Status and the Prospects of Development of Laboratory of Information Technologies

Vladimir Korenkov

LIT JINR

LIT Fundamentals

- Provide IT services necessary for the fulfillment of the JINR Topical Plan on Research and International Cooperation in an efficient and effective manner
- Building world-class competence in IT and computational physics
- 24/7 support of computing infrastructure and services such availability is called nonstop service

User policies

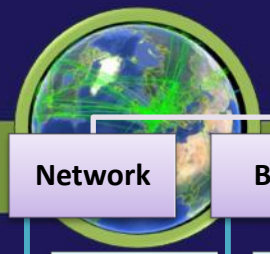
Computing infrastructure

Mathematical and software support

Corporative information system

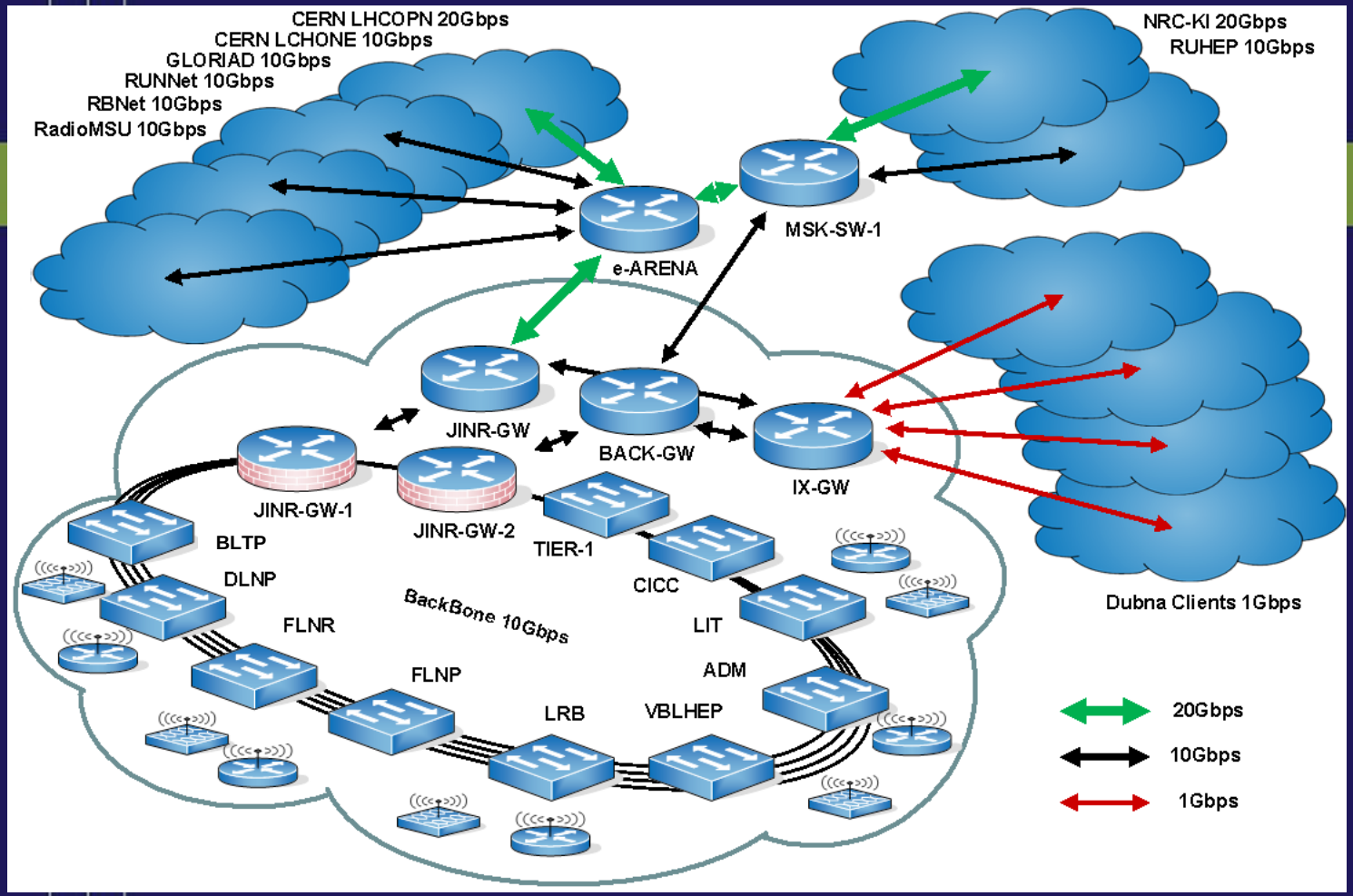
Training, education and user support

IT-infrastructure is one of the JINR basic facilities



IT-services

- **Network**
  - Telecommu-nication channels JINR (LAN) JINR IXP
  - JINR LAN Remote Access Datacenter Network
  - Device registration DHCP DNS IPDB Network Registration & Connection Network Monitoring
  - Technical Network WIFI WLCG Network
- **Basics**
  - Account Management JINR Certificate Authority Computer Security
  - Controls Security Firewall Single Sign On
  - SSH (Secure SHell) E-mail Resources Portal
- **Collaboration**
  - Audio Conferencing Eduroam Indico
  - Video Conferencing Webcast and Recording
  - Project Management
  - GIT
  - JINR Document Server Invenio
- **Database Services**
  - Administration Database Service ADB2 ISS 1.C EPR
  - General Purpose Database Service
- **Computer Science & Physics Computing**
  - **Development**
    - **Computing**
      - **Grid**
        - Tier-1 and Tier-2 Support
        - Storage Support
        - File Transfer Compute Element Grid Information Infrastructure Monitoring
        - LFC Service MyProxy VOMS Workload Management
      - **Cloud**
        - IaaS
        - SaaS
        - PaaS
      - **HybriLIT**
        - CUDA MPI OpenMP
  - **Research**
    - **Applied Software**
      - Computer Algebra
      - JINRLIB
      - Math. Methods algorithms, software
      - Big Data analytics
      - Quantum computing



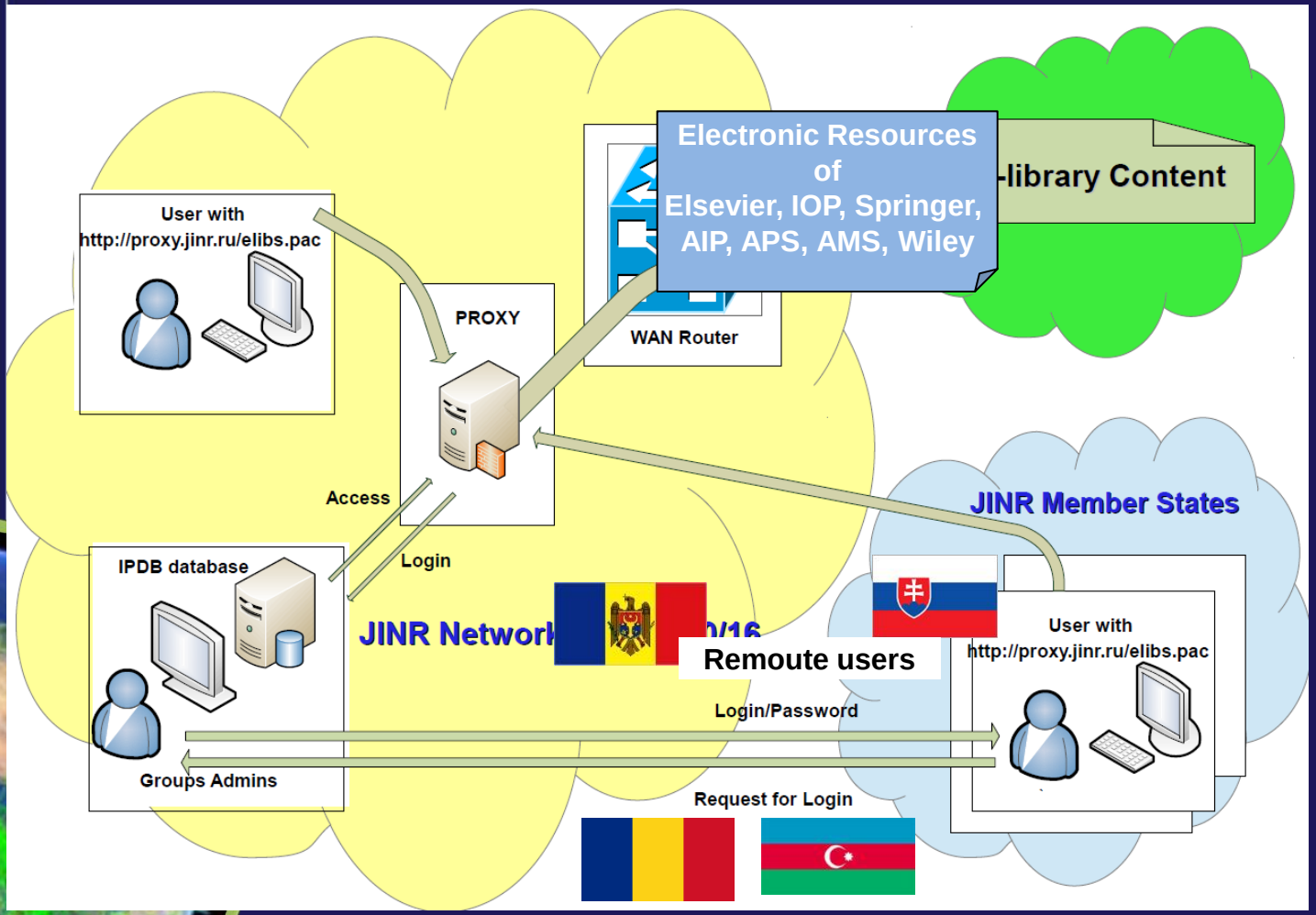
JINR Local Area Network

Comprises **7955** computers & nodes
Users – **4099**, IP – **12568**
Remote VPN users – **864**
E-library**- 1435,** mail.jinr.ru**-2000**
High-speed transport (10 Gb/s)

Controlled-access at network entrance.
General network authorization system involves basic services (Kerberos,AFS, batch systems, JINR LAN remote access, etc.)
IPDB database - registration and the authorization of the network elements and users, visualization of statistics of the network traffic flow, etc.

Access Service to Electronic Resources of World Publishers

Local users

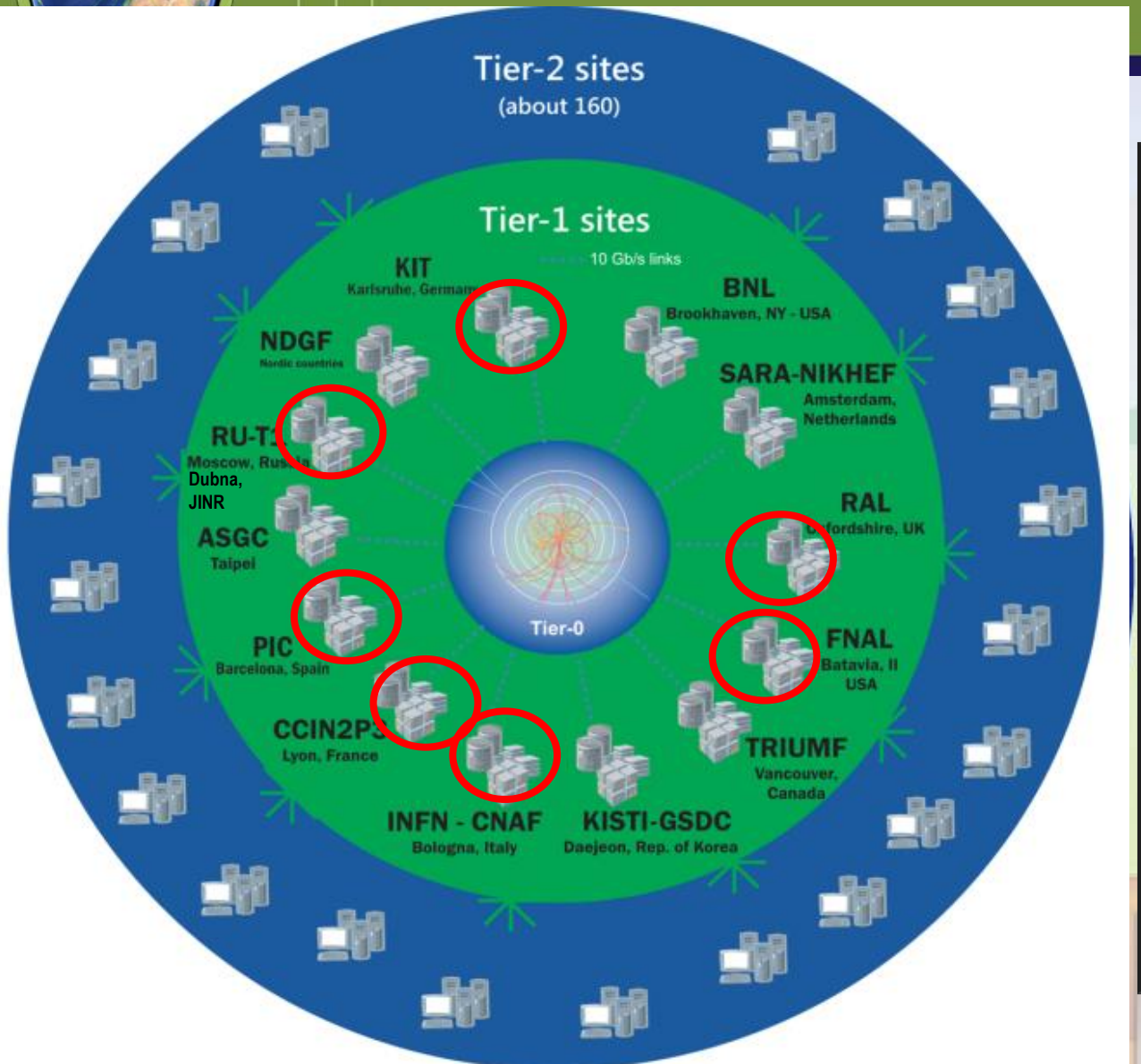


Total e-library users: 1375

Remote JINR users from Member States :

Republic of Azerbaijan - 24
Slovak Republic - 39
Republic of Moldova – 6 (+3)
Romania – 37, Bulgaria -1 (+8), Georgia-1(+7)

LHC Computing Model

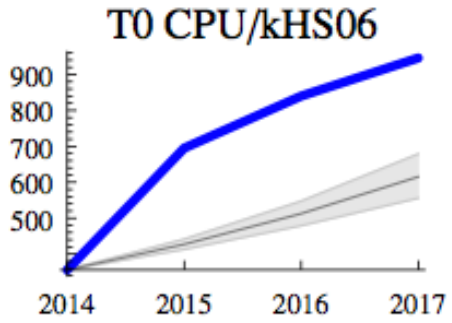


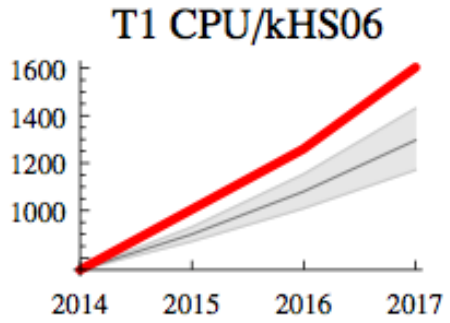
Tier-0 (CERN):
- Data recording
- Initial data reconstruction
- Data distribution

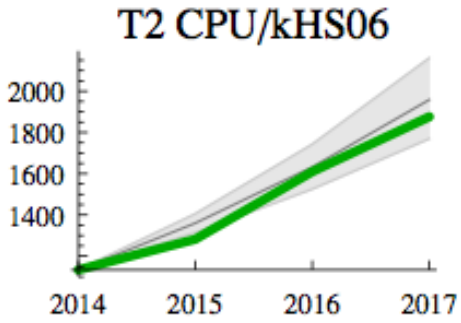
Tier-1 (>14 centres):
- Permanent storage
- Re-processing
- Analysis
- Simulation

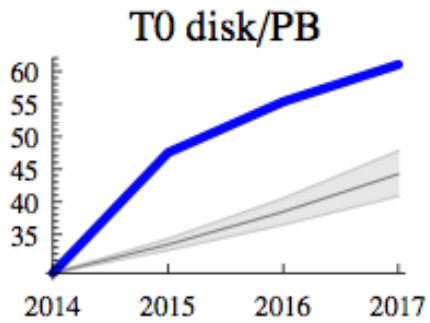
Tier-2 (>200 centres):
- Simulation
- End-user analysis

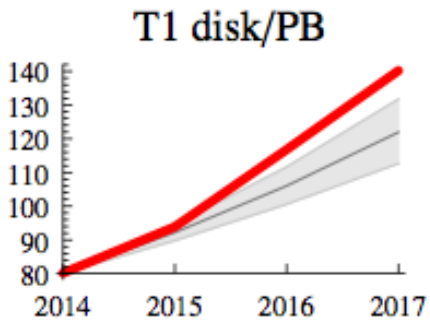
Combined (sum of experiments)

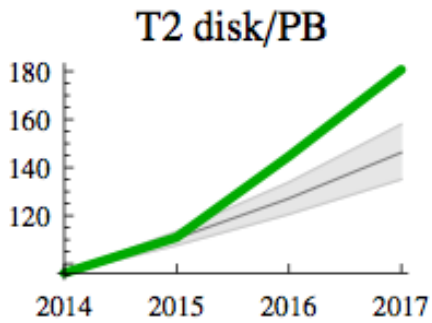


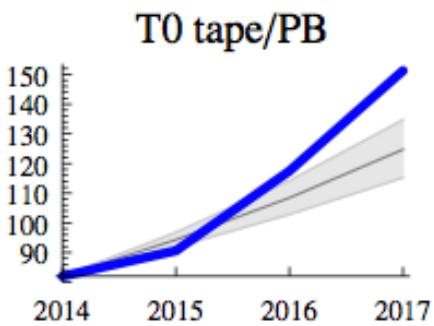


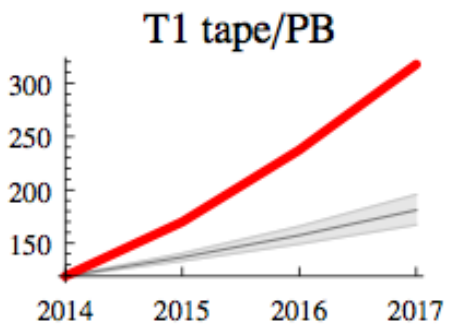


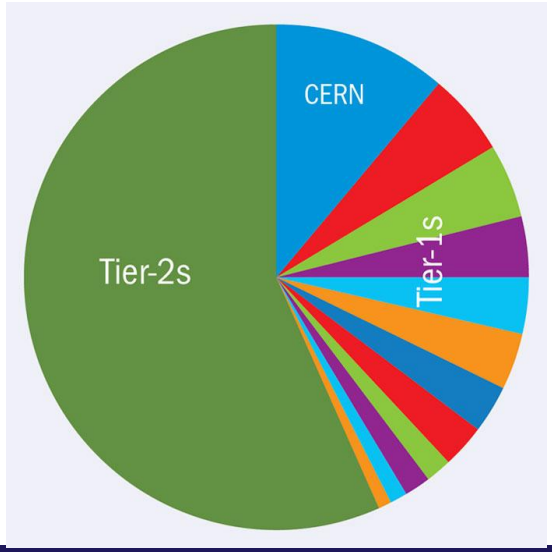












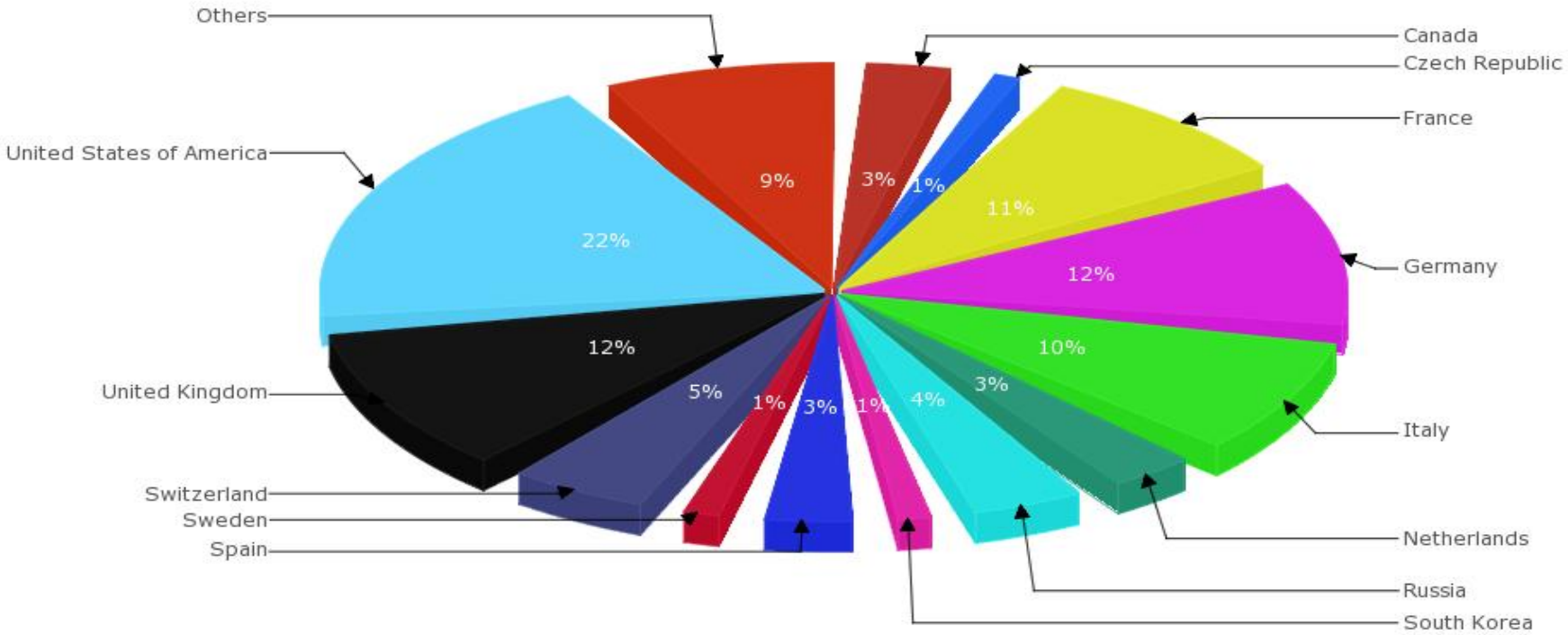
Starting from 2014 pledges

Country Normalized CPU time 2014-2015

CESGA 'EGI View' : / normcpu / 2014:10-2015:5 / COUNTRY-VO / lhc (x) / GRBAR-LIN / I

2015-

COUNTRY Normalised CPU time (kSI2K) per COUNTRY



All Country - 26,419,964,640 **Russia- 1,132,803,028**

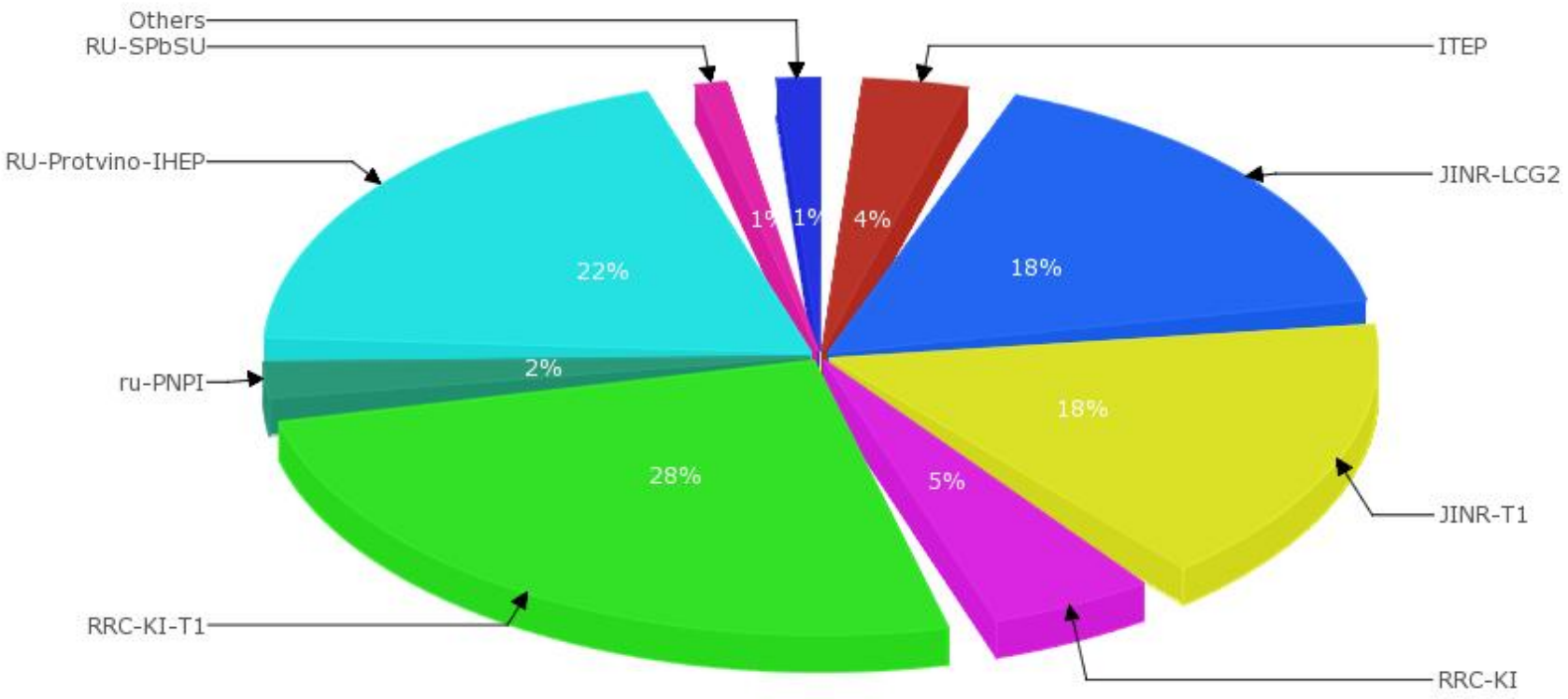
Job 904,233,970 **29,385,350**

RDIG Normalized CPU time (2015)

'EGI View': / normcpu / 2015:5-2015:6 / SITE-DATE / all (x) / GRBAR-LIN / I

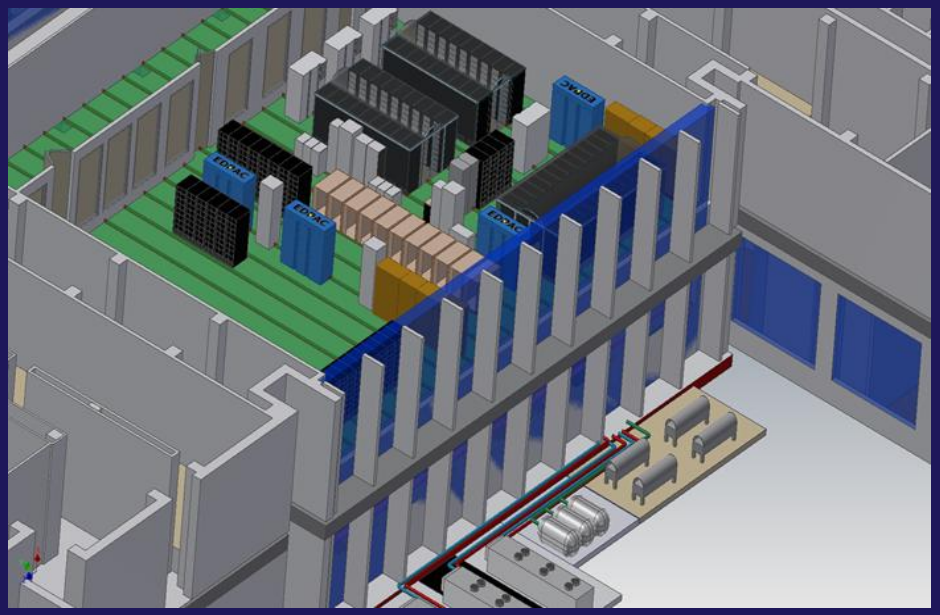
2015

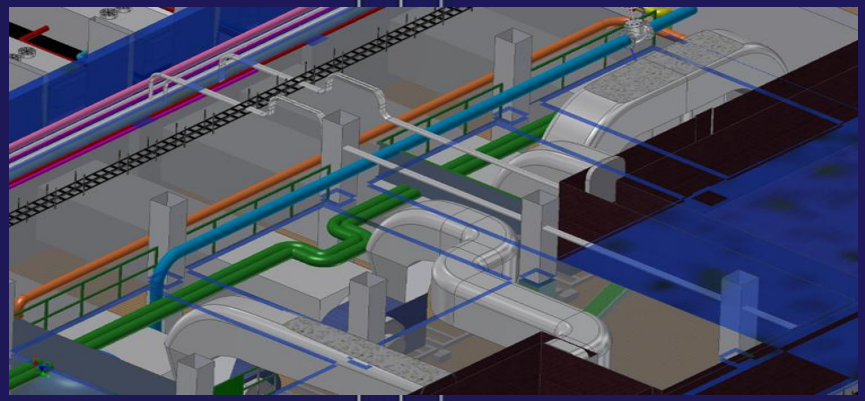
Russia Normalised CPU time (kSI2K) per SITE

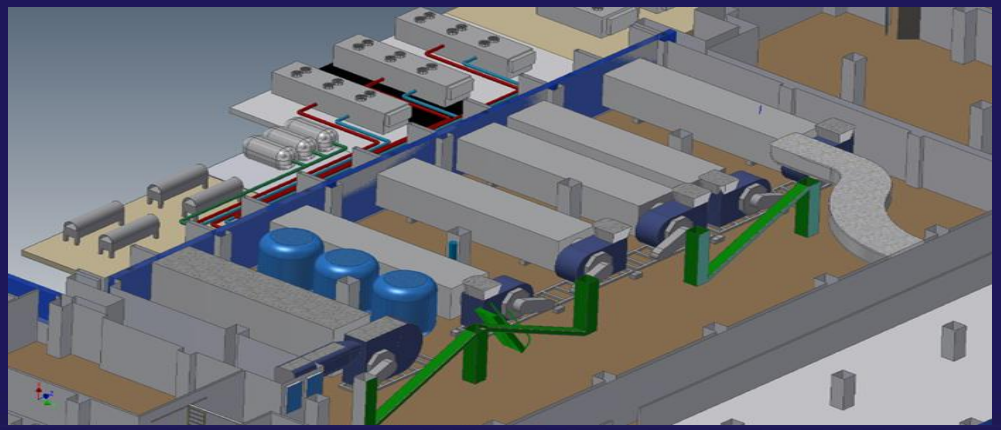


Creation of CMS Tier1 in JINR

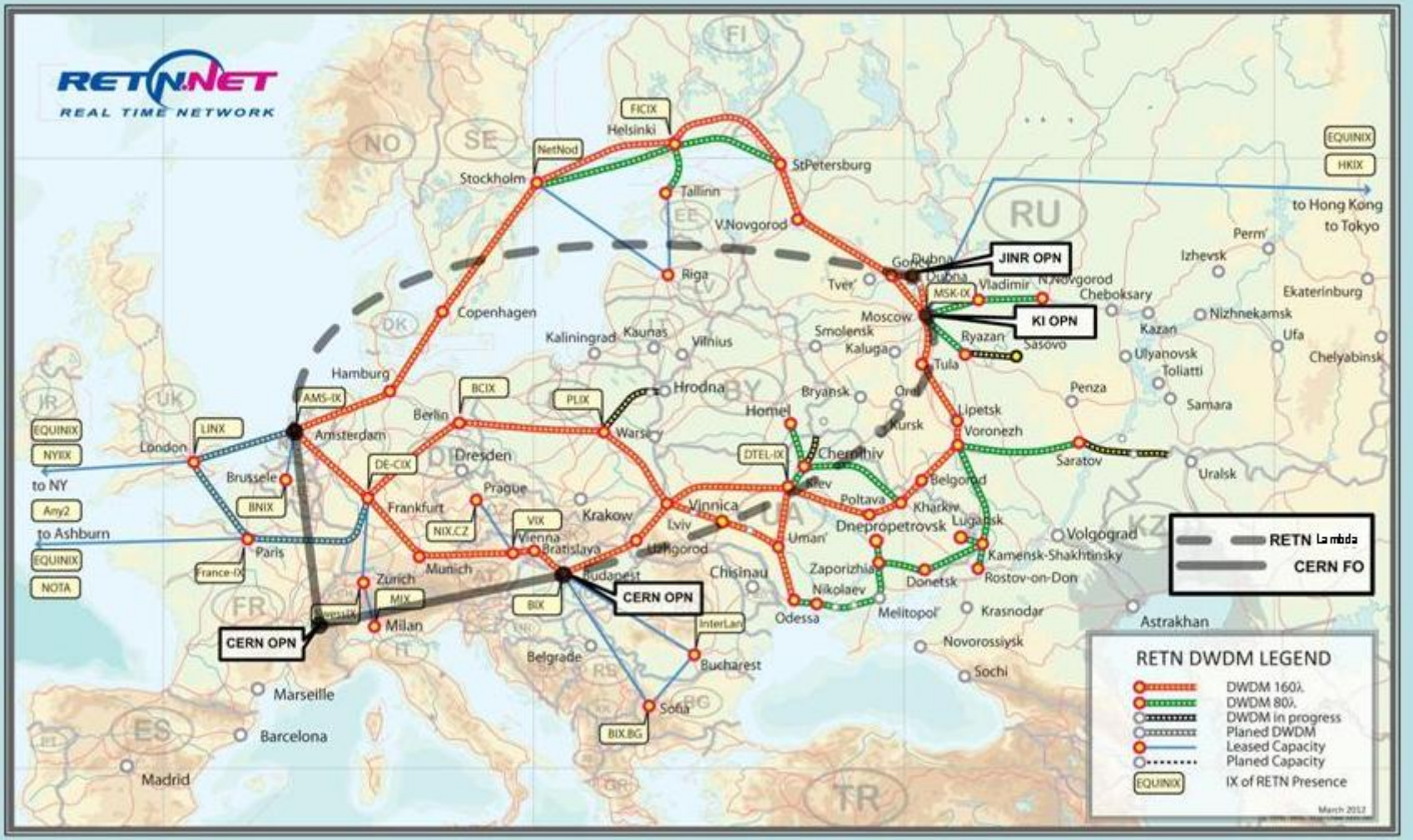
- Engineering infrastructure (a system of uninterrupted power supply, climate - control);
- High-speed reliable network infrastructure with a dedicated reserved data link to CERN (LHCOPN);
- Computing system and storage system on the basis of disk arrays and tape libraries of high capacity;
- 100% reliability and availability.







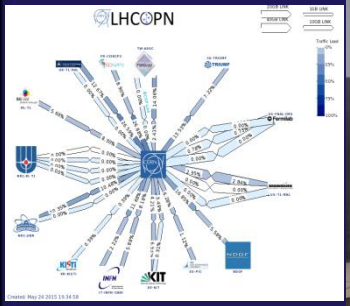
JINR Tier1 Connectivity Scheme

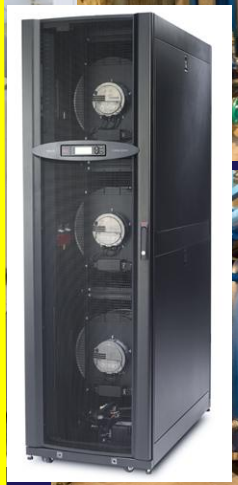


Tier-1 Components

March 2015

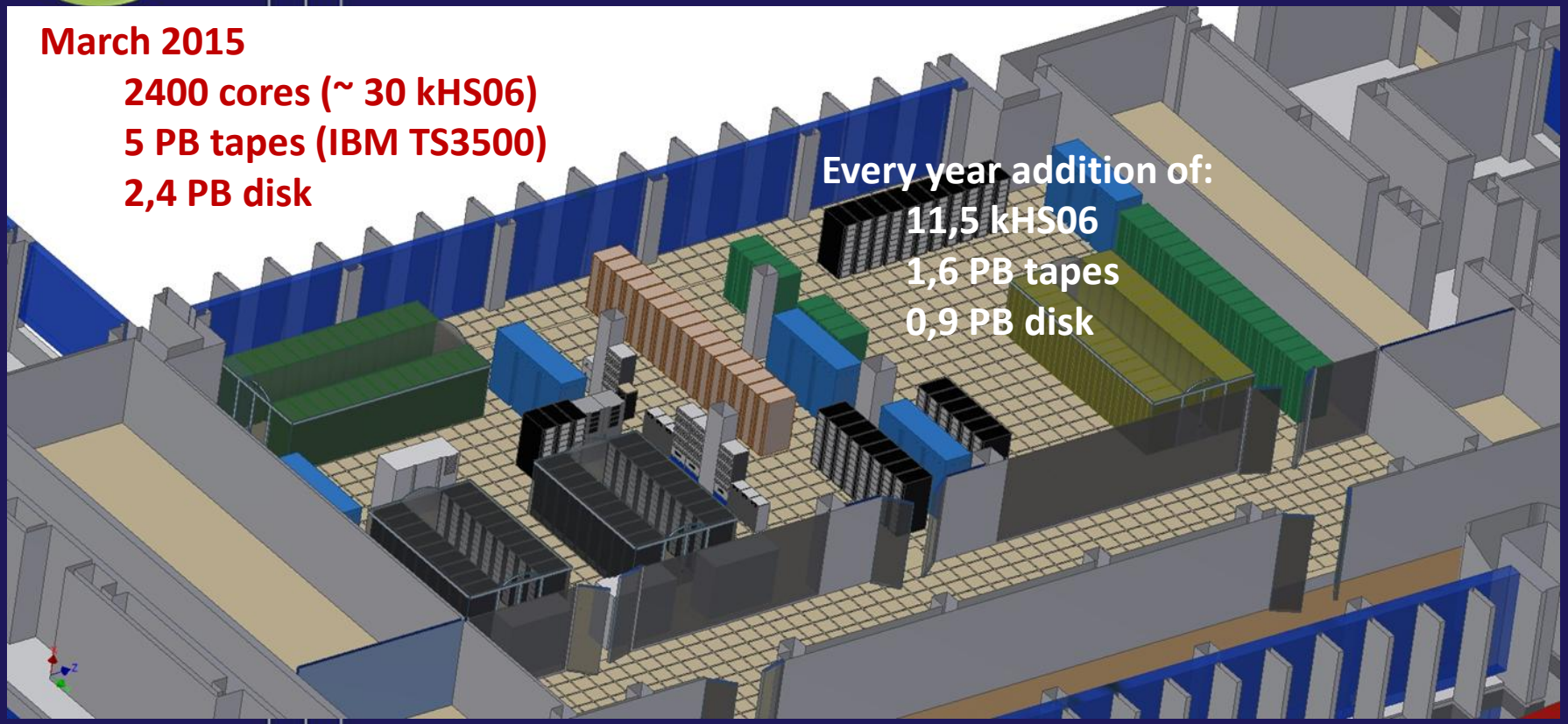
- LHCOPN
- 2400 cores (~ 30 kHS06)
- 5 PB tapes (IBM TS3500)
- 2,4 PB disk
- Close-coupled, chilled water cooling InRow
- Hot and cold air containment system
- MGE Galaxy 7000 – 2x300 kW energy efficient solutions 3Ph power protection with high adaptability





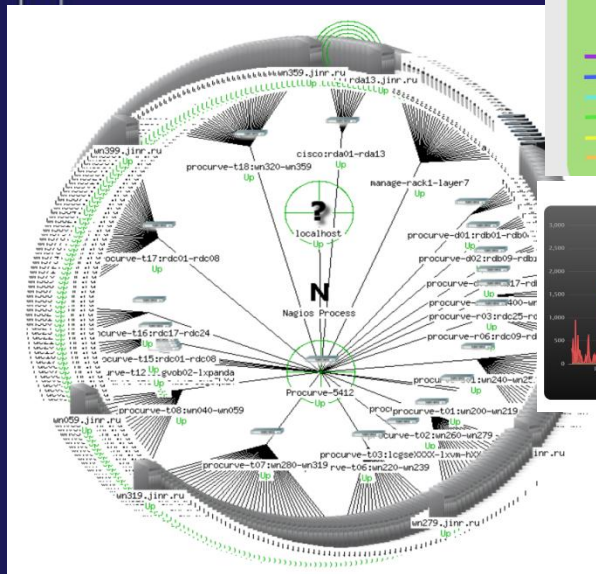
Inauguration of Tier1 CMS center in LIT JINR

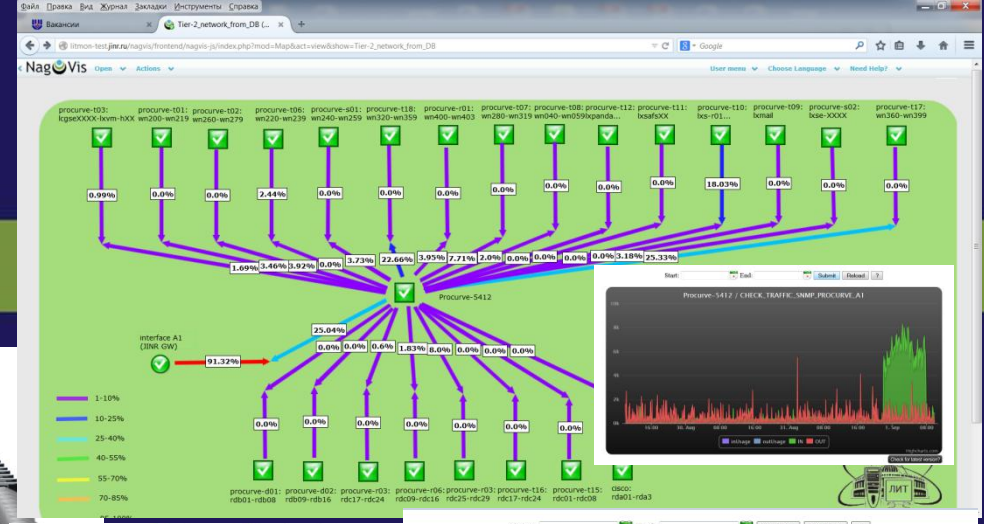
Tier-1 CMS Development

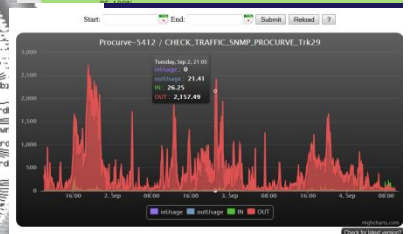


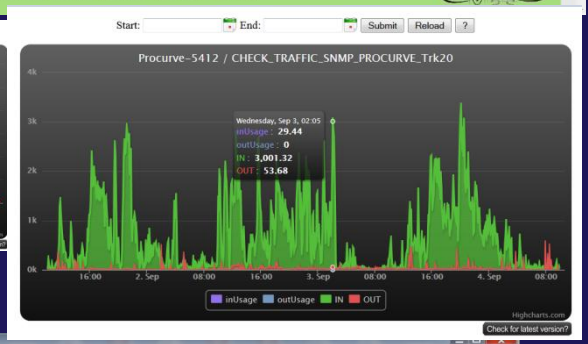
Monitoring

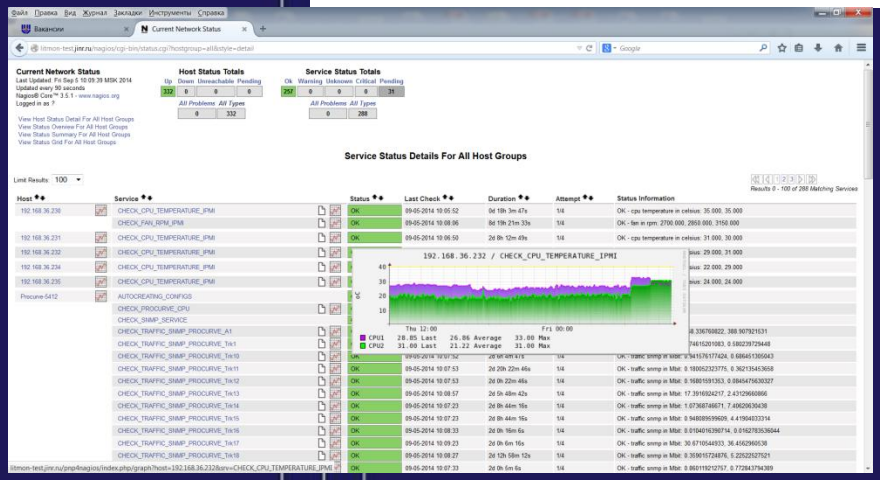
Network monitoring information system - more than 623 network nodes are in round-the-clock monitoring

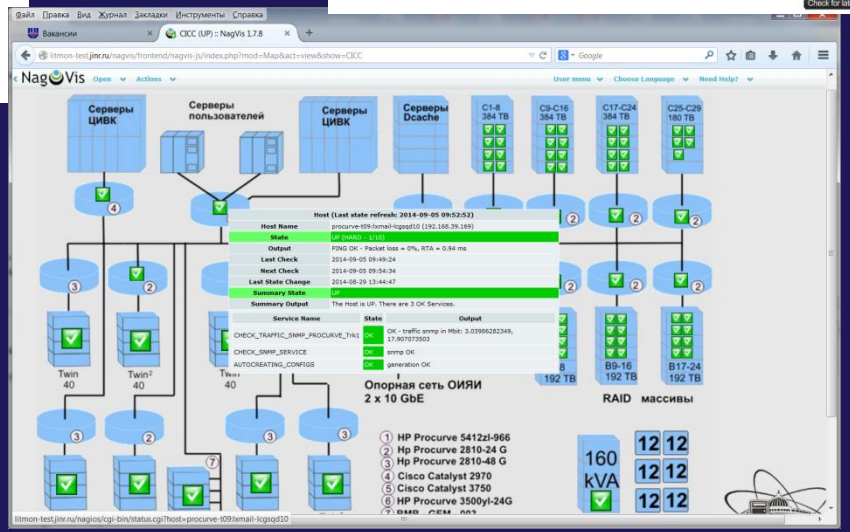












HybriLIT heterogeneous computing cluster: current state

❑ **Computing resources:**

CPU Intel Xeon E5-2695v2	**168** cores
GPU K40 & K20	**37248** cores
Intel Xeon Phi 7120P&5110P	**182** cores

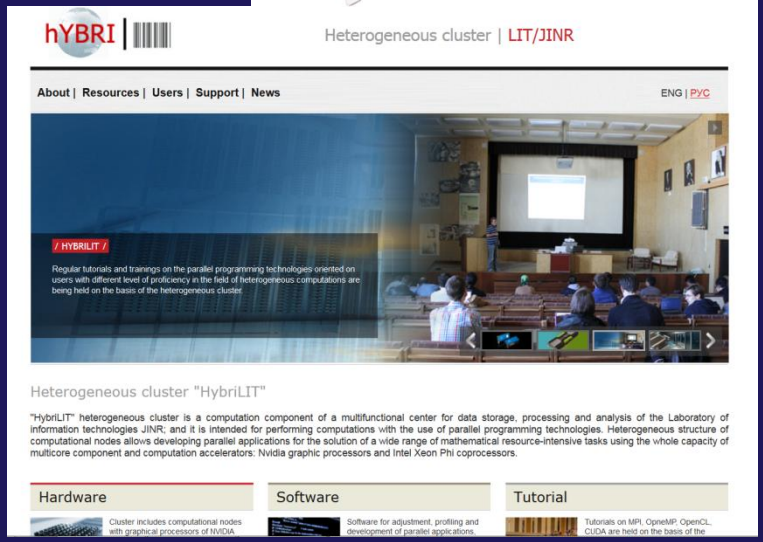
RAM **896** Gb
Disk storage **57** Tbyte
Ethernet
InfiniBand **40** Gb/s

❑ **Peak performance** for floating point computations

single precision **77** TFLOPS
double precision **29** TFLOPS

Power consumption: 7 kW

Operating system: Scientific Linux 6.5
File systems: EOS and NFS
Batch system: SLURM

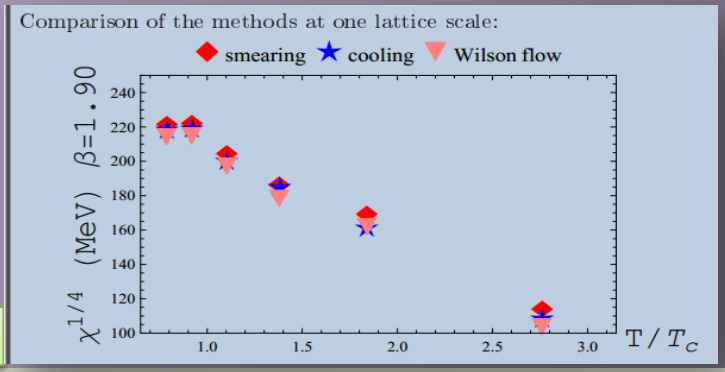


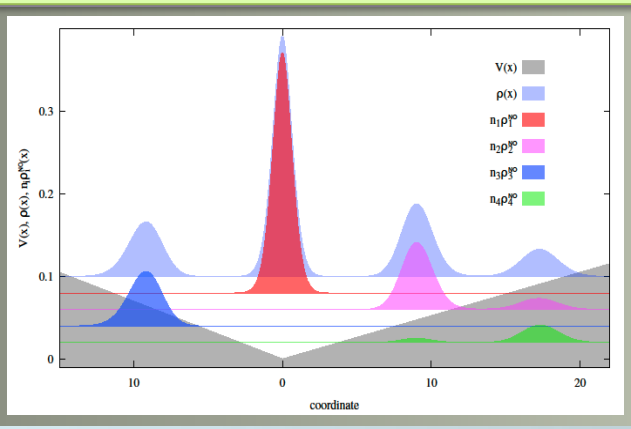
Parallel computing on HybriLIT

Parallel computing for QCD problems:

F. Burger(IP, HU, Berlin,),
M. Müller-Preussker (IP HU, Berlin, Germany),
E.-M. Ilgenfritz (BLTP& VBLHEP, JINR),
A. M. Trunin (BLTP JINR)

http://theor.jinr.ru/~diastp/summer14/program.html#posters





Parallel computing for investigation of Bose-systems:

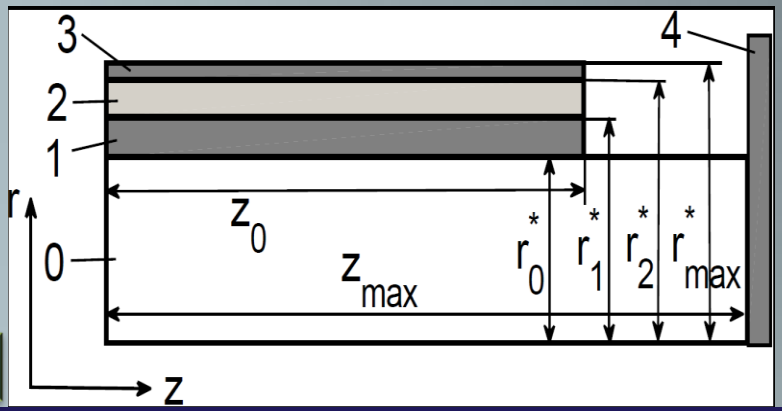
Alexej I. Streltsov ("Many-Body Theory of Bosons" group at CQD, Heidelberg University, Germany),
Oksana I. Streltsova (LIT JINR)

http://MCTDHB.org

Parallel computing for Technical problems:

A. Ayriyan (LIT JINR), J. Busa Jr. (TU of Kŏsice, Slovakia),
E.E. Donets (VBLHEP, JINR),
H. Grigorian (LIT JINR,;Yerevan State University, Armenia),
J. Pribis (LIT JINR; TU of Kŏsice, Slovakia)

arXiv:1408.5853



Training courses on HybriLIT

hYBRI

Parallel programming technologies on hybrid architectures

MPI OpenMP intel Xeon Phi Cluster Studio NVIDIA CUDA OpenCL

7 – 17 July, 2014
Participants
From Mongolia, Romania, Russia

27 August, 2014
Participants from CIS and Russian institutes and companies

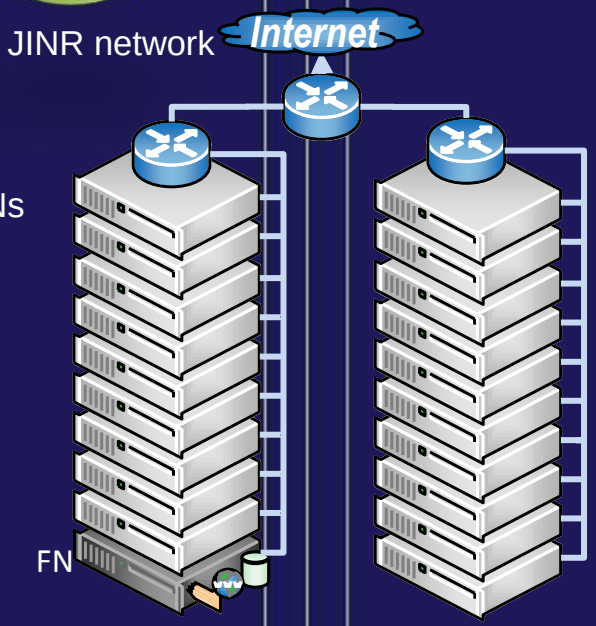
International Conference for Young Scientists
«MODERN PROBLEMS OF APPLIED MATHEMATICS & COMPUTER SCIENCE»

MPAMCS 2014 | August 25 - 29 2014, Dubna, Russia

1 and 5 September, 2014
Participants from India, Germany, Japan, Ireland, Austria, Ukraine, Russia

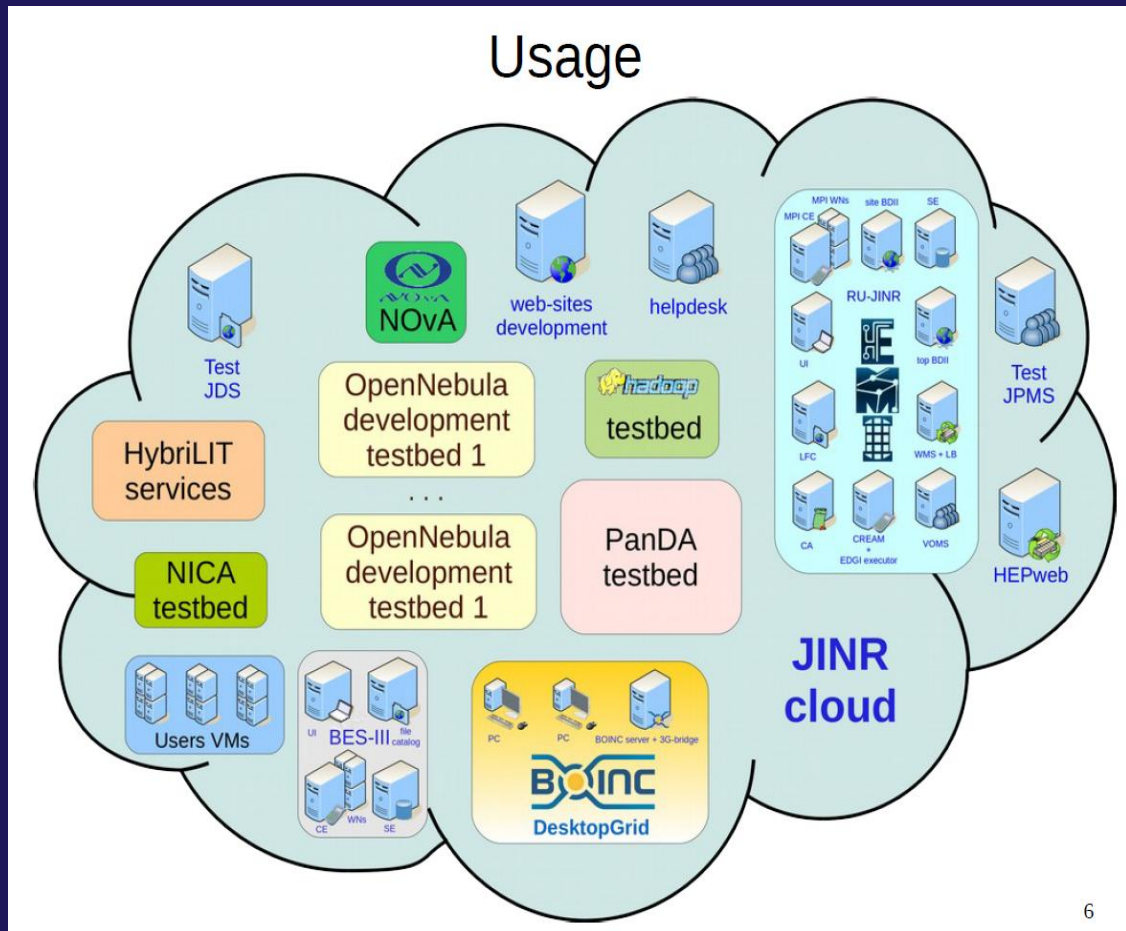
More **100** students and young scientists from Germany, India, Mongolia, Ukraine, Romania, Bulgaria, Moldova , Egypt…

JINR cloud service: current state



FN — front-end node,
CNs — cloud nodes

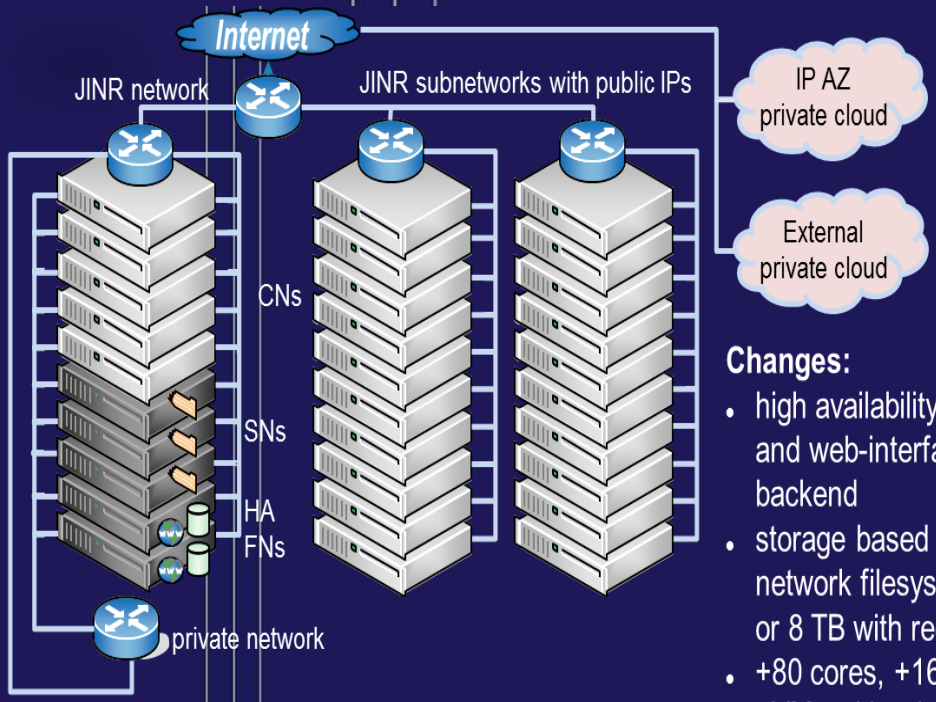
Cloud characteristics:
- Number of users: 74
- Number of running VMs: 81
- Number of cores: 122
- Occupied by VMs: 134
- Total RAM capacity: 252 GB
- RAM occupied by VMs: 170 GB



Cloud and heterogeneous cluster development

Advanced cloud infrastructures

- Dynamically reconfigurable computing services
- Large-scale open data repository and access services



HA FNs — highly-available front-end nodes
CNs — cloud nodes
SNs — storage nodes
IP AZ — Institute of physics (Azerbaijan)

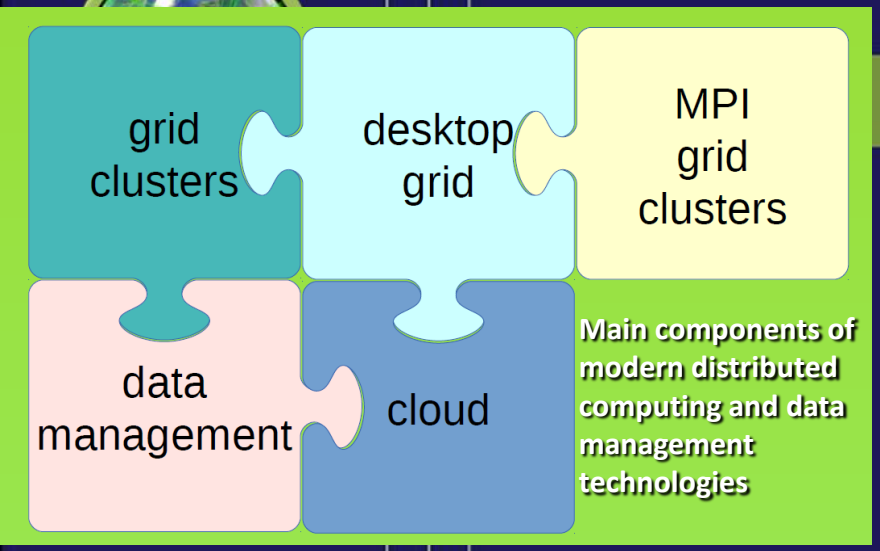
Advanced heterogeneous computing

- User friendly information-computing environment
- New methods and algorithms for parallel hybrid computations
- Infrastructure for tutorials on parallel programming techniques

Changes:

- high availability for cloud core and web-interfaces as well as DB backend
- storage based on distributed network filesystem (16 TB in total or 8 TB with redundancy=2)
- +80 cores, +160 GB of RAM
- +VMs with private IPs
- connected with external private clouds

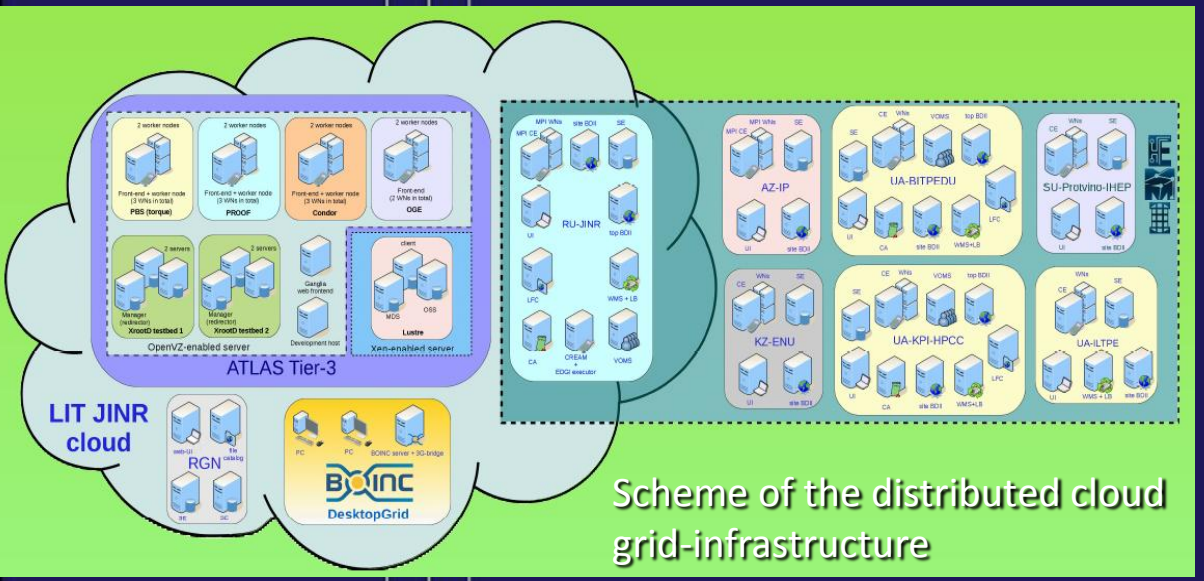
JINR distributed cloud grid-infrastructure for training and research



Main components of modern distributed computing and data management technologies

There is a demand in special infrastructure what could become a platform for training, research, development, tests and evaluation of modern technologies in distributed computing and data management.

Such infrastructure was set up at LIT integrating the JINR cloud and educational grid infrastructure of the sites located at the following organizations:



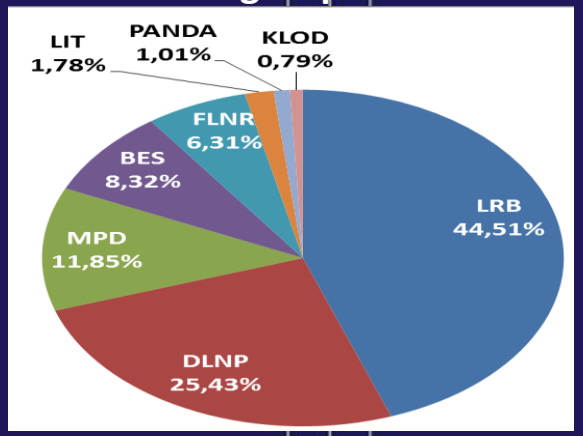
Scheme of the distributed cloud grid-infrastructure

- Institute of High-Energy Physics (Protvino, Moscow region),
- Bogolyubov Institute for Theoretical Physics (Kiev, Ukraine),
- National Technical University of Ukraine "Kyiv Polytechnic Institute" (Kiev, Ukraine),
- L.N. Gumilyov Eurasian National University (Astana, Kazakhstan),
- B.Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine (Kharkov,Ukraine),
- Institute of Physics of Azerbaijan National Academy of Sciences (Baku, Azerbaijan)

JINR Computing Centre for Data Storage, Processing and Analysis

General Purpose Computing Cluster Local users (no grid)

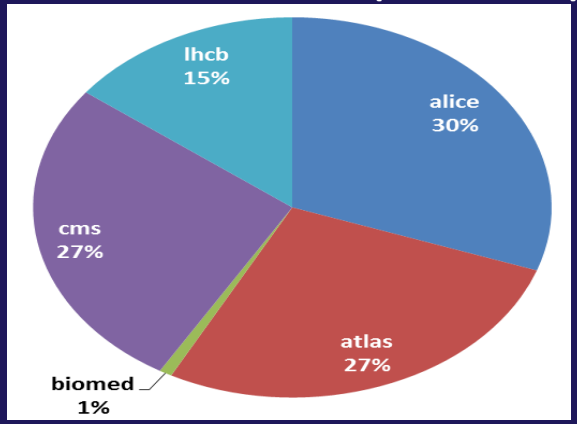
Sharing of the resources according to the processing time among the divisions of the Institute and user groups in 2015.



Grid-Infrastructure: JINR-LCG2 Tier2 Site JINR-CMS Tier1 Site

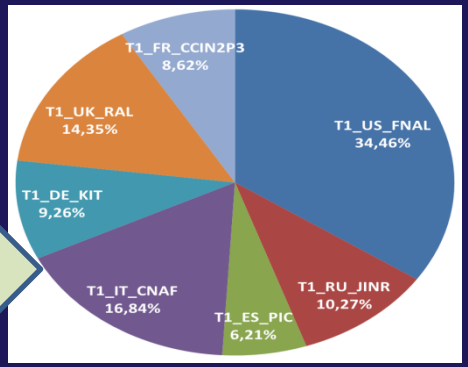
Usage summary of the JINR Tier2 grid-infrastructure by virtual organizations of RDIG/WLCG/EGI (2014-2015)

JINR Tier-2
~ 7 million jobs
~220 million HEPSPEC06-hours



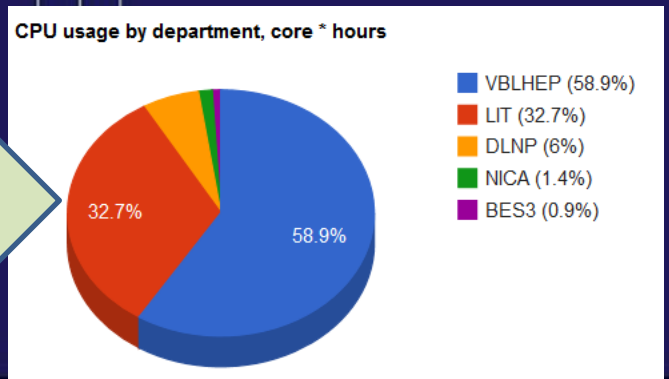
Usage of Tier1 centers by the CMS experiment (last month)

JINR Tier-1 CMS
617 413 jobs



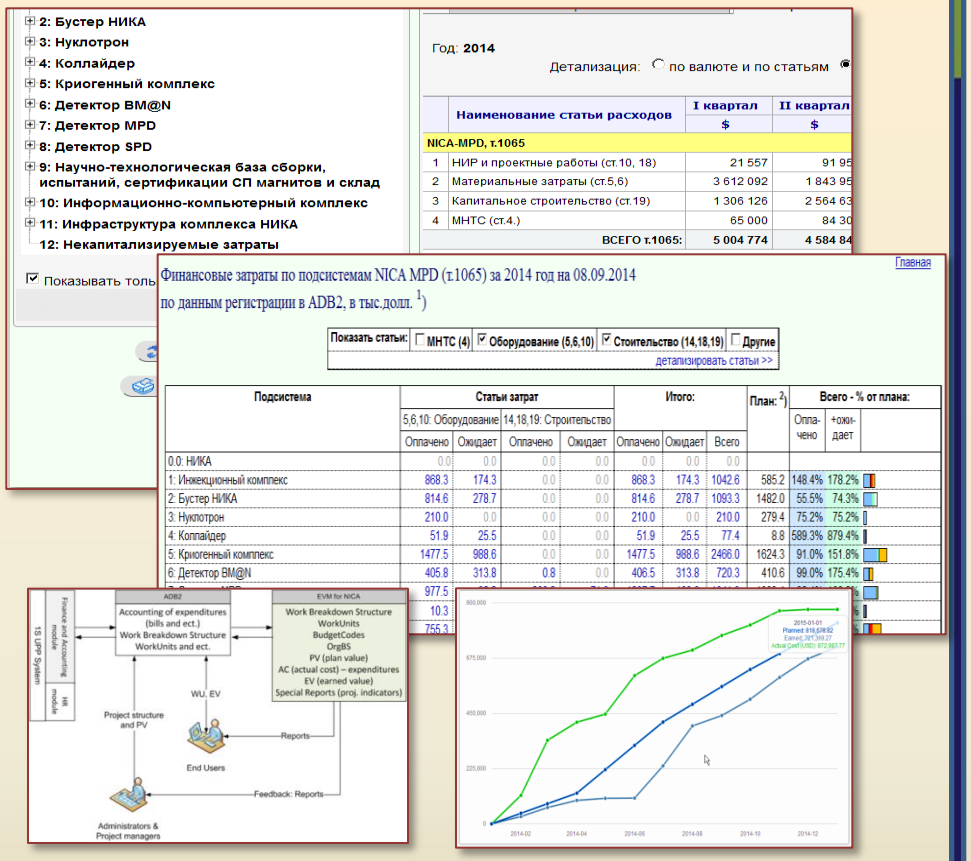
Cloud Infrastructure

Distribution of cloud resources among the Laboratories and JINR groups in 2015.



Computing for NICA

Development of management system for NICA project

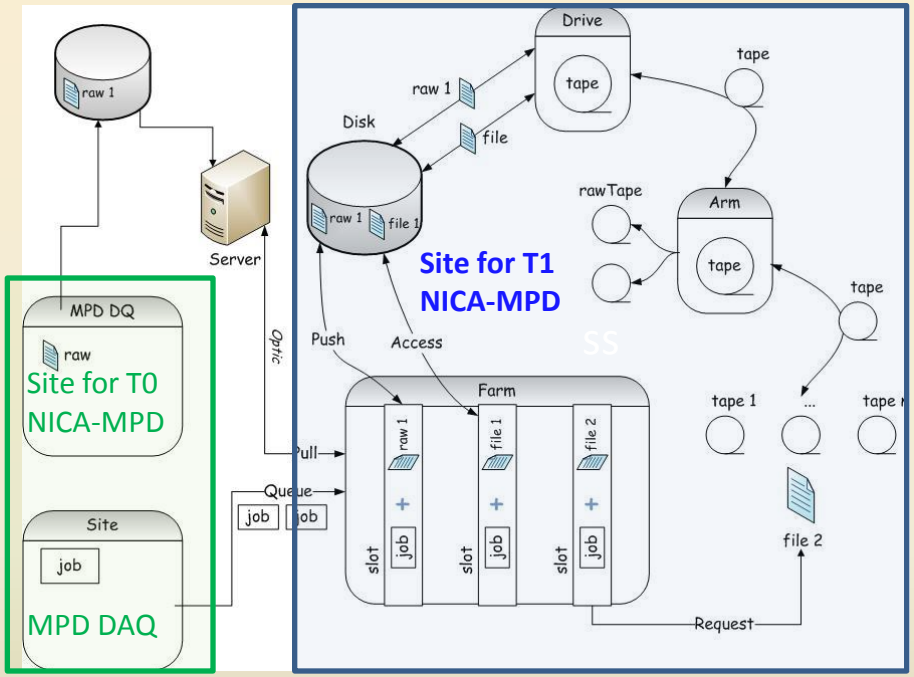


Current status:

- ❑Financial planning and cost control – in production;
- ❑Distributed collection of earned value data – in production;
- ❑Installation of CERN's EVM system at JINR and system integration – finished, in production;
- ❑Development of subsystem for versioning of plans – in progress.

Solution of tasks on processing, storage and security of petabyte data volume of experiments on NICA complex

Aim: get optimal configuration of processors, tape drives, and changers for data processing



Job & data flow scheme of T0-T1 NICA-MPD

Under study structure composition:

- ✓Tape robot,
- ✓Disk array,
- ✓CPU Cluster.

LIT JINR - China collaboration

LIT team is a key developer of the BES-III distributed computing system

A prototype of BES-III Grid has been built (9 sites including IHEP CAS and JINR). Main developments have been done at IHEP and JINR. The Grid is based on DIRAC interware.

Monitoring

- BES-III grid monitoring system is operational since February 2014.
- Implementation of the new monitoring system based on DIRAC RSS service are in progress

Job management

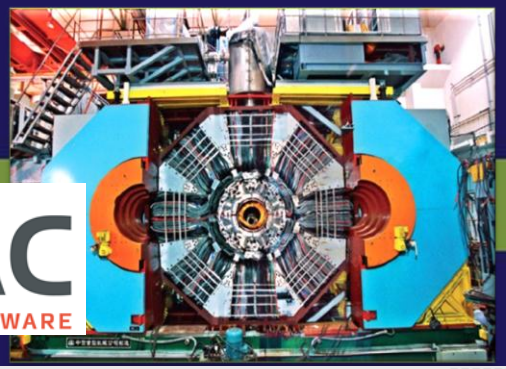
- Advising on the CE's installation and management
- BES-III jobs can be submitted on JINR cloud service now

Data management

- Installation package for Storage Element was adopted for BES-III Grid
- Solution on dCache-Lustre integration was provided for main data storage in IHEP
- Research on the alternative DB and data management service optimization is in progress

Infrastructure

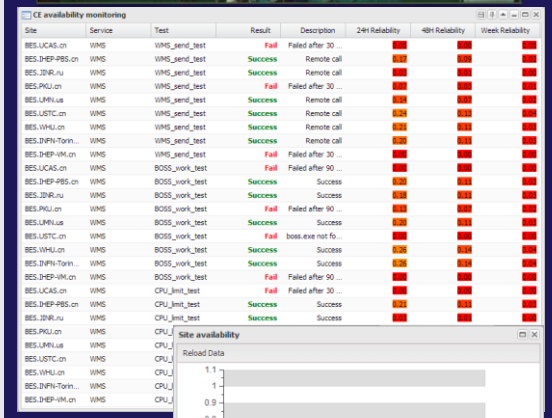
- Creation of the back-up DIRAC services for BES-III grid at JINR is in progress

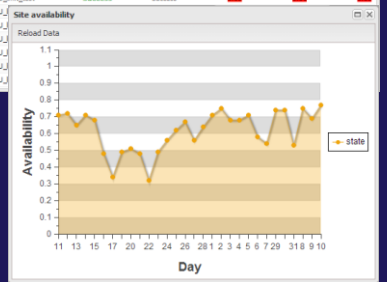


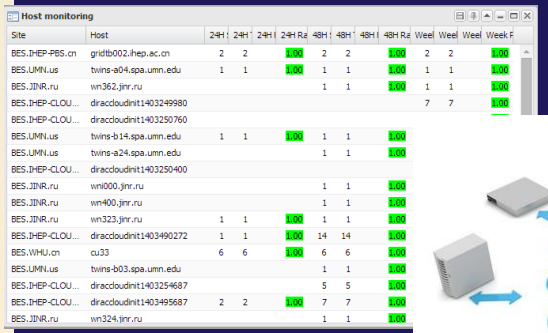
DIRAC
THE INTERWARE

SE latency monitoring

Source	Destination	Latency(sec)
IHEPD-USER	IHEPD-USER	2.678
IHEPD-USER	JINR-USER	16.316
IHEPD-USER	USTC-USER	15.932
IHEPD-USER	WHU-USER	6.728
JINR-USER	IHEPD-USER	14.322
JINR-USER	JINR-USER	14.24
JINR-USER	USTC-USER	14.827
JINR-USER	WHU-USER	8.516
USTC-USER	IHEPD-USER	3.677
USTC-USER	JINR-USER	17.855
USTC-USER	USTC-USER	2.746
USTC-USER	WHU-USER	624.375
WHU-USER	IHEPD-USER	5.727
WHU-USER	JINR-USER	20.227
WHU-USER	USTC-USER	9.199
WHU-USER	WHU-USER	3.092







Worldwide LHC Computing Grid (WLCG)

The primary goal of the WLCG project is to create a global infrastructure of regional centers for processing, storage and analysis of data of the LHC physical experiments.

The grid-technologies are a basis for constructing this infrastructure.

A protocol between CERN, Russia and JINR on participation in the LCG project was signed in 2003. MoU about participation in the WLCG project was signed in 2007.

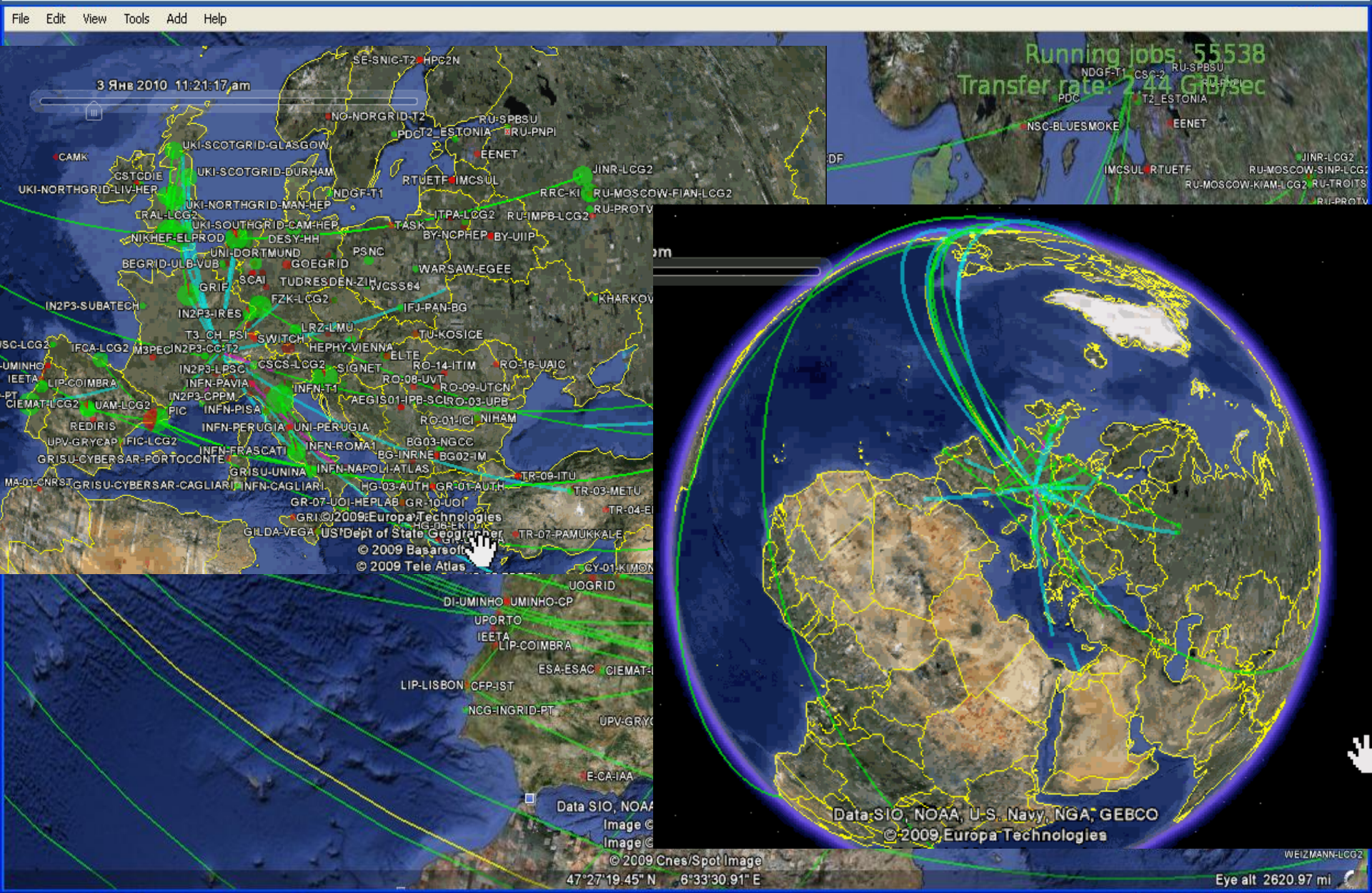
Tasks of the Russian centers and JINR within WLCG :

- Creation of a complex of tests for WLCG software
- Introduction of WLCG services for experiments
- Development of WLCG monitoring systems
- Development of simulation packages for experiments
- Creation of a Tier1 center in Russia

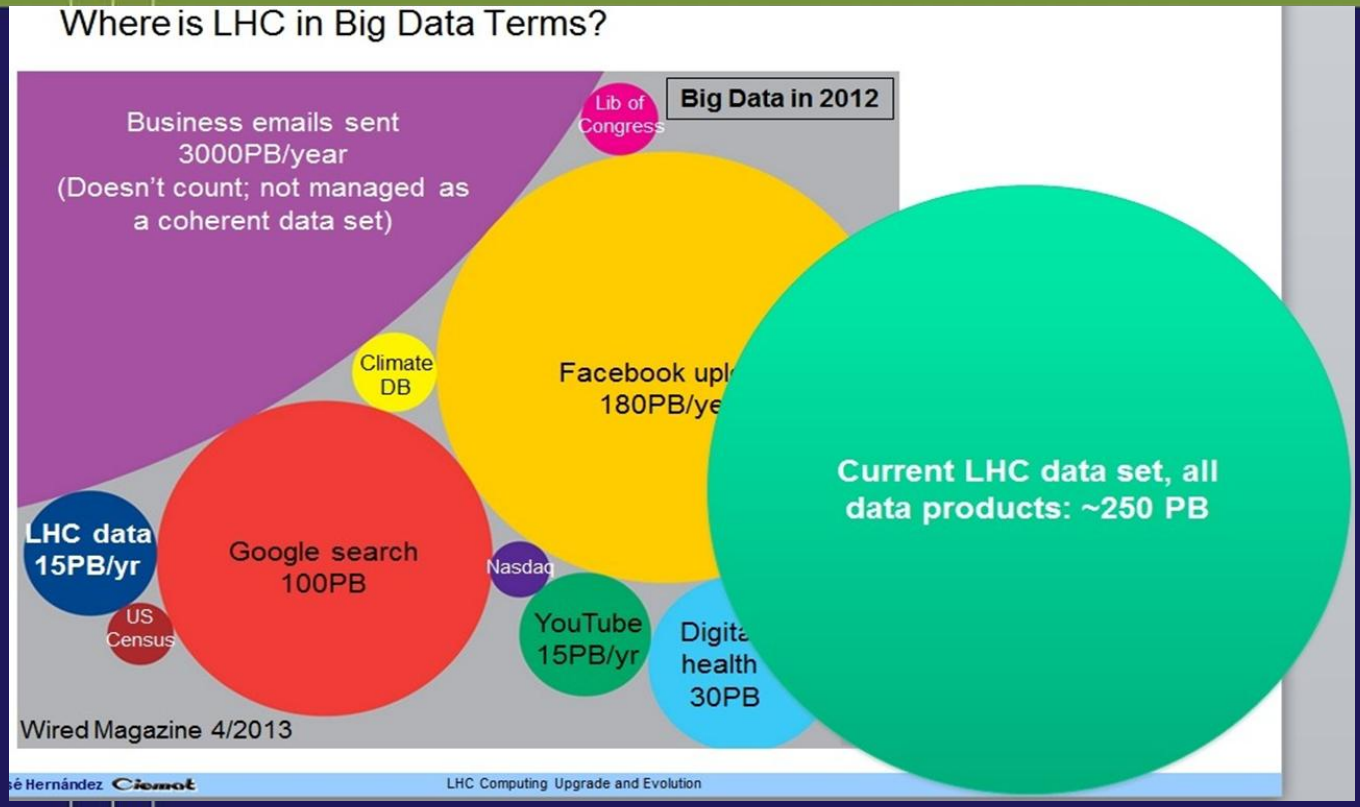
JINR activity at WLCG project

- Participation in development of software for ATLAS, ALICE, CMS
- Development WLCG Dashboard
- Global data transfer monitoring system for WLCG infrastructure
- NOSQL storage
- Integration GRID, Cloud, HPC
- Local and global Monitoring of Tier3 centers
- Development of DDM, AGIS for ATLAS
- GENSER & MCDB

WLCG Google Earth Dashboard

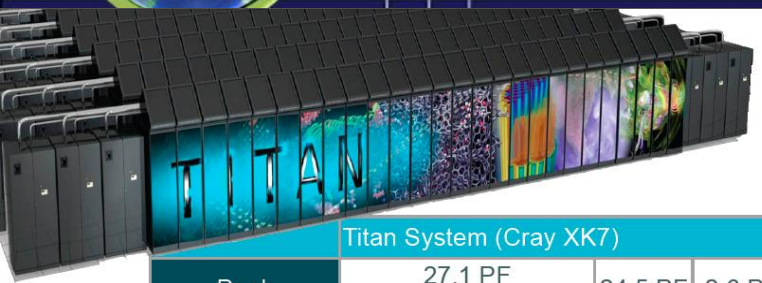


Entering into the era of Big Data

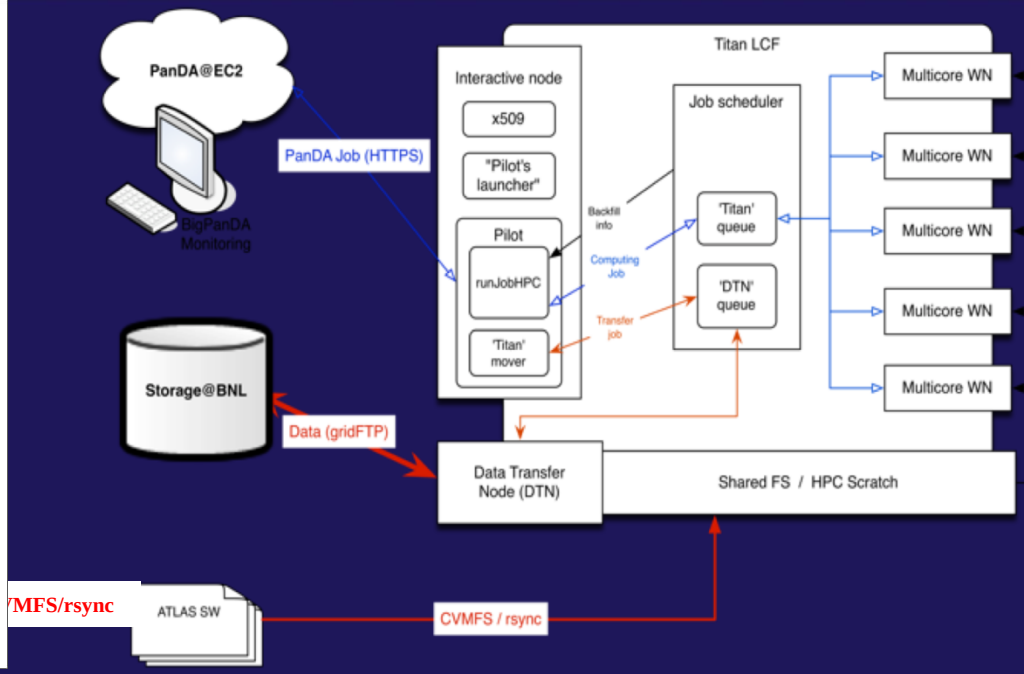


A comparative diagram of processed data evidently shows that the studies underway at CERN are performed under Big Data conditions.
After LHC modernization and start-up in 2015, the data stream will increase 2.5 times thus demanding increase in the resources and optimization of their use.

Evolving PanDA for Advanced Scientific Computing



	Titan System (Cray XK7)		
Peak Performance	27.1 PF 18,688 compute nodes	24.5 PF GPU	2.6 PF CPU
System memory	710 TB total memory		
Interconnect	Gemini High Speed Interconnect	3D Torus	
Storage	Lustre Filesystem	32 PB	
Archive	High-Performance Storage System (HPSS)	29 PB	
I/O Nodes	512 Service and I/O nodes		



ATLAS (BNL, UTA), OLCF, ALICE (CERN,LBNL,UTK), LIT JINR:

- adapt PanDA for OLCF (Titan)
- reuse existing PanDA components and workflow as much as possible.
- PanDA connection layer runs on front-end nodes in user space. There is a predefined host to communicate with CERN from OLCF, connections are initiated from the front-end nodes
- SAGA (a Simple API for Grid Applications) framework as a local batch interface.
- Pilot (payload submission) is running on HPC interactive node and communicating with local batch scheduler to manage jobs on Titan.
- Outputs are transferred to BNL T1 or to local storage

JINR AIS Complex

1C:Enterprise 8.3 ERP
Accounting, Management accounting ,
Budgeting, Human resources, Resource Planning

EVM (NICA)
Large project management

ADB2 adb2.jinr.ru
Financial reports on data imported from 1C and budgeting

ISS iss.jinr.ru
Various reports and information on financial and personnel data imported from 1C

Document Management System

baza.jinr.ru

JINR document database

Storage, coordination and delivery of documents on the main office work at JINR

pin.jinr.ru

PIN

General information on the JINR staff and results of their scientific activity

indico.jinr.ru

Indico

Manage complex conferences, workshops and meeting, storage of materials on procurement activities

The JINR corporative information system

- General Information platform 1C,
- APT EVM system (Activity Planning Tool Earned Value Management) for NICA and future projects management,
- JINR Document Server – electronic archive-repository of scientific publications and documents,
- JINR and JINR Member-states access to e-library,
- PIN – JINR staff personal information,
- JINR Events at Indico,
- JINR video portal,
- geographic information system (GIS) - a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data of the JINR infrastructure

Cognitive system

- Collaborative work support
- Advanced knowledge management tools

Main objective of the 7-year plan

Creation of a **unified information environment** integrating a number of various technological solutions, concepts, techniques, and software in order to offer **optimal approaches** for solving various types of **scientific and applied** tasks on a global level of the development of advanced information and computation technologies

Unified environment

- Grid
- Supercomputer (heterogeneous)
- Cloud
- Local computing cluster
- ….

Requirements:

- scalability
- interoperability
- adaptability to new technical solutions.
- operates 12 months a year in a 24x7 mode

CICC to MICC

Build up the Multifunctional Information and Computing Complex (MICC)

- fault-tolerant infrastructure with electrical power storage and distribution facilities with expected availability of 99.995%,
- supports and uses a large variety of architectures, platforms, operational systems, network protocols and software products
- provides means for organization of collective development
- supports solution of problems of various complexity and subject matter
- enables management and processing of data of very large volumes and structures (Big Data)
- provides means to organize scientific research processes
- enables training IT infrastructure users

Multifunctional Information&Computing Complex

- Engineering infrastructure
- Local network infrastructure and telecommu-nication data links
- Tier1 level grid automated system of data processing of the CMS experiment on the Large Hadron Collider (LHC) , including that as a prototype of the system of data storage and processing of the NICA experiments in a role of the center of Tier0 and Tier1 levels
- Tier-2 level grid-system to support LHC experiments (ATLAS, ALICE, CMS, LHCB), FAIR (PANDA) and other large-scale experiments and projects within the global grid-infrastructure
- High-performance computing system (including parallel computations) beyond the range of heterogeneous and grid systems
- Heterogeneous computer complex for high-efficiency calculations
- Cloud environment

Research and Development

- development of a distributed research environment ;
  - research in the field of integration of heterogeneous computing resources and data sources;
  - research on the questions of optimizing usage of the existing capacities, in particular supercomputers, for data processing in a distributed environment;
  - scientific studies in the field of integrating hybrid (HPC), cloud and grid technologies with the purpose of their optimal use;
  - research in the field of the local and global monitoring of distributed computing systems;
  - research and development of intellectual methods of new generation computing infrastructure management;
  - introduction and development of the methodology of a short-term/medium term/long-term forecast of the development of the multifunctional computer center;
- research in the field of intensive operations with massive data in distributed systems (Big Data), development of corresponding tools and methods of visualization, including 3D;
- development of new parallel applications, cross-platform and multi-algorithm software complexes in a heterogeneous computing environment that allows one to expand the spectrum of solvable computationally intensive fundamental scientific problems.

Methods, Algorithms and Software for Modeling Physical Systems, Mathematical Processing and Analysis of Experimental Data

New computing technologies need new mathematical support and adaptation of the earlier developed software to the functioning on heterogeneous architectures and creation of new applications on the basis up-to-date paralleling technologies

- software development and realization of mathematical support of experiments conducted on the JINR basic facilities and in the frameworks of international collaboration;
- development of numerical methods, algorithms and software packages for modelling complex physical systems:
  - interactions inside hot and dense nuclear matter,
  - physicochemical processes in materials exposed to heavy ions,
  - evolution of localized nanostructures in the open dissipative systems,
  - properties of atoms in magnetic optical traps,
  - electromagnetic response of nanoparticles and optical properties of nanomaterials,
  - evolution of quantum systems in external fields,
  - astrophysical studies;
- development of methods and algorithms of computer algebra for simulation and research of quantum computations and information processes;
- development of symbolic-numerical methods, algorithms and software packages for the analysis of low-dimensional compound quantum systems in molecular, atomic and nuclear physics.

Methods, Algorithms and Software for Modeling Physical Systems, Mathematical Processing and Analysis of Experimental Data

- Creation, validation, and maintenance of **software**, as part of the computational support provided to our partners.

Instances:

- **Software upgrade** for components of the improved **ATLAS** and **CMS** detectors, as part of JINR contribution.
- Modeling, algorithm and software for **CBM@FAIR**.
- Mathematical modeling of the hot and dense nuclear matter and spin physics phenomena within the flagman JINR **NICA/MPD** project.
- Contributions to the upgrade of the **Geant4 package**.
- Implementation of numerical programs to the **JINRLIB** package.
- Implementation of computer algebra programs to the specialized dedicated server.

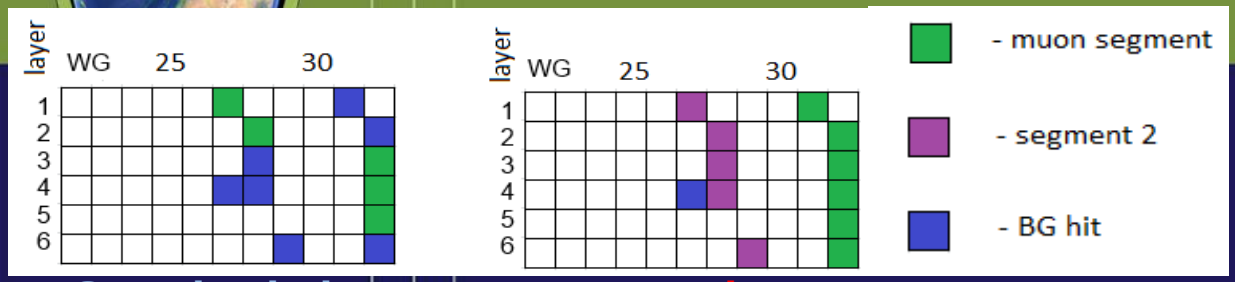
SOFTWARE

Parallel software will be the mainstream:

- development and support of the program libraries of general and special purpose;
- creation and support of program libraries and software complexes realized on the parallel programming technologies CUDA, OpenCL, MPI+CUDA, etc.;
- support and development of a specialized service-oriented environment for modeling experimental installations and processes and experimental data processing;
- tools and methods for software development:
  - flexible, platform-independent simulation tools
  - self-adaptive (data-driven) simulation development software

New Cathode Strip Chamber segment finding from Dubna

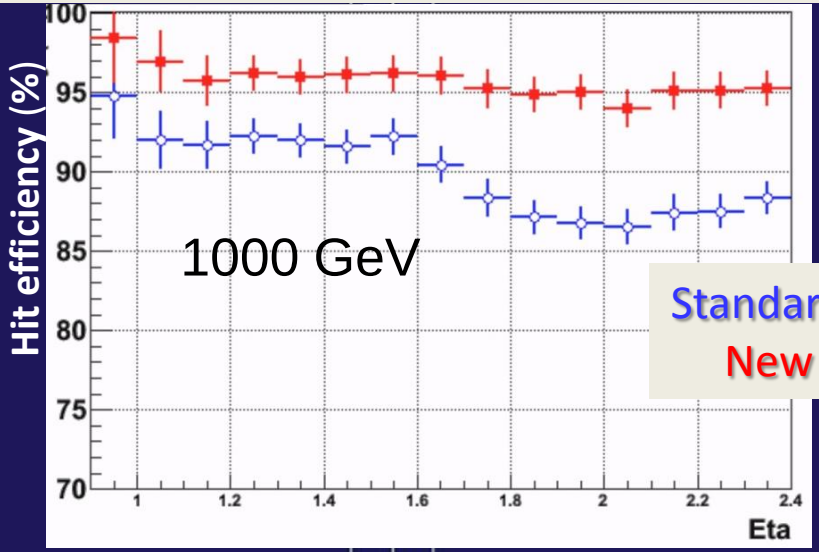
Vladimir Palichik and Nikolai Voytishin; LIT JINR



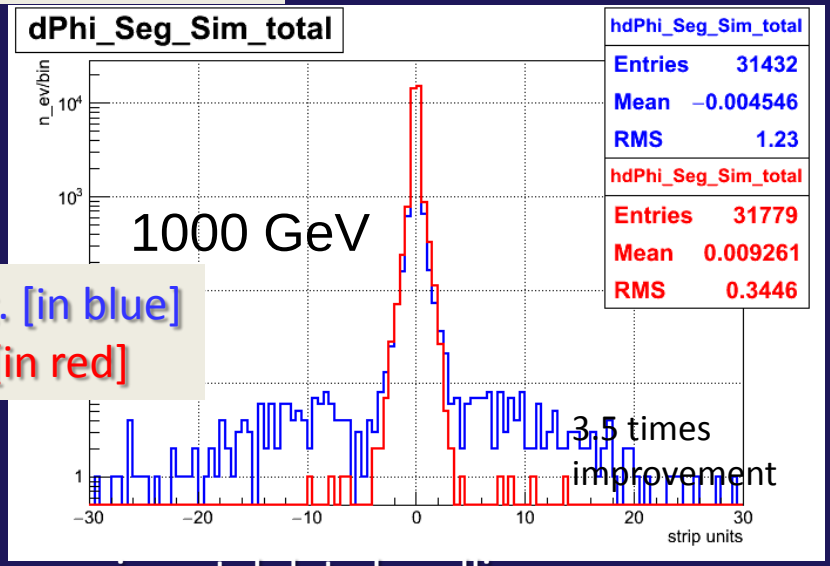
Standard alg. New alg.

- The IP is taken into account for non-bend plane view
- Base roads defined for bend-plane view using hits that are furthest apart in z
- Then add additional hits along road

Reported at CERN: 22.04.2015 and 11.05.2015;
the results were included into the CMS Spokesman's plenary talk at CMS week in May, 2015



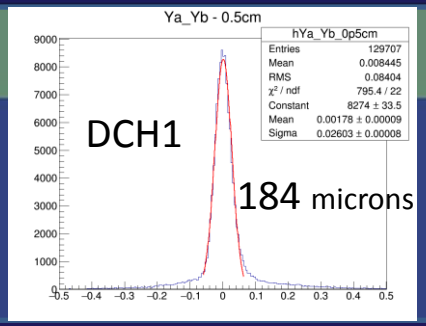
Standard alg. [in blue]
New alg. [in red]

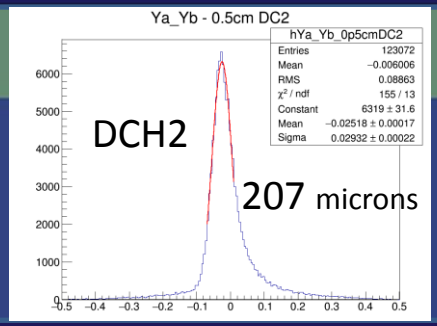


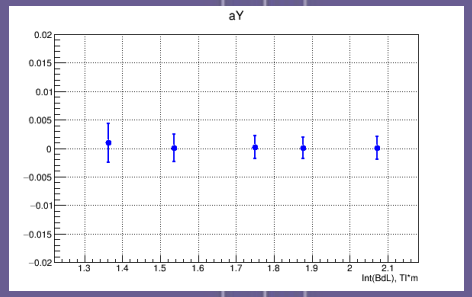
Plans: CMS/LHC and BM@N/Nuclotron experimental data handling: development and improvement of pattern recognition algorithms

Track Reconstruction in Drift Chambers (DCH) and Momentum Estimation in BM@N experiment (excerpts)

BM@N First Test Runs with Nuclotron beams [February-March 2015]***:***
Two DCHs have been used.
The best resolution was obtained for the Y-coordinate

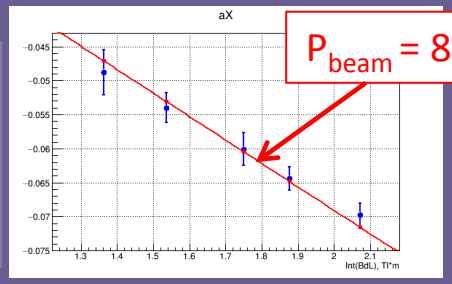




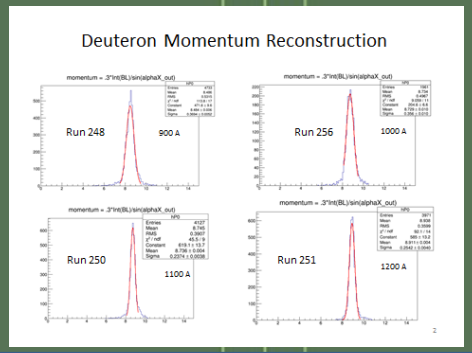


Y-slope is close to zero

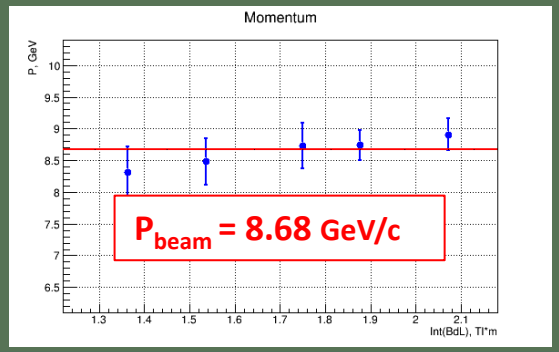
The DCHs have been aligned to the beam (track reconstruction with the both DCHs):



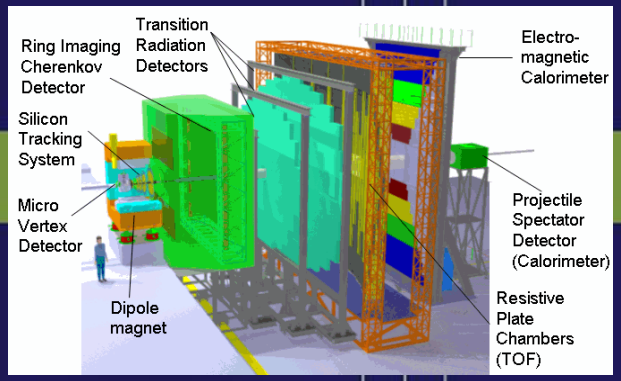
X-slope [extrapolated to magnetic field B=0] is close to zero



Estimation of deuteron beam momentum at different magnetic fields using X-slope

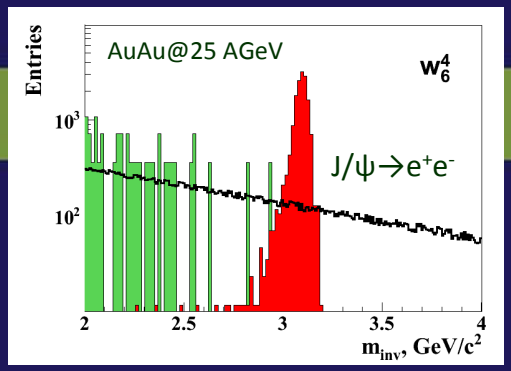


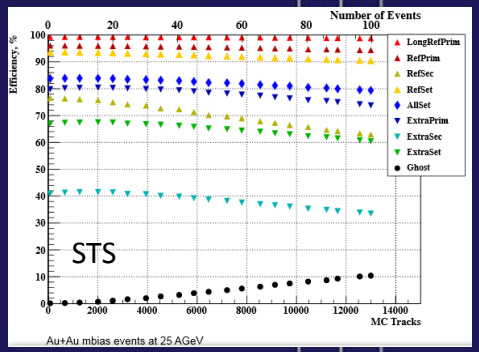
CBM@GSI – Methods, Algorithms & Software for Fast Event Reconstruction

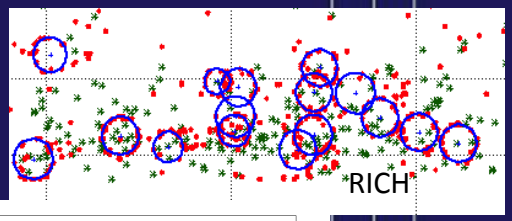


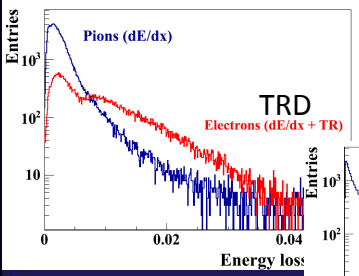
Tasks:

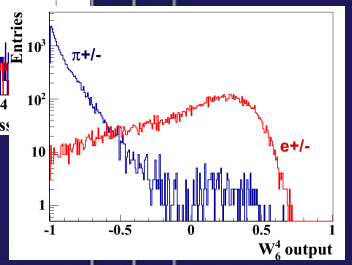
- global track reconstruction;
- event reconstruction in RICH;
- electron identification in TRD;
- clustering in MVD, STS and MUCH;
- participation in FLES (First Level Event Selection);
- development of the Concept of CBM Databases;
- magnetic field calculations;
- beam time data analysis of the RICH and TRD prototypes;
- contribution to the CBMROOT development;
- D0-, vector mesons, $J/\psi \to e^+e^-$ and $J/\psi \to \mu^+\mu^-$ reconstruction;











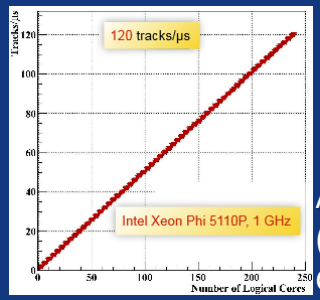
a: $S/Bg_{2\sigma}$, b: Efficiency (%), c: J/ψ per hour (10 Mhz)

	a	b	c
pC@30GeV	14	22	11
pAu@30GeV	18	22	27
AuAu@10AGeV	0.18	18	64
AuAu@25AGeV	7.5	13.5	5250

Modern parallelization involves multiplicative effects coming from:

1) Vectorization (SIMD - Single Instruction Multiple Data) **factor 2 to 4;**

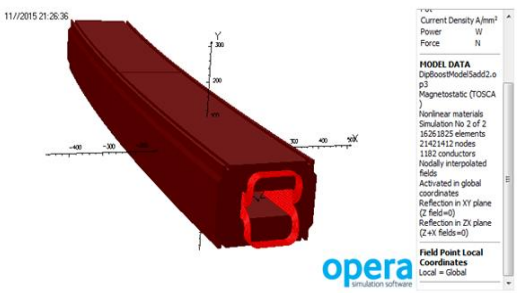
2) Multithreading – factor 4/3 ; 3) υ -Many core processor – factor υ. Total ≈ 4 υ



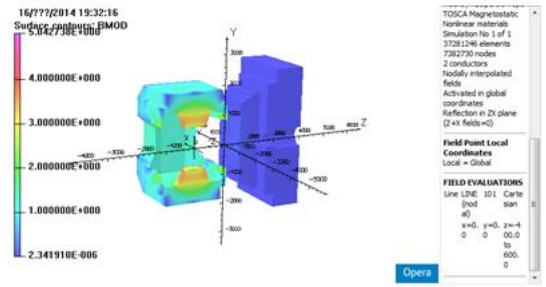
STS: CA	STS: Kalman Filter	RICH: ring reconstruct.	TRD: track reconstruct.	TRD: el. id. ω(k,n) criterion	KFPar - ticle
164.5	0.5	49.0	1390	0.5	2.5

Average time per core (μs/track or μs/ring) of SIMD-algorithms (besides track reconstruction in the TRD) for data processing. Global throughput increases linearly with the number of cores.

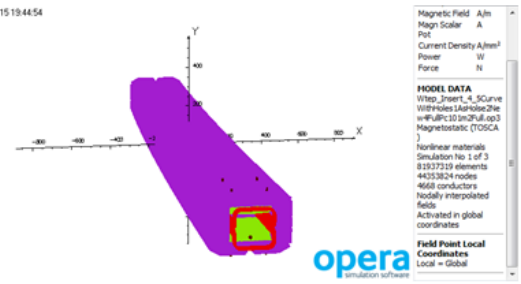
The 3D modeling of the magnetic systems



The booster dipole magnet (NICA)

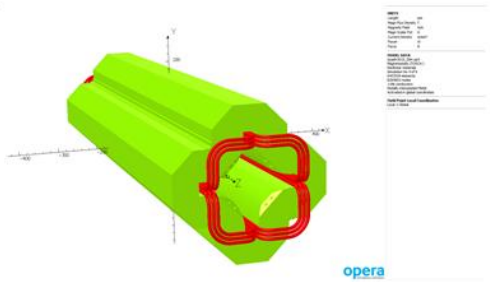


The magnetic system of the CBM experiment (FAIR)



The dipole magnet of SIS100 (FAIR)

The booster quadrupole magnet (NICA)



The quadrupole magnet of SIS100 (FAIR)

HepWeb Overview

http://hepweb.jinr.ru/

Provides: WEB access to computing resources of LIT for Monte Carlo simulations of hadron-hadron, hadron-nucleus, and nucleus-nucleus interactions, by means of most popular generators.
Realization: service - oriented architecture.

Goals:

- Monte Carlo simulations at the server
- Provide physicists with new calculation/simulation tools
- Mirror site of GENSER of the LHC Computing GRID project
- Provide physicists with informational and mathematical support
- Introduce young physicists into HEP world

Improvement of QGSp in Geant4

[Author of original code – N.S. Amelin (LIT, JINR)]
Developer – V.V. Uzhinsky (LIT, JINR)

RHIC

CERN

FAIR Facility for Antiproton and Ion Research in Europe GmbH

Superconducting accelerator complex NICA (Nuclotron based Ion Collider fAcility)

NICA

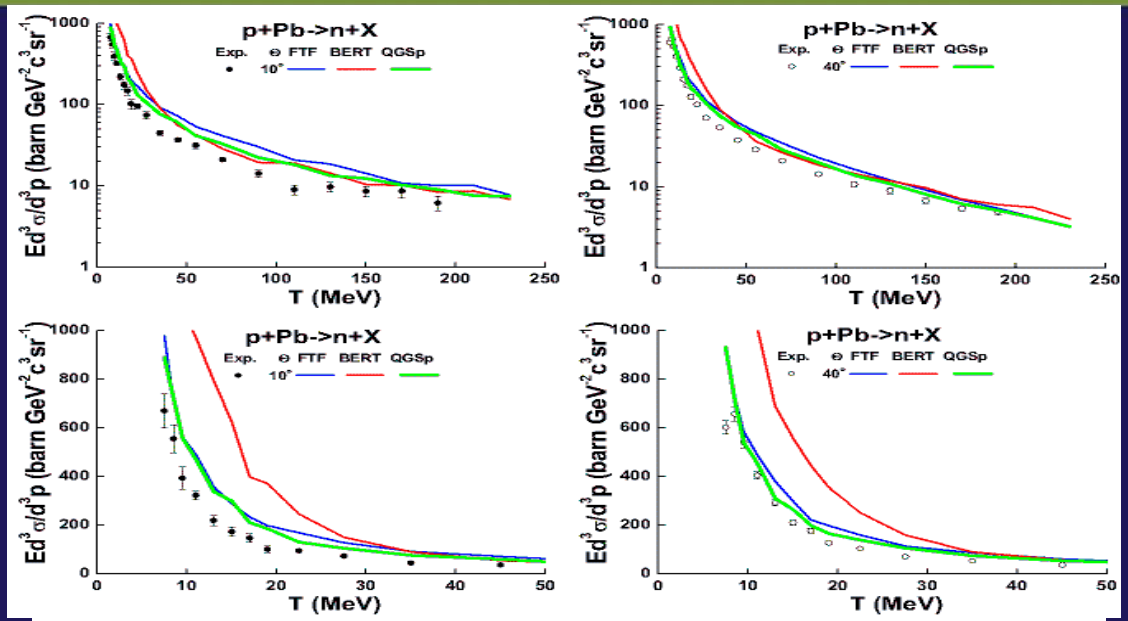
Geant 4

Physics List – QGSp_BERT used by ATLAS and CMS

Tasks solved (2015):

- Improvement of string fragmentation
- Improvements of processes cross sections
- Inclusion of the Reggeon cascading for correct description of nucleus breakups
- Improvement of parton momenta sampling

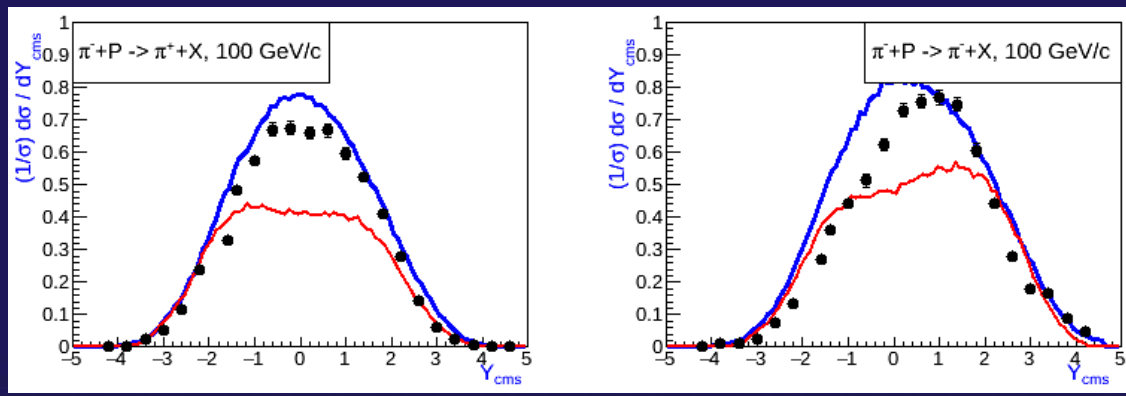
To do: fine tuning of the model parameters



Slow neutron production, ITEP experimental data (1983)

[It is expected this improves shower shape]

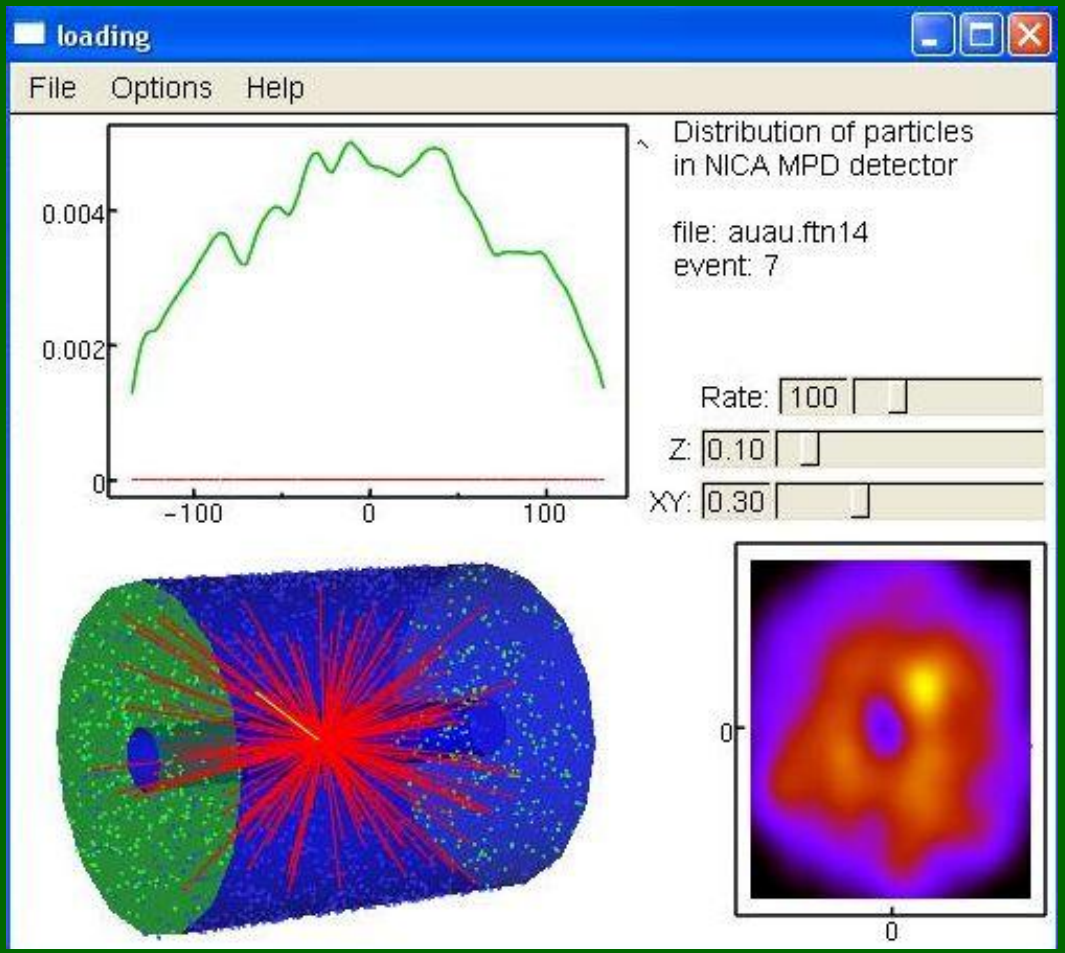
Improved QGSp will be available in G4.10.2.beta (end June 2015)
It is expected that new QGSp will improve calorimeter responses!



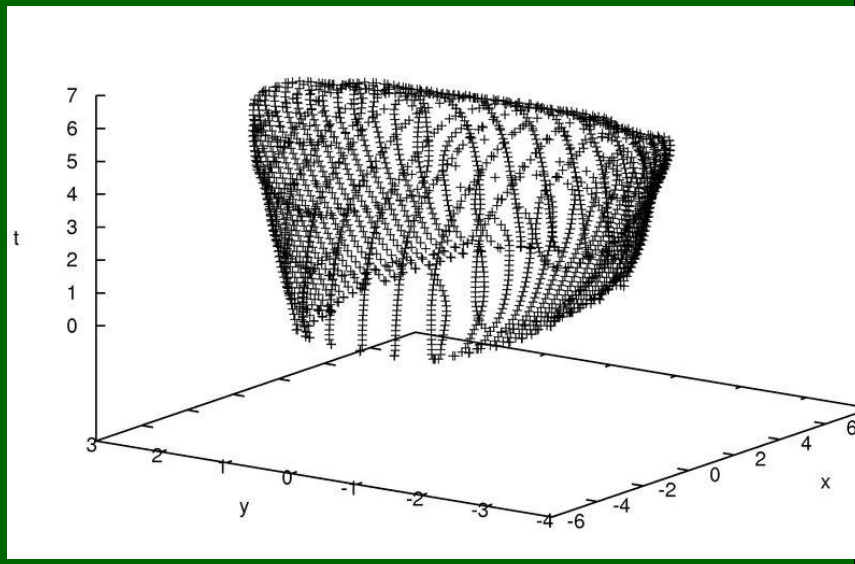
πP interactions at 100 GeV/c

Red lines – old QGSp Blue lines – new QGSp

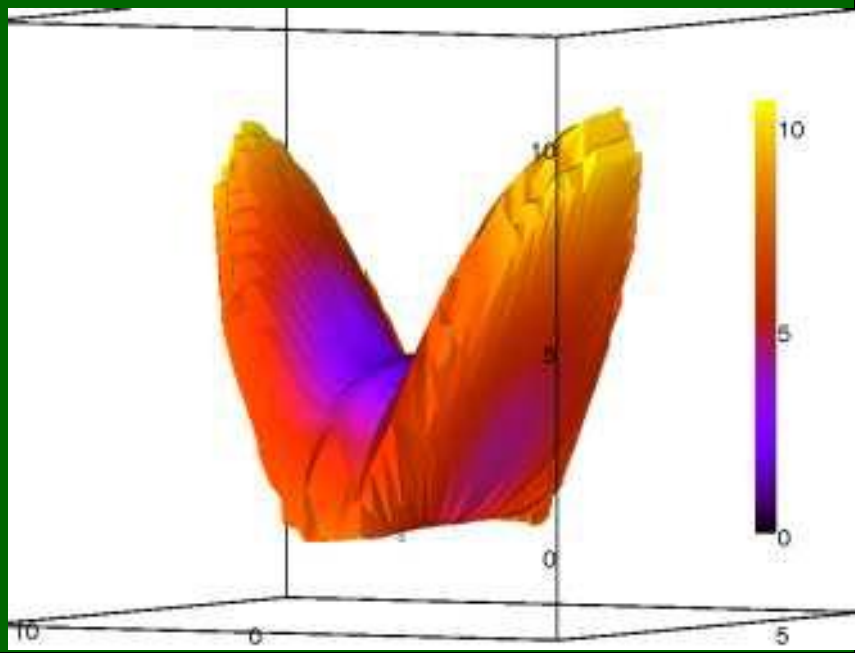
Track visualization in TPC of NICA/MPD
Au + Au at √s = 7 GeV



Visualization of freezeout surface
Au + Au at √s = 7 GeV



Au + Au at √s = 15 GeV



Visualization for Heavy Ion Collision Experiments

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Projects in framework Distributed computing

- Worldwide LHC Computing Grid (WLCG)
- EGI-InSPIRE
- RDIG Development
- Project BNL, ANL, UTA "Next Generation Workload Management System for BigData"
- Tier1 Center in Russia (NRC KI, LIT JINR)
- 6 Projects at CERN
- CERN-RFBR project "Global data transfer monitoring system for WLCG infrastructure"
- BMBF grant "Development of the grid-infrastructure and tools to provide joint investigations performed with participation of JINR and German research centers"
- "Development of grid segment for the LHC experiments" with South Africa;
- Development of grid segment at Cairo University and its integration to the JINR GridEdu JINR - FZU AS Czech Republic Project "The grid for the physics experiments"
- NASU-RFBR project "Development and implementation of cloud computing technologies on grid-sites at LIT JINR and BITP for ALICE experiment"
- JINR-Romania cooperation Hulubei-Meshcheryakov programme
- JINR-Moldova cooperation (MD-GRID, RENAM)
- JINR-Mongolia cooperation (Mongol-Grid)
- JINR-China cooperation (BES-III)
- Cooperation with Belarus, Slovakia, Poland, Bulgaria, Kazakhstan, Armenia, Georgia, Azerbaijan…

- On 28 September – 02 October, 2015, Montenegro (Budva), will host the regular JINR XXV Symposium on Nuclear Electronics and Computing - NEC'2015 and students' schools on advanced information technologies
- **http://NEC2015.jinr.ru**

Thank you for your attention!