SPIRE Thermal/Systems Analysis

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The SPIRE instrument will be flying onboard Herschel in 2007 along with the PACS and the HIFI instruments. SPIRE consists of five bolometer arrays, which will be cooled and controlled at 310 mK for nominal observation periods of 46 hours. To achieve such a low temperature, SPIRE will interface with four temperature stages of the Herschel cryostat nominally operating at 15, 12, 4, and 1.7 K. The final 300 mK temperature stage is provided by a He^3 sorption cooler onboard SPIRE itself. This poster presents the technical aspects of the instrument thermal design and implementation. The SPIRE Focal Plane Unit (FPU) is mounted off the Herschel Optical Bench (HOB) at 12 K on isolating supports to limit the parasitic loads into the instrument. Two JFET electronic boxes also mounted off the HOB are thermally linked to the 15 K stage of the cryostat to heat sink most of their internal power dissipation during operation. The JFET electronic boxes connect to SPIRE FPU through low conductance harnesses to reduce their heat leak into the instrument. The SPIRE FPU is then thermally linked to the 4 K stage of the cryostat to heat sink most of the parasitic loads from the 12 K stage as well as additional heat dissipated by the various mechanisms mounted inside SPIRE FPU. The 300 mK detectors are fitted within internal enclosures, mounted off the SPIRE FPU on isolation supports and thermally linked to the 1.7 K stage of the cryostat. The last 300 mK temperature stage is provided by a He^3 Sorption cooler mounted off the SPIRE FPU, with its cold tip connected to each detector through an arrangement of thermal straps. This cooler operates 48 hr cycle which consists of 2 hr of recycling during which the cooler He3 is being regenerated, followed by a nominal 46 hr operation period during which the detectors runs at an absolute temperature of 310 mK. A thermal control has also been implemented on the 300 mK strap to maintain the detector temperature as stable as possible. The poster also presents the thermal model of SPIRE developed to analyze and optimize the instrument thermal design. The Herschel cryostat performances are highly dependent on the loads from SPIRE. Therefore the instrument thermal model has then been integrated with the Herschel cryostat thermal model to allow the analysis of the cryostat temperature stages dynamics in conjunction with the instrument performances.

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