Master examination project at the FREIA Laboratory

Design study of a -53 degrees CO_2 cooling systems for the ATLAS experiment at CERN with the aim that the system be produced in Swedish industry

The ATLAS experiment at the CERN Large Hadron Collider is developing a new version of its so-called Inner Tracker, which will measure with very high precision (order 10-100 µm) the tracks of all the charged particles being produced in the collisions of the two proton beams. It will be located just centimeters away from the line of the colliding beams, where the level of ionizing radiation is extremely high. The integrated read-out electronics, which dissipates high power, will be located in the Inner Tracker and needs to be cooled at a temperature of -36 degrees using a secondary evaporative CO2 system located near the ATALS detector 100 m under ground level. The reason for cooling the electronics at this low temperature is that the electronics will survive a significantly longer time in the hash radiation environment than if it was cooled at only a few degrees higher temperature than -36 degrees. This secondary circuit is cooled in a heat exchanger using a primary CO2 cooling system located at ground level which, in order to maintain -36 degrees inside the Inner Tracker in ATLAS, needs to cool down to the, for CO2 cooling, extremely low temperature of -53 degrees.

CERN plans to issue a tender for about 10 such primary CO2 refrigeration circuits for which the current estimated order value is about 4.5 MCHF. Commercially available CO2 cooling systems cool down to -48 degrees. The FREIA Laboratory in Uppsala, which is currently developing and testing cryogenic equipment for the LHC as well as for the European Spallation Source (ESS), has been in contact with the cooling consultancy firm Gefyr Cool & Energy AB to organize a one-day seminar on the 6 February 2020, inviting a renowned expert on cooling technology prof. Armin Hafner at the Norwegian University of Science and Technology and several Swedish firms producing cooling equipment, to discuss a CO2 cooling circuit that can satisfy CERNs requirement of cooling down to -53 degrees.

The task of the Master examination project is to make a literature study of the current status of CO2 cooling, follow up the outcome and the industrial contacts at of the workshop of 6 February with the help of the FREIA Laboratory and the consultancy firm Gefyr Cool & Energy AB, which has offered assistance for this study, study the specification for the CO2 cooling system required by CERN and ATLAS and with this as background make a technical design of a cooling system which could be of use for Swedish industry when they should offer to fabricate a primary CO2 cooling system at -53 degrees for CERN and ATLAS. Funding will be made available to finance a few days visit to CERN in Geneva and at the Norwegian University of Science and Technology to discuss with experts there.

If you would like to know more please contact
Tord Ekelöf
FREIA Laboratory
Department of Physics and Astronomy
Uppsala University
Tord.Ekelof@physics.uu.se
Mobile: +46 70 4250210

UPPSALA UNIVERSITET
INNOVATION