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Planck 2015 results: III. LFI systematic uncertainties

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Abstract

© ESO, 2016.We present the current accounting of systematic effect uncertainties for the Low Frequency Instrument (LFI) that are relevant to the 2015 release of the Planck cosmological results, showing the robustness and consistency of our data set, especially for polarization analysis. We use two complementary approaches: (i) simulations based on measured data and physical models of the known systematic effects; and (ii) analysis of difference maps containing the same sky signal ("null-maps"). The LFI temperature data are limited by instrumental noise. At large angular scales the systematic effects are below the cosmic microwave background (CMB) temperature power spectrum by several orders of magnitude. In polarization the systematic uncertainties are dominated by calibration uncertainties and compete with the CMB E-modes in the multipole range 10-20. Based on our model of all known systematic effects, we show that these effects introduce a slight bias of around 0.2σ on the reionization optical depth derived from the 70GHz EE spectrum using the 30 and 353GHz channels as foreground templates. At 30GHz the systematic effects are smaller than the Galactic foreground at all scales in temperature and polarization, which allows us to consider this channel as a reliable template of synchrotron emission. We assess the residual uncertainties due to LFI effects on CMB maps and power spectra after component separation and show that these effects are smaller than the CMB amplitude at all scales. We also assess the impact on non-Gaussianity studies and find it to be negligible. Some residuals still appear in null maps from particular sky survey pairs, particularly at 30 GHz, suggesting possible straylight contamination due to an imperfect knowledge of the beam far sidelobes.

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Keywords

Cosmic background radiation, Cosmology: observations, Methods: data analysis, Space vehicles: instruments