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The bearable inhomogeneity of the baryon asymmetry

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I will discuss the implications of precision measurements of light element abundances in concordance with the Cosmic Microwave Background for scenarios of physics beyond the Standard Model that generate large inhomogeneities. I will show that precision Big Bang nucleosynthesis (BBN) imposes strong constraints on any mechanism that produces large scale inhomogeneities at temperatures of the order or below a TeV. In particular, we see that inhomogeneities of the order of 20% at comoving lengths scales larger than the comoving horizon at the temperature of 3 TeV are in conflict with the measured light element abundances. This sensitivity to physics at such early times is because inhomogeneities in baryon number homogenize predominantly through diffusion, which is a slow process. BBN therefore acts as a novel probe of baryogenesis below the TeV scale, and readily rules out some of the proposed scenarios of baryogenesis in the literature. I will discuss the implications for electroweak baryogenesis. In addition I will show that precision BBN is a new probe of first order phase transitions which produce a gravitational wave signal in the frequency range from pHz to mHz. This leads to constraints on the electroweak phase transition, as well as the first order phase transitions that have been postulated to explain the pulsar timing array signal.

Author: EKHTERACHIAN, Majid (EPFL)

Presenter: EKHTERACHIAN, Majid (EPFL)

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