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C3Po1E-01: Research on temperature control of Adiabatic Demagnetization Refrigerators

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In astronomical observations, detectors operating in the sub-Kelvin temperature range require extremely stable working temperatures. Adiabatic demagnetization refrigerators (ADR), as the sub-Kelvin refrigerator that is independent of gravity and offers high temperature control precision, have become the preferred choice for astronomical observation missions. The high temperature control precision originates from the intrinsic nature of ADR, which generates cooling power through demagnetization. By controlling the demagnetization rate through PID control, high stability in the order of μK can be achieved. Here we present the study of temperature control for the second stage of a two-stage ADR. The influence of P, I, or even D has been analyzed. Simulation of the influence of PID has also been compared with the experimental results. Additionally, the effects of factors such as environmental noise, the resolution of the magnet power supply, excitation and filtering in temperature measurement, on temperature fluctuations are investigated.

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