PRESS RELEASE

The European Cryogenics Days 2017 focus on the challenges to cryogenic applications

For a third consecutive year the Cryogenics Society of Europe organized the European Cryogenics Days 2017 in partnership with the High-Energy Physics Technology Transfer Network (HEPTech). The event was held on 13th September 2017, in Karlsruhe, Germany.

This year's forum focused on the challenges the cryogenics faces in the field of astrophysics, particle physics, computing, transportation, and power applications.

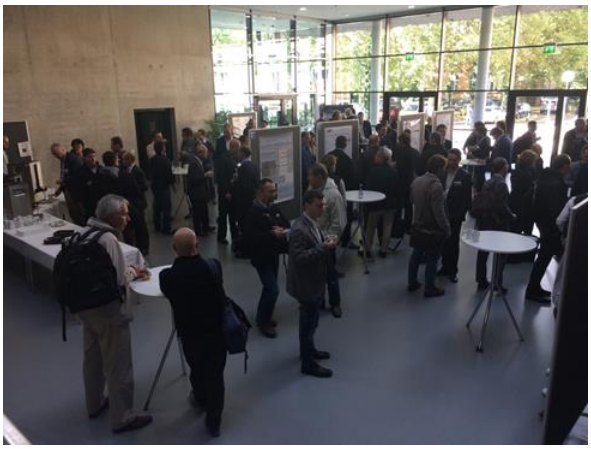
The European Southern Observatory (ESO), Germany and CEA (University Grenoble Alpes), France, revealed the specific requirements for sub-kelvin cooling in space and ground-based telescopes and emphasized the use of low-temperature detectors. ESO discussed the cooling needs of the Extremely

Large Telescope (ELT), which is in process of building. While the telescope optics operates at ambient temperature, the instrument optics and in particular, the detectors, will be cooled to cryogenic temperatures down to 4 Kelvin. A combination of liquid nitrogen cooling and low-vibration cryo-coolers will be installed to provide the required temperature levels and cooling capacities. Once being operational around 2025, the ELT will be the largest optical/near-infrared telescope in the world, gathering 13 times more light than the largest optical telescopes existing today.

In terms of particle physics, CERN outlined the main cryogenic challenges to a possible future hadron-hadron collider (FCC-hh). The FCC-hh cryogenic system will have to produce up to 120 kW at 1.8 K for the superconducting magnet cooling, 6 MW between 40 and 60 K for the beam-screen and thermal-shield cooling. In addition, the total mass to be cooled down will be about 250’000 t and an innovative cool-down process will have to be proposed.

Fermi National Accelerator Laboratory, USA, focused on the main features, modes of operation, expected performance and status of the design of the cryogenic system of the Long-Baseline Neutrino Facility (LBNF) that supports the Deep Underground Neutrino Experiment (DUNE).

Another talk summarized the progress of the engineering of the target moderator cryogenic plant (TMCP) at the neutron spallation source facility of the European Spallation Source (ESS). The TMCP will provide maximum cooling capacity of 31.8 kW which will make it the world's largest plant of its kind.



(Photos: Antonio Pacheco)

In terms of the further development of the information technologies and speeding up the processors, University of Twente, Netherlands, introduced new computing paradigms - superconducting 'RSQF' circuitry and quantum computation. Both technologies require (ultra)-low temperatures, providing interesting challenges for cryogenic engineering.

The challenges cryogenics faces in the field of transportation were illustrated by a presentation from the University of Tokyo, Japan, which gave an update on maglev (magnetic levitation - a public transport technology that uses magnetic levitation to move vehicles without making contact with the ground or an electrical pickup) train system, currently being tested near Tokyo. The superconducting maglev vehicles have superconducting magnets for the electrodynamic suspension and linear synchronous motor propulsion, which enable a super high-speed operation at 500 km/h with lower noise and higher efficiency. The magnets use NbTi superconducting wires cooled with liquid helium and 4K GM-JT cryocoolers for the closed-loop cooling system. Although NbTi superconducting magnets have proved sufficiently good performance, high-temperature superconducting magnets using Bi2223 or REBCO wires are highly expected to be introduced. They would have better stability and simpler cryostat structure, and will need simpler cooling systems.

Siemens AG - Corporate Technology – eAircraft, Munich, Germany, explored some opportunities of the high-temperature superconductivity as a key technology to produce a lightweight electric aircraft. It was pointed out that the high-temperature superconductors provide higher airgap magnetic fields than the best NeFeB magnets and much higher current densities in the stator. Therefore, they could allow to significatly increase the power-to-weight ratio (currently about 5.2 kW/kg, which is the world record) of hybrid electric propulsion systems and be a key technology for hybrid electric aircrafts.

A study of the University of Twente, Netherlands, on quenching of a material in a liquid nitrogen pool provided new insights into the thermal processes during quenching of materials, leading to potential improvement of applications in which rapid cooling is essential, such as cryopreservation of tissue and superconducting power equipment.

In terms of power applications, Karlsruhe Institute of Technology, Germany, introduced cooling requirements of superconducting power cables. It was pointed out that the cooling design parameters of a superconducting cable depend mainly on the length of the cable and the heat input. These parameters should be adapted to each cable to fulfil the specification. Design options for two different examples – of medium- and high-voltage power cables – were presented.

Industry demonstrated high interest by taking part in the exhibition and sponsoring the event.

(Photos: Antonio Pacheco)

Eleonora Getsova,
HEPTech Communication Officer