ISTC Annual Report 2016 – Exploring New Frontiers
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STATEMENT OF THE CHAIRMAN OF THE ISTC GOVERNING BOARD

During periods of rapid technological transformation and societal change, the value of international scientific cooperation increases. This helps to explain the surge in interest around the world in the International Science and Technology Center (ISTC). The ability of the Parties to promote the health, prosperity and security of their citizens in this volatile environment has been further advanced by the renewed legal status of the ISTC. The necessary ratification or legal approval steps taken by the governments of the Parties, some involving complex constitutional processes, demonstrate the commitment of the Parties to the renewed International Science and Technology Center.

The spirit of the renewed Science Center is a true partnership. The focus is more on the priority needs of the member governments. The most powerful tool is the multi-disciplinary, multi-national science cooperation that advances each Party's science and technology more quickly. The goal is to enhance wellbeing while promoting the important international security goal of nonproliferation. The ISTC has made great contributions as it has transformed itself from an intergovernmental organization focused on the almost overpowering and threatening legacies from the past to a lean and agile vehicle for addressing the emerging challenges of the future.

The year 2016 was transformational for the ISTC. The move into the wonderful new headquarters at Nazarbayev University in Astana, the capital of Kazakhstan, was completed successfully. The Parties reached an agreement on the principles for continuing the work of the ISTC and important legal documents were completed. The year 2017 will mark major steps to build upon the new consensus. Already additional partners from important regions of the world have joined the Center. This brings additional resources, both financial and intellectual, to our efforts.

This year, in Astana, the ISTC will help support Expo 2017, focused on "Future Energy." Five years ago, the International Exhibitions Bureau (BIE) selected Astana for this important event. At least one hundred countries will attend and a comparable number of large, international businesses will join in. Several million people are expected to attend from June to September 2017. This presents an excellent opportunity for the Center to ensure that existing and possible future Parties and Partners are familiar with the contributions of the International Science and Technology Center and the opportunities that may be available to them. The location of Expo 2017 is adjacent to the campus of Nazarbayev University and thus very close to the ISTC headquarters.

The momentum that is building for 2017 is the result of successful international cooperation. Of particular value has been the leadership of the Government of Kazakhstan. Many practical legal, logistical, and financial steps were necessary. More important, in many ways, however has been the leadership's commitment to the vision of a stronger, more flexible ISTC. On behalf of the Governing Board, I wish to thank the President of Kazakhstan for his strong support of that vision. Throughout the Kazakh government, complex actions were completed because of commitment to that vision. Timely initiatives were taken by senior ministers and by

the President of Nazarbayev University to keep the advancement of the consensus agreement on schedule.

Sound advice and support were also essential from other officials and experts in all of the capitals of the member Parties. We have also benefited greatly from the Science Advisory Committee and its peer review process. Along with Partners from industry, government agencies, and non-governmental organizations, we have been able to network with a broad set of the finest science and technology activities around the world to ensure the quality of our own projects.

Not only must our science and technology be first rate, but also the day-to-day management of the organization must meet the highest international standards including our audits, personnel practices, and efficiency. We continue to improve and get high scores. For this, we must thank our Executive Director, David Cleave, and the Secretariat. They are responsible to the Board, but they are also the structure that facilitates our projects among scientists and engineers from around the world. They also work closely with professionals in the capitals of the Parties to ensure that the Parties interests are promoted in every action we take. Our Branch Offices also play a vital role in coordination with both scientists and the governments of the countries in which they reside.

Over a quarter of the countries of the world have participated in projects or seminars under the auspices of the ISTC. This has involved over 75,000 scientists, engineers, mathematicians, and senior technical staff. The ISTC has developed more flexible ways to bring an even more diverse group of participants in the future. During 2017, the Center will engage in greater outreach and will entertain the possibility of additional Parties.

To the Parties, to participating scientists and institutions, to the officials of the governments with whom we work, to our own staff, the Governing Board of the ISTC pledges to continue to advance the common cause of advancing our science and technology for peace, prosperity, and wellbeing for all humanity.

Ronald F. Lehman II
Chair of the Governing Board
International Science and Technology Center

STATEMENT OF THE EXECUTIVE DIRECTOR

2016 saw the first full year of operations in Astana since moving and transitioning to the Head Office in Kazakhstan. In that period the office staff consolidated their knowledge and understanding of the role of the ISTC and importance of many new programs, which have commenced and newly expanded the ISTC's reach and development.

From the signing of the ISTC's Continuation Agreement on 9th December 2015 at the 61st Governing Board meeting in Astana, the Country Party Members have proceeded along the road to ratify the new Agreement and in 2017 we anticipate the outstanding countries to complete ratification of the Agreement in the coming months.

Whilst the funding of regular projects has been curtailed over recent years, this has been replaced with new funding instruments and program activities. With the new direction of Targeted Initiatives in thematic funding areas having been approved by the Governing Board, the ISTC has embarked on programs in biosafety and biosecurity, dual use and export control, seismic and mitigation monitoring and hazard mitigation, nuclear non-proliferation, security and safety capacity, radiological source risk mitigation, clean/renewable energy and energy efficiency and Astana EXPO 2017.

Some of the most significant highlights and accomplishments of 2016 are listed below:

At the end of 2015, the ISTC and the European Union signed a delegation agreement for the implementation of the EU CBRN Centers of Excellence Project 53. In 2016 work was initiated on Project 53, which is implemented in cooperation by the ISTC, and an EU team of experts and local implementers. The objective of the project is to harmonize local legislation according to the international biosafety and biosecurity standards, as well as to provide training in this area to the participating countries from Central Asia. To that effect, the ISTC has reached out to Afghanistan, Kyrgyzstan, Kazakhstan, Mongolia, Pakistan, Tajikistan and Uzbekistan to join the project. This is very much part of the Governing Board's new strategy and policy on outreach to encourage new countries towards membership and partnership with the ISTC.

Initially, four countries (Afghanistan, Kyrgyzstan, Tajikistan and Uzbekistan) joined Project 53 and at the end of September 2016 national kick-off meetings were organized in each participating country. In December, Mongolia formally joined the project, and ISTC is in communication with Kazakhstan to join as well. Work has started on preliminary legislative assessments and identification of training needs and available infrastructure.

New EU Partner's Initiatives were signed at the end of 2016 - MC 5.01/15B under the instrument for nuclear security cooperation and P-60 under the instrument contributing to stability and peace. These two ISTC-managed projects will provide support to various African states in nuclear safety, security & safeguards. The first one focuses on four African states, Tanzania, Malawi, Zambia and Namibia, involved in the mining, processing and transport of uranium ore and products. It aims to strengthen the capacity of the Southern African Development Community (SADC) in coordinated monitoring and in harmonization of the nuclear safety governance of the SADC Member States. The second program will cover

twelve African countries and will include nuclear and radiological security training, border control and monitoring, nuclear waste management specifically securing orphan sources, legal frameworks and legislation on safety, security and safeguards on CBRN risks mitigation and response preparedness. This also sees the ISTC starting work in new non-ISTC countries.

In fact, the ISTC will begin two new projects in 2017 in both Iraq (with the tender and supply of equipment for a static and mobile radiochemical laboratory), and also in Amman, Jordan for the construction of a training center for MESIS (Middle East Scientific Institute for Security) that will be used to address CBRN risks through the training of local and regional experts.

Such expansion of initiatives and activities into new countries is ground-breaking territory for the ISTC.

From the US side, actions have been moving ahead with various Targeted Initiatives mainly on the seismic cooperation and hazard mitigation monitoring US DOE-funded TI involving both the ISTC and the STCU, based on long-standing seismic activities in the Caucus and Central Asian region. Initial activities included provision of computer equipment and software for seismic institutes in Kazakhstan, Kyrgyzstan and Tajikistan, and logistics support for Kazakh and Kyrgyz scientists travelling to a US National Laboratory for training.

Another US DoE funded Targeted Initiative on radioactive source risk mitigation, again involving both Centers, conducted kick-off engagement meetings in Atyrau and Astana and discussed the importance of the risk posed by the use of small, mobile well logging sources. Furthermore, it has been agreed to form a working group, led by a technical consultant to perform a technology status report. The report will provide an overview of regional usage of radioactive sources in well logging, industry operational requirements and security measures, and industry familiarity with suitable replacement technologies. The Initiative will culminate in a workshop that brings industry, government, and other international partners together to discuss source security in well logging.

As to news from our Japanese Party, Japan has moved to start the provision of a non-proliferation and nuclear security training to support the activities of the newly established Kazakhstan Nuclear Security Training Center (NSTC) which is dedicated as a regional capacity building center for nuclear non-proliferation security and safety. This support will be provided by JAEA as a joint program with the US DOE/NNSA. This support provides training exercises to CIS experts in JAEA Tokai as well as at the NSTC Centre itself. This program started as one of the main vehicles of the targeted initiative on nuclear non-proliferation, Security and Safety capacity building.

During 2016, the ISTC, in collaboration with the UK MoD's International Biological Security Program, initiated two three-year projects. These projects are «Improving capabilities to detect and characterize Brucella in the veterinary and public health sectors in the Republic of Tajikistan» and «Molecular characterization of field isolates and improving surveillance for rabies in Tajikistan». Both projects aim to improve biosafety and biosecurity in Tajikistan, improve communication between the human and animal health sectors, and build capacity to improve diagnosis and control. The introduction and training of modern molecular techniques will give insight into the disease prevalence in both the human and animal populations within Tajikistan, with the aim of implementing targeted control strategies for both Brucella and rabies. Both projects will therefore also contribute to an improved health situation in both the human and agricultural sectors.

The ISTC was involved in the content arrangements for Astana's 2017 EXPO. A Memorandum of cooperation between EXPO & ISTC for free exhibition space was signed on 8 August, 2016 with the Vice Minister of Foreign Affairs, and National Expo Commissioner Mr. Zhoshibayev.

In September 2016, ISTC participated in a meeting organized by the Ministry of Foreign Affairs and the National Company «Expo 2017-Astana». ISTC invited various scientific experts to speak at the Forum held in Astana in September as well as inviting 14 Science

Experts for participation in 5 Expert Panels within the EXPO "eBPa" Best Practice Projects Competition for the following areas: a) renewable and alternative energy; b) energy efficiency and traditional energy; c) energy storage; d) energy distribution; and e) using natural energy resources.

In January 2017 the ISTC participated in the World Energy Summit held in Abu Dhabi at the request of and in support of the Astana EXPO 2017 and also invited 2 Science Experts who delivered presentations at the Summit.

For 2017 the ISTC has committed to invite 24 Science experts/speakers during the 24 weeks of EXPO and on the various themes on Future Energy. The ISTC will also invite 5 Nobel Laureates for the final Forums at the end of the EXPO in August / September 2017.

On the home front the ISTC's staff as at the end of 2016 numbered 23 local Kazakh Staff along with 8 Branch Staff. Two additional temporary fellow grantee staff were hired to assist in the specific activities of the EU P53 Bio-Safety, Bio-Security Instrument and the Astana EXPO 2017. As regards the Branches, the staffing will be reduced to one ISTC employee per branch from 2017. The Governing Board has also approved the closure of the Almaty Branch Office as of the end of the year and all operations are now centered out of the Astana Head Office.

The ISTC continues to develop excellent relations with the Kazakh Government and especially with the Ministry of Education and Science, Science Committee, and other Kazakh stakeholders as well as our office hosts, Nazarbayev University.

The current office at Nazarbayev University was seen as a temporary facility for a few years and 2017 will see ISTC move to new and larger premises, although exact timing and location are still under negotiation. The current office facility is now filled to capacity.

I would like to thank the Governing Board and all the ISTC Party Representatives for their strong support and guidance and commitment to the ISTC over this last year as the ISTC has embarked on its new journey into new countries which will likely see further outreach activities taking place in 2017.

The ISTC can look forward to an exciting and busy 2017 as many new initiatives begin to progress and take shape.

Lastly, any organization can only be as good as its staff and the ISTC is no exception. The ISTC Staff deserve much credit for their hard work, enthusiasm and dedication during 2016. Their contribution will only improve as they become more experienced as time goes by.

On behalf of the ISTC, I look forward to many more highlights and accomplishments on what will be the busiest yet for the new ISTC.

David Cleave
Executive Director
International Science & Technology Center

FINANCIAL ACTIVITY

With the ISTC's transition completed in FY2015, the Center was able to focus on projects and program activities in scientific research. The value of new projects that were launched in FY2016 increased to $3.8 million from $1.6 million in FY2015. While selection and approval of traditional projects by the Funding Parties had a slow start in FY2016, new untraditional program agreements in the amount of €14.2 million were provided by the European Union and will be implemented over three years. In FY2017, the EU Party is estimated to provide an additional €2 million for new programs while the U.S. partners is estimated to fund $3 million in new projects.

The total cost of the projects and program activities implemented in FY2016 reached $6.6 million, which is a growing trend from the transitional FY2015.

Supplemental Budget (SB) programs established to promote the international scientific and commercial development of research results represented 43% of the ISTC's project and program activities in FY2016. Scientific conferences and workshops in the amount of $700 thousand facilitated participation and training of over 1,000 scientists.

The ISTC's continued commitment to efficiency and effectiveness led to a reduction of FY2016 Administrative Operating Budget (AOB) by 21% in comparison with FY2015. The reduction trend continued into FY2017 with additional 23% cut in the AOB of FY2017.

In FY2016, KPMG Baltics SIA issued the results of the ISTC's FY2015 financial operations. The external auditors noted a successful transfer of financial data to the new accounting program Navision (NAV15) and removed several minor recommendations that were implemented within the financial management and accounting system in FY2016. In addition, the ISTC and STCU carried out a joint open call for external audit tender in FY2016 and KPMG Baltics SIA was awarded the contract to perform external audit of the Centers' FY2016 and FY2017 operations.

OVERVIEW OF ISTC ACTIVITIES IN TABLES

2016 Project Funding - by source

	2016	1994-2016
EU (USD)	250,000	247,238,848
Japan	195,575	65,776,370
USA	1,004,280	229,905,216
Canada	0	35,302,224
Finland	0	1,185,960
Sweden	0	3,831,906
Norway	0	1,881,450
Korea	0	5,161,952
Partner	300,000	286,076,634
Other	0	12,566,221
Total funds allocated (USD)	**1,749,855**	**888,926,781**

2016 Project Funding - by beneficiary country

Country	Number. of funded projects 2016	Allocated funds 2016 (USD)	Number of funded projects Total 1994-2016	Allocated Funds Total 1994-2016 (USD)
Armenia	2	708,705	182	44,524,863
Belarus	0	0	100	27,481,454
Georgia	2	441,150	170	32,990,797
Kazakhstan	1	300,000	207	76,004,315
Kyrgyzstan	1	300,000	94	24,803,074
Russia	0	0	2033	667,127,177
Tajikistan	0	0	51	15,073,657
Ukraine	0	0	1	64,296
Total	**6**	**1,749,855**	**2838**	**888,926,781**

2016 Partner project funding and total partner funding - by party

Party	Type of Partner Company	Number of projects 2016	Partner Funding 2016 (USD)	Number projects Total 1994-2016	Partner Funding Total 1994-2016 (USD)
Canada	Total	0	0	5	622,456
	g	0	0	2	390,000
	n	0	0	3	232,456
European Union	Total	1	300,000	143	55,690,362
	g	0	-	82	44,048,902
	n	1	300,000	61	11,641,460
Japan	Total	0	-	65	8,469,857
	g	0	-	17	3,169,953
	n	0	-	48	5,299,904
Korea	Total	0	-	11	2,119,189
	g	0	-	7	1,780,000
	n	0	-	4	339,189
United States	Total	0	-	570	219,025,770
	g	0	-	537	212,637,808
	n	0	-	33	6,387,962
****Total:**	**Total**	**1**	**300,000**	**794**	**285,927,634**
	GAP	0	-	645	262,026,663
	Non-GAP	1	300,000	149	23,600,971

Quantity of ISTC scientists

Country	Number of Scientists in 2016	Amount of Grant Payments in 2016 (USD)	Number of Scientists in 1994-2016	Amount of Grant Payments in 1994-2016 (USD)
Armenia	246	627,232	3,537	29,241,144
Belarus	0	0	1,868	15,923,194
Georgia	291	770,205	2,676	21,250,032
Kyrgyzstan	104	275,570	1,418	11,139,262
Kazakhstan	234	1,059,989	4,903	39,933,570
Russia	0	0	60,935	434,165,510
Tajikistan	254	746,235	767	7,612,325
Total	**1,129**	**3,479,231**	**76,104**	**559,265,038**

2016 Project Funding - by technology area

Tech area	No. of projects 2016	Allocated funds 2016	No. of projects	Allocated funds
Agriculture	2	591,150	94	35,432,565
Biotechnology	3	850,000	343	129,913,787
Chemistry	0	0	210	56,069,154
Environment	1	308,705	447	138,536,632
Fission Reactors	0	0	275	98,345,836
Fusion	0	0	52	15,622,334
Information and Communications	0	0	107	28,536,916
Instrumentation	0	0	136	37,424,855
Manufacturing Technology	0	0	75	21,412,969
Materials	0	0	219	70,026,612
Medicine	0	0	243	86,618,424
Non-Nuclear Energy	0	0	64	22,470,981
Other	0	0	18	2,798,135
Other Basic Sciences	0	0	30	6,859,930
Physics	0	0	420	109,012,928
Space, Aircraft and Surface Transportation	0	0	105	29,844,723
Total	**4**	**1,749,855**	**2,838**	**888,926,781**

MAIN EVENTS OF 2016

The 25th Conference of the Asian Pacific Association for the Study of the Liver – Modern Hepatology

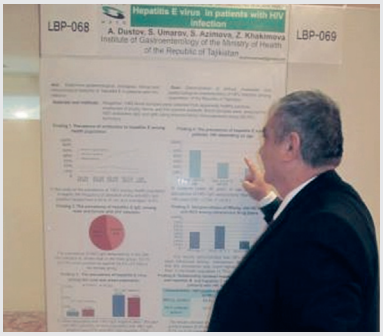
The APASL conference aimed to raise awareness of the current status and future prospects of developing a better understanding of the roles, objectives and operations of the various institutions, academics, companies, associations, non-profit organizations, and other related sectors.

Under the theme of "Modern Hepatology" the conference showed high quality content full of the most up-to-date information and cutting edge lectures by eminent researchers. In order to reconfirm the significance of achievements on basic and clinical practice, the scientists gave a mature, time-honored, well-established explanation of Hepatology.

The conference provided an excellent opportunity for more than 4,000 delegates of experts from more than 60 countries to share state-of-the-art views, values, experiences and practices regarding liver diseases, such as Viral Hepatitis, Liver Cancer, NASH, Liver Failure and other topics.

The event enhanced communication and collaboration among scientists and clinicians to deliver mutual benefits to the people in the Asian Pacific region, where liver disease has been one of the most common and serious problems.

Participants at the 25th Conference of the Asian Pacific Association for the Study of the Liver



Dr. Abdusamad Dustov (Institute of Gastroenterology of the Ministry of Health of Tajikistan) presents his project findings at the APASL 2016

Promising talks in Japan for US, Japan, Kazakhstan multilateral collaboration on Nuclear Security Training

In June 2016, the International Science and Technology Center coordinated the visit of a Kazakhstan delegation from the Committee for Atomic and Energy Supervision and Control to Japan to tour the Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) of Japan Atomic Energy Agency (JAEA) and to discuss the best practices for managing and operating a nuclear security training center. In addition, opportunities for future cooperation, including capacity building for NSTC's instructors with support from the ISCN, were discussed. The visit was funded by the Japan JAEA and U.S. DOE/NNSA and coordinated through the ISTC. By the time of the visit of the

Kazakhstan delegation meets with the representatives of Lawrence Livermore National Laboratory (USA) and ISCN of JAEA (Japan)

Kazakhstan delegation to Japan, Nuclear Security Training Center (NSTC) of Kazakhstan was under construction and it was expected to enter into operation by the beginning of 2017.

The talks were conducted between the Kazakhstan delegation (the committee for Atomic and Energy Supervision and Control; Institute of Nuclear Physics), US Department Of Energy National Nuclear Security Administration (DOE/NNSA) represented by Lawrence Livermore National Laboratory, and representatives of ISCN of JAEA on June 7-8 2016 in Tokai-mura. The talks included topics such as "Experience of Operation and Personnel Management on Capacity Building Support (CBS) Activities in ISCN", and "Development of Training Curriculum in Nuclear Security and Safeguards". Additionally, opportunities for future cooperation amongst the Kazakhstan NSTC, the ISCN and DOE/NNSA were discussed. The Kazakhstan delegation also visited the Ministry of Education, Culture, Sports, Science and Technology (MEXT), and Ministry of Foreign Affairs (MOFA) on June 9.

Preliminary Meeting for Human Resource Development among Kazakhstan, DOE/NNSA and ISCN/JAEA June 7-8, 2016

Nazarbayev University's young researchers learn about renewable energy technologies in Japan

NU team at Renewable Energy exhibition in Yokohama

NU team in front of the LCCM (Life Cycle Carbon Minus) Demonstration House of the Building Research Institute

Visiting Energy Self-Sufficient Research House at Nihon University

Five Ph.D. students of Nazarbayev University (NU) participated in Japan's leading renewable energy exhibition and forum "Renewable Energy 2016 Exhibition" which was held in Yokohama, Japan June 29 – July 1, 2016. The young researchers also visited the satellite meeting sessions with distinguished Japanese institutes and universities. The purpose of the visit was to exchange ideas and professional interests as well as to establish contact with fellow graduate-students and research groups in Japan.

At the 11th Renewable Energy 2016 Exhibition approximately 200 companies, research institutes and universities demonstrated their research and products. The exhibition was visited by more than 25,000 people. During the exhibition, PhD students of Nazarbayev University presented their research work to visitors and other exhibition participants through posters, 3D-models and video materials.

During the visits to research institutes and universities (the Fukushima Renewable Energy

Wind Power Generation at the Fukushima Renewable Energy Institute

Attending Toyota vehicle showcase

Facilities of the Laboratory for Algal Biomass and Energy System of the University of Tsukuba

Institute, Nihon University, the University of Tsukuba and the Building Research Institute) The Nazarbayev University team became acquainted with various research activities and research facilities of distinguished universities and institutions, visited their laboratory facilities, renewable energy demonstration fields and experimental energy efficient houses. At each place PhD candidates of Nazarbayev University presented the activities in which they are involved and discussed their research projects.

The participation in the Renewable Energy Exhibition and the visits to the leading research institutions and universities in Japan provided the NU research team with technological trends in renewable energy sources. The trip was a good platform to share ideas and establish collaboration with academic and industrial partners.

This visit, supported by the ISTC, provided a great opportunity for a young generation of researchers to experience Japanese high-tech culture and to present their research on the international stage.

Certificates award ceremony at the Embassy of Japan in Astana, Kazakhstan

The Twenty Fifth Annual International Laser Physics Workshop (LPHYS'16) was held from July 11 to July 15, 2016 in the city of Yerevan, Armenia

The LPHYS workshop in Armenia marked its 25th anniversary of the Laser Physics Workshop. It was also dedicated to the 100th anniversary of the Optical Society (OSA) and the 100th birth anniversary of Alexander Prokhorov, novel prize winner for invention of lasers. It was an honor for ISTC to contribute to this memorial event. ISTC supported participation of 24 Armenian scientists and also those from other countries of Japan, UK, Kazakhstan, Ukraine, Germany and Italy.

The contribution is our second support for LPHYS following the Kyoto event in 2005. This year approximately 350 participants gathered in Yerevan. Fifty six posters were also presented mostly by students. In this way, the workshop has been spurring young researchers of laser, and bringing up creative successors. This aspect must be a vital reason why it continues for 25 years as annual event.

Website:
http://www.lasphys.com/workshops/lasphys16/

Fire Blight Workshop: with special reference to ecological aspect and control measures

During 24-27 August 2016 the ISTC, together with the Kazakh Research Institute for Plant Protection and Quarantine, organized the "Fire Blight Workshop: With Special Reference to Ecological Aspect and Control Measures" in the Ritz Carlton Almaty, Kazakhstan.

It was the first meeting with representatives from the ISTC, USA, Switzerland, Belgium, Poland, Czech Republic, Bulgaria, Romania, England, Spain, Turkey, Kyrgyzstan, Kazakhstan, Tajikistan, Uzbekistan and other countries. The main aim of this 3-day seminar was to find ways to limit the spread of the Fire Blight in Central Asia, identify and study of antagonists, bacteriophages and their application against the Fire Blight and discuss possible measures against the Fire Blight in Central Asia.

During the workshop there was a visit to four farms in the Almaty region which have the infection of Fire blight, the Dendrarium "Forest nursery" to review the species of apple Sievers and the natural habitat of Sivers apple tree in Alatau.

The participants of the workshop reviewed and discussed the study of fire blight, presenting the latest advances in relevant fields such as disease epidemiology and ecology, pathogen identification, host range, host and pathogen genetics/genomics, forecast and management strategies of disease.

The highest international level of the seminar with the participation of scientists, who have achieved great success in the study of Fire Blight, was very useful for the development of effective control measures.

Biosafety Capacity Building Training Seminar

From September 19-23th 2016, the International Science and Technology Center (ISTC) in collaboration with the Biosafety Association of Central Asia and the Caucasus (BACAC) and Regional Biosafety Training Centre (Dushanbe) delivered a regional capacity building training seminar focused on the

Crimean-Congo Haemorrhagic Fever Virus (CCHFV), Ebola virus and Zika virus. The participants included 42 leading and young scientists from the Tajik Research Institute of Preventive Medicine (TRIPM), Tajikistan, as well as representatives from Armenia, Azerbaijan, Georgia, Iran, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Turkmenistan and Uzbekistan.

The training included sessions and seminars promoting safe and secure working practices for the viruses. Laboratory-based training focused on antibody (Enzyme linked immunosorbent assay (ELISA)) and nucleic acid based techniques including Polymerase Chain Reaction (PCR) and Recombinase Polymerase Amplification (RPA) to detect/ diagnose the presence of CCHFV, as well as the safe use of biosafety cabinets. The seminar also included sessions on the current status of CCHFV globally and in participating countries, and presentations on recent Ebola and Zika virus outbreaks in West Africa, South America and related countries.

The ISTC would like to thank the international experts and specialists from BACAC and UK Public Health England (PHE) for facilitating and providing the training, the World Health Organisation (WHO) for their participation and the UK's International Biological Security Programme for co-funding the event with the ISTC Funding Parties (USA, EU). Since its inception, BACAC has led the

delivery of improved biosafety and biosecurity knowledge and training across Central Asia and the Caucasus. Please contact the ISTC (www.istc.int) and BACAC (www.bacac.net) for further details on this and future Biosafety and Biosecurity events.

Memorial scientific assembly in Semipalatinsk

The National Nuclear Center of the Republic of Kazakhstan carried out a memorial conference in its Kurchatov Branch from September 21 to 23, 2016. The event was dedicated to the 25th Anniversary of Semipalatinsk Test Site Closure.

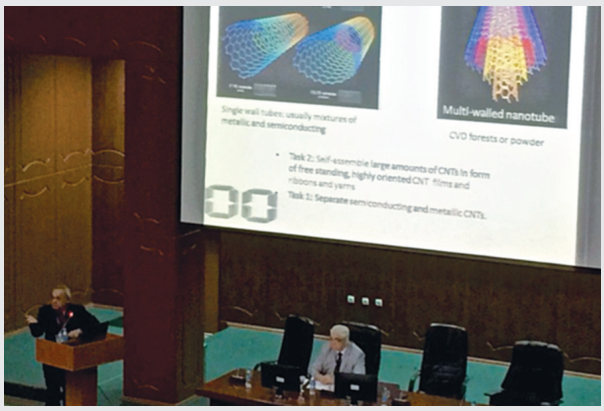
The assembly was the 7th International Scientific and Practical Conference. This forms a series of annual conferences of the NNC. However, this year's event was in memory of the 25th year after the Semipalatinsk Test Site Closure. The most impressive feature of the memorial event is not simply in looking back at the history of the site nor an array of case studies but also at a number of very latest investigations on the Semipalatinsk Test Site which were exhibited. Included presentations were: tritium migration in the site in surface and ground water bodies, complex contamination with chemical and radiological materials, and more. This feature means that the site offers a field for intensive radiological studies. The Institute of Radiation Safety and Ecology, one of the organizers, is actively providing new facilities for a plant radiology study. Nowadays, 25 year after the closure of the test site, the site has new significance to contribute to global nuclear/radiological problems peacefully.

The Institute of the Combustion Problems, Al-Farabi Kazakh National University and the ISTC joint Symposium

The symposium was organized by the Institute of the Combustion Problems, Al-Farabi, Kazakh National University and the ISTC. The symposium was opened by a plenary lecture by Prof. Z.A. Mansurov, Head of the Institute of Combustion Problems, Kazakhstan, followed by six keynote lectures on the two main subjects – carbon nanomaterials and combustion science. More than 50 oral presentations were given during a three day period. Many students of KazNU participated as audience members and also as poster presenters.

The Conducting Symposium provided an exchange of scientific information between scientists of Uzbekistan, Georgia, Italy, US, Israel, Germany, China, Japan, and other countries that contributed to the solution of important scientific and technical problems and the creation of new energy-intensive manufacturing processes with a high level of environmental safety, attracting the attention of scientists to the problems of processing hydrocarbon raw materials, development of new materials with improved properties and modern efficient technologies and nanotechnology, which is an urgent task today for the further scientific and practical development of nanochemistry and nanoengineering carbon materials in Kazakhstan.

Proceedings of the symposium in the form of extended abstracts were published in the journals “Combustion and Plasma chemistry” and “Eurasian Chemical-Technological Journal”.



ISTC OUTREACH TO POTENTIAL NEW MEMBERS AND PARTNERS AND TO ACHIEVE GREATER VISIBILITY

Enriching reliable partnerships

In 2016, a year of change and continuity of the organization, the ISTC focused its outreach activities on its major goals. It sought to harness the firm commitment and the unremitting support of its State Parties to guarantee a smooth ratification process of the Continuation Agreement signed in December, 2015.

The EU Delegation to Kazakhstan played a pivotal role in that regard, ushering the way for a sequence of visits by the Ambassadors of Member States to the ISTC main office at Nazarbayev University in Astana. The EU is one of the most active members of the ISTC Executive Board and a funding source for numerous ISTC projects in Central Asia and beyond. During his visit to the ISTC Headquarters on 25 October 2016, the Head of the EU Delegation, Ambassador Traian Hristea, outlined the EU's continuous staunch support for the organization and suggested specific forms of cooperation for the presentation of European scientific achievements at EXPO 2017. In December 2016, for the first time since the ISTC's re-location to Astana, ISTC Executive Director David Cleave briefed the EU Heads of missions on the prospects and areas for interaction with the European Union, and with interested individual Member States. European institutional and private sector actors provide examples in that regard, such as the UK Department of Defence bio-security training project in Kyrgyzstan and Tajikistan, or the engagement of the French company AREVA in the Nuclear Society in Kazakhstan training programs.

Visit of the EU Delegation

The official visits of President Nazarbayev to Japan and Korea in November 2016 provided an opportunity for the manifestation of international recognition of Kazakhstan's policies in nuclear non-proliferation, including the ratification of the ISTC Continuation Agreement. The U.S. Department of State also commended the act of ratification by the Majlis through a special statement on the occasion.

The United States Department of Energy (DOE) Secretary Ernest Moniz met with ISTC Executive Director David Cleave during the course of a visit to Nazarbayev University in Astana, Kazakhstan. During his visit, the Secretary met with the President of Kazakhstan Nursultan Nazarbayev as well as counterparts within the Kazakh Government including the Ministry of Energy. Secretary Moniz congratulated Mr. Cleave on the recent move of ISTC operations to Astana, Kazakhstan and of DOE's continued support to ISTC's regional role in facilitating science development objectives and engagement between international science communities.

The Secretariat increased the volume and frequency of correspondence with Canada and

US Secretary of Energy Ernest Moniz greeting ISTC Executive Director David Cleave at Nazarbayev University

with Norway. The latter, despite the closure, for budgetary reasons, of its Embassy in Astana, remained committed to the ISTC and encouraged the Oslo University Centre for Ecological and Evolutionary Synthesis to establish partnership relations with it.

Solidifying and diversifying the ISTC presence in Central Asia and the Caucuses

Throughout 2016, the Secretariat continued to encourage active exchange with the ISTC Parties from Central Asia and the Caucuses. On 20 September 2016, Ara Sahakyan, Ambassador of Armenia, visited the ISTC HQ to discuss the organization's strategy and outreach policy, as well as the scientific cooperation with Armenian scientists and institutes, including the role of the Branch Office in Yerevan. The next day Revaz Sakvarelidze, Chargé d'Affairs of Georgia, visited the ISTC Main Office at Nazarbayev University to discuss a similar set of topics, including the ISTC project activities in Georgia, and the role of the Branch Office in Tbilisi.

The ratification of the ISTC Continuation Agreement featured prominently on the agenda of the exchange with State Parties from the Caucuses but did not exhaust it. As Alexandre Jejelava, the Minister of Education and Science of Georgia, stated during a meeting with the EU Executive Director in Tbilisi on 5 December 2016, the ISTC is a reliable partner and a source of scientific and organizational know-how for Georgia, which are much needed in the reform efforts of the government aimed at the revival of the Georgian scientific community and at increasing its capacity for participation in regional and international research projects.

Meeting with Mr. Alexandre Jejelava, the Minister of Education and Science of Georgia

One of the first and foremost objectives of the ISTC transformation therefore was to build on the enduring commitment of its State Parties from Central Asia and the Caucuses, to expand the scope and purposes of the activities therein, to ensure proper and constructive understanding of local ownership of the organization, particularly of the HQ host country – the Republic of Kazakhstan. The ISTC Secretariat undertook an array of specific actions to examine and support the relevant foreign policy of Kazakhstan, particularly in non-proliferation and peaceful use of nuclear energy, as well as preparation for EXPO 2017.

Raising public awareness about the ISTC mission

On the eve of GB62, the Secretariat initiated an International Conference: The Manifesto. The World. XXI Century - A New Paradigm of Security of Global Development (Astana, 20 June 2016), organized by the Library of the First President and supported by the EU Delegation. The interactive discussion delivered a message about ISTC priorities and its role in the context of Kazakh foreign policy including non-proliferation and the nuclear weapons free zones (NWF) zones. This high-level forum helped raise public awareness about ISTC's mission, achievements, and priorities, and provided a favorable media environment which generated public support for the ratification of the ISTC Continuation Agreement. Members of the ISTC Governing Board, politicians, and well-known experts delivered important messages on the continuous vital importance of non-proliferation of WMD in contemporary international relations.

The same logic defined the participation of the ISTC in the

International Conference "Building a Nuclear Weapon Free World" (Astana, 28 - 31 August 2016) initiated jointly by the Senate and the MFA and the organization "Parliamentarians for Nuclear Non-Proliferation and Disarmament" to mark the 25th anniversary of the closure of the nuclear test ground in Semipalatinsk. In this case, the target groups of the positive messages about the ISTC were international participants from more than fifty countries and seven international and regional organizations, along with a selection of disarmament experts, policy analysts, and civil society campaigners. On the eve of the conference, the ISTC Executive Director David Cleave sent a letter to Foreign Minister Erlan Idrissov, congratulating the organizers of the event.

Major ISTC state Parties had an impressive array of representatives at the conference, namely: Anita Friedt, Principal Deputy Assistant Secretary in the U.S. State Department's Bureau of Arms Control, Verification, and Compliance; Daniel Poneman, former U.S. Deputy Secretary of Energy; Motome Takisawa, Parliamentary Vice-President for Foreign Affairs in Japan; Kazuo Ishiwatari, Executive Director for Peace Affairs of Soka Gakkai International; Uta Zapf, former Chair of the Bundestag Sub-Committee on Disarmament Arms Control and Non-proliferation; Jan Hoekema, mayor of Wassenaar; Hong Yong-pyo, Minister of Unification in Korea.

Another innovative step undertaken in 2016 was the ISTC's participation in Astana Inter-Parliamentary Forum on Science, Technology and Innovation (APF-STI) (Astana, 26-27 September 2016), organized in Astana by the Majlis, the Islamic Educational, Scientific and Cultural Organization (ISESCO) and the Islamic Development Bank. The meeting adopted a Declaration and praised the offer of the Government of Kazakhstan to host the First OIC Summit on Science and Technology (Astana, 10-11 September 2017). Representatives from twenty-five OIC member states and organizations attended the event.

Other similar steps to strengthen the positive public perception of the ISTC included the Secretariat's participation in the International Congress of Political Scientists on N. Nazarbayev's Manifesto "The World 21st Century" and Global Challenges of Modernity (Astana, 21 October 2016). The ISTC used the opportunity to draw the attention of the audience to the opportunities for the Center to provide useful contributions, particularly through the advocacy of the expert scientific community in Kazakhstan and beyond.

The ISTC pursued its public advocacy objectives through its participation in the International forum "Nursultan Nazarbayev's Model: 25 Years of Peace and Harmony" (Astana, October 28, 2016) and in the meeting of the Central Asian International Scientific-Expert Council. The main address delivered by the State Secretary Ms. Gulshara Abdykalykova, was designed to provide an impetus to the work for the implementation of the Manifesto and the Kazakhstani program for participation in the UNSC. She stated that hosting the ISTC is a major element of that program.

In line with the GB guidelines on ISTC participation in EXPO 2017, the Secretariat supported thematic international conferences: "Green Bridge – Bridge to Green Technologies, Innovations and Accessible Energy" (Astana, 14 September 2016) and "Marrakech: A New Stage in the Realization of the Paris Agreement at the Global and National Levels" (Astana, 28 November 2016). The ISTC, traditionally a non-proliferation organization, has accumulated valuable experience in environmental remediation, and offers scientists from various energy-related fields opportunities for networking and sharing experience.

The Executive Director David Cleave participated in the preparatory meeting on 30 September arranged by the MFA and the National Company "EXPO-2017", and discussed modalities for ISTC participation with Akhmetzhan Esimov, the Chairman of the NC "EXPO-2017", and with Rapil Zhoshibaev, EXPO National Commissioner of Kazakhstan.

The ISTC staff participated as observers on the Second High-Level Meeting on TB and Migration (7-8 December 2016, Astana) hosted by the Kazakhstan Ministry of Health and Social Development and organized by the NGO "Project HOPE" and the National Center for TB Problems of Kazakhstan. The forum focused on a set of draft bilateral agreements on cross-border TB, as well as Kazakhstan's National Guidelines for TB control among migrants.

Going global to bridge scientific communities

A new and very promising development in 2016 was the inclusion of the ISTC in the Working Group meeting of the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction (Tokyo, 7-9 September 2016). The meeting took stock of the implementation of the Nuclear Security Summit (NSS) Action Plan, including the priority areas of coordination and funding in nuclear and radiological security, and the Global Partnership enhancement of its geographic focus areas. The presentation of the ISTC transition and priorities at the Centres of Excellence (CoE) Working Group allowed potential partners to be updated about the ongoing transformation of the ISTC.

Visit of Ms. Nomaindiya Cathleen Mfeketo, Deputy Minister of International Relations and Cooperation of the Republic of South Africa

In 2016 the ISTC participated – also for the first time – in an important EU coordination platform through the attendance of the Fourth Meeting of the Heads of Regional Secretariats of the EU CBRN CoE:"Building on regional experiences to better address new security challenges "(Brussels, 22-24 November 2016). This participation allowed the Secretariat to make a presentation on the organization's transformation following the transfer of its Main Office from Moscow to Astana, and more specifically the benefits the CoE could have from cooperation with the ISTC, STCU, and MESIS both in terms of project implementation and complementarity.

These ISTC performances in wider international formats illustrated the emerging tendency, as defined by the GB, towards gradual globalization of the organization's activities, turning the ISTC into a facilitating factor capable of bridging scientific communities from regions of the world geographically far apart from each other. The ISTC promoted complementarity between participation in ISTC-implemented projects, membership in the ISTC, and adhesion to the EU CBRN CoE while preparing the possible expansion of the geographical scope of its activities, beyond the boundaries of CIS and Georgia.

EU Centre of Excellence for South East and Eastern Europe, headquartered in Tbilisi

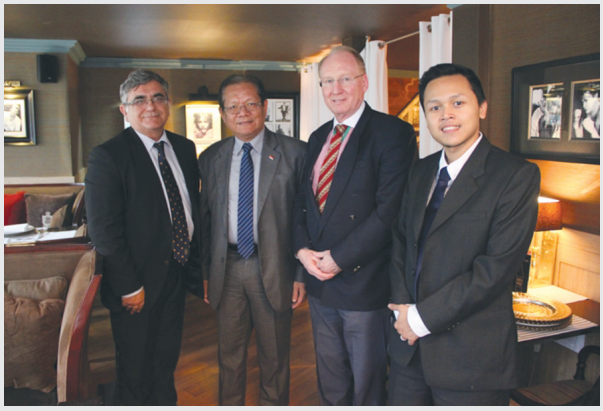
The visit on 7 December 2016 by members of the Governing Boards of the ISTC and of the STCU to the Regional Secretariat of the EU CoE for South East and Eastern Europe, headquartered in Tbilisi, Georgia, provided additional insights on the possibilities for interaction between the ISTC and the EU CBRN CoE. Following the briefing on the progress made by the eight countries' participants in the network, during the ensuing discussion, GB Chairman Eddie Maier, ISTC Executive Director David Cleave, and STCU Executive Director Curtis Bjelajak pointed out the benefits and prospects for enhanced cooperation between the science and technology Centres and the EU CBRN CoE.

In 2016 the acknowledged need for greater inter-regional interaction was for the most part related to Parties Projects, namely the signed Pagoda Delegation Agreements on three ISTC implemented projects, specifically the P-53 Project Strengthening the National Legal Framework and Provision of Specialized Training on Bio-Safety and Bio-Security in Central Asian

Countries, the P-60 Project Support to the EU CEA CBRN CoE in Nuclear Security and the Project MC5.01/15B Support to Southern African States in Nuclear Safety and Safeguards.

A telling example in that regard was the adhesion of Mongolia to the P-53 Project. ISTC initiated a dialogue with the Mongolian Embassy in Astana, and welcomed the visit of Ambassador Jagir Sukhee to the organization's HQ in May 2016. Based on a good record of interaction between Mongolian scientists and institutes with ISTC projects, the appropriate preparatory steps were undertaken that may allow Mongolia to become an active collaborator or partner in ISTC activities. On 12 December 2016, the National Committee on the Biosafety of Mongolia formally agreed to participate in the EU CBRN CoE Project 53.

Another impressive illustration of the ISTC's search for new partnerships was the visit to the ISTC main office on 9 November 2016 of Ms Nomaindiya Cathleen Mfeketo, Deputy Minister of International Relations and Cooperation of the Republic of South Africa. Executive Director David Cleave debriefed the South African delegation on the ISTC transition and outlined the excellent relations that the ISTC maintains with the Embassy of the Republic of South Africa in Astana, manifested by regular dialogue with the RSA Ambassador Dr. Shirish M. Soni. Deputy Minister Mfeketo received a debriefing on the two upcoming EU-funded projects, P-60 and MC5.01/15B, contracted to the ISTC the previous day. These projects and other ISTC initiatives offer many opportunities for cooperation between the ISTC and South African organizations, universities and research institutes. The projects aim at increasing the capacity in the nuclear safety and nuclear security field of the Southern African Development Community.



Meeting with Mr. Foster Gultom, Ambassador of Indonesia to Kazakhstan

On 11 October 2016, ISTC Executive Director David Cleave met with Foster Gultom, Ambassador of Indonesia to Kazakhstan, to discuss potential areas of joint interests and possibilities for cooperation in geothermal power generation, forest fire hazard mitigation, earthquake hazards, nuclear, bio-safety and security, tropical diseases spread prevention, etc. Information sharing took place with the embassies of Iraq and Jordan, on ISTC implemented projects in these countries, as well as with the Ambassador of India.

The contacts in 2016 of the Secretariat and project teams with potential new partners for the ISTC paved the way to establish relationships and allowed the accumulation of useful information and communication channels so that the Governing Board may consider modalities for engagement with non-Parties, in their capacity of observers or prospective applicants for membership.

Throughout 2016, the ISTC Secretariat worked intensively to spread the word about the ISTC's mission and impressive record of achievements, as well as on the new stage of the ISTC twenty-five years of performance, following the re-location of the organization to Astana, Kazakhstan.

NOTABLE PROJECTS OF 2016

ISTC Initiative Framework - Astana EXPO 2017 Targeted Initiative

Kazakhstan will host Astana EXPO-2017. Kazakhstan has chosen "Future Energy" as the theme of EXPO-2017 in order to help bring together the global community in its response to global energy challenges. The International Science and Technology Center (ISTC) Governing Board (GB) established the "Future Energy EXPO-2017" Targeted Initiative (TI) on December 9, 2015 at GB 61 in support of Kazakhstan.

The ISTC, on behalf of the European Union and the ISTC Parties, conducted a meeting to establish a working framework to support EXPO-2017 in Brussels, Belgium on March 3, 2016. The goal of the meeting was to set objectives, resource requirements and timelines for activities. Based upon the meetings the following tasks were established:

1. Identify dedicated points of contact within the parties' bureaucratic structure for information exchange and to facilitate scientist/expert exchange (defined in points 2-4 below).
2. Support dissemination of information on Energy Best Practices Area (eBPa) of EXPO to the Parties scientific communities to encourage the participation of their science communities.
3. Identify and confirm 40 potential technical experts and speakers to participate in defined activities. These areas include: 1) 15 experts to participate in expert panels within the eBPa Projects Competition on a case study basis, 2) 24 experts/speakers to participate during Astana EXPO-2017, and 3) 5 expert panelists to participate in the Astana Forum (pre-event in Sept 2016).
4. Identify and confirm 5 Nobel Laureate stature participants for EXPO in August 2017.
5. Continue to review the possibility of hosting an ISTC exhibit within the international organizations pavilion at EXPO. Negotiations are underway with the EXPO Organizer related to the free provision of space within the pavilion.
6. In addition, a Memorandum of Understanding (MOU) was signed between ISTC and NU EXPO.

ACTIONS taken from June 2016

1. **June 2016** – Supported the dissemination of information on Energy Best Practices Area (eBPa)* of EXPO to the parties scientific communities.
   - Disseminated information about eBPa through the ISTC Parties to their respective countries to stimulate international participation in eBPa (through formal submission of scientific projects that are complete or nearing completion). Selected projects would be allowed to use EXPO as a forum for demonstrating their proposed technology free of charge at the international event to be held June-Sept 2017.
   - Document package related to eBPa project submission provided to the Parties for distribution during June, July 2016.
2. **End of July 2016** - 14 experts confirmed for participation in 5 expert panels within the eBPa Projects Competition for the following areas: a) renewable and alternative energy; b) energy efficiency and traditional energy; c) energy storage; d) energy distribution; and e) using natural energy resources.
   - Each Panel consisted of 3 Experts with a panel reviewing up to 20 projects to establish scientific merit. An aggregate score was then tabulated and provided to EXPO's International Selection Committee (ISC), as a selection consideration. As of the middle of August, 249 applications were received by Nazarbayev University for evaluation.
   - Project reviews by Experts were paid in line with international norms on a 'case study' basis. Procedural guidelines were provided in June 2016 by NU.

1	Dr. Yoshiyuki Shimoda	Professor, Graduate School of Engineering, Osaka University
2	Dr. Atsushi Tsutsumi	Project Professor, Collaborative Research Center for Energy , The University of Tokyo
3	Dr. Kazuhiko Ogimoto	Institute of Industrial Science, The University of Tokyo
4	Dr. Takayuki Takarada	Professor, Graduate School of Science and Technology, Gunma University
5	Dr. Atsushi Akisawa	Professor, Tokyo University of Agriculture and Technology
6	Dr. Yasukuni Okubo	Institute for Geo-Resources and Environment, Geological Survey of Japan,
7	Dr. Frank Hardeman	Applied Mechanics and Energy Conversion Section; Dept of Engineering
8	Dr. Maurice Leroy	Vice Pres- CNE2; Professor Emeritus - Univ. of Strasbourge
9	Dr. Vincenzo Rondinella	Head of the Hot Cells Unit at the Institute for Transuranium Elements
10	Dr. Ad van Wijk	Professor in 'Future Energy Systems' at the Delft University of Technology
11	Dr. Alexander Ni	ABB-Alstom, Switzerland, Alstom Power Expert - Technical Director
12	Dr. Eric Plan	General Secretary of CleantechAlps, the Cleantech Cluster in Western Switzerland since 2010.
13	Dr. Thomas Zednicek	European Passive Components In... Solid State Physics, Materials Physics, Condensed Matter Physics Ph.D.
14	Dr. Eric Van wale	Eric Van Walle

3 By end July 30, 2016 –5 experts (3 EU and 2 Japanese) participated as speakers in the EXPO Astana Forum held on 14 September:

1	Dr. Herbert Girardet	Cultural and urban ecologist
2	Dr. Atsushi Tsutsumi	Project Professor, Collaborative Research Center for Energy, The University of Tokyo
3	Dr. Yasukuni Okubo	Institute for Geo-Resources and Environment, Geological Survey of Japan,
4	Dr. Frank Hardeman	Applied Mechanics and Energy Conversion Section; Dept of Engineering
5	Dr. Ad van Wijk	Professor in 'Future Energy Systems' at the Delft University of Technology

- ISTC provided logistical support.

During the September Forum, David Cleave made a welcoming speech and presentation about the ISTC and our projects in the field of Energy;

4. School engagement (EU 1 and Japanese 2), experts made presentations to the children of the Republican School of Physics and Math on 13 and 15 September;
5. Memorandum of Cooperation between EXPO & ISTC for free exhibition space was signed on 8 August, 2016 with the Vice Minister of Foreign Affairs, the National Expo Commissioner Mr. Zhoshibayev.

On 30 September the Executive Director of the ISTC participated in a meeting organized by the Ministry of Foreign Affairs and the National Company «Expo 2017-Astana». There were around 50 diplomatic organizations which took part in the meeting. During the meeting the Chairman of the NC «EXPO-2017», Mr. Esimov presented in detail the ongoing work related to the construction of the Exhibition. Currently 103 countries and 17 international organizations have confirmed participation. 98 Commissioners were nominated. Around 82 agreements were signed with countries including the international organizations and 61 countries reserved the celebration of their national days. In total the amount of sponsor's funds as of today are 125 million EURO.

ISTC Targeted Initiative on Radiological Well Logging Source Risk Mitigation

The Targeted Initiative on Radiological Well Logging Source Risk Mitigation is focused on raising awareness in countries belonging to ISTC and STCU of the options for mitigating the risks of using radionuclide-based tools for oil well logging, including possibilities to replace such tools with less vulnerable technologies.

Meetings with regards to this TI were organized and held between 17th and 19th of October 2016 in Astana and Atyrau. The ideas were shared among the participants from the U.S. Department of Energy (DOE), STCU representatives in Ukraine & Azerbaijan, the Institute of Geophysics National Academy of Sciences of Ukraine, the U.S. Pacific Northwest National Laboratory (PNNL), the Committee of Atomic Energy Supervision and Control of

Kazakhstan Energy Ministry, the Institute of Nuclear Physics, the Nuclear Technology Safety Centre, Atyrau Oil and Gas Institute and oil gas industry representatives.

The outcomes of these meetings were the mutual agreement between industry and academia on well logging sources being small, mobile, used worldwide and transported across international boundaries to carry the risk of use in a radiological dispersal device. Mitigating this risk would require tightened regulations, internationally-accepted source-use protocols, use of electronic tagging of sources, and further development and deployment of alternative logging technologies to replace radionuclide-based logging devices.

The Targeted Initiative will consider all aspects of mobile radioactive source security, to include alternative technologies. The next steps of this TI are:

- Technology Status Report;
- Radioactive Well Logging Source Risk Mitigation Workshop in 2017, where the report results will be discussed.

ISTC Targeted Initiative on Seismic Monitoring

The U.S. Department of Energy-funded Targeted Initiative on Seismic Monitoring held a project planning workshop from November 7-10, 2016 in Almaty. Experts from Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, and the United States discussed a project to digitize paper archives of seismic “bulletins” and to merge separate seismic network data into a unified seismic catalog for Central Asia. This updated seismic catalog will serve as the basis to conduct new Probabilistic Seismic Hazard Assessments (PSHA) and produce new seismic hazard maps in Central Asia. U.S. project collaborators will work with participating experts on database management, seismic event re-location and magnitude analyses, and PSHA software and hazard mapping. Participants at the November workshop reached agreement on project scope and organization, and prospective project participants are currently preparing the ISTC project proposal documentation.

Nuclear Forensics TI

The ISTC started to develop TI Nuclear Forensics in 2007. At that time the first workshop «Nuclear Forensics and Law Enforcement» was carried out in Dushanbe. Since then there have been number of meetings and workshops on this topic. Last year, in 2016, ISTC representatives visited the workshop that was based on Project exercises and findings within Ukraine (STCU) that provide a better understanding on the identification and classification of the forensics items. During the workshop, the Ukrainian project participants presented their views on project implementation to further the knowledge in the technical field of nuclear forensics in GUAM countries. As the result of these meetings, the ISTC initiated project proposal was submitted and successfully supported by a funding Party in 2017.

ISTC expands its geographical reach, helps African countries improve nuclear safety and security

At the end of 2016, the process of change and continuity that ISTC is experiencing, took a new turn with the signing of Delegation Agreements on two new projects: the P-60 Project Support to the EU CEA CBRN CoE in Nuclear Security and the Project MC5.01/15B Support to Southern African States in Nuclear Safety and Safeguards. They will expand ISTC's implementation activities in Africa. Eleven countries from Eastern, Central and Southern Africa, and a regional organization – the Southern African Development Community – will benefit from the expertise in addressing nuclear safety and security issues that ISTC will provide based on the experience accumulated over the past twenty-five years. Funded by the EU and conceived as complementary to each other, the two initiatives illustrate the internationally recommended "Triple S" approach addressing simultaneously nuclear safety, safeguards and security issues.

In search of development opportunities, some Eastern and Southern African countries have attempted to use their uranium ore resources as a source of export revenue. For example, transportation of concentrated uranium ore is planned through the territories of Tanzania, Zambia, Malawi and Namibia, from production sites in Tanzania to the sea port of Walvis Bay in Namibia. The four countries recognize that sustainable uranium mining and processing requires the application of the best international standards to avoid environmental damage and other hazards. Throughout the project, they will acquire both scientific and organizational know-how to successfully fulfil the nuclear safety requirements. The Secretariat of the Southern African Development Community, based in Gaborone, Botswana, will coordinate the actions of the four pilot countries and will seek to harmonize in the future the nuclear safety legal frameworks and policies of all its fourteen member states. This will include the development of a regionally harmonized system of accountancy, control and transport of radioactive and nuclear materials designed to improve the communication and interaction among the originating, transit and destination countries. The harmonization on a regional basis of legal frameworks and policies will address the challenges at border crossings and crucial nodal points to prevent illicit trafficking of radioactive materials.

ISTC will be implementing this project in parallel to providing support for the Centre of Excellence of Eastern and Central Africa and its participating states in raising the level of their nuclear security and treating RN orphan sources in the area with the due caution. The Centre of Excellence in Central and Eastern Africa is a leading part of a network of similar hubs, established by the EU to boost the capabilities of countries in three continents to address chemical, biological, radiological and nuclear risk mitigation issues. P-60 is designed to provide methodological knowledge and expert know-how to Burundi, the Democratic Republic of Congo, Ghana, Kenya, Malawi, Rwanda, the Seychelles, Tanzania, Uganda, Zambia and Namibia. These countries face radiological and nuclear risks arising from uranium mining, milling, processing and transportation as well as from the management of radioactive sources. The licensing, handling and control of these sources, especially at the end of their economic lifetime, occasionally results in leftover orphan sources. At the same time a more efficient regulatory oversight of licensed radiation sources has acquired greater importance, as do the regular compliance inspections. Hence, a multifaceted approach to these challenges is the corner stone of the project: from better control of radioactive materials and sources, to efficient detection, recovery and safe storage of orphan sources, as part of national radioactive waste management policies, to development of national response plans for potential radiological or nuclear incidents. The long-term objective of the project is to strengthen and harmonize the nuclear regulatory frameworks in the participating countries, to enhance their nuclear safety and

security and to support their efforts to fulfill a range of international safeguard obligations they have undertaken under the Nuclear Non-Proliferation Treaty, safeguard agreements with the IAEA, the Convention on the Physical Protection of Nuclear Material, the UN Security Council Resolution 1540, as well as the African Nuclear-Weapon-Free Zone Treaty.

By symbolic coincidence the first public presentation of the two new projects took place during an official visit of Ms Nomaindiya Cathleen Mfeketo, Deputy Minister of International Relations and Cooperation of the Republic of South Africa to the ISTC main office at Nazarbayev University in Astana on 9 November 2016. Deputy Minister Mfeketo received a debriefing on both projects. She and the visiting delegation of officials from various South African ministries were impressed that the projects offer ample opportunities for cooperation between ISTC and African organizations, universities and research institutes, such as the Institute for Strategic Studies in Pretoria, the Southern African Development Community, the African Union Commission on Nuclear Energy, etc.

Over the course of 36 months, through trainings, simulation exercises, self-assessment studies, and public events, experts from academia, public institutions, regulatory agencies and regional organizations will expand their scientific knowledge, hone new personal skills and improve institutional capabilities to address nuclear safety, security and safeguard challenges at national and regional levels. The two projects in Africa will test and provide evidence that ISTC is capable of assuming a tailor-made approach in meeting the needs of individual states while at the same time stimulating regional legal and policy harmonization and facilitating an inter-regional exchange of experience.

EU funded Project 53 of the EU CBRN Centres of Excellence Initiative.

Under the scope of the European Union Chemical Biological Radiological and Nuclear Risk Mitigation Centres of Excellence Initiative (EU CBRN CoE), which is funded under the Instrument for Stability (IfS), the EU signed a Delegation Agreement (IFS/2015/369-100) with the International Science and Technology Center (ISTC) in December 2015, titled 'Strengthening the National Legal framework and Provision of Specialized Training on Bio-Safety and Bio-Security in Central Asian Countries' (**CBRN CoE Project 53**), for a budget of 5 million EURO and a duration of 36 months (December 2015 – December 2018), from here on referred to as P53.

The technical implementation of P53 is divided into seven work packages (WPs):

WP1: Assessment and revision of the national legislations and best practices in the area of biosafety and biosecurity, and harmonization with the appropriate international regulations such as IHR, BTWC and *Codex Alimentarius* including the area of regional emergency response with the aim of coming to a "One Health" system;










EU CBRN CoE Project 53







EU CBRN CoE Project 53
EU CBRN CoE Project 53





WP2: Organization of national and regional awareness-raising events to sensitize political and executive bodies from the participating countries to biosafety and biosecurity issues;

WP3: Evaluate the existing regional training capabilities and resources;

WP4: Assess facilities dealing with bio-hazardous materials to target the training in each participating country and procurement of biosafety/security equipment and consumables;

WP5: Training of Trainers activities and other educational events (introducing a "security culture");

WP6: Training of technical, scientific and other professionals involved in biosecurity and biosafety;

WP7: Strengthening and formalising regional cooperation and the integration of the delivered training programs within the already existing national and educational programs, notably at the level of universities.

During the 1st part of 2016, ISTC contracted a Team of Experts (ToE) consortium, which is led by Sustainable Criminal Justice Solutions (SCJS) and includes Public Health England (PHE), Verification Research, Training and Information Centre (VERTIC), and Rijksinstituut voor Volksgezondheid en Milieu (RIVM). This ToE will work cooperatively with National Team of Experts (NTEs) from the participating countries in the implementation of P53.

Initially four countries joined P53: Islamic Republic of Afghanistan, Kyrgyz Republic, Republic of Tajikistan and Republic of Uzbekistan for which national kick-off meetings were organized in September 2016 under WP2:

- 19 – 20 September 2016: Kyrgyz Republic
- 22 – 23 September 2016: Republic of Uzbekistan
- 26 – 27 September 2016: Islamic Republic of Afghanistan
- 28 – 29 September 2016: Republic of Tajikistan

During these national kick-of meetings, interested stakeholders for the NTEs were identified, and initial implementation strategies were discussed. Since then work on WP1, WP3 and WP4 has been initiated.

At the same time the ISTC has invited Mongolia and the Republic of Kazakhstan to join P53. As a result of these efforts Mongolia formally joined P53 in December 2016. A national workshop for Mongolia is to be conducted 26-27 January 2017. Kazakhstan agreed to a P53 informative meeting for 30 January with interested stakeholders, after which it will be decided whether Kazakhstan will join P53.

Train-the-trainer workshops are planned for the 2nd half of 2017 (WP5), while training of experts (WP6) will be conducted during 2018.

While under WP1 legislative assessments will be conducted during 2017, using developed tools for comparative analysis of local legislations with international regulations (IHR, BWC, *Codex Alimentarius*) by the ToE and NTEs. This work will be continued during 2018 and based on the analysis performed recommendations to harmonize legislation will be formulated, and where possible adjustment to existing or new legislation will be drafted.

REPUBLIC OF ARMENIA

Control of light in structured nonlinear media: Application to all-optical devices

ISTC Project Number	A-2130
Project manager	Rafael Drampyan E-mail: rafael.drampyan@gmail.com rdramp@ipr.sci.am
Leading Institute	Institute for Physical Research of National Academy of Sciences of Armenia
Foreign collaborators	University of Franche-Comté, FEMTO-ST Institute, Besancon, France University of Muenster, Muenster, Germany University of Ghent, Ghent, Belgium.
Project Duration	January 1, 2016 – December 31, 2018
Financial Parties	European Union
Total Cost of the Project	357 285 USD

MAIN OBJECTIVES:

The objective of the project is the formation of micrometric-scale regular refractive structures in photorefractive materials by laser methods for the control of probe light propagation and its localization in the induced light-guiding arrays, which is highly demanded for the targeted delivery of optical information.

- Development of novel methods and creation of annular symmetry refractive micro-structures in solid and liquid crystals by non-diffracting an optical beam technique providing high contrast light-guiding refractive micro-arrays.
- Characterization of novel light-guiding structures by optical methods and numerical simulations.
- Elaboration of a novel optical device for controlled localization and addressing of optical beam (encoded information carrier) to different micro-array channels (optical interconnects) and other all-optical devices.

ACHIEVEMENTS:

One of the aims of the Project is optical formation of micrometric scale refractive index regular structures in photorefractive solid and liquid crystals. Illumination of a photorefractive medium by an optical beam with spatially modulated intensity distribution leads to the corresponding refractive index modulation thus creating refractive lattices. For an optical recording of two-dimensional (2D) high contrast non-spreading refractive lattice structures the non-diffracting beams with intensity modulated profiles were used, which are able to propagate in free space without any change. Bessel optical beams are a fundamental example of non-diffracting beams, where the light intensity is distributed over concentric rings described by the Bessel function of first kind (Fig.1).

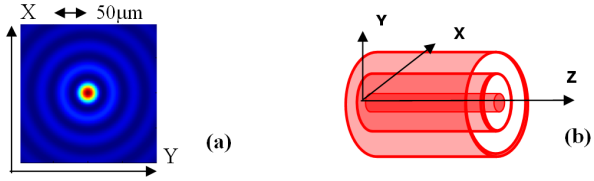


Fig.1. Profile and 3D schematic image of Bessel beam.

For the first time, we have demonstrated an effective method for the formation of a whole variety of different non-diffracting beams (Fig.2) by coherent superposition of two transversely shifted Bessel beams.

The use of non-diffracting beams is very promising for the creation of 2D refractive

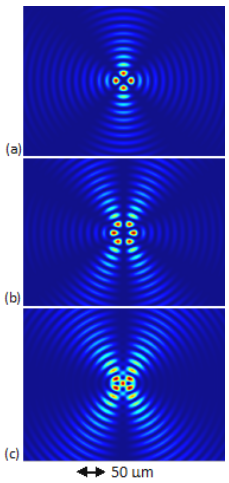


Fig.2 Examples of family of non-diffracting beams.

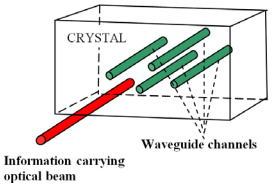


Fig3. Schematic of optical interconnect.

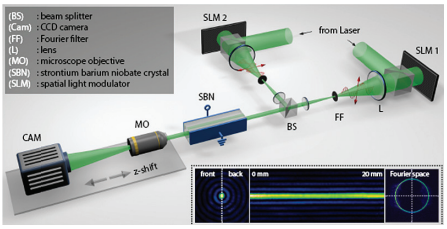


Fig.4. Experimental setup for realization of optical interconnect

lattice structures of different symmetry in photorefractive crystals, capable of controlling the propagation of probe optical beams in light-guiding structures, which is highly demanded for the targeted delivery of optical information.

During the implementation of the Project, novel equipment and materials were acquired and modern experimental setups were arranged.

The main technical progress during the first year's implementation of the Project was the design and fabrication of an fully-optical device, based on the quadruple-like light-guiding structure in strontium barium niobate (SBN) crystal with the use of 532nm laser, as well as the demonstration of probe light controlled guiding into chosen channels.

The azimuthally modulated 4-fold rotation symmetry pattern with central quadruple-like structure (Fig.2a) has been used for the recording of a light-guiding structure in SBN crystal. The idea of such an experiment is shown schematically in Fig. 3, which serves as a device for channeling optical information along 4 different waveguides, i.e. quadruple photonic interconnect.

The experimental realization of the scheme depicted in Fig.3 was performed in SBN crystal with the use of 532 nm laser (Fig.4). The quadruple-like refractive structure was optically recorded in SBN crystal. A probe beam with the diameter of 25 µm smaller than the distance ~50 µm between opposite poles of quadruple-like structure has been launched. In the experiment, the localization and guidance of the probe beam (optical information) in the nearest channel of lattice structure has been found in the self-focusing regime (Fig.5). The device can be termed as 2D 1 × 4 photonic interconnect.

Investigations were performed in collaboration with Muenster University, Germany. Results are published in "Optics Express", Vol. 24 (12), 2016, pp.12933-40. doi: 10.1364/OE.24.012933

The fabricated interconnect can serve as a basic building block in more complex 2D m × n photonic interconnects. Such all-optical devices can find important applications in information optical storage and readout, addressing of information, communication systems, and new generation of optical computers.

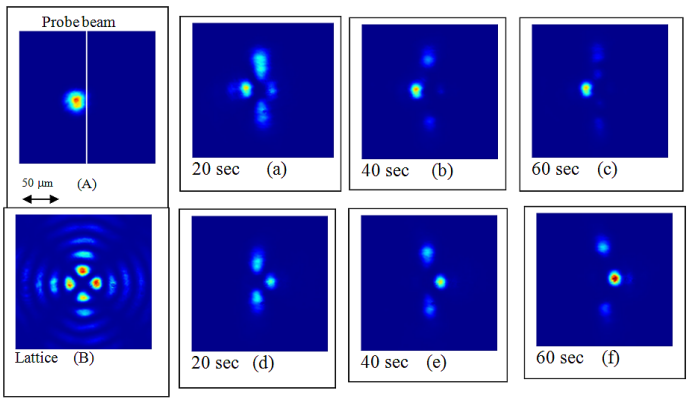
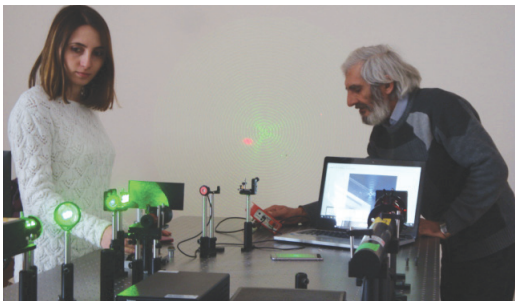
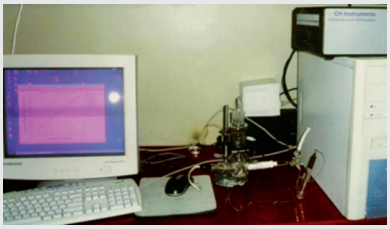


Fig.5. Off-center input probe beam (A) propagation and localization in the periodic 2D quadruple-like wave-guiding structures (B) for self-focusing regime. (a-f) Time evolution of the output profile for probe beam shifted left (a-c) and right (d-f) relative to the lattice center. The same effect was observed when the probe beam was shifted up and down relative to the quadruple lattice center.



Development in iron biodegradable stents: Fe-stent, polymer-coated, and drug eluting stents

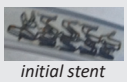
ISTC Project number	**A-2115**
Project Manager	**Hovhannesyan Ashot**
Leading Institute	**Scientific Centre of Radiation Medicine and Burns, Yerevan, Republic of Armenia**
Foreign collaborator	**Prof. Kiejin Lee** **Sogang University, Seoul, Republic of Korea**
Project Duration	**December 01, 2014 – December 01, 2017**
Financial parties	**Republic of Korea**
Total cost of the project	**180 000 USD**



The electroforming setup (electrolytic cell)

The artificial blood circulation apparatus

In vitro static immersion test



initial stent

degradation

Dynamic in vitro degradation test

One-stage electroforming iron stents without laser cutting

The development of degradable metallic stents is one of the strategic directions for the improvement of stents used in interventional cardiology. Recently, iron-based materials were developed as potential degradable coronary stents using an electroforming technique.

Within the frame of A-2115 project the developed electroforming method of obtaining hollow iron thin-walled tubes of small diameter was used to fabricate of model stents.

Model stents were manufactured from electroformed tubes using laser cutting.

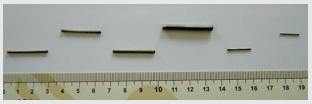
For the A-2115 project researchers developed a new method to obtain iron model stents. For the first time iron stents of different configurations were manufactured through electroforming process without laser cutting.

The study within the frame of the A-2115 project was aimed to test the safety of biodegradable iron stents in animals and, as far as possible, to reveal the period of complete degradation of iron.

An In vitro static immersion test and dynamic in vitro degradation of electroformed iron allowed for a decrease in the number of experimental animals used for the in vivo degradation studies.

It was shown that selected iron tubes possess a non-toxic profile for human fibroblasts and have good blood compatibility. Newly fabricated electroformed iron tubes are considered as potential cardiovascular model stents and recommended for in vivo experiments.

To evaluate the biological reaction of experimental animals the following methods of implanting the iron sample with and without polymer covering were used:



Electroformed iron tubes

Iron stents by laser cutting

Iron stent under the light microscope

- Intramuscular and caudal implantation in rats;
- Implantation into auricular veins of rabbits and femoral artery of rabbits, pigs, and dogs.

The invasive mode of implantation into animals was selected as less traumatic.

The obtained results on in vivo degradation of electroformed iron in direct contact with blood in animals allow for an assessment of the complete degradation of the sample during a period of up to 1.5-2 years.

One-stage technology of electroformed iron stents that is under development within A-2115 Project implementation is promising for commercialization.

GEORGIA

ISTC project number	**G-2117**
Project manager	**Tinatin Sadunishvili** **t.sadunishvili @agruni.edu.ge**
Leading Institute	**Agricultural University of Georgia, Durmishidze Institute of Biochemistry and Biotechnology**
Foreign collaborators	**Hanyang University, Seoul, Korea (Sang B)**
Project duration	**Beginning from 1 Dec 2014 for 36 months**
Financial parties	**Republic of Korea**
Total cost of the project	**$200,000 USD**

The project is focused on obtaining stable enzymes from DIBB unique extremophilic mycelial fungi collection (accounting above 2500 individual strains) for the creation of the biotechnology for the production of fuel-bioethanol from agricultural and industrial lignocellulosic wastes.

The overall goal of the project is the development of cost effective, ecologically friendly, biotechnology of the fuel bioethanol production from agricultural and industrial lignocellulosic wastes. The main objective of the project is obtaining stable, industrially robust enzymes: cellulases, xylanases and laccases for lignocellulosics effective degradation and fermentation of hydrolysis product glucose by yeasts to ethanol.

Specific approaches proposed for project realization involve:

1. Selection of producers of stable cellulases, xylanases and laccase among the diverse mycelial fungi extremophile strains collection of DIBB, AUG.
2. Selection of optimum cultivation conditions of selected fungi strains for cellulase, xylanase and laccase biosynthesis in submerged conditions.
3. Characterization of cellulases and xylanases synthesized by microscopic fungi (temperature and pH optimum of action, heat and pH stability, potential to hydrolyze of crystalline and amorphous cellulose).
4. Development of lignocellulosic substrates effective pretreatment method (physical, chemical and biological by selected basidial fungi strains, active producers of laccase).
5. Hydrolysis of different pretreated lignocellulosic substrates by selected stable cellulase and xylanase preparations (time and deepness of hydrolysis, optimum enzyme-substrate ratio, glucose yield).
6. Fermentation of hydrolyzed glucose to ethanol by selected yeasts strains.

This multidisciplinary project will combine studies in microbiology, biochemistry and biotechnology and will be completed with the selected fungal stable cellulases, xylanases and laccases for the creation of the biotechnology of production of fuel-bioethanol from

Project scientific leader, Professor Giorgi Kvesitadze

Process of strains identification, obtaining of enzyme technical preparations, etc.

agricultural and industrial lignocellulosic wastes.

The expected results of the project are:

- Production of industrially important, stable cellulases, xylanases and laccase among the mycelial fungi extremophilic strains collection of DIBB, AUG, isolated from extreme environment of diverse soil climatic zones of southern slopes of Caucasus will be selected.
- The physiology of growth and development of selected fungi strains optimal for cellulase, xylanase and laccase biosynthesis in submerged conditions will be established.
- Industrially important characteristics of cellulases and xylanases such as: temperature and pH optimum of action, heat and pH stability, hydrolysis of crystalline and amorphous cellulose will be determined. To accelerate the process of lignocelluolse hydrolysis possible activators and inhibitors of enzymes action will be revealed.
- Effective pretreatment method of lignocellulosic substrates with the aim of delignification for further enzymatic degradation will be developed.
- Optimum parameters for exhausted enzymatic hydrolysis of delignified cellulosic wastes with maximum glucose yield will be determined.
- Effective yeasts strains will be selected and fermentation conditions of hydrolyzate to ethanol will be designed.

The project has theoretical significance from the point of view of the identification of novel extremophilic mycelial fungi producers of lignocellulose deconstruction enzymes from a diverse geographical region, characterized by multiply repeated 15 soil-climatic zones and extreme environments. Taking into consideration that the stability of the enzymes with desired properties are the main limiting factors in fuel bioethanol production from lignocellulosic wastes, the project is of great practical importance. Stable enzymes from extremophilic fungi effectively degrading lignocellulose have high potential for commercialization for which a substantial effort will be made to establish business contacts with research teams and companies involved in cellulosics-based fuel ethanol R&D and production.

Expanding global knowledge of tuberculosis by establishing the Georgia

ISTC project number	G-2143
Project manager	Sergo Vashakidze
Leading Institute	National Center for Tuberculosis and Lung Diseases, Georgia
Foreign collaborators	National Institute of Allergy and Infection Diseases, Washington DC, USA (Gabrielian A)
Project duration	January 01, 2015– December 31, 2017
Financial parties	US Department of Health & Human Services / National Institute of Health / National Institute of Allergy and Infectious Diseases, Bethesda, MD, USA
Total cost of the project	$ 252 680

Tuberculosis Portal

THE MAIN TASKS AND RESULTS:

Tuberculosis (TB) is a major public health threat in Georgia. The recent escalation of the occurrence of the disease has been complicated due to the appearance and development of multi-resistant tuberculosis (MDR TB) or extensively drug-resistant tuberculosis (XDR TB), as well as HIV/TB co-infection, which requires long-term treatment. The ability for the Georgian and worldwide community of TB researchers to understand the nature of TB will be greatly improved by using a common database containing patients' medical images, treatment information, lab work, and clinical data. This common database can facilitate adherence to the treatment protocol as well as serve as a consistent repository of the records of the treatment regime for particular histories of the disease.

Over the last 5 years, the Office of Cyber Infrastructure and Computational Biology / National Institute of Allergy & Infectious Disease (OCICB /NIAID) in collaboration with the two leading Belarusian research institutions has devised and developed a TB Database and TB Portal technologies and instantiate these technologies with the appropriate data (medical images, lab work, treatment information and clinical data) from Belarus. For now, the TB Portal Consortium includes 5 countries: Belarus, Georgia, Moldova, Romania and Azerbaijan.

In the ISTC G-2143 the project we are developing for the Georgia TB Portal is to facilitate research aimed at diagnosis and treatment of drug-resistant tuberculosis. The clinical images of lungs (CT and X-ray) are used for the development of computational methods of TB diagnosis. Clinical data is being collected and stored in the Portal's database for a computer-aided analysis of factors contributing to the development of the disease. The connection of the Portal's metadata with the original clinical samples collection (clinical lab samples taken from TB patients) would allow researchers to establish various cohorts for subsequent partial or full-genome sequencing of Georgian TB strains. The Analysis of genomes of Georgian TB strains would allow for an improved analysis of the epidemiological situation in Georgia, and allow for an informed opinion about the required drug regimes and efficiency of diagnosis with common microbiological tools.

Fig. 1. Steering committee meeting in Tbilisi

Fig.2. Training of Azerbaijan laboratory team on M.tb DNA extraction

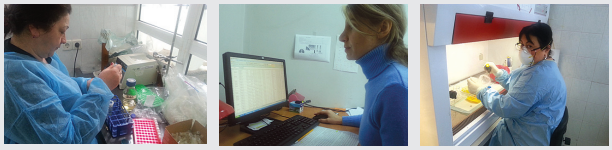


Fig.3 Laboratory team at work

The National Center for Tuberculosis and Lung Diseases (NCTLD) has a unique field of expertise to contribute to the project: the NCTLD research team has extensive experience in bacteriology, genotyping, and DNA sequence analysis of the Mycobacterium tuberculosis genome.

One of the projects emphases is on the comparative analysis of sputum vs. surgical samples for interesting clinical cases. The purpose of surgery is to remove a large, focal burden of bacilli present in necrotic and non-viable lung tissue. By removing the main focus of infection, it may be possible to prevent further spread of the disease and allow medical therapy to improve. Two potential mechanisms by which the tuberculous cavity hinders effective medical therapy include the reduction of drug penetration and providing an environment conducive to drug resistance amplification. While no clinical data exists for second-line drugs, older studies found reduced cavitary penetration of isoniazid and rifampicin. Studies found worse outcomes among MDR-TB patients with severe cavitary disease compared to those without cavitary disease thus providing indirect evidence for poor second-line drug penetration into cavitary lesions.

The project gives the possibility for scientists from different countries to join efforts in the global struggle against tuberculosis, and to create an extremely valuable resource of anonymized data of TB patients, which can be used by scientists globally.

Fig.4 James Jubilee planting ISTC tree in the yard of the NCTLD

Pharmacokinetics of second-line anti-tuberculosis drugs among patients with multidrug-resistant tuberculosis in Georgia

ISTC Project number	**#G-2200**
Project Manager	**Maia Kipiani**
Leading Institute	**National Center for Tuberculosis and Lung Diseases, Tbilisi, Georgia**
Foreign collaborators	**Emory University / School of Medicine, Atlanta, GA, USA (Kempker R)** **University of Florida, Gainesville, FL, USA (Peloquin C)**
Project Duration	**December 01, 2015 – May 31, 2017**
Financial parties	**US Department of Health & Human Services / National Institute of Health / National Institute of Allergy and Infectious Diseases, Bethesda, MD, USA**
Total cost of the project	**$ 100 000**

THE MAIN TASKS AND RESULTS:

The global emergence of multidrug-resistant tuberculosis (MDR TB) is an enormous public health threat and major barrier to effective TB control. In 2013, the World Health Organization (WHO) estimated 480,000 new cases of MDR TB worldwide and 210,000 MDR TB related deaths. Of significant concern is that among patients with MDR an estimated 9% have extensively drug-resistant (XDR) TB. Response rates to second-line

anti-TB drugs used to treat MDR and XDR TB are widely variable and significantly and substantially lower than those for drug susceptible TB. A largely unexplored area that offers significant promise in improving the treatment outcomes of patients with MDR TB is the optimization of anti-TB drug pharmacokinetics.

The large range of successful treatment outcomes among patients with MDR TB implies that there is room to significantly improve response rates to second-line drugs (SLDs). Recent reports finding a strong association between first-line drug levels and treatment outcomes among patients with drug-sensitive TB highlight the importance of clinical pharmacokinetics; however, there are critical knowledge gaps in regards to SLD pharmacokinetics and pharmacodynamics. The standard SLDs used to treat MDR TB have never been rigorously tested in clinical trials and there is extremely limited data on their pharmacology among patients with MDR TB including the variation of SLD levels among individuals and the relationship of drug levels and treatment outcomes. A better understanding of optimal SLD levels will help ensure MDR TB patients receive proper dosing and thus help improve MDR TB treatment and outcomes.

Building upon an existing collaboration, we investigate the pharmacokinetics and pharmacodynamics (PK/PD) of key drugs used to treat MDR TB and also in a subset of patients with XDR the pharmacokinetics of newly introduced anti-TB drugs including linezolid and bedaquiline. These clinical pharmacokinetic studies are being carried out among MDR TB patients receiving treatment at the National Center for TB and Lung Diseases (NCTLD) in Tbilisi, Georgia.

The implementation of this Project will lead to results that will reveal whether the current dosing of second-line anti-tuberculosis medications is adequate for the majority of patients with MDR TB and whether drug concentrations effect time

to culture conversion and rates of drug related side effects. This data could help to optimize drug dosing for patients and directly improve MDR TB treatment outcomes. The successful implementation of this project will also help to establish the NCTLD as an attractive site for TB pharmacokinetic research.

In the framework of the project we have successfully conducted the following activities: preparation and implementation of the project protocols, submission of IRB documents for approval to the Institutional Review Boards of the leading institution (NCTLD) and all collaborating partners including Emory University, study team training for implementation the project protocols.

The main objective of this project is to investigate: 1) PK analyses of key anti-tuberculosis SLDs, 2) PK analyses of newly introduced drugs for pre XDR and XDR TB, 3) SLD MIC values from M. tuberculosis isolates obtained study patients, and 4) the association of serum drug concentrations and clinical outcomes. *M. Tuberculosis MIC Testing:* The Sensititre MYCOTB MIC plate (MYCOTB; Trek Diagnostic Systems) is a recently developed method to assess the MICs to first- and second-line anti-tuberculosis drugs and would be implemented for the first time at the NCTLD through this proposal. The MYCOTB has performed well in

comparison to traditional phenotypic based DST and has the advantage of ease of use and most importantly of determining true MIC values as opposed to a static drug susceptibility cut off.

We have enrolled 60 patients in the study with MDR-TB, pre-XDR or XDR-TB who were hospitalized from December 1, 2015 to November 30, 2016 at the NCTLD for the treatment of their infection including NEW drugs in the treatment regimen. All study procedures were followed under the required study protocols and all data were obtained from medical chart abstraction: Socio-demographic characteristics, TB drug treatment history, Sputum smear, culture, and DST results, Radiographic findings (CXR), Laboratory Results, Audiometry and EKG results, etc. Approximately one month after initiation of SLDs we collected Blood samples from each study patient 0, 2, 6, 10 and 12 hours after administration of SLDs. Blood samples were centrifuged at the NRL, serum separated, and then 400 µcl samples were frozen at -80°C in freezers located at the NRL. In total 668 blood samples were collected and stored in an -80 °C freezer at the NCTLD.

On May 26, 2016 there were a total of 109 frozen serum samples, and on December 7th, 2016, a total of 281 frozen serum samples were shipped from Tbilisi, Georgia on dry ice via World Courier to the University of Florida Infectious Disease Pharmacokinetics Laboratory (IDPL) of Charles Peloquin, Pharm.D, in Gainesville, FL for drug level measurements. LEVO, CM, PZA, LNZ, and BDQ concentrations will be determined using high performance liquid chromatography (HPLC). Drug Level Measurements is in progress.

The project has been extended for an additional two quarters (December 1st 2016, through May 31st, 2017).

- In the first no cost extension quarter (December 1st 2016, through February 28th, 2017) we plan to continue and complete the pharmacokinetic analysis in the University of Florida, to initiate and carry out the shipment of the MYCO TB plates to Tbilisi and complete MYCO TB plate training.
- In the second no cost extension quarter (March 1st, through May 31st, 2017) we plan to carry out the MIC analysis with the MYCO TB plates.

The implementation of this project will lead to results that will reveal whether the current dosing of second-line anti-tuberculosis medications is adequate for the majority of patients with MDR TB and whether drug concentrations effect time to culture conversion and rates of drug related side effects. The proposal addresses ways to potentially improve MDR TB treatment outcomes, which are a major problem not only in Georgia but also surrounding countries (some of the highest MDR TB burdened countries in the world).

The project gives the possibility for young scientists, participating in the project, to obtain valuable experience and establish international links with the project collaborators and to take part in joint seminars and conferences. The presentation of study results will also facilitate the integration of Georgia TB researchers into the international scientific community.

Lastly, the proposed collaborations will leverage ongoing relationships to build an expert clinical TB pharmacokinetic team and help to establish the NCTLD as an attractive site for TB pharmacokinetic research that will be well positioned to apply for further NIH NIAID funding in the area of TB pharmacokinetics/ pharmacodynamics.

"Early key events in the successful control of acute HCV infection"

ISTC Project number	G2212
Project Manager	Nino Badridze
Leading Institute	Infectious Diseases, AIDS and Clinical Immunology Research Center
Foreign collaborators	Massachusetts General Hospital, Boston, MA, USA (M.Lauer G)
Financial parties	US Department of Health & Human Services / National Institute of Health / National Institute of Allergy and Infectious Diseases, Bethesda, MD, USA
Project Duration	February 1, 2016 – July 31, 2017
Total cost of the project	90 000 USD

THE MAIN TASKS AND RESULTS:

An estimated 185 million people are living with hepatitis C virus (HCV) globally and up to 500,000 deaths are attributed to the disease annually. Approximately 25% of acute HCV infection cases are self-limited, with spontaneous clearance of the virus usually within 6 months of infection. The remaining 75% of patients progress to chronic disease, with the possibility of developing liver cirrhosis and/or hepatocellular carcinoma (HCC) in a significant proportion of infected persons.

Despite development of these highly potent new treatment regimens, development of an effective prophylactic HCV vaccine remains a high priority for the following reasons: High treatment costs will most likely result in absent or limited access in middle and low resource countries and selective use even in wealthier countries. The limited efficacy of current HCV screening programs leads to a majority of cases being undiagnosed or diagnosed at a late stage and DAAs will not cure the virus-induced end-stage liver disease such as hepatocellular carcinoma. Certain patient subgroups may not respond or not be eligible for DAA-based treatment strategies. Finally, reinfection remains possible, making control of HCV infection in people with ongoing infection risk difficult. Based on experience with other epidemics, it is likely that significantly reducing the burden of HCV infection worldwide will require a dual approach with both effective treatments and a prophylactic vaccine.

Figure 1 Blood collection

Within the ISTC project G-2212, we are investigating blood donors and injection drug users anti-HCV negative blood samples by PCR method, to identify patients who were very recently infected with HCV (HCV RNA positive prior to anti-HCV seroconversion). The ISTC G-2212 project focuses on the analysis of both host immune response and infecting virus during the initial weeks of HCV infection, which is extremely rare. G-2212 gave us the possibility to directly generate critical clinical, immunological and virological data. The collection of blood was conducted in blood banks for donors and NGO's working with IDUs

Figure 2 Lab physician performing immunology test

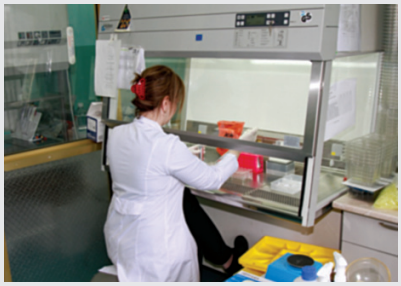


Figure 3 Lab physician performing PCR testa

Figure 4 Team work

in Tbilisi, Georgia. Identification of cases, viral detection, clinical diagnoses, as well as other immunology response analyses was performed in the Infectious Diseases, AIDS and Clinical Immunology Research center with intellectual support of a foreign collaborator institute - Massachusetts General Hospital and Harvard Medical School.

In the end, G-2212 will give us the possibility to a) demonstrate the quality of the research specimen generated from this cohort b) to generate preliminary data for a subsequent larger grant application and c) to evaluate which immunological assays can be transferred to the Georgian site in the future. The data obtained from this cohort will be critical since they will add timepoints from pre-seroconversion which are rare in the US and Brazilian cohorts of the US collaborator consisting mostly of symptomatic subjects.

Based on recent findings from AIDS National Center and other laboratories the researchers will study:

Inhibitory receptor expression profiles; cytokine receptor expression (e.g.CD122, CD127, IL-6R, IFNAR, IFNgR, IL-18R), homing and migration markers (CD161, CXCR6, CCR5, CD103), and metabolic function (CD26, CD39, CD73; function of HCV-specific CD4 T cells. Overall this data will allow us to define critical differences in successful versus unsuccessful CD4 responses and, through the very early samples tested from this cohort, whether differences arise early or late and thus are more likely the cause or consequence of an infection outcome.

Understanding the drivers of the emerging HIV epidemic among men who have sex with men (MSM) in the country of Georgia

ISTC Project number	**G-2216**
Project Manager	**Otar Chokoshvili, MD**
Leading Institute	**Infectious Diseases, AIDS and Clinical Immunology Research Center, Tbilisi, Georgia**
Supporting Institutes	**Center for Information and Counseling on Reproductive Health - Tanadgoma, Tbilisi, Georgia**
Foreign collaborators	**Emory University / School of Medicine, Atlanta, GA, USA (del Rio C)**
Project Duration	**March 01, 2016 – August 31, 2016**
Financial parties	**National Institutes of Health/ National Institute of Allergy and Infectious Diseases (NIH/NIAID), Tbilisi, Georgia**
Total cost of the project	**94,000 USD**

THE MAIN TASKS AND RESULTS:

The tasks

HIV/AIDS remains one of most serious global health challenges. Since the first cases of AIDS reported in 1981, HIV/AIDS has evolved to a pandemic level composed of multiple epidemics at regional and national levels. Advances in access to treatment and prevention have led to encouraging declines in the number of new infections globally. However, progress in reducing new infections is uneven by regions and populations. The epidemic among men who have sex with men (MSM) is expanding globally, including in industrialized countries despite the widespread access to HIV prevention and treatment. More recently emerging epidemics among MSM have been reported from areas traditionally viewed as non-MSM epidemic settings such as Africa and Asia.

Georgia belongs to the region of Eastern Europe and Central Asia (EECA), comprised of countries of the former Soviet Union (FSU). There are 1.1 million people living with HIV in

the region, with more than 85% of them living in the Russian Federation and Ukraine. Despite the global declines, the HIV epidemic in EECA continues to grow, with the highest incidence observed in Ukraine, the Russian Federation, Estonia and Moldova.

The first case of HIV infection in Georgia was identified in 1989. As of December 1, 2014 a total of 4,646 cases of HIV infection had been reported with the majority (73%, n=3,413) occurring in men. However, the estimated number of people living with HIV in Georgia is believed to be 6,400. Geographic proximity to the Russian Federation and Ukraine significantly contributed to the development of the HIV epidemic in Georgia. As in the rest of EECA, for many years IDU has been a major driver of epidemic in the country, currently accounting for 50% of total cases reported, followed by heterosexual contacts (42%) and male-to-male sex (6%). Trends in the distribution of newly reported cases show a decrease in the proportion of cases due to IDU, with an increase in the proportion of homosexually acquired infections. The proportion of MSM among newly diagnosed HIV patients in Georgia increased from 3% in 2003 to 12% in 2013. Repeated surveys conducted among MSM showed a more than 3-fold increase in the prevalence from 4% in 2007 to 13% in 2012. Surveillance data shows an increase in the rates of reported cases of HIV among MSM and the number of cases has more than tripled since 2009. Studies using a recent infection testing algorithm (RITA) and phylogenetic analyses provide further evidence of the emerging epidemic among MSM. In these studies MSM had highest rates of recent infection and showed a substantial phylogenetic clustering indicating active ongoing transmission in this population.

Currently available prevention services for MSM include awareness raising, distribution of educational materials, distribution of condoms and lubricants, HIV testing and counseling and diagnosis and treatment of sexually transmitted infections (STI). Many of the services are provided through peer-driven approaches. While recent surveys show improvements in the reach of MSM, the coverage with specific services remains low. For example, in a 2012 survey 38% of respondents had never had an HIV test, and only 49% were covered by prevention programs. With regard to anti-retroviral therapy (ART), since 2004 Georgia has ensured universal access to this lifesaving therapy for all eligible persons living with HIV.19 As of November 2014, of 243 HIV positive MSM known to be alive, 155 eligible patients were started on ART.

One of the possible barriers for better coverage with prevention services is the high stigma and discrimination against homosexuality. Although male-to-male sex in Georgia is not criminalized, it is a highly stigmatized behavior. However, a negative societal attitude alone is not sufficient to explain epidemic expansion. Given the IDU-driven nature of Georgia's HIV epidemic much of the efforts, including research efforts, were focused on IDU population. There is lack of knowledge about individual, structural and environmental factors influencing the surge of the epidemic in MSM in the country.

We aim to establish the first in Eastern Europe cohort of MSM in order to fill the knowledge gap and better understand the drivers of this epidemic in the population. The overall goal of the proposed project is to study the epidemiology of HIV among MSM and to explore the feasibility of intruding new prevention approaches in Georgia. The long-term objective is to move obtained knowledge into effective prevention and treatment strategies towards zero new infections. The specific aims of our study are the following, to:

Specific aim 1: Evaluate the epidemiology of HIV among MSM and drivers of the epidemic

Interview and blood sample collection of MSM participant.

a. Estimate baseline prevalence and incidence of HIV, viral hepatitis and syphilis among MSM
b. Evaluate risk behaviors associated with these infections

Specific aim 2: Evaluate the HIV cascade of care among MSM

a. Quantify stages of care and identify gaps in the continuum of HIV care
b. Assess barriers for engaging in the continuum of HIV care

Specific aim 3: Evaluate barriers for accessing prevention and testing services for MSM and explore attitudes towards new approaches

a. Explore the feasibility of introducing new HIV testing strategies
b. Explore the feasibility and acceptability of introducing pre-exposure prophylaxis (PrEP) for high-risk MSM in Georgia

We have intitated a prospective cohort study design utilized to accomplish the proposed specific aims. For this purpose 500 HIV seronegative MSM and 100 HIV seropositive MSM were planned to be enrolled over the first 6 months of the study. The epidemiology of HIV among MSM in Georgia was studied in a cohort of 500 HIV seronegative MSM recruited using an incentivized chain-referral approach in three cities of Georgia - Tbilisi (capital city), Kutaisi and Batumi. After informed consent, participants will undergo study procedures at recruitment and after 6 months. The procedures include the collection of blood specimens for estimating baseline prevalence and 6-month incidence of HIV infection. In addition epidemiology of closely related infections such hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis will be studied. Of note the previous survey found a high prevalence of HCV in MSM of 17%, which was not associated with a history of drug use. Each participant was interviewed at study visits to elicit information on risk factors using a structured questionnaire.

Effective engagement in HIV care continuum with a goal of achieving durable virologic suppression is now considered as a key component of combination HIV prevention. We will quantify

Laboratory testing process:

the engagement of MSM starting from HIV diagnosis through virologic suppression. For this purpose we will use the latest estimates as well as clinical data from the National AIDS Health Information System. The system comprises an electronic database containing comprehensive information on all reported cases of HIV infection in Georgia. In addition to describing the care cascade for MSM, the 2nd specific aim will also explore barriers for successful engagement in care. At least 100 HIV positive MSM receiving care at the Infectious Diseases, AIDS and Clinical Immunology Research Center will be enrolled in the cohort. Patients will be interviewed to identify risk factors from disengagement from care. The interview will address issues related to quality of life, adherence to general clinical care and specifically to ART.

As mentioned above the coverage with prevention services and HIV testing remains low, with less than half of MSM covered. This study will aim at identifying barriers and ways to overcome them. The 3rd proposed aim will also explore the possibility of introducing new prevention and testing approaches in Georgia. The introduction of pre-exposure prophylaxis (PrEP) added significantly to the HIV prevention armamentarium. The efficacy of PrEP for MSM was first shown in the landmark iPrEx study and now it is recommended by the U.S. CDC and World Health Organization. However, uptake remains low and there are significant implementation challenges that have limited the impact of this prevention tool. Another novel approach is HIV self-testing, which is considered an effective addition to the current efforts for scaling up HIV testing. The first home use rapid HIV test was approved by FDA in 2012 and it is now recommended by the International

Antiviral Society–USA Panel. Home test kits are planned to be introduced in some European and African countries. Neither PrEP nor HIV self-testing is available in Georgia, and anecdotal evidence suggests that the knowledge about these approaches is very low. The 3rd specific aim will be accomplished using qualitative research methodology, namely through conducting focus group discussions.

The chairs

The leading institution National AIDS Center takes overall responsibility for project management. Dr. Otar Chokoshvili (National AIDS Center) as project manager and Dr. Kakhaber Kepuladze (Tanadgoma) as sub-manager are coordinating and implementing activities for study. Dr. Nikoloz Chkhartishvili (National AIDS Center) is providing scientific guidance on project implementation in his capacity of scientific leader. Dr. Tengiz Tsertsvadze from the National AIDS Center serves as a non-salaried advisor to provide technical assistance related to project implementation. The US PI for this proposal is Dr. Carlos del Rio, Professor of Global Health and Medicine and co-director of the Emory Center for AIDS Research at Emory University in Atlanta, GA. Dr. del Rio is a leading expert in HIV prevention research and has significant experience conducting HIV prevention research with MSM populations in the US having served as the Emory PI for HPTN 061.

The results

The study was implemented by the Infectious Diseases, AIDS and Clinical Immunology Research Center (National AIDS Center, leading institution) in collaboration with the Center for Information and Counseling on Reproductive Health – Tanadgoma (Tanadgoma, participating institution). The National AIDS Center is Georgia's referral institution for HIV diagnosis, treatment and care, and is the country's leading research institution in the fields of HIV, viral hepatitis and other infectious diseases. Tanadgoma is a prominent civil society organization which has worked in the field of HIV/STI prevention since 2000. Tanadgoma has extensive experience in working specifically with the MSM population, with a scope of work covering prevention interventions as well as bio-behavioral surveys.

The study team elaborated all necessary documents and forms and the project manager had developed web based database for study. At the end of 3rd quarter and first half of 4th quarter the following results have been achieved:

- Some forms and mechanisms for recruiting patients have been improved.
- Useful study literature has been reviewed.
- 95 % (475 MSM) of planned 500 HIV negative MSM have been recruited and interviewed.
- 120 % (120 MSM) of planned 100 HIV positive MSM have been recruited and interviewed.
- Repeated recruitment has started.
- All planned interviews of 8 focus groups have been conducted in Tbilisi, Batumi and Kutaisi, under qualitative research.
- Longitudinal ART adherence methodology was implemented and used.
- Data preparation for analysis and generation MSM care cascade has started.
- Laboratory tested 467 blood samples on HIV, viral hepatitis B and C and syphilis.
- From 467 MSM samples 24 (5.1%) were confirmed on HIV infection using western blot.
- From 467 MSM samples 29 (6.2%) were HCV positive on Anti HCV test.
- From 467 MSM samples 23 (4.9%) had positive results on HBsAg test.
- From 467 MSM samples 125(26.7%) had positive results on anti-HBc test.
- From 467 MSM samples 54 (11.6%) had positive results on of IgM antibodies to Treponema pallidum test.
- From 467 MSM samples 100 (21.4%) had positive results on Treponema pallidum hemagglutination (TPHA) test.

At the end of 3rd quarter two scientific abstracts were submitted at the IAS 2017 conference:

"Georgian MSM Cohort Study: baseline prevalence of HIV and viral hepatitis."

Results: Among 467 MSM enrolled 30 (6.4%) were positive for HIV, 29 (6.2%) for HCV, 125 (26.8%) for anti-HBc and 23 (4.9%) for HBsAg. HIV/HCV co-infection was presenting 2 persons (0.4%) and HIV/HBVco-infection in 6 (1.2%). There were no cases of triple co-infection (HIV/HCV/HBV).The prevalence of HIV but not viral hepatitis was significantly higher in Tbilisi as compared to the other two cities (9.4% vs. 2.8%, $p<0.0001$). HIV-infection among younger MSM (<25 years) were found only in Tbilisi and among then the HIV prevalence was 9.6% (10/104).

Prevalence of HIV and viral hepatitis markers

	Total	Tbilisi	Batumi/Kutaisi	p value
HIV+	6.4% (30/467)	9.4% (24/254)	2.8% (6/213)	<0.0001
anti-HCV+	6.2% (29/467)	7.5% (19/254)	4.7% (10/213)	0.21
anti-HBc+	26.8% (125/467)	27.6% (70/254)	25.8% (55/213)	0.67
HBsAg+	4.9% (23/467)	5.1% (13/254)	4.7% (10/213)	0.83

Conclusions: MSM in Georgia have a high prevalence of HIV and viral hepatitis. Higher prevalence of HIV in Tbilisi, particularly among younger men, suggests that capital city is the site of an evolving HIV epidemic. Low HIV and hepatitis co-infection rates suggests that the risk of acquisition of HIV and hepatitis may be different among MSM in the country of Georgia.

"High rates of smoking among HIV negative and HIV positive men who have sex with men in the country of Georgia"

Results: Among the 596 persons enrolled in the cohort the median age was 26 years, 33.4% had university degree, 32.1% were unemployed, 78.7% reported alcohol consumption in the preceding month and 22.3% used illicit drug within a year. Overall 440 (73.8%) reported recent smoking within 1 month. The prevalence of recent smoking was 73.8% among HIV negative MSM and 73.9% among HIV positive MSM (p=0.98). Among the 440 recent smokers, 87.2% reported everyday smoking, the median number of cigarettes consumed a day was 20 and 64.8% had their first cigarette within 30 minutes after waking up. Factors associated with recent smoking in multivariate analysis included older age >26 years (OR: 1.66, 95% CI: 1.08-2.56, p=0.02), history of alcohol consumption (OR: 2.59, 95% CI: 1.67-4.01, p<0.0001) and illicit drug use (OR: 4.11, 95% CI: 2.21-7.64, p<0.0001).

Conclusions: Rates of smoking are very high both among HIV negative and HIV positive MSM. Older persons and those with a history of substance use are at a higher risk for smoking. There is a need for developing smoking cessation programs tailored for MSM in Georgia.

KYRGYZSTAN

Study of migration of thorium and other waste from rare earth production site with natural waters in Kyrgyzstan

ISTC Project number	KR-2019
Project Manager	Valentina Mikhailovna E-mail: valentina_ma@mail.ru
Leading Institute	Institute of Physics and Technical Problems and Materials Science, National Academy of Sciences, Kyrgyz Republic
Foreign collaborators	Dr. Howard D. Passel, Sandia National Laboratory, US Department of Energy Prof. Dr. Joonhong Ahn, University of California, Berkeley, USA
Total cost of the project	258185 USD

THE OVERALL TASKS, TECHNICAL APPROACH AND RESULTS:

Overall Tasks.

The main purpose of the Project is to evaluate man-caused thorium-232 and radium-228 migration from the sites of rare-earth raw materials extraction and processing in Kyrgyzstan and to assess their impact on man and biota.

Specific Objectives.

1. Development of practical technique and methods for tracing radioactive and migration of rare earth production waste with natural water.
2. Building of ecological maps adjacent to the tail deposits site with outlining space distribution of radionuclides and accompanying other toxins due to their water migration from tail deposits.
3. Assessment of radioecological hazard on water and soil.
4. Development of recommendations for mitigation of radioecological and toxic hazard of monitoring objects.
5. Creation of mathematical models of migration of thorium, its daughters and other toxic elements generated through rare-earth production.

Technical approach

1. Radionuclide, chemicals, and isotop composition of water and soil entering natural and disturbed due to human activities systems was estimated. To investigate current water and soil condition the samples of water (boreholes, springs, rivers and so on), rock (tail deposits, dumps), soil, bottom sediment and riverside (floodplain) sediment were selected in a influenced zone of former Ak-Tyuz Mining and Processing plant.
2. Hydrogeological and hydrological investigation of the sites was implemented with consideration of water balance formation.
3. The parameters controlling thorium-232 migration were determined by literature data and by the results of field observations.
4. The combination of field observations, testing, and analytical methods used in this investigation construct a spatial picture of distribution of toxic water from man-caused sources of pollution – tail deposits and waste rock dumps.

Results.

1. Results of mathematical simulation of surface and groundwater dynamics and pollution migration from tail deposits as well as predictive

calculations were made based on a two-year monitoring. The calculations allowed for the prediction of the following scenario of pollution movement with groundwater and clearing the latter in the future:

– Dissolved thorium arrival with tributaries and ground water in the Kichi-Kemin river results in an increase of thorium content in water in the sites with additional sources (depending on water quantity in a year) by a value from 15 to 35 Bq/m3;
– The content of dissolved in water thorium down the stream relative to points of water coming from additional sources immediately decreases due to dilution;
– Dissolved thorium goes beyond the modeled site (carrying out through the lower downstream boundary) only at low parameters of exchange with bottom sediment, at that its excess concentration (due to the increase on the site of mining) does not exceed 10 Bq/m3;
– Thorium is accumulated in bottom sediment, and the increase of its maximum concentrations reaches 20 Bq/m3, however this accumulation is absent beyond the modeled site.

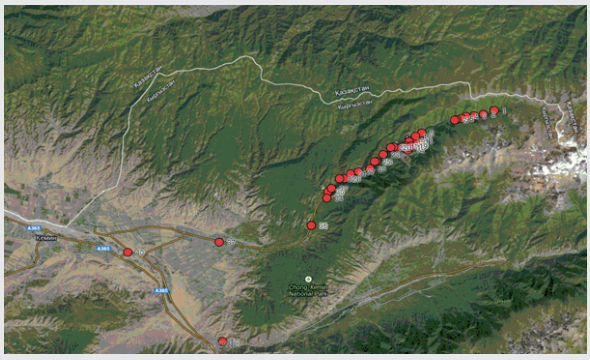


Fig.1 – Location of points of sampling along Kichi-Kemin river

Thus, it is shown, that there is no negative influence on radioecological situation in area of location of former mining enterprise due to thorium moving out from the area of mining work with surface and ground water.

The increase of thorium content in this part of the river reaches 35 Bq/m3 for river water and 20 Bq/m3 for bottom sediment depending on water quantity in a year and mass-exchange parameters between river water and bottom sediment.

Deterioration of the radioecological situation outside the investigated area of the Kichi-Kemin river is practically absent at the chosen hydrological parameters corresponding to average many-year river discharges. It is necessary to note that the transport of bottom sediment (coarse and dragged debris) containing increased concentration of thorium is possible downstream beyond the area under study only in two cases:

– At high rain floods (less probable scenario);
– At spring flood due to seasonal snow melting and simultaneous spring atmospheric precipitation peak (more probable scenario).

2. It was established that on the site upper the Ak-Tyuz village a level of radiation background

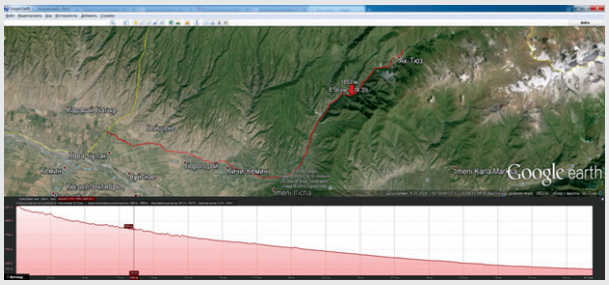


Fig.2 – Space arrangement of modelled site of the Kichi-Kemin river channel and the channel relief profile on this site: upper panel – a modelled site of the river Kichi-Kemin (red curve); bottom panel – the river channel profile on the modelled site.

reaches 7–11 μR/h. At tail deposits № 1 and № 3, a level of radiation background varies from 30 to 630 μR/h. With remoteness from the tail deposits the radiation background decreases.

3. Based on the results of the Project, the following main practical recommendations are proposed to reduce and prevent the negative impact of industrial facilities on the environment:

– The creation of monitoring infrastructure which could connect independent organizations and also protect residents and the environment from the hazard associated with the proximate location of radioactive tail deposits.
– The problem of tail deposits surface water isolation is evident and urgent. This is important for protection from γ-radiation and for prevention of wind evacuation of radionuclides from the tail deposits surface. Due to the lack of an anti-filtration layer on the tail deposit bed and unsatisfactory condition of drainage ditches, the pollution of ground water is possible due to precipitation infiltration.
– The protective covers, fences and compulsory signs should be restored in order to avoid moves of the radionuclides and heavy metals in the river Kichi-Kemin.

– The program should be developed for complex radiological, geotechnical monitoring in considered areas of the tail deposits, dumps, and the industrial platform of former dressing works.
– It is necessary to monitoring in scientific methods. The former project researches showed local anomaly caused by sulfides oxidation and high alkalinity of some river water samples (pH> 9) which indicates the inflow of polluted water from reservoirs of technological solutions storage.

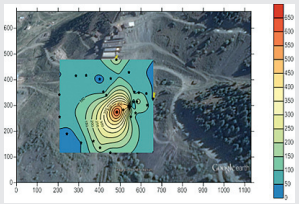


Fig. 2–A scheme of space distribution of radiation dose rate on area of tail deposit № 1.

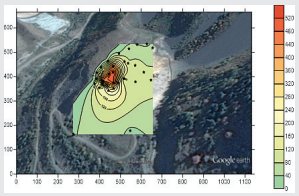


Fig.3 – Radiation dose rate on area of tail deposit № 3.

ISTC PROJECT # KR-2105
«CLIMATIC EFFECTS OF CENTRAL ASIA MICROSCALE AEROSOLS»

General view of Lidar station Teplokluchenka

In 2016 on the basis of daily average values of the aerosol optical depth (AOD), the Angstrom parameter (A), the mean cosine of the scattering indicatrix (the asymmetry parameter g), and the single scattering albedo (SSA) are considered their statistical distributions by seasons and years for the period 2014-2015. It is established that the accumulation modes in the particle size distribution in the atmosphere of the region are always present and can be associated with transboundary transfer of nano - and microscale particles. In the boundary layer in the range of 300 nm-10 μm, the particle size spectra are most adequately described by lognormal distributions and characterize the soil-erosion aerosol distribution predominantly of the coarse mode. In 2014-2015 in the region fine nanoscale particles principally created an anti-greenhouse effect. At the same time the impact of these particles is different seasonally: in winter and spring the greenhouse effect was observed but in summer and autumn – the anti-greenhouse effect. The coarse nanoscale particles produced the anti-greenhouse effect during all seasons.

Equipment of Lidar Station Teplokluchenka

On the basis of software for calculation of aerosol radiative forcing is developed, which is based on the algorithm of calculation of fluxes of direct and scattered solar radiation under the delta-Eddington approximation studies are being conducted to determine the effect of nano- and microscale particles on the radiation transfer in the region's atmosphere and, thereby, on the variable climate of the atmosphere and the underlying surface.

Equipment on a platform located above the Lidar station

TAJIKISTAN

ISTC project number	T-2109
Project Manager	Narzulloev Naim narzulloev naim <naimnn@mail.ru>
Leading Institute	Tajik National University
Foreign collaborators	Tosoh SMD, Inc., Grove City, OH, USA (Ivanov E)
Project duration	Beginning from 1 Nov 2014 for 36 months
Financial parties	US
Total cost of the project	$305,800 USD

The project aim. The project will develop technology for producing hydrogen by electrolysis and thermolysis gas from hydrocarbons and coals using idle energy discharge of water from reservoirs.

The main tasks of the project, such as the development of technology for producing hydrogen by electrolysis using idle energy discharges of water from reservoirs and the development of systems for the accumulation of hydrogen, have exclusively peaceful uses and are focused on the solution of environmental protection problems and the economic security of the population.

The present project corresponds to the following purposes and tasks of the ISTC such as:

- Problems of the creation of alternative energy technology through the use of idle discharge of water from reservoirs and protection of the atmosphere from greenhouse gases represent an essential scientific interest for not only Tajikistan and Central Asian countries but also for the world scientific community, public institutions and the commercial organizations operating in the regions characterized by similar environmental problems. The proof of it is a significant amount of publications in scientific magazines and materials of the international scientific conferences devoted to the matter.
- Development during the implementation of the project methods of an assessment, decrease and/or compensation of technological and natural hazards will allow development to be optimized and reasonable, from the point of view of the market economy and actions to decrease or eliminate the consequences of global climate change.
- Promotes the solution of national and international legal problems.

Volume of works:

- Development of technology for water electrolysis;
- Research of efficiency of electrolysis of water from materials of electrodes and constructional features of a Diaphragm; Development of modes of analytical quality control of gases of decomposition of water;
- Development of technology for the separation and accumulation of hydrogen and oxygen, and an analyses of the chemical composition of coal and organic matter;
- The creation of pilot installation and working off technology of electrolysis of water and thermolysis.

Role of Foreign Collaborators/Partners

The collaborator will represent available data on a project theme, make comments on annual reports, and give permission to use available experimental methods and methodology of chemical processes. Also, they will promote the organization and carry out the training of the TNU personnel, assist participants of the project in visiting international meetings and set up joint symposiums and working seminars.

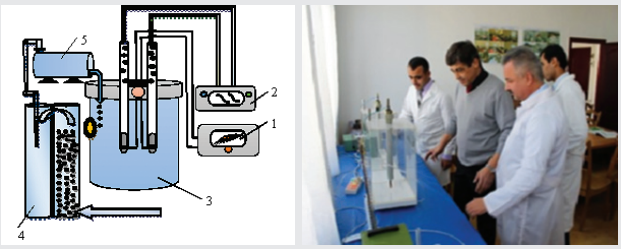
Technical approach and methodology

The methodology of the project will be based on the close coordination of experimental works, engineering and design decisions and the wide application of modern methods on the analysis and identification of the products of reactions to electrolysis and thermolysis.

Modern devices and installations will be used for this purpose. The interpretation of the results of the experiments will be carried out with the application of mathematical statistics. For the automation of technological processes, it will be a widely used mathematical model operation based on computer programs.

Development of research and main results

To achieve the versatility of an experimental setup, this will consist of rapid changes in the electrodes for electrolysis, collecting and analyzing electrolysis gases. Also, to achieve the possibility of electrolysis by adding reagents to modify the electrical conductivity of the electrolyte, and the possibility of changing the current intensity to the applied voltage, a wide range has been developed for the installation. A schematic diagram of this is shown on Fig. 1.



Scheme of the technological line for production of hydrogen by electrolysis of water: 1-power unit; 2 - manometer; 3-cell; 4-cleaning system;5 - water tank.

The water electrolysis is carried out through the use of stainless steel electrodes and copper at a voltage from 2.4 to 4.4 V. The current-voltage characteristics of the electrolytic cell using the electrode of copper and stainless steel differ significantly. Formed hydrogen in the electrolysis process is qualitatively determined by the formation of bubbles on the surface of the electrodes and quantitatively by measuring the gauge connected to the cell.

For electrolysis river water has been used and also water after a softening process. It should be noted that when using river water without treatment deposition on the electrodes were found. Conglomerates of complex composition and process of the electrolysis of water was barely observed. To establish if the deposits of components in composition of water shift the values of voltage of electrolysis, physical and chemical analyses were carried

The composite chemical composition of river water explains the observed process of accumulation of conglomerates on a surface of electrodes and specifies the need for their preliminary cleaning for electrolysis implementation.

The influence of a concentration of potassium hydroxide on the efficiency of water electrolysis process by use of electrodes of graphite and stainless steel are investigated. For this reason a standard solution of KOH with concentrations 0.1 - 0.8 M is consistently added to the water electrolysis cell and the amount of hydrogen was measured. The rate of hydrogen formation at fixed concentration of KOH was investigated at voltages on the electrodes 18V and 24 V.

We conducted a series of studies of water electrolysis using combined electrodes, stainless steel electrodes with a thin layer of chromium deposited. The processed thin layers of chromium influenced the efficiency of electrolysis in the presence of potassium in the alkali electrolysis cell. This was performed using electrodes coated with a layer of chromium 15 microns and 8 microns. It should be noted that regardless of the thickness of

Presentation of the ISTC T-2109 results and discussion

the chrome plating, a sharp increase in the hydrogen production rate was observed. It was found that the process of electrolysis of water will play a crucial role in the catalytic surface phenomena and applications of the electrode layer on the surface of chromium plating when it is not eroded even in an alkaline medium for a duration of 45 hours.

Main conclusions and publication

- It was found that the chemical composition of Mountain Rivers is formed because of flushing rocks by water runoff;
- Generation of hydrogen by the electrolysis of water should be preceded by a preliminary electro-sedimentation of mountain river waters;
- The addition of potassium hydroxide during electrolysis greatly accelerates the decomposition of water to produce hydrogen and oxygen;
- The influence of an alkaline medium in the electrolysis process on the microstructure of the electrode surface by formation of recesses on the surface;
- The use of stainless steel electrodes with a thin layer of chromium deposited significantly accelerates the process of electrolysis, and is resistant to an alkaline environment. Shows promising use of multicomponent catalysts based on coal coated with iron family metals (Fe, Ni, Co) as the electrodes;
- For the production of hydrogen by electrolysis of high purity and in a semi-industrial scale, it is necessary to combine the membrane separation method with the pressure swing adsorption (PSA) gas.

Hepatitis delta virus: co-infection and superinfection in Tajikistan

ISTC Project number	**T-2192**
Project Manager	**Dustov Abdusamad** **E-mail: dustovsamad@gmail.com, samad-dustov@rambler.ru**
Leading Institute	**Institute Gastroenterology of the Ministry of Health and Social Protection Population of the Republic of Tajikistan**
Foreign collaborators	**Prof. Dr.Dr.h. mult H.Blum Department Inter Medicine Freiburg University (Germany)** **Prof. Jianguang Ji Clinical Research Centre (CRC), building 28, floor 11 Jan Waldenströms gata 35 Jan Waldenströms gata 35, Skåne University Hospital, Sweden**
Total cost of the project	**346402 USD**

The main tasks and results:

The results of this work, which will determine the particularities of etiological structure, clinical course, the character and immunological changes of delta infection, will allow us to considerably improve early diagnostics of viral hepatitis D, timely state the adequate treatment tactics and further dispenser observation. The work will evaluate the role of different risk factors and genotype diversity of delta infection among different population groups.

The ISTC project T-2192 focuses on the HBV and HDV- co-infection that cause cirrhosis and liver cancer. Importantly, it will be determined which particularities of the etiological structure HDV infection, clinical course, its character and immunological changes of delta infection in the Gastroenterology clinic of the Ministry of Health and Social Protection Population of the Republic of Tajikistan, where patients will be checked.

The international scientific community now has information on circulating hepatitis Delta co-infection in Tajikistan. We have the possibility to exchange material with our collaborator for genotyping and sequencing HBV, HDV infection.

The main objective of this project is to renew some of the virology investigations of the delta infection in the Republic of Tajikistan.

This would provide a clear understanding of the determination of molecular epidemiological and clinical particularities of the delta infection (HDV) with the genotypes circulating in the Republic of Tajikistan. Most importantly, to help address public health issues and develop control plans, we have informed the population and medical staff about the risks particularly associated with HBV and HDV infection.

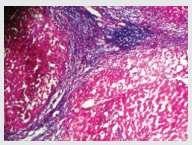


Fig. 1. Cirrhosis of the liver in patient with HBV + HDV infection showing a macro nodular mixed cirrhosis

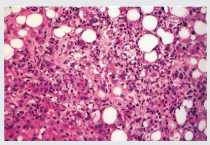


Fig. 2. Liver biopsy from patient with chronic HBV and HDV infection. In the cytoplasm of hepatocytes, along with a hydropic degeneration fat deposition was detected.

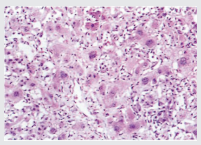


Fig. 3. Liver biopsy sample of the patient with chronic HDV hepatitis shows a moderate activity. Dysplasia of liver cell.

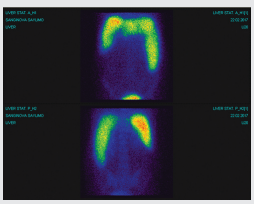


Fig.4 On scintigraphy liver cirrhotic patients with HDV infection noted diffuse liver destruction and splenomgaliya

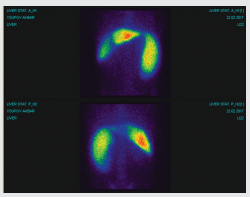


Fig.5. On scintigraphy liver cirrhotic patients with HDV infection noted diffuse liver destruction, fibrosis and splenomgaliya

The project gives the possibility for young scientists, participating in the project, to obtain valuable experience and establish international links with the project collaborator and to take part in joint seminars and conferences.

Fig. 5. Examination of the patient with hepatitis HBV and HDV on Gamma Camera SPIRIT DH-V in the Department for Nuclear Medicine

Fig. 6. Study blood samples of patients with hepatitis HBV and HDV in virology laboratory

Results.

Our results have shown that the accession of the hepatitis D virus to the HBeAg negative and HBeAg positive of HBV develops several options for virological situations: a) when D virus superinfection joins the HBeAg negative variant chronic hepatitis B can occur in both suppression of viral replication. As a result, the minimum hepatitis (HBsAg +, anti-HDV +) . b) D virus superinfection joins HBeAg negative chronic hepatitis B variant may develop suppression of HBV replication c) when D virus superinfection joins HBeAg positive chronic hepatitis B variant may increase the replication of both viruses and may develop chronic active hepatitis.

Morphological characteristics of hepatitis B+D

We have studied morphological features in 18 patients with chronic HBV and HDV infection and liver cirrhosis.

In the liver biopsies from patients with chronic HBV infection chronic hepatitis with moderate or severe activity has been found. In the biopsy “sand core” was detected, which was fluorescence positive by immunostaining with anti-HBs.

KAZAKHSTAN

ISTC Project	**K-1920**
Full Title	**Estimation of Apricot and Pear Genetic Diversity and Germplasm Preservation in Kazakhstan**
Leading Institute	**National Biotechnology Center of Kazakhstan / Institute of Plant Biology and Biotechnology, Almaty, Kazakhstan**
Collaborators	**United States Department of Agriculture / Agricultural Research Center / ARS National Clonal Germplasm Repository, Corvallis, OR, USA (Reed B, Aradhya M)** **United States Department of Agriculture / Agricultural Research Center / ARS National Germplasm Resources, Beltsville, MD, USA (Garvey E J)**
Partners	**United States Department of Agriculture / Agricultural Research Service, Beltsville, MD, USA**
Project Duration	**January 2011 - April 2016**

Objective: The aim of the current project was to explore and preserve the wild forms of apricot though a systematic study of their genetic structure and differentiation and storage techniques.

Technical approach: Field observations and population mapping of natural populations were completed concurrently with studies of apricot germplasm preservation. The phenotypes were

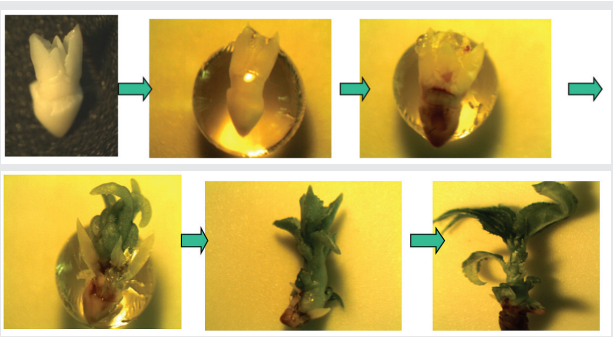


Figure 1 - Different stages of the development of an apricot embryo after the cryofreezing by encapsulation-dehydration method

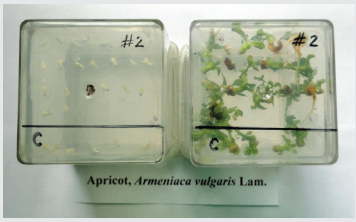


Figure 2 - The development of embryonic axes without endosperm after 1 month following freezing in LN a) stratified at +4°C (development of embryos started after they had been placed in conditions +24°C), b) without stratification at +24°C

characterized by international descriptors. Genetic diversity and areas of important populations of apricot in Kazakhstan were defined by DNA analysis. The most valuable genotypes and small at-risk populations were determined, based on the DNA data. Improved tissue culture protocols and optimal mineral nutrition for micro propagation were determined. The optimization of cryopreservation protocols for seeds, buds and shoots was carried out in vitro and seed banks of apricot germplasm were established.

Obtained results: Surveying, phenotype data collection, and DNA analysis of the genetic diversity of apricots in Kazakhstan established where important populations exist and provided a framework for developing preserves to protect this important genetic resource.

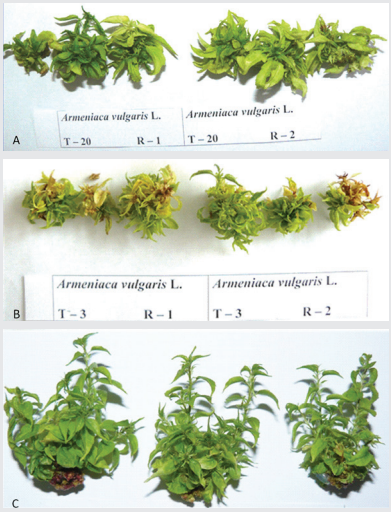


Figure 3. Shoot cultures grown on A. Treatment # 20 with leaf deformation (2× Nitrogen, 3× Mesos and K2SO4 and 4× Minors) B. Treatment #3 with shoot tip necrosis (0.5× NH4NO3, 2× Ca(NO3)2, 3× Mesos, 4× Minors, 3× K2SO4) and C. Trial medium 1 (1.75× Nitrogen, 2.5× Mesos, other nutrients 1×).

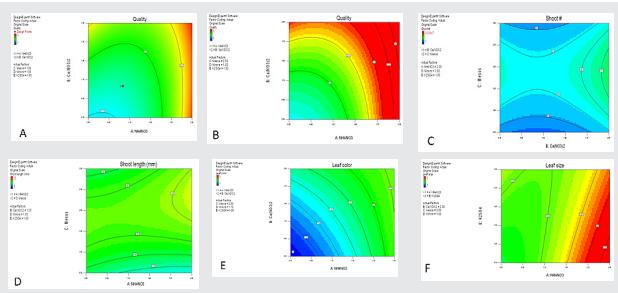


Fig. 4. Models for apricot shoot growth responses. A. Quality graph with WPM control nutrient concentrations (red dot). B. Optimized quality graph. C. WPM (red dot) control shoot multiplication. D. WPM (red dot) control shoot length in mm. E. WPM leaf color (red dot) rated 1 yellow, 2 light green, 3 green. F. WPM leaf size (red dot) rated 1 small, 2 medium and 3 large.

Cryopreservation of apricot seeds/axes and buds or shoot tips provide long-term storage of these genetic resources. The plant material collected in these expeditions is used to creation national and international in vitro and seed gene banks for apricot. Optimization of micro propagation protocols allow using it for reproduction and vegetative reproduction, as well as for medium-term germplasm storage and for in vitro cryopreservation.

List of completed projects

Project No#	Short title	Lead Institute	Funding party	Collaborator Country
#A-2071	Deactivating Polymeric Systems	Yerevan Institute "Plastpolymer"	JP, Other	USA, Japan
#A-2072	Remediation of Cs-contaminated soils by polymeric sorbents	Institute of Hydroponics Problems	JP, Other	Korea, USA, Japan
#G-1081	Leishmaniasis in Georgia	National Center for Diseases Control	Partner	USA
#G-1462	Salmonella Surveillance and Control in Georgia	Georgian National Center for Disease Control	Partner	USA
#G-1759	Clostridium Difficile-Associated Disease in Georgia	National Center for Diseases Control	Partner	USA
#G-1937	Nonlinear Waves in Nanostructures	Georgian Technical University	USA	USA
#G-2094	A universal test on magneto sensitivity	Heliomagnetocardiological and Practical Centre	EU	Korea, Belgium
#G-2098	Study of New Physics at ATLAS experiment	Tbilisi State University	USA	USA, Switzerland, Czechia
#G-2099	Toxigenic E. coli	National Center for Diseases Control	Partner	USA
#G-2100	Multidrug Resistant and Extensively Drug Resistant Tuberculosis	National Center for Diseases Control	Partner	USA
#G-2103	HIV drug resistance in Georgia	National Center for Diseases Control	Partner	USA
#K-1860	Carbon-Silicon-Bearing Nanomaterials	The National Center for Mineral Raw Materials Complex Processing	Partner	
#K-1920	Preservation of Apricot and Pear Germplasm	National Biotechnology Center of Kazakstan / Institute of Plant Biology and Biotechnology	Partner	USA
#K-2051	Track-etched membranes in modern materials science	National Nuclear Center of the Republic of Kazakstan / Institute of Nuclear Physics	Partner	USA
#K-2057	Treatment and Safe Disposal of LRW	Nuclear Technology Safety Center	Partner	USA
#K-2058	Primers and PCR test kits for detection of Salmonella and Shigella	Kazakh Scientific Center for Quarantine and Zoonotic Diseases	Partner, Other	
#K-2081	Express-diagnostics of plague	Kazakh Scientific Center for Quarantine and Zoonotic Diseases	Partner	USA
#K-2085	Production of agricultural goods under radioactive contamination conditions	National Nuclear Center of the Republic of Kazakstan / Institute of Radiation Safety and Ecology	EU, Other	USA, Austria
#K-878	Molecular Epidemiology of Swine Influenza in Siberia and Kazakhstan	Institute of Microbiology and Virology	Partner	USA
#KR-2011	Rupture mechanisms of major earthquakes	Kyrgyz-Russian Slavonic University	USA	USA
#KR-2088	Microbiological Monitoring of Uranium-Contaminated Environments	Biotechnology Institute of NSAK	Partner	USA
#KR-2092	Ecological risk assessment	National Academy of Sciences of Kyrgyzstan / Institute of Chemistry and Chemical Technology	USA	USA
#KR-2093	Detoxication technology	National Academy of Sciences of Kyrgyzstan / Institute of Chemistry and Chemical Technology	EU	USA
#T-1298.2	Brucellosis Disease in Tajikistan	Republican Center for State Sanitary Epidemiological Control	Partner	UK

ISTC Structure

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- Japan
- Kazakhstan
- United States

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CIS Parties and Georgia

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