ID de Contribution: **43** Type: **Non spécifié**

Cosmology with a varying vacuum refractive index

As initially proposed by H.A. Wilson, then R.H. Dicke, the curved spacetime in a stationary gravitational field can be equivalently interpreted as being due to a spatial change of both the vacuum refractive index and the inertial masses in a Euclidean metric. Dicke further extended this framework to explain the cosmological redshift, assuming a flat and static Euclidean metric but a vacuum index increasing with time.
In a recent published paper (X. Sarazin et al., Eur. Phys. Journal C, (2018) 78:444; arXiv:1805.03503), we have investigated Dicke's formalism in the modern observational cosmology era showing that it can, remarkably, reproduce not only the cosmological redshift but also the evolution of the CMB energy density and the cosmological time dilation of the supernovae light curves. We have shown in addition that the type Ia supernovæ data are well fitted by a vacuum index varying exponentially as $n(t) = exp(t/\tau_0)$, where $\tau_0 = 8.0 + 0.2 - 0.8$ Gyr. Hence the time-dependent scale factor $a(t)$ of the curved spacetime metric in standard cosmology, including the dark energy, can be replaced by a static metric with a vacuum refractive index increasing exponentially with time.
There are three important interests with this formalism. First, the apparent acceleration of the expansion is naturally obtained with an exponential variation of the vacuum index. Secondly, this solution corresponds to the absence of a beginning in the universe evolution and a speed of light infinitely large in an infinitely distant past, thereby solving the horizon problem without the necessity to recourse to the inflation epoch. Finally, given the ab initio flat Euclidean metric used, the observed flatness of the Universe does not require any fine-tuning here.
The main experimental consequence of this formalism is that the cosmological redshift should affect any atom, with a relative decrease of the energy levels of about $-2\ 10^{-18}\ s^{-1}$. Possibilities for an experimental investigation of this prediction are discussed.
The present study is far from being complete. BAO anisotropies in the CMB must still be formulated in this new framework with possible time dependence of the gravitational constant (which was one of the prime motivations of Dicke).

Authors: SARAZIN, Xavier (LAL); COUCHOT, François (CNRS/IN2P3/LAL)

Orateur: SARAZIN, Xavier (LAL)