

Seminar

Institute for Plasma Research

- Title:** Design and Development of closed-loop pulse tube refrigeration (PTR) system for a Cryopump
- Speaker:** Dr. Sarvesh Kashyap
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- Date:** 19th February 2025 (Wednesday)
- Time:** 03:00 PM
- Venue:** Committee Room 1, IPR
- Online:** https://meet.ipr.res.in/join/9386264338?be_auth=NzEyMTQ1
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Abstract

The Stirling Pulse Tube Cryocooler (SPTC) has indeed established itself as a highly reliable device for achieving low temperatures. The SPTC consists of a linear compressor, a pulse tube assembly, and phase-shifting mechanics. This work focuses on the initial design and testing of a pulse tube cryocooler for use in cryopump applications. The inertance tube phase-shifting mechanism is used with the high-frequency cryocooler, which operates at a frequency of 50 Hz.

Regen software is used to optimize the regenerator of the cryocooler for maximum coefficient of performance and length. The dimensions of the pulse tube and inertance tube are approximated using phasor analysis. The initial dimensions obtained from these calculations are used for fabricating the various components of the cryocooler.

The first double piston compressor, featuring a dual-opposed configuration, has been fabricated and tested for leak-proof performance along with the pulse tube assembly. Initial testing of the complete system, including double piston Compressor, was conducted to obtain the cooldown curve. The cryocooler was operated at different frequencies and power inputs, achieving a lowest temperature of 197 K. However, it was observed that the system could not reach the targeted temperature due to a low pressure ratio inside the system.

The limitation in piston displacement was identified, leading to the redesign of the compressor. A second single piston compressor was developed to achieve the target temperature at a lower cooling capacity. This new compressor was successfully tested, achieving a lowest temperature of 178 K. Meanwhile, a vacuum chamber has been fabricated, and the complete assembly is now ready for further testing and optimization.
