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C4Or1A-08: Design and performance testing of the 3-stage ADR

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As an important sub-Kelvin refrigeration technology, the adiabatic demagnetization refrigeration (ADR) is used for space detector cooling and ground-based experiments because of its wide temperature coverage, high efficiency and gravity-independence. We design a 3-stage adiabatic demagnetization refrigerator pre-cooled by a GM-type pulse tube cooler and operating from 4 K to 50 mK. Gadolinium Gallium Garnet (GGG) is used for high temperature stage and chromium potassium alum (CPA) is used for low temperature stage. All the salt pills are supported by polyether ether ketone (PEEK) suspensions. The active/passive air-gap heat switches are used to control heat transfer between stages. The system has achieved a lowest temperature of 35mK in a single-shot mode as well as 100mK intermittent cooling. This paper introduces the refrigeration performance of the 3-stage ADR as well as details of critical components. An interesting configuration for realizing an ADR with multiple continuous cooling stages will also be discussed.

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