
Contribution ID: **196** Type: **Contributed Oral**

# C2Or3A-04: High efficiency operation of a 4K-Gifford-McMahon cryocooler without rotary valve with a metal bellows compressor

*Tuesday 11 July 2023 17:00 (15 minutes)*

Traditional Gifford-McMahon cryocoolers are operated with an integrated rotary valve which regulates the compressed Helium supply and return into the cold head. Theory predicts that 50% of the input energy is lost in this rotary valve. In this work we removed the rotary valve from a Sumitomo RDK-101G cold head and drove the Gifford-McMahon cryocooler in Stirling mode directly with a slow-moving metal bellows compressor at around 1.2Hz. We could demonstrate that the energy efficiency of the cryocooler system improves substantially. As a result, we were able to operate this cold head with 650W of total electrical input power with cooling powers of 140mW @ 4.2K on the second stage and no- load temperatures of below 40K on the first stage. The experimental set-up as well as further sources of inefficiencies are discussed.

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**Session Classification:** C2Or3A: Non-Aerospace Coolers V: GM and Pulse Tube Coolers