Contribution ID : **157** Type : **Plenary/section talk**

Leptogenesis and baryon asymmetry in the early Universe for the case arbitrary hypermagnetic helicity

Tuesday, 11 October 2016 14:00 (15)

We study hypermagnetic helicity and lepton asymmetry evolution in plasma of the early Universe before the electroweak phase transition (EWPT) accounting for chirality flip processes via inverse Higgs decays and sphaleron transitions which violate the left lepton number and wash out the baryon asymmetry of the Universe (BAU). In the scenario where the right electron asymmetry supports the BAU alone through the conservation law B/3−L_{eR}=const at temperatures T>T_{RL}˜ 10TeV the following universe cooling leads to the production of a non-zero left lepton (electrons and neutrinos) asymmetry. This is due to the Higgs decays becoming more faster when entering the equilibrium at T=TRL with the universe expansion, Γ{RL}˜T>H˜Tˆ2, resulting in the parallel evolution of both the right and the left electron asymmetries at T<T_{RL} through the corresponding Abelian anomalies in SM in the presence of a seed hypermagnetic field. The hypermagnetic helicity evolution proceeds in a self-consistent way with the lepton asymmetry growth. The role of sphaleron transitions decreasing the left lepton number turns out to be negligible in given scenario. The hypermagnetic helicity can be a supply for the magnetic one in Higgs phase assuming a strong seed hypermagnetic field in symmetric phase.

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Session Classification : Nuclear physics and particle physics - parallel II

Track Classification : Nuclear physics and particle physics