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Creating matter antimatter asymmetry with non-standard cosmology

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We study the consequence of a non-standard cosmological epoch in the early
universe on the generation of baryon asymmetry through leptogenesis as well as dark matter abundance. We consider two different non-standard epochs: one where a scalar field behaving like pressure-less matter dominates the early universe, known as early matter domination (EMD) scenario while in the second scenario, the energy density of the universe is dominated by a component whose energy density red-shifts faster than radiation, known as fast expanding universe (FEU) scenario. While a radiation dominated universe is reproduced by the big bang nucleosynthesis (BBN) epoch in both the scenario, the high scale phenomena like generation of baryon asymmetry and dark matter relic get significantly affected. Adopting a minimal particle physics framework known as the scotogenic model which generates light neutrino masses at one-loop level, we find that in one specific realisation of EMD scenario, the scale of leptogenesis can be lower than that in a standard cosmological scenario. The other non-standard cosmological scenarios, on the other hand, can be constrained from the requirement of successful low scale leptogenesis and generating correct dark matter abundance simultaneously. Such a low scale scenario not only gives a unified picture of baryon asymmetry, dark matter and origin of neutrino mass but also opens up interesting possibilities for experimental detection.

Authors: Mr MAHANTA, Devabrat (Indian Institute of Technology Guwahati); Dr BORAH, Debasish (Indian Institute of Technology Guwahati)

Presenter: Mr MAHANTA, Devabrat (Indian Institute of Technology Guwahati)

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