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Regional and International Cooperation
in Central Asia and South Caucasus:
Recent Developments in Agricultural Trade

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Samarkand | Uzbekistan

IMPROVING THE MANAGEMENT OF TECHNOLOGIES TRANSFER SYSTEM AND DEVELOPMENT OF INFORMATION INFRASTRUCTURE OF INNOVATIVE ACTIVITY IN UZBEKISTAN

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Committee for Coordination Science and Technology Development
under the Cabinet of Ministers of Uzbekistan

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2. Analysis of National Capabilities
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4. Future Plans for Discussion

SAMARKAND Conference 2016

1. Overview of S&T Policy

Administrative Framework on S&T

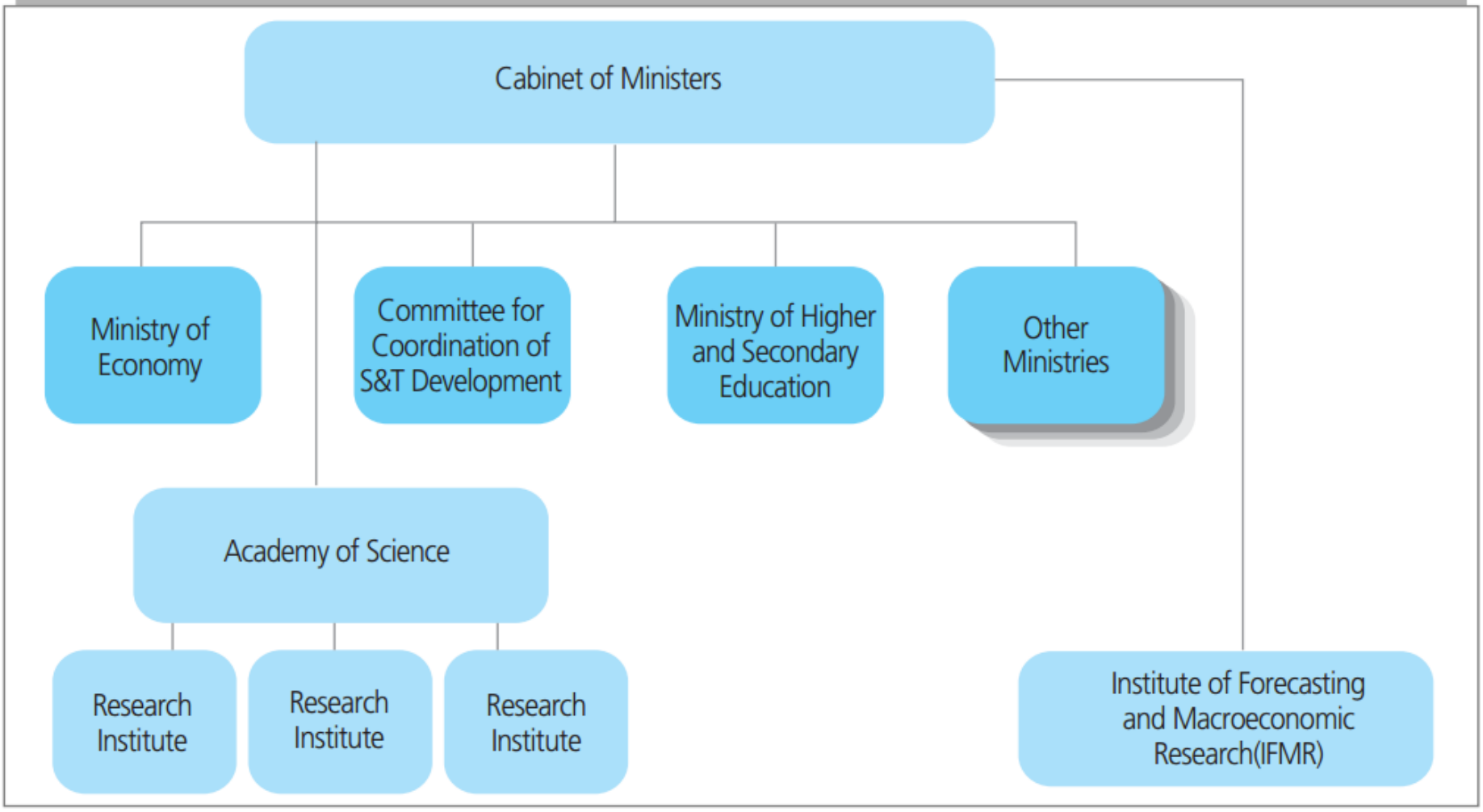
There is no coincidence that in the sovereign Uzbekistan since the first days of independence, great attention is paid to the development of national science and leading scientific schools and innovative research, regulated at the legislative level. This can be seen in a number of decrees and resolutions of the President of Uzbekistan Islam Karimov and relevant resolutions of the government of the Republic of Uzbekistan adopted in the field of innovative development.

- Uzbekistan has been trying to develop its economy through science and technology. It has been formulating and implementing national S&T policies in order to strengthen its national innovation system

Demand-oriented policies

- Uzbekistan introduced demand-oriented S&T policies. Recently, Uzbekistan adopted the Decree of the President of the Republic of Uzbekistan “On th e Priorities of Industrial Development of Uzbekistan in 2011-2015”. It has provisions on S&T policies for the period from 2011 to 2015.
- The decree specifies priority industrial areas such as energy, oil and gas, chemical, textile and light industry, nonferrous metallurgy, engineering, automobile, pharmaceutics, high-quality and deep processing of agricultural products, and construction materials. Accordingly, R&D activities of the national innovation system of Uzbekistan are expected to address the demand of those industrial sectors.

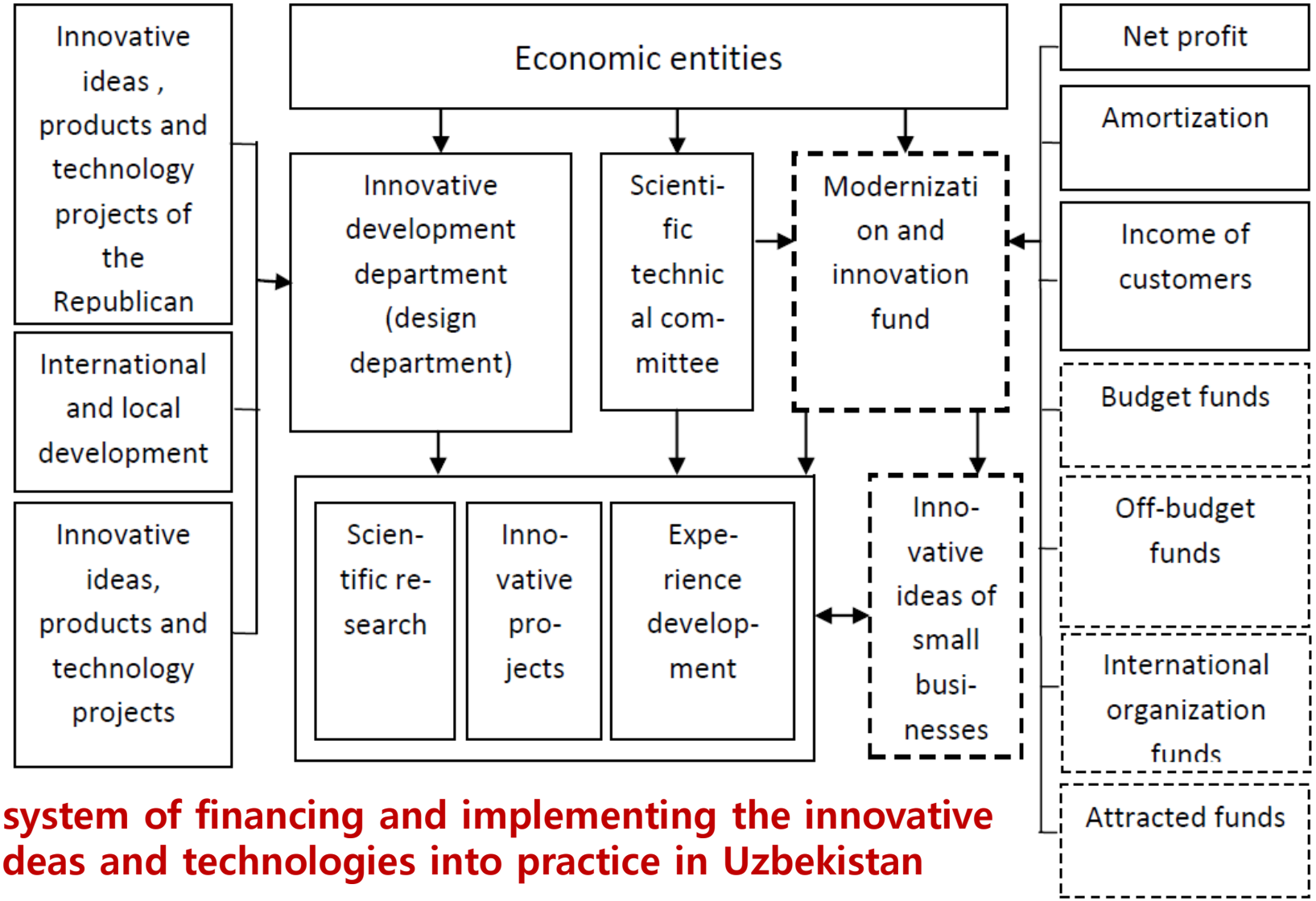
S&T administration system of Uzbekistan



Organization of the Committee for Coordination of S&T Development

Committee for Coordination of Science and Technology Development

- Committee Chairman
- Deputy Chairman of the Committee - Head of Executive Office
- Interdepartmental scientific and technical advice and expert groups in priority areas of science and technology
- Analysis Division of the formation and coordination of scientific and technical programs of basic and applied research
- Analysis Division and coordination of innovative activities and introduction of scientific and technical development in production
- Finance Division of the Fund innovative scientific and technological activities
- Dapartment for international scientific cooperation
- General Department



The system of financing and implementing the innovative ideas and technologies into practice in Uzbekistan

Financial distribution of investments of the state budget to research programs is determined by the Ministry of Finance of the Republic of Uzbekistan on the basis of offers of Committee for Coordination of Science and Technologies Development under the Cabinet of Ministers of the Republic of Uzbekistan and is realized on the basis of the decree on "On procedures of Formation and Realization of Scientific and Technical Programs of Fundamental and Applied Researches".

According to this decree, financial distribution consists of following six parts:

The Academy of Sciences;
Ministry of Higher and Secondary Specialized Education;
Ministry of a rural and water management;
Ministry of Public Health Services;
Ministry of national education;

Committee for Coordination of Science and Technologies Development under the Cabinet of Ministers of the Republic of Uzbekistan which develops and finances research programs of the scientific and experimental-design institutions which don't enter the above-mentioned ministries and organizations, as well as, organizations, which have certain scientists and experts, acquire opportunities and scientific potential for carrying out researches.

1. Overview of S&T Policy

S&T Policy

Special Governmental Programs for Supporting R&D

- Governmental Programm for Scientific equipment for Research organizations (2009-2012) - $10 mln.
- Creating of the Center for Genomics and Bioinformation (2010)
- Crating International Institute for Solar Energy (2011)
- Creating High Technologies Center with Cambridge University (2012)

Short-term tasks

- A highly qualified personal for the innovation economy
- Improvement of the legal framework
- The creation of technological platforms
- The creation of clusters of innovative development

Analysis of National Capabilities

successes and perspectives

Key macroeconomic trends of Uzbekistan in 2011-2015 and projections of those till year–end of 2015, as percentages

Indicators	2011	2012	2013	2014	2015
GDP growth rates	8.3	8.2	8.0	8.2	8.2
GDP deflator	16.1	14.7	13.0	12.6	12.2
Investment growth rates into the main capital	7.9	11.6	9.3	9.4	9.7
Share of investments in the GDP	23.1	22.8	22.6	22.9	23.2
The manufacturing sector's growth rates	6.4	7.7	8.4	9.1	9.3
The share of the manufacturing sector in GDP	24.0	24.0	24.2	25.2	26.8
The agricultural sector growth rates	6.6	7.0	6.0	5.2	5.1
The share of services in the GDP	50.5	52.0	53.0	54.0	54.0
Exports growth rates	15.3	11.6	14.0	15-18	18-20

Source: The State Committee of the Republic of Uzbekistan on Statistics.

The ultimate objective of the above priority tasks implemented will be to achiev e the following targets of economic development by the year 2015:

- The assurance of sustainably-high rates of economic growth, with an average growth rate equal to no less than 8.0 to 8.2 per cent a year.

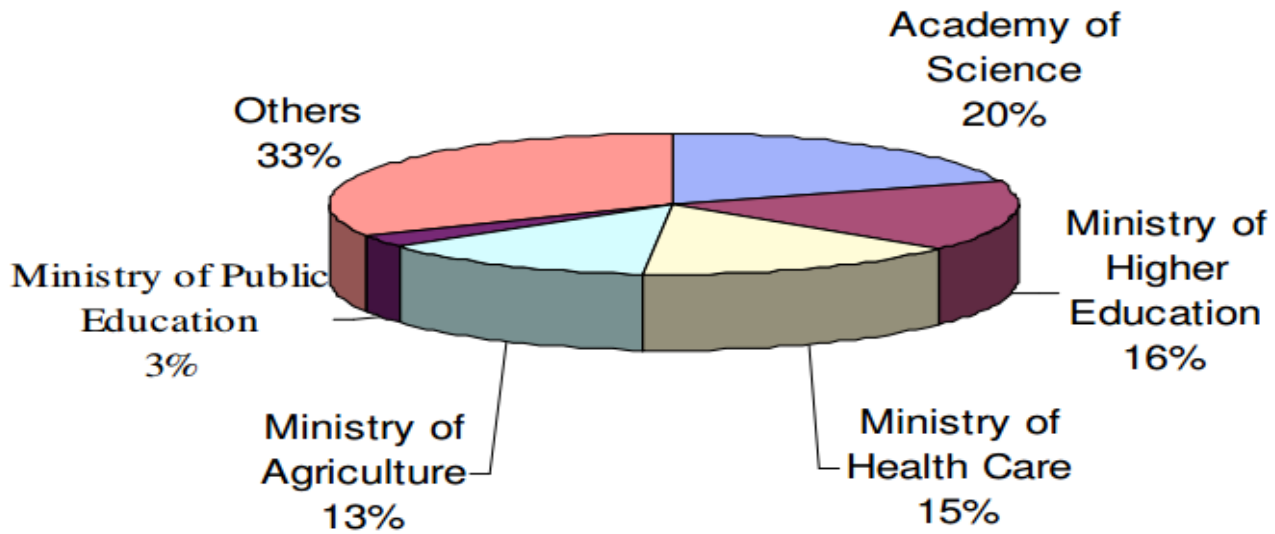
- Accomplishment of qualitative structural shifts in the economy on the basis of advanced development of manufacturing industries and services' sector to increase t heir shares in die GDP to 26.8 and 55 per cent respectively by the year 2015;

- The increased economic contribution of small businesses and private entrepre neurship, by increasing their share in the GDP to 57.5 per cent by 2015;

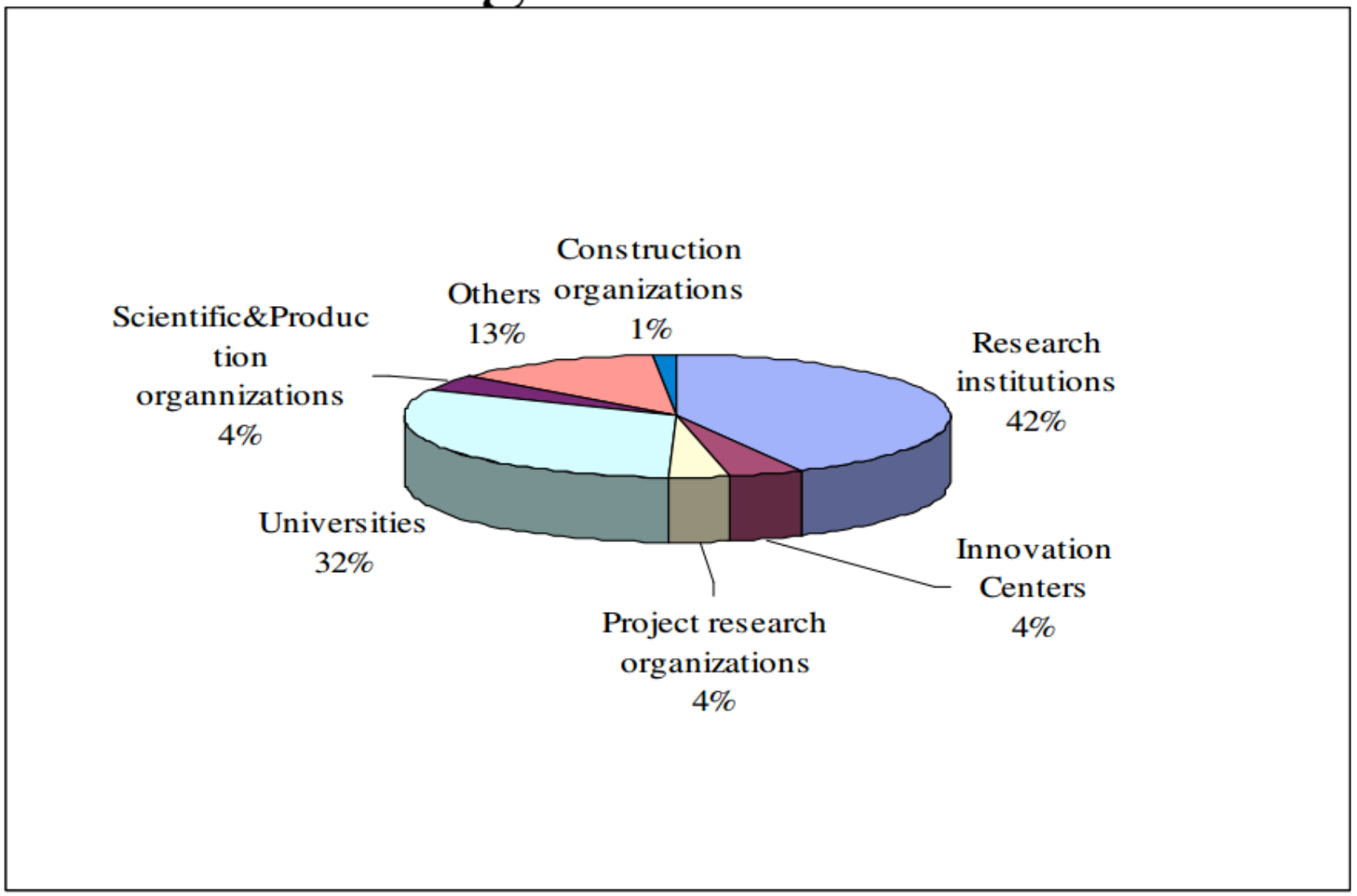
- The assurance of an increase in the attraction of investments to 9.3-9.7 per ce nt annually;

- A significant increase in the banking sector's contribution to the invocat ion of investment processes, by increasing the gross capital of commercial banks by 1.52 times, and that of credit investments by 1.73 limes, during the period of 2013-2 015

Scientific Organizations



Scientific Organizations



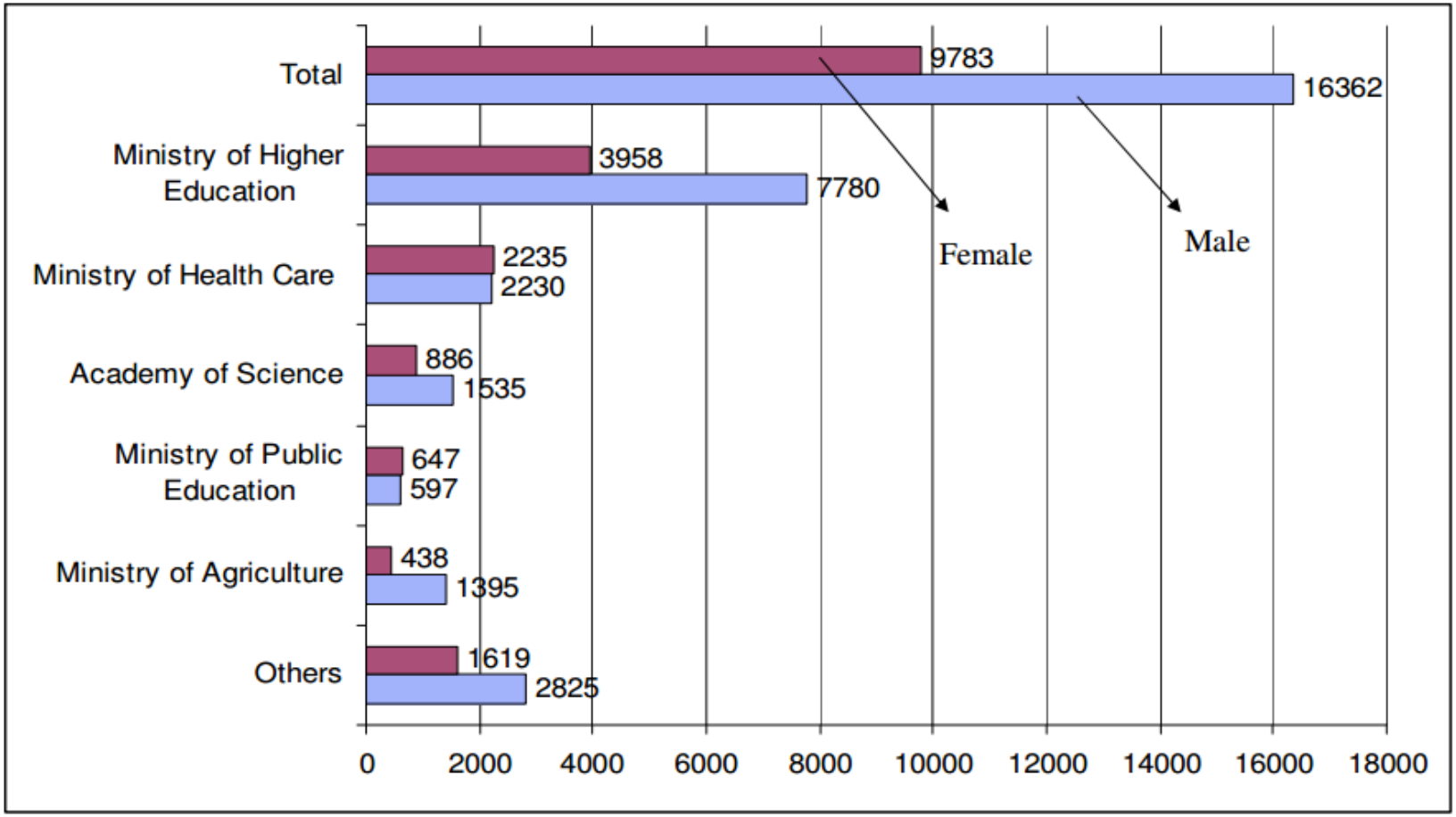
S&E Personal

Ministry	Researchers	Engineers	Total
Academy of Science	2421	3169	**5590**
Ministry of Higher Education	11738	1914	**13652**
Ministry of Health Care	4465	609	**5074**
Ministry of Agriculture	1833	1109	**2942**
Ministry of Public Education	1244	33	**1277**
Others	4444	1608	**6052**
Total	**26145**	**8442**	**34587**

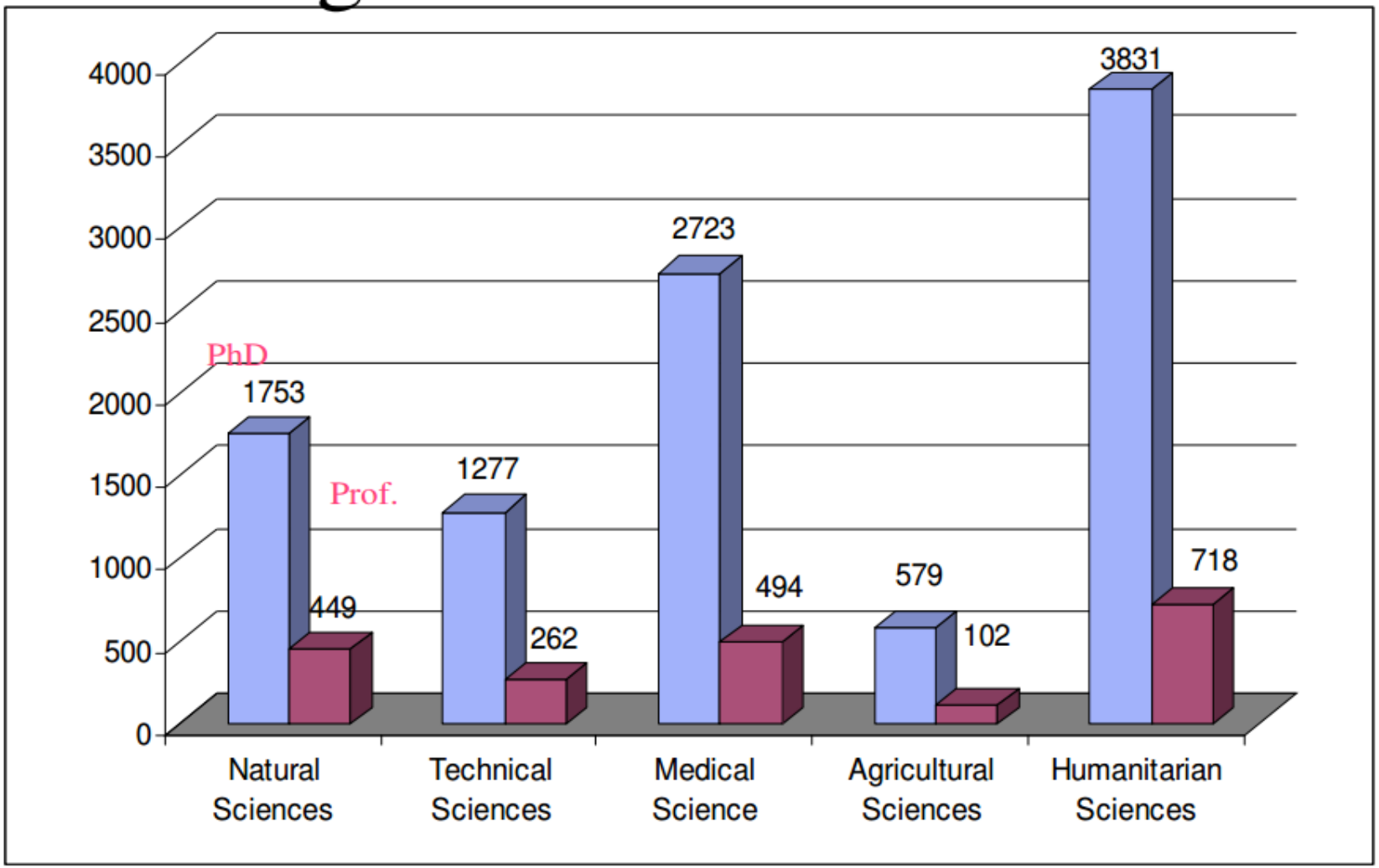
S&E Personal

Ministry	Professors	PhD	No degrees	Total
Academy of Science	447	1056	918	**2421**
Ministry of Higher Education	996	4526	6216	**11738**
Ministry of Health Care	666	1674	2125	**4465**
Ministry of Agriculture	190	618	1025	**1833**
Ministry of Public Education	353	911	3180	**1244**
Others	353	911	3180	**4444**
Total	**2721**	**9231**	**14193**	**26145**

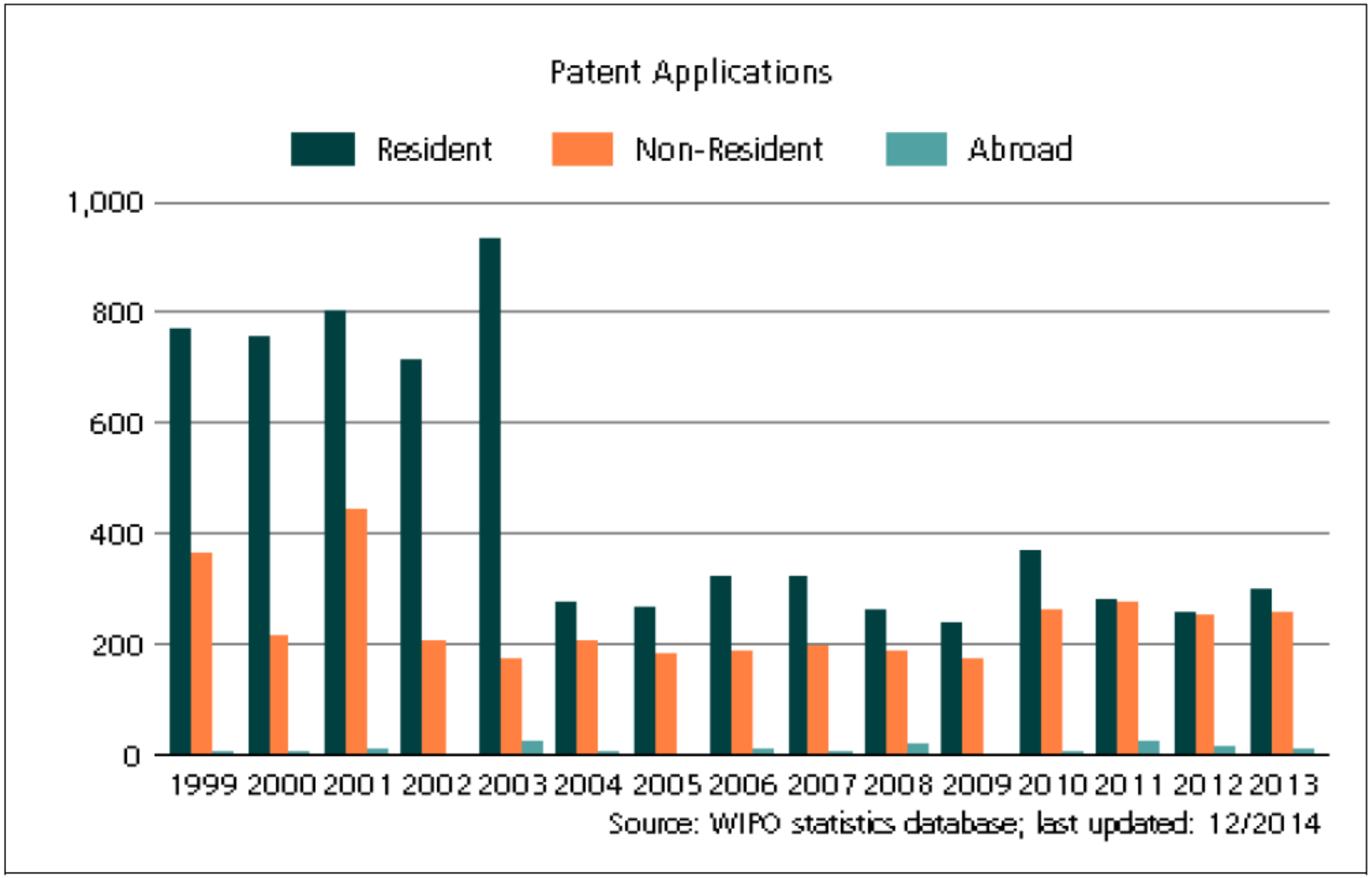
S&T Personal by Sex



S&T Degree


4000
3500
3000
2500
2000
1500
1000
500
0
PhD
Prof.
1753
449
1277
262
2723
494
579
102
3831
718
Natural Sciences
Technical Sciences
Medical Science
Agricultural Sciences
Humanitarian Sciences

Patent applications dynamics



2. Analysis of National Capabilities

National S&T Indicators of Uzbekistan

		Indicators	Figures (2015)
RESOURCES	Human Resource	Researchers (FTE) - Total	26145
		Researchers (FTE) per 10,000 population	8,4
	Organization	Number of Universities	68
		Number of S&T Research Institutes	222
	Knowledge Resources	Scientific Journal Articles in 2014	12887
		Number of Domestic Patent Applications in 2014	473
		Number of International Patent Applications in 2014 (e.g. USPTO, EPO, etc.)	156

* FTE: Full Time Equivalent
USPTO: United States Patent and Trademark Office
EPO: European Patent Office

Priority directions

Our scientists working on the following priority directions:

- 1. Astronomy investigations
- 2. Nuclear physics and technologies
- 3. Photonics
- 4. Information and communication technologies
- 5. Renewable energy sources
- 6. Energy conservation and efficiency
- 7. Technology and technical means of mechanical engineering
- 8. Nanotechnology
- 9. Development of agriculture and industry complex
- 10. Chemicalization of Agricultural production
- 11. Pharmacological compounds
- 12. Conservation and utilization of biodiversity
- 13. Biotechnology
- 14. Resource of minerals and raw materials
- 15. Exploiting water resources
- 16. Seismology and seismic safety
- 17. Development social and humanitarian sciences

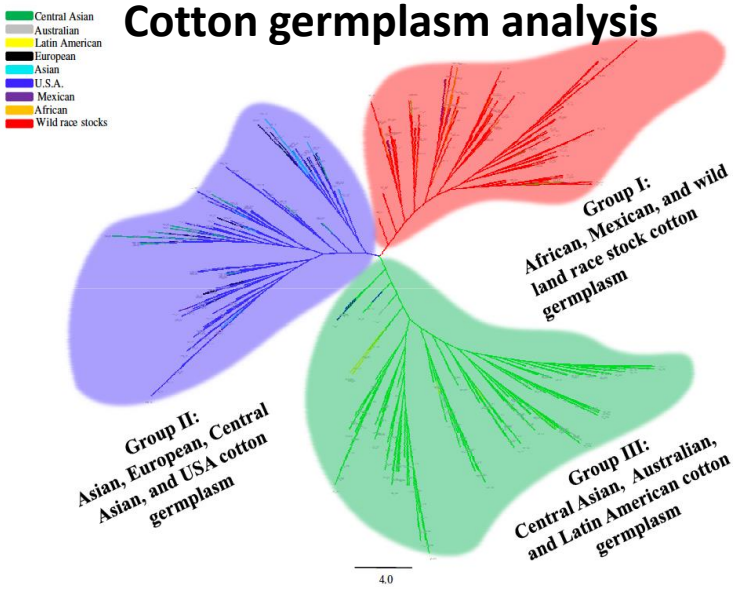
Annually, we conduct an exhibition of innovative science technologies and d uring 2008-2014, we demonstrated 800 new technologies. More than 30% s cientists of Academy are under 35.

Today I will introduce you brief achievements on some of above priority dir ections

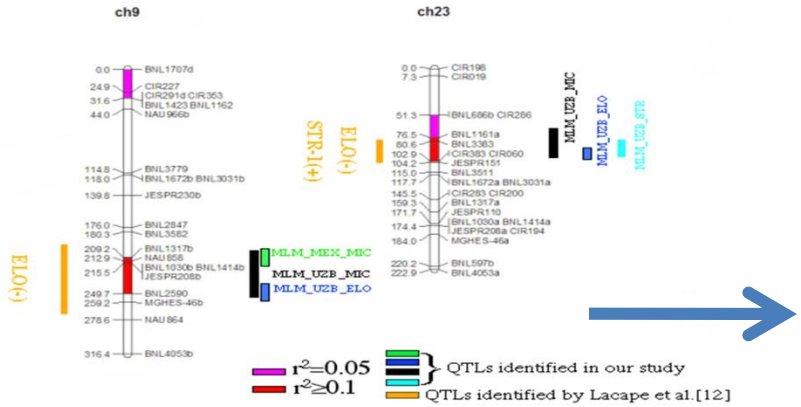
Achievements on cotton genomics and biotechnology

Basic research

Cotton germplasm analysis



Genetic mapping of traits of interest

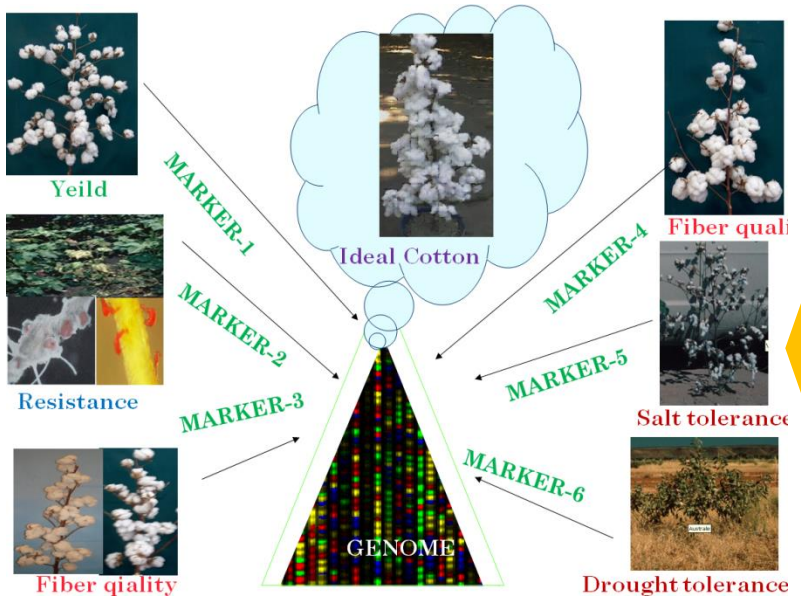


Abdurakhmonov et al. 2008. Genomics 92:478-487
Abdurakhmonov et al. 2009. Genetica 136:401-417

➢For the first time in cotton science, the recombination block sizes (or linkage disequilibrium level) for cotton genome have been estimated;

➢A number of agronomically important cotton genes have been mapped using modern association mapping approach;

➢The first marker assisted selection (MAS) technology successfully applied for cotton improvement.



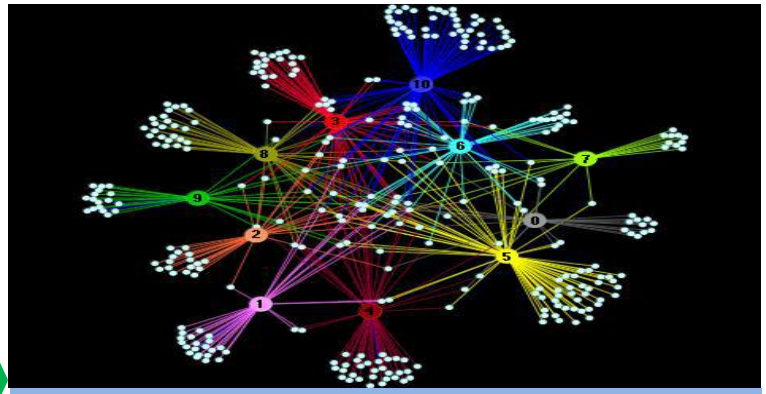
Pyramiding the genes via MAS

Applied research

Basic research

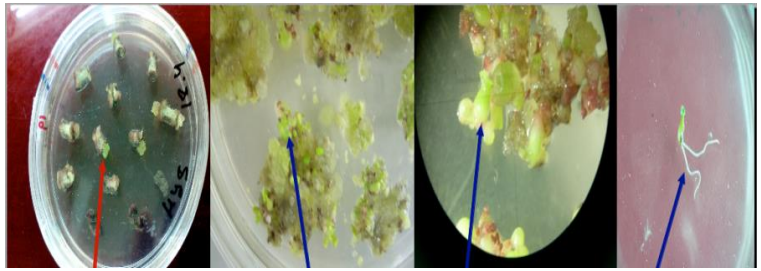
Applied research

Cloning and sequencing cotton genes

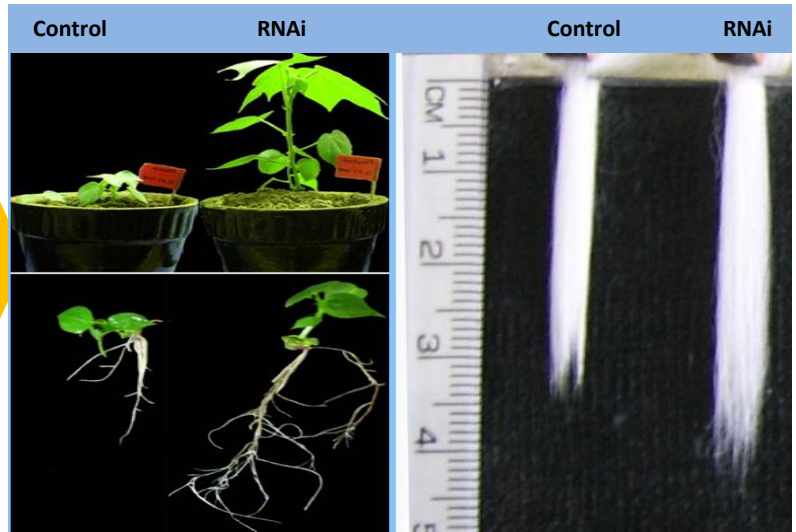


Abdurakhmonov et al. 2008. BMC Plant Biol. 8:93
Abdurakhmonov et al. 2010. BMC Plant Biol. 10:119

Cotton tissue culture and transformation



Superior quality RNAi gene-knockout cotton forms



Achievements on cotton genomics and biotechnology

- For the first time in cotton science, a number of cotton genes and microRNAs controlling fiber quality, early-flowering, root development, tolerance to diseases and abiotic stresses were characterized;

- An efficient cotton tissue culture program has been established and superior quality transgenic cotton forms have been developed using gene overexpression and knockout (RNAi);

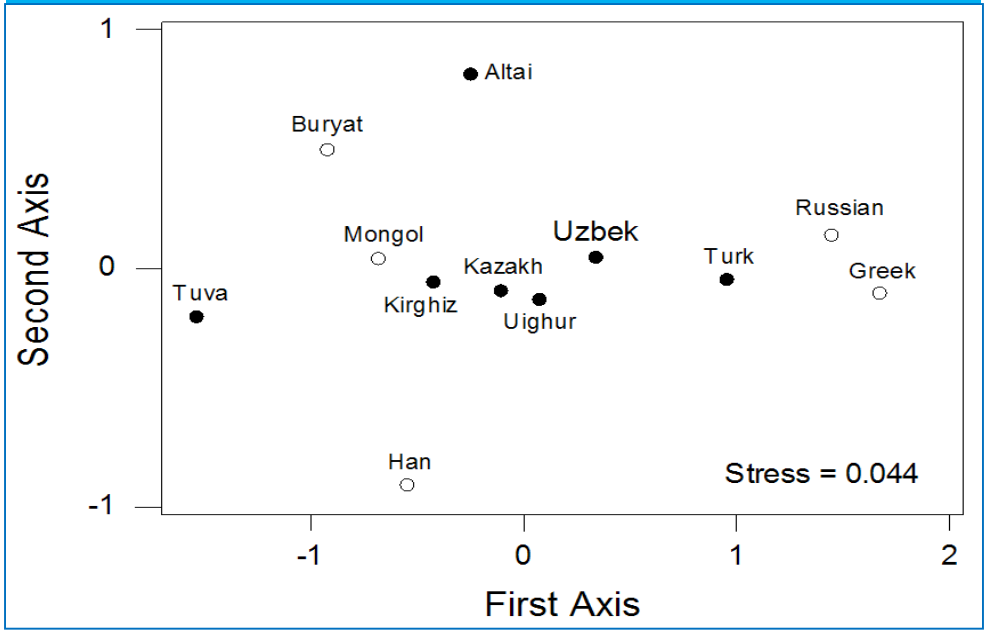
- Qualified young genomics scientists and molecular breeders have been prepared.

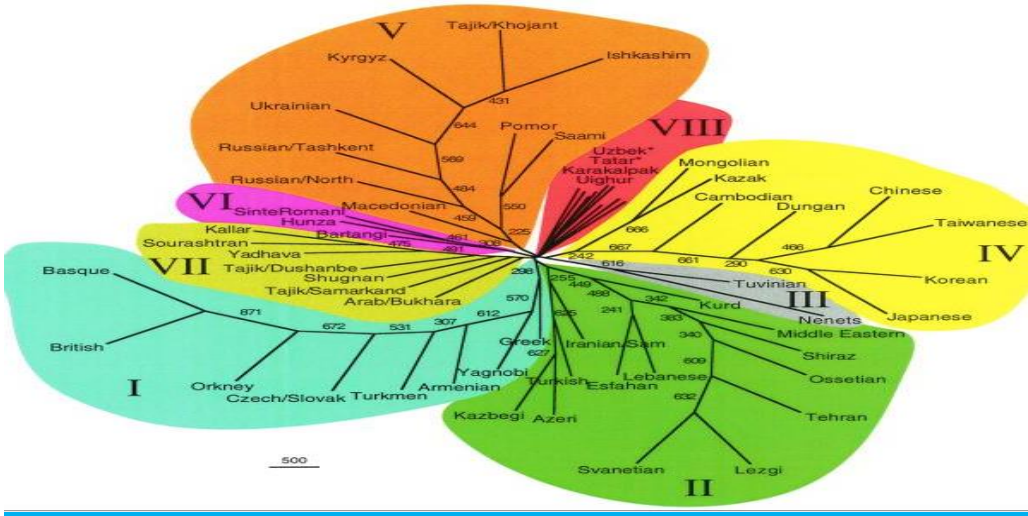
Human genomics of Uzbekistan populations

- The multilocus genetic landscape of Central Asian populations using microsatellite markers
- Genetic traces of East-to-West human expansion waves in Eurasia using mtDNA, Y-chromosome and Alu insertions
- Looking for local genetic adaptations to diet in Central Asian human population
- Lactase persistence in Central Asia: phenotype, genotype and evolution
- Genome-wide association analysis and genetic basis of heredity disease

Results of these efforts suggest wide genetic diversity that reflects Uzbekistan's long history as a crossroad of humanity.

Devor E, Abdurakhmonov IY et al. The Open Genomics Journal, 2009, 2, 1-11

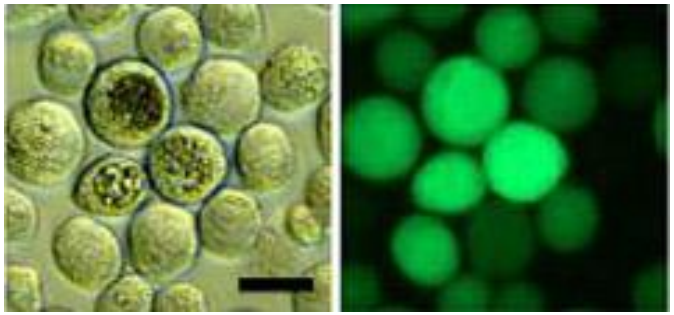




Wells, Yuldasheva, Ruzibakiev et al. 2001. PNAS 98: 10244-10249
In collaboration with Oxford University, UK

Baculovirus-based recombinant protein production

We have 12 insect cell lines. Most intresting is BMN from *Bombyx mori* (silkwor m)

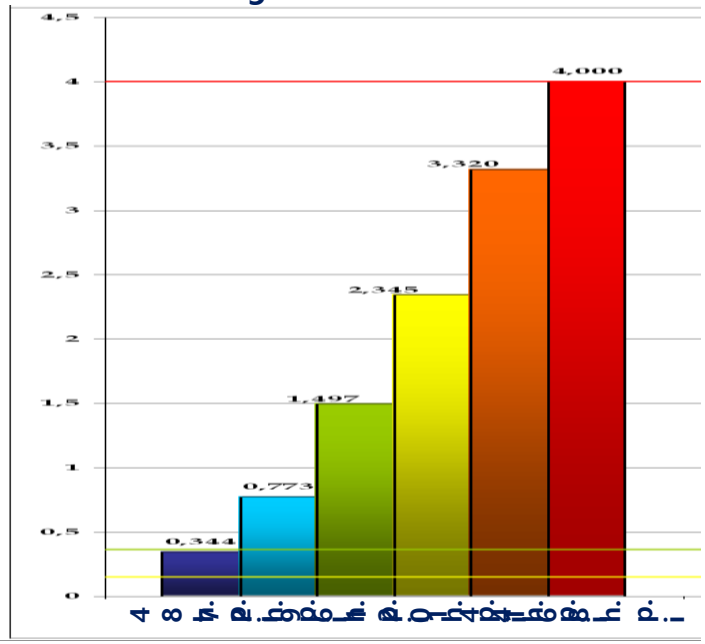


- BNP cells cotransfected with recombinant plasmid co tained fusion gene preS2-S region (Uzbek population) with GFP

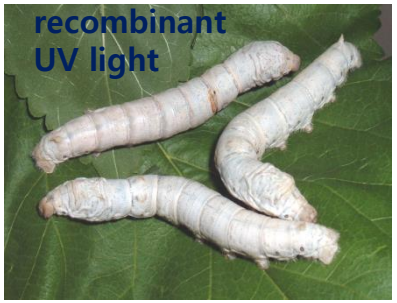
Ogay et al. 2006. Cytotechnology, 51(2):89-98.

The M-HBsAg production in silkworm larvae

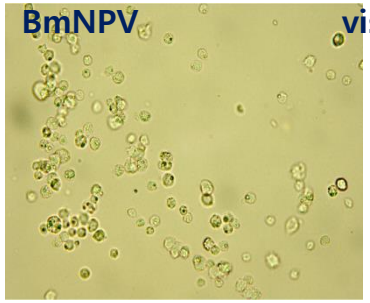
HBsAg concentration



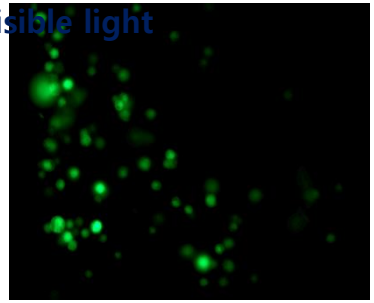
Insects infected with recombinant emolymph,



Insect haemolymph, BmNPV



Insect ha visible light



For the foreign gene expression, B. mori larvae in the beginning of fourth instar were us ed. The larvae were fed with polyhedral suspension, contained recombinant baculovirus.

The haemolymph was screened for GFP-specific fluorescence in 24h intervals. GFP+ silkw orms were collected. The extracted protein was analyzed for the presence of HBsAg by u sing ELISA test system "ORTHO" with antibody to HBsAg.

As it shown on the diagram, the concentration of M-HBsAg is stable increasing in larvae .

In conclusion – the silkworm larvae could be used as a source for recombinant p roteins production.

Chemistry of Plant Substances

- The Central Asian flora includes 1150 species of medicinal plants, 600 of them were chemically inv estigated by scientists from ICPS.

- Pharmacology and toxicology of 2000 plant subst ances were investigated, 60 medical preparations and biologically active additives clinically trialed, 35 preparations approved for use in medical pract ice. 16 drug substances, biologically active additi ves and agricultural preparations are manufactur ed now on the Pilot manufacturing of the Institute Preparations and bioreagents manufactured on th e base of scientific achievements of the Institute, are exported to France, USA and Russia.

- Scientific cooperation achieved with “Christian Di or” (France), Marburg University (Germany), Xinji ang Technical Institute of Physics & Chemistry (C hina), Shanghai Institute of Materia Medica (Chin a) etc.

Full information on structure and function of biologically active natural comp ounds are available at:
http://www.springer,com/chemistry/organic+chemistry/book/978-085729-322-0

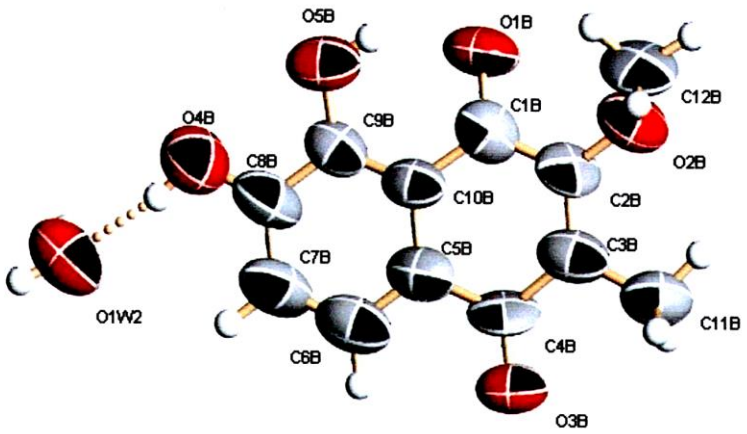
Plant's Resistance Mechanisms

Lignification Tissues

Activation of Enzyme Systems

Biosynthesis of Phytoalexins

The importance of Cotton and ot her plants family *Malvaceae* terpe noids in forming of plant pathog en and fungi resistance were inve stigated

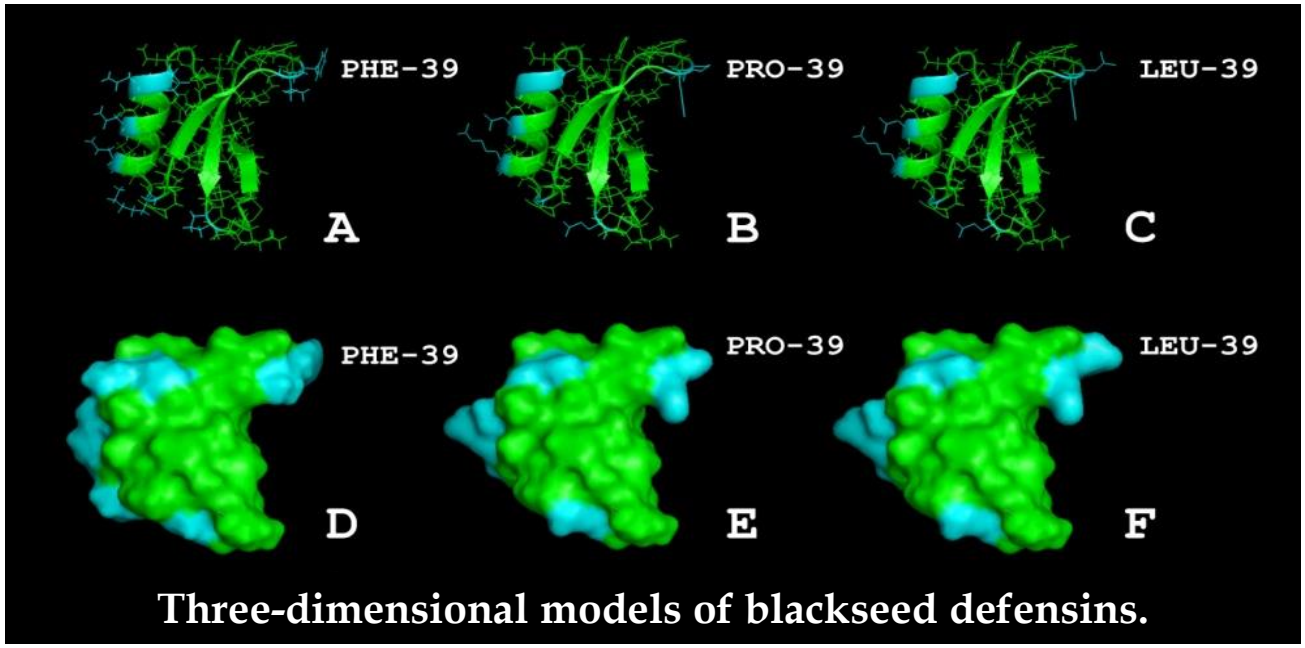


Report: Malvone A, a new phytoale xin found in *Malva sylvestris*

Cystein-rich cation peptides of *Nigella sativa*

➢From seeds of Nigella sativa L. (Ranunculaceae), an endemic p lant of Uzbekistan, five novel peptides were isolated and seque nced.

➢The peptides display strong although different antifungal activ ity towards a number of phytopathogenic fungi



Three-dimensional models of blackseed defensins.

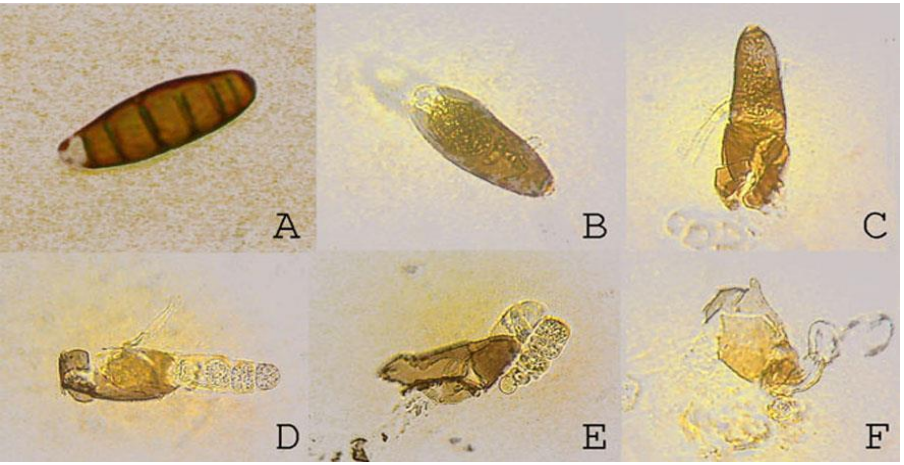
Ns-D1: **K**F**C**EK**PSGTWSGVCGN**SG**ACK**DQ**CIRL**EGAK**HGSCNYK**PPAHRCICY**YE**C** - 5485 Da
Ns-D2: **K**F**C**EK**PSGTWSGVCGN**SG**ACK**DQ**CIRL**EGAK**HGSCNYK**LPAHRCICY**YE**C** - 5498 Da
Rs-AFP2:Z**K**LCQR**PSGTWSGVCGN**NN**ACK**N**QCIRL**EKAR**HGSCNY**VF**PAH**KCICY**FP**C**

Ns-LTP1: -IS**C**QD**V**KQSLAP**C**LP**Y**VTGRAPKPA **P86527**
Ns-W1: **KSCC**KNTLERNC**Y**NT**C**RFIKKPR---KT**CA**GL**C**

BIOLOGICAL ACTIVITY PEPTIDES OF *NIGELLA SATIVA*

Dynamics of development and spread the potat o phytophytora

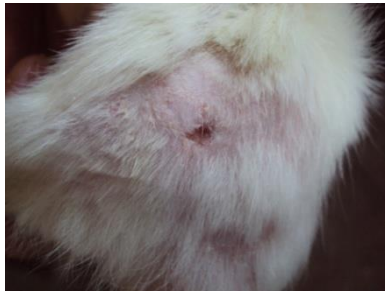
5 days after inoculation



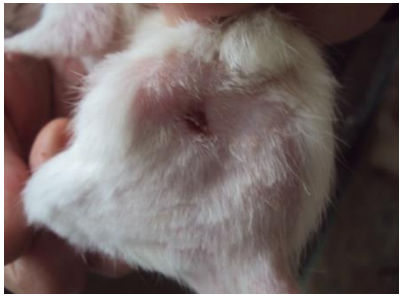
Morphological changes in B. sorokiniana con idia after 48 h incubation with Ns-D2. (A) Co ntrol conidia; (B-F) Conidia at different Ns-D 2 concentrations:
6.9 mg/ml (B), 13.8 mg/ml (C), 7.5 mg/ml (D), 55 mg/ml (E), 110 mg/ml (F).

New plant peptide regenerating wounds

14 days, control



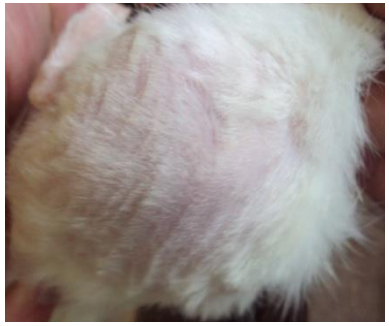
21 days, control



14 days, Leavomecole

21 days, Leavomecole

14 days, Peptide cream

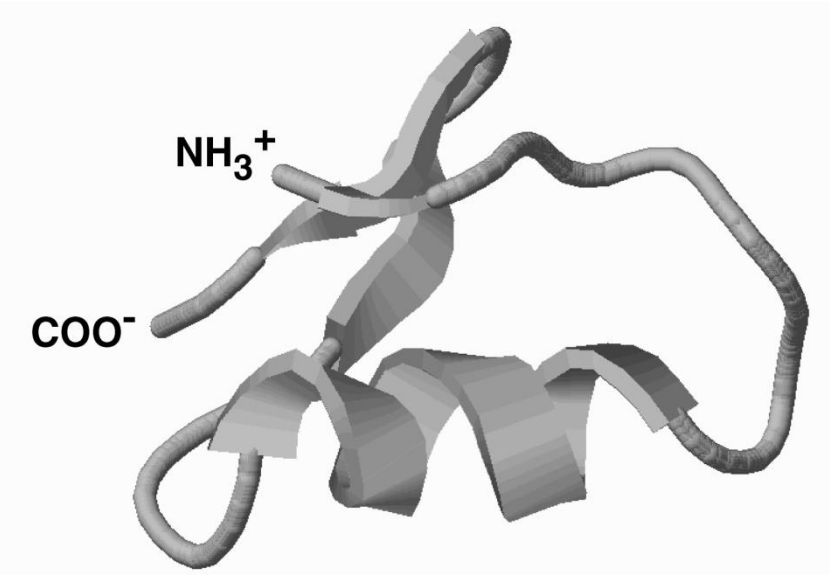


21 days, Peptide cream

Leavomecole = chloramphenicole + methyluracil

Isolation and primary structure chlorotoxin from the venom o f the scorpion (*Mesobuthus caucasicus*)

Scorpion *Mesobuthus caucasicus*



3D structure of BucaIT

Met-Cys-Met-Pro-Cys-Phe-Thr-Thr-Asp-Ala-Asn-Met-Ala-Ar g-Lys-Cys-Ser-Asp-Cys-Cys-Gly-Gly-Asn-Gly-Lys-Cys-Phe-Gl y-Pro-Gln-Cys-Leu-Cys-Asn-Arg-Ala

Primary structure chlorotoxin BucaIT

Exploiting solar energy

We developed technology cre ating of nanocomposite coatings with predict properties and develo ped two classes of coatings:

- Effective monolayer antireflect ive nanocomposite coatings for so lar cells;
- Selective absorbing nanocom posite coatings for solar vacuum heat receiver tubes, for solar pow er stations with trough concentrat ing systems.

In Uzbekistan in 1987 Big Solar Furnace of 1000 kW was built and launched. It is a sec ond furnace in the world, after the Big Sol ar furnace in Odeillo, France.

PV VOLTAICS

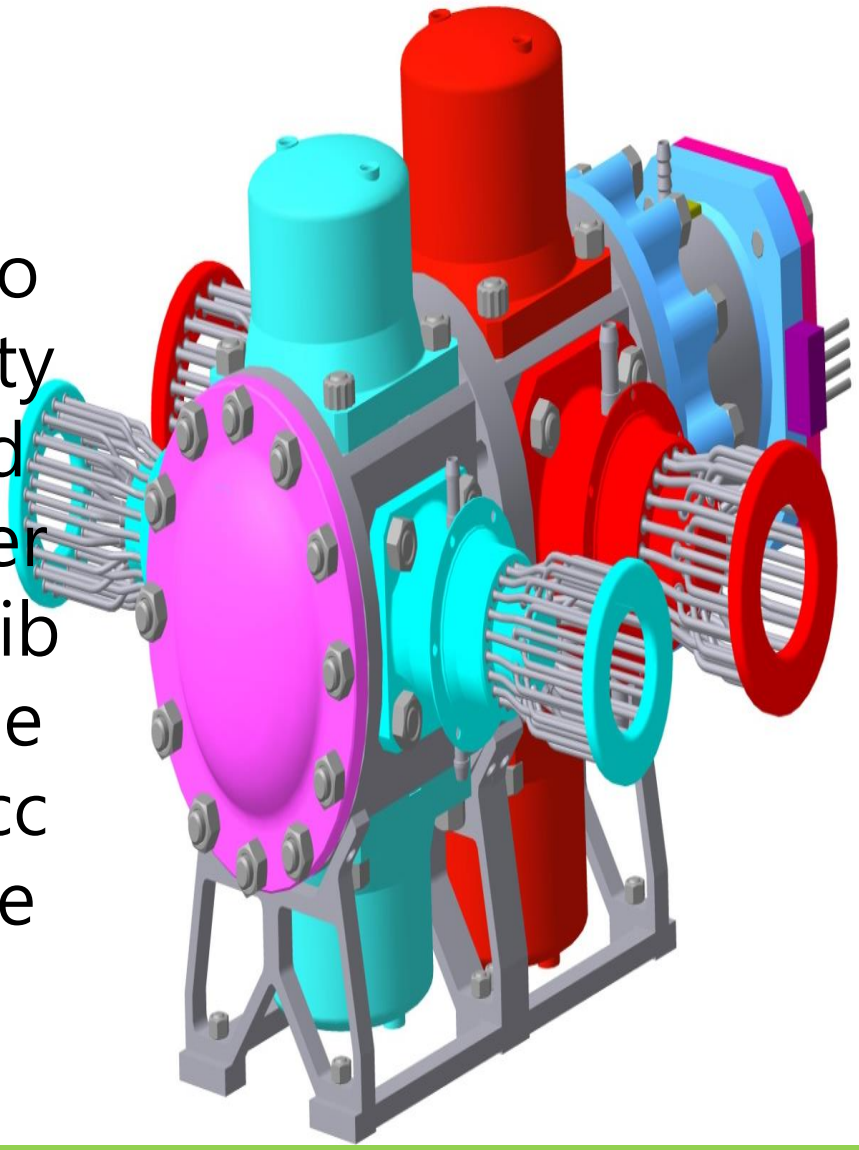




Photovoltaic plant on the basis of silicon solar cells functions with efficiency up to 16%. Unlike their foreign counterparts, it can operate efficiently in hot condi tions of Uzbekistan. In the shade the temperature reaches 40-50 ºC, and under direct sun rays the temperature rises up to 80 ºC.

MODULAR STERLING ENGINE FOR SYSTEMS OF INTEGRATED POWER SUPPLY

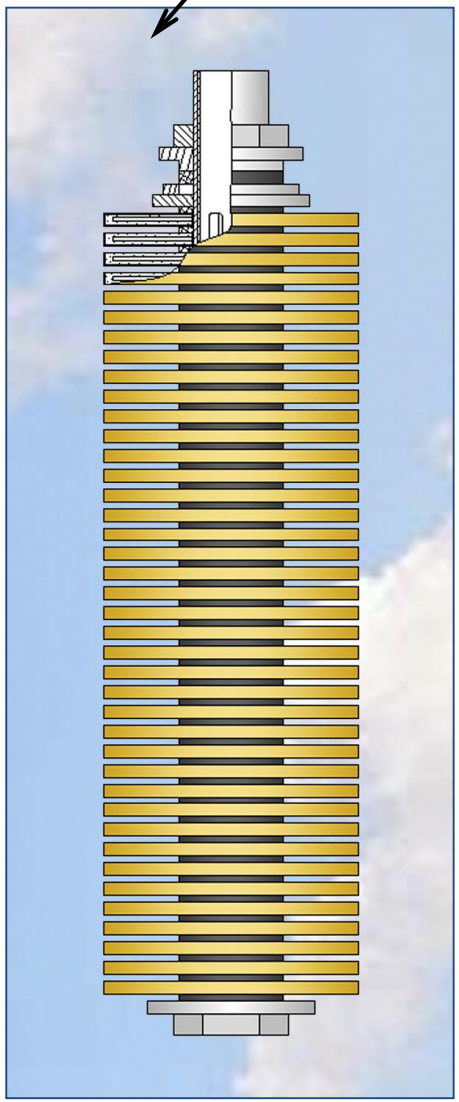
The engine is designed to pro vide consumers with electricity , cold and hot water. Powered by a burner, biogas, solar ener gy, wood and other combustib le waste. Modularity of engine allows to increase capacity acc ording to customer requireme nts.



License for the manufacturing of Sterling engines was sold to Enviromate.Inc, company, USA

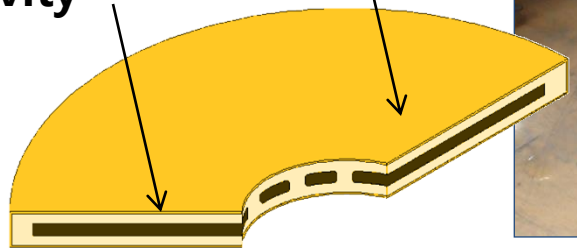
Ceramic filters for purification of organic absorbents

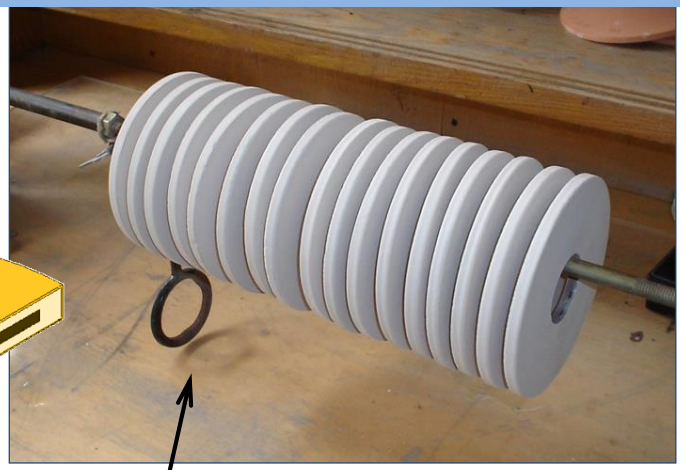
Construction



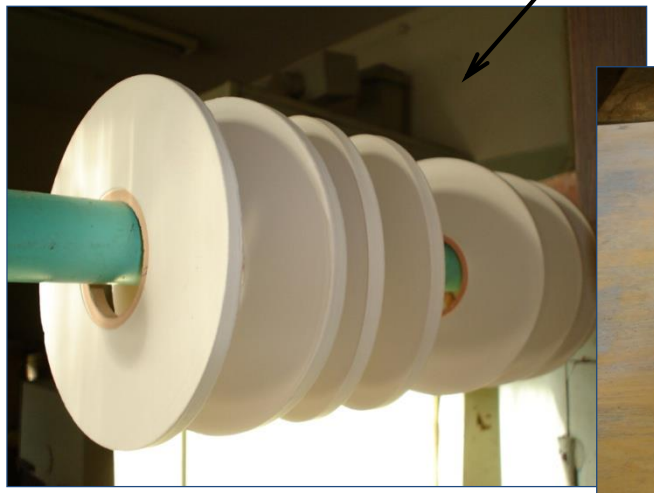
Selective membra ne layer

Drainage c avity





Outer view of the ceramic filters for purification o f organic absorbents



Radioisotope and radiopharmaceutical tracers production

Produced isotopes meet all requirements of the domestic market in Uzbekistan and i s also exported to the USA and more than 10 European countries.

- ^{32}P, ^{33}P
- ^{35}S
- ^{125}I, ^{131}I
- ^{198}Au
- ^{55}Fe
- ^{58}Co
- ^{203}Hg

- Isotonic solution of $Na^{131}I$
- ^{131}I labeled orthoiodine-gippurat solution
- Bengal roze with ^{131}I
- Oxabiphor – ^{153}Sm
- ^{99m}Tc generator

Treatment of natural gemstones

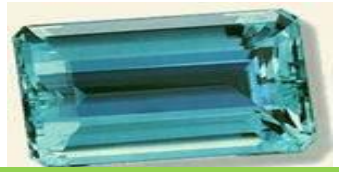
Ennobling of color and clarity

TOPAZ




BERYL



International contracts on such services were signed with German, Italian and Russian com panies and are being carried out for more than 500 000 US Dollars per year.

3. Main Issues in S&T

Challenges in S&T Development

The significant brake of the promotion of innovation is a lack of qualified specialists: economists, managers, lawyers, with experience in the innovative development of the economy. In most of the technical universities of the country a little time is devoted to studying the organization of the innovation process, in the context of differentiated industries, sectors and generally in the country. Also, there are no courses and programs of retraining and training of managers and leading specialists of enterprises, hence they have a lack of knowledge in the organization of the innovation process, they do not see it and cannot take advantage of it.

No more than 10 percent of the technologies exhibited at innovative fairs and other new products are actually used in practice. That is, there is a small demand on the part of the country in the production of new domestic technologies and products that often do not fit into the existing production cycle.

Another reason for this situation is unsustainable funding for research: R & D in the country are financed mainly through the budget, and up to 40% of the allocated budgetary funds account for basic research, about 50% - on applied programs, and only 10-12% - on innovative research and development.

Moreover, only innovations are funded, but the stages of pre-production and production testing of new domestic developments, in most cases, must also be funded by the interested industries and enterprises. Therefore at the level of completion of the application of state science and technology projects it is necessary to provide real direct involvement of industries interested in these works.

3. Main Issues in S&T

Challenges in S&T Development

To ensure a successful competition and commercialization of innovative domestic products in the global and national market, the work of patent and license departments and services of the ministries, departments and enterprises of the Republic should be organized in a new way. It is necessary to involve the most qualified professionals who have already had experience in the creation of inventions in their departments. In this organizational work the representatives of private enterprises and small business should not remain on the sidelines.

It is necessary to create a network of innovative infrastructure in the form of promotional, marketing, consulting and sales departments and specialized organizations of intermediary firms.

Therefore in the country, along with generated at the ministries, departments and companies funds for the modernization and new technologies , it is high time to create new and ancillary infrastructures. They need to make technical tasks, business plans, passports, technical documentation to promote patenting, licensing, marketing and others, i.e. to develop the steps necessary to promote and adopt new technology and products.

4. Future Plans

Goals/Vision

In Uzbekistan, the progress of innovative activity and development of infrastructure which provides this system with information are demanding the realization of targeted measures by state.

Firstly, at the first level - producing the mechanisms of cooperation for main priority issues of local Manufacturers and for the implementation of scientific-technical and integrative technological programs and uniting the academic, higher education institutions and scientific research strength of industry are. At the second level - the implementation of these mechanisms and upgrading the existing legal base for providing technology transfer and providing the commercialization of innovations are.

Secondly, essential conditions for providing bilateral interests of science and manufacturing on commercializing objects of intellectual properties created in the Republic should be created.

Thirdly, the proposals in science and industry should be selected the essential proposals for the state as a priority and should be separated the state-backed investment projects and government investments and bank credits should be directed for implementing these projects.

Fourthly, mutual relations of the chain "science-innovation-investment-production" should be set straight for providing effective transfer of innovative technologies.

Fifthly, at the legislative level innovative developments of scientists and financing of implementing new technologies should be fixed to sectors, wider usage of new technologies and funds of modernization should be set forward.

Sixthly, new infrastructures which will engage in innovative activity can be organized in ministries, sectors and firms. The duties of them will be technical specifications, business plans, new products, gauging, technical documents, training, marketing and design.

THANK YOU