ILC SITING IN MOSCOW REGION NEAR DUBNA AND ILC RELATED ACTIVITY AT JINR

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Abstract

The investigations on ILC siting in the Dubna region and ILC technical activity at JINR are presented. International intergovernmental status of JINR, stable geological and plain relief conditions, comfortable location and well developed infrastructure create a set of advantages of the JINR site in the neighborhood of Dubna. The shallow layout of accelerator tunnel makes it possible to use a communication gallery at the surface instead of second one. This is an effective way of significant cost reduction of all conventional facilities and explicit labor of the project.

Besides JINR physicists take part in several fields of activity in ILC: works on photo injector prototype, participation in design and construction of cryomodules, laser metrology, etc. [1].

INTRODUCTION

The last Global Design Effort (GDE) and ILC Steering Committee (SC) meetings took place at JINR, in Dubna on June 3-7, 2008. These meetings were dedicated to ILC convention facilities and siting and were focused at proposals of JINR [2]. The meetings finished with helicopter flight for leaders of ILC SC and GDE along the ILC possible layout (Fig. 1).

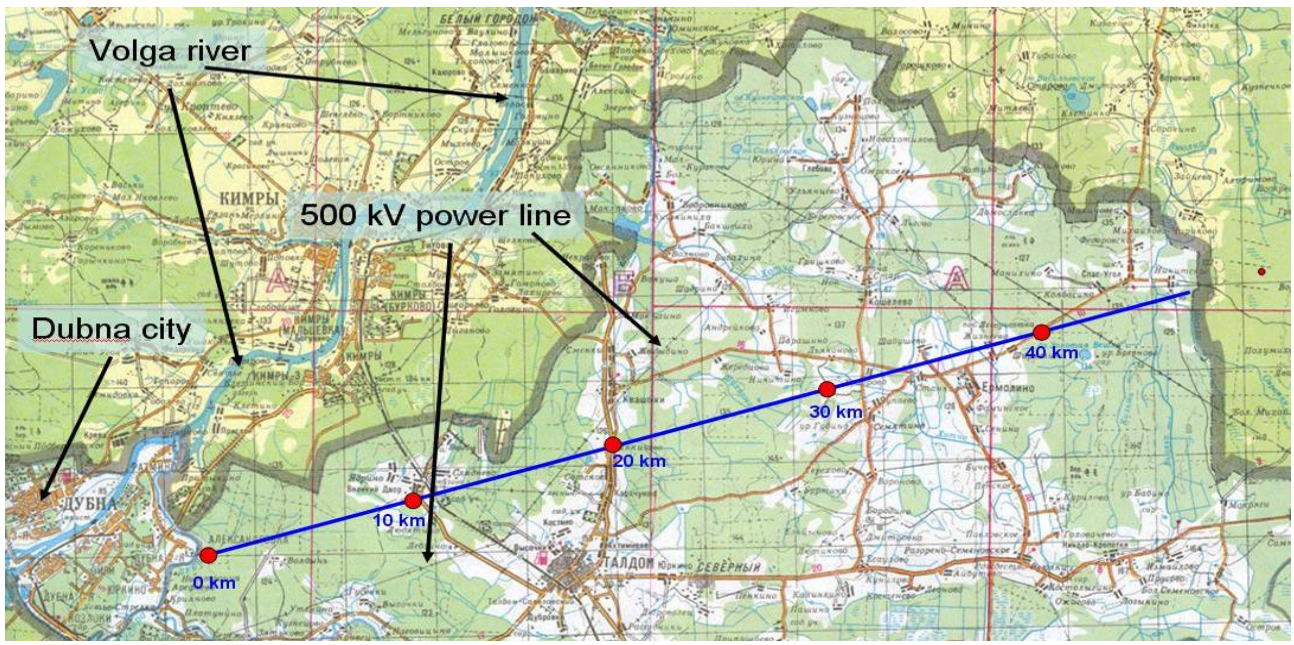

Figure 1: Planned location for ILC near Dubna, Moscow region.

The international scientific community has demonstrated a considerable interest to the proposal of ILC construction in Russia, in Dubna region, where JINR has essential benefits and privileges as an International Intergovernmental Organization and has a unique experience of organization and successful realization of large-scale research projects based on wide cooperation of scientific centers and industrial enterprises of many countries.

Taking into account that the ILC project is considered by the international scientific community as a strategic priority in the field of high energy physics after the LHC era, the International Scientific Council of the JINR has supported the idea of ILC siting in the Dubna region and has recommended to take part in preparation of the collider project. These recommendations had been approved by the Committee of Plenipotentiaries of the JINR Member States. The ILC project and it's siting in the Dubna region have been discussed and supported at different meetings of the Russian Academy of Sciences (RAS).

The initiative to host the ILC in the Dubna site has been strongly supported by the Moscow region governor B. Gromov.

DUBNA SITE DESCRIPTION

The ILC linear accelerator is proposed to be placed in the northern part of Moscow region to the north-east from the existing scientific center JINR in the town Dubna (Fig. 1). This area is thinly populated, the path of the accelerator traverses only two small settlements and a railway with light traffic between the towns Taldom and

Kimry at the distance up to 50 km from Dubna. The region is mainly covered with forest with small inclusions of agricultural lands (see Fig. 2) and it is uniform along the line of 150-200 km in this direction.

Figure 2: The typical view of ILC proposed area from helicopter.

This area is situated within the Russian plate, a part of the Eastern European ancient platform, is a stable, steady structural element of the earth's crust. 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 Baltic Sea level (see Fig. 3).

The ILC area is located in the southern part of a very gently sloping saucer-shaped structure – the Moscovian syneclise. Alluvial deposits are bedded above, i.e. fine water-saturated sands, 1-5 m of thickness. Below one can find semisolid drift clay of the Moscovian glaciations with inclusions of detritus and igneous rocks. The thickness of moraine deposits is 30-40 m. Under the moraine of the Moscovian glaciations fluvioglacial water-saturated sands and loams of the Dnieper glaciations are bedded. Jurassic clays and carboniferous limestone of the platform mantle are spread under the overburdens at the depth of 50-60 m. This has been confirmed by the geological survey carried out during the selection of site for construction of the U-70 accelerator.

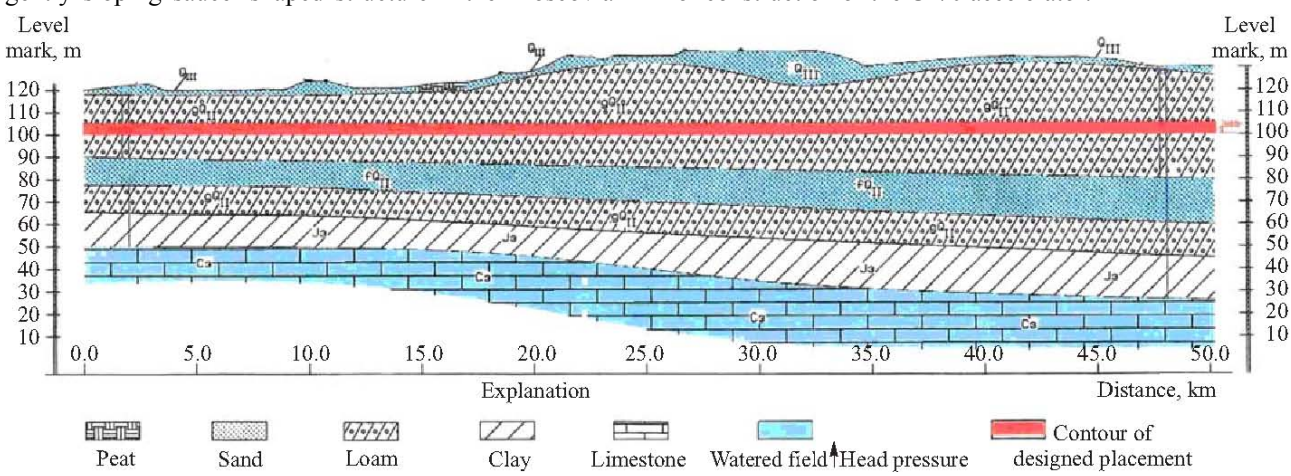

Figure 3: Engineering-geological sectional view along the ILC path axis.

The ILC linear accelerator is proposed to be placed in the drift clay at the depth of 15÷25 m so that below the tunnel there should be watertight soil preventing from the underlying groundwater inrush. This will make it possible to construct tunnels of the accelerating complex using tunnel shields with a simultaneous wall timbering by tubing or falsework concreting. Vertical shafts, experimental and service halls, and some other

underground service volumes could be constructed in the cut and cover way and this should sufficiently reduce the price of civil engineering construction.

JINR and Dubna have at their disposal all the necessary infrastructure to accommodate specialists for the period of the accelerator construction, to accumulate the equipment, to provide for the project-production support during manufacturing of the special-purpose equipment at the enterprises located in Dubna and the region. The town Dubna possesses all the necessary means of transport to deliver all kinds of the equipment of the accelerator itself and its technological systems: highways, railways, waterways (the Volga River and Moscow channel). The international airport "Sheremetyevo" is situated at the distance of 80 kilometers from Dubna.

The northern part of Moscow region and the neighboring regions have enough of objects of generation, transmission and distribution of electrical energy. There are first-rate generating stations: the Konakovo electric power station and the Udomlia atomic power plant. Two trunk transmission lines with the voltage 220 and 500 kV pass through the territory of Dubna and along to the possible ILC line. The preliminary study of the existing possibilities of the power supply for the accelerator and its infrastructure with the total power up to 300 MW resulted in the convenient variant: construction of the 220 kV power line, 35-40 km long, directly from the center of generation – the Konakovo power station to the central experimental zone of the accelerator.

ONE TUNNEL SOLUTION

A possible one-tunnel solution for the accelerator structure and convention facilities for Dubna site is presented in Fig. 4. The scheme is as follows:

- the main technological tunnel with accelerating structures, magnetic elements for beam focusing and diagnostics means will be put on depth of ~ 20м so that from below and above the tunnel there will be an impermeable stratum preventing break of underground waters;
- communication tunnel (collector) will be placed directly above the technological one near the ground surface at the depth of 3-4 m practically following its form. This tunnel is necessary for power supplies, RF power sources, data storage devices, electronic and control systems, etc.;
- technological connection between the accelerator tunnel and collector will be provided by vertical shafts of various diameters made by drilling;
- connection of ground and underground structures will be provided by vertical and horizontal shafts (stairs, elevators, etc).

The one-tunnel design is economically and technically preferable for a number of reasons:

- communication tunnel practically can be of any size to discharge the basic tunnel. Moreover it can be made by open way that is rather inexpensive;
- vertical communication service lines (service ducts) can be made by means of drilling that is rather cheaper then underground horizontal lines; their number and sizes can be optimized, and waterproofing will not be required as well;
- export of ground waters will be performed directly on the surface without pumping facilities;
- operation of communication tunnels will be substantial simplified;
- technological and cable communications between the communication tunnel and ground buildings and constructions will be considerably reduced.

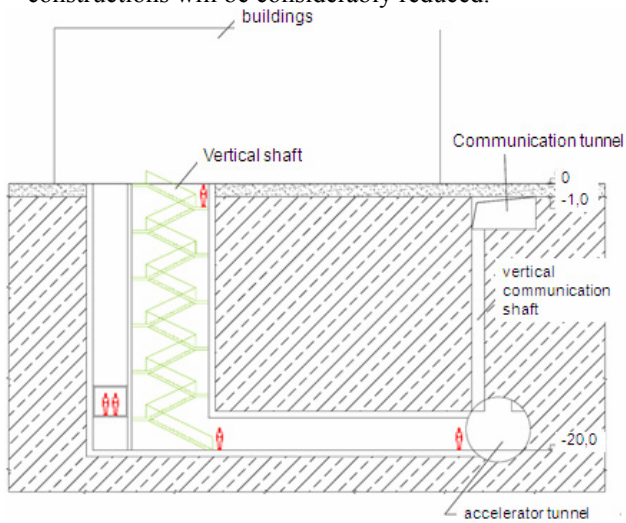

Figure 4: One tunnel solution.

ILC ACTIVITY AT JINR

The JINR is carrying out active work to develop international cooperation in the ILC project and in the related projects, in the XFEL and CLIC projects in particular. The scientists from JINR participate in all international forums and committees on the ILC. JINR has successfully organized wide cooperation in Russia in order to perform experimental and theoretical investigations on the project with Russian research centers: BINP of Siberian Brunch of RAS, Institute for Applied Physics (IAP) of RAS (Nizhniy Novgorod), GSPI, Physical Institute of RAS etc.

JINR in collaboration with KEK (Japan), DESY (Germany) and IAP of RAS is carrying out research and design works for creation of the injector, an electron source on the base of a photoemissive gun. Creation of the test bench to study properties of photocathodes, new materials and also creation of new unique laser system are planned (Fig. 5). The test bench on the base of the linear accelerator of electrons LINAC-800 for adjustment of beam diagnostics tools will be made in JINR. The injector will be a part of the bench.

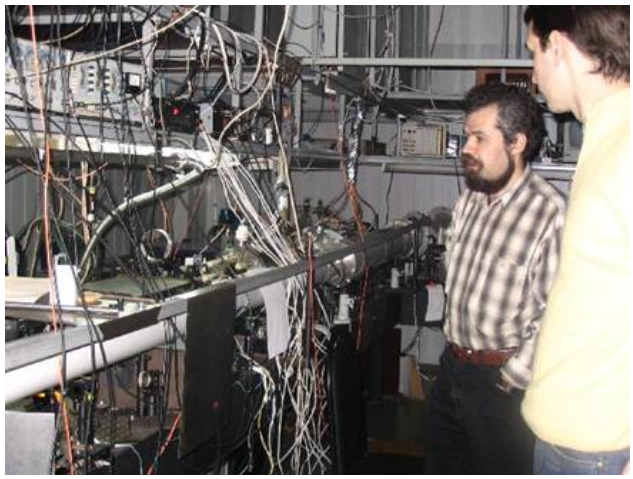

Figure 5: JINR and IAP experts at the superpower laser system at IAP of RAS in Nizhniy Novgorod.

Specialists from JINR and VNIIEF (Sarov) have studied the production of bimetal tubes (stainless steel and titanium) by explosion welding (Fig. 6). The tube is used as a transitional load-bearing element in the 4th generation cryomodule construction for the ILC.

Figure 6: Explosion welding of bimetal tubes.

The R&D works have result in developing the pilot technical process for production of bimetal billet of the tube by explosion welding and researching a micro-structure of the weld joint.

JINR develops a test bench at CERN for the precise laser metrology. The precision of 1.0 micron of laser beam position is achieved on the base of 100 m. At JINR it is planned to set this system at the LINAC-800 accelerator complex on the base of 2 x 250 m.

DR magnetic system simulations and magnet prototype construction in collaboration with SLAC are in progress. The aim is to design and possibility to construct and to test at JINR a series of magnetic system elements (dipole magnets) of ILS damping ring.

A series of activities in the field cryogenic engineering and diagnostics has been started and well developed at JINR.

CONCLUSION

The main advantages of the ILC construction in Dubna are as follows:

- JINR as a basic international intergovernmental organization.
- 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.
- The proposed territory is extremely thinly populated and practically free of industrial structures, rivers and roads.
- The area is absolutely steady seismically and has stable geological characteristics.
- A flat relief and geological conditions allow to place ILC on a small depth in the dry drift clay and to perform construction of tunnels, experimental halls and other underground objects with the least expenses, including cut-and-cover.
- The only one shallow tunnel with accelerator structures and communication gallery on the surface
- Sources of the electric power of sufficient capacity.
- The developed system of transport and communication services.
- Presence of a modern network and information infrastructure, including one of the largest Satellite Communication Center.
- The special economic zone of Dubna with preferential terms for high technology technical production.
- A powerful scientific and technical potential of Dubna town.

Realization of such a wide scale project namely in Dubna will let Russia to become in a perspective future by a leader and center of attraction for scientists from Russia and neighbor countries. Another obvious factor is an attraction of significant investments and financial resources at all stages of the project including further exploitation of the new accelerator center during long years. Creation of ILC accelerator complex as international collaboration will raise prestige of the fundamental science in a total and the role of Russia as one of the world leader.

REFERENCES

[1] G. Trubnikov, Yu. Budagov, Yu. Denisov et al. ILC. International Linear Collider, JINR Communication D9-2008-78, edited by A.Sissakian and G.Shirkov, Dubna, JINR, (2008), 15.

[2] http://www.linearcollider.org/.