A2 calculation

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In this document I will be recording the HWP emission models used, and will present data on the HWPSS 2f signal for a warm and cold HWP.

1 Absorption Model

[CITE PAPER]

When an absorption coefficient is introduced into the HWP, the transmitted electric fields become:

$$E_t{}^{e\prime} = e^{\alpha_e d} E_t^e \qquad \text{and} \qquad E_t{}^{o\prime} = e^{\alpha_o d} E_t^o$$

The amount of power absorbed is then:

$$A^e(\nu) = 1 - \left|E_t{}^{e\prime}\right|^2 - \left|E_r{}^{e\prime}\right| \qquad \text{and} \qquad A^o(\nu) = 1 - \left|E_t{}^{o\prime}\right|^2 - \left|E_r{}^{o}\right|$$

giving us a differential absorption

$$A^{e-o} = \frac{\left|E_t{}^{o\prime}\right|^2 - \left|E_t{}^{e\prime}\right|^2}{2} \sim \frac{1}{2}\left[(1-e^{\alpha_e d})^2 - (1-e^{\alpha_o d})^2\right] E_t^2$$

The coefficients α_e and α_o are experimentally determined, and are fitted by the polynomials

$$\alpha_e = 1.47 \times 10^{-7}\nu^{2.2} \qquad \alpha_o = 8.7 \times 10^{-5}\nu + 3.1 \times 10^{-7}\nu^2 + 3.0 \times 10^{-10}\nu^3$$

At 145 GHz, we have $\alpha_e = .00836$ and $\alpha_0 = .02004$. Plugging these in gives a polarized emissivity of $\epsilon_{\text{pol}} = 1.503 \times 10^{-5}$.