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Template fitting of WMAP 7-year data: anomalous dust or flattening synchrotron emission?

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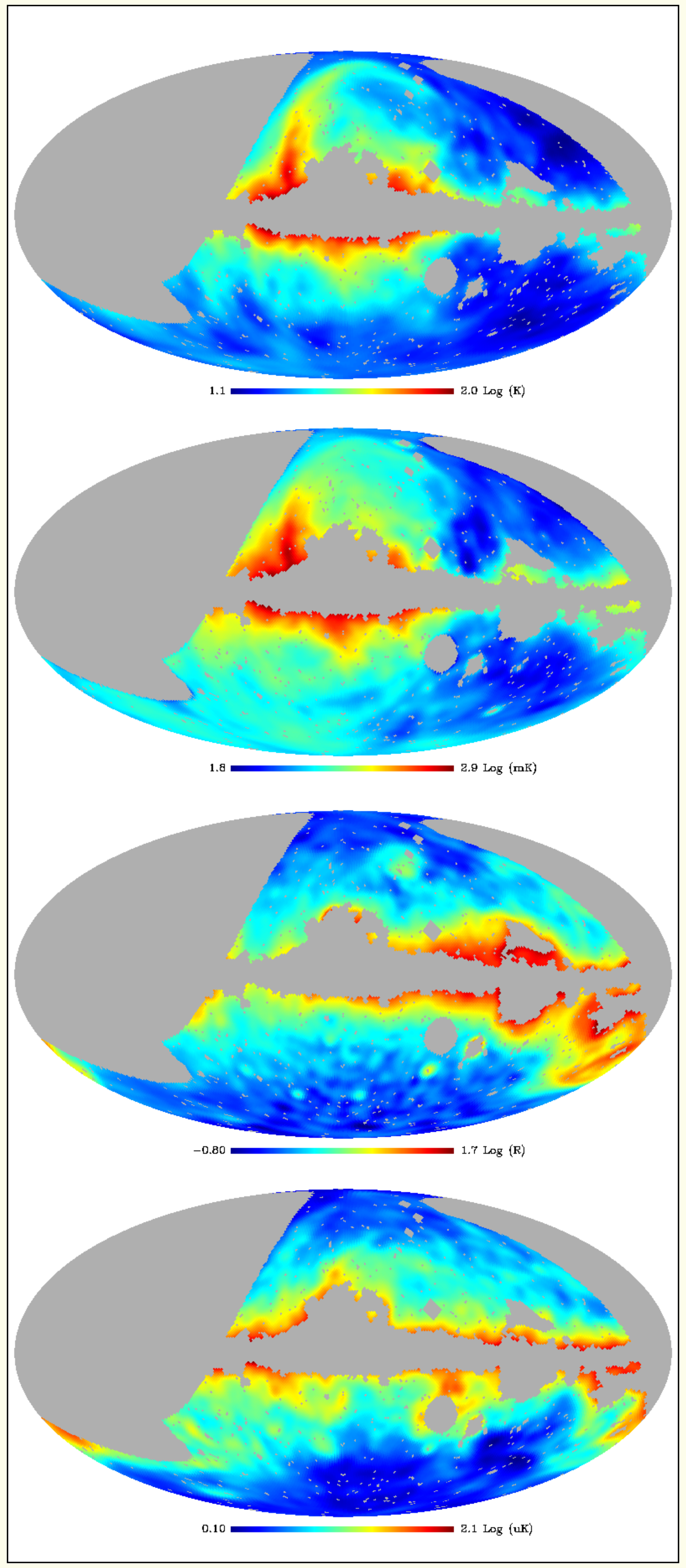

Figure 1: The input templates. Top to bottom: Haslam 408 MHz, Jonas 2.3 GHz, Hα, FDS 94 GHz

Anomalous microwave emission at 20-40 GHz has been detected across our Galactic sky. It is highly correlated with thermal dust emission and hence it is thought to be due to spinning dust grains. Alternatively, this emission could be due to synchrotron radiation with a flattening (hard) spectral index.

Following the method set out in Davies et al. [1], we **cross-correlate** synchrotron, free-free [2] and thermal dust [3] templates with the WMAP 7-year maps **using synchrotron templates either at 408 MHz** [5] **or 2.3 GHz** [6]. Comparison of these results lets us assess the amount of flat synchrotron emission that is present, and the impact that this has on the correlations with the other components, since the higher frequency map will be a better tracer of flat-spectrum emission. The templates shown in Figure 1 display the clear differences in morphology between the different emission mechanisms that they trace.

Figure 2a shows the template coefficients for the three components as a function of frequency, using either 408 MHz (solid lines) or 2.3 GHz (dashed lines) smoothed to 3°. We find that there is only a small amount of flattening visible in the synchrotron spectral indices by 2.3 GHz, of around $\Delta\beta \approx 0.05$, and that **the significant level of dust-correlated emission in the lowest WMAP bands is largely unaffected by the choice of synchrotron template**, particularly at high latitudes (it decreases by only ~7 per cent when using 2.3 GHz rather than 408 MHz).

The robustness of this result has been tested by looking at the effects of different resolutions, Hα templates and areas of the sky (hemispheres, masks and regions). Figure 2b shows a strong dependence of the 22.8 GHz template coefficients on the map resolution, likely due to a number of artifacts in the templates, which converge by 3°, in agreement with the findings of Ghosh et al. [4]. Figure 2c shows the dependence of the 22.8 GHz coefficients with foreground mask; there is a difference when masking less of the Galactic plane implying that flat-spectrum emission becomes more important nearer the plane. The results are otherwise shown to be robust.

These results agree with expectation if the bulk of the anomalous emission is generated by spinning dust grains. In the future, C-BASS data at 5 GHz will further constraint the relative levels of flat-spectrum synchrotron emission and anomalous microwave emission.

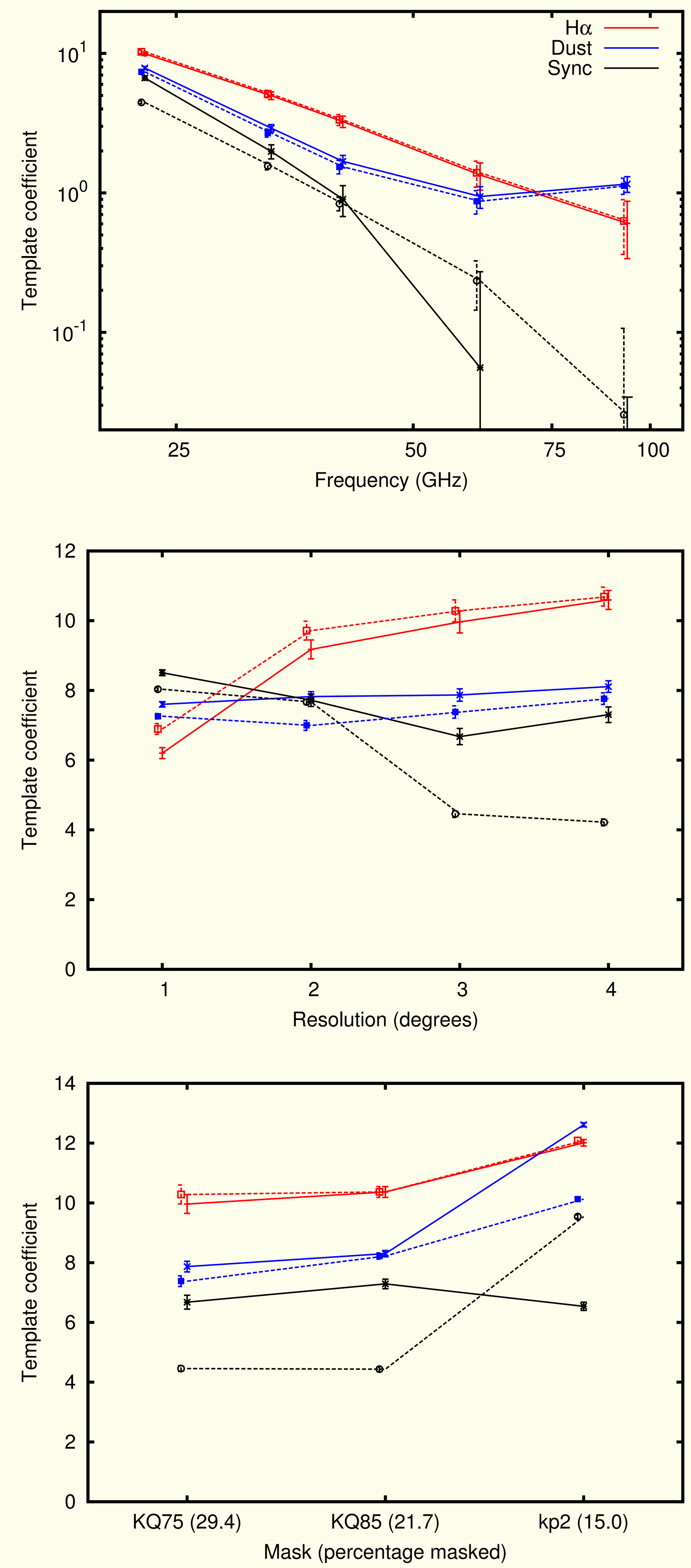

Figure 2: Template coefficients. Top: As a function of frequency. Middle: varying resolution. Bottom: different masks.

[1] Davies et al. (2006), MNRAS, 370, 1125
[2] Dickinson et al. (2003), MNRAS, 341, 369
[3] Finkbeiner et al. (1999), ApJS, 146, 407
[4] Ghosh et al. (2011), arXiv:1112.0509
[5] Haslam et al. (1982), A&AS, 47, 1
[6] Jonas et al. (1998), MNRAS, 297, 977