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Kinematic mounting of stackable multi-layer large format low temperature arrays

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The mounting of large-format low-temperature detector arrays needs to be done in such a way that any stresses that are produced while cooling it down do not damage the detector or cause it to move uncontrollably from its intended location. Stresses can easily be created due to the thermal expansion mismatch of different materials in the detector and surrounding mounting structure. The mounting of low-temperature detectors for satellite missions is further complicated by the need for the detector to survive severe vibration conditions, maintaining structural and position integrity. The use of kinematic mounting is one approach that can be designed to meet these requirements. In this mounting scheme, six independent constraints uniquely locate the structure, and are typically made using either a ball in groove to provide the unique constraints or with flexures that are sufficiently soft in the unconstrained directions of each feature to avoid it becoming over constrained.

It is often desirable for transition-edge sensor (TES) detectors to be configured with two or more arrays, with one array being a signal array and the other array being an anticoincidence detector to discriminate from the events that come from a telescope optic from those that come about from background photons and gamma rays such as due to cosmic ray events. An optimized mounting scheme would provide a closely packed stack of multiple arrays in which electrical connections to the arrays are accessible and the supporting mount structure does not add substantial amounts of mass. It also is important that the structure is modular to allow for exchange of detector elements or repair and exchange of mounting structures.

Our design meets these requirements as it is 1) low mass, 2) low profile, and 3) modular. We show how using nested mounting structures with low profile titanium clamps can provide both the inherent stackability of a flexure approach. This clamping scheme does not obscure the outer edges of the array, which makes electrical connections easily accessible. In this paper we will present a detailed description of the design, a dynamic FEA analysis, and will describe the status of on-going vibration test of the prototype. This detector mounting approach could be employed for a wide-range of applications.