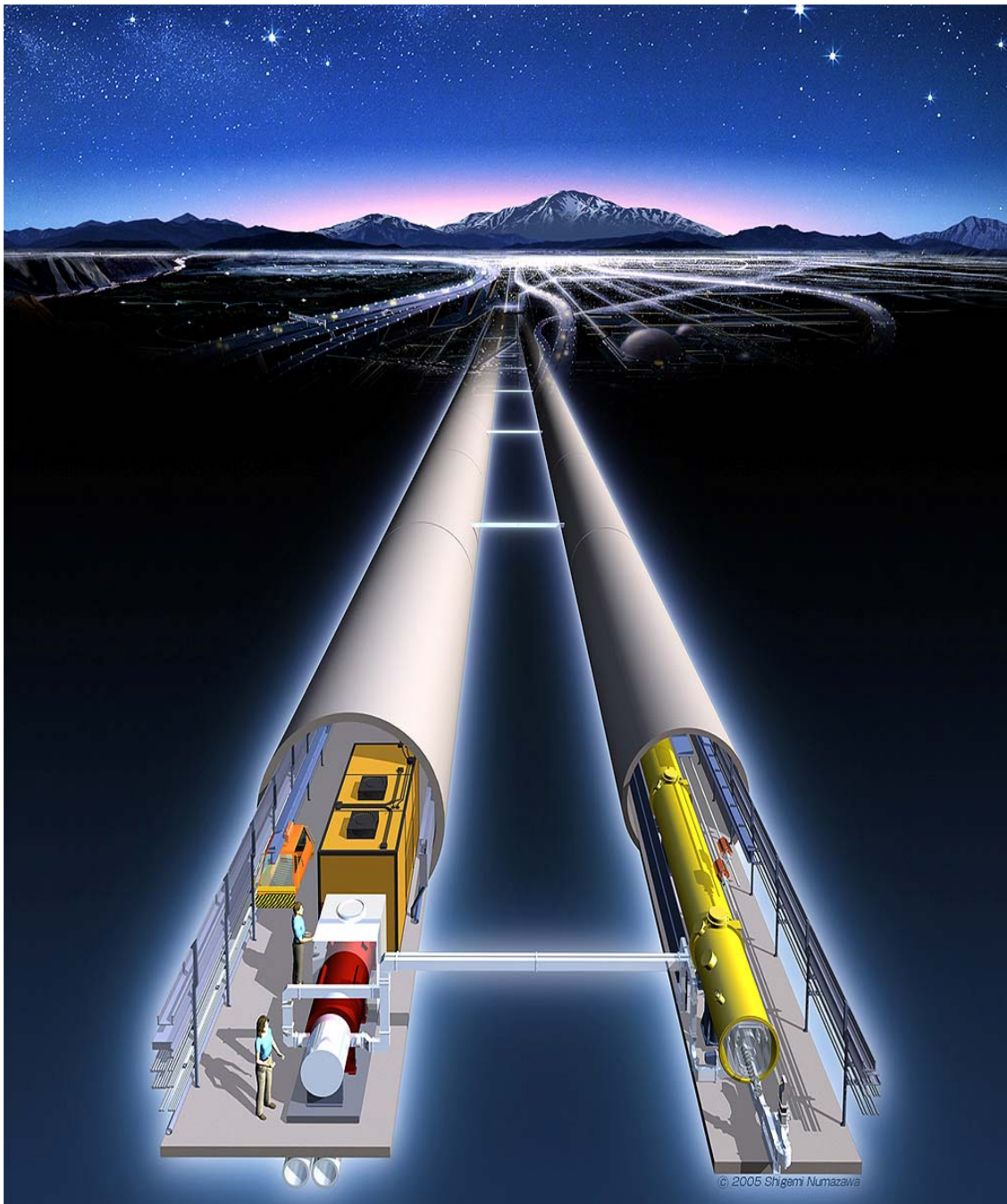


# The International Linear Collider (ILC) – Dubna Siting

*Leaders: JINR Director  
A. Sisakyan*

*JINR Head Engineer  
G. Shirkov*

**Международный  
Линейный  
Коллайдер**



# Schematic of the ILC

$e^- (e^+)$  source and delivery system

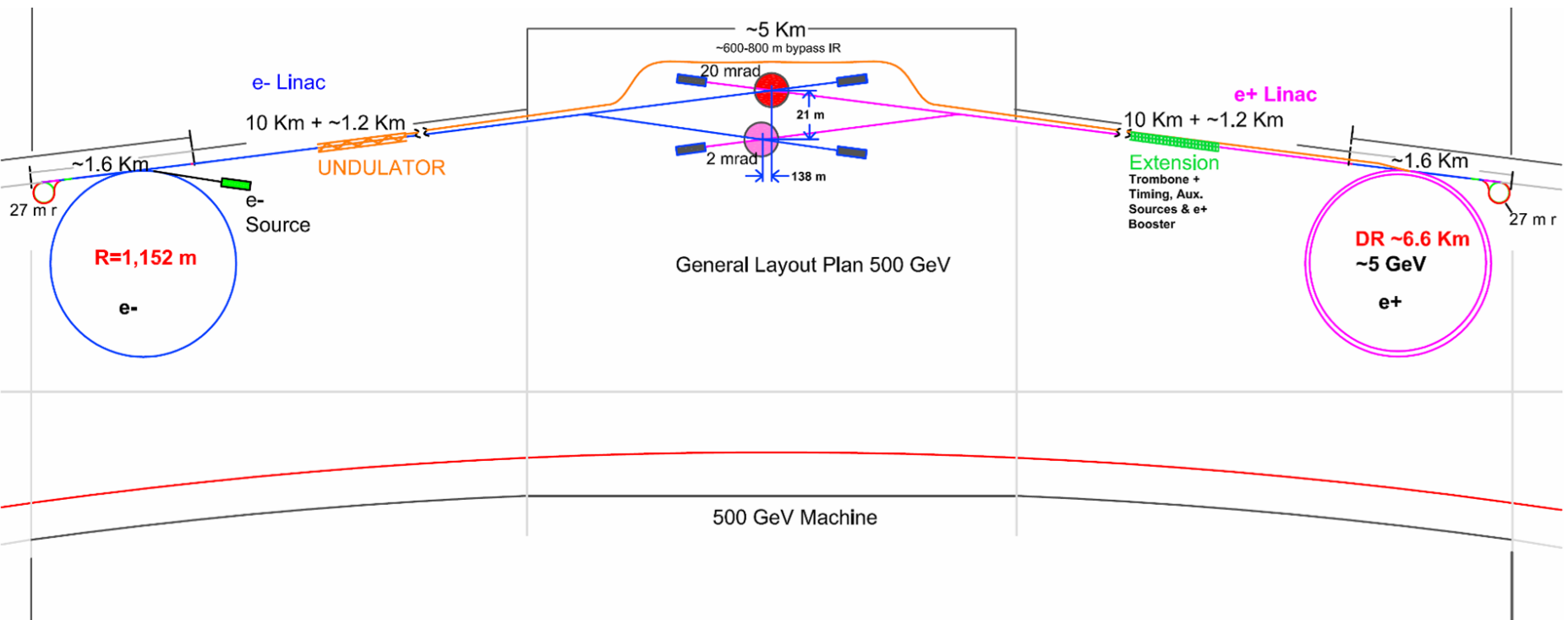
Damping Ring(s)

Ring(s) To Main Linac (RTML system)

Main Linac (ML)

Beam Delivery System (BDS)

Beam Dump (BD)



# ILC Site Power ~ 330MW

**Main Linacs**  
**140MW**

**Sub-Systems**  
**60MW**



**RF:**  
**90MW**

**Cryogenics:**  
**50MW**

Injectors

Damping rings

BDS

Auxiliaries

78%

60%

65%

**Beam** **22MW**





## ***Cryogenic Plants***



## ***Water Processing Plants***



## ***Electrical Substations***



# **ILC siting and conventional facilities in Dubna region**



# Joint Institute for Nuclear Research

*Dubna, Russia*

International Intergovernmental Organization

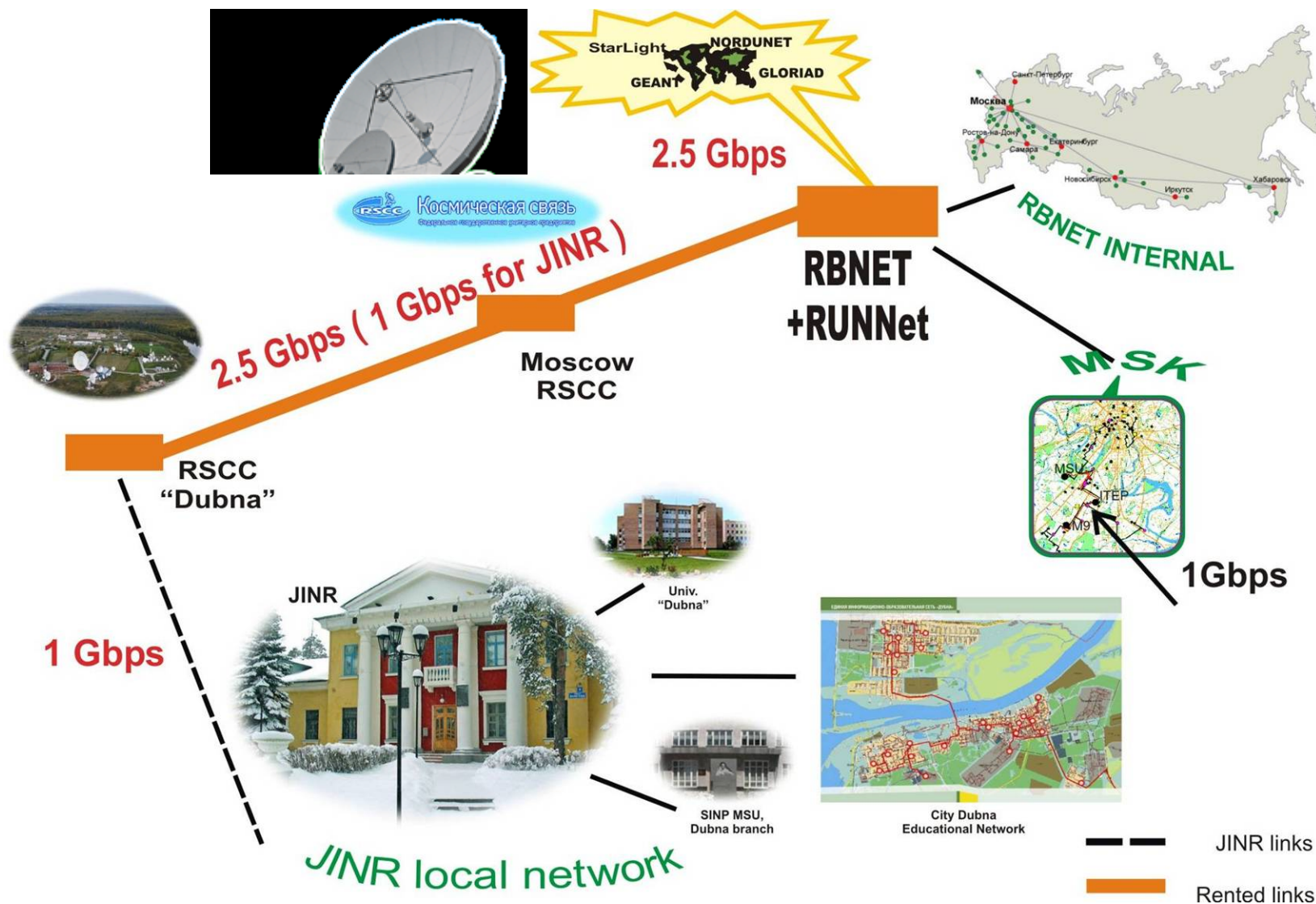


**18 member states; 4 associate members**

# Advantages of Location

- The international intergovernmental organization Joint Institute for Nuclear Research - prototype of ILC host institution;
- Experienced personal of JINR in accelerators, cryogenics, power supplies and etc.
- Infrastructure and workshops of JINR on the first stage of ILC project realization;
- The town Dubna provides with all the necessary means of transport to deliver all kinds of the equipment of the accelerator itself and its technological systems: highways, railways, waterways (through Volga river to Black sea, Baltic sea, Polar ocean);
- The international airport «Sheremetyevo» is situated at the distance of 100 km from Dubna (1.5 hours by highway);
- Developed Internet and satellite communication;
- A Special Economic Zone (industrial+scientific) in the Dubna region (Edict of Russian Government, Dec. 2005), provides unique conditions in taxes and custom regulations;
- A positive reaction received in preliminary discussions with the interested governmental persons and organizations in Russia.



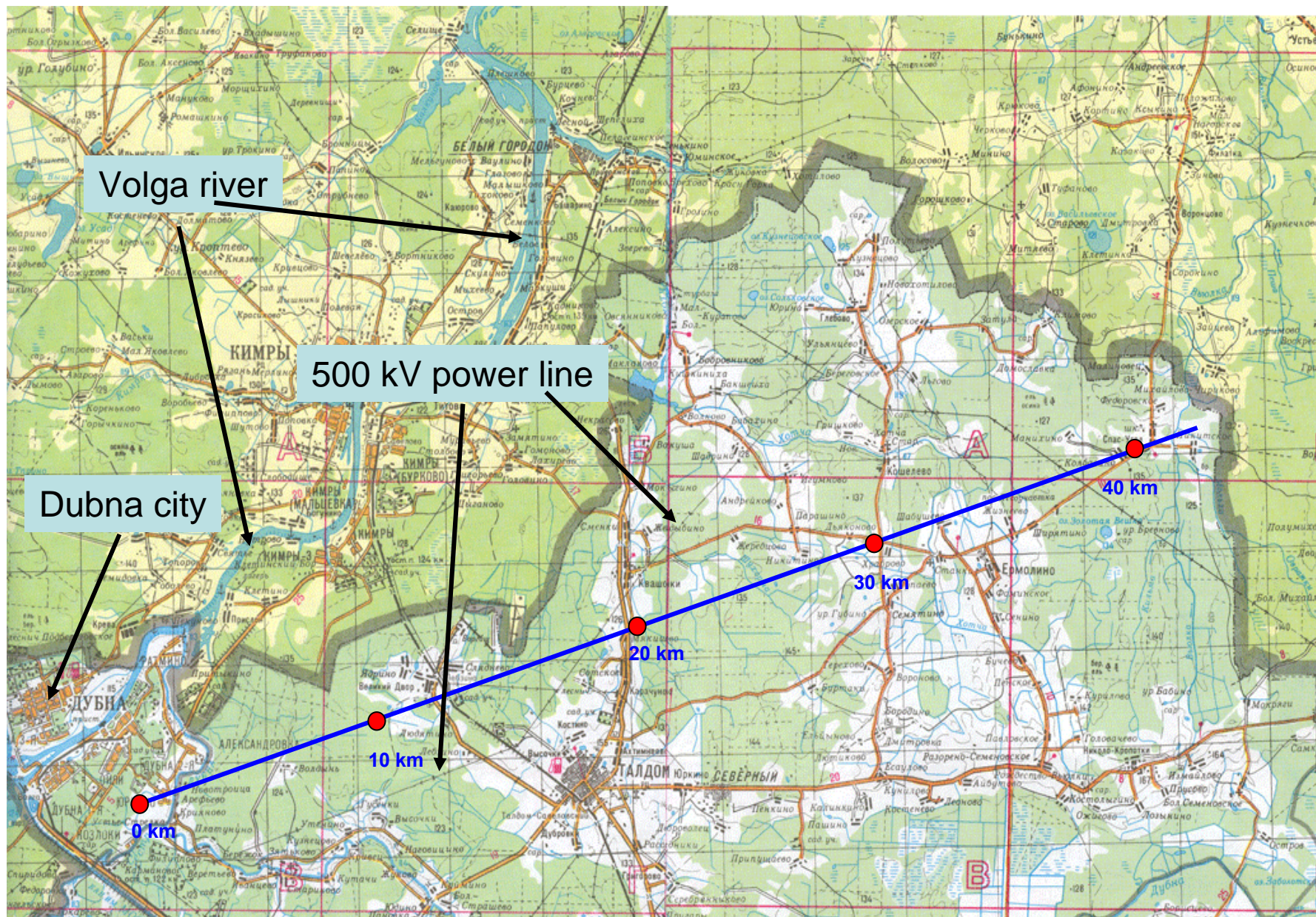




# Russian Satellite Communications Center







# Area and Climate

The area is thinly populated, the path of the accelerator traverses 2 small settlements and a railway with light traffic between Taldom and Kimry. Possible “line” crosses only the railway to Savelovo (of low utilization) and the River Hotcha with a very small flow rate.

The climate is temperate-continental. The mean temperature in January is  $-10.7^{\circ}\text{C}$ . The mean temperature in July is  $+17.8^{\circ}\text{C}$ . The mean annual rainfall is 783 mm. The mean wind speed is 3.2 m/s. Strong winds (15 m/s) blow only 8 days/year. According to the climatic parameters, the territory of Dubna is considered to be comfortable.



# Power and energetics

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).



# Relief

The area of the proposed location of the accelerator is situated within the Upper Volga lowland. The characteristic feature of this territory is the uniformity, monolithic character of the surface. The existing rises of the relief in the form of single hills and ridges have smoothed shapes, soft outlines and small excesses. The territory of the area is waterlogged. The absolute marks of the surface range from 125 to 135 m with regard to the level of the Baltic Sea.

*The difference of surface marks is in the range of 10 m only on the base of 50 km.*

# Geology

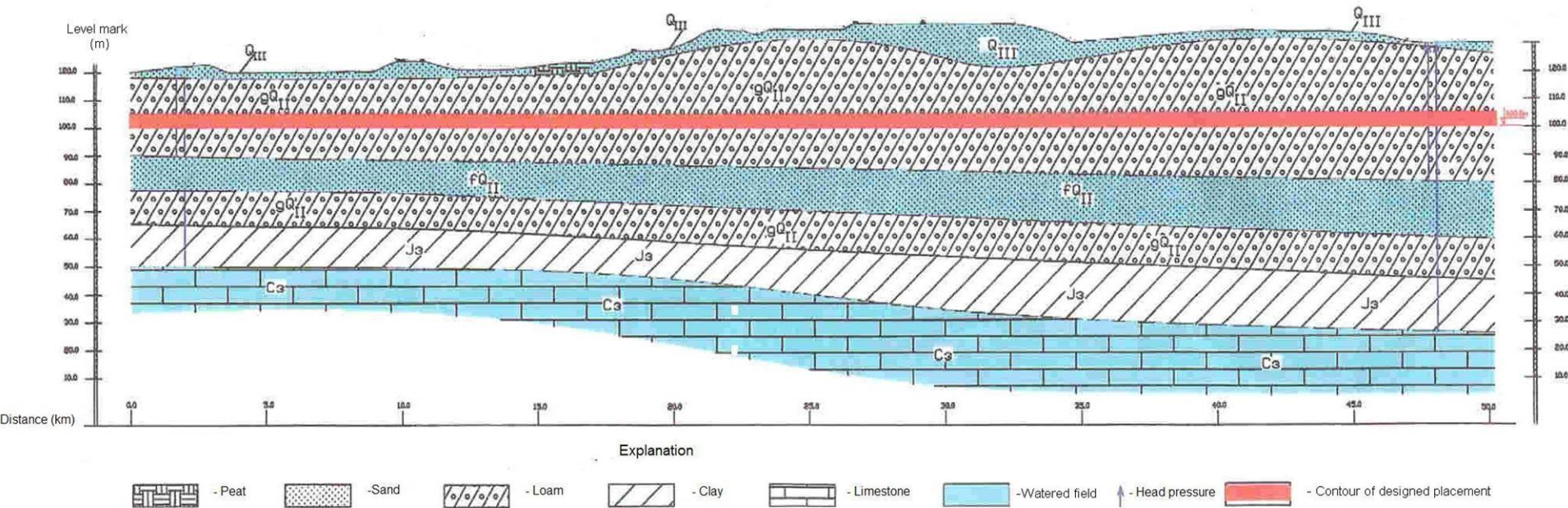
The area of the proposed location of the accelerator is situated within the Russian plate – a part of the Eastern European ancient platform – a stable, steady structural element of the earth's crust.

The Russian plate, like all the other plates, has a well-defined double-tier structure. The lower tier or structural floor is formed by the ancient – lower Proterozoic and Archaean strata of metamorphic and abyssal rocks, which are more than 1.7 billion of years old. All these strata are welded into a single tough body – the foundation of the platform. The area of the ILC accelerator is located in the southern part of a very gently sloping saucer-shaped structure – the Moscovian syncline.

Alluvial deposits i.e. fine water-saturated sands, 1-5 m of thickness. Below one can find semisolid drift clay of the Moscovian glaciation with exception of detritus and igneous rocks. The thickness of moraine deposits is 30-40 m.

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).



# Documentation and Cost Estimation

*JINR prepared and filled the following  
Documents for the possible hosting ILC:*

**BCD document (Conventional Facilities part)**

**Site Assessment Matrix**

**First official document from Russian State Project Institute with estimations on:**

**Conventional facilities cost**

**Siting (tunnel, land acquisition) cost and time schedule**

**Energetics 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\$.



# JINR participation in ILC

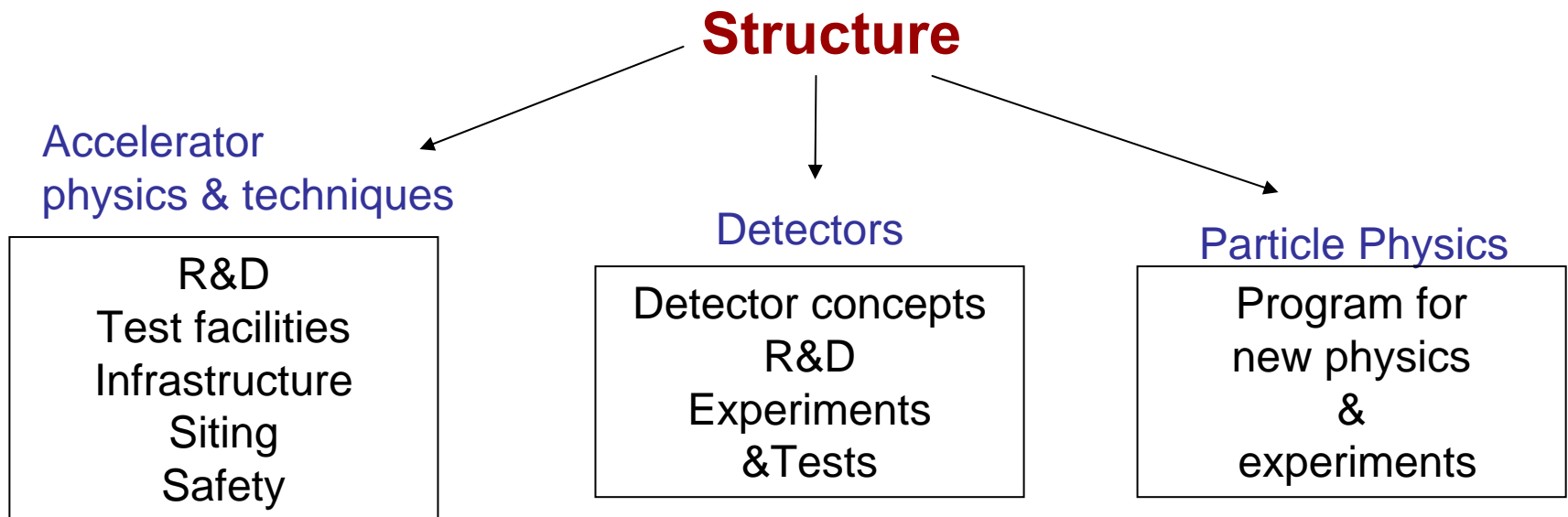


## Scientific Council of JINR (20.01.2006):

- encourages JINR to be involved in the ILC design effort and to invest appropriate resources in scientific and technological developments to support its ability to play a leading role in the ILC project;
- supports the intention of JINR to participate actively in the ILC project and the possible interest of JINR to host the ILC

**JINR Committee of Plenipotentiaries** approved this recommendation on 25.03.2006

*The Committee of Plenipotentiary Representatives of the Governments of the Member States is **the supreme body governing the Institute.***



## 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);
- February 2007** - **GDE in China** – Conceptual report of GDE,  
G.Shirkov -> Directorate of GDE

# JINR at ILC - accelerator

**New theme 02-0-1067-2007/2009**

**JINR participation in design, construction and testing of prototype elements of the ILC accelerator complex (2007-2009).**

**Leader: A.N. Sisakian G.D. Shirkov**

**Deputies: E.M. Syresin, G.V. Trubnikov**

**Studying problem and main goal of researches:**

Development and creation of accelerator complex elements, study of the beam dynamics in linear colliders.

**Participating countries and international organizations**

**Belarus, Germany, Italy, Russia, USA, Japan, CERN**

1. Creation of the ILC injection complex prototype. Development and study of electron sources on the base of photocathode and control laser system. Creation and launching of the electron injector prototype with RF or DC gun.

2. Development and creation of the test facility on base of the electron linear accelerator LINAK-800 for testing with high-energy electron beam of accelerating RF resonators, beam parameter diagnostics and transportation channels prototypes for ILC. Creation of the free electron laser on the base of photo-injector and linac LINAK-800. Development and testing of RF system elements of the linear accelerator.

3. Researches on possible creation of high-precise metrological laser complex with extended coordinate length up to 20 km.

4. Development and creation of cryogenic modules for the acceleration system of linac. Participation in creation of design documentation (work drawings) in ANSYS standard for manufacturing at ZANON (Milano) plant the first cryostat prototypes for ILC.



5. Preparation of design documentation on creation of hardware-software complex and facility for study of cryomodels, with the goal of further transition to production of documentation for mass cryostats fabrication and/or their element with referring to technologies and standard group of of the work performers.
6. Theoretical study of electron beam dynamics in transportation channels using software packages, calculation of electric and magnetic fields in accelerating structures, transportation systems and systems of  $e^-/e^+$  beam formation.
7. Preparation of the project of hardware-software complex for studies of radiation stability of superconductive materials using powerful  $\gamma$ ,  $e$ ,  $n$  beams
8. Engineering studies and design works with purpose of the study and preparing the possible hosting of ILC in the region near Dubna.
9. Development of the magnetic systems of ILC. Calculation on choosing parameters of electromagnetic elements for Damping Rings (DR). Development and creation of the magnetic systems on base of superconducting and warm electromagnets, also for constant magnet variant.

## LINAC – 800

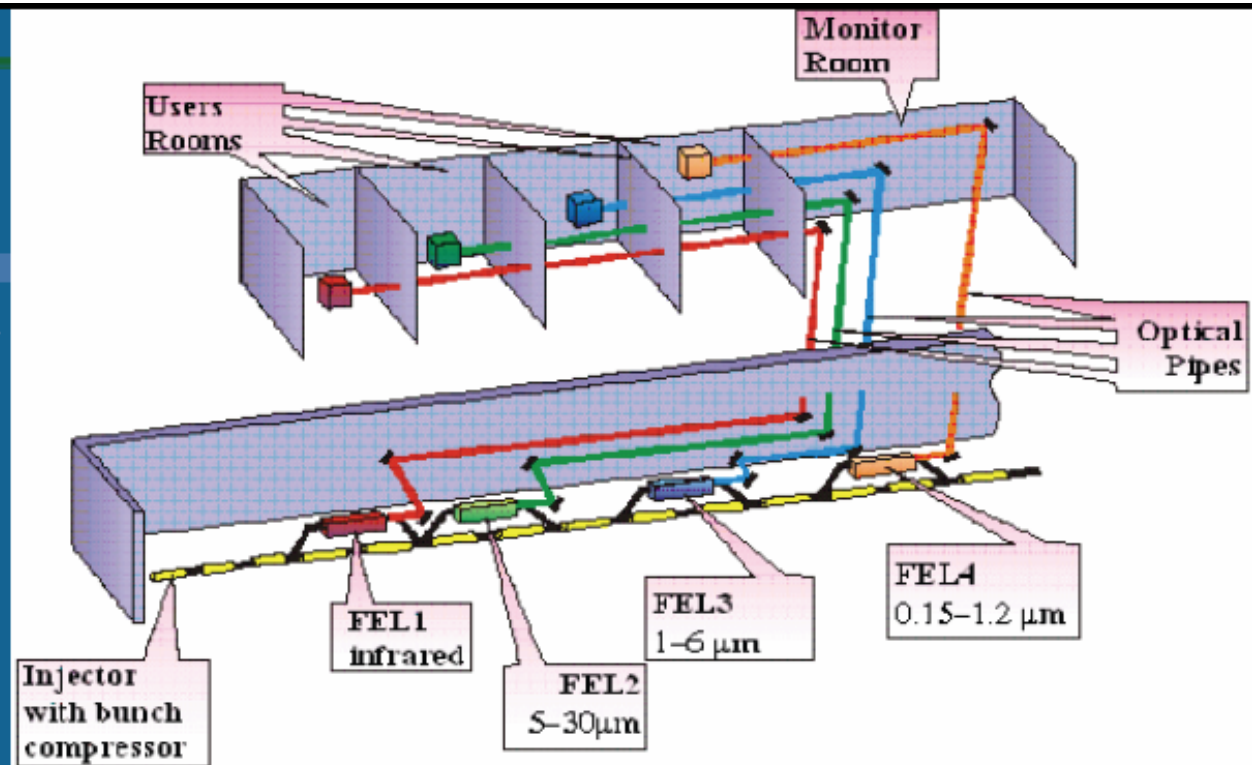
LINAC-800 parameters:

- 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)*

# **JINR in the ILC - physics and detector R&D**

02-0-1062-2006/2008 Leader: A.G. Olshevski

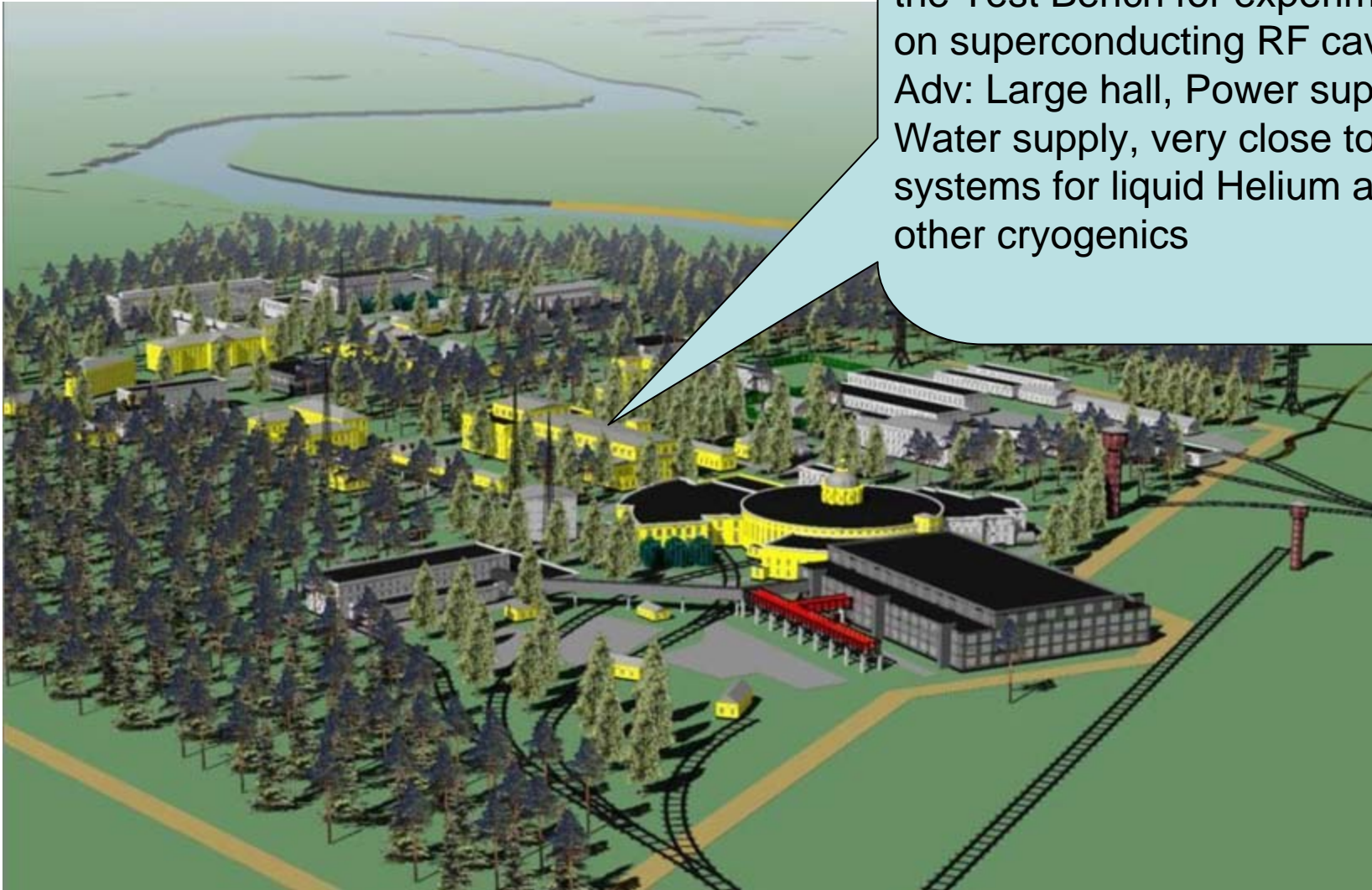
## **Studying problem and main goal of researches:**

The analysis of precision measurements in the framework of the Standard Model (SM). For this analysis a worldwide known tool, ZFITTER, has been developed by the group of D.Bardin from JINR.

- Beam energy measurement
- The R&D for the Luminosity Calorimeter with diamond sensors.
- The Hadron Calorimetry with very new and promising photo-detector SiPM
- Forward Tracking - the development of the reconstruction algorithms and detector optimization.

**Participating countries and international organizations**  
**Belarus, Germany, Italy, Russia, USA, Japan, CERN**

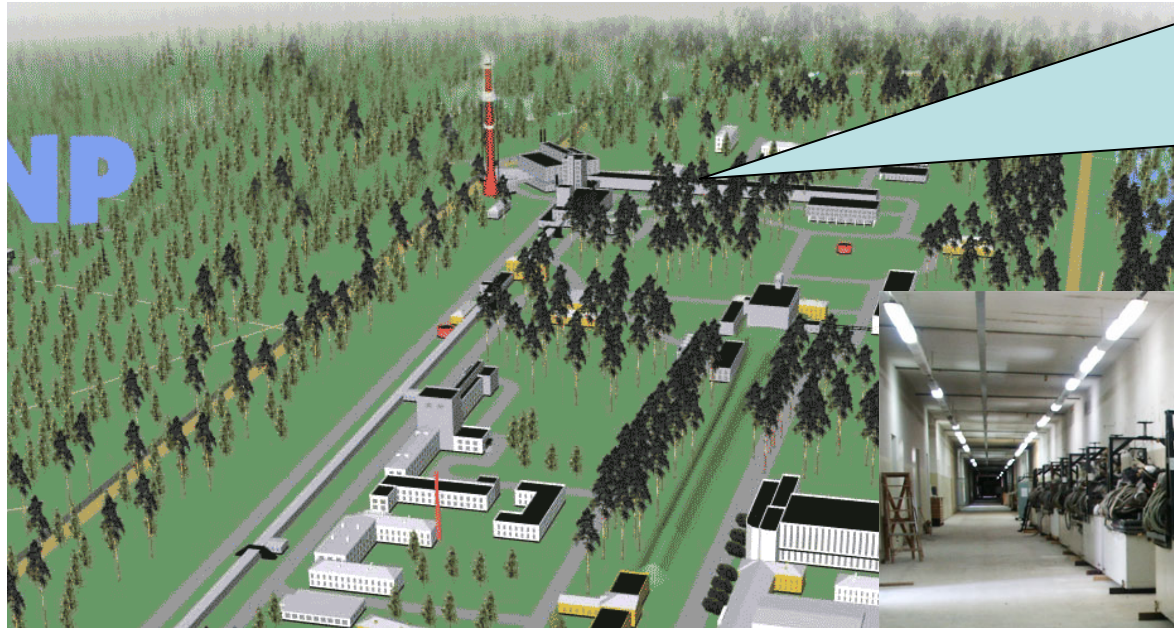
# LHE ground



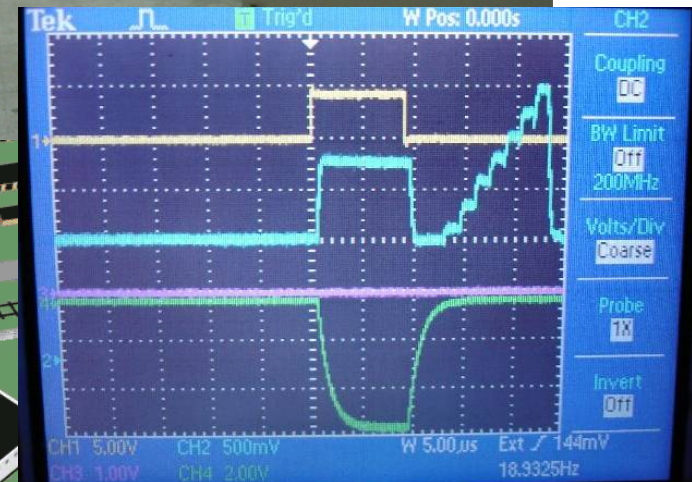
Machinery Hall # 2:  
Possible place for location of  
the Test Bench for experiments  
on superconducting RF cavities.  
Adv: Large hall, Power supply,  
Water supply, very close to  
systems for liquid Helium and  
other cryogenics



# LNP ground



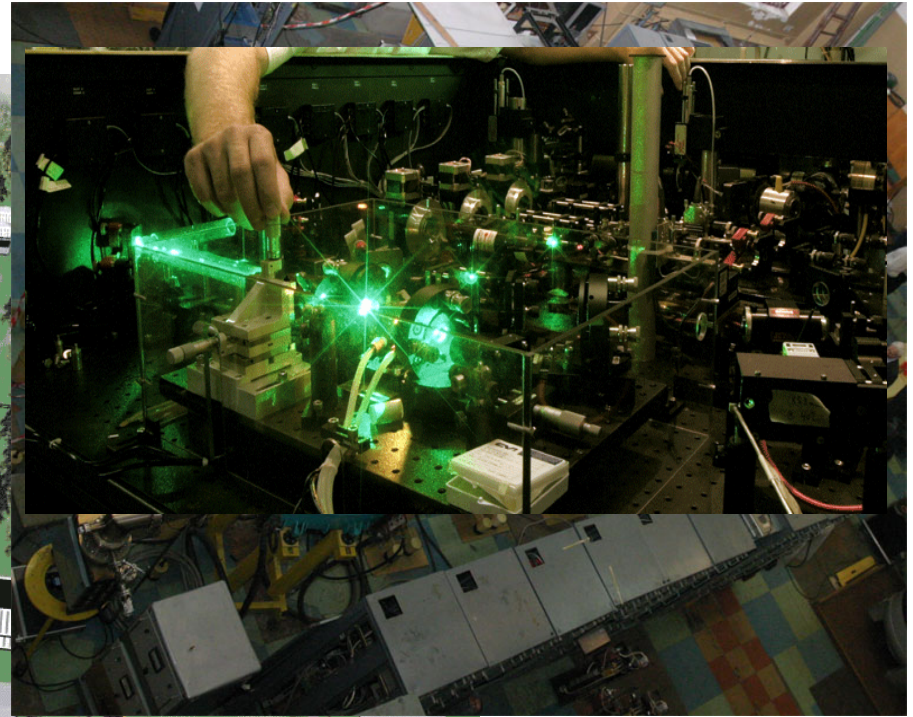
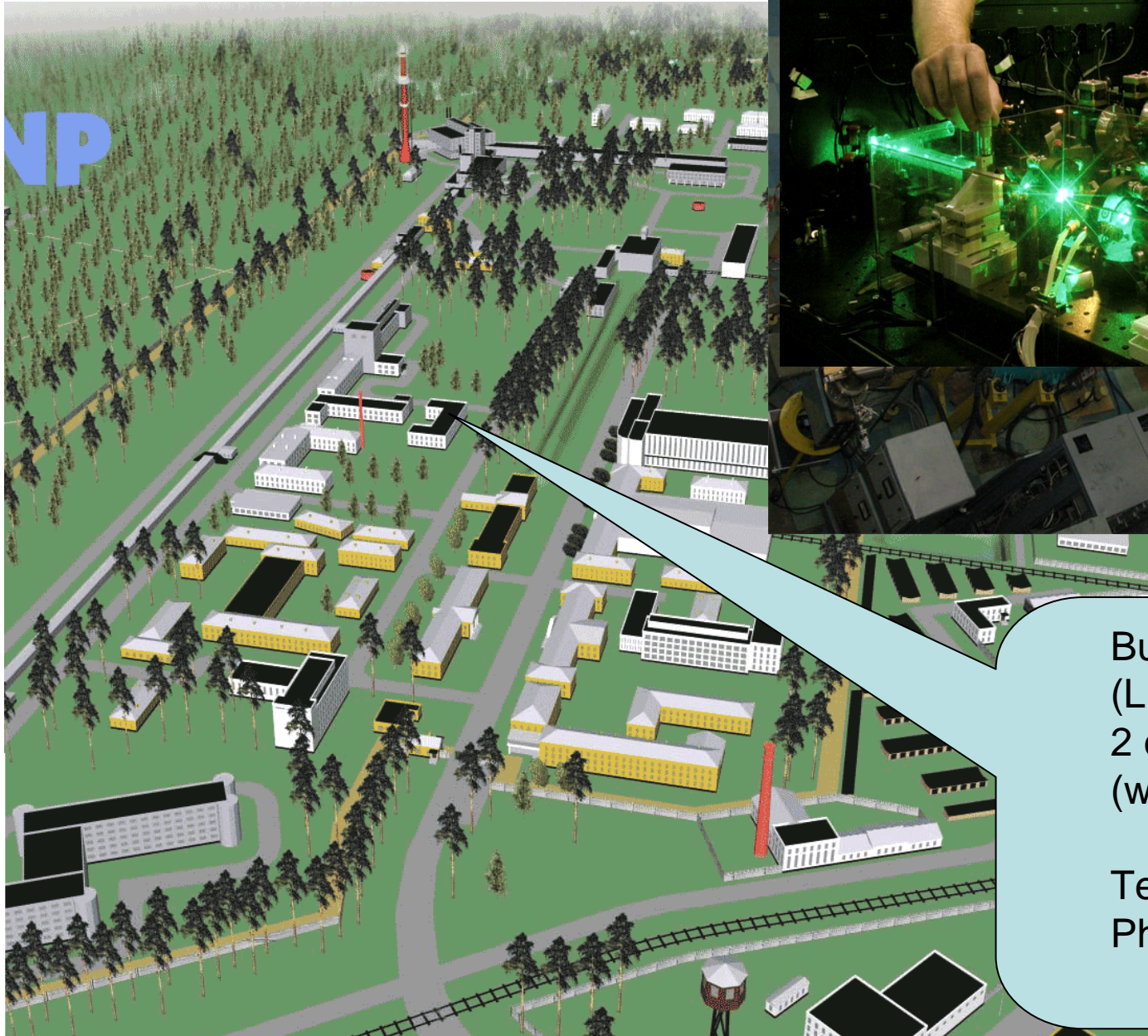
Building 118  
Location of constructed  
LINAC-800.  
Test of RF accelerator  
sections and cryo modules  
LINAC with super-



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



# Welcome to JINR (Dubna)



Thank you  
for your attention !

The materials of the talk of G.Shirkov at CALC-2006 were used.