Seminar

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Institute for Plasma Research

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Title: Design and Development of closed-loop pulse tube refrigeration (PTR) system for a Cryopump

Speaker: Dr. Sarvesh Kashyap
Institute for Plasma Research, Gandhinagar

Date: 20th February 2024 (Tuesday)

Time: 03:00 PM

Venue: Seminar Hall, IPR

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Abstract

Cryogenic technologies play a crucial role in various fields for achieving and maintaining low temperatures in various applications, including cryopumps. The diminishing helium reserves emphasize the need for closed-cycle cryocoolers. Stirling pulse tube cryocoolers, offer benefits such as vibration-free operation and miniaturization. This talk discusses the details of the Stirling pulse tube cryocooler design. The regenerator, pulse tube, and phase shifter assembly are important subcomponents of this cryocooler. The REGEN 3.3 software is utilized for regenerative heat exchanger (regenerator) optimization and approximate phasor analysis is used to design the pulse tube. The complete dimension of the system (including phase shifter assembly) is approximated to perform a comprehensive evaluation. These approximated dimensions along with the linear compressor are used for the one-dimensional (SAGE) and 2-dimensional (ANSYS fluent) modelling of the complete cryocooler system. The SAGE and CFD results are presented and compared with the earlier design results. The transient behavior inside the cold heat exchanger has been demonstrated. The results obtained from all three methods closely align, with the cooling capacity predicted by the CFD being the lowest. The cooling capacity obtained by the SAGE and CFD is 9 W and 5.7 W respectively, compared to the 12 W proposed design at 80 K. However, it is noteworthy that the computational cost and time associated with CFD are significantly higher compared to the other two methods.