F., Ditrói F., Hermanne A., Takács S., Ignatyuk A. V.: *Investigation of activation cross-sections of proton induced nuclear reactions on ^{nat}Mo up to 40 MeV: New data and evaluation.*
Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **280** (2012)45-73.

Maslov O. D., Starodub G. Ya., Vostokin G. K., Gustova M. V., Dmitriev S. N., Shvetson V. N., Szûcs Z., Jansen D., Zeevaart J. R.: *Production of ^{117m}Sn with high specific activity by cyclotron.*
Applied Radiation and Isotopes **69** (2011)7:965-968.

Spahn I., Steyn G. F., Vermeulen Ch., Kovács Z., Szelecsényi F., Shehata M. M., Spellerberg S., Scholten B., Coenen H. H., Qaim S. M.: *New cross section measurements for the production of the Auger electron emitters ⁷⁷Br and ^{80m}Br.*
Radiochimica Acta **98** (2010)12:749-755.

Szelecsényi F., Vermeulen Ch., Steyn G. F., Kovács Z., Aardaneh K., van der Walt T. N.: *Excitation functions of ^{186,187,188,189,190,192}Ir formed in proton-induced reactions on highly enriched ¹⁹²Os up to 66 MeV.*

Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **268** (2010)1:3306-3314.

van der Meulen N. P., Steyn G. F. ⁴, van der Walt T. N., Szelecsényi F., Kovács Z., Raubenheimer H. G.: *The isolation of ¹³³Ba produced by proton-induced reactions on Cs using cation exchange chromatography.*

Journal of Radioanalytical and Nuclear Chemistry **285** (2010)3:490-498.

Spahn I., Shehata M. M., Spellerberg S., Scholten B., Coenen H. H., Qaim S. M., Steyn G. F., Vermeulen Ch., Kovács Z., Szelecsényi F.: *Investigation of production possibilities of radiobromines for diagnostic and therapeutic applications.*

Journal of the Korean Physical Society **59** (2011)23:1986-1986.

Steyn G. F., Vermeulen Ch., Szelecsényi F., Kovács Z., Suzuki K., Fukumura T., Nagatsu K.: *Excitation functions of proton induced reactions on ⁸⁹Y and ⁹³Nb with emphasis on the production of selected radio-zirconiums.*

Journal of the Korean Physical Society **59** (2011)23:1991-1994.

Szelecsényi F., Kovács Z., Nagatsu K., Fukumura K., Suzuki K., Mukai K.: *Investigation of direct production of ⁶⁸Ga with low energy multiparticle accelerator.*

Radiochimica Acta **100** (2012)1:5-11.

Vermeulen Ch., Steyn G. F., Szelecsényi F., Kovács Z., Suzuki K., Nagatsu K., Fukumura T., Hohn A., van der Walt T. N.: *Cross sections of proton-induced reactions on ^{nat}Gd with special emphasis on the production possibilities of ¹⁵²Tb and ¹⁵⁵Tb.*

^SNuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms **275** (2012)1:24-32.

A. Hermanne, S. Takács, F. Tárkányi, R. Adam-Rebeles, A. Ignatyuk: *Excitation function for ⁷Be production in carbon by deuteron irradiations up to 50 MeV*

Original Research Article

Applied Radiation and Isotopes, In Press, Corrected Proof, Available online 18 February 2012

F. Ditrói • S. Takács • F. Tárkányi • E. Corniani • R. W. Smith • M. Jech • T. Wopelka: *Sub-micron wear measurement using activities under the free handling limit*

Journal of Radioanalytical and Nuclear Chemistry, Akadémiai Kiadó, Budapest, Hungary 2012

Received: 25 November 2011

Conference talks in 2010-2012

Ditrói F., Takács S., Tárkányi F., et al: *Thin layer activation for wear measurement under the micrometer range (Abstr.: p. 107).*

10th European Conference on Accelerators in Applied Research and Technology. Athens, Greece, 13-17 Sept., 2010 **0** (2010)

Ditrói F. , Takács S. , Tárkányi F. : *New developments in the Cyclotron Laboratory of Atomki. CYCLEUR. Cyclotron Research Workshop. JRC Enlargement and Integration Programme. Ispra, Italy, 25-26 Nov., 2010 **0** (2010)0-*

Ditrói F., Takács S., Tárkányi F., et al. : *Investigation of proton and deuteron induced reactions on cobalt.*

International Conference on Nuclear Data for Science and Technology. Jeju Island, Korea, 26-30 April, 2010 **0** (2010)0

Hermanne A., Tárkányi F., Takács S. , et al. : *Optimisation of the long lived ^{121}Te contaminant in production of ^{123}I trough the $^{124}\text{Xe}(p,x)$ route.*

16th Radiochemical Conference. RadChem 2010. Mariánské Lázně, Czech Republic, 18-23 April, 2010 **0** (2010)0

Hermanne A., Tárkányi F., Takács S., et al. : *High Yield production of the medical radioisotope ^{167}Tm by the $^{167}\text{Er}(d,2n)$ reaction (Abstr.: p. 191).*

International Conference on Nuclear Data for Science and Technology. Jeju Island, Korea, 26-30 April, 2010 **0** (2010)0

Király B., Tárkányi F., Takács S., Ditrói F., et al. : *Investigation of production of the medical radioisotope ^{167}Tm at accelerators (Abstr.: p. 181).*

10th European Conference on Accelerators in Applied Research and Technology. Athens, Greece, 13-17 Sept., 2010 **0** (2010)0-X./ 0.000⁰

Takács S., Tárkányi F., et al.: *Activation cross sections of proton induced nuclear reactions on natural hafnium.*

10th European Conference on Accelerators in Applied Research and Technology. Athens, Greece, 13-17 Sept., 2010 **0** (2010)0-X./ 0.000⁰

Takács S., Ditrói F., Tárkányi F. : *Calculation tool to help for planning TLA experiments. CYCLEUR. Cyclotron Research Workshop. JRC Enlargement and Integration Programme. Ispra, Italy, 25-26 Nov., 2010 **0** (2010)0*

Takács S., Tárkányi F., et al. : *Activation cross section of deuteron induced nuclear reactions on hafnium (Abstr.: p. 211).*

International Conference on Nuclear Data for Science and Technology. Jeju Island, Korea, 26-30 April, 2010 **0** (2010)0-X./ 0.000⁰

Tárkányi F., Király B., Takács S., Ditrói F. , et al. : *Investigation of activation cross sections of deuteron induced reactions on indium up to 40 MeV for production of $^{113}\text{Sn}/^{113m}\text{In}$ generator.*

10th European Conference on Accelerators in Applied Research and Technology. Athens,

Greece, 13-17 Sept., 2010 **0** (2010)0

Tárkányi F., Takács S., Ditrói F., Király B., et al. : *Investigation of activation cross sections of deuteron-induced reactions on vanadium, molybdenum, tin and gold for accelerator technology.*

10th European Conference on Accelerators in Applied Research and Technology. Athens, Greece, 13-17 Sept., 2010 **0** (2010)0

Tárkányi F., Király B. : *Activation cross section data of deuteron induced reactions.*
2nd Research Coordination Meeting of the Nuclear Reaction Data for Advanced Systems - Fusion Devices. FENDL-3. Vienna, Austria, 23-26 March, 2010 **0** (2010)0

Tárkányi F., Takács S., Ditrói F., Király B., et al.: *Study of production of ^{99m}Tc radioisotope via charged particle induced reactions up to 100 MeV: New data and review.*
European Nuclear Conferen. ENC 2010. Barcelona, Spain, 30 May - 2 June, 2010 **0** (2010)0

Tárkányi F., Ditrói F., Takács S., Király B., Csikai Gy., et al. : *Systematic study of activation cross-sections of deuteron induced reactions used in accelerator applications. (in Hung.)*
Workshop on Nuclear Measurements, Evaluations and Applications. NEMEA 6. Krakow, Poland, 25-29 Oct., 2010 **0** (2010)0

Ditrói F., Takács S., Tárkányi F., et al. : *Development of thin layer activation technique towards radioactive isotope application under the free handling limit.*
11th International Conference on Applications of Nuclear Techniques. Crete, Greece, 12-18 June, 2011 **0** (2011)0

Hermanne A., Tárkányi F., Takács S., Király B., et al. : *Cross sections of deuteron induced reactions on ⁴⁵Sc up to 50 MeV : Experiments and comparison with theoretical codes.*
11th International Conference on Applications of Nuclear Techiques. Crete, Greece, 12-18 June, 2011 **0** (2011)0

Hermanne A., Tárkányi F., Takács S., Adam-Rebeles R., Csikai Gy. : *Experimental cross sections of Be-7 production in Al, Si, Mg and C by deuteron irradiation up to 50 MeV (Abstr.: p. 37).*
3rd International Nuclear Chemistry Congress. Palermo, Sicily, Italy, 18-23 Sept., 2011 **0** (2011)0

Takács S. , Ditrói F., Tárkányi F., Takács M. P., et al.: *Proposal of reactions on nickel for monitoring deuteron beam in the 10-50 MeV energy.*
11th International Conference on Applications of Nuclear Techiques. Crete, Greece, 12-18 June, 2011 **0** (2011)0

Tárkányi F., Takács S., Ditrói F., et al. : *Study of activation cross sections of deuteron induced nuclear reactions on manganese, rhodium and palladium for nuclear applications.*
11th International Conference on Applications of Nuclear Techniques. Crete, Greece, 12-18 June, 2011 **0** (2011)0

Tárkányi F., Ditrói F. : *Cyclotrons in medicine: Production routes of therapeutic radioisotopes.*
7th Annual CYCLEUR Workshop on Cyclotron Research and Radio-labeled Nanoparticles.

Ispra, Varese, Italy, 28-29 Nov., 2011 **0** (2011)0

Tárkányi F.: *Systematic study of activation cross sections of proton and deuteron induced reactions for accelerator applications.*

Advisory Group Meeting on Long-Term Needs for Nuclear Data Developments. Vienna, Austria, 2-4 Nov., 2011 **0** (2011)0

Tárkányi F. : *Status of the IAEA medical database and proposal for upgrade.*

Consultants' Meeting on Improvements in Charged Particle Monitor Reactions and Nuclear Data for Medical Isotope Production. Vienna, Austria, 21-24 June, 2011 **0** (2011)0

Tárkányi F. : *Applied nuclear research and applications in MTA Atomki.*

Nuclear Physics European Collaboration Committee 72 Meeting. Budapest, Hungary, 7-8 Oct., 2011 **0** (2011)0

Spahn I., Kovács Z., Szelecsényi F. et al.: *Investigation of production possibilities of radiobromines for diagnostic and therapeutic applications.*

International Conference on Nuclear Data for Science and Technology. Jeju Island, Korea, 26-30 April, 2010 **0** (2010)0

Steyn G. F., Szelecsényi F., Kovács Z., et al. : *Excitation functions of proton induced reactions on ^{89}Y and ^{93}Nb with emphasis on the production of selected radio-zirconiums.*

International Conference on Nuclear Data for Science and Technology. Jeju Island, Korea, 26-30 April, 2010 **0** (2010)0
