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COMMENT ON "A CMB/DARK ENERGY COSMIC DUALITY"

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SUMMARY-The recent calculation on the suppression of the power at low multipoles in the CMB spectrum due to a IR cut-off presented in hep-th/0406019 misses the evualuation of the Integrated Sachs-Wolfe (ISW) term, which is crucial in models aiming to the explanation of the present acceleration of the Universe. Due to this observation, we show that a realistic IR cut-off cannot deplete the quadrupole to the values shown in hep-th/0406019.

Recently an attempt to lower the quadrupole of the CMB temperature anisotropies pattern by imposing an IR cut-off has been tried in [1]. The IR cut-off is imposed in the relation between the multipoles of the CMB anisotropy pattern and scalar metric fluctuations in Fourier space. Such relation for an adiabatic initial scale invariant spectrum is [2]:

$$\langle \left(\frac{\Delta T}{T} \right)^2 \rangle_\ell = \frac{A^2}{100\,\pi\,\ell(\ell+1)} K_\ell^2 \,, \tag{0.1}$$

where A is the amplitude of gravitational fluctuations and the coefficient K_l^2 is given by [2]

$$K_\ell^2 = 200\,\ell(\ell+1) \int_{k_c}^{\infty} \frac{dk}{k} \left[\frac{1}{10} j_\ell(k(\eta_0 - \eta_r)) + \right. \\ \left. + \int_{\eta_r}^{\eta_0} d\eta \, \frac{df}{d\eta} j_\ell(k(\eta_0 - \eta)) \right]^2 \,, \tag{0.2}$$

where $\eta_r \,, \eta_0$ are the conformal times at recombination and at present, respectively. k_c is an IR cut-off and the function f, defined as

$$f(\eta) = 1 - \frac{a'}{a^3} \int_0^\eta d\tau \, a^2(\tau) \,, \tag{0.3}$$

describes the time-dependence of metric fluctuations in a ΛCDM scenario.

The ISW term is zero in a CDM scenario (where $K_\ell = 1$), while is actually of the same order of magnitude of the SW term in presence of Λ [2]. All the results presented here are obtained with $\Omega_\Lambda^0 = 0.75$, $\Omega_b^0 = 0.05$, $\Omega_{\rm CDM}^0 = 0.2$, $h = 0.7$ (the same as in [1]).

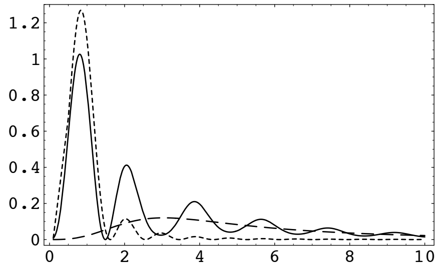

Figure 1: Integrands of ordinary SW (short-dashed), ISW (long-dashed) and the total (solid) with respect to $s = k/H_0$. The IR cut-off used in [1] corresponds to $s_* \simeq 2.6$.

$s_c = k_c/H_0$	K_2^2	SW	ISW
$\pi 10/12$	0.500	0.035	0.594
1/10	1.544	0.999	0.600

Table 1: Numerical values of K_2^2 for the IR cut-off chosen in [1] and for a much smaller cut-off (not zero for numerical reasons).

Before performing the integral in k, the SW and ISW terms look very different, as shown in Fig. 1 for the $\ell = 2$ case. An IR cut-off can easily kill the SW term, but cannot erase the ISW term since its shape is broader in Fourier space. Therefore the ISW contribution to the quadrupole (and lower multipoles) cannot be much decreased by an IR cut-off. Table 1 shows how an IR cut-off decreases the SW term by almost two orders of magnitude, while leaving inalterate the ISW term.

Fig. 2 shows the CMB temperature power spectrum computed by CMBFAST. Note that the introduction of an IR cut-off of the same magnitude as in [1] decreases the quadrupole to a third of the ΛCDM value, in agreement with Table 1 and in contrast with Fig. 1 of [1].

Similar considerations hold for dynamical DE models (but with additional DE perturbations).

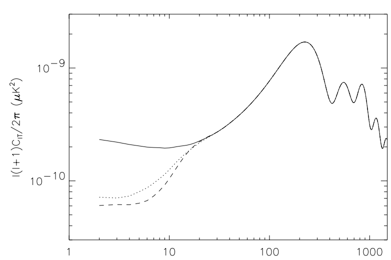

Figure 2: CMB temperature power spectrum computed with CMBFAST: the solid line is a ΛCDM model without IR cutoff, the dashed line has an IR cut-off, the dotted line has the same IR cut-off, but a different window function.

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