Books & Reports

Cryogenic Pupil Alignment Test Architecture for Aberrated Pupil Images

A document describes cryogenic test architecture for the James Webb Space Telescope (JWST) integrated science instrument module (ISIM). The ISIM element primarily consists of a mechanical metering structure, three science instruments, and a fine guidance sensor. One of the critical optomechanical alignments is the co-registration of the optical telescope element (OTE) exit pupil with the entrance pupils of the ISIM instruments. The test architecture has been developed to verify that the ISIM element will be properly aligned with the nominal OTE exit pupil when the two elements come together.

The architecture measures three of the most critical pupil degrees-of-freedom during optical testing of the ISIM element. The pupil measurement scheme makes use of specularly reflective pupil alignment references located inside the JWST instruments, ground support equipment that contains a pupil imaging module, an OTE simulator, and pupil viewing channels in two of the JWST flight instruments.

Pupil alignment references (PARs) are introduced into the instrument, and their reflections are checked using the instrument's mirrors. After the pupil imaging module (PIM) captures a reflected PAR image, the image will be analyzed to determine the relative alignment offset. The instrument pupil alignment preferences are specularly reflective mirrors with non-reflective fiducials, which makes the test architecture feasible. The instrument channels have fairly large fields of view, allowing PAR tip/tilt tolerances on the order of 0.5°.

This work was done by Brent Bos, David A. Kubalak, Scott Antonille, Raymond Ohl, and John G. Hagopian of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15650-1

Thermal Transport Model for Heat Sink Design

A document discusses the development of a finite element model for describing thermal transport through microcalorimeter arrays in order to assist in heat-sinking design. A fabricated multiabsorber transition edge sensor (PoST) was designed in order to reduce device wiring density by a factor of four.

The finite element model consists of breaking the microcalorimeter array into separate elements, including the transition edge sensor (TES) and the silicon substrate on which the sensor is deposited. Each element is then broken up into subelements, whose surface area subtends 10×10 microns. The heat capacity per unit temperature, thermal conductance, and thermal diffusivity of each subelement are the model inputs, as are the temperatures of each subelement. Numerical integration using the Finite in Time Centered in Space algorithm of the thermal diffusion equation is then performed in order to obtain a temporal evolution of the subelement temperature. Thermal transport across interfaces is modeled using a thermal boundary resistance obtained using the acoustic mismatch model.

The document concludes with a discussion of the PoST fabrication. PoSTs are novel because they enable incident x-ray position sensitivity with good energy resolution and low wiring density.

This work was done by James A. Chervenak, Richard L. Kelley, Ari D. Brown, Stephen J. Smith, and Caroline A. Kilbourne of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15671-1