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Temperature Fluctuactions of CMB in Delta Gravity

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Introduction
We have been computing the scalar modes of the temperature fluctuations of the CMB in the context of Delta Gravity (DG) [1,2]. For this purpose we developed the perturbation theory of the equations of motions of this theory and studied the propagation of photons in the extended FRWL background using the hidrodynamical approximation and the sharp transition approximation at the time of last scattering [3].

As in General Relativity (GR), we could split the temperature fluctuation in an early",late" and "ISW" term, which we have probed they are gauge invariant. Then we assumed that all scalar contributions to the fluctuations were dominated by a single mode and we can study the temperature multipole coefficients.

Final calculations are in progress.

The Model
In DG photons follow null geodesics in an effective metric, if we consider a light ray travelling toward the center of this coordinate system from the direction $\hat{n}$, this ray will have a co-moving radial coordinate r related to t by:

\begin{equation}
0={\bf g}*{\mu\nu}dx^{\mu}dx^{\nu}=-(1+\kappa_2 F(t)+E(r\hat{n},t)+\kappa_2 \tilde{E}(r\hat{n},t))dt^2\\+(R^2(t)(1+\kappa_2 F(t))+h*{rr}(r\hat{n},t)\kappa_2\tilde{h}_{rr}(r\hat{n},t))dr^2\,,
\end{equation}

where $E,\ \tilde{E},\ h_{rr}$ and $\tilde{h}_{rr}$ are perturbations. κ_2 is just a parameter which can be 0 (GR case) or 1 (DG case), and it has no physical meaning because we can always re-scale the fields in the Delta sector.

If we make the approximation of a sharp transition from thermal equilibrium to complete transparency at a moment t_L of last scattering then we get
\begin{equation}
\left(\frac{\Delta T(\hat{n})}{T_0}\right)^S=\left(\frac{\Delta T(\hat{n})}{T_0}\right)^S_{\text{early}}+\left(\frac{\Delta T(\hat{n})}{T_0}\right)^S_{\text{late}}+\left(\frac{\Delta T(\hat{n})}{T_0}\right)^S_{\text{ISW}}\,.
\end{equation}
Each term is gauge invariant under transformations that leave $\mathbf{g}_{i0}$ equal to zero.

The "late" term only affects terms in the multipole expansion of the temperature correlation function with $l = 0$ and $l = 1$, so it can be ignored if from now on we consider only multipole orders $l \geq 2$. Besides, the integrate Sachs-Wolfe effect can also be neglected, because this effect is important only for relatively small values of l, say $l < 20$, where cosmic variance intrudes on measurementes of $C^S_{TT,l}$.

Finally, we are now calculating higher orders of the temperature multipole coefficients for the scalar modes.

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Primary authors: Mr RUBIO, Carlos (Pontificia Universidad Católica de Chile); ALFARO, Jorge (Pontificia Universidad Católica de Chile)

Presenter: Mr RUBIO, Carlos (Pontificia Universidad Católica de Chile)

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