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Baryogenesis and baryon isocurvature perturbation from primordial magnetic fields

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Gamma-ray observations of blazars suggest the existence of the intergalactic magnetic fields and their origin is interest for both astro physicsts and cosmologists. Among several proposals, magnetogenesis in the early Universe is an interesting option since it might also be a probe for the physics beyond the Standard Model of particle physics. Recently, it has also been proven that the baryon asymmetry of the Universe can be also generated if the magnetic fields are produced before the electroweak symmetry breaking with helicity without imposing any new physics. However, baryon isocurvature perturbations are also generated at the scale of the magnetic field coherence length in the mean time, which is constrained by the inhomogeneous Big Bang Nucleosynthesis. Note that this is an inevitable consequence of the Standard Model of particle physics. In this talk, I give generic constraints of the hypermagnetic field properties generated before the electroweak symmetry breaking. Noting that the baryon isocurvature perturbations are generated even from non-helical magnetic fields, I show that with reasonable parameter sets for the Standard Model of particle physics and magnetic field evolution laws, the intergalactic magnetic fields suggested by the blazar observations are hardly explained solely by the hypermagnetic fields generated before the electroweak symmetry breaking. Helical hypermagnetic fields can still be the origin of the present baryon asymmetry of the Unvierse, but we need an additional magnetogenesis or an unknown magnetic field amplification mechanism.

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