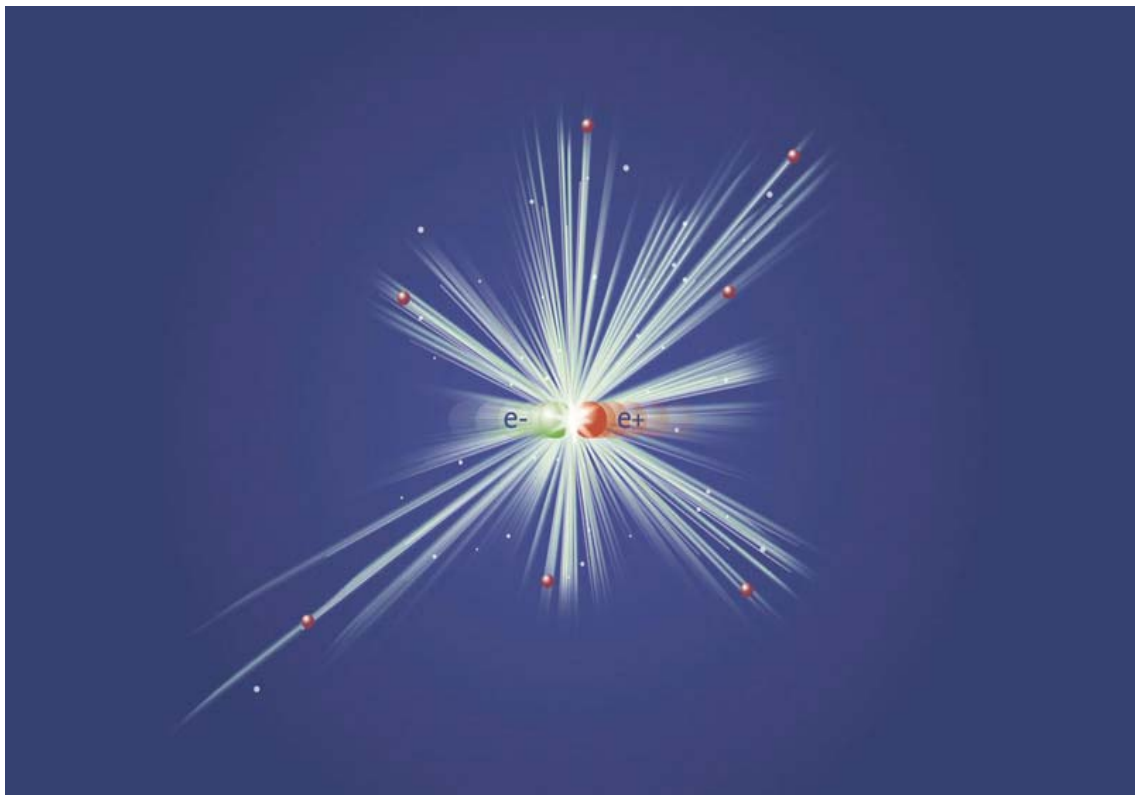
ILC activity at JINR and proposals of ILC siting in the Dubna region



G.Shirkov
JINR, Dubna

CERN, january,12, 2007

Международная межправительственная организация
International Intergovernmental Organization

Объединенный институт ядерных исследований
Joint Institute for Nuclear Research

Joint Institute for Nuclear Research: International Scientific Centre

BİRLƏŞMİŞ NÜVƏ TƏDQİQATLARI İNSTITUTU

ՄԻԱՁՈՒԿԱՅԻՆ ՅԻԶԻԿԱՅԻ ՄԻԱՑՅԱԼ ԻՆՍՏԻՏՈՒՏ

АБ'ЯДНАНЫ ІНСТЫТУТ ЯДЗЕРНЫХ ДАСЛЕДАВАННЯЎ

ОБИДЕНЕН ИНСТИТУТ ЗА ЯДРЕНИ ИЗСДЕДОВАНИЯ

VIỆN LIÊN HIỆP NGHIEN CỨU HẠT NHÀN

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БІРІККЕН ЯДРОЛЫҚ ЗЕРТТЕУ ИНСТИТУТЫ

현한힌지뼈연구소

INSTITUTO UNIFICADO DE INVESTIGACIONES NUCLEARES

INSTITUTUL UNIFICAT DE CERCETARI NUCLEARE

ЦӨМИЙН ШИНЖИЛГЭЭНИЙ НЭГДСЭН ИНСТИТУТ

ZJEDNOCZONY INSTYTUT BADAŃ JĄDROWYCH

ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ

INSTITUTUL UNIFICAT DE CERCETARI NUCLEARE

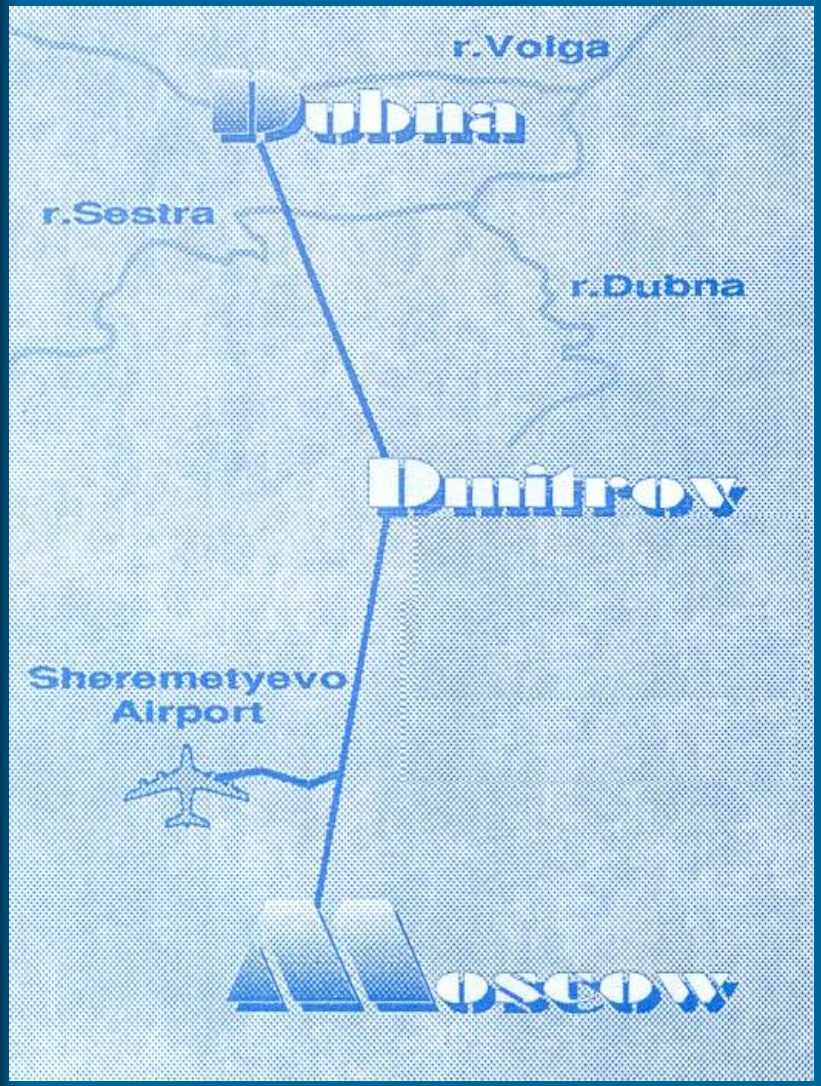
SPOJENÝ ÚSTAV JADROVÝCH VÝSKUMOV

ЯДРОВИЙ ТАДҚИҚОТЛАР БИРЛАШГАН ИНСТИТУТИ

ОБ'ЄДНАНИЙ ІНСТИТУТ ЯДЕРНИХ ДОСЛИДЖЕНЬ

SPOJENÝ ÚSTAV JADERNÝCH VÝZKUMŮ

JINR Dubna



Joint Institute for Nuclear Research (JINR) is an international intergovernmental organization located in Dubna, Russian Federation, about 120 km north of Moscow

Photo of Dubna from satellite (look from 250 km height)

JINR

Dubna


Albania


Bulgaria


China


Czechoslovakia

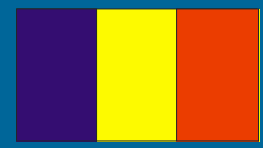

GDR


Hungary


DPRK


Mongolia


Poland


Romania


USSR

The agreement on the establishment of JINR was signed on 26 March 1956 in Moscow

JINR Dubna

JINR Member States


Armenia


Azerbaijan


Belarus


Bulgaria


Cuba


Czech Republic


Georgia


Kazakhstan


Democratic People's Republic of Korea


Moldova


Mongolia


Poland


Romania


Russia


Slovak Republic


Ukraine


Uzbekistan


Vietnam

JINR Dubna

Basic Documents

26.03.1956:	Foundation of JINR
23.09.1956:	Adoption of the JINR Charter
1.02.1957:	JINR was registered by UN
23.06.1992:	Renewed Charter signed
24.09.1997:	UNESCO – JINR Agreement
2.01.2000:	The Federal Law on the Russian Government – JINR Agreement

JINR Dubna

JINR – Russia Agreement

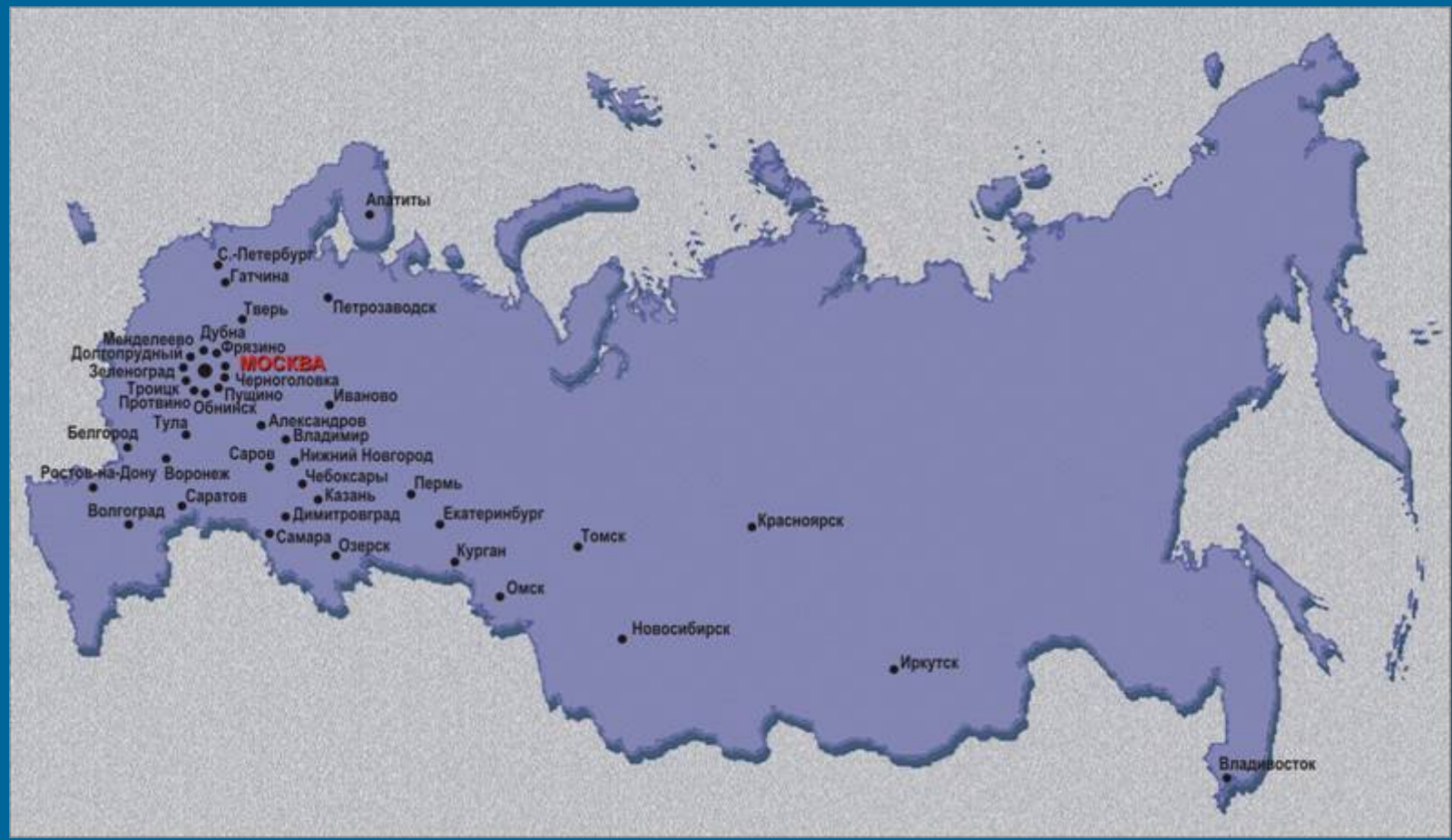
Российская газета

ЧЕТВЕРГ,
6 ЯНВАРЯ
2000 ГОДА
№ 4 (2368)

WWW.RG.RU

JINR Dubna

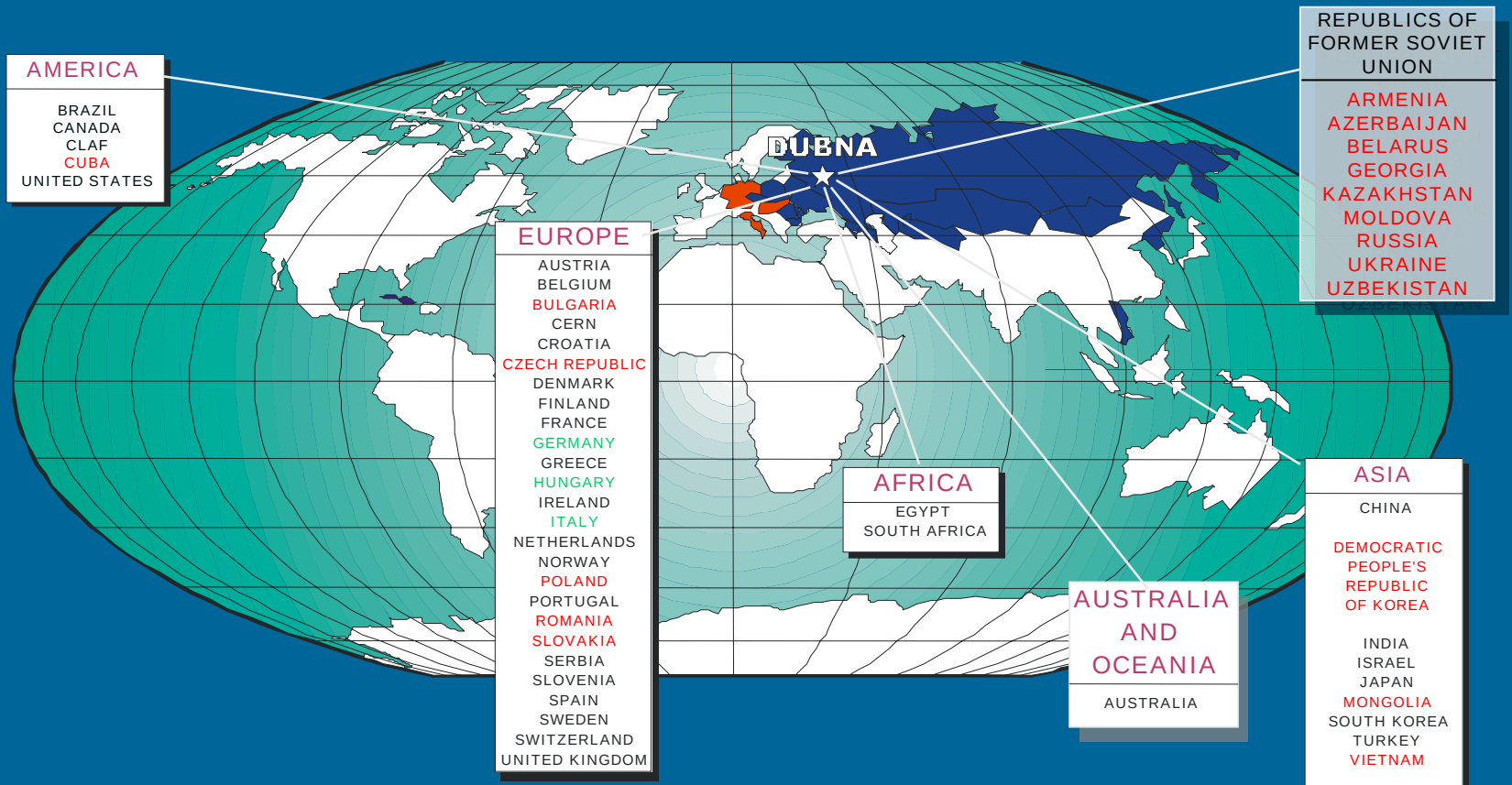
Cooperation with Russia



JINR's partners are 150 institutions located in 40 cities of Russia

JINR Dubna

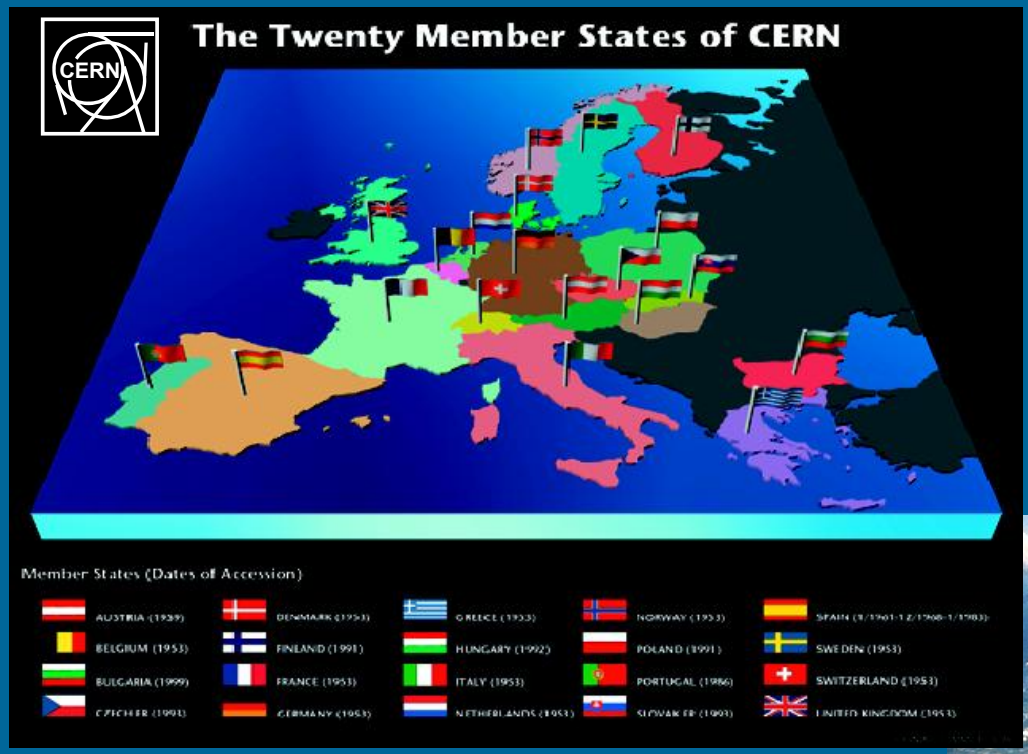
International Cooperation

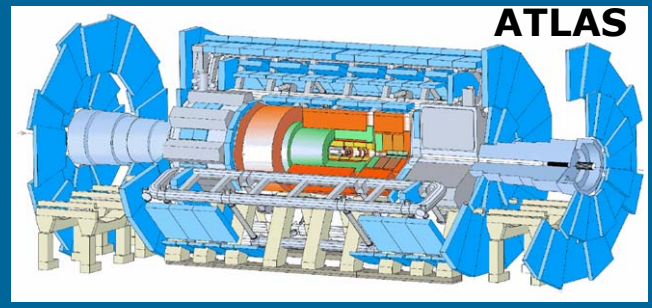


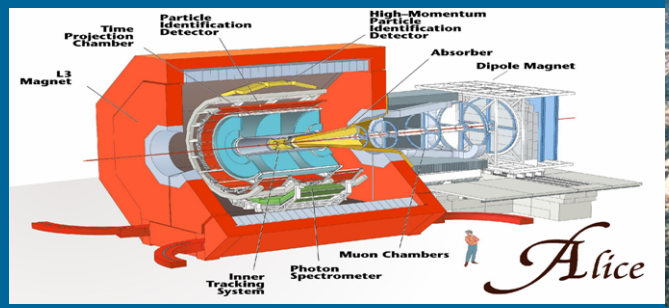
JINR's partners are about 700 institutions located in 60 countries, including 337 institutions and universities from the JINR Member States

JINR Dubna

Cooperation with CERN

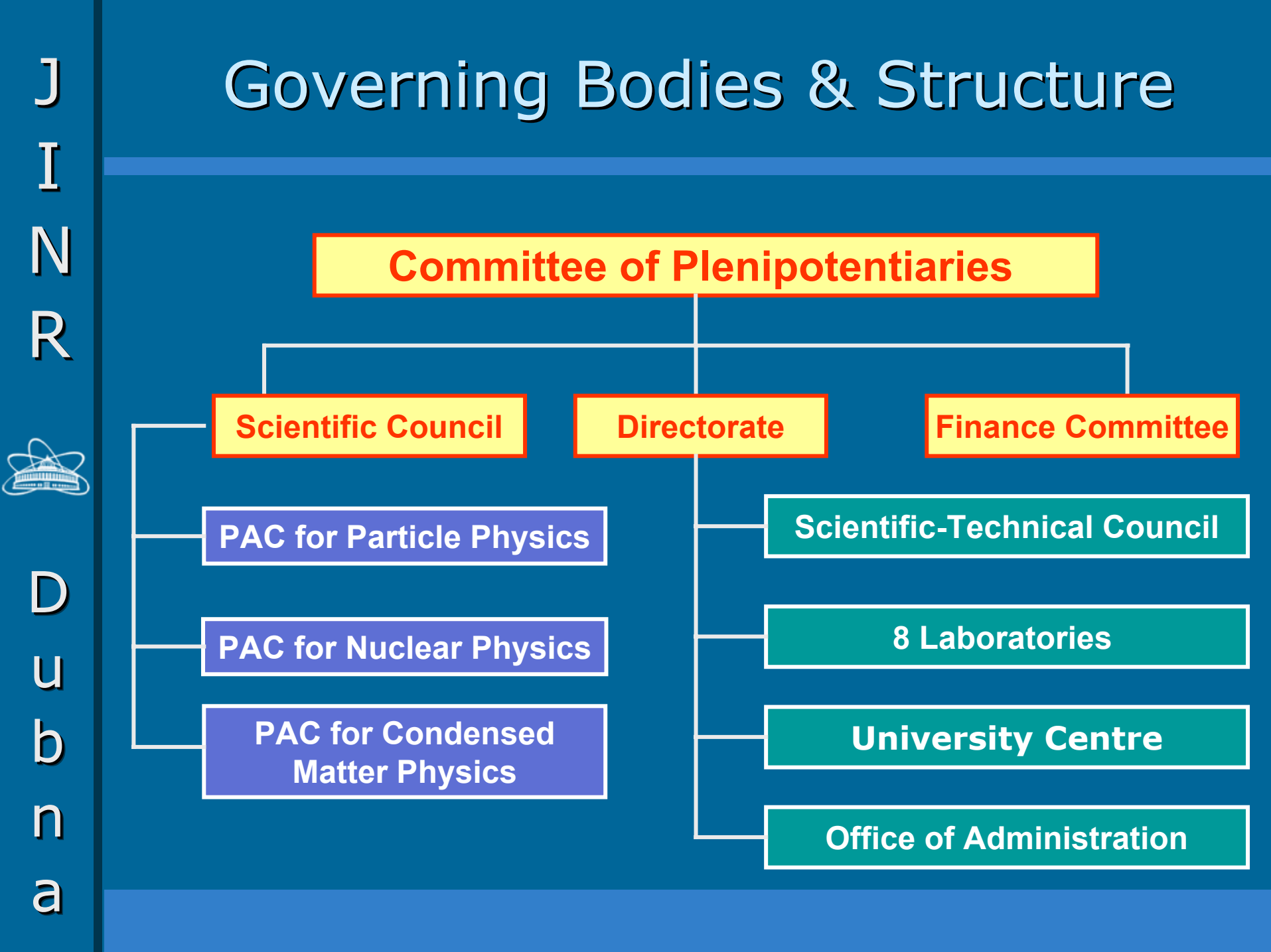






JINR Dubna

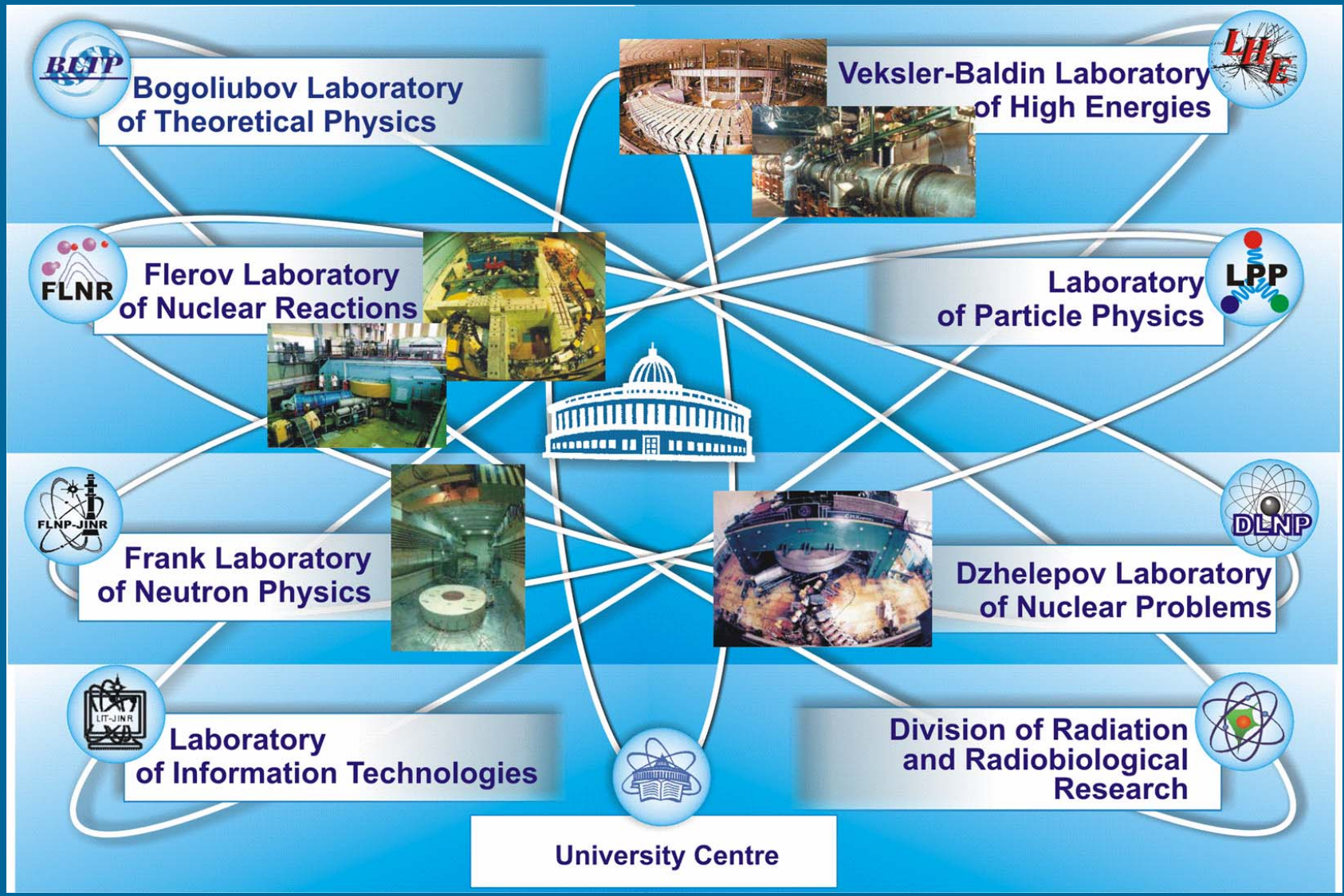
Governing Bodies & Structure



JINR Dubna

Directorate

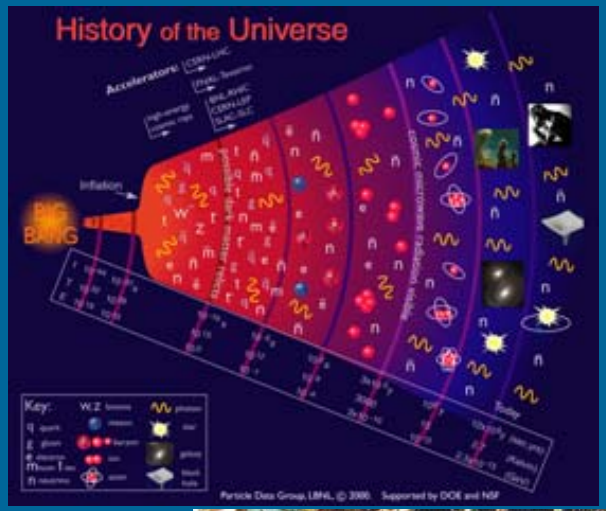
JINR Dubna



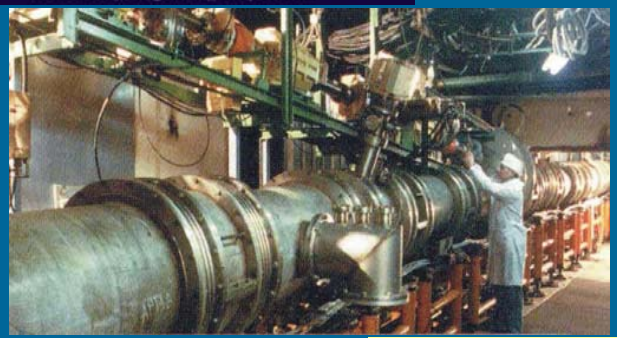
JINR has grown into a large multi-branch physics centre. It employs about 5500 people, including 1300 scientists. Among the scientists there are full members (academicians) and corresponding members of Academies of Sciences, more than 260 Doctors of Sciences and 650 Candidates of Sciences.

JINR Dubna

JINR is a large multidisciplinary scientific centre incorporating:



– basic research in frontier particle, nuclear and condensed matter physics,



– development and application of high technologies, and

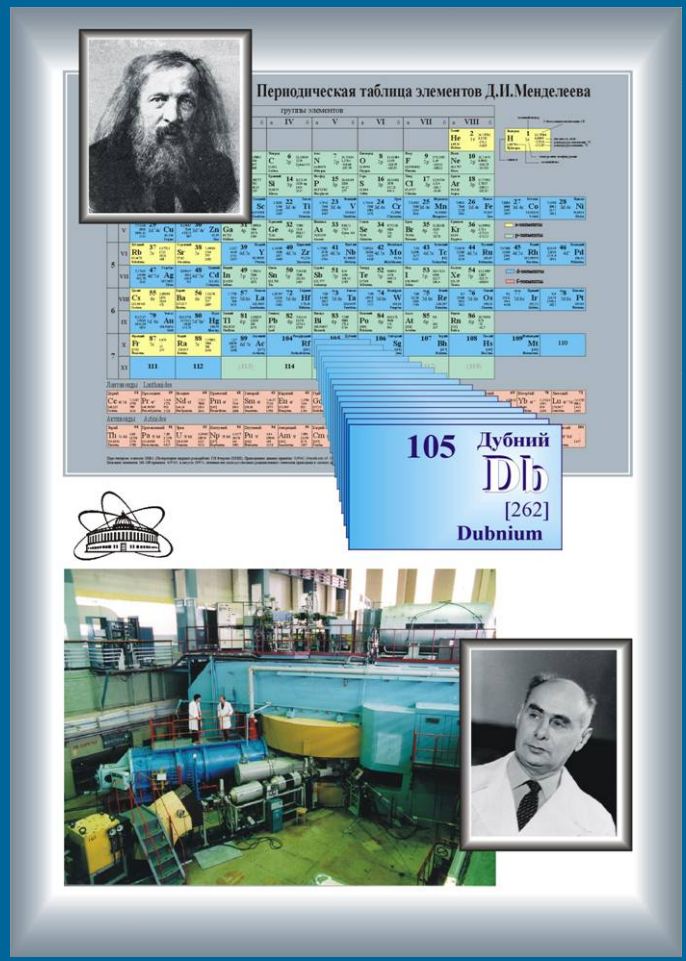
– university education in the relevant fields of knowledge.

JINR Dubna

Discoveries

37 discoveries, 46 diplomas and prizes of Russia, Bulgaria, Romania, Czech Republic, Uzbekistan and Georgia including

- 1958: Theory of superfluidity and superconductivity
- 1960: Anti-sigma-minus-hyperon
- 1963: Element 102
- 1973: Quark counting rules
- 1988: Colour as a new quantum number
- 1999: Element 114
- 2000: Element 116
- 2001: Element 118
- 2003: Elements 115 and 113



University Education

University Centre of JINR

Lectures

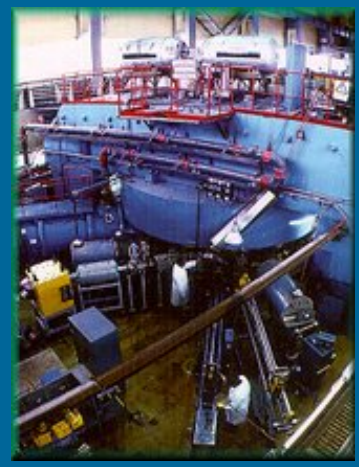
Training

University "DUBNA"

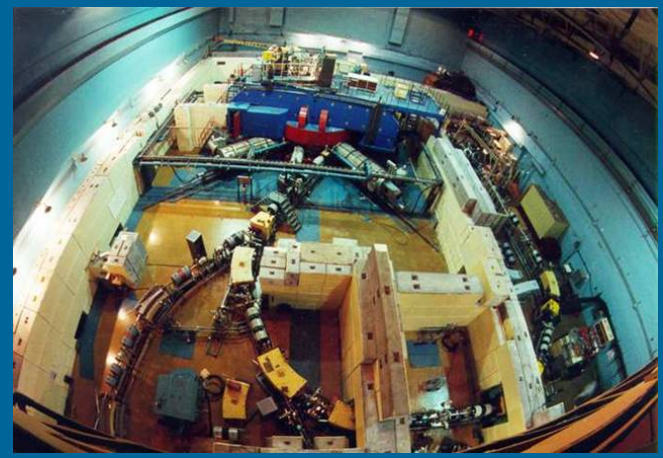
JINR Dubna

JINR's facilities

Nuclotron
(superconducting synchrotron)
has been operating since 1993



Cyclotron U400
has been operating since 1979

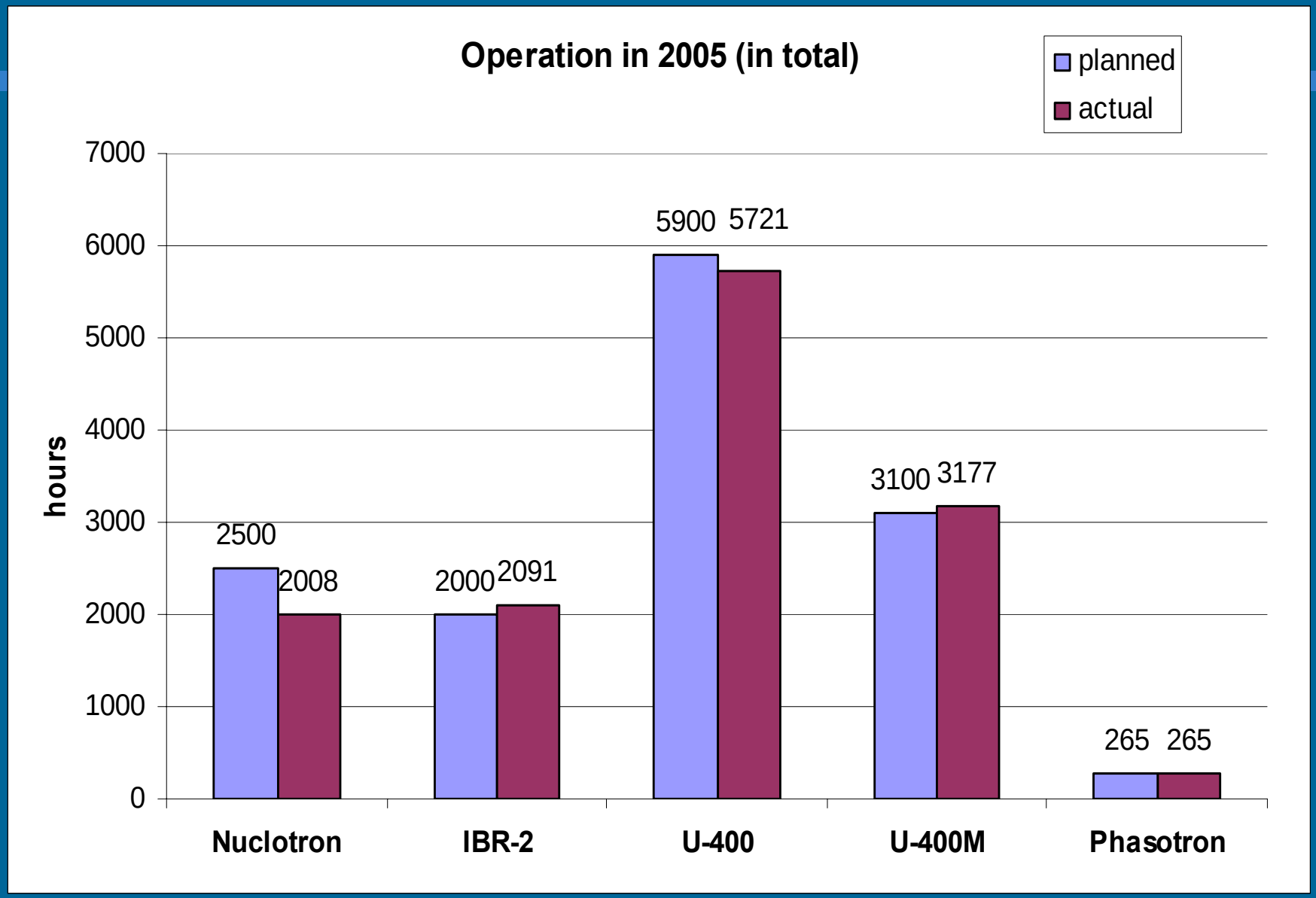


Cyclotron U400M
has been operating since 1993

Phasotron (synchrocyclotron)
has been operating since 14.12.1949

Neutron pulsed source IBR-2
has been operating since 1984

JINR Dubna


Operation in 2005 (in total)
planned
actual
hours
7000
6000
5000
4000
3000
2000
1000
0
2500
2008
2000
2091
5900
5721
3100
3177
265
265
Nuclotron
IBR-2
U-400
U-400M
Phasotron

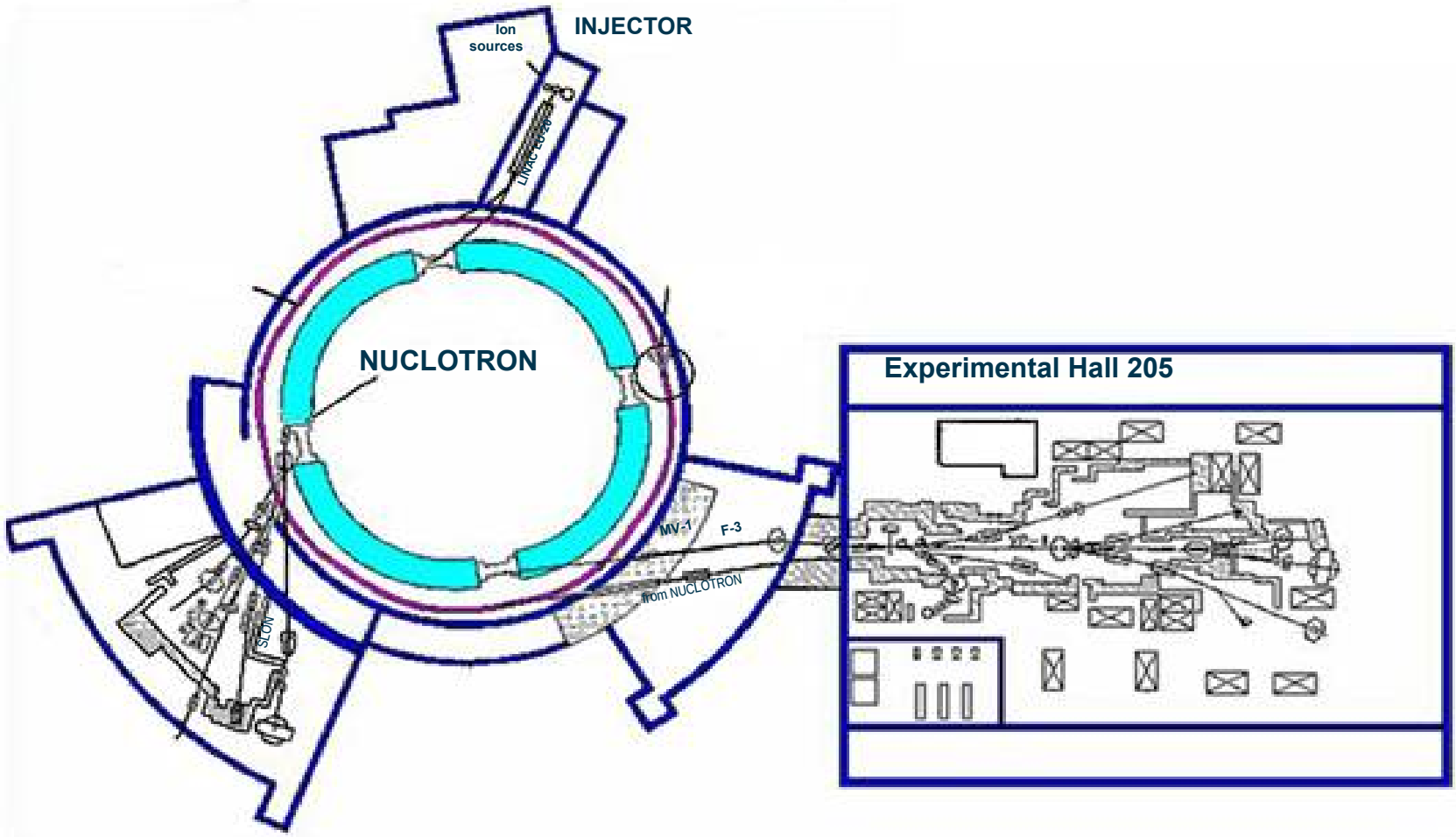
JINR Dubna

Nuclotron of Baldin-Veksler Laboratory of High Energy

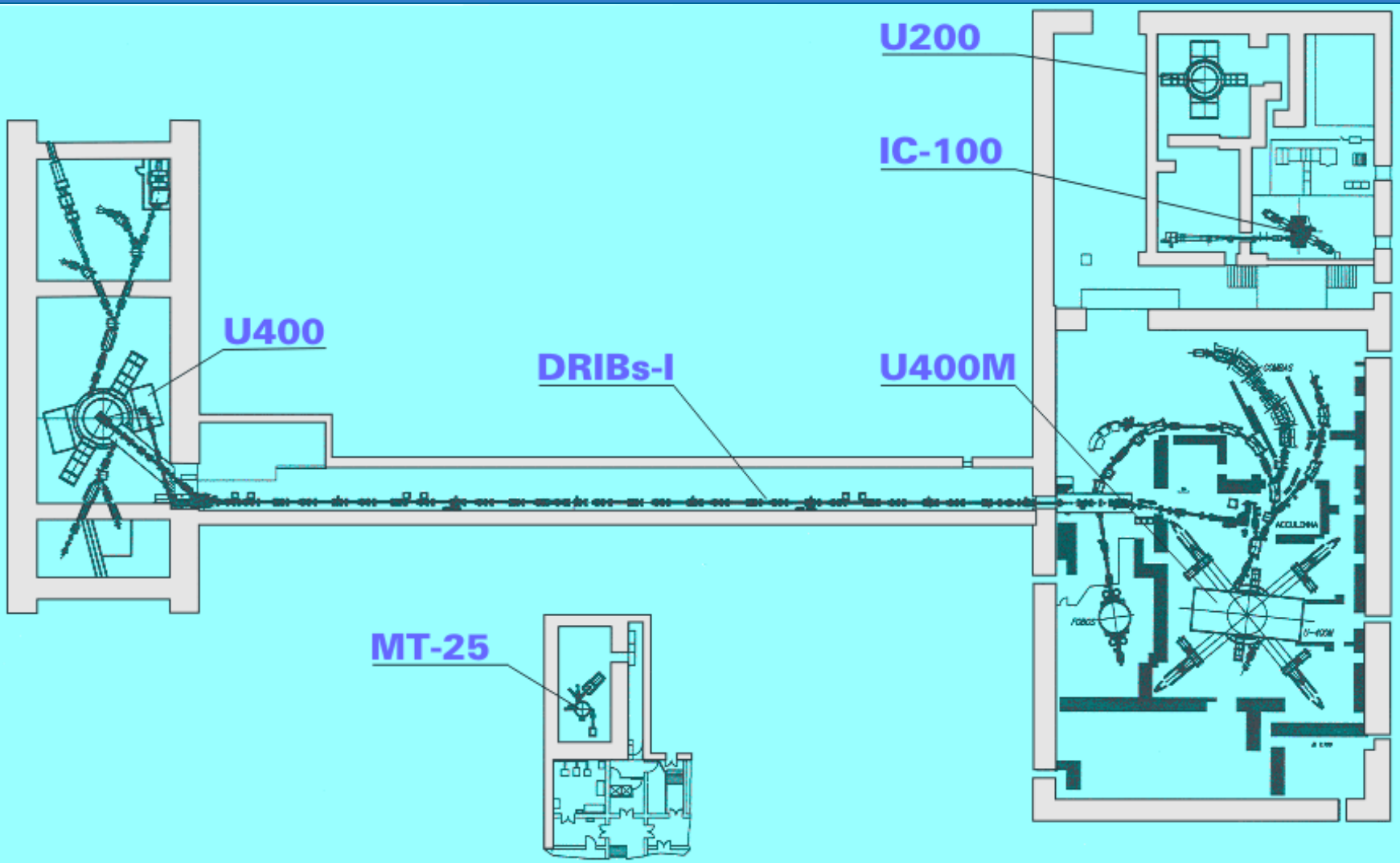
NUMBER OF USER'S GROUPS - 14

ACCELERATED BEAMS - p, d, He, C, B, Mg, N^{6+}, N^{7+}, Ar^{16+}, Fe^{24+}

BEAM ENERGIES - 0,5 - 3.0 GeV/u, (nuclei) 5.7 GeV (protons)



FLEROV LAB ACCELERATORS



Phasotron - Dzhelepov Laboratory of Nuclear Problems

JINR Dubna

Fundamental Investigations:

• DUBTO - Resonant behaviour of the both the ppπ- and nnπ+ systems, produced in π4He interaction.

• MUON – Investigation of the muon properties and the muon interactions with matter.

• FAMILON - The study of the two-particle muon decay on an electron and golston's massless boson.

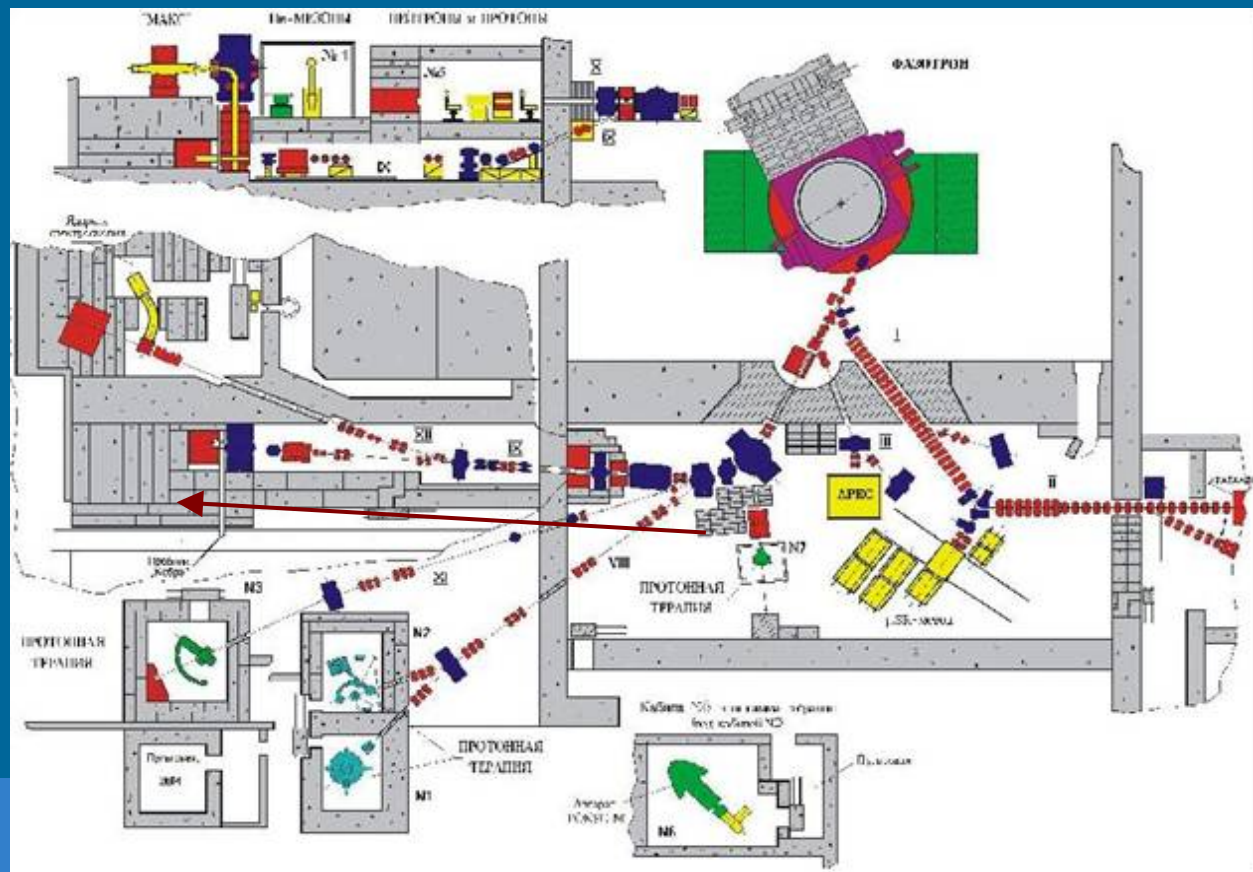
• μ-CATALISIS- Measurements of muon catalyzed fusion cycling rate temperature dependence in a binary mixture D/T in the temperature range 40-300 K.

Applied investigations:

• Cancer therapy;

•*(~100 patients per year)*

• SAD- Subcritical Assembly Driven by Proton Accelerator

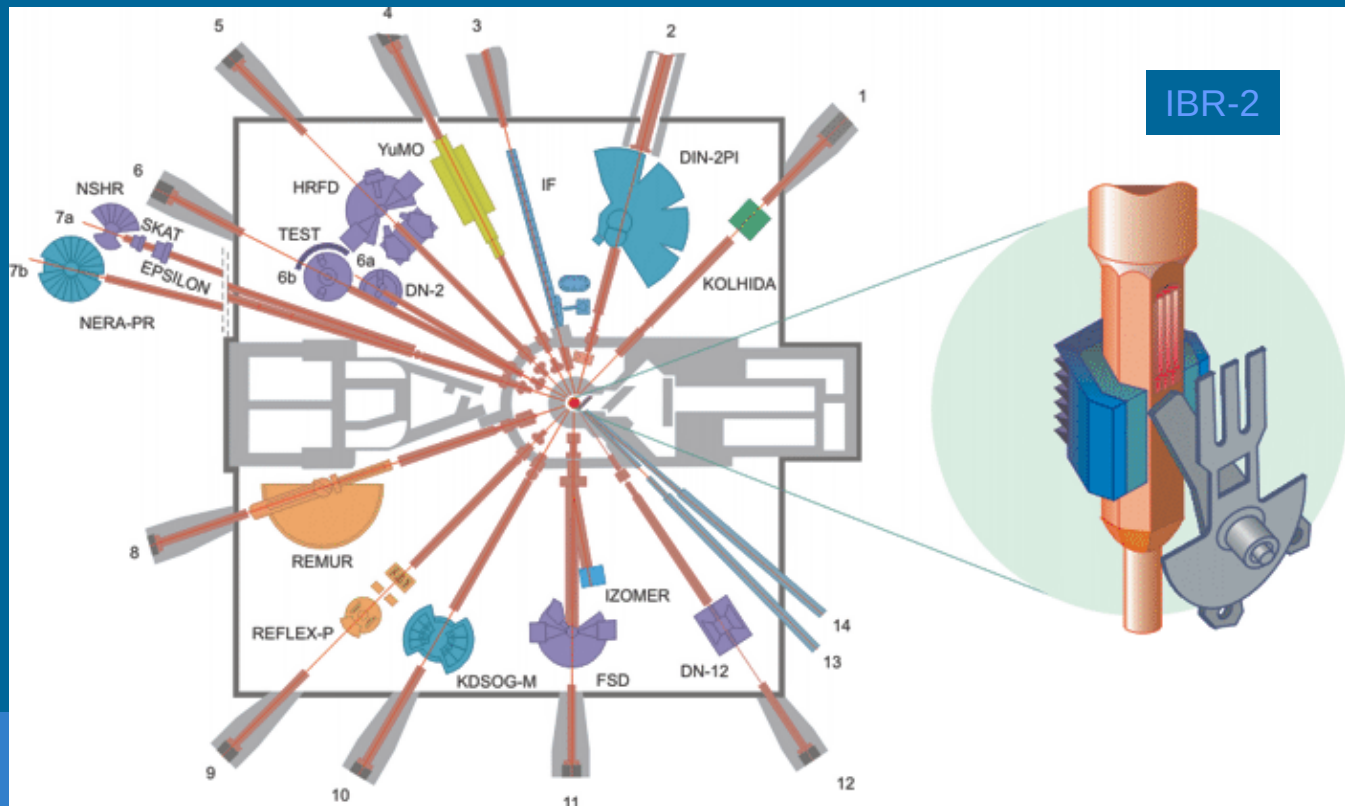


JINR Dubna

FRANK LABORATORY of NEUTRON PHYSICS

Main results in 2005:

I. Total running time of IBR-2: 2091 hours
II. Modernization of IBR-2
III. Dismantling of IBR-30
IV. New Movable Reflector (MR-3)
V. New Fuel Loading

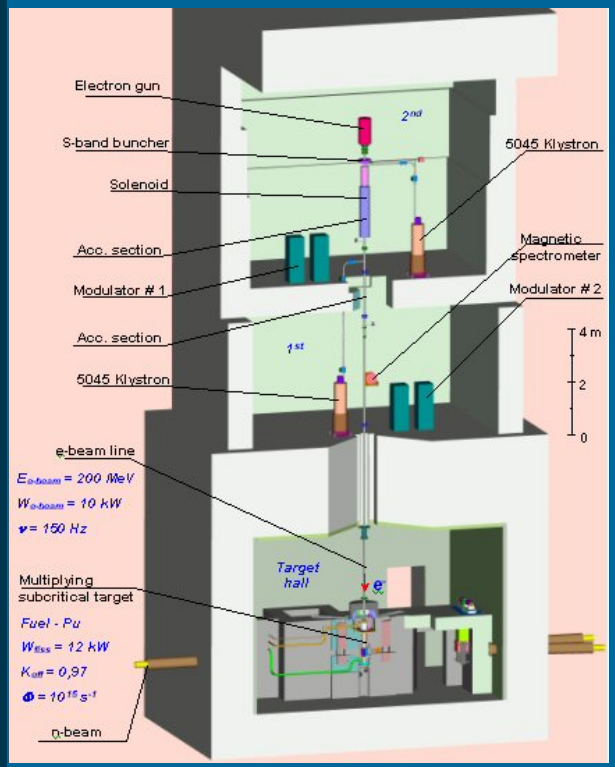


Accelerators for the JINR Member States

JINR Dubna

New Basic Facilities Under Construction

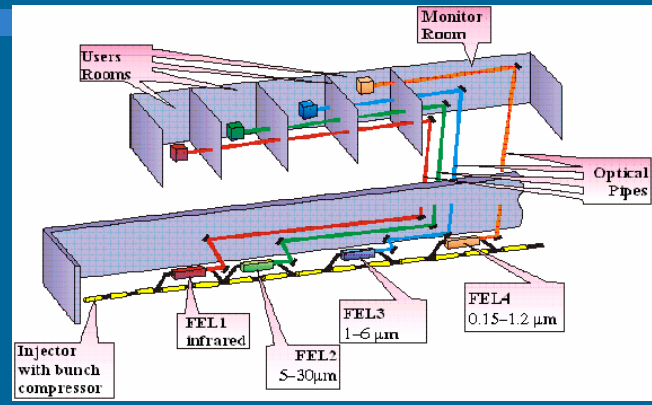
IREN:

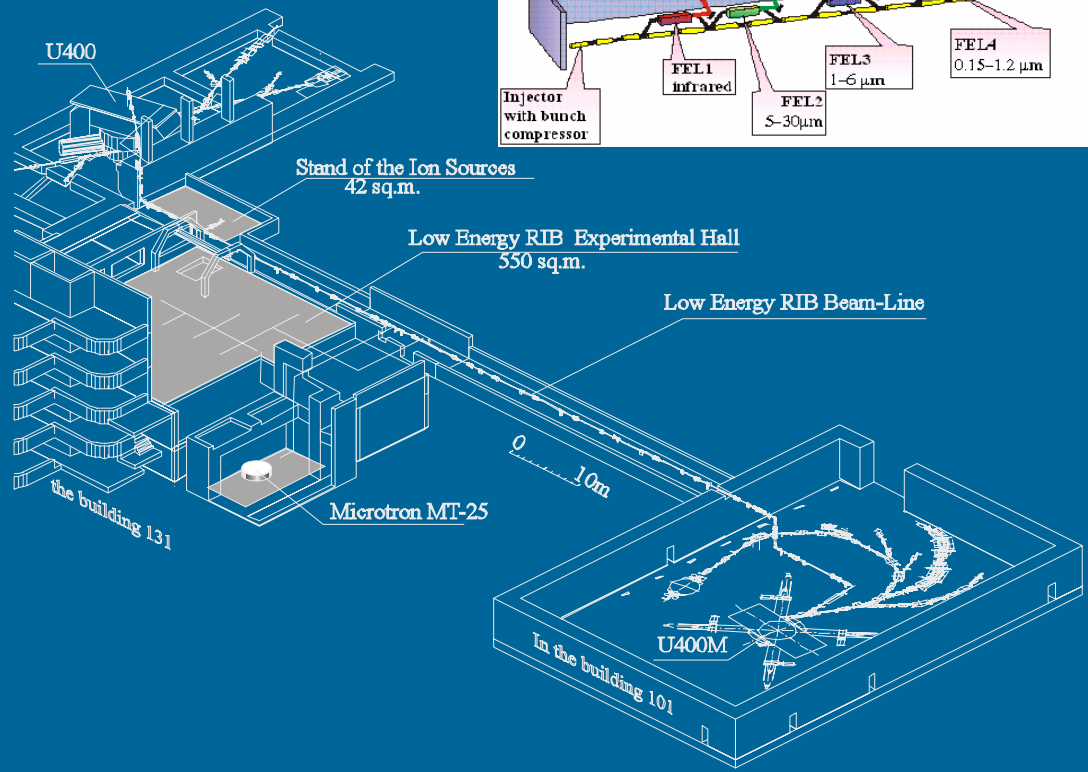


High intensity pulsed source of resonance neutrons

DRIBs:

ILC test bench and FELs





Dubna Radioactive Ion Beams

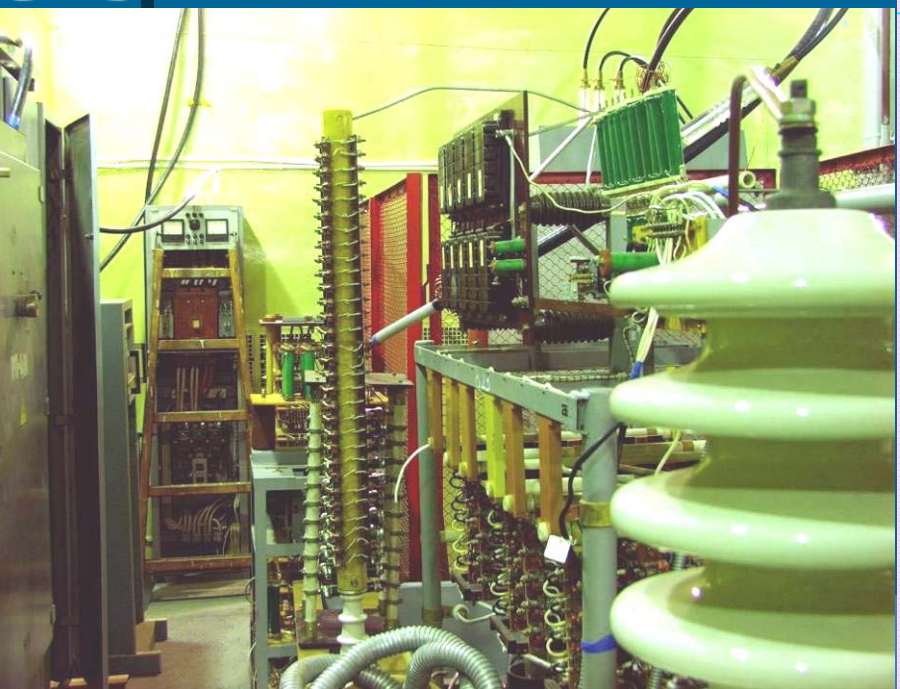
IREN – Intense REsonance Neutron source

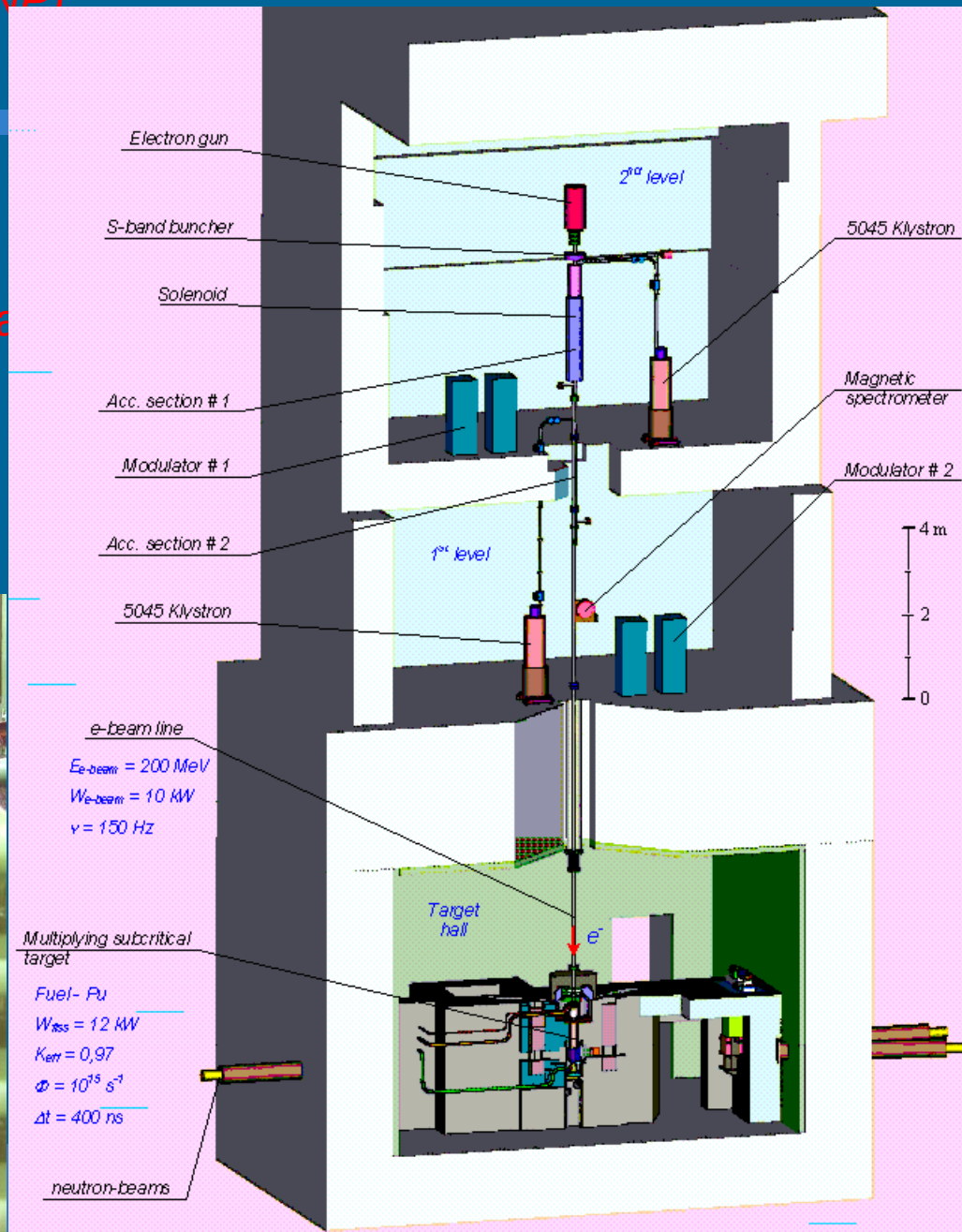
(facility is under construction at FLNP)

J I N R

IREN consists:

- powerful (10KW) electron linac LUE-200
- plutonium subcritical multiplied ta





JINR Dubna

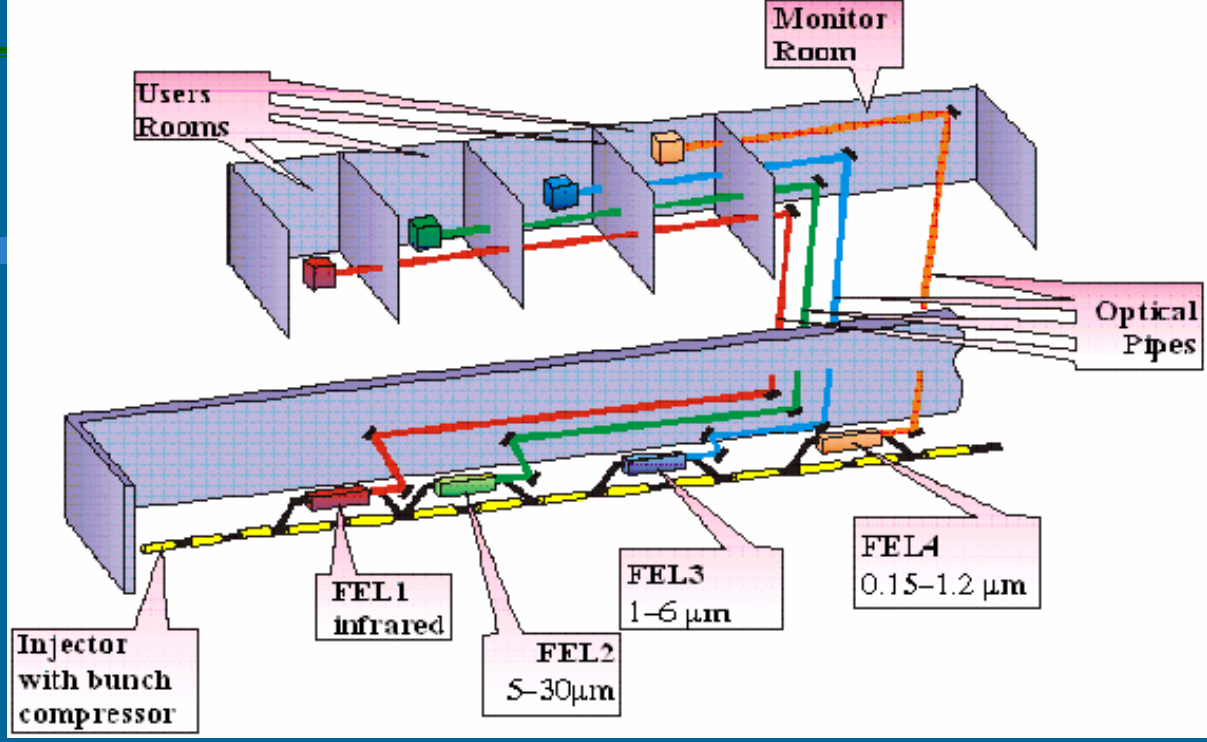
LINAC – 800

LINAC-800 parameters:

- energy – 800 MeV
- average current – 50 mA

Applications of LINAC-800:

- **Test Facility for ILC (photoinjector, SRF cavities traced with electron beam)**
- Free Electron Lasers
- Material modification



Free Electron Lasers at LINAC-800 (Bld.118)

First beam – April 2006

Parameter	FEL1	FEL2	FEL3	FEL4
Electron energy, MeV]	30 - 60	30 - 70	50 - 110	120 - 280
Radiation wavelength, μm	20-150	5-30	1-6	0.15-1.2
Bunch charge, nC	1	1	1	1
Peak current, A	50-70	50-70	50-70	150-250
Bunch length, mm	2.4	2.4	2.4	0.5-0.8
Norm. emittance, mm.mrad	30	30	30	30
Energy spread, keV	150	150	150	450-750
Micropulse repet. rate, MHz	19.8 / 39.7 / 59.5			
Macropulse duration, μs	5-10	5-10	5-10	5-10
Repetition rate, Hz	1-100	1-100	1-100	1-100

ILC siting and conventional facilities in Dubna region

Joint Institute for Nuclear Research

Dubna, Russia

International Intergovernmental Organization

Milestones of JINR activity in ILC

November 2005 – International Program Advisory Committee proposed to investigate an opportunity to construct the ILC in the Dubna region

December 2005 – **GDE in Frascati** – A.N. Sissakian with first proposals from JINR to be involved into global accelerator project and Dubna siting;

January 2006 – a special workgroup on ILC was created at JINR

January 2006 – JINR Scientific Council encourages JINR to be involved in the ILC design effort and supports the intention of JINR to participate in the ILC project and the possible interest of JINR to host the ILC

March 2006 – JINR Committee of Plenipotentiaries approved SC recommendation;

March 2006 – visit of European GDE director Prof. B.Foster to Dubna;

May 2006 – **European GDE in DESY** - Detailed information from JINR as from sample site;

July 2006 – **GDE in Vancouver** – Documentation from JINR to BCD with RSPI estimation on CFS (Site Assessment Matrix);

Milestones of JINR activity in ILC

November 2006 – **GDE in Valencia** – Documentation from JINR to RDR with new RSPI estimation on CFS (Work Breakdown Structure) officially submitted. Participation of JINR representative in a GDE Directorate round table; JINR (Dubna) is officially approved by GDE Director as sample site for ILC hosting. RDR will include information about Dubna sample site. Detailed Cost Estimation on subsystems from JINR will be in TDR;

December 2006 – Directorate of approved the unification of a few accelerator projects (ILC, X-FEL&FLASH, CLIC, LEPTA and some others) in one scientific theme under the leadership of A.Sissakian and G.Shirkov in order to concentrate the recourses and manpower at JINR;

26 December 2006 – The ILC activity at JINR was considered at the special meeting in the Russian Academy of Science.

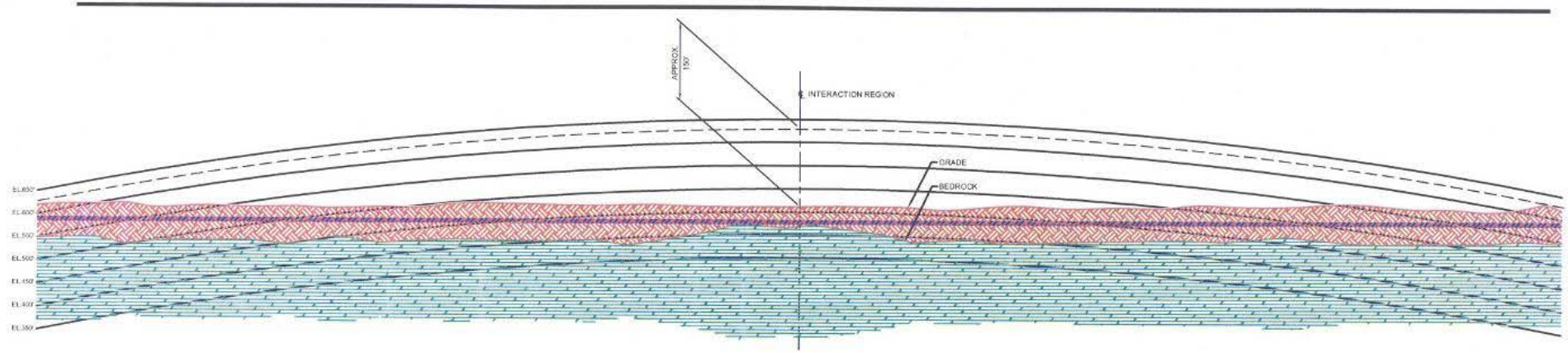
In Frascati

Prof. A.Wagner at LINAC-800

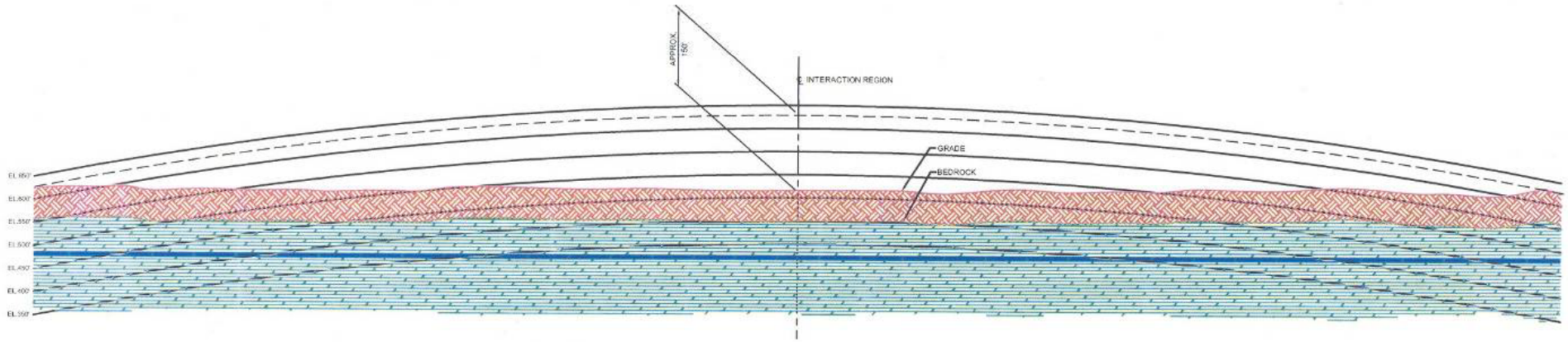
Prof. B.Foster in Dubna

Round table in Valencia

PROPOSALS of the ILC SITING - 50 KM LINE



IDEAL - "CUT AND COVER" CONSTRUCTION



IDEAL - "ROCK" CONSTRUCTION

ILC/SG-SC

INTERNATIONAL LINEAR COLLIDER / STEERING GROUP - SUPER CONDUCTING

LINEAR COLLIDER

CONVENTIONAL FACILITIES

FY05NS-SC

SLAC PROJECT NO

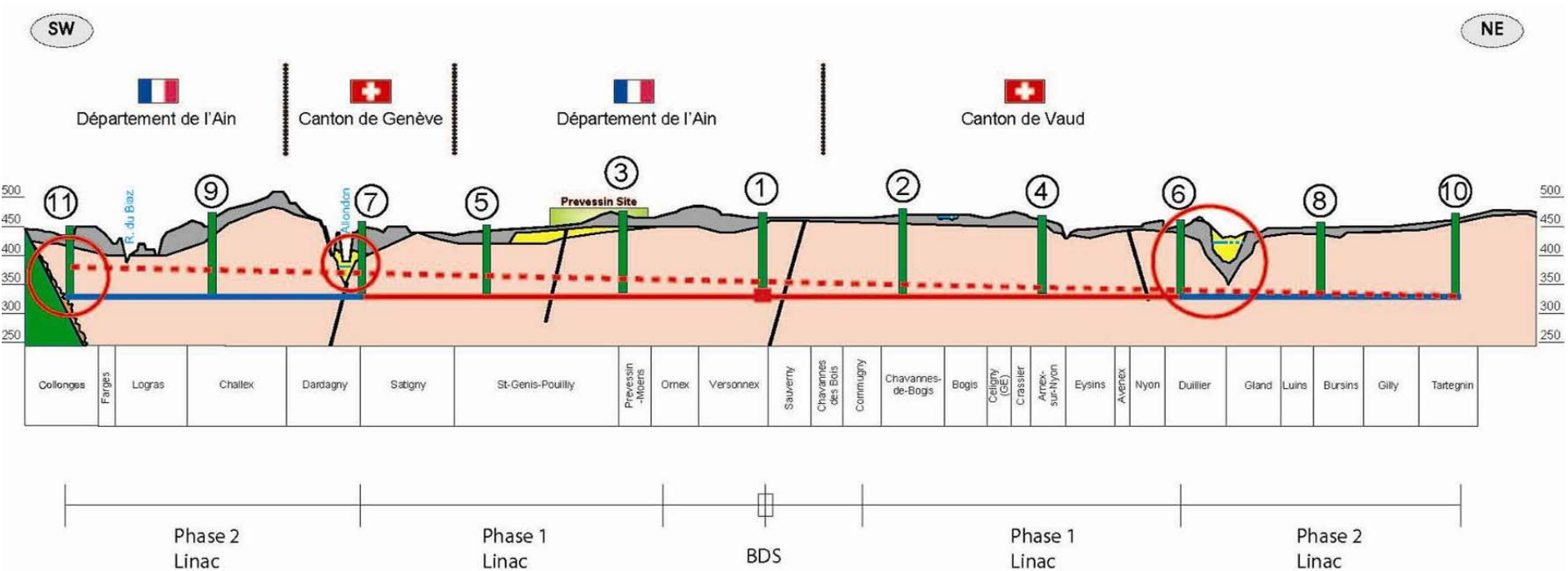
FNAL PROJECT NO

DATE 2/01/2005

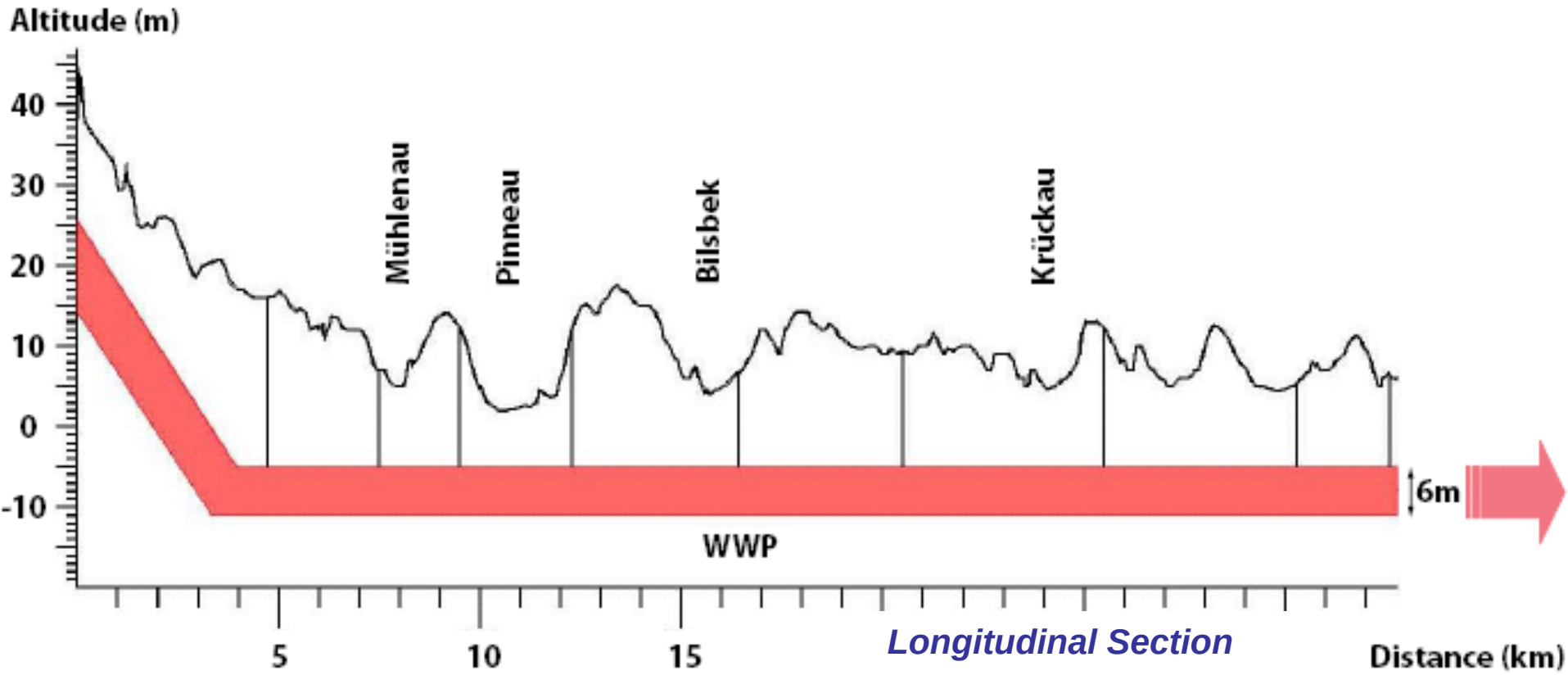
DRAWING NUMBER

EUROPEAN SAMPLE SITE - CERN

Longitudinal Section

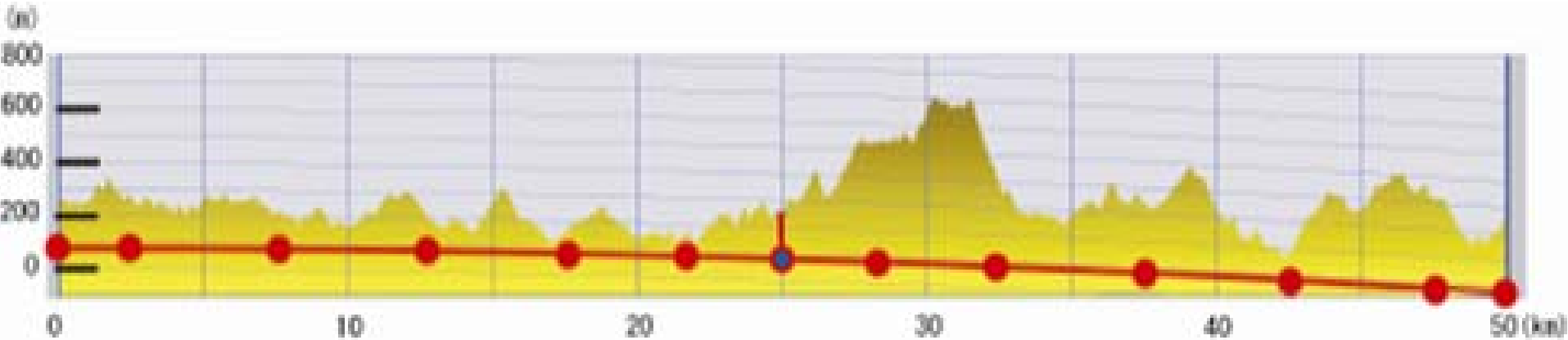


EUROPEAN SAMPLE SITE - DESY



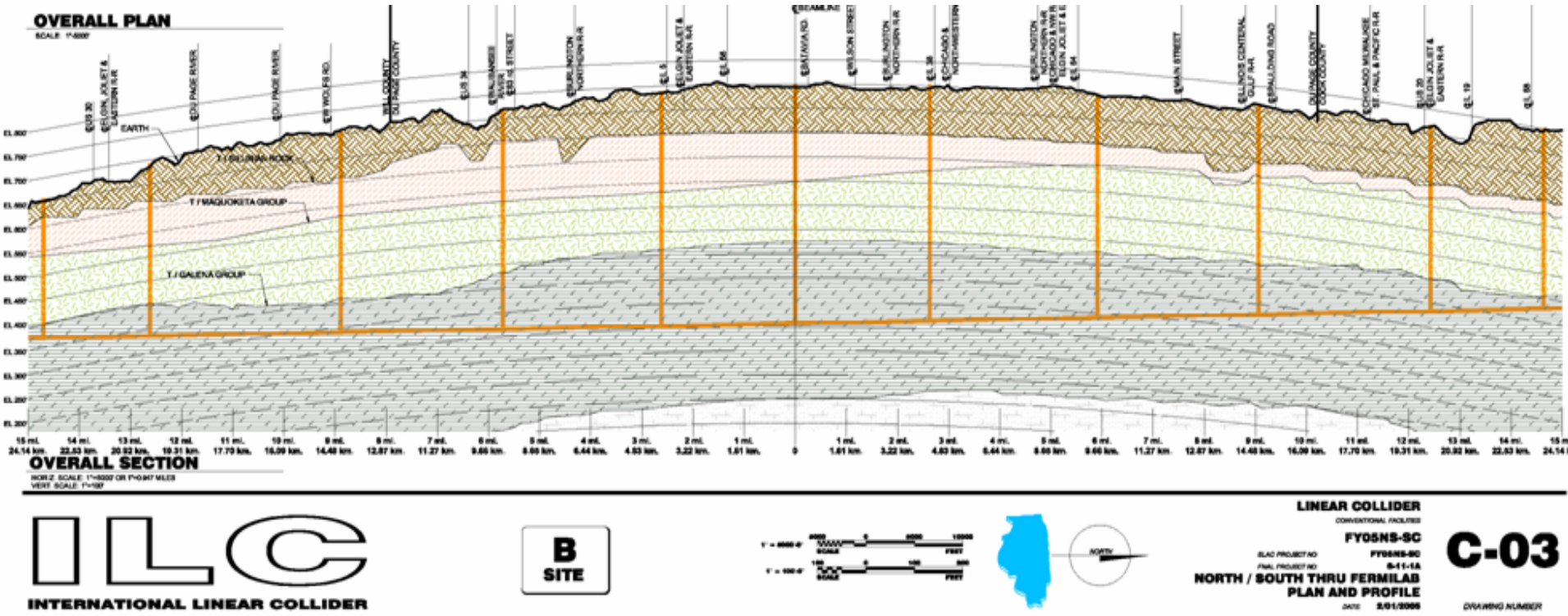
Longitudinal Section

ASIAN SAMPLE SITE



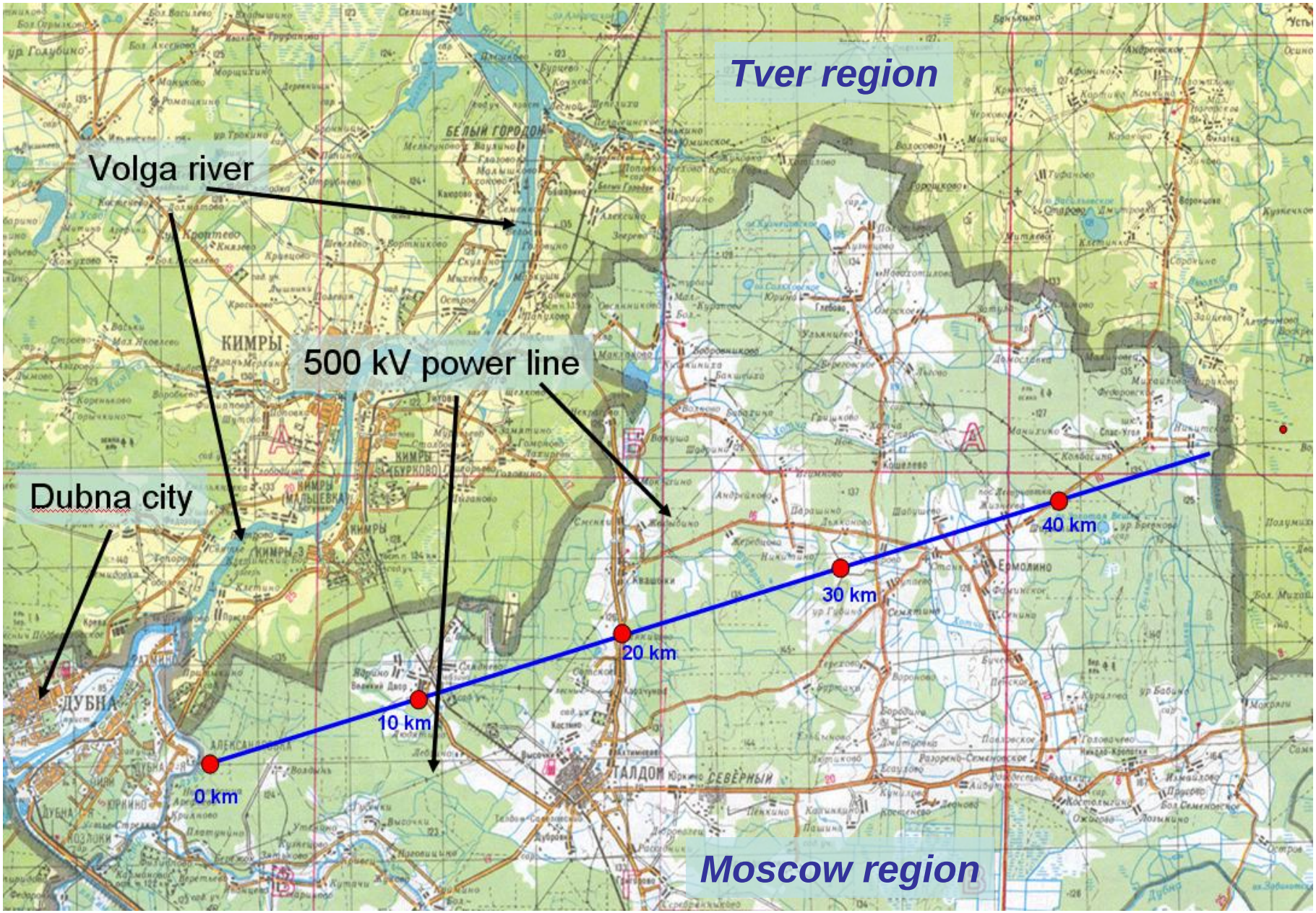
Longitudinal Section

AMERICAS SAMPLE SITE



Longitudinal Section

Dubna Siting: Layout of ILC in the Moscow Region



Advantages of the ILC construction in Dubna:

1. The presence of JINR as a basic scientific and organizational structure. JINR is an international intergovernmental organization, which includes 18 Member States and 4 States, which are associated members.

2. The proposed territory is extremely thinly populated and practically free of industrial structures, rivers and roads. The proposed placement of the accelerator tunnels in relatively dry drift clay excludes the influence on abyssal distribution of the underwater.

3. The area is absolutely steady seismically and has stable geological characteristics.

4. A flat relief and the unique geological conditions allow one to place ILC on a small depth (about 20 m) and to perform construction of tunnels, experimental halls and other underground objects with the least expenses, including open working.

5. The extremely attractive feature of placing the ILC complex on the chosen territory is a unique opportunity to solve the problem of value at the purchase of land. Prevalent legal practice makes it possible to get the land of the ILC location to permanent free use just as it has been done for JINR, according to the agreement between JINR and the RF government.

6. There are sources of the electric power of sufficient capacity in the area of the ILC construction: transmission line of 500 kV, the Konakovo electric power station (EPS) and the Udomlia atomic power plant (APP).

7. The developed system of transport and communication services, advantageous location, good highways and railways, water-way (the Volga river basin), good position in the European region;

8. Presence of a modern network and information infrastructure, including one of the largest center in Europe the “Dubna” Satellite Communication Center.

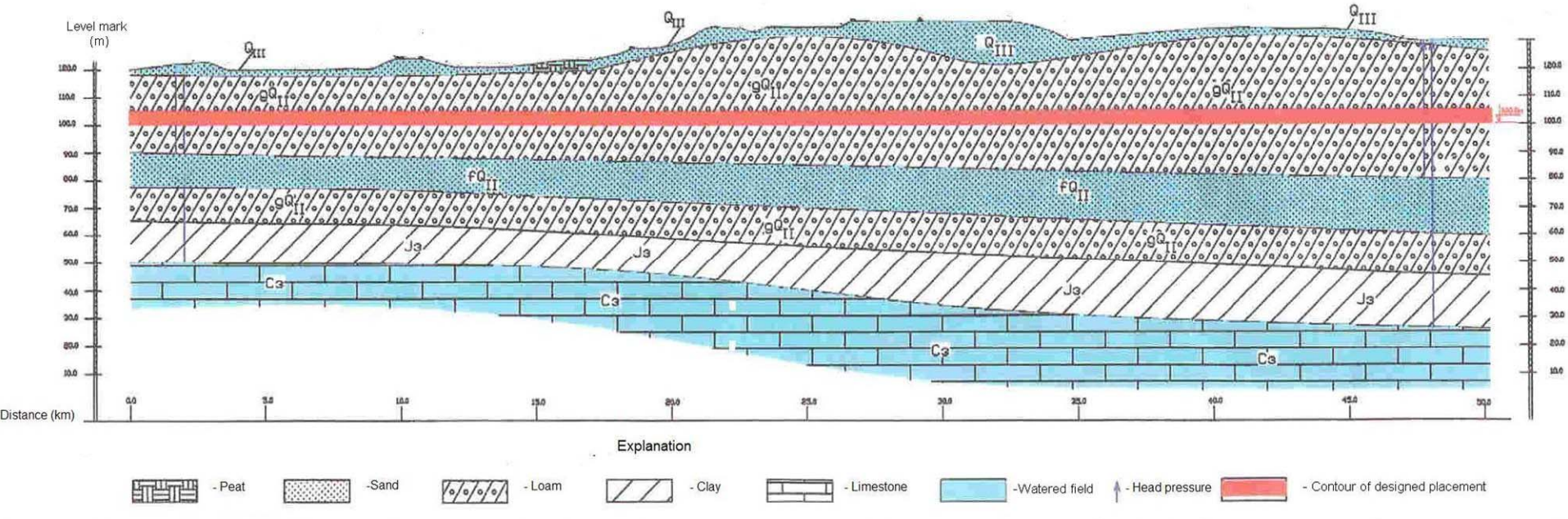
9. A special the economic zone established in Dubna in December, 2005 provides preferential terms for development and manufacture of high technology technical production.

10. Dubna has a powerful scientific and technical potential. The developed infrastructure makes it possible to involve additionally specialists from world scientific centers into the already formed international collective of highly-qualified scientific manpower providing comfortable conditions for them to work. This guarantees a high quality of investigations on ILC and obtaining of new research results of fundamental scientific importance.

In front: Russian Satellite Communications Center
In the back ground: the starting point of ILC layout, between Dubna and Volga rivers

The ILC linear accelerator is proposed to be placed in the drift clay at the depth of 20 m (at the mark of 100.00 m) with the idea that below the tunnel there should be impermeable soil preventing from the underlying groundwater inrush. It is possible to construct tunnels of the accelerating complex using tunnel shields with a simultaneous wall timbering by tubing or falsework concreting.

Standard tunnel shields in the drift clay provide for daily speed of the drilling progress specified by the Project of the accelerator (it is needed for tunnel approximately 2.5 y's).



Power and energetic

The northern part of Moscow region and the neighboring regions have a developed system of objects of generation and transmission of electrical energy. There are first-rate generating stations: the Konakovo EPS (electric power station, ~30 km from Dubna) and the Udomlia APP (atomic power plant, ~100 km from Dubna).

Two trunk transmission lines with the voltage 220 kV and 500 kV pass through the territory of Dubna.

The investigation of possibilities of the power supply for the accelerator and its infrastructure with the total power up to 300 MW gives the following variant: Construction of the power line - 220 kV, 35÷40 km long, directly from the center of generation – the Konakovo EPS to the Central Experimental Zone of the accelerator with a head step-down substations 220/110 kV.

It will require the investment in larger amount but the cost of power obtained directly from the centers of generation will be lower for 40÷50 % (from 0.05$ per 1kWh down to 0.02-0.03 $ per 1kWh in prices of 2006).

Documentation and Cost Estimation

July 2006 (for Vancouver GDE):
JINR prepared and filled the necessary documents for possible ILC hosting to BCD (Conventional Facilities part), *so called Site Assessment Matrix.*

Official document from Russian State Project Institute (RSPI, Moscow) with estimations on:

- Conventional facilities cost
- Siting (tunnel, land acquisition) cost and time schedule
- Energetic and power cost
- Operational cost
- Labor cost

The overall value on consolidated estimated calculations in the prices of year 2006 for civil engineering work, underground and surface objects of the main construction gives the sum in order of 2,3 B$, including 1 B$ of costs of the tunnels construction for linear accelerator, all its technological systems and mines.
Cost of power supply objects which will provide electric power directly from generator sources with special (favorable) cost of energy (tariff) is of order of 170 M$.

November 2006 (for Valencia GDE):
JINR prepared and filled the necessary documents as a sample site for possible ILC hosting to RDR *(Work Breakdown Structure - WBS)* **– in a special required format with all the details on infrastructure parts. This document was also prepared with RSPI and submitted by Design Cost Board of GDE.**

New Project at JINR: Preparation of proposals for JINR participation in design, manufacturing and testing of the Linear Collider element prototypes

Project leaders:

A.N. Sissakian
G.D. Shirkov

Period: 2007- 2009

Expected results in 2007:

-Preparation of works of JINR;

- Participation in estimations and design of ILC elements

Accelerator theme

PREPARATION OF PROPOSALS FOR JINR PARTICIPATION IN DESIGN, MANUFACTURING AND TESTING OF THE LINEAR COLLIDER ELEMENT PROTOTYPES

Theme leaders: A.N. Sissakian, G.D. Shirkov

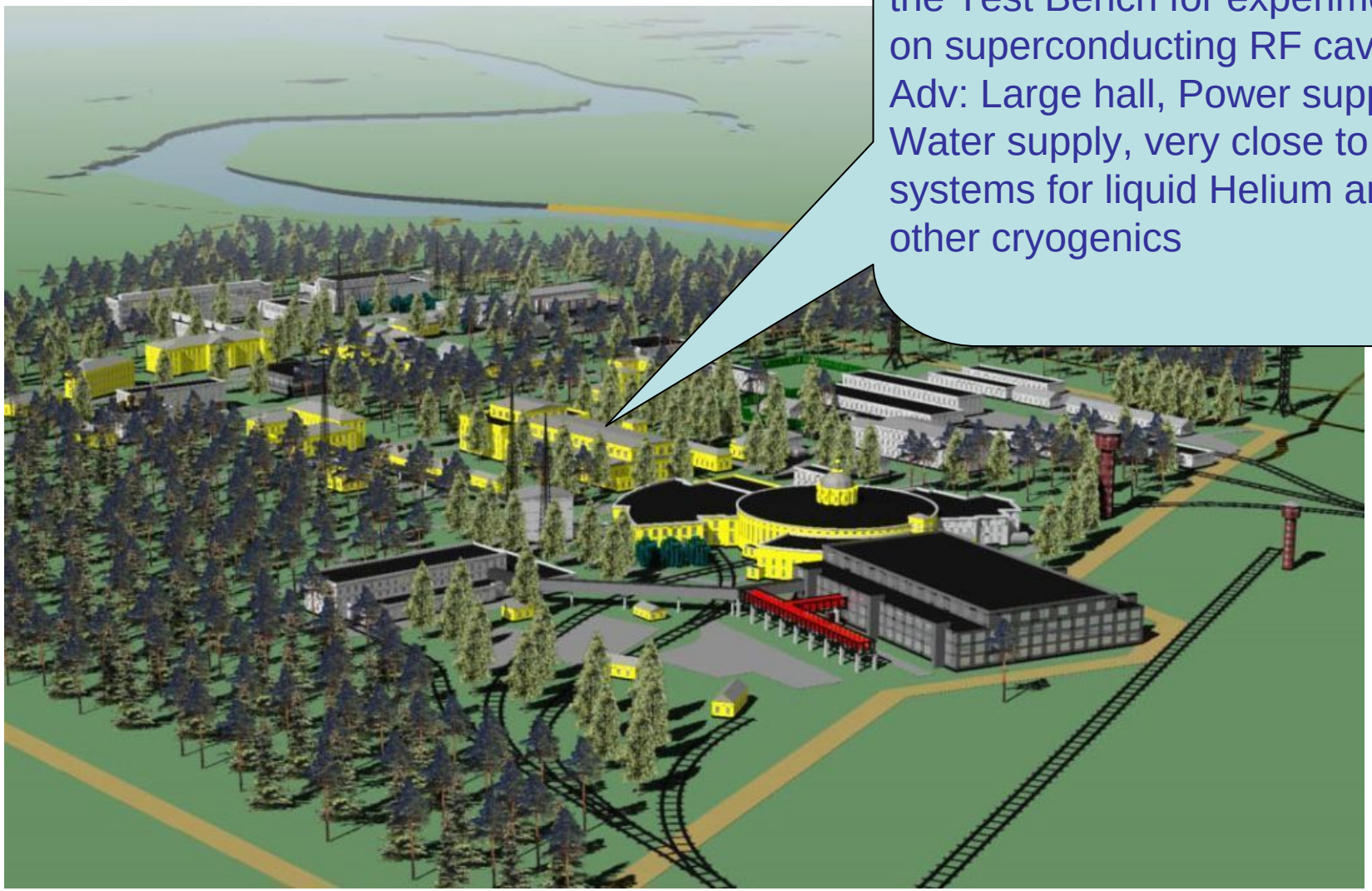
Participating countries and international organizations:
Byelorussia, Germany, Italy, Russia, USA, Japan, Ukraine, Greece.

Problem and the main goal of investigation:
Preparation of proposals for JINR participation in the development of International Linear Collider (ILC).

Expected results at completion phase of theme or projects:
Fulfillment of scientific research and design construction works (SR&DCW) in physics and techniques of accelerators, in precision laser metrology and preparation of proposals for the project of JINR participation in international collaboration on the ILC construction.

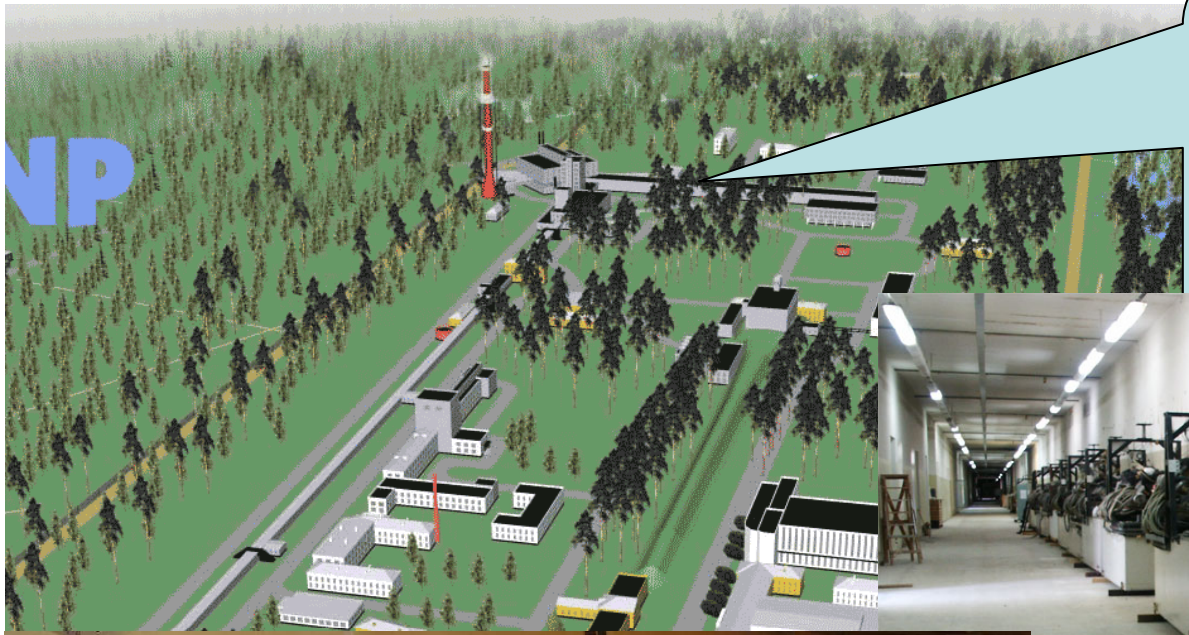
Laboratory	Person in charge at the Laboratory	Key executors and number of participants
Elaboration of photoinjector prototype (DLNP, LPP) Calculation of electron beam dynamics in the injector (DLNP)	I.N. Meshkov, G.V. Trubnikov	Meshkov I.N. + 8, Tyutyunnikov S.I., Kobets V.V. + 3.
The LINAC-800 based test-bench; FEL on the base of LINAC-800; photoinjector; Development of the RF system elements Development of diagnostic, Development of inside devices LPP, DLNP	G.D. Shirkov, N.I. Balalykin, A.I. Sidorov E.M. Syresin	N.I. Balalykin, Kobetz V.V. + 3, A.I.Sidorov + 2 E.M.Syresin + 4.
Metrological laser complex DLNP, LIT	Yu.A. Budagov, V.V.Ivanov D.I. Khubua, G.A. Shelkov	Yu.A. Budagov, V.V. Ivanov + 1, D.I. Khubua+ 5, G.A.Shelkov + 5.
Development of prototype of the 4th generation cryogenic modules and testing systems for them (LPP, DLNP, VBLHE)	Yu.P. Filippov, Yu.A. Usov, Yu.A. Budagov	Yu.P. Filippov + 3. Yu.A. Usov + 3, S.V. Mironov Yu.A. Budagov, B. Sabirov
Preparation of a production basis at JINR for cryogenic ensuring of testing of the 4th generation cryogenic modules VBLHE, LPP, DLNP	N.N. Agapov, Yu.P. Filippov, Yu.A. Usov, Yu.A.Budagov	N.N. Agapov + 3, Yu.A. Usov + 3 Yu.P. Filippov + 3. Yu.A. Budagov, B. Sabirov + 3, S.V. Mironov, A.B.Lazarev + 3.
Calculation of electrical and magnetic fields of complex configuration (DLNP)	S.B. Vorozhtsov, G.V. Trubnikov	V.B. Vorozhtsov + 3, G.V. Trubnikov + 2.
Project of the complex for radiation stability studies (VBLHE)	L.N. Zaitsev	L.N. Zaitsev + 2.
Engineering survey and design developments DLNP, OGE, GSPI	Yu.N. Denisov, G.V. Trubnikov, V.I. Boiko	Yu.N. Denisov + 5. G.V. Trubnikov, V.I. Boiko
Development of magnetic systems of the ILC damping rings DLNP	E.M. Syresin, N.A. Morozov	E.M. Syresin + 3, N.A. Morozov + 2.

LHE ground

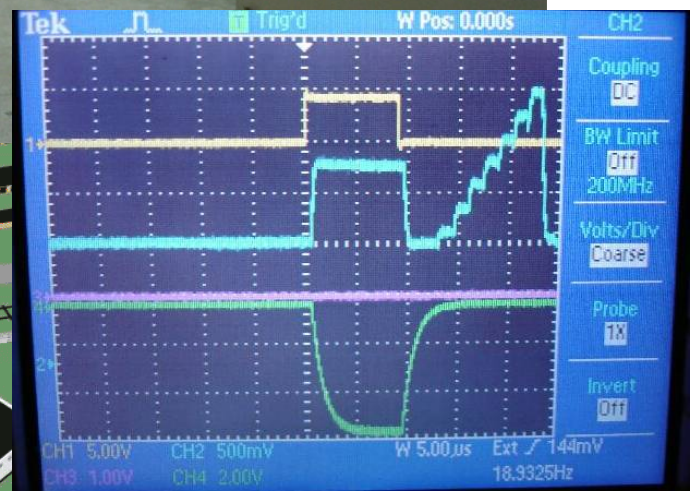


Machinery Hall # 2:
Possible place for location of the Test Bench for experiments on superconducting RF cavities.
Adv: Large hall, Power supply, Water supply, very close to systems for liquid Helium and other cryogenics

LNP ground

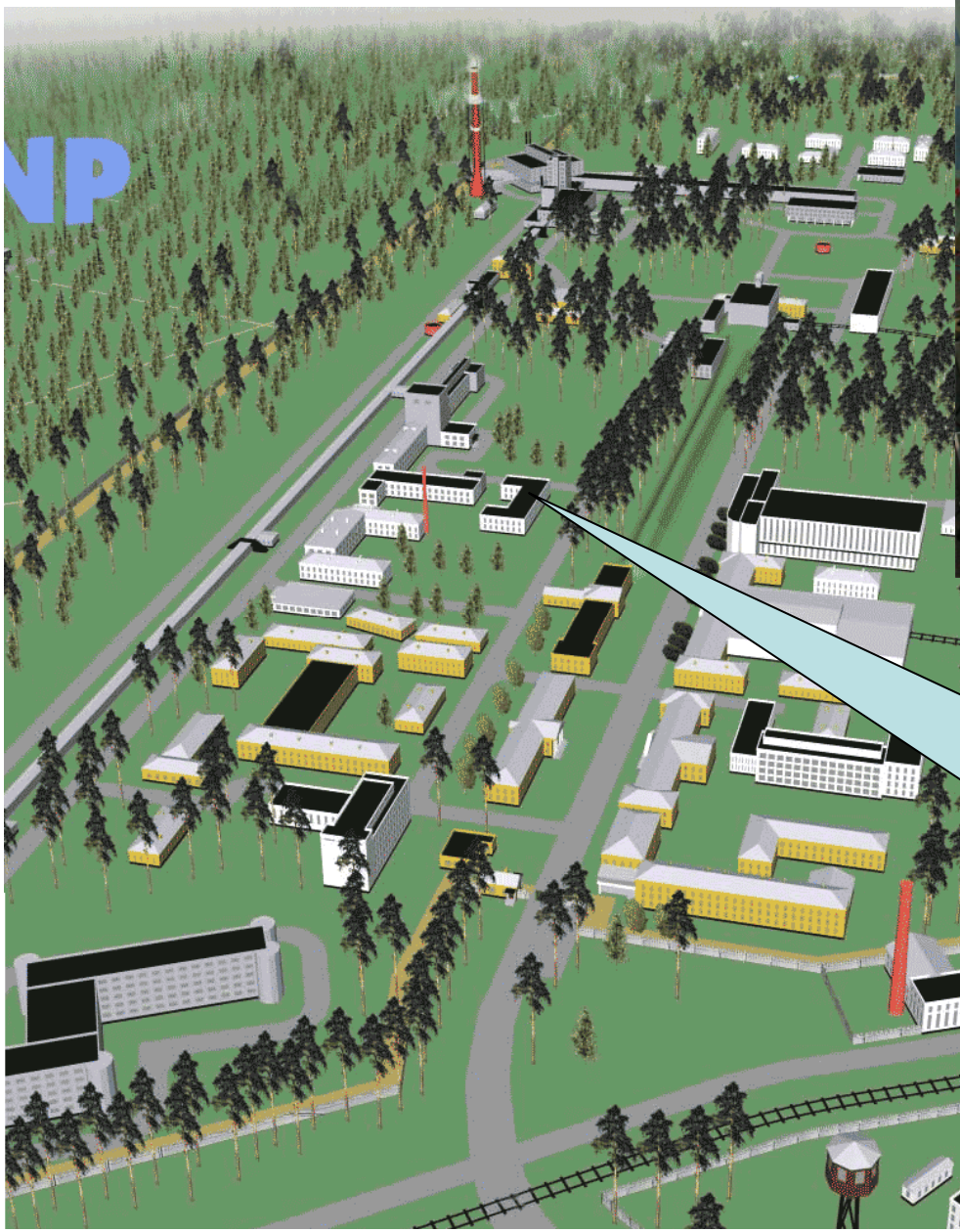


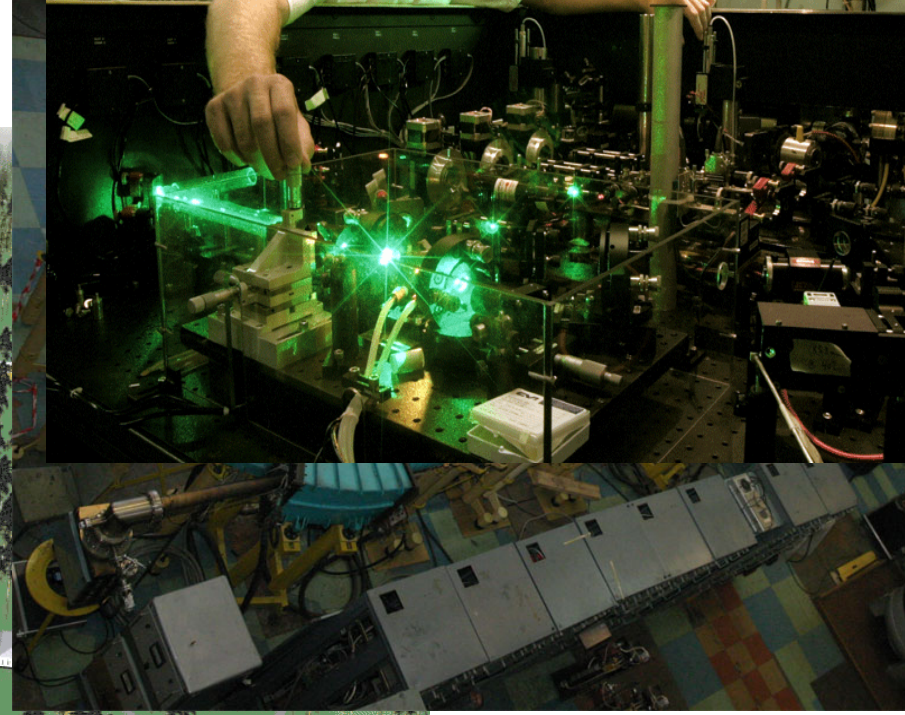
Building 118
Location of constructed LINAC-800.
Test of RF accelerator sections and cryo modules
LINAC with super-



LINAC-800 – first electron beam on 27.04.2006

LNP ground





Building 108
(LEPTA project)
2 experimental Halls
(water, power, …)

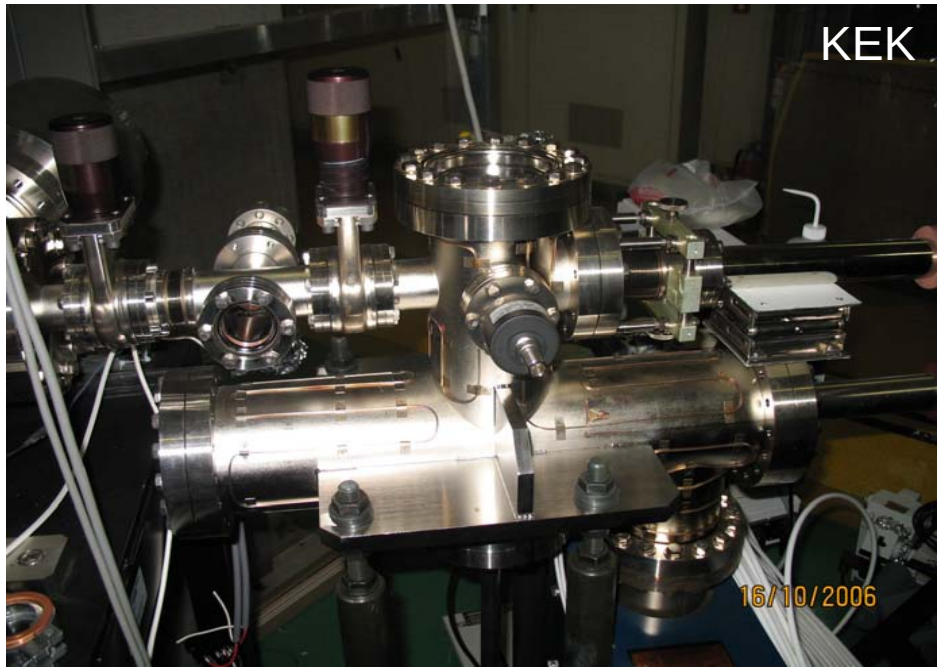
Test Bench for
Photo Injector

Photoinjector prototype

Several visits and officially organized collaboration with:

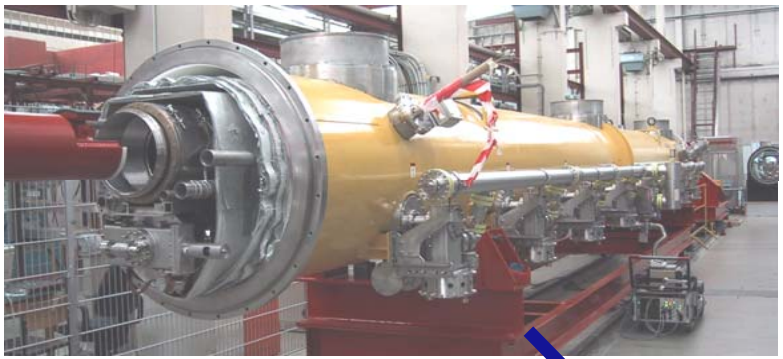
1. KEK (Tsukuba, Japan). Visits: June 2006 (I.Meshkov,G.Trubnikov) – signed MoU, October-November (50 days) – Dr. Yu.Korotaev, I.Kryachko for experiments with new KEK RF photogun (participation in design, assembly, tests of injector elements, study of different gun regimes). Collaboration in design and creation of new laser system for KEK “ILC drive beam”.
2. BINP (Novosibirsk). Visit of G.Shirkov and G.Trubnikov. Collaboration on photocathodes manufacturing and vacuum test benches for their assembly (P.Logachev, E.Levichev)
3. Institute for Applied Physics (Nizhny Novgorod). Several visits, last – 14 Dec’06. Collaboration and MoU on design and manufacturing of laser system for KEK and for JINR photoinjector test bench.

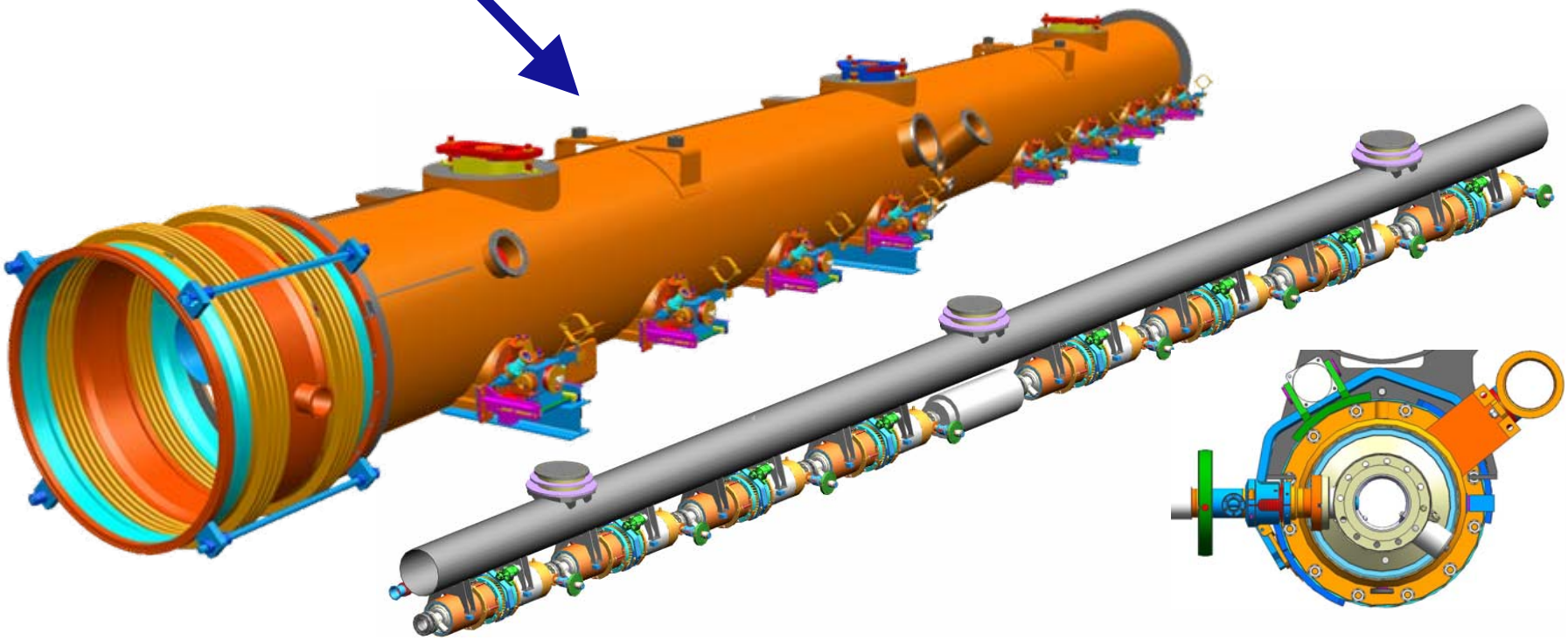
4. DESY (Hamburg and Zeuthen sites), December 2006, visits and negotiations of G.Shirkov and G.Trubnikov. Decision to collaborate and to coordinates activities in ILC at JINR with X-FEL & FLASH at DESY


KEK
16/10/2006

Design of 4th generation cryomodule prototype

- International collaborative Effort in the three regions
- Design changes are towards nailing down slot length of components
  - Costing should be straight-forward from TTF (and possibly XFEL) experience

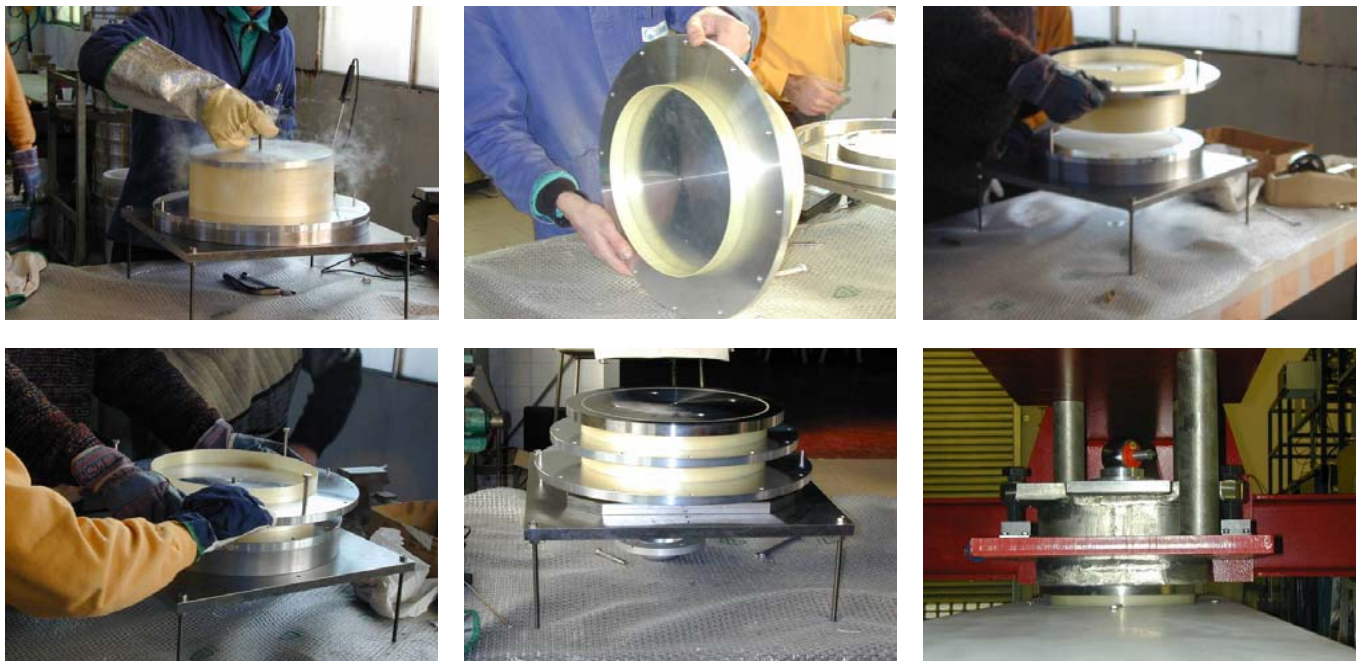




Collaboration with INFN (Pisa). Scientist from JINR for almost a year actively works in design bureau at INFN (Pisa). The task is to learn software and standards of cryomodule elements design (ANSYS, I-DEAS)

Several working design documents are created and successfully submitted by INFN and ZENON (Milan). Plans for the 2007 – to have few persons from JINR design bureau at INFN to be involved in.

Support Posts and Brackets



At JINR the activity on cryogenic diagnostics is already started and rather well developing and challenging.

Test bench with e- beam at LINAC-800

First beam obtained. Beam with energy of about 20-40 MeV – 2007. A lot of users (including possible ILC – irradiation of detector parts with beam) are ready (Dr.G.Shelkov & team).

Laser metrology

JINR developed test bench at CERN for precise laser metrology. Results ofAug'06 0,5 micron precision of laser beam position measurement on the base of 40m is achieved. At JINR it is planned to set this complex at b.118 (base is 2x250m).

Civil engineering

Very fruitfut collaboration with GSPI. All official documentations (Site Assessment Matrix, Work Breakdown structure, geological and geodetical characteristics) was made by GSPI in the frame of Contracts with JINR. Work is actively going on.

Damping Ring magnetic system simulations

Dr. N.Morozov (with group) in collaboration with INFN-LNF (S.Guiducci) works on design and modeling of magnetic system elements of DR. In near future plans Is design and creation of those elements prototype at JINR Workshop and providing their test.

VII International scientific workshop to the memory of Prof. V.P.Sarantsev

Problems of Charged Particle Accelerators: Electron-positron Colliders

Joint Institute for Nuclear Research (Dubna, Russia) and Budker Institute of Nuclear Physics (Novosibirsk, Russia)

Alushta (Crimea, Ukraine), September 02-08, 2007

Topics:

- ILC and linear electron-positron colliders
- Circular electron-positron colliders and factories
- New methods of acceleration and applied accelerators

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Welcome to JINR (Dubna)

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