

# I. VEKUA INSTITUTE OF APPLIED MATHEMATICS

## OF TBILISI STATE UNIVERSITY – 45

On October 29, 1968, the independently financed Scientific-Research Institute of Applied Mathematics was founded at Tbilisi State University (TSU). As basic scientific directions were determined:

- Investigation (by using computers) of multi-dimensional differential and integral equations and development of methods of their solutions for the problems of shell theory, theory of elasticity, meteorology and radiation transfer theory
- Investigation (by using computers) of problems of probability theory and mathematical statistics and their applications to problems of dynamic programming, mass service and processing of experimental data
- Elaboration (by using computers) of problems of mathematical economics and their implementation in planning and management in different fields of economics with application of computers
- Theoretical investigation and elaboration (by using computers) of numerical methods for solving some problems of optimal control
- Development of theoretical and applied problems of programming, including the formation of the system of algorithms and programs to solve the typical problems on the computer
- Development and application of methods of applied mathematics and computer techniques in organizing the teaching process at Universities.

The Institute's aims were to carry out research on topical problems of applied mathematics, to involve University professors, teachers, and students in research activities in order to integrate mathematics into the study processes and research, and to implement mathematical methodologies and calculating technology in the non-mathematical fields of the University.

Ilia Vekua was the Director of the Institute until his decease in 1977. In 1978, the Institute was named after its founder and first Director – Ilia Vekua.

A. Bitsadze and D. Gordeziani were subsequent Directors of the Institute in the periods 1979-1983 and 1986-2006, respectively, and since 2006 the Director of the Ilia Vekua Institute has been George Jaiani.

For many years the Ilia Vekua Institute of Applied Mathematics had been the most significant scientific center of a new type and was equipped with the most advanced computer equipment in the southern Soviet Union. Soon it became powerful research center with more than 400 person strong staff, mostly young researchers and engineers. The Institute's Seminar was established and guided by Ilia Vekua until his death and had a great scientific reputation in the Soviet Union and abroad. Since 1985 the Institute has been organizing annual conferences named “Enlarged Sessions of the Seminar” with the participation of scientists from Georgia and abroad. At that period the Institute was the initiator and main organizer of Third Symposium in the Shell

Theory organized under aegis of the International Union of Theoretical and Applied Mechanics – IUTAM (1978, Chair of the International Scientific Committee I. Vekua), of the All-union Conference (by participation of scientists from abroad) on “Partial Differential Equations and Their Applications” (1982) and symposium on “Modern Problems of Mathematical Physics” (1987). The Institute’s members have received numerous awards, namely, I. Vekua (the Soviet State Premium, 1984, posthumous), T. Gegelia, M. Bashelishvili (the Georgian State Premium, 1971), A. Bitsadze (N. Muskelishvili Premium of the Georgian Academy of Sciences, 1980), I. Kiguradze (A. Razmadze Premium of the Georgian Academy of Sciences, 1976), G. Jaiani (Medal and Premium of the Georgian Academy of Sciences for young researchers, 1978), Z. Chanturia (A. Razmadze Premium of the Georgian Academy of Sciences, 1981), and I. Tavkhelidze (I. Vekua Premium of the Georgian Academy of Sciences, 1984). From the very beginning the Institute has cooperated through bilateral and multilateral agreements with other leading centers and universities abroad, in particular, with V. Steklov Mathematical Institute, M. Keldysh Institute of Applied Mathematics, I. Kurchatov Institute of Nuclear Energy, M. Lomonosov Moscow State University, scientific institutions of Novosibirsk, Kharkov Institute of Physics and Technics, Friedrich Schiller University (Jena), A. Komensky University (Lodz). J.-L. Lions, G. Fichera, A. Tikhonov, A. Samarski, G. Marchak, A. Weil, R. Glovinsky and others have visited the Institute and gave lectures. The Institute’s members as trainees visited significant scientific centres of the World such as Paris Universities, INRIA (D. Gordeziani, K. Tsiskaridze), University of Rome “La Sapienza” (G. Jaiani), etc. For his part, scientist from USA, Great Britain, East Germany, Poland, Chekh and Slovak Republics, Bulgarian, North Vietnam visited the Institute as trainees and for the scientific work.

The Institute’s members have worked on contracted projects, including those for the government. Researches of this kind in this direction have been implemented in industry with economic effects annually one million soviet rubles at the average. In this connection the achievements of the Institute have been marked with the premium of the Government of the Soviet Union (G. Sharashidze) and the premium of the Georgian Government (D. Gordeziani, R. Devdariani).

The contacts of the Institute with educational processes at TSU and other institutions were widened and deepened. Annually about 1500 students did practical works of different kind at the Institute. Annually about 200 students participated in the scientific activities of the Institute.

The school of young mathematicians and programmers of the Institute played an important role in the sense of professional orientation of high school pupils.

In nineties of the last century because of very hard financial-political situation in Georgia the research at Institute become difficult; a great part of members left the Institute, some of them went abroad. Nevertheless, those scientists who remained with their enthusiasm keep preserving the scientific potential and material and technical basis and scientific library and as possible renewed computer technics of the Institute.

Even throughout the most difficult times for Georgia, the Institute continued to be a successful scientific center. During those years the Institute published 14 monographs by Pitman Advanced Publishing Program, North-Holland Publishers, Lodz University Press, Наукова думка (Scientific Thought), Hayka (Science) and Georgian publishing houses as well. They also published 339 articles in foreign and Georgian periodicals. At the same time 11 doctoral and 11 pre-doctoral theses were defended by researchers at the Institute; the works of seven researchers received awards of the Georgian National Academy of Sciences: G. Manjavidze (A. Razmadze Premium, 1991), T. Tadumadze (A. Razmadze Premium, 2001), S. Kharibegashvili (N. Muskhelishvili Premium, 1997), M. Basheleishvili (N. Muskhelishvili Premium, 2000), A. Kharazishvili (N. Muskhelishvili Premium, 2009), T. Vashakmadze (I. Vekua Premium, 1993), I. Koplatadze (I. Vekua Premium, 1996), T. Kaladze (I. Vekua Premium, 2002); four were awarded the President's scholarship; ten were awarded Soros fellowships; two TSU students involved in the Institute research activities obtained the President's award; and six students won awards at Soros conferences.

In the 1990s, in particular, the following projects (which were awarded SofTEC99 (Republican scientific-technological conference-exhibition "Applied program technologies" 1999) diplomas) were being carried out:

- Preparation of all levels of elections in the Georgian Republic (joint with Central Election Commission of Georgia);
- Automated measuring systems of environmental (water, air) pollution (joint with the National Center of Environmental Monitoring);
- Unified TSU computer network, connected to the internet;
- Computer model of urination and specialized game development (joint with specialists of urological diseases in children);
- Computer network for the G. Chilashvili Gurjaani Gymnasium (joint with the Gymnasium specialists).

In the 1990-s the following centers had been acting at the Institute:

- Tbilisi International Center of Mathematics and Informatics – TICMI (with the support of the European Mathematical Society; TICMI acts at present as well);
- Sociological Information and Public Opinion Research Center (with the TSU Faculty of Geography and Geology), which was collaborating with the United States Information Agency (USIA), the United Nations and certain organizations of the European Union;
- Teachers Advanced Training Institute of the Ministry of Education of Georgia;
- Computer Training Center for Unemployed, Ministry of Social Security of Georgia;
- Training Center in Mathematics for Georgian Secondary School Teams (with the support of the Georgian Mathematical Union). Members of these teams were awarded one gold, four silver, 14 bronze medals and many honorable prizes at international mathematical Olympiads.

Since 1997 the agreement regulating direct scientific cooperation of the Institute with Department of Mathematics “Guido Castelnuovo” of Rome University “La Sapienza” is in force.

From 2005-2008, reforms in Georgian research institutes became very intense. This process had its positive and its painful aspects. Presently the Institute employs 50 persons, including three PhD students and seven graduate students. In 2007-2012, the members of the Institute published a total of 381 articles in international and Georgian journals, including 155 well-known scientific journals with impact factor. At the same time, the Institute published 9 monographs by Springer (G. Jaiani), Kluwer (T. Vashakmadze), the Tbilisi University Press (G. Akhalaia, G. Giorgadze, V. Jikia; N. Chinchaladze; D. Natroshvili; J. Rogava, M. Tsiklauri), Nova Publisher (G. Giorgadze; G. Pantsulaia), besides textbooks and lecture courses, three of which were published in hard copy by the Tbilisi University Press and 10 electronically. Institute's members gave 234 talks at 20 Institute's and 135 international conferences.

In 2007-2012, 18 projects were carried out through funding from the Georgian National Science Foundation and Shota Rustaveli National Science Foundation (for fundamental and applied researches, researches with countrymen working aboard, and within the framework of bilateral programmes with CRNS (France) and CNR (Italy); leaders: J. Antidze, N. Chinchaladze, G. Giorgadze, D. Gordeziani, G. Jaiani, T. Jangveladze, T. Kaladze, N. Khatiashvili, N. Khomasuridze, R. Koplatadze, R. Omandze, M. Svanadze, T. Tadumadze, M. Tsiklauri). Three were funded by INTAS (The International Association for the Promotion of Cooperation with Scientists from the New Independent States of the Former Soviet Union; leaders of Georgian teams: G. Aburjania, J. Antidze, G. Jaiani) and three others by CRDF/GRDF (Civil Research and Development Foundation/Georgian Research and Development Foundation; leaders of Georgian teams: G. Jaiani, T. Kaladze), one project – by FP7 (Seventh Framework Programme; Group leader T. Davitashvili), two projects – by STCU (Science and Technology Center in Ukraine; leaders of Georgian teams G. Giorgadze), and one more project – by ECONET (Dynamical Simulation and Network Analysis Software for Ecological Systems; leader of Georgian team T. Tadumadze).

Until 2005 the Institute had its own printing house with the Tbilisi University Press and published about 15 scientific brochures and about 10 books annually, including monographs by its members and collaborators, for example, the monographs of prominent scientists S. G. Mikhlin and V. G. Maz'ya. Today the Tbilisi University Press publishes six peer-reviewed scientific journals of the Institute, in English and with international editorial boards. Two of them are journals of TICMI. Within the framework of exchange agreements, the Institute continues to exchange the above journals with scientific centers around the world and receives about 50 well-known journals in return, in the fields of mathematics, mechanics and informatics for the Institute's library. The Institute has an electronic subscription to the journal *Mathematical Reviews* and users from the TSU Central Library and other TSU buildings have access.

From the very beginning, the Institute scientific staff members were involved in teaching at TSU through combined jobs, hourly contracts, supervising theses and managing students' educational and practical works. Thus the Institute maintains its scientific potential and international reputation. This is also illustrated by the number and quality of international conferences and symposia held there under the auspices of international organizations. Three examples include symposia on shell theory (in 1978 and 2007) sponsored by IUTAM (International Union of Theoretical and Applied Mechanics) and the ISAAC (International Society for Analysis, its Applications and Computation) Conference (2007). In 2008 the Institute hosted an international conference on "Modern Problems in Applied Mathematics" and in 2010, 2011, and 2012 held conferences by the Georgian Mechanical Union with the participation of foreign scientists.

Some Institute members have continued their professional activities abroad, for example in the USA, Israel, Holland, Germany and Austria. Others continue working in Georgia, for example in the Department of Mathematics and the Department of Computer Sciences of the Faculty of Exact and Natural Sciences of TSU, the A. Razmadze Institute of Mathematics, and the Georgian Technical University. However, despite different career routes, they continue to maintain scientific ties with the Ilia Vekua Institute of Applied Mathematics.

**At the Institutue in the different periods before 2006 there were the following departments**

- Shell theory (Head first V. Zhgenti then T. Meunargia)
- Mathematical physics (Head first L. Magnaradze then I. Tavkhelidze)
- Mechanics of continua (Head T. Gegelia)
- Differential equations and optimal control (Head first G. Kharatishvili then T. Tadumadze)
- Mathematical logic and theory of algorithms (Head first Sh. Pkhakadze then Kh. Rukhaia)
- Probability theory and mathematical statistics (Head E. Nadaraia)
- Problems of physics and engineering (Head A. Khvoles)
- Mathematical and cybernetic problems of economics (Head first A. Toronjadze then R. Chitashvili)
- Numerical methods and programming (Head Sh. Nikolaishvili)
- Computers (Head N. Svanidze)
- Differential and integral equations of mathematical physics (Head L. Magnaradze)
- Numerical methods (Head first D. Gordeziani then R. Botchorishvili)
- Ordinary differential equations (Head I. Kiguradze)
- Projective methods (Head T. Vashakmadze)
- Theory of elasticity (Head M. Basheleishvili)
- Complex analysis and its applications (Head first G. Manjavidze then N. Avazashvili)
- Applied mechanics (Head R. Sajaia)
- Transfer theory (Head Sh. Nikolaishvili)

- Applied works (Head G. Sharashidze)
- Partial differential equations (Head A. Bitsadze)
- Hydrodynamics (Head first R. Devdariani then G. Devdariani)
- Mathematical programming and control systems (Head K. Tsiskaridze)
- Functional analysis and their applications (Head Z. Chanturia)
- Discrete mathematics (Head A. Kharazishvili)
- Scientific-technical Information (Head K. Zhvania)
- System Programming (Head J. Antidze)
- Computing of Economical information (Head M. Jibuti)
- Software (Head first A. Kvitalashvili then A. Tsiskaridze)
- Electronic modeling (Head G. Varazi)
- Modernization of computers (Head R. Berulava)
- External devices of computers (Head S. Kipshidze)
- Computer BESM-4 (Head first N. Svanidze then Z. Didishvili)
- Computer M-220 (Head first O. Chkhaidze then K. Samsonia)
- Computer BESM-6 (Head first N. Svanidze then O. Chigvinadze)
- Computer ES-1020 (Head first N. Svanidze then A. Katamadze)
- Computer BESM-6/7 (Head first O. Chkhaidze then J. Ukleba)
- Computer ES-1033 (Head first K. Samsonia then A. Katamadze then J. Gabrashvili)
- Computer ES-1061 (Head J. Kelbakiani)
- Computing of Economical information (Head M. Jibuti)

#### **Laboratories**

- Solid-fluid interaction problems (Head N. Khomasuridze)
- Investigations of extraordinary phenomena (Head G. Aburjania)
- Investigations of magneto-hydrodynamic processes in plasma (Head T. Kaladze)
- Mathematical Modelling of Hydro-Meteorological Processes (Head T. Davitashvili)
- Hardware and VLSI Design (Head A. Gamkrelidze)
- Hardware (Head I. Khokhiashvili)

and besides Youth Centre for implementation and development of information technologies (Head G. Avalishvili)

In 2006 the Institute was reorganized. Since that time the Institute is acting in four scientific directions:

- Mathematical problems of the mechanics of continua and related problems of the analysis (Head G. Jaiani)
- Mathematical modelling and numerical mathematics (Heads: D. Gordeziani, T. Vashakmadze)
- Discrete mathematics and theory of algorithms (Head A. Kharazishvili)
- Probability theory and mathematical statistics (Heads: E. Nadaraia, G. Sokhadze)

At present, the Institute sees its mission as sixfold:

- Undertaking fundamental and practical scientific research in applied mathematics, mathematical and technical mechanics, industrial mathematics and informatics, undertaking state and private sector contracts to provide expert services;

- Offering the university a high-level computer technology base for University professors and teachers; research employees and students of every description undertaking their scientific research activities;
- Supporting the involvement of going to specialize within the framework of scientific directions of the institute PhD and graduate students in scientific grants of the Institute and their participation in student, young researcher, local and international scientific conferences;
- Supporting application of mathematical methods and computer technologies by non-matematician under-graduate, graduate, and PhD students during preparation of their theses, especially on interdisciplinar topics;
- Training of PhD, graduate, and under-graduate students within the framework of the scientific directions of the Institute and providing their employment within the Institute;
- Proposing the Institute for different of kinds laboratory and practical works of students specialized in various mathematical and non-mathematical fields.

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