

Progress Report
NRDC-2021 Technical Meeting
(4-7 May, 2019, Webex event)

Institute for Nuclear Research, ATOMKI
(S. Takács)

New administrative structure

From September 2019 ATOMKI belongs to the Eötvös Loránd Research Network

The network has 11 research centers
7 research institutes and
one support office.



ATOMKI is one of the 7 research institutes.

Its new name is: **Institute for Nuclear Research, ATOMKI**

Nuclear Data Activities at ATOMKI in 2020

Research groups and related experimental work

- Nuclear reaction data group: to measure reaction cross section for applications first of all for use in medical and industrial applications (TLA).
- Nuclear astrophysics group: for measuring cross sections and other astrophysics related data in low energy relevant for astrophysics.
- Nuclear spectroscopy data group: to collect new experimental nuclear structure and decay data of exotic nuclei using radioactive beams, study of exotic shapes of nuclei, excitation modes and decay of nuclei, as well as study of neutron skin and neutron halo in nuclei data for nuclear spectroscopy and nuclear structure.

Nuclear Reaction Data group at ATOMKI

The research program:

- Experimental determination of cross sections for light charged particle induced reaction on various target materials.
- Compilation, evaluation of low and medium energy data.
- Contribution to international collaborations.

Staff in 2020:

- 5 physicists
- 2 chemists

Activity in 2020:

- Measurements of reaction cross sections of Ni+p, Y+p, Mo+p, Tm+p, Th+p, Sc+d, Te+d, Ru+d, Rb+d, Lu+d, Ta+d,
- Evaluations of cross section data of nuclear reactions for production of medical isotopes in use of PET, (^{11}C , ^{13}N , ^{15}O , ^{18}F), SPECT (^{64}Cu , ^{81}Rb , ^{123}I , ^{124}I) and therapy (^{67}Cu , $^{102\text{m,g}}\text{Rh}$, ^{103}Pd , $^{114\text{m}}\text{In}$, ^{125}I , ^{169}Yb , $^{177\text{g}}\text{Lu}$, ^{186}Re , ^{192}Ir , $^{210,211}\text{At}$) applications.
- Beside medical applications part of the collected data can be used in TLA applications, CPAA analytics and also may contribute to improve theoretical models and update data libraries like TENDL.

IAEA related activity:

- EXFOR: Compilation of all newly measured and published experimental data.
- TC: Evaluation of cross sections for medical isotope production and charged particle beam monitoring.
- CRP: Therapeutic radiopharmaceuticals labeled with new emerging radionuclides (^{67}Cu , ^{186}Re , ^{47}Sc).
- CRP: Imaging Technologies for Process Investigations and Components Testing: Radioactive tracing of industrial processes by using Thin Layer Activation (TLA) and Positron Emission Tomography.

Publications in 2020:

Tárkányi F., Ditrói F., Takács S., Hermanne A., Ignatyuk A.V., Spahn, I., Spellerberg S.
Investigation of activation cross-sections of deuteron induced reactions on ruthenium up to 50 MeV, APPLIED RADIATION AND ISOTOPES 168 (2021) 109401

Tárkányi F., Hermanne A. Ditrói F. Takács S. Ignatyuk A. V., Spahn I. Spellerberg S.
Activation cross section data of deuteron induced nuclear reactions on rubidium up to 50 MeV
EUROPEAN PHYSICAL JOURNAL A: HADRONS AND NUCLEI 57 (2021) 21

Aboudzadeh-Rovais M., Alliot C., Al Rayyes A., Bilewicz A., Chakraborty S., Gagnon K., Gizawy M., Jalilian A., Khandaker M.U., Lapi S.E., Mikołajczak R, Nagatsu K, Osso Jr. J., Okarvi S., Park J.H. Pupillo G., Takacs, S.
Therapeutic Radiopharmaceuticals Labelled with Copper-67, Rhenium-186 and Scandium-47
IAEA TECDOC No. 1945 Wien, Ausztria : International Atomic Energy Agency (IAEA) (2021)

Tsoodol Z., Aikawa M., Ichinkhorloo D., Khishigjargal T., Norov E., Komori Y., Haba H., Takács S., Ditrói F., Szűcs Z.
Production cross sections of ^{45}Ti in the deuteron-induced reaction on ^{45}Sc up to 24 MeV
APPLIED RADIATION AND ISOTOPES 168 (2021) 109448

Steyn G. F., Motetshwane M.A., Szelecsényi F., Brümmer J.W.
Pairing of thorium with selected primary target materials in tandem configurations: Co-production of $^{225}\text{Ac}/^{213}\text{Bi}$ and $^{230}\text{U}/^{226}\text{Th}$ generators with a 70 MeV H⁻ cyclotron
APPLIED RADIATION AND ISOTOPES 168 (2021) 109514

Steyn G. F., van der Walt T.N., Szelecsényi F., Perrang C., Brümmer J.W., Vermeulen C., van der Meulen N.P., Motetshwane M.A., van Heerden M.R., *Large-scale production of ^{88}Y and $^{88}\text{Zr}/^{88}\text{Y}$ generators: A proof of concept study for a 70 MeV H⁻ cyclotron*
APPLIED RADIATION AND ISOTOPES 168 (2021) 109469

Hermanne A., Tárkányi F., Takács S., Ditrói F., Ignatyuk A.
Deuteron induced reactions on tellurium: An alternative for production of ^{123}I ?
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS 466 (2020) 20-30

Hermanne A., Tárkányi F., Takács S., Ditrói F.
Additional excitation functions for radionuclides obtained by deuteron irradiation of Ta up to 50 MeV, NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS 481 (2020) 82-90

Tárkányi F., Takács S., Ditrói F., Hermanne A., Adam-Rebeles R., Ignatyuk A. V.
Investigation of the deuteron induced nuclear reaction cross sections on lutetium up to 50 MeV: review of production routes for ^{177}Lu , ^{175}Hf and ^{172}Hf via charged particle activation
JOURNAL OF RADIOANALYTICAL AND NUCLEAR CHEMISTRY 324 (2020) 1405-1421

Adel Doha, Mohamed Gehan Y., Yousef Zeinab, El Wahab Magda Abd; Ditrói, F., Takács, S., Al-abyad M., *Experimental investigation and theoretical evaluation of proton induced nuclear reactions on nickel*, APPLIED RADIATION AND ISOTOPES 159 (2020) 109094

Saito M., Aikawa M., Murata T., Komori Y., Haba H., Takács S., Ditrói F., Szűcs Z. *Production cross sections of ^{169}Yb by the proton-induced reaction on ^{169}Tm* , NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS 471 (2020) 13-16

Elbinawi A., Al-Abyad M., Bashter I., Seddik U., Ditrói, F. *Study of proton induced nuclear reactions on molybdenum: Cross section measurements and theoretical calculations*, RADIOCHIMICA ACTA 108 (2020) 1-9

P. Brisset, F. Ditrói, D. Eberle, M. Jech, A. Kleinrahm, C. Lenauer, T. Sauvage, J. Thereska *Radiotracer Technologies for Wear, Erosion and Corrosion Measurement*, Vienna, Ausztria, International Atomic Energy Agency (IAEA) (2020), IAEA TECDOC No. 1897

Corniani, E.; Ditrói, F. *Secondary implantation of ^{51}Cr and ^{48}V radioisotopes into plastic surfaces for nano-TLA study* JOURNAL OF RADIOANALYTICAL AND NUCLEAR CHEMISTRY 323 (2020) 1209-1216

Brezovcsik K., Veres Sz, Molnár J., Fenyvesi A. Szűcs Z. *Comparison of manganese uptake and transport of maize seedlings by mini-PET camera* APPLIED RADIATION AND ISOTOPES 160 (2020) 109127

Kadenko, I. M.; Biró, B. ; Fenyvesi, A. *Statistically significant observation of and cross-sections for a new nuclear reaction channel on Au-197 with bound dineutron escape*, EUROPHYSICS LETTERS 131 (2020) 52001

Nuclear Astrophysics Group at ATOMKI

The research program:

The main task of the nuclear astrophysics group of ATOMKI is to measure charged particle induced reaction cross sections at low energies relevant for various astrophysical processes. Using the accelerators of Atomki, the following reaction cross sections have been investigated during the last three years.

- $^{115}\text{In}(\alpha,\gamma)^{119}\text{Sb}$ $^{115}\text{In}(\alpha,n)^{118}\text{Sb}$ $^{121}\text{Sb}(\alpha,\gamma)^{125}\text{I}$
- $^{121}\text{Sb}(\alpha,n)^{124}\text{I}$ $^{123}\text{Sb}(\alpha,n)^{125}\text{I}$ $^{197}\text{Au}(\alpha,\gamma)^{201}\text{Tl}$
- $^{197}\text{Au}(\alpha,n)^{200}\text{Tl}$ $^{197}\text{Au}(\alpha,2n)^{199}\text{Tl}$ $^{191}\text{Ir}(\alpha,n)^{194}\text{Au}$
- $^{193}\text{Ir}(\alpha,n)^{196}\text{Au}$ $^{193}\text{Ir}(\alpha,n)^{196\text{m}}\text{Au}$ $^{96}\text{Zr}(\alpha,n)^{99}\text{Mo}$
- $^3\text{He}(\alpha,\gamma)^7\text{Be}$ $^{14}\text{N}(\text{p},\gamma)^{15}\text{O}$ resonance strengths

In the framework of the LUNA international collaboration (Gran Sasso, Italy), the low energy cross sections of the $\text{d}(\text{p},\gamma)^3\text{He}$, $^6\text{Li}(\text{p},\gamma)^7\text{Be}$, $^{22}\text{Ne}(\text{p},\gamma)^{23}\text{Na}$, $^{18}\text{O}(\text{p},\gamma)^{19}\text{F}$, $^{18}\text{O}(\text{p},\alpha)^{15}\text{N}$ and $^{23}\text{Na}(\text{p},\gamma)^{24}\text{Mg}$ reactions have been measured. At GSI, Germany, the cross section of the $^{124}\text{Xe}(\text{p},\gamma)^{125}\text{Cs}$ reactions has been studied.

Staff in 2020:

- 9 physicists

Activity in 2020:

Half-lives measurements of the ^{95}Ru , ^{95}Tc , $^{95\text{m}}\text{Tc}$ radioisotopes.

In the framework of the LUNA international collaboration the $^6\text{Li}(\text{p},\gamma)^7\text{Be}$ reaction was investigated.

Publications in 2020:

T.N. Szegedi et al., High precision half-life measurement of ^{95}Ru , ^{95}Tc and $^{95\text{m}}\text{Tc}$ with gamma-spectroscopy, Eur. Phys. J. A 56 (2020) 182

D. Piatti et al., Underground experimental study finds no evidence of low-energy resonance in the $^6\text{Li}(\text{p},\gamma)^7\text{Be}$ reaction, Phys. Rev. C 102 (2020) 052802(R)

V. Mossa et al., The baryon density of the Universe from an improved rate of deuterium burning, Nature 587 (2020) 210

Nuclear Spectroscopy Data Group at ATOMKI

The research program:

- Measurements and evaluation of new nuclear structure and decay data.
- Mass-chain evaluation work for ENSDF and compilation work for XUNDL.
- An evaluation centre with responsibility of the $A=101 - 105$ mass chains.
- Collaboration work with research groups at RIKEN, GANIL, GSI, Gammasphere, Exogam, Jurogam

Staff in 2020:

- 12 physicists

Activity in 2020:

- Nuclear structure and decay data compilation and mass-chain evaluation work.
- Horizontal evaluation of beta-delayed neutron emission probabilities
- Measurements of new experimental nuclear structure and decay data of exotic nuclei using radioactive beams, study of exotic shapes, excitation modes and decay of nuclei, as well as study of neutron skin and neutron halo in nuclei.

Publications in 2020:

Basu, A. et al. "*Evolution of collective and noncollective structures in Xe 123*". *PHYSICAL REVIEW C* 101. (2020).

Cederwall, B. et al. "*Isospin Properties of Nuclear Pair Correlations from the Level Structure of the Self-Conjugate Nucleus Ru 88*". *PHYSICAL REVIEW LETTERS* 124. (2020).

Timár, János et al. "*Triaxiality-related nuclear phenomena in the $A \approx 100$ mass region*". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1555. (2020).

Firak, D. S. et al. "*Confirmation of the existence of the X17 particle*". *EPJ WEB OF CONFERENCES* 232. (2020).

Petrache, C.M. et al. "*Signatures of enhanced octupole correlations at high spin in Nd 136*". *PHYSICAL REVIEW C* 102. (2020).

- Majola, S. N. T. et al. "First candidates for gamma vibrational bands built on the $[505]11/2(-)$ neutron orbital in odd- A Dy isotopes". *PHYSICAL REVIEW C* 101. (2020).
- Petrache, C. M. et al. "Multiple chiral bands in ^{137}Nd ". *EUROPEAN PHYSICAL JOURNAL A: HADRONS AND NUCLEI* 56. (2020).
- Ertoprak, A. et al. "Lifetimes of core-excited states in semi-magic ^{95}Rh ". *EUROPEAN PHYSICAL JOURNAL A: HADRONS AND NUCLEI* 56. (2020).
- Krasznahorkay, Attila et al. "A new anomaly observed in ^4He supporting the existence of the hypothetical $X17$ particle". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1643. (2020).
- Dimitriou, Paraskevi et al. "International network of nuclear structure and decay data evaluators". *EPJ WEB OF CONFERENCES* 239. (2020): 15004.
- Basu, A. et al. "Highly deformed band structures due to core excitations in $\text{Xe } 123$ ". *PHYSICAL REVIEW C* 103. (2021).
- Zavatarelli, Sandra et al. "Nuclear astrophysics at Gran Sasso : the study of BBN and post-main sequence fusion reactions at LUNA". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1468. (2020): 012251.
- Revel, A. et al. "Extending the Southern Shore of the Island of Inversion to $F 28$ ". *PHYSICAL REVIEW LETTERS* 124. (2020).
- Syndikus, I. et al. "Probing the $Z = 6$ spin-orbit shell gap with $(p,2p)$ quasi-free scattering reactions". *PHYSICS LETTERS B* 809. (2020).
- Chilug, A. I. et al. "Nuclear Breakup and Coulomb Dissociation of ^9C Nucleus Studied at RIBF RIKEN". *JPS CONFERENCE PROCEEDINGS* 32. (2020).
- Huang, S. W. et al. "Experimental study of $4n$ with $^8\text{He}(p,2p)$ reaction". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1643. (2020).
- Storck, S et al. "Lifetime measurement of the 260 g.s. at SAMURAI". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1643. (2020).
- Juhász, M.M. et al. "First spectroscopic study of ^{51}Ar by the $(p,2p)$ reaction". *PHYSICS LETTERS B* 814. (2021): 136108.
- Balibrea-Correa, J. et al. "Direct cross-section measurement of $^{13}\text{C}(\alpha,n)^{16}\text{O}$ in the s -process Gamow peak". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1643. (2020).
- Cortés, M.L. et al. "Shell evolution of $N = 40$ isotones towards ^{60}Ca : First spectroscopy of ^{62}Ti ". *PHYSICS LETTERS B* 800. (2020).

- Sun, Y.L. et al. "Restoration of the natural $E(1/2^+ 1^-) - E(3/2^+ 1^-)$ energy splitting in odd-isotopes towards $N = 40$ ". *PHYSICS LETTERS B* 802. (2020).
- Guo, S. et al. "Evidence for pseudospin-chiral quartet bands in the presence of octupole correlations". *PHYSICS LETTERS B* 807. (2020).
- Gottardo, A. et al. "Transition strengths in the neutron-rich $^{73,74,75}\text{Ni}$ isotopes". *PHYSICAL REVIEW C* 102. (2020).
- Koseoglou, P. et al. "Spectroscopy of neutron-rich scandium isotopes". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1555. (2020): 012026.
- Garrote, F. L. Bello et al. "Beta decay of Ni-75 and the systematics of the low-lying level structure of neutron-rich odd- A Cu isotopes". *PHYSICAL REVIEW C* 102. (2020).
- Guo, S. et al. "Pseudospin partner bands in Ba 130". *PHYSICAL REVIEW C* 102. (2020).
- Siciliano, M. et al. "Pairing-quadrupole interplay in the neutron-deficient tin nuclei: First lifetime measurements of low-lying states in $^{106,108}\text{Sn}$ ". *PHYSICS LETTERS B* 806. (2020).
- Cortés, M.L. et al. " $N=32$ shell closure below calcium: Low-lying structure of Ar 50". *PHYSICAL REVIEW C* 102. (2020).
- Giovinazzo, J. et al. "Two-proton radioactivity: The interesting case of ^{67}Kr and further studies". *ACTA PHYSICA POLONICA B* 51. (2020): 577-585.
- Wimmer, J. et al. "Shape coexistence revealed in the $N=Z$ isotope ^{72}Kr through inelastic scattering". *EUROPEAN PHYSICAL JOURNAL A: HADRONS AND NUCLEI* 56. (2020).
- Kulikov, I. et al. "Masses of short-lived ^{49}Sc , ^{50}Sc , ^{70}As , ^{73}Br and stable ^{196}Hg nuclides". *NUCLEAR PHYSICS A* 1002. (2020): 121990.
- Liang, J. et al. "Compilation and Evaluation of Beta-Delayed Neutron Emission Probabilities and Half-Lives for $Z > 28$ Precursors". *NUCLEAR DATA SHEETS* 168. (2020): 1-116.
- Kulikov, I. et al. "Masses of short-lived ^{49}Sc , ^{50}Sc , ^{70}As , ^{73}Br and stable ^{196}Hg nuclides". *NUCLEAR PHYSICS A* 1002. (2020).
- Vitez-Sveicz, A. et al. "STUDYING THE EXOTIC DECAY $\text{Kr-70} \rightarrow \text{Br-70}$ ". *ACTA PHYSICA POLONICA B* 51. (2020): 587-594.
- Estienne, M. et al. "Impact of the Most Recent Total Absorption Gamma-ray Spectroscopy Data for Fission Fragments on Reactor Antineutrino Spectra and Comparison with the Daya Bay Results". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1643. (2020).

- Guadilla, V. et al. "Disentangling decaying isomers and searching for signatures of collective excitations in β decay". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1643. (2020).
- Orrigo, S.E.A. et al. " β decay of the very neutron-deficient Ge 60 and Ge 62 nuclei". *PHYSICAL REVIEW C* 103. (2021).
- Wilson, J. N. et al. "Angular momentum generation in nuclear fission". *NATURE* 590. (2021): 566-570.
- Lokotko, T. et al. "Shell structure of the neutron-rich isotopes Co 69 , 71 , 73". *PHYSICAL REVIEW C* 101. (2020).
- Korten, W. et al. "Physics opportunities with the Advanced Gamma Tracking Array: AGATA". *EUROPEAN PHYSICAL JOURNAL A: HADRONS AND NUCLEI* 56. (2020).
- Frotscher, A. et al. "Sequential Nature of $(p, 3p)$ Two-Proton Knockout from Neutron-Rich Nuclei". *PHYSICAL REVIEW LETTERS* 125. (2020).
- Liu, J. J. et al. "Isomeric and beta-decay spectroscopy of Ho-173, Ho-174". *PHYSICAL REVIEW C* 102. (2020).
- Göbel, et al. "Coulomb dissociation of ^{16}O into 4He and ^{12}C ". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1668. (2020).
- Bagchi, S. et al. "Signature of a possible α -cluster state in $N=Z$ doubly-magic ^{56}Ni ". *EUROPEAN PHYSICAL JOURNAL A: HADRONS AND NUCLEI* 56. (2020).
- Stuhl, László et al. "Study of spin-isospin responses of radioactive nuclei with the background-reduced neutron spectrometer, PANDORA". *NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS* 463. (2020): 189-194.
- Stuhl, László et al. "Study of spin-isospin response of ^{11}Li neutron-drip-line nucleus with PANDORA". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1643. (2020): 189.
- Eriksen, T. et al. "Improved precision on the experimental $E0$ decay branching ratio of the Hoyle state". *PHYSICAL REVIEW C* 102. (2020).
- Kibédi, T. et al. "Radiative Width of the Hoyle State from γ -Ray Spectroscopy". *PHYSICAL REVIEW LETTERS* 125. (2020).
- Jungclaus, A. et al. "Evolution of proton single-particle states in neutron-rich Sb isotopes beyond $N=82$ ". *PHYSICAL REVIEW C* 102. (2020).

Shearman, R et al. "*Determination of beta-delayed neutron emission probability limits of rhodium isotopes by gamma-ray spectroscopy*". *JOURNAL OF PHYSICS-CONFERENCE SERIES* 1643. (2020).

Introduction

The research program: compilation, evaluation and application of low and medium energy charged particle induced nuclear reaction data in international collaborations (see below).

- Systematic experimental study of activation cross sections of proton, deuteron, ^3He and α -particle 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.
- Systematic investigation of nuclear data for production of radioisotopes candidate for use in diagnostic (SPECT and PET) and radiotherapy, not covered by international projects.
- Investigations of nuclear data of new candidate monitor reactions.
- Investigation of nuclear data for thin layer activation technique
- Testing theoretical nuclear reaction model codes

Experimental works and theoretical comparisons

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

- Cyclotron Laboratory of the Vrije Universiteit Brussel (VUB, Brussels, Belgium)
- Division of Advanced Technology for Medical Imaging of the National Institute of Radiological Sciences (Chiba, Japan)
- Nishina Center for Accelerator-Based Science, RIKEN, Wako, Saitama 351-0198, 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)
- LUNA international collaboration (Gran Sasso, Italy),
- GSI, Germany

In the experiments are also involved co-workers from other foreign institutes:

- Institute of Physics and Power Engineering (IPPE), Obninsk, Russia
- Institute of Nuclear Chemistry (FZ Jülich, Germany)
- Faculty of Science, Hokkaido University, Sapporo 060-0810, Japan
- Physics Department (Cyclotron Facility), (Nuclear Research Centre, Atomic Energy Authority, Cairo, Egypt)
- Nuclear Data Section, IAEA, Wien A-1400, Austria

Theoretical calculation of the measured data was done mostly in collaboration with scientist from Institute of Theoretical Physics, IPPE, Obninsk, Russia (ALICE-IPPE, TALYS, EMPIRE codes). We also use our own calculations using the EMPIRE code

Comparison is made in all cases with results from TENDL-2017 and 2019 libraries (TALYS, Nuclear Research and Consultancy Group (NRG) Petten, The Netherlands))

Data compilations and evaluations

EXFOR compilations

Our responsibility to compile experimental data of charged particle induced nuclear reactions reported from Debrecen, Brussels and Jülich were compiled in EXFOR format.

In the last 3 years about 40 papers containing new experimental cross section data were compiled in EXFOR.

CRP and TC participations

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

Staff

The staff partly connected to the experimental nuclear reaction data measurement practically did not change (F. Tárkányi, S. Takács, F. Ditrói, A. Szelecsényi, Z. Kovács, Z. Szűcs, K. Brezovcsik, A. Fenyvesi). Out of them two (F. Tárkányi, S. Takács). Physicists are working also on data compilation and evaluation.