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On the Electromagnetic Nature of Dark Energy and the Origin of Cosmic Magnetic Fields

Abstract : Out of the four components of the electromagnetic field, Maxwell's theory only contains two physical degrees of freedom. However, in an expanding universe, consistently eliminating one of the "unphysical" states in the covariant (Gupta-Bleuler) formalism turns out to be difficult to realize. In this talk we explore the cosmological consequences of the presence of this third electromagnetic polarization. Although the new state cannot be produced from charged matter, it can be excited gravitationally. In fact, primordial quantum fluctuations produced during inflation can give rise to super-horizon temporal electromagnetic modes whose energy density behaves as a cosmological constant. The value of the effective cosmological constant is shown to agree with observations provided inflation took place at the electroweak scale. On the other hand, on sub-horizon scales, because of the high electric conductivity of the cosmic plasma, the new state gives rise to both vorticity and magnetic fields. Present upper limits on vorticity coming from CMB anisotropies are translated into lower limits on the present value of cosmic magnetic fields. We find that fields $B_{\lambda} > 10^{-12}$ G can be typically generated with coherence lengths ranging from sub-galactic scales up to the present Hubble radius.

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Lugar: ***Sala de Conferencias de Serrano 121***
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