DEVELOPMENT OF STRUCTURAL AND THERMAL ELEMENTS FOR CRITICAL DYNAMICS IN MICROGRAVITY EXPERIMENT

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We report 011 the. design, fabrication and test of cryogenic sample cells and structures for the Critical Dynamics in Microgravity Experiment (DYNAMX), an experiment scheduled to fly 011 the space shuttle as part of the Microgravity Science Payload (MSP) in early calendar 2001. The design requirements for these components, and the resultant design and implementation experiences will be presented.

DYNAMX will measure fundamental physics that is only possible in the microgravity of space. DYNAMX will examine the critical behavior of a second order phase transition driven far from equilibrium by measuring the thermal conductivity of liquid helium, as a function of applied heat, at temperatures around the normal/superfluid transition temperature. To achieve the scientific objectives of the experiment requires the apparatus has silt)-l~;ll~(~Kclvi]] temperature control and resolution, sub-nanoWatt heat control and resolution, and control and readout resolution of the helium superfluid/normal fluid interface within the ccl] at the micrometer level. In addition to the science requirements, the apparatus must also meet environmental requirements, (e.g., shuttle launch loads), as well as al] safety verification requirements that accompany a shuttle borne experiment. These levels of requirements, however, have not previously been simultaneously met by any cryogenic apparatus, and the current challenge is to meet all requirements within the inherited experiment configuration to the degree possible.

The sample cells contain three sidewall temperature probes, which are made from rings Of thin (25 micron) high thermal conductivity material (copper) sandwiched between cell wall segments of low thermal conductivity material (Vespel) and epoxied together. '1'1 ic Cell interior diameter is 1.8 cm and wall segments of 508 and 762 micrometer thickness have been tested. Probe spacings (segment lengths) as small as 300 micrometer have been achieved in a superfluid leak tight cell. We will report the thermal characteristics of these sample Cells under USC, and the results of launch load shake tests.

Experiences with the use of stainless steel, Vespel, Kevlar and gamma alumina composite as materials for use in thermal isolation structures in this Ic'quilt.]]lcllt range and the experimental results of the actual thermal characteristics of fabricated prototype structures will also be presented.

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