

A Passive Displacer for a Stirling Pulse Tube Cryocooler

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Stirling pulse tube cryocoolers (SPTCs) can operate by incorporating a displacer into the warm end of a pulse tube cryocooler. Previous studies have shown that SPTCs running with an active displacer demonstrate good performance and higher efficiencies than pulse tube cryocoolers that utilise inertance tubes. Having an actively driven displacer requires a second phase from the power electronics, and the extra motor and electrical feedthrough adds to the complexity of the design, so it is desirable to have a passively driven displacer. This study presents the analysis and design of a passive displacer driven by the pressure difference across the displacer piston and shaft. A harmonic analysis and design of the displacer unit was completed, in conjunction with a numerical model constructed in Sage. This permitted the correct characteristics for the displacer to be designed in order to operate with the existing compressor and cold head. This included testing and analysis of different spring assemblies, optimisation of the displacer dimensions, and the piston moving mass. The passive displacer will replace the active displacer in an existing 80 K coaxial SPTC.