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# DR-TES: Balloon-Borne TES Microcalorimeter Mission for Gamma-Ray Detection

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DR-TES (Dilution Refrigerator - Transition Edge Sensors) is a balloon-borne experiment aimed at demonstrating advanced cryogenic and detector technologies for X-ray and gamma-ray spectroscopy in a near-space environment. The mission utilizes a low-temperature TES detector array, cooled to ˜75 mK by a miniature dilution refrigerator (mini-DR), which itself is pre-cooled by a liquid helium cryostat. During pre-flight calibrations, the TES array, read out by Superconducting Quantum Interference Devices (SQUIDs) and microwave-multiplexed electronics, achieved an energy resolution of ˜70 eV FWHM at 97 keV.

On September 24, 2024, DR-TES completed a one-day balloon flight, maintaining operational temperatures between 75 mK and 100 mK for nearly 90% of the total flight time, and demonstrated excellent cryogenic stability. The TES detector array successfully recorded X-ray and gamma-ray signals from an onboard radioactive source, confirming the TES array's capability to operate in a space-like environment.

This presentation covers the objectives of the mission, experimental setup, pre-flight performance, and in-flight results. We emphasize the first successful demonstration of a TES microcalorimeter array for X-ray and gamma-ray detection, cooled by a mini-DR system, in a near-space environment aboard a stratospheric balloon. These results establish a foundation for future high-energy astrophysics investigations with balloon-borne and space-based cryogenic TES missions.

## Collaboration(s)

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