Contribution ID: **410** Type: **Contributed Oral**

C3Or3D-04: SPHEREx payload thermal architecture and analysis

Wednesday 12 July 2023 14:45 (15 minutes)

The SPHEREx (Spectro-Photometer for the History of the Universe, Epoch of Reionization and Ices Explorer) is an all-sky spectral survey in a sun-synchronous low earth orbit. It measures spectrum in the near infrared band from 0.75um to 5um. To achieve this wavelength coverage, the instrument has two focal plane arrays, both passively cooled at <55K (mid-wave infrared) and <80K (short-wave infrared). Additionally, the instrument requires no moving parts for spectral resolution, relying instead on spacecraft-controlled pointing. A thermally isolating structure and a set of V-grooves reduce the heat flow conducted and radiated from the spacecraft bus. The thermal system also blocks the incident solar flux and earth radiation from reaching the sensitive cryogenic instrument while still allowing substantial pointing flexibility. The combination of passive cryogenic cooling and survey requirements in a sun exposed low earth orbit environment presents a challenge for the thermal design. This paper will discuss the SPHEREx payload overall thermal architecture, bounding thermal environments, the component thermal and thermo-optical properties, design trades and sensitivities, and analysis of on flight performance.

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Session Classification: C3Or3D: Aerospace Applications IV: Space