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# Seminar

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## Institute for Plasma Research

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**Title:** Development of Cryocooler for Application in Cryopump  
**Speaker:** Dr. Abhinav B. Desai  
Institute for Plasma Research, Gandhinagar  
**Date:** 5<sup>th</sup> September 2023 (Tuesday)  
**Time:** 10:00 AM  
**Venue:** Online - Join the talk:  
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### Abstract

Vacuum is essential for cryogenic systems, including large fusion machines. Closed-loop refrigerator-based cryopumps can produce the required clean and oil-free vacuum. There is a demand for indigenous cryopumps, and an attempt is being made to develop cryogen-free cryopumps at the Cryopump and Pellet Injector Division (CPPI), Institute for Plasma Research.

An indigenous cryocooler is under development at the CPPI division, IPR, which will be augmented with cryo-panels and other parts to develop cryogen-free cryopumps. For this, a prototype of a Gifford McMahon-type Pulse Tube Cryocooler (GM PTC) has been developed. PTC as an integrated system comprises a Helium compressor, a pressure distribution valve – rotary valve (for GM PTC), a regenerator, and a pulse tube. The performance of the regenerator has been analyzed using an open-source software REGEN and an algorithm is proposed to optimize the performance of the regenerator for using multi-layer configuration. Critical heat-exchanging elements of a PTC have also been intuitively designed through flow study. To completely indigenize the GM PTC, a prototype of a Helium compressor is developed. This single-stage, low-frequency, GM PTC prototype has been integrated with the developed Helium compressor through high-pressure solenoid valves. Preliminary experiments showed successful integration and achieved a no-load temperature of 233 K. The same GM PTC is also experimented with by using a commercial Helium compressor and performance with both the compressors is evaluated. Additionally, the last important link in the GM PTC package, the pressure distribution valve, is also in-house fabricated. This rotary type of pressure distribution valve is ready for testing and experimentation. The details of the above work and the plan for future work will be discussed.

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