The National and International Large Scale Sciences Applications

Lambda - enabled Applications in Russia

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РОСНИИРОС RIPN

GLIF
Daejeon, Korea,
2009

Russian Federation

Geography

Location:
Northern Asia (the area west of the Urals is considered part of Europe), bordering the Arctic Ocean, between Europe and the North Pacific Ocean

Area:
total: 17,075,200 sq km
land: 16,995,800 sq km
water: 79,400 sq km

Climate:
ranges from steppes in the south through humid continental in much of European Russia; subarctic in Siberia to tundra climate in the polar north; winters vary from cool along Black Sea coast to frigid in Siberia; summers vary from warm in the steppes to cool along Arctic coast

Research and Technological Trends

1. Multidisciplinary projects
   - More complex sets of data
   - Increasing need for tools and infrastructure to support this work
2. The “Data-Intensive projects”
   - Need for advanced techniques to manipulate, visualize and interpret data
   - Virtual organizations
3. Globalization
   3. Development of global partnerships and platforms
   4. Emphasis on internationally collaborative research
4. Interest in deriving economy and science research
   3. Relationship between research and innovation
   4. Collaborative partnerships

Mission and Task

The mission

Creating an integrated information environment in scale of the strategy of developing of the Russian Federation's information society for increasing of efficiency of a basic and applied research, building up of a research and technical potential of the country, developing of a *science innovative technologies*, providing *a global research project participation*, ensuring further of a *high level of accessability* to information and technologies, and increasing of quality life of a citizens in Russian Federation.

Task

- integration of the existing science networks to create a National Advanced High Performance Telecommunication and Computation Infrastructure.

- the National e-Infrastructure will function as major Advanced Network of Nx10 Gps capacity which connected to it:

- number of a Research and Education DataCenters, High Performance Computers of Nx100 TF, as well as major scientific facility, equipment, scientific collection and structured information for conducting leading-edge research by science and research organizations, universities, industry.

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Russian Science and Technology

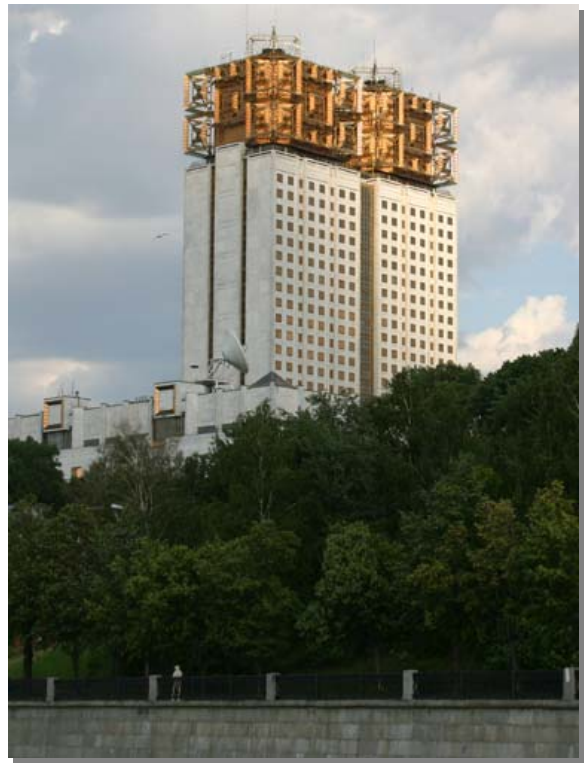
There are around 4000 organizations in Russia involved in research and development with almost one million personnel. Half of those people are doing scientific research. It is coordinated by Ministry of education, science and technologies, Russian Academy of Sciences where strategy and basic priorities of research and development are being formulated.

Russian Academy of Sciences

Russian Academy of Sciences

Fundamental scientific research is concentrated in Russian Academy of Sciences, which now includes hundreds of institutes specializing in all major scientific disciplines such as mathematics, physics, chemistry, biology, astronomy, Earth sciences etc.

Russian Academy of Sciences is the community of the top ranking Russian scientists and principal coordinating body for basic research in natural and social sciences, technology and production in Russia. It is composed of more than 350 research institutions. Outstanding Russian scientists are elected to the Academy, where membership is of three types - academicians, corresponding members and foreign members



Russian Academy of Sciences

Russian Academy of Sciences

Regional Branches of RAS

1. FAR EASTERN BRANCH, RAS
2. SIBIRIAN BRANCH, RAS
3. URAL BRANCH, RAS

1. Division of mathematics;
2. Division of physics;
3. Division of nanotechnology and information technology;
4. Division of energy, machine engineering, mechanics and control process problems;
5. Division of chemistry and materials sciences;
6. Division of biology;
7. Division of Earth Sciences
8. Division of historical and philological Sciences;
9. Division of social Sciences;

Russian Institute for Public Network

123182, Russia, Moscow,
Kurchatov square, 1

(ROSNIIROS)

Russian Institute for Public Networks (RIPN) has been founded in 1992 by the Science and Higher School State Committee of Russia, Russian Research Centre "Kurchatov Institute"

International Connections

➢**RBnet's connections**

NORDUnet - NorthenLight - NetherLight - StarLight

➢**RBnet's connections:**

Moscow – Petersburg - Stockholm - Amsterdam - Chicago

STM-64

➢**RUNnet's connection:**

NORDUnet

➢**RUNnet's channel:**

Moscow – Petersburg - Stockholm STM-64

Domestic Connection

- **Constructed on R&E Russian networks - joint efforts of the RBNET/RUNNet/RASnet (e-arena)**
- **RBnet/Runnet have constructed own DWDM-infrastructure S.Petersburg - Helsinki (32 channels, NORTEL equipment)**
- **S.Petersburg - Moscow - leased optical channels**
- **Today: 2-level structure, 7 main PoPs at Russia**
- **Covers over 50 regions of Russian Federation**
- **Based on Russian optical infrastructure of the providers such as Rostelecom/TransTeleCom/Eurotel**

RUSSIAN R&E IP-BACKBONE NETWORK

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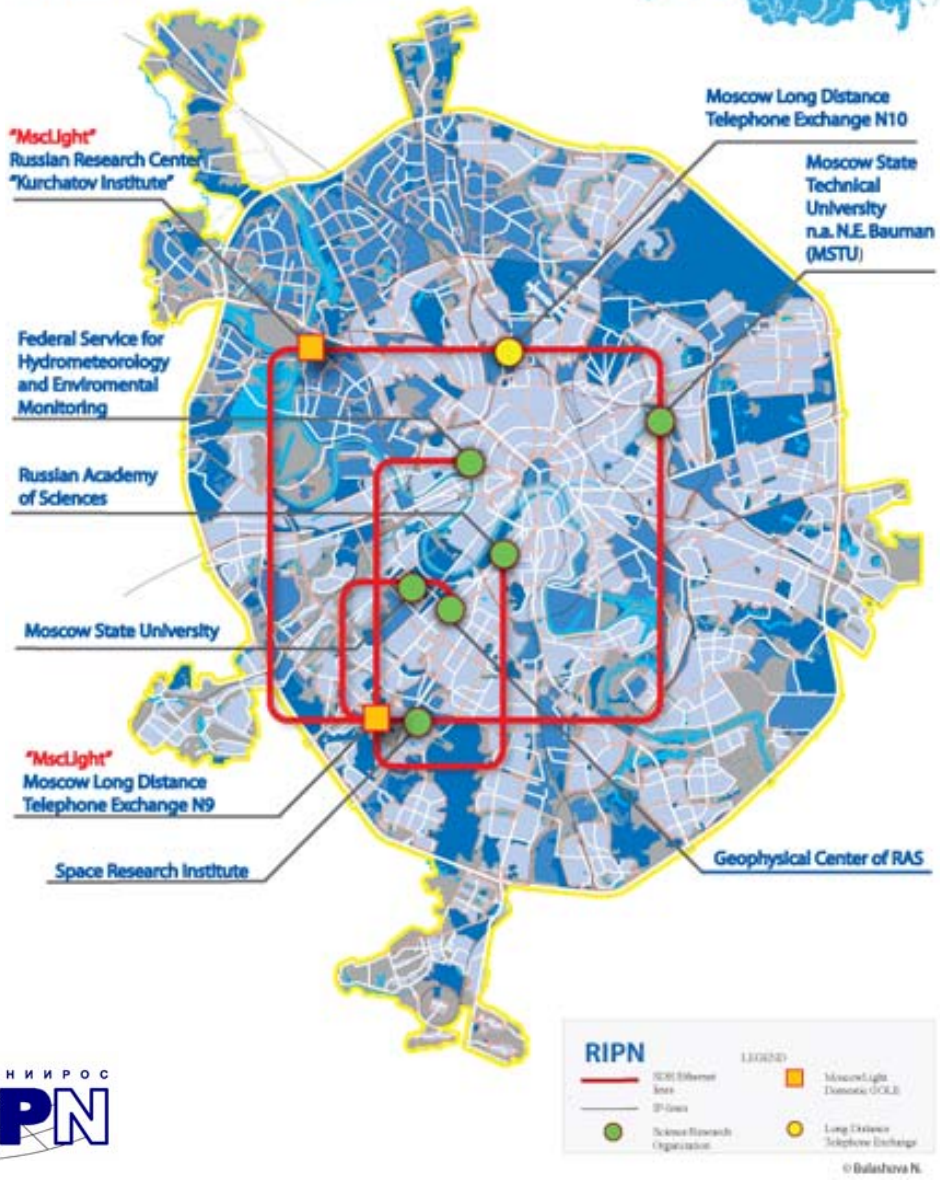
Daejeon, Korea, 2009

MscLight

1
MscLight

GEANT-PoP

2
MscLight



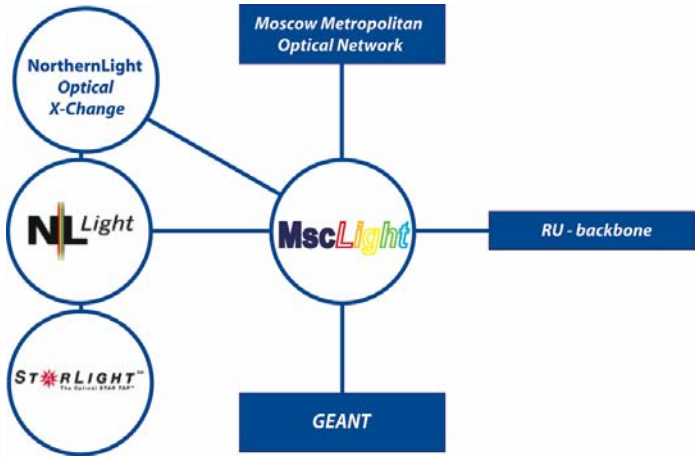
Locations

1

ROSNIIROS,
1, Kurchatov square
Moscow, Russia,123182

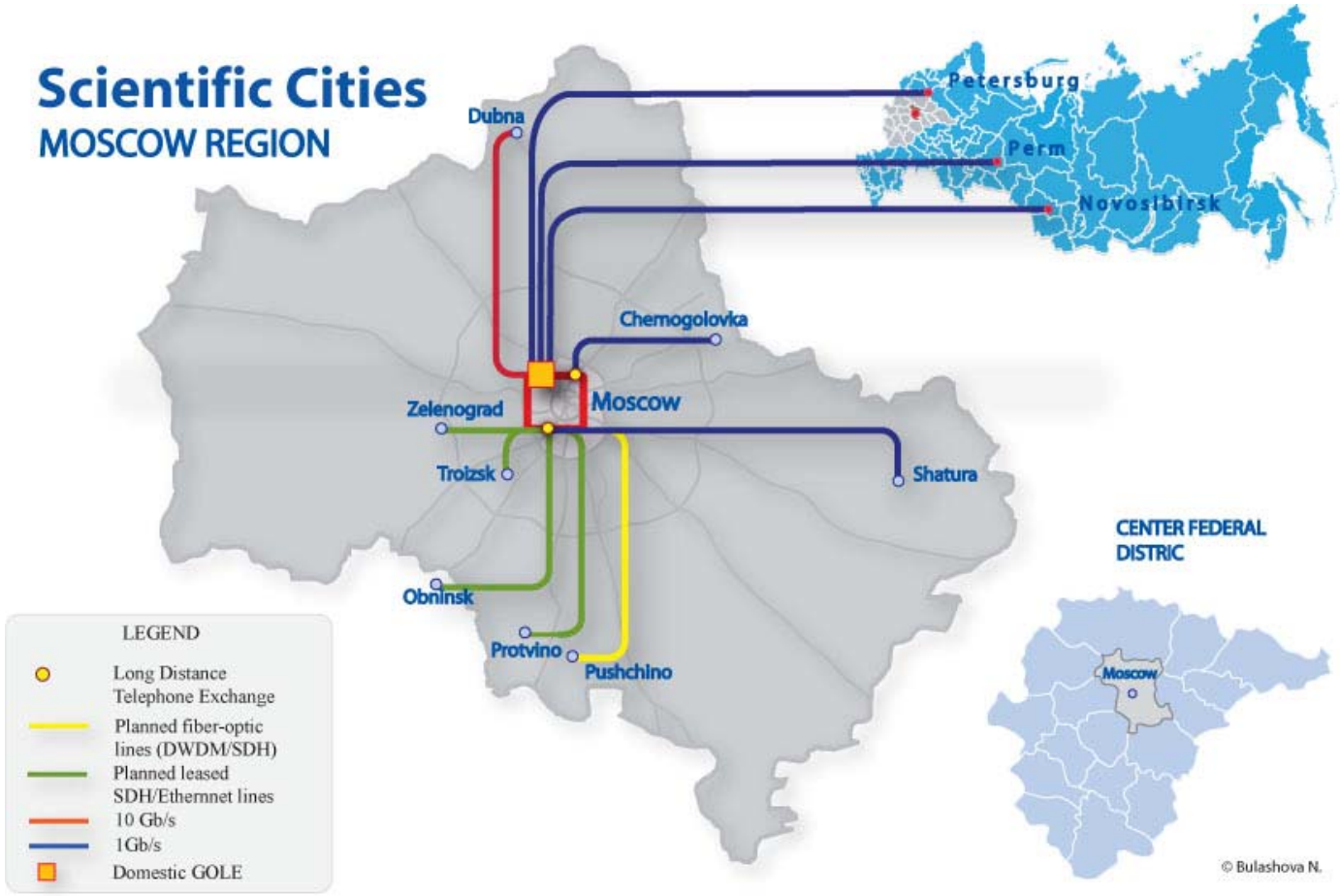
2

M9 Telephone Exchange,
7, Butlerov Street,
Moscow, Russia



RIPN in partnership with Regions. Moscow Region and Far East of Russia

Advanced Networking infrastructure for the National Large scale science applications.



Moscow (1-10Gps)	**ITEP, RRC KI, SINP MSU,ITEP, MEPhI,..**
Protvino (plans 1Gbps, go10Gps)	**IHEP**
Dubna (10Gbps)	**JINR**
Novosibirsk (1Gps)	**BINP**
Troisk (100Mbps now, 1Gps)	**INR RAS**
Gatchina (Plans 1 Gbps)	**PNPI**
S-Peterburg 1Gbps now	**SPbSU**

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GLIF-2009
Daejeon, Korea, 2009

The National and International Large Scale Sciences Applications

Lambda - Enabled Applications in Russia

Number of Examples of the Lambda - enabled Applications in Russia

РОСНИИРОС RIPN

GLIF
Daejeon, Korea,
2009

Very Long Baseline Interferometry (VLBI) Network

http://www.astronet.ru/db/msg/1233549

Current IVS Components

Very Long Baseline Interferometry (VLBI) is a type of astronomical interferometry used in radio astronomy.

It allows observations of an object that are made simultaneously by many telescopes to be combined, emulating a telescope with a size equal to the maximum separation between the telescopes.

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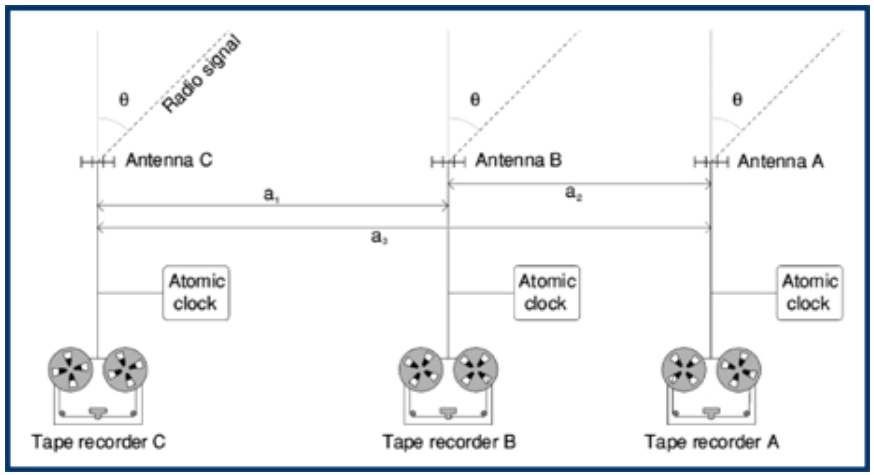
GLIF-2009
Daejeon, Korea, 2009

VLBI Network



Data are recorded at each of the telescopes in a VLBI array. Extremely accurate high-frequency clocks are recorded alongside the astronomical data in order to help get the synchronization correct.

Data received at each antenna in the array is paired with timing information, usually from a local atomic clock, and then stored for later analysis on magnetic tape or hard disk.

At that later time, the data are correlated with data from other antennas similarly recorded, to produce the resulting image.

VLBI is most well-known for imaging distant cosmic radio sources, spacecraft tracking, and for applications in astrometry.

The Large Pulkovo rafio Telescope
Source:IVC newsletter,Issue 24,2009

History of VLBI Network in Russia

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http://www.ipa.nw.ru/

In the USSR The method of **VLBI** first proposed by ***Leonid Matveenko, Nikolay Kardashev and G.Sholomiskii at 1965*** allows to determine positions of sources with nanoradian precision (1 nrad ≈ 0.2 mas).

"The method of interferometry with independent elements (VLBI) is connected with the space epoch. **In 1959 the** first of the Lunnik rockets went to the Moon, and radio astronomers from FIAN measured its trajectory by interferometry. The year **1961** saw the construction of the Deep Space Network (DSN) radio interferometer for measuring trajectories of deep space rockets.

In March **1962** we discussed with Gennadyi Guscow (Head of the DSN) the method of Doppler long baseline measurements and decided to create an "independent interferometer" using the experimental DSN stations at Simferopol and Evpatorya, operating at 32 cm. The FIAN radio astronomers did not support the idea, but GAISH recommended that we be patient.

In 1963 we discussed VLBI with Bernard Lovell, and signed an EVP-JB Memorandum to conduct experiments at 32 cm. Our first VLBI research paper was published **in *Radiofizika* in 1965**. In February **1968, Ken Kellermann and Marshall Cohen** sent **V. Vitkevich** a letter about a 3cm Green Bank-Puschino experiment, and this proposal helped launch VLBI in the USSR.

VLBI observations at 6 and 2.8 cm were made at Crimea-GB in September 1969, followed by CR-GB-GST at 3.5 cm May 1971, and 1.35 cm CR-HST observations of H2O maser sources. This led to the Space-Ground project at 1.35 cm, the global VLBI Network, and the VLBI epoch of QSS, star formation region studies and applied measurements.

Source:"E**arly VLBI in the USSR"** Leonid Matveyenko
Institute for Space Research, Moscow, Russia.

History of VLBI Network in USA, CANADA

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Lovell (1973) described his discussions with the Russians beginning in 1963, which resulted in a concept for a VLBI system linking telescopes at Jodrell Bank and Crimea at 700 MHz. For various reasons the project never got going, but the discussions may have facilitated US- Russian experiments that began in 1969.

Left: Ken Kellermann, right: Tom Clark
Source: A History of OVRO:Part II, *Marshall H.Cohen*, Engineering&Science, N3

The early "pioneers"of VLBI, who received the Rumford Prize from the American Academy of Arts and Sciences for work done in 1967 on quasars and masers are listed in Table. They belonged to three groups: Canadian, NRAO/Cornell and MIT

Table 2. 1971 AAAS Rumford Prize

NRAO/Cornell	Canadian	MIT
Bare (D)	Broten (R)	Ball (A)
Clark (A)	Chisholm (D)	Barrett (D)
Cohen (A)	Galt (R*)	*Burke* (A)
Jauncey (A)	Gush (R)	Carter (A)
Kellermann (A)	Legg (R*)	Crowther (C)
	Locke (R)	Hyde (R)
	McLeish (D)	*Moran* (A)
	Richards (R)	Rogers (A)
	Yen (D)	

Source: Thirty Years of VLBI Early Days, Successes and Future, J.M. Moran, 1998

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Source: Bernard F. Burke
MIT

“Success has many fathers, and the same is true of Space VLBI.

In 1975 Bob Preston presented a paper to the AAS on the possibilities of space VLBI, I submitted a Proposal to Marshall Space Center for a Space Shuttle Experiment, and Leonid Matveenko wrote a memo about that time for the Soviet Space Program. This started the machinery moving in both the USA and in the USSR.

The international VLBI community was a very close-knit social organization. There were no secrets among us (or at least very few) and we had all worked together; that was an essential part of the VLBI pioneer culture. We knew that the Soviets were seriously engaged in the early stages of a space project, led by L. Matveenko and N. Kardashev, and in Europe there was also activity starting, with Richard Schilizzi being the centralfigure, along with many colleagues. Morimoto-san had also *stirred* up interest in Japan.”

Source: Bernard F. Burke, MIT, Early Days of VLBI in Space, Sagamihara: 3 Dec 2007

VLBI Network “Quasar”

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http://ivscc.gsfc.nasa.gov/meetings/gm2008/#Pictures

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

Part of the movies “Quasar”
Full movie please look at http://www.ipa.nw.ru/PAGE/ENG/engstructure.htm

VLBI Network “Quasar”- 2009

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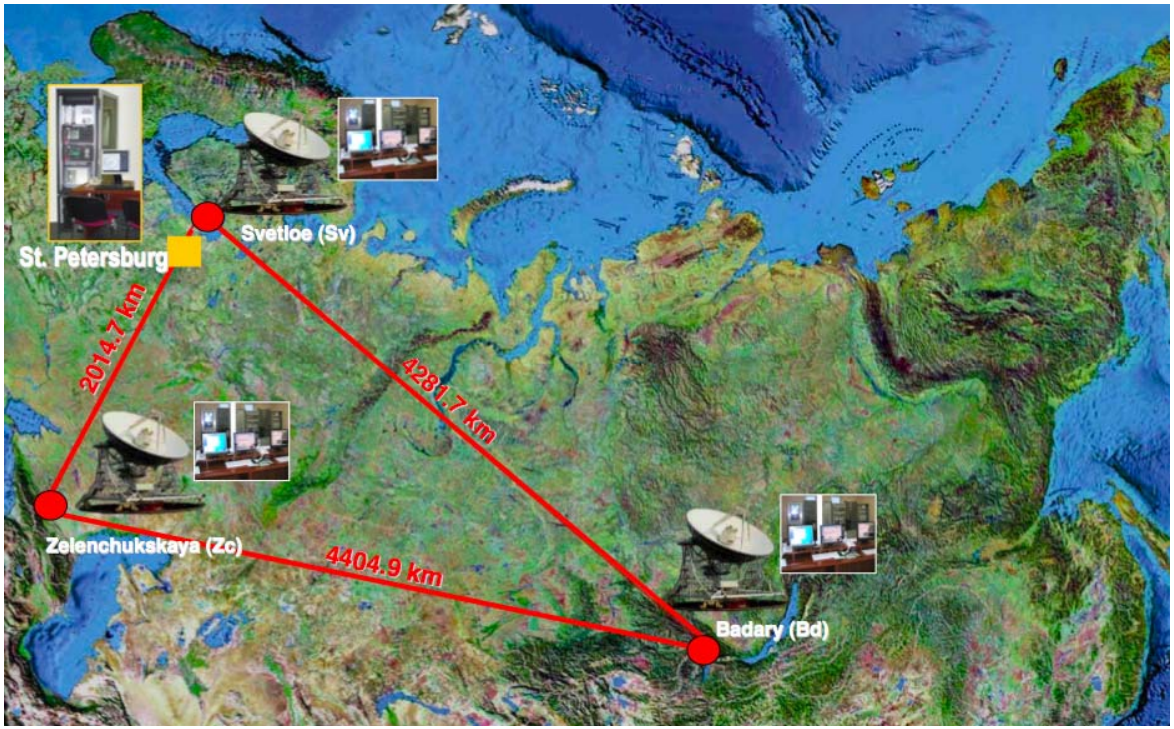
http://www.ipa.nw.ru/



Source: Andrey Finkelstein and others. The Network “Quasar”: 2008-2011. Institute of Applied Astronomy Russian Academy of Sciences. www.ipa.nw.ru,

MAIN DOMESTIC PROGRAMS

In 2005 three radio astronomical observatories of the VLBI Network “Quasar” were put in service. As a result the three-element VLBI Network with baselines of about 2015 x 4282 x 4404 km connected to the Control and processing center in St.Petersburg was established.

Observatory
“Zelenchukskaya”
“Svetloe”,
“Badary”

VLBI Network “Quasar”- 2009

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MAIN DOMESTIC PROGRAMS

RU-E - daily sessions carried out once per 2 weeks for determining all EOPs (Universal Time, pole coordinates, Celestial pole coordinates) using three observatories of the VLBI-Network “Quasar”

RU-U -1- and 8-hour sessions once per 2 weeks for determining Universal Time using “Zelenchukskaya” - “Svetloe” or “Badary”- Svetloe” ⏲aselines.

Observatory “Svetloe”

Source: Andrey Finkelstein. Institute of Applied Astronomy Russian Academy of Sciences, www.ipa.nw.ru, *26 May 2009,Onsala*

VLBI Network “Quasar”- 2009

MAIN INTERNATIONAL PROGRAMS

IVS-R1, IVS-R4- sessions carried out twice per week on Monday and Thursday for obtaining EOP;

IVS-T2 -sessions carried out once per two or three months for monitoring stations coordinates of the global VLBI- Network;

IVS-Intensive - sessions carried out twice per month for obtaining the Universal Time;

EURO- sessions organized not rare than once per year; the purpose of this experiment is to determine station coordinates and their evolution in the European geodetic VLBI Network;

VLBI-RDV -few sessions during a year for the aim of geodetic source mapping in collaboration with VLBA- Network;

RU-List 1,2 -sessions fulfilled in radiometric regime for investigating flux density of geodetic radio sources

Source: Andrey Finkelstein. Institute of Applied Astronomy Russian Academy of Sciences. www.ipa.nw.ru, *26 May 2009,Onsala*
http://www.ipa.nw.ru/PAGE/rusipa.htm

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Kutusov embankment, 10
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fax: (812) 275-11-19
http://www.ipa.nw.ru/

Observatory “Badary”

e-VLBI Network “Quasar”- 2009

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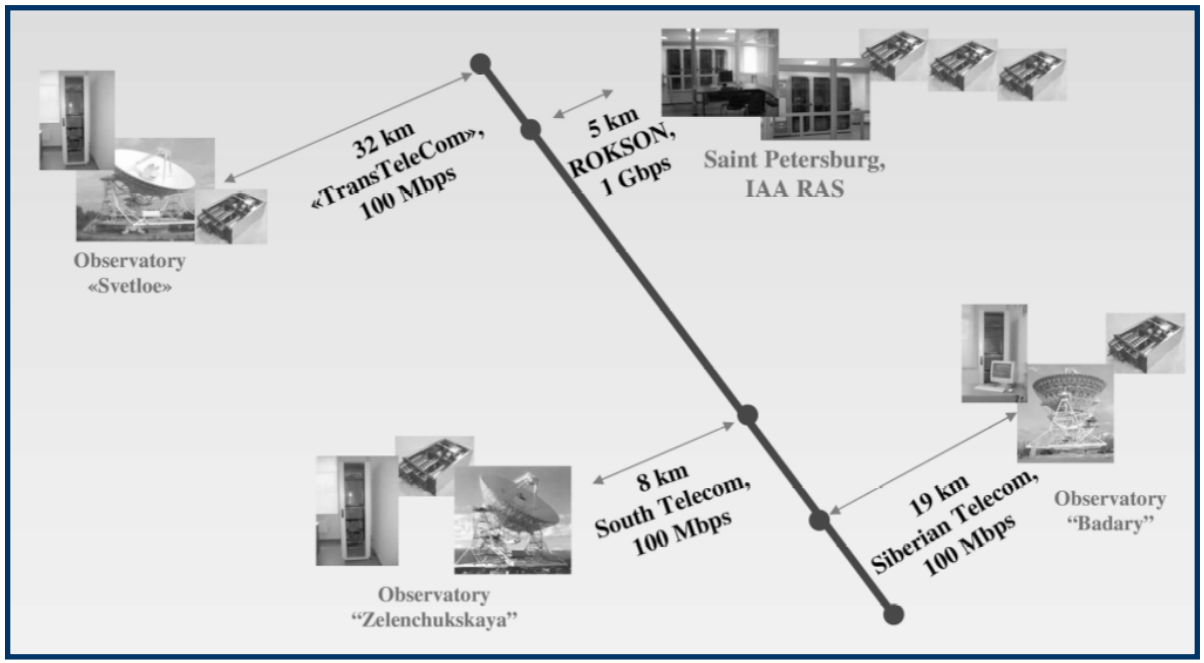
fax: (812) 275-11-19
http://www.ipa.nw.ru/



Source: Andrey Finkelstein. Institute of Applied Astronomy Russian Academy of Sciences. 5G eneral Meet i ng Measuri ng t he Fut ure March 3-6 2008, Sai nt P et ersburg, Russia

In 2007 all observatories of the VLBI Network “”Quasar” were linked to provide both e-VLBI mode for determining the Universal Time in intensive 1-hour sessions and real-time remote monitoring of each part of the Network.

DOMESTIC PROGRAMS

One time per two weeks
2010 - One time per week
2011 - Every day determination of UT-1 (e-VLBI mode), one time per week - EOP determination

VLBI Network "Quasar" Development: 2010-2013

- **Putting into the action the 6-station correlator 2010**
- **Unification of «Quasar»Network with 70-meter radio telescope in Ussurijsk (Far East) 2010**
- **Installation of 2-3 new 12-or 8-meter radio telescopes with joint horn for S/X/Kq – bands on «Quasar»observatories 2012 -2013**
- **Installation of 3 satellite laser ranging stations on «Quasar»observatories 2010 -2011**

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http://www.ipa.nw.ru/

Observatory "Zelenchukskaya"

Source: Andrey Finkelstein. Institute of Applied Astronomy Russian Academy of Sciences, www.ipa.nw.ru, *26 May 2009,Onsala*

VLBI Network “Quasar”- 2011

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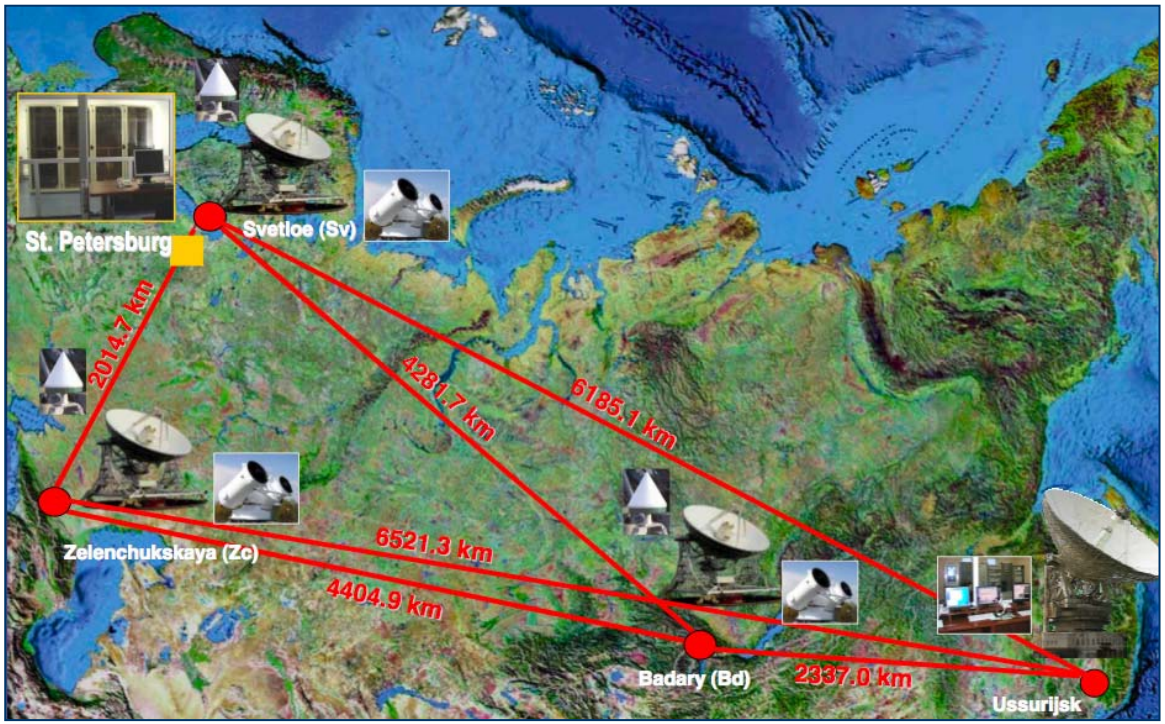
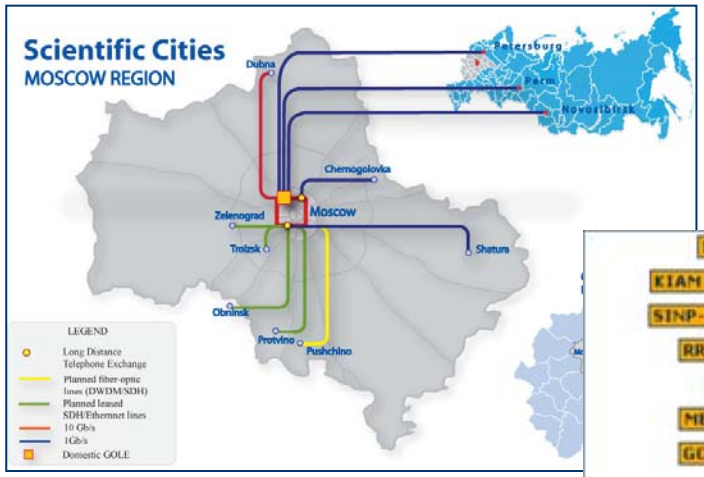


Source: Andrey Finkelstein. Institute of Applied Astronomy Russian Academy of Sciences, www.ipa.nw.ru, *26 May 2009,Onsala*

Unification of VLBI Network “Quasar” with Radio telescope RT-70

RT-70
Usurijsk, Far East

Russian Data Intensive Grid (RDIG)



RDIG

The Russian consortium RDIG (Russian Data Intensive Grid, http://www.egee-rdig.ru) was established in September 2003 to create a Grid infrastructure for the intensive processing of research data.

Such infrastructure has been requested by Russian scientists to be able to participate in experiments in High Energy PhysicsLHC experiments (http://www.cern.ch/LHC), and in Biomedicine and Earth Science as two other pilot applications.

RDIG

Now the RDIG infrastructure comprises 15 Resource Centers with more 7000 kSI2K CPU and more 1850 TB of disc storage.

- IHEP-Institute of High Energy Physics (Protvino),
- IMPB RAS-Institute of Mathematical Problems in Biology (Pushchino),
- ITEP-Institute of Theoretical and Experimental Physics
- JINR-Joint Institute for Nuclear Research (Dubna),
- KIAM RAS-KeldyshInstitute of Applied Mathematics
- PNPI-Petersburg Nuclear Physics Institute (Gatchina),
- RRC KI-Russian Research Center “KurchatovInstitute”
- SINP-MSU -SkobeltsynInstitute of Nuclear Physics,MSU,

RDIG Resource Centres:

- ITEP
- JINR-LCG2
- Kharkov-KIPT
- RRC-KI
- RU-Moscow-KIAM
- RU-Phys-SPbSU
- RU-Protvino-IHEP
- RU-Troitsk-INR
- Ru-IMPB-LCG2
- Ru-Moscow-FIAN
- Ru-Moscow-CRAS
- Ru-Moscow-MEPHI
- Ru-PNPI-LCG2
- Ru-Moscow-SINP

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Source: Korenkov Vladimir (LIT,JINR), GRID Activity at Russia and JINR, GRID Activity at Russia and JINR, Dubna, 07.07.2009

RDIG

The main directions in development and maintenance of RDIG e-infrastrthe following:

-support of basic grid-services;
• -Support of Regional Operations Center (ROC);
• -Support of Resource Centers (RC) in Russia;
• -RDIG Certification Authority;
• -RDIG Monitoring and Accounting;

• -participation in integration, testing, certification of grid-software;
• -support of Users, Virtual Organization (VO) and application;
• -User & Administrator training and education;
• -Dissemination, outreach and Communication grid activities.

Flagship applications:

LHC, Fusion (toward to ITER), nanotechnology
Current interests from: medicine, engineering

Source: Korenkov Vladimir (LIT,JINR), GRID Activity at Russia and JINR, GRID Activity at Russia and JINR, Dubna, 07.07.2009

LHC

High Energy Physics

The Large Hadron Collider (LHC) is a gigantic scientific instrument near Geneva, where it spans the border between Switzerland and France about 100 m underground.

It is a particle accelerator used by physicists to study the smallest known particles – the fundamental building blocks of all things. It will revolutionise our understanding, from the minuscule world deep within atoms to the vastness of the Universe.

The LHC experiments

Each experiment is distinct, characterised by its unique particle detector.

The six experiments at the LHC are all run by international collaborations, bringing together scientists from institutes all over the world:

ATLAS and CMS(Two large experiments**),** are based on general-purpose detectors to analyse the myriad of particles produced by the collisions in the accelerator.

ALICE and LHCb(Two medium-size experiments**),** have specialised detectors for analysing the LHC collisions in relation to specific phenomena.

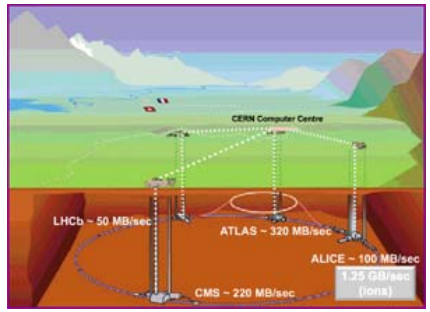
TOTEM and LHCf (much smaller in size experiments), they are designed to focus on 'forward particles' (protons or heavy ions). These are particles that just brush past each other as the beams collide, rather than meeting head-on

Source:
http://public.web.cern.ch/public/en/LHC/LHCExperimentsen.htm

LHC

High Energy Physics

Collaboration between CERN and USSR, then Russian Federation



Individual contacts with scientists from the Soviet Union started in 1964. The scientific co-operation with CERN is based on various Agreements and Protocols with the first one signed in 1967. The 1996 Protocol on the participation in the LHC project defined the first Russian contributions to the LHC accelerator. The 2002 Extension to this Agreement brought an additional contribution to the LHC accelerator.

The 2003 Protocol is now the official document governing Russian participation in the LHC programme.

The $5.8 billion international project, which will be officially unveiled on October 21, 2008 at the European Organization for Nuclear Research, known by its French initials CERN, has involved more than **2,000 physicists** from hundreds of universities and laboratories in 34 countries since 1984.

The development of the Large Hadron Collider (LHC), the world's largest and most powerful particle accelerator, has involved over **700 Russian physicists** from 12 research institutes

Source: http://public.web.cern.ch/public/en/LHC/LHCExperimentsen.html, http://www.spacedaily.com/reports/Over_700_Russian_Scientists_Part_Of_LHC_Project_999.html

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Image: http://articles.kompass.ua/publ/133-1-0-501

LHC High Energy Physics

Russia Tier2 facilities in World-wide LHC Computing Grid :

RuTier2 functional model in the WLCG:

• RuTier2 - federation of several (now 6) centers of the Tier2 functionality: *MC generation, analysis of real data, users data support*

And other (now 5) of Tier3 functionality: *local user support*

• each RuTier2 site operates for all four experiments- **ALICE, ATLAS, CMS and LHCb**, thus *sharing CPU and partitioning storage resources between Experiments at each Tier2 site*

RuTier2 Computing Facilities are operated by RDIG

Source: V.A.Ilyin, Grid and LHC, Session NP DPS RAS, 22 December 2008

RuTier2 resources

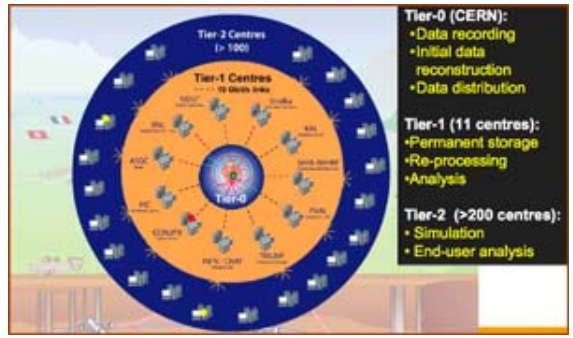
End of 2008, installed and available for WLCG:

•3800++ KSI2K CPU
•600+ Tbyte Disk
•No Tape

Resources available for WLCG at the beginning of 2009:

• *~4000-4500++ KSI2K CPU (pledged 3800 KSI2K)*

• *1700+ Tbyte (pledged)*
•No tape



Source: V.A.Ilyin, Grid and LHC, Session NP DPS RAS, 22 December 2008

LHC High Energy Physics

International Infrastructur (bandwidth view)

1) GEANT2

• PoP (connected to Moscow GNAP) operates in JSCC RAS(Moscow since December 2006, and now bandwidth 2,5 Gbps.
10 Gbps upon the real request by RDIG and LCG. Real use by RuTier2 sites during 2008 *(stable file transfer at thelevel >20Mbyte/s(max 70Mb/s)*

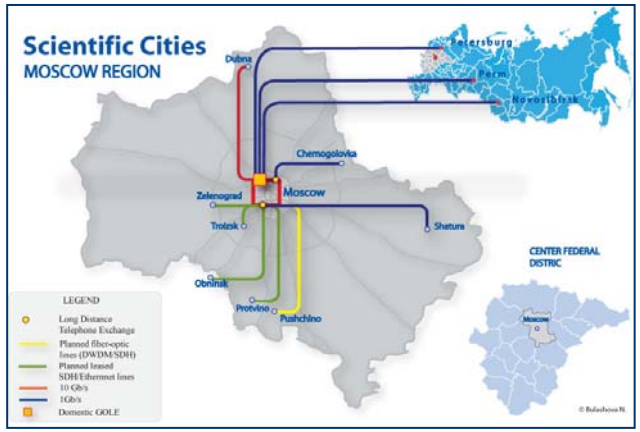
2) RBnet-Gloriad now bandwidth 1 Gbps

RuTier2 sites have started real use in September 2009
Moscow (G-NAP)-Stockholm (NORDUnet)-Amsterdam(SURFnet-CERN)-USA
CMS FNAL T1 -> Moscow T2s (RRC KI, SINP MSU) file transfer we see 20 Mbyte/s++, but still unstable (probably problems with networking cross Europe - under investigation)

3) RUNNET link

Moscow (G-NAP)-S.Petersburg-Stockholm (NORDUnet)
Today total bandwidth 10 Gbps
RuTier2 sites have started real use in September 2009
CMS Taiwan T1-->Moscow T2s (RRC KI, SINP MSU) file transfer we see 20 mbyte/s++, but still unstable (probably problems with networking cross Europe - under investigation)

Domestic Infrastructur (bandwidth view)



Moscow (1-10Gps)	**ITEP, RRC KI, SINP MSU,ITEP, MEPhI,..**
Protvino (plans 1Gbps, go10Gps)	**IHEP**
Dubna (10Gbps)	**JINR**
Novosibirsk (1Gps)	**BINP**
Troisk (100Mbps now, 1Gps)	**INR RAS**
Gatchina(Plans 1 Gbps)	**PNPI**
S-Peterburg 1Gbps now	**SPbSU**

РОСНИИРОС RIPN

GLIF-2009
Daejeon, Korea, 2009

Source: V.A.Ilyin, Grid and LHC, Session NP DPS RAS, 22 December 2008

Earth Science

near real-time data streams and database applications

- **Astronomy:** database mirrors like Sloan Digital Sky Survey (SDSS), VLBI and telescope network hunting for transients
- **Space weather:** satellite telemetry, ionospheric, geomagnetic and cosmic ray observatories, database mirrors like Space Physics Interactive Data Resource (SPIDR)
- **Climate change:** sharing of numerical modeling of climate change like NCEP/NCAR or ECMWF reanalysis, real-time meteorological observations, distributed interactive modeling and data mining like Environmental Scenario Search Engine (ESSE)
- **Early alarms on strong earthquakes and tsunami:** rapid collection and stream processing of multiple data sources including seismic stations, hydrophones, GPS and SAR data

Source:M.Zhizhin, Geophysical Center and Institute of Physics of the Earth RAS

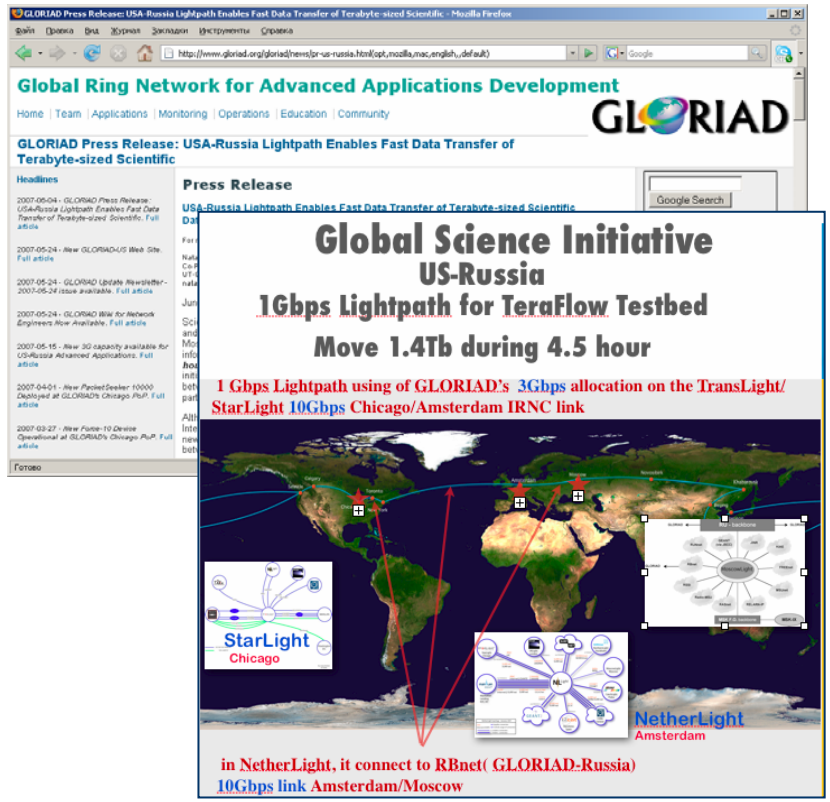
Earth Science

USA-Russia Lightpath for Fast Data Transfer of Terabyte-sized Scientific Datasets

- National Center for Data Mining (NCDM) at the University of Illinois at Chicago, Geophysical Center RAS and Space Research Institute RAS have successfully moved 1.4 TB of data in 4.5 hours over a 1 Gbps lightpath between Chicago and Moscow as part of the Teraflow Network initiative
- Using NCDM's open-source UDP-based Data Transfer protocol (UDT), we were able to transfer the MS SQL database with SDSS astronomy catalog. The 2.5 TB database dump was compressed to 1.4 TB, split into 60 files, transferred over a 1 Gbps lightpath and then decompressed in Moscow and loaded back to MS SQL Server
- The SkyServer portal and the SDSS database were developed by Jim Gray at MSR and Alex Szalay at JHU. Russian language mirror now resides at www.skyserver.ru in Moscow
- Direct Lightpath link from IKI in Moscow to NGDC NOAA in Boulder has been successfully tested

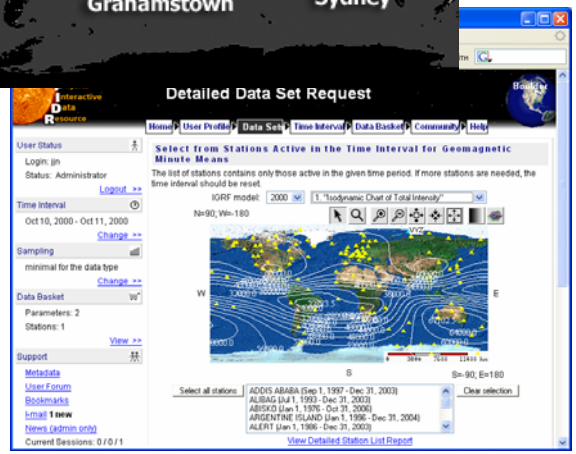
Russian Mirror:
www.skyserver.ru

GLORIAD Press Release June 4, 2007



Earth Science

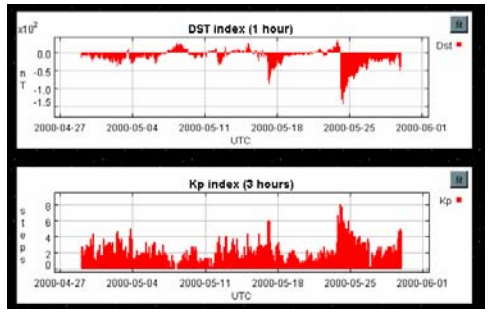
National Geophysical Data Center NOAA,
Space Physics Interactive Data Resource - SPIDR
http://spidr.ngdc.noaa.gov =http://spidr.wdcb.ru

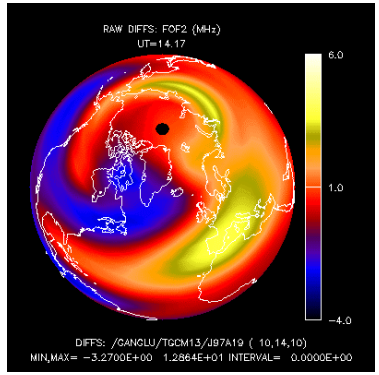


The Space Physics Interactive Data Resource (SPIDR) is a distributed network of synchronous databases and application servers designed to allow a space weather modeling and prediction customer or application to intelligently access and manage historical space physics data for integration with virtual environment models and real-time space weather forecasts. Space Physics Interactive Data Resource (SPIDR)

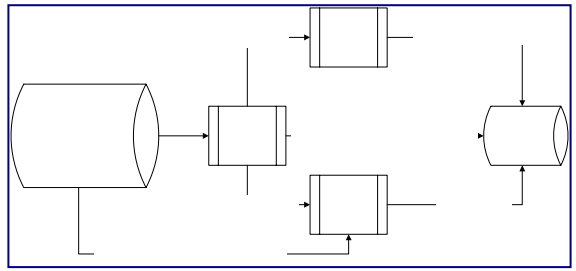
Space Weather Re-Analysis

Input: ground and satelite data from **SPIDR**





Space weather numerical models



Output: high-resolution representation of the near-Earth space

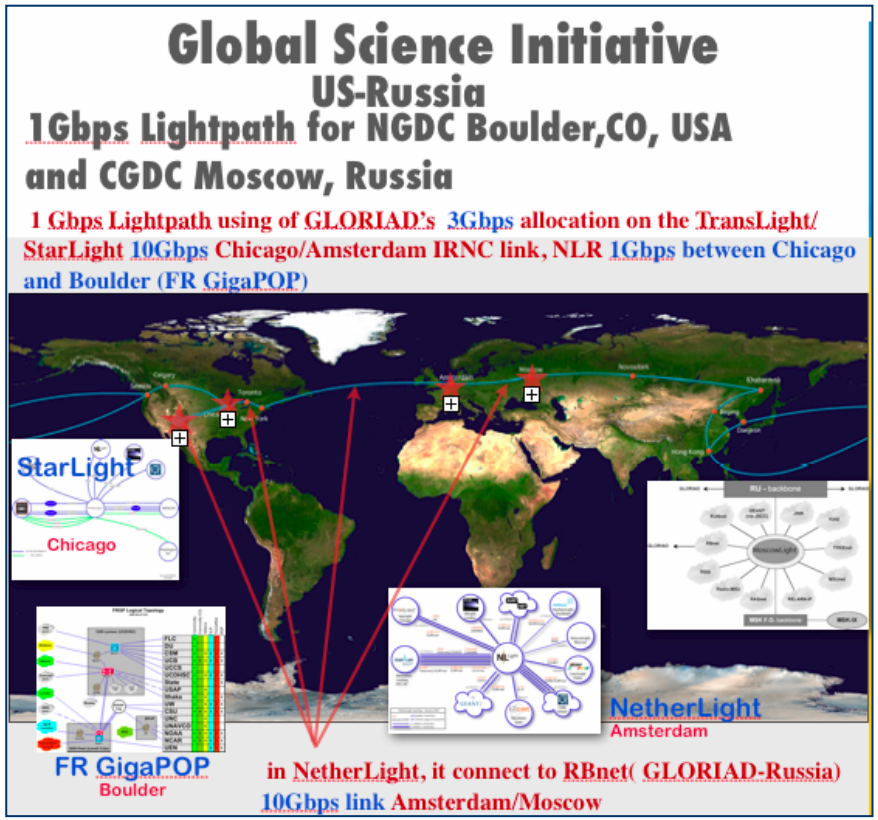
РОСГИДРОМЕТ RIPN

GLIF-2009
Daejeon, Korea, 2009

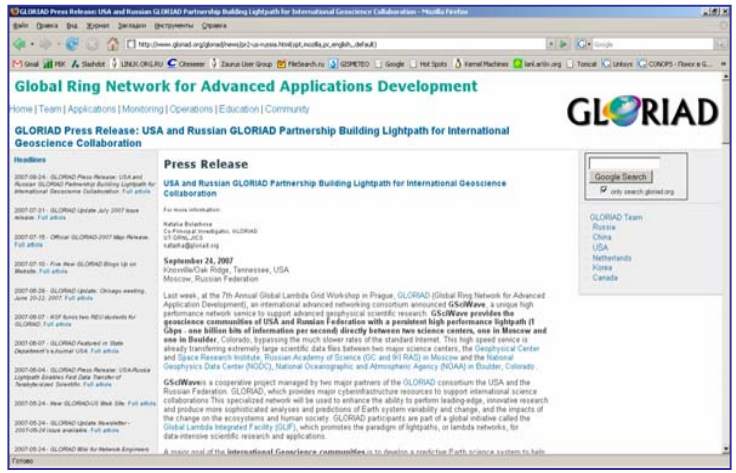
Source:M.Zhizhin, Geophysical Center and Institute of Physics of the Earth RAS

Earth Science

National Geophysical Data Center NOAA,
Space Physics Interactive Data Resource - SPIDR
http://spidr.ngdc.noaa.gov =http://spidr.wdcb.ru



GLORIAD Press Release, September 24, 2007



Participants:

GSciWave was made possible through a unique international partnership among organizations and international projects, global network facilities, and national networks including:

Gloriad
Translight/StarLight
StarLight
MoscowLight
FrontRange GigaPOP in Boulder, Colorado
NetherLight, Netherlands
NationalLambdaRail (NLR), USA
RBnet, Russia
Space Research Institute,RAS,Russia
Geophysical Center and Institute of Physics of the Earth RAS
RRC KI, Russia

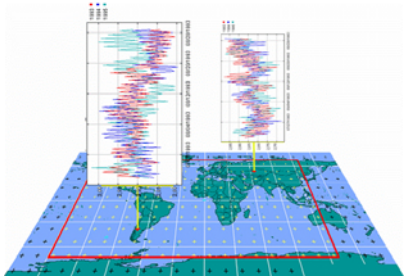
РОСНИИРОС RIPN

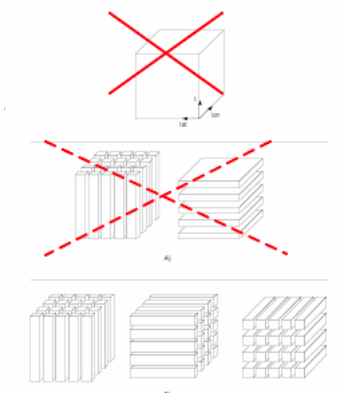
GLIF-2009
Daejeon, Korea, 2009

Earth Science

Active Storage for Common Data Model

Common Data Model is an array of values of a parameter at different times on regular grids, at specified locations (point or station data) or space-time trajectories

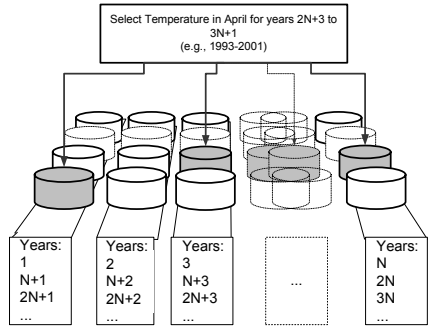




Index space explosion

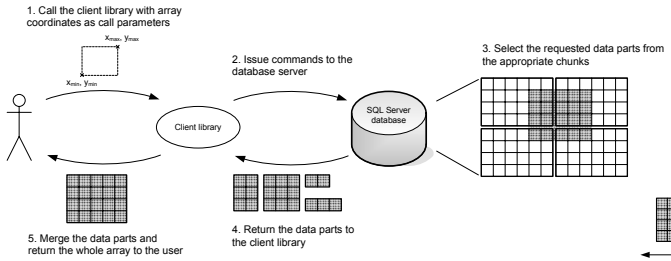
MySQL databases, 1998-2007

Database cluster design, 1999

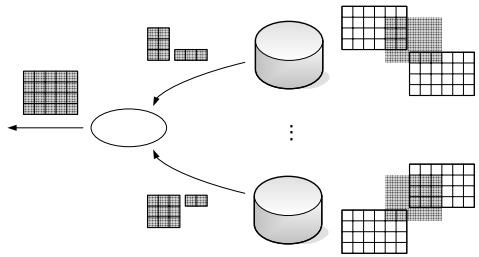


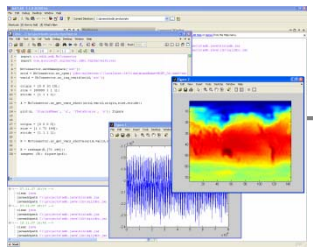
The data had been stored on a cluster of 58 separate databases, each containing 1 year data, stored in a separate binary field for each grid point. The databases were queried sequentially or in parallel threads at the application level

Active Storage for Common Data Model
2 TB of climate history data



Parallel database cluster





MS SQL2008
single server storage

Description: Environmental Scenario Search Engine The main idea behind ESSE is a flexible, efficient and easy to use search engine for data mining in environmental data archives. What makes it so different from conventional text-based search engines is that it actually searches inside the numeric datasets. With ESSE scientists will be able to find specific parameter values, conditions, and scenarios among the huge amount of available environmental data. ESSE will help you find useful data even if you don't know exactly what you are looking for. ESSE uses Common Data Model for internal data representation, thus acting as a bridge between the user and the multiple heterogeneous data sources.

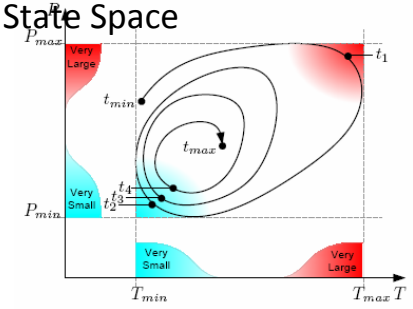
GLIF-2009
Daejeon, Korea, 2009

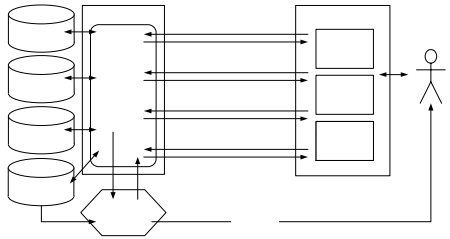
Source:M.Zhizhin, Geophysical Center and Institute of Physics of the Earth RAS

Earth Science

Environmental data Mining and Visualization (OGA-DAI Activities)

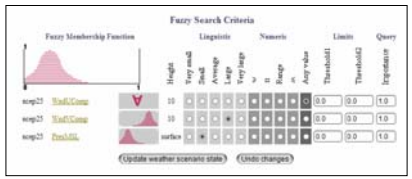
Fuzzy Logic State Space

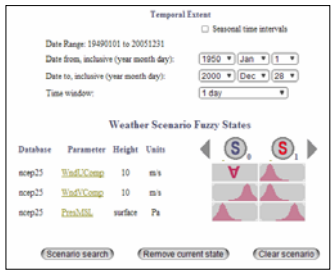


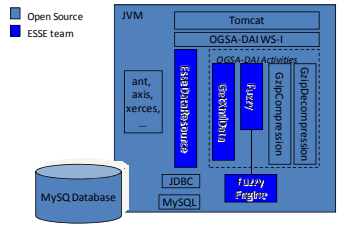


Linux/Java

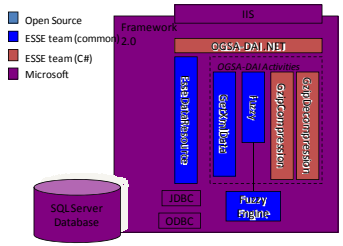
Web Interface for Fuzzy Queries

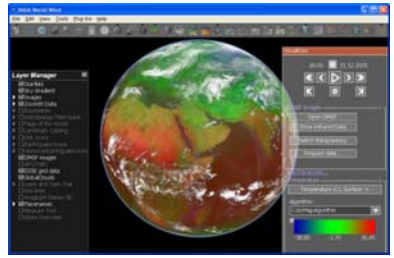


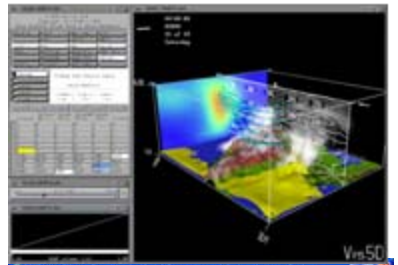


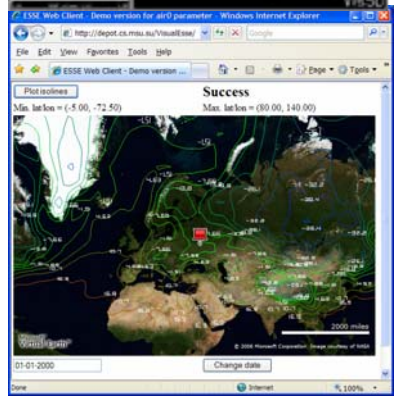


.NET Port









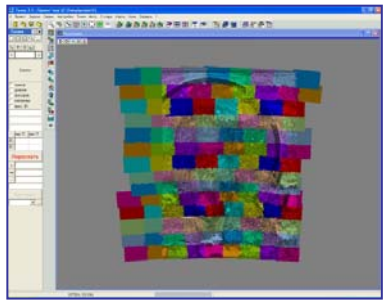
http://www.wdcb.ru
http://spidr.ngdc.noaa.gov
http://esse.wdcb.ru

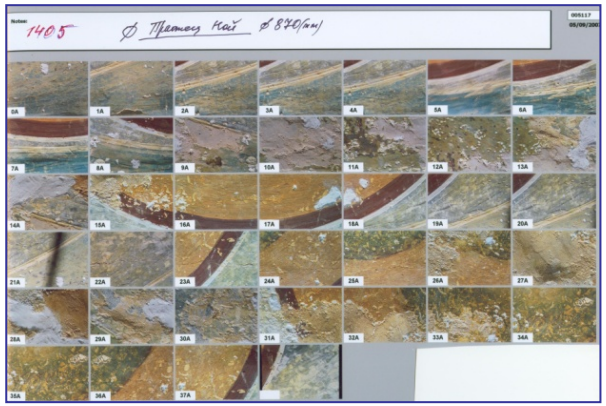
GLIF-2009
Daejeon, Korea, 2009

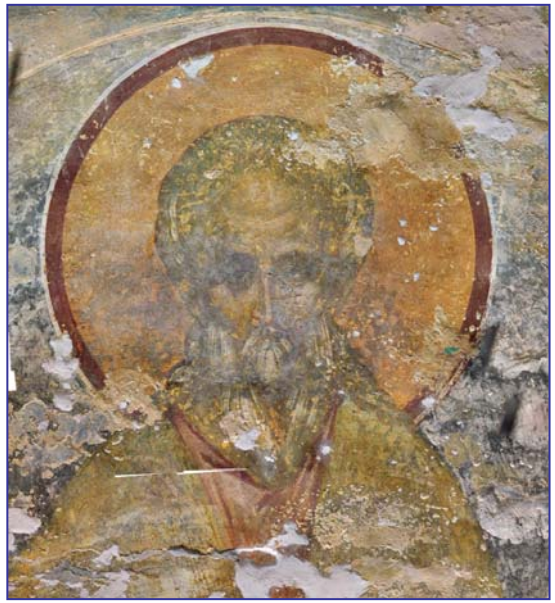
Source:M.Zhizhin, Geophysical Center and Institute of Physics of the Earth RAS

Earth Science

Computational Photography for Digital Art Maps
St.Ferapont Monastery in Ferapontovo, XVI century





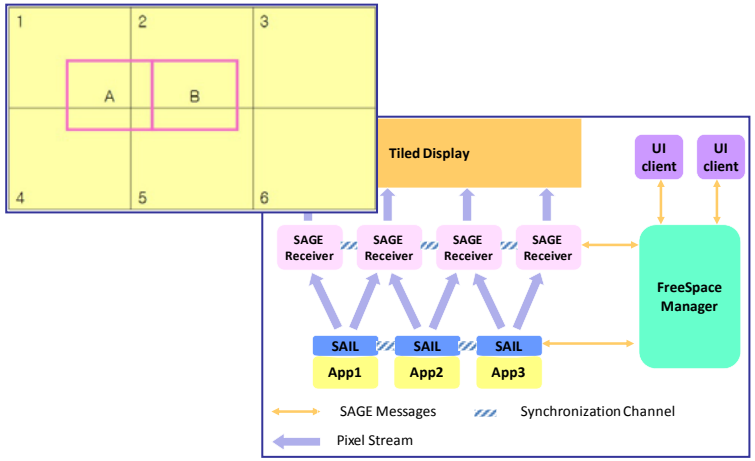


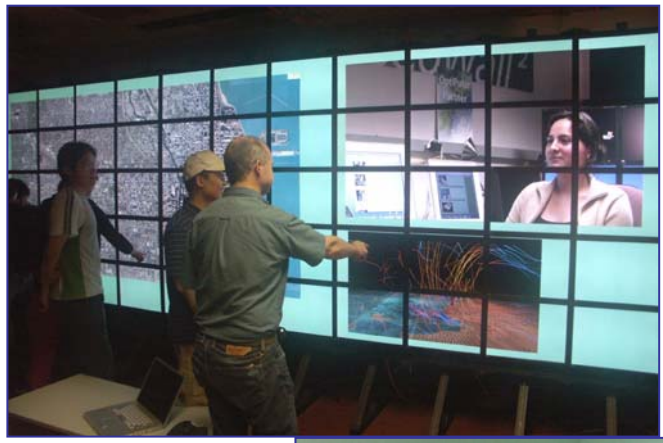
GLIF-2009
Daejeon, Korea, 2009

Source:M.Zhizhin, Geophysical Center and Institute of Physics of the Earth RAS

Earth Science

Tiled Display Video Wall: SAGE 3.0 ported to .NET





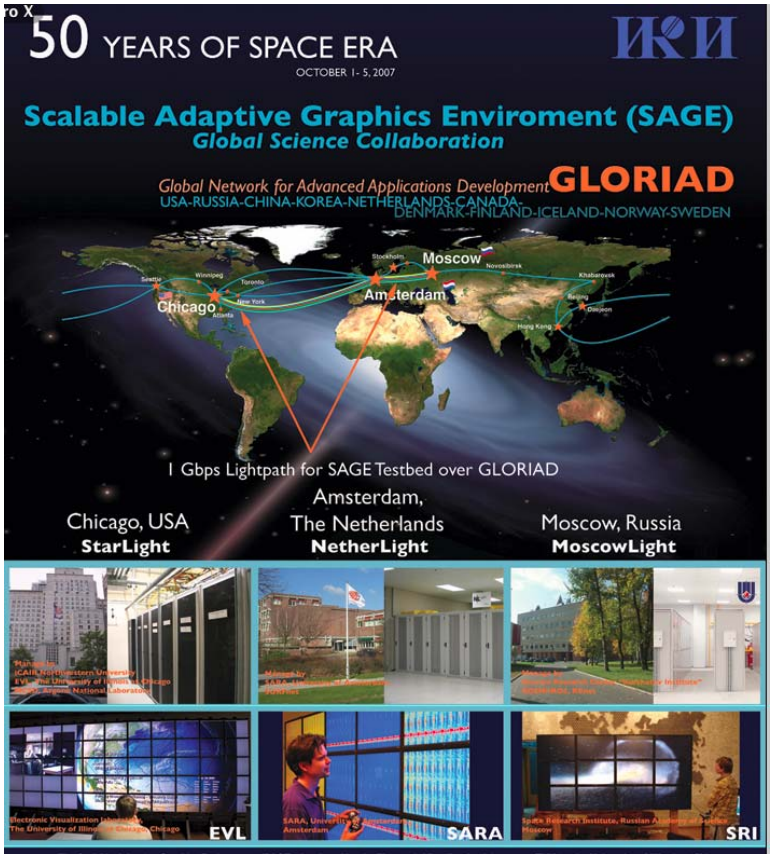
РОСНИИРОС RIPN

GLIF-2009
Daejeon, Korea, 2009

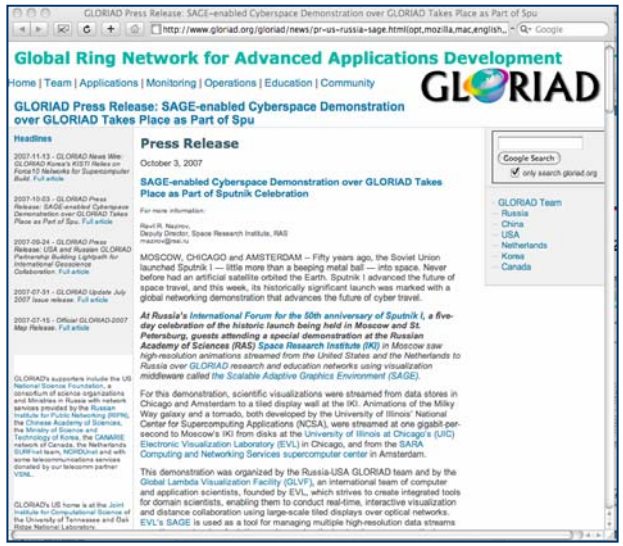
Source:M.Zhizhin, Geophysical Center and Institute of Physics of the Earth RAS

Earth Science

Tiled Display Video Wall: SAGE



GLORIAD Press Release, October 3, 2007



Paricipants:

Grid Laboratory, Space Research Institute, Russian Academy of Sciences,Russia
NetherLight/SURFnet, The Netherlands
Russian Research Center Kurchatov Institute
Russian Institute for Public Networks (RIPN)
University of Illinois at Chicago, Electronic Visualization Laboratory
Space Research Institute, Russian Academy of Sciences
StarLight
SARA
Gloriad
TransLight/StarLight
University of Amsterdam, Systems and Networking Engineering Research Group
University of Tennessee, Oak Ridge National Laboratory JICS
University of Illinois at Chicago, Electronic

Source:M.Zhizhin, Geophysical Center and Institute of Physics of the Earth RAS

Atmospheric Science

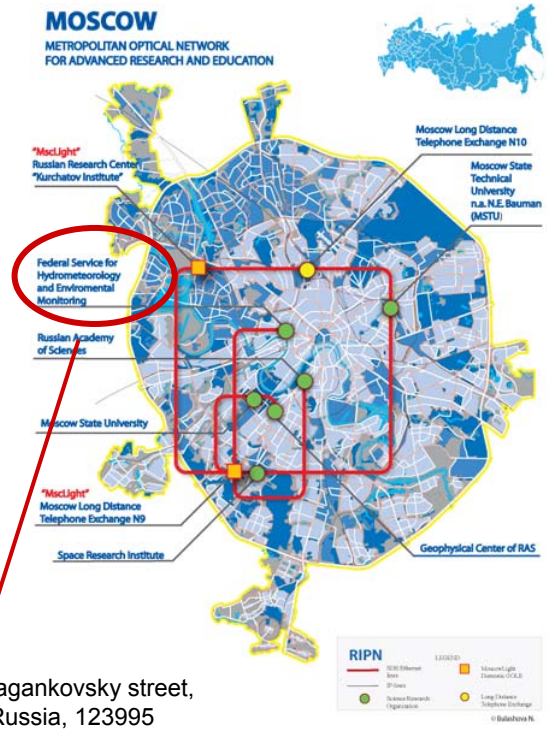
Russian Federal Service for Hydrometeorology and Environmental monitoring Roshydromet

THORPEX
A GLOBAL ATMOSPHERIC RESEARCH PROGRAMME

Project: THORpex
Description:

A Global Atmospheric Research Programme THORPEX is a ten-year international research programme, under the auspices of the Commission of the Atmospheric Science, and its World Weather Research Programme (WWRP).

Source:Image courtesy of the THORPEX



The purpose of THORPEX is to accelerate improvements in short-range (up to 3 days), medium-range (3 to 7 days) and extended-range (week-two) weather predictions and the social value of advanced forecast products. THORPEX would examine global-to-regional influences on the predictability of high-impact weather and establish the potential to produce significant statistically-verifiable improvements in forecasts of those time scales

Address:
12, Novovagankovsky street,
Moscow, Russia, 123995

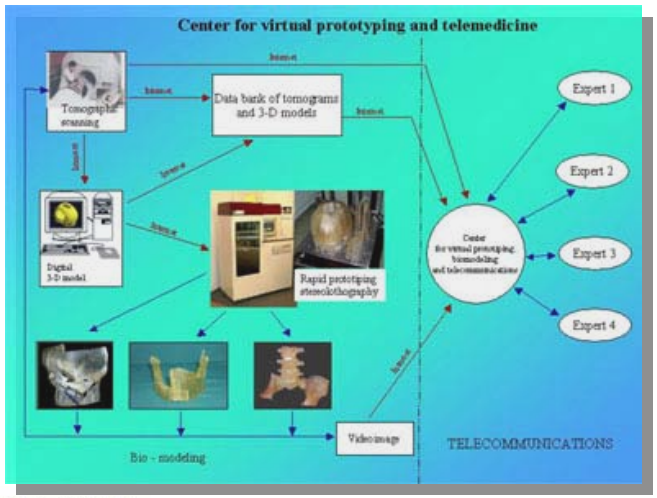
Phone: (7-095) 252-03-13
Fax: (7-095)255-22-69

Medical Science

Institute on Laser and Information Technologies, RAS

Project: Project on NEUROSURGERY
Description:

The purpose of the present project is the creation of resources and technologies for the allocated virtual designing, fast prototyping and telemedicine. Virtual designing and fast prototyping apply in various areas of industry (aviation, mechanical engineering, automobile) and in medicine. We suppose as the basic direction of this project the elaboration of technology for bio-medical applications: the creation of bio-models for surgery and planning of the operations in videoconferences-regime.

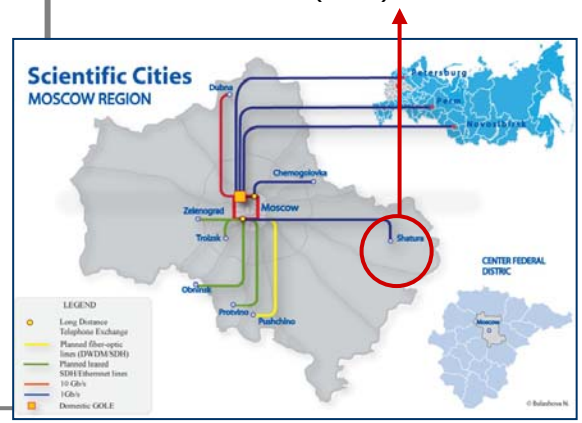


ILIT,RAS
Shatura,
Moscow Region

Source: Pancheko V.

Address:

IPLIT RAN
140700, Sviatoozerskaya
1, Shatura,
Moscow reg., Russia
Email:panch@laser.ru
Phone: +7 (095) 135-02-54

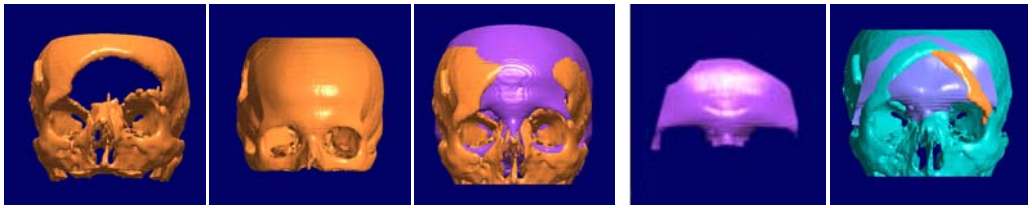


Medical Science

Institute on Laser and Information Technologies, RAS

COMPUYER MODELING OF IMPLANTS

Creation of 3D model of an implant
using "virtual donor"



3D model of patient skull | **"Virtual donor"** | **Intersection** | **Suitable fragment** | **Computer adjust**

Participants:

N.N. Burdenko Institute of Neurosurgery, Russian Academy of Medical Sciences.

N.N. Blokhin Russian Cancer Research Center, Russian Academy of Medical Sciences Moscow Center for childrens jaw facial surgery.

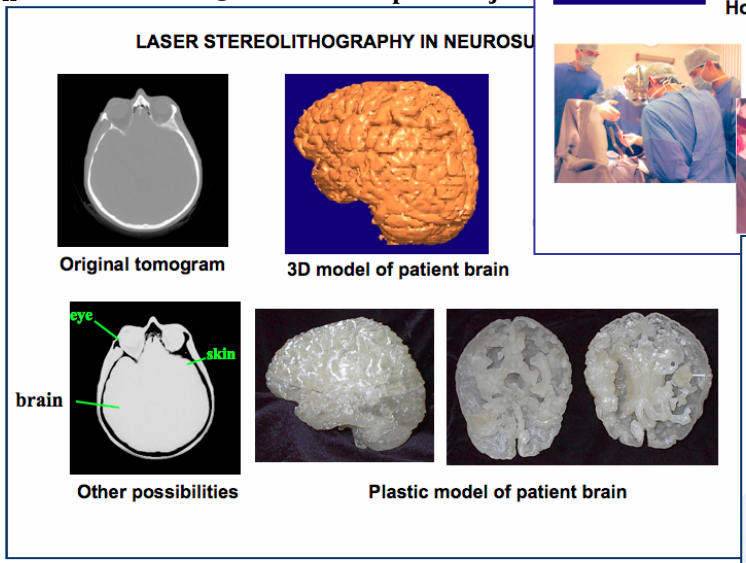
Moscow region scientific research clinical institute. (MONIKI).

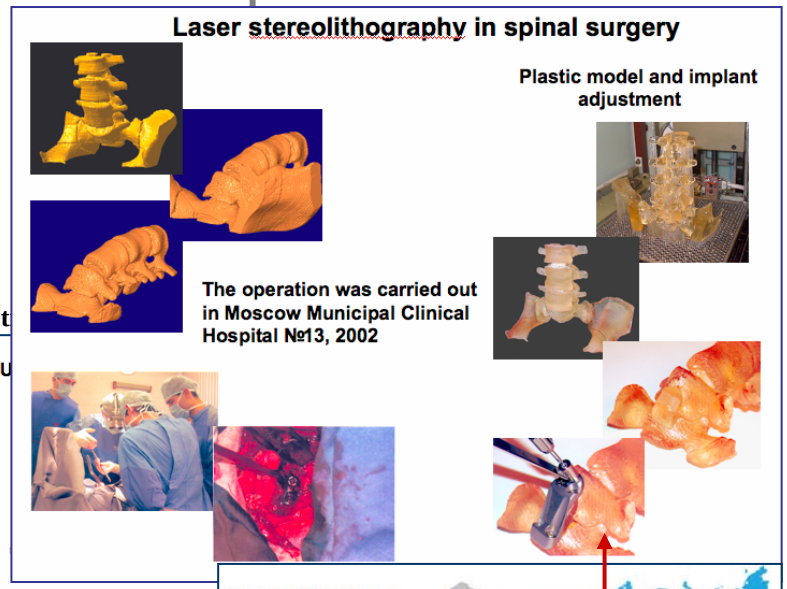
P.A. Gertsen Moscow scientific research oncological institute.

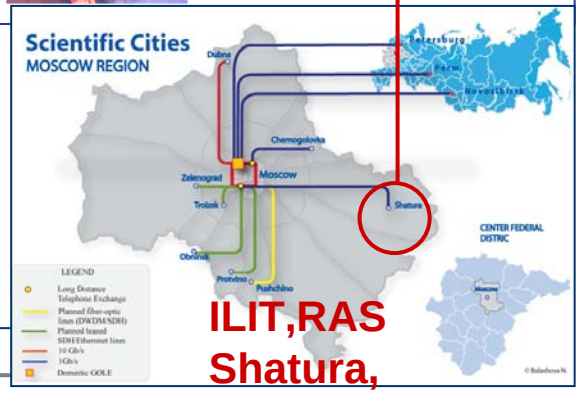
M.V. Lomonosov Moscow State University, Physics Department, Medical Physics Chair. Center of Magnetic Tomography & Spectroscopy

Russian Research Center "Kurchatov Institute"

Others.







ILIT,RAS Shatura, Moscow Region

РОСНИИРОС RIPN

GLIF-2009
Daejeon, Korea, 2009

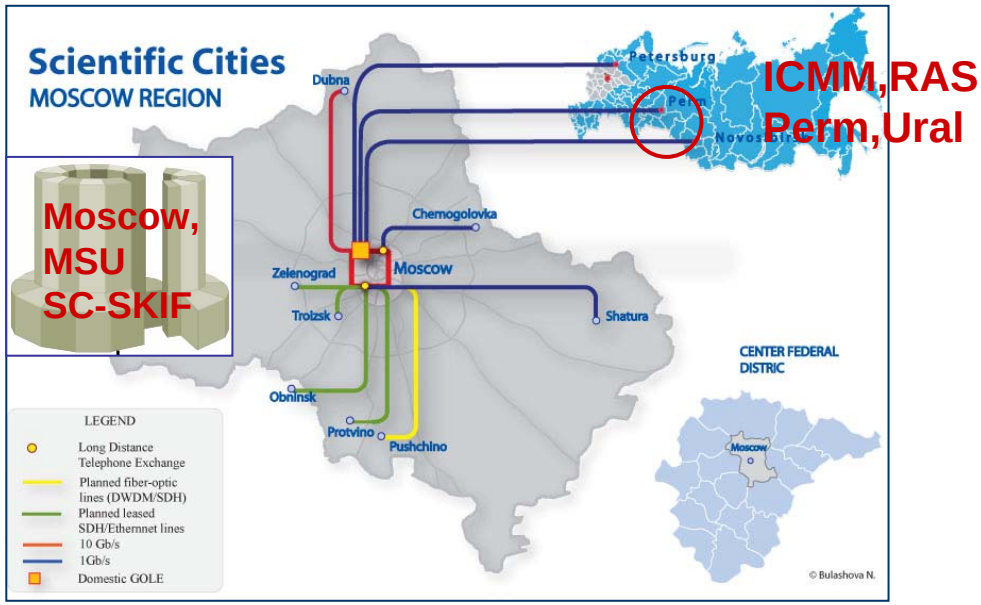
Source: Pancheko V.

Applied Physics

Institute of Continuous Media Mechnics, RAS, Ural Branch

Project: **Distributed Particle Image Velocimetry**

Description:
Distributed Particle Image Velocimetry is on-line Image computation performed on the SKIF-supercomputer at Moscow State University.The data is streamed from experimental facility in Perm Ural to Moscow across a 1500 ↓↗ 1GE dedicated channel with data speed transfer 600 Mbit/s



Address:

614013 Perm, street Academ. Koroleva, 1
Telephone: (342) 237-84-61
Fax: (342) 237-84-87

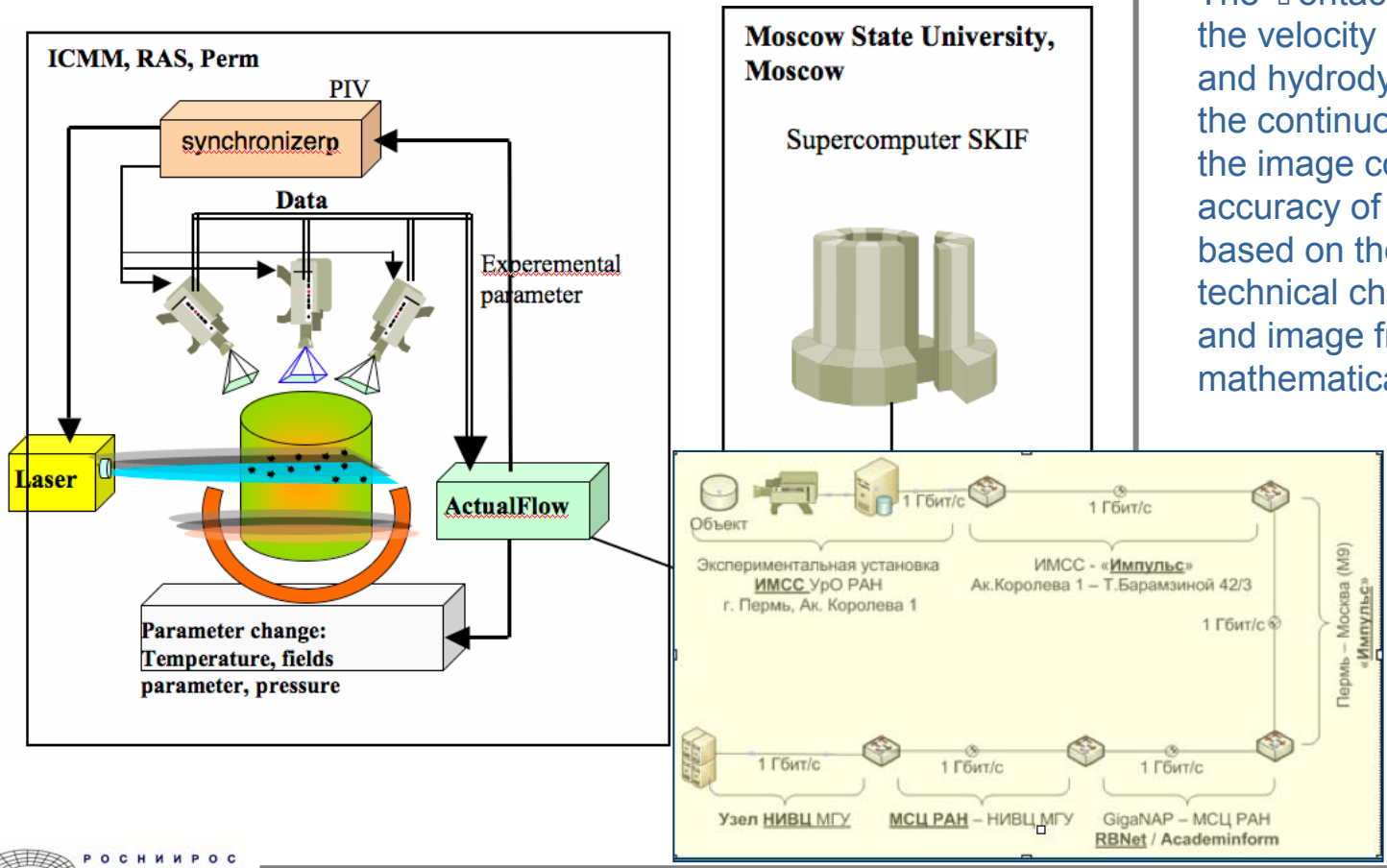
Source: Stepanov R.A., Masich A.G.

Source: Stepanov R.A., Masich A.G

Applied Physics

Institute of Continuous Media Mechnics, RAS, Ural Branch

Project: Distributed Particle Image Velocimetry

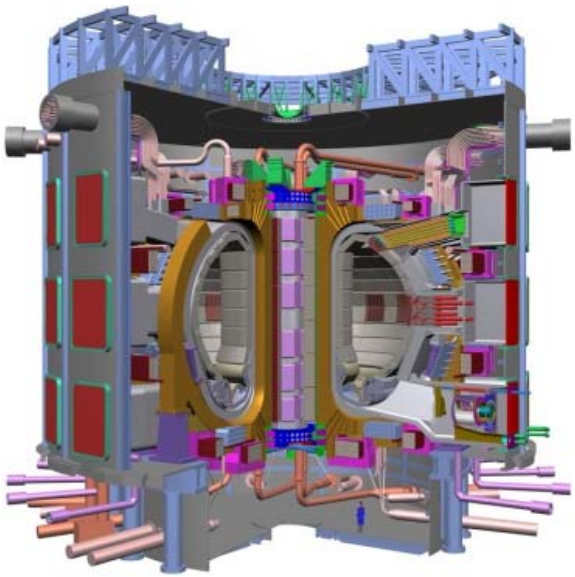


The ⇧ontactless measurements of the velocity of the field in the gas- and hydrodynamic experiment of the continuous media are based on the image computation. The accuracy of the measurements are based on the video-camera technical characterstics (resolution and image frequency) and the mathematical algorithm

Source: Stepanov R.A., Masich A.G

ITER

International
Thermonuclear
Experimental
Reactor



Q ≥ 10

ITER is a large-scale scientific experiment that aims to demonstrate that it is possible to produce commercial energy from fusion

- **Major Plasma Radius: 6.2 □**
- **Plasma Temperature: ~ 20 □□□ □□□ 200 □□□. □□□□.**
- **Fusion power: 500 M□□**

Fusion:
The merging of two light atomic nuclei into a heavier nucleus, with a resultant loss in the combined mass and a massive release of energy.

Fusion Performance:
The level of power amplification, Q, or the energy confinement time during a fusion reaction. Plasma power amplification; the ratio of fusion power input to the plasma divided by external power supplied to the plasma. In ITER, the programmatic goal - Q≩10 - signifies delivering ten times more power it consumes.

Tokamak:
A fusion device for containing a plasma inside a torus chamber through the use of two magnetic fields--one created by electric coils around the torus, the other created by intense electric current in the plasma itself. The tokamak was invented in the 1950s by Soviet physicists Igor Yevgenyevich Tamm and Andrei Sakharov. The term **Tokamak** is a transliteration of a Russian expression *(toroidalnaya kamera + magnitnaya katushka)* meaning toroidal chamber with magnetic coils.

Source: iterrf.ru, www.iter.org

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Experimental
Reactor

The signing of the ITER Agreement takes place on Tuesday, **21 November 2006** at the Elysee Palace, in Paris.

Present are French President Jacques Chirac, European Commission President Jose Manuel Barroso and some 400 invited guests including high level representatives from the ITER Parties and European Member States. In the afternoon, the Interim ITER Council (IIC) convenes for its first meeting.

ITER formally established
At 24 October 2007

ITER Participants:
European Union,
China,
India,
Japan,
Korea,
Russian Federation,
United States

Members agree on Cadarache.

After a period of high-level political negotiations, the decision locate ITER in Cadarache, France, is reached on **28 June 2005** at a ministerial-level meeting in Moscow.

РОСНИИРОС RIPN

GLIF-2009
Daejeon, Korea, 2009

Source: iterrf.ru,

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Project History

1985 г.	The USSR Initiative on ITER made by Soviet Secretary-General Mikhal Gorbachev, Academician Evgeny Velikhov (at the Geneva Superpower Summit in November 1985, US President Ronald Reagan and Mikhai Gorbachev).
1986 г.	The beginning ITER negotiation between USSR, USA, Japan, European Union
1988-1990 гг.	ITER Conceptual Design Activities (CDA)
1992-1998 гг.	ITER EDA (Engineering Design Activities)
1999-2001 гг.	A new design ("ITER-FEAT") produced for ITER, which was approved by the ITER Council in July 2001. The new design maintains the overall programmatic objectives of the project, while integrates cost-cutting measures.
2002-2005 гг.	Continuing engineering design, the decision making to locate ITER in Cadarache, France
2006 г.	Signing of the ITER Agreement
2007 г.	ITER fhas been formally established

ITER

Project History - Tokamak

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O.A. Lavrentiev

Start of USSR Fusion programme

July 1950 Letter of Soviet soldier O.A. Lavrentiev to Stalin

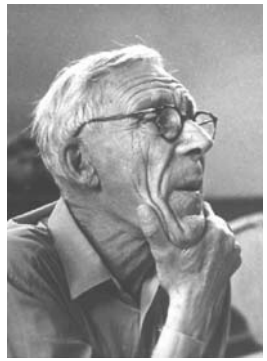
January 1951 I.E. Tamm, A.D. Sakharov's proposal on toroidal magnetic trap is approved


A.D. Sakharov

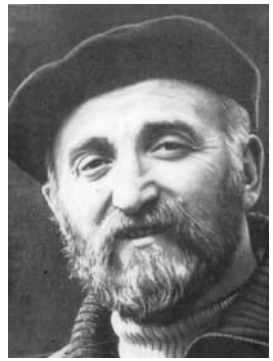

I.E. Tamm

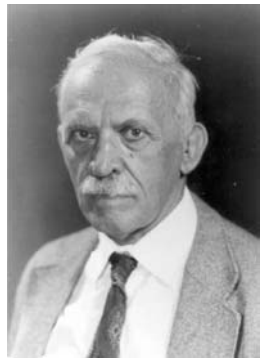
Leaders of Kurchatov fusion team


L.A. Artsimovich


M.A. Leontovich


B.B. Kadomtsev


G.I. Budker


I.N. Golovin

Toroidal systems → Z-pinch → Tokamak


E.P.Velikhov

Leaders of USSR fusion programme

Academician L.A. Artsimovich ~ till 1973
Academician E.P. Velikhov ~ after 1973

Source: V.P. Smirnov, Nuclear fusion institute, RRC,Kurchatov institute, 22nd IAEA Fusion Energy Conference, Geneva, 18. 10. 2008

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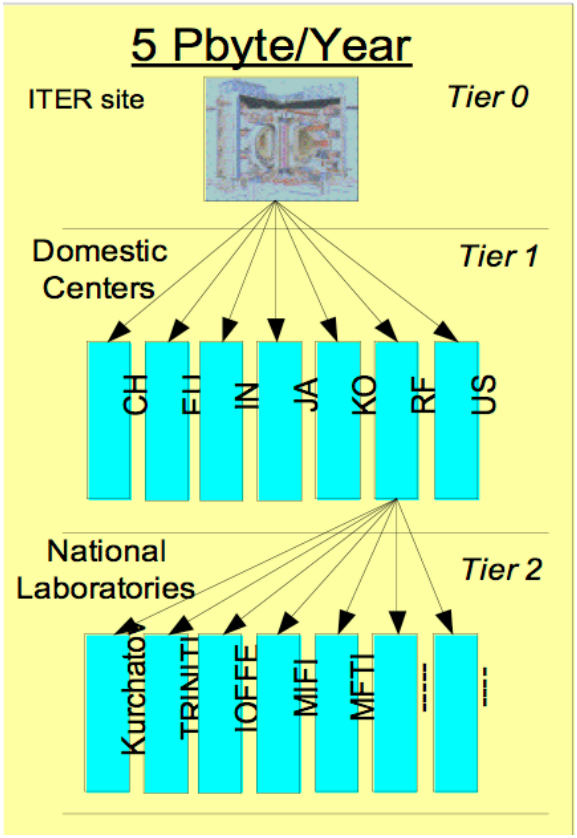
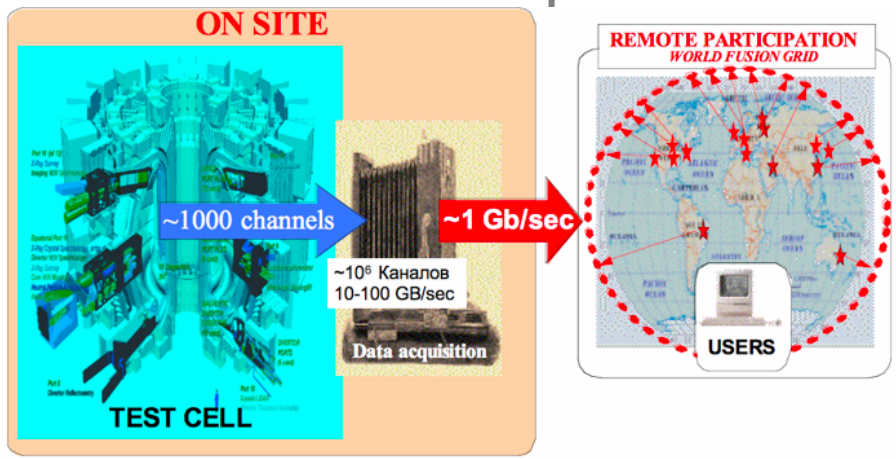
Project Activities



ITER Data distribution



Source: I.B. Semenov, RRC Kurchatov Institute

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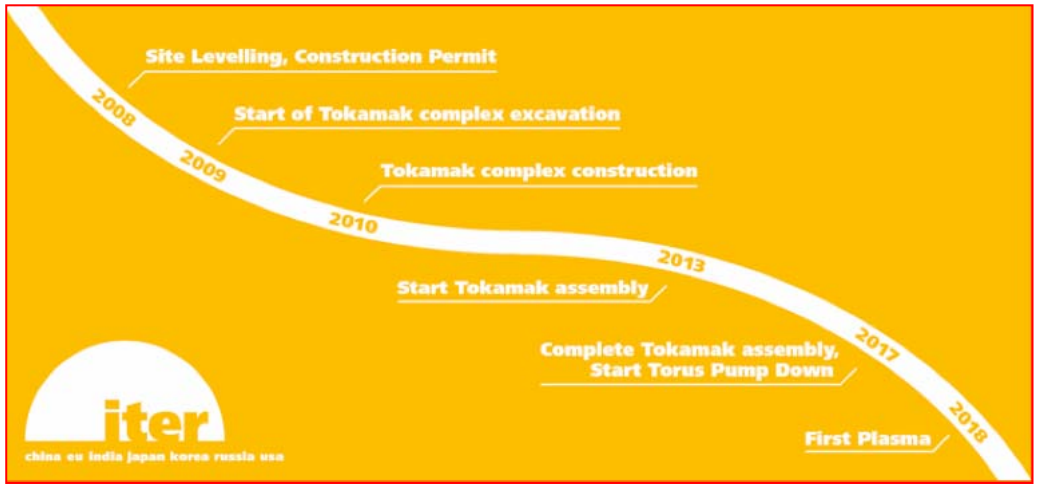
Project plan



The construction work on ITER is expected to come to an end in 2017. A commissioning phase will follow that will ensure all systems operate together and prepare the machine for the achievement of the first plasma. ITER's operational phase is expected to last for 20 years.

Source: www.iter.org

First a several-year "shakedown" period of operation in pure Hydrogen will be run during which the machine will remain accessible for repairs, in order to test the most promising physics regimes. This will be followed by operation in Deuterium with a small amount of Tritium to test shielding provisions. Finally, scientist will launch a third phase with increasingly frequent full operation with an equal mixture of Deuterium and Tritium, at full fusion power.

This is the next step after ITER: the Demonstration Power Plant, or DEMO for short. A conceptual design for such a machine could be complete by 2017. If all goes well, DEMO will lead fusion into its industrial era, beginning operations in the early 2030s, and putting fusion power into the grid as early as 2040.

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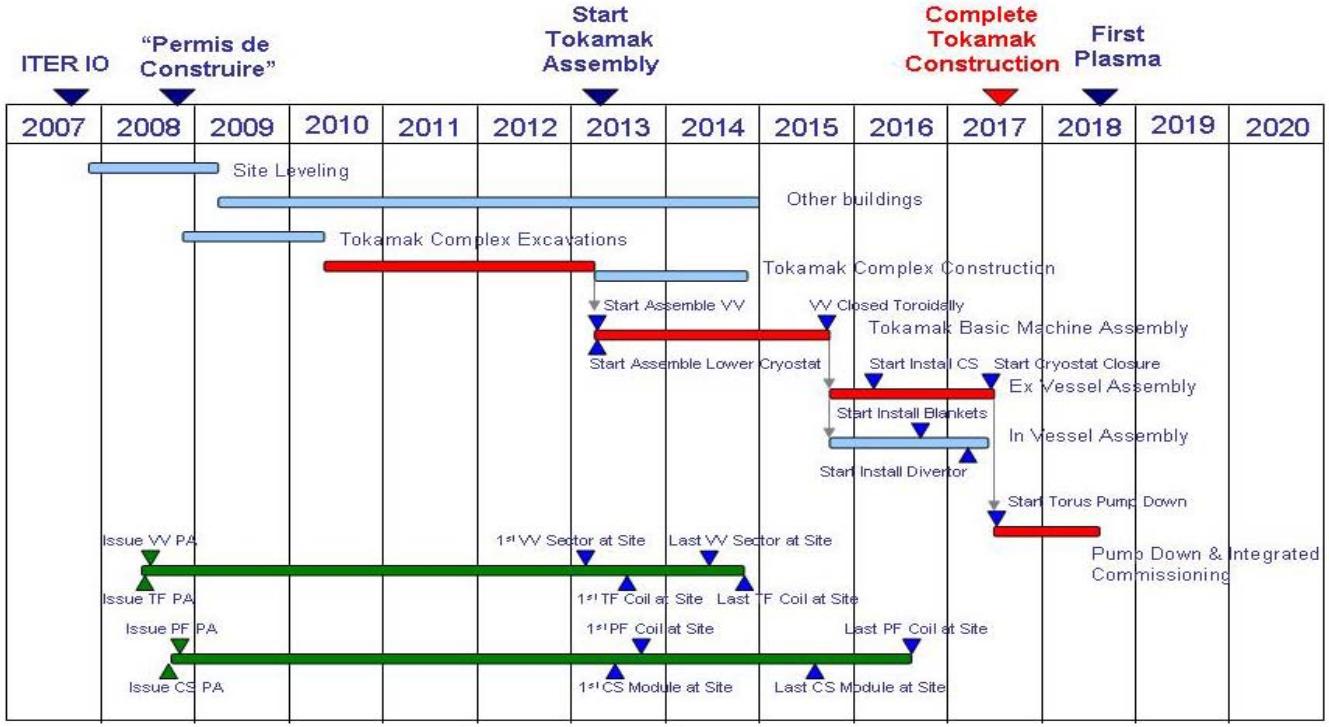
Lambda - Enabled Applications in Russia

Project plan



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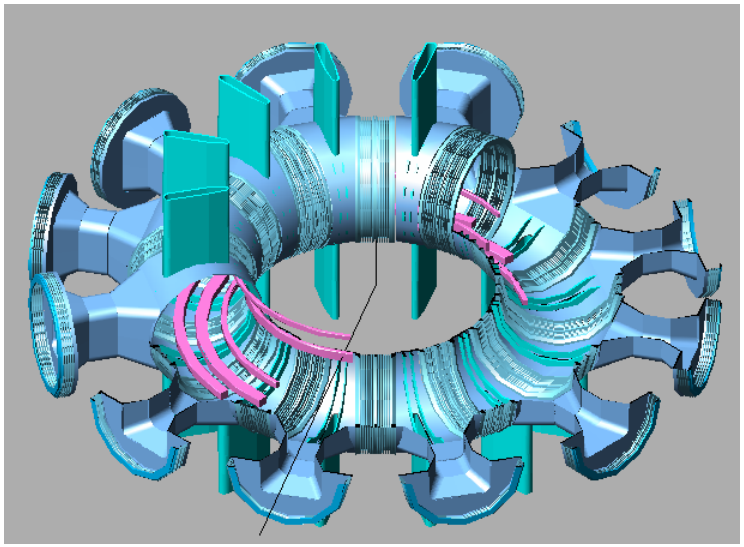
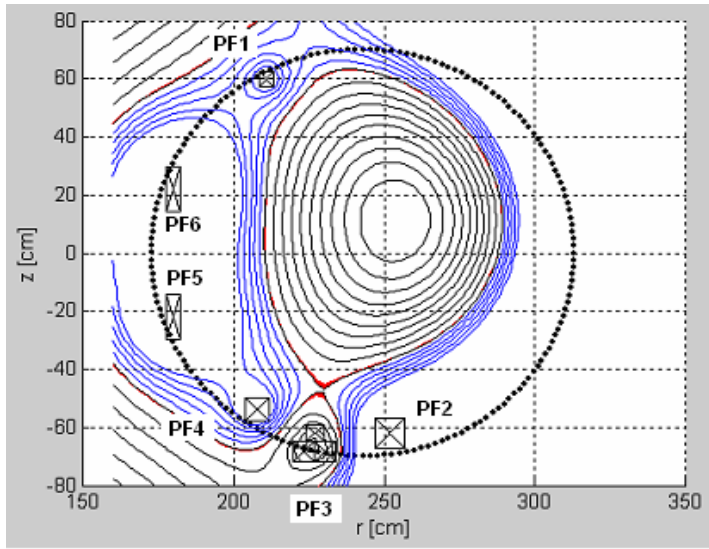
Source: www.iter.org

T-15 is expected to be main tokamak in Russia till 2040 year





2009 2011 2013 2015 2017 2019 2021

ISSUE OF T-15U FINAL PROJECT, PURCHASE OF STANDART EQUIPMENT, DEVELOPMENT OF NON-STANDART EQUIPMENT

ASSEMBLY AND ADJUSTMENT OF EQUIPMENT

PLASMA EXPERIMENTS WITH CIRCULAR PLASMA AT ADDITIONAL POWER HEATING 16 W AND PULSE DURATION 5 S

ASSEMBLY OF DIVERTOR COILS AND IN-VESSEL ELEMENTS. PLASMA EXPERIMENTS WITH ELONGATED PLASMA AT ADDITIONAL POWER HEATING 20 W AND PULSE DURATION 30 S

Source: V.P. Smirno, Nuclear fusion institute, RRC,Kurchatov institute, 22nd IAEA Fusion Energy Conference, Geneva, 18. 10. 2008

T-15 is expected to be main tokamak in Russia till 2040 year

- Invention of tokamak and development of its physics and technology have provided solid starting base for way to fusion power plant (FPP)
- Strategy of Russian activity in fusion is aimed to construction of FPP about 2050

Source: V.P. Smirno, Nuclear fusion institute, RRC,Kurchatov institute, 22nd IAEA Fusion Energy Conference, Geneva, 18. 10. 2008

Clean Energy for Future

Fusion Energy

Fusion Energy program leads the national research effort to advance plasma science, fusion science, and fusion technology - the knowledge base needed for an economically and environmentally attractive fusion energy source.

The Fusion Energy program states that fusion power has the long-range to serve as an abundant and clean source of energy. The future is bright and will be lit by Clean energy.

Source: V.P. Smirno, Nuclear fusion institute, RRC,Kurchatov institute, 22nd IAEA Fusion Energy Conference, Geneva, 18. 10. 2008

Lambda - enabled Applications in Russia

Thank you for your attention!

Questions …

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