ILC ACTIVITY AT JINR AND SITING IN DUBNA REGION

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Abstract

JINR actively participates in ILC project. JINR physicists are taking part in several fields of activity in ILC: works on photo injector prototype, participation in design and construction of cryomodules, laser metrology, etc. Moreover Joint Institute is officially approved candidate for possible hosting of ILC in the region near Dubna. International intergovernmental status of JINR, comfortable location of site, well developed infrastructure, geological, climate and relief conditions may become powerful advantages of Dubna siting among other proposals of ILC location. All above mentioned topics are discussed in the presented report.

INTRODUCTION

Prominent achievements of the fundamental science form the material and technical basis of the modern civilization. The crucial role here belongs to the elementary particle physics. Its main discoveries and laws are the result of complicated experiments, many of which have been carried out on beams of the elementary particle accelerators.

Expressing the undivided opinion of many leading scientists of the present time, the International Committee for Future Accelerators (ICFA) and the International Union of Pure and Applied Physics (IUPAP) declared about the major decision to join efforts of world scientific centers in construction of the advanced accelerating complex – the International Linear Collider (ILC) [1].

The unprecedented task of the ILC is to provide measurements in the field of elementary particle physics at the unprecedented accuracy in the wide region of maximally high energies of colliding particles (electrons and positrons). The possibility of energy variation (in the system of the center of mass of colliding particles from 500 to 1000 GeV) is of key importance to provide the maximal accuracy of measurements.

Today the ILC project is seen as a completely international scientific project, which must be developed, financed, governed, maintained and exploited in the framework of the wide international scientific cooperation organized properly.

The following main parameters of the facility are recommended at the international meeting in Snowmass. The luminosity at the energy of electrons 500 GeV is $2 * 10^{34}$ cm^2 s^{-1}. For a 500 GeV facility based on the resonator of the TESLA type the maximal acceleration rate of all the 20000 resonators must be 35 MV/m and operating gradient – 31.5 MV/m at the length of each of two linear accelerators 10.6 km. At the subsequent increase of energy up to 1 TeV the resonators having the maximal gradient 40 MV/m and operating gradient 36 MV/m are recommended, which will lead to the increase of length for 9.3 km of each of two linear accelerators (Fig.1). In this case, the total length of two linear accelerators will be about 40 km and the length of the whole facility (total tunnel length) – about 50 km.

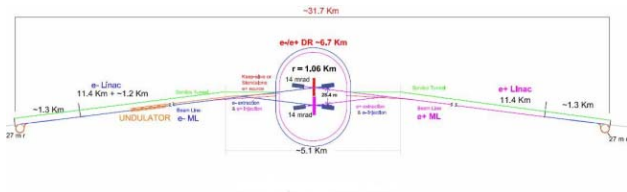

Figure 1. Schematic layout of the 500 GeV machine

PROJECT ORGANIZATION

Organization and scale of the works to construct the ILC accelerator are unprecedented. Wide interstate relations at every stage of the project realization will allow the participants to use mutually the best scientific and technological achievements in their countries. Involvement of scientists and specialists from the Russian Federation (RF), JINR and its Member States in a high-tech project of the accelerator construction of such scale will contribute to accelerated development of advanced technologies in these countries and, first of all, in Russia. By now scientific, technological and organizational development in the framework of the ILC project has started. In accordance with the schedule, the basic and alternative configurations of the facility have been formulated at the end of 2005. As a result, the Baseline Configuration Document (BCD) has been prepared. On the basis of this document in the course of 2006 the designing is carried out, the cost is estimated and the physical program of investigations at ILC is formed. The accelerator project is worked up by scientists and specialists from leading research centers and engineering companies of America, Asia, Europe, including Russian Institutes and JINR in Dubna.

COST OF THE PROJECT

Currently, cost of the full-scale ILC project is estimated about 8-9 B$, by the GDE. The estimate is performed for the ILC length of 50 km and is obtained by the extrapolation of the approximate cost of the TESLA collider, 33 km long, (Germany). The cost of experimental installations is not included here. Expenses for labor resources are not taken into account either, since they are proposed to be covered by the organizations participating in the project. The given estimate will be corrected after preparation of the BCD document, which will make the ILC parameters clearer.

By the GSPI (Moscow) specialist estimate, in case of placing the accelerator in the vicinity of Dubna, the total cost of building and assembly works of underground and

overground facilities of the main construction will be 2.3 B$, according to the summary estimated calculation in prices of 2006. This cost includes the cost of tunnel construction of the linear accelerator itself and all of its technological systems and shafts about 1 B$.

The cost of power supply objects, which are necessary to erect in order to provide the electric power from the power supply sources at a reduced rate is 170 M$.

According to the preliminary plans, the country interested in the ILC construction on its territory finances no less than 30 % of the project realization cost.

LOCATION

The contemporary international scientific community has shown a considerable interest to the initiative to construct ILC in Russia, in Dubna, 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. The main advantages of the ILC construction in Dubna are as follows:

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. The agreement between the Russian government and JINR on the special status of the scientific organization has been put into effect by the Federal Law from January 2000;

2. Experienced personal of JINR in accelerators, cryogenics, power supplies and etc. Infrastructure and workshops of JINR on the first stage of ILC project realization;

3. A good position in the European region. 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;

4. The location in Dubna of the “Dubna” Satellite Communications Center (SCC), a unique center, according to the world standards. The Center is a branch of the Federal “Russian Satellite Communications Company”, the largest satellite communications operator in Russia. The “Dubna” SCC closely collaborates with JINR. SCC is equipped by powerful fiber-optic channels providing the communication of information flows without distortions at the processing of scientific data received from accelerators of leading scientific centers throughout the world (CERN, FNAL, BNL, DESY, etc.).

5. The presence of up-to-date network and data-processing infrastructure in JINR and Dubna. In the course of 2003-2004 in JINR and the town the optical cables for data communication with the speed 1 Gbit/s were built. This formed a basis to create and start the Dubna-Moscow communication channel of 2.5 Gbit/s in 2005. In order to provide the effective participation of JINR in international and national projects in the framework of this channel a segment with carrying capacity 1 Gbit/s was formed. The adequate development of external channels and networks of JINR and the town is planned: extension of the Dubna-Moscow channel up to 40 Gbit/s, extension of the international segment in the framework of the projects GEANT2, GLORIAD, increase of the carrying capacity of the channels up to 100 Gbit/s.

6. 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 was received in preliminary discussions with the interested governmental persons and organizations in Russia.

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 (Fig.2).

There are no any national parks, biological reservations, any religious and historical places an the planned area. There are no new projects planned to develop on the allocated territory.

It possible to avoid purchasing land and get the development area for free use without time-limit; like that has been done for the international intergovernmental organization JINR by the existing agreement between the JINR and the Government of the Russian Federation.

The climate is temperate-continental. The mean annual rainfall is 783 mm. The mean wind speed is 3.2 m/s. According to the climatic parameters, the territory of Dubna is considered to be comfortable.

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).

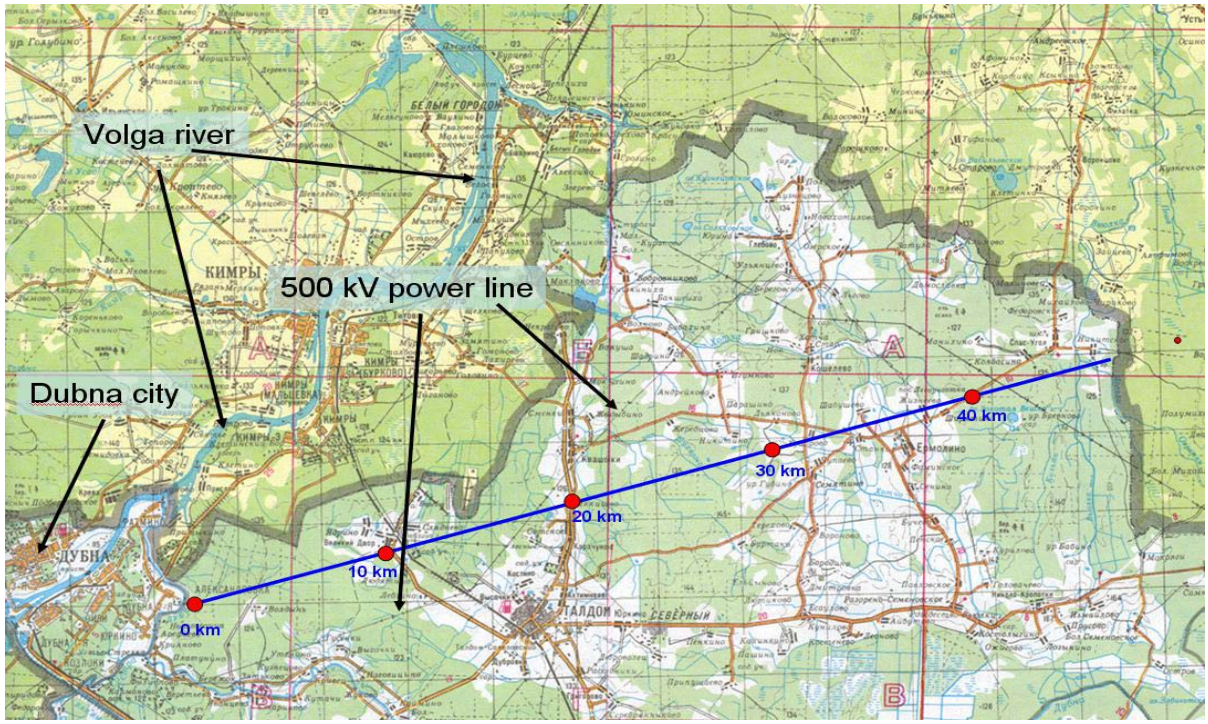

Figure 2. Planned location for ILC near Dubna, Moscow region.

GEOLOGY AND 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.

This area 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 syneclise. 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 with the idea that below the tunnel there should be impermeable soil preventing from the underlying groundwater inrush. It is possible to construct tunnels using tunnel shields with a simultaneous wall timbering by tubing or false work 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 approximately 2.5 years.

CONCLUSION

Initiative in the decision of question of the ILC siting in Dubna could take jointly with JINR the leading European accelerator centers (DESY, CERN, INFN, and some others), and also Russian Academy of Science and Budker INP firstly, Kurchatov RSC, Lebedev Ph. Institute, ITEP, INR RAS, MSU as well as some other organizations and institutions. Such an offer obviously would get an approvement from all sides of international community, if at the first stage of the project the main part of funding will take European countries and Russia. Of course it doesn't limit but assumes wide collaboration with other institutes and their countries.

Realization of such a widescaled 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 in a mentioned format of 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] International Linear Collider GDE official page, http://www.linearcollider.org