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New Ideas for Baryogenesis

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The Standard Model fails at explaining the matter antimatter asymmetry of the universe encoded in the baryon to photon ratio $n_b/n_\gamma \sim 10^{-10}$. The subtle properties of the electroweak theory allow in principle to satisfy the three Sakharov criteria for baryogenesis but are unable to account for the observed asymmetry. New physics ingredients are needed. While the Higgs sector has started to be well measured at the LHC, the nature of the electroweak phase transition (EWPT) still remains very poorly constrained. In fact, it depends only weakly on the value of the Higgs mass which is only one parameter of the Higgs potential while the nature of the EWPT depends mainly on the Higgs cubic and quartic couplings and/or on the Higgs couplings to other scalar fields. The second run of the LHC is going to be an interesting step in providing new probes of models leading to potentially strong EWPT, which would have dramatic implications for electroweak baryogenesis and therefore our understanding of the origin of the matter antimatter asymmetry of the universe.

I will review the status of baryogenesis theories with emphasis on mechanisms occurring at the electroweak scale, in which the Higgs is a key player, and their experimental tests. I will in particular present new ideas motivating the existence of a strong first-order EW phase transition in minimal extensions of the Standard Model.