Subject : Superconducting Cyclotron

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Superconducting cyclotron is the most advanced and high tech accelerator ever constructed in the country. Internal beam of charged particles circulating in the cyclotron has been observed. High speed charged particles will be used by our scientists for frontline basic and applied research in nuclear sciences. This facility will soon be dedicated to the nation and will open for research also to the international community. There are only 6 such accelerators in the world. VECC thus, joins an exclusive club of the world.

A large number of systems of the accelerator, mostly constructed in the country, are working in unison to give acceleration kicks to the tiny nuclei of oxygen. They will get over 2500 acceleration kicks during their entire journey of about 7 Km within the accelerator to attain full energy in about a few microseconds (microsecond ~ one millionth of a second.

The 100 tonne iron-core superconducting magnet, largest in the country, has been operating for over 3 years non stop. It produces magnetic field of about 5 Tesla, about 100000 times the earth's magnetic field over an area of about 1.5 sq.m. Over 8 tonnes of mass, consisting of the superconducting coil and stainless steel structures, has been continuously kept cooled at-269 degree centigrade (269 degree centigrade below zero) inside a most sophisticated 'dewar' called the cryostat. Over 35 Km of

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superconducting wire was used to construct the coil at VECC winding its way round and round the bobbin. About 300 litres of liquid helium is required to keep the coil fully dipped at any time. In order to produce 1 litre of liquide helium about 750 litres of highly pure helium gas is needed at normal pressure and temperature. Thousands of litres of liquid nitrogen at – 95 degree centigrade is also needed to keep the coils cooled at the operating temperatures. Such large scale superconducting system, the first time in India is also rare in the world.

The complex radiofrequency system that, eventually, gives acceleration kicks to the tiny particles has also been functioning very satisfactorily. This system comprises of huge copper structures, called cavities, fabricated under strict quality control and a variety of high power electronic units, mostly developed by our engineers. This system will deliver over 200 kW of radiofrequency power, which is about 20 times the **power** of a **very large** radio station, for acceleration of charged particles.

The tiny particles covering several kilometers of distance during the process of acceleration, circulate in a chamber that is evacuated to a fraction of a millionth of a mm of mercury pressure. This pressure level is maintained round the clock, 7 days a week with the help of a specially designed vacuum system. Ultra low pressure is also required to maintain high electric fields for acceleration of the particles. Hundreds of litres of very low conductivity water flows through various systems every minute to keep them cool.

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Scientists and engineers monitor the performance of all the systems round the clock through the sophisticated computer control system from a set of control rooms.

The main control room of the accelerator is buzzing with activities since 11th of May when the first beam of low energy charged particles was first injected for acceleration. All systems of the cyclotron have been undergoing endurance tests continuously during all this period. All possible critical tests have been carried since May 11 to ensure that the internal beam has been circulating and the cyclotron is functioning.

The superconducting cyclotron will offer highly challenging opportunities to young scientists and engineers of the country. They are getting ready with equally sophisticated experimental facilities for their research. The cyclotron also offers unique opportunities for material science research. It is capable of delivering about 70 MeV proton beam which is an ideal tool for treating melanoma of the eye, loosely speaking cancer of the eye. Interestingly, a superconducting cyclotron for cancer treatment using proton beams will be almost of the same size as the one constructed by VECC but with a simpler design. So, India now has expertise to build such a facility – some of them just became operational in the world.

Operation of the superconducting cyclotron puts India in the world map of the most advanced technology and science.