On the Origin of Cosmological Magnetic Fields

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The presence of substantial magnetic fields in galaxies and even on larger scales such as in clusters of galaxies is observationally indicated. The origin of such magnetic fields with large coherent length, however, is still one of the biggest mysteries in cosmology. Several models have been proposed to explain the origin, which are often involved with inflation in the early universe, or astrophysical activities during the structure formation of the universe until today. Here we propose a new mechanism for generation of magnetic fields \([1, 2]\). We showed that cosmological density fluctuations, which explain the large scale structure of the universe and cosmic microwave background temperature anisotropies, can also produce sufficient amount of magnetic fields on the cosmological scales at the epoch of recombination if we take the second order couplings into account. Evaluating the power spectrum of magnetic fields we found that the fields of \(10^{-16.8}\) Gauss are created at 1 Mpc scale and can be even stronger at smaller scales (Fig. 1). These fields should inevitably exist since we do not introduce any arbitrary assumptions. The magnetic fields generated in this mechanism may affect the formation of the primordial stars in the universe and be observed through time delays in pulses of gamma rays.

References
