Planck 2013 results. IX. HFI spectral response

The Planck HFI spectral response was determined through a series of ground based tests conducted with the HFI focal plane in a cryogenic environment prior to launch. The main goal of the spectral transmission tests is to measure the relative spectral response (including the level of out-of-band signal rejection) of all HFI detectors to a known source of electromagnetic radiation individually. This was determined by measuring the output of all detection channels for radiation propagated through a continuously scanned polarizing Fourier transform spectrometer. As there is no on-board spectrometer within HFI, the ground-based spectral response experiments provide the definitive data set for the relative spectral calibration of the HFI. The spectral response of the HFI is used in Planck component separation and data analysis; this includes extraction of CO emission observed within Planck bands, dust emission, Sunyaev Zeldovich sources, and intensity to polarization leakage. The HFI spectral response data have also been used to provide unit conversion and colour correction analysis tools. While previous papers have already described the pre-flight experiments conducted on the Planck HFI, this paper focuses on the analysis of the pre-flight spectral response measurements and the derivation of data products, e.g. band-average spectra, unit conversion coefficients, and colour correction coefficients, all with related uncertainties. Verifications of the HFI spectral response data are provided through comparisons with HFI flight data. This validation includes use of HFI Zodiacal emission observations to demonstrate out-of-band spectral signal rejection better than $10^8$. The accuracy of the HFI relative spectral response data is verified through comparison of complementary bandpass based and flight-data based unit conversion coefficients and colour correction coefficients.

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