



Contribution ID: 419

Type: **Poster Presentation**

Pulse tube phase shifter with separating membrane

Wednesday, July 12, 2017 9:00 AM (2 hours)

The inertance of Stirling type pulse tube coolers is an efficient solution for the phase shifter in the 50 – 80 K cooling range. For lower temperature, and especially below 20 K, the phase shifting effect required for the most efficient operation cannot be reached using only inertance. We propose here a new type of phase shifter based on the use of an inertance filled with a high density fluid such as a liquid or high density gas. This design requires the use of a sealed metallic diaphragm to separate the fluid operating in the cold finger from the inertance fluid. The operation has been validated on an 8 K pulse tube cooler. These results demonstrates the capabilities of this setup. Long term operation of the metallic seal membrane has been validated on a dedicated test bench and studies have been made to make the use of this phase shifter possible for space application.

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Session Classification: C3PoA - Pulse Tube Cryocoolers (Aerospace)