Onco-Diagnoscope, Tuberculoscope, Laser marker, paint removal by CO_2 laser, laser additive manufacturing, artificial cloud formation, superconducting maglev train, water jet cutting, demonstration of glass blowing, etc. and also on the experiments set up to explain the basic principles of physics, technologies and cryogenics.

The students interacted with the expert panel of RRCAT by communicating their questions through chat box as well as live online interaction. The interaction session of about 90 minutes received overwhelming and enthusiastic response from the students. A separate interactive online session was conducted for about 40 students of special schools for hearing and speech impaired (deaf and mute) students, who interacted with the Director and other experts. They tried to address their queries with the help of interpreter-teachers available at the special school. The students participated actively with wholehearted enthusiasm in this interactive session. A special session of more than 120 minutes for the college students has also been conducted in the afternoon in which about 250 students interacted with the expert panel of RRCAT. The NSD-2021 celebration was highly appreciated by the participants, as was evident from a number of feedback messages received from the teachers and the students.

Online program execution team at RRCAT.

The Webex platform received from Homi Bhabha National Institute (HBNI), Mumbai was used for the online program session with all the students, teachers and invited guests. Each student, teacher and invited guest could join the interactive program from his or her home or office. Students of colleges and schools were in touch with an assigned respective volunteer through telephone. The event was managed, under keen supervision of Shri Debashis Das, Director, RRCAT, by an Organizing Committee with Shri Purushottam Shrivastava as the Chairman of the Apex Committee and Shri Rajesh Arya as the Convener. The committee made elaborate arrangements for the event with the help and cooperation of a large team of experts, volunteers, exhibitors, administrative staff, and security personnel to make the event a grand success.

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N.4: An incubation agreement signed between RRCAT and Tata Motors Ltd.

On April 17, 2021, Incubation Centre, RRCAT and Tata Motors Limited (TML), India's largest commercial vehicle manufacturer, signed an incubation agreement to jointly develop next generation refrigeration technology for vehicles and cold chain transports in the category of chilled, frozen and cryogenic temperature range. This will be widely used for transportation of perishable goods, fruits and vegetables, pharmaceuticals, and most importantly, vaccines. Liquid nitrogen (LN2) based refrigeration system - SHIVAY (शीतल वाहक यंत्र) will bring benefits to the society, echoing our commitment towards 'आत्मनिर्भर भारत'.

At present, the diesel-powered and chlorofluoro carbon based refrigerated trucks are predominantly used in cold chain for transportation. This joint working will help to develop eco-friendly liquid nitrogen based vehicular level refrigeration system, which will not only reduce the total cost of ownership but also maintain life and freshness of the goods and efficacy of vaccines during transit.

Shri Debashis Das, Director, RRCAT and Shri Aniruddha Kulkarni, Vice President & Head, CV Engineering, Tata Motors Ltd. after signing incubation agreement.

After signing the agreement, Shri Debashis Das, Director, RRCAT said, "The incubation agreement signed with Tata Motors Limited for jointly developing the LN2 based refrigeration system technologies (SHIVAY) developed by RRCAT for vehicular applications to transport fruits and vegetables (F&V), pharmaceuticals and other similar products, is a significant step towards percolation of DAE technologies in the country under the 'आत्मनिर्भर भारत' mission of Government of India." He expressed the confidence that SHIVAY technologies of RRCAT will find wider use in cold-chain transportation through this initiative of TML.

On the occasion, Shri. Aniruddha Kulkarni, Vice President and Head, CV Engineering, Tata Motors Ltd., said, "Tata Motors always pioneers new products through structured approach of technology creation and deployment by leveraging innovation and consistently driving towards energy efficient vehicles to reduce carbon footprint for environment sustainability. Incubation for SHIVAY would catalyse development of future technologies in vehicular level refrigeration system and cold chain transportation, which will be deployed across multiple platforms of Tata Motors commercial vehicle".

LN2 based refrigeration system - SHIVAY-V.

The incubation agreement was signed as per recently formulated policy and guidelines for DAE Incubation Centres. Shri S. V. Nakhe, Director, Laser Group and Materials Science Group, played a pivotal role in signing this agreement. It includes technology transfer of both SHIVAY and SHIVAY-V, and their subsequent development for Tata vehicles in three variants: small commercial vehicle (SCV), intermediate light commercial vehicle (ILCV) and medium and heavy commercial vehicle (MHCV). It may be noted that the lowest temperature for SHIVAY is -20 °C, while it is -70 °C for SHIVAY-V. The technology of SHIVAY and SHIVAY-V is developed by Cryomodule Development & Cryoengineering Application Section of Proton Accelerator Group.

The incubation agreement was signed through virtual meeting by Shri Debashis Das, Director, RRCAT and Shri Aniruddha Kulkarni, Vice President & Head, CV Engineering, Tata Motors Limited. The meeting was also attended by Shri S. V. Nakhe, Director, Laser Group and Materials Science Group, Shri Prashant Khare, Technology Developer and Dr. C. P. Paul, Convener, Incubation Centre RRCAT, while Shri Rajeev Dave, Head, Application Engineering, and other TML delegates attended from TML.

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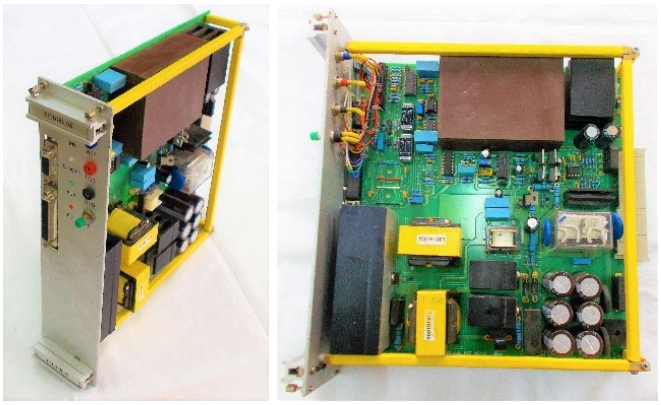
N.5: Technology transfer of high-stability, unipolar and bipolar power converters for electromagnets

Power converters for electromagnets is an important sub-system of particle accelerators. Power converter with very high stability of the output current are deployed in large numbers to energize electromagnets in an accelerator installation. Various types of power converters, namely, the dc or slow-ramped, fast-ramped, pulsed, unipolar, bipolar, etc., are used. Each type of power converter has different sets of specifications and challenges.

Most of the power converters being manufactured in the industry are voltage regulators, being used for common commercial applications. The technological know-how of the output-current-controlled power converters feeding high-stability current to the inductive load such as electromagnets is limited in the Indian industry.

The output power rating of power converters for electromagnets may vary in a wide range from few watts to few 100s of kilowatts and further to megawatts. However, unipolar and bipolar power converters with relatively lower output power (few 100s of watt) are required in large numbers for applications such as corrector magnets as well as for various magnets in beam transport line of low-energy accelerators used for various research, industrial, medical and societal applications. For such applications, the power converters based on single printed circuit board (PCB) and using switch-mode power conversion schemes were developed, tested and deployed for various applications at RRCAT. Subsequently, the technologies of these unipolar and bipolar power converters were made available for transfer to the industry through TT&CD, BARC.



Photographs showing unipolar power converter on 6U printed circuit board.

The unipolar power converter is capable of delivering up to 50 V DC output voltage, 15 A DC output current, and 300 W output power ratings with minimum alterations. It operates using 230 V, 50 Hz AC mains.