Contribution ID: **77** Type: **not specified**

Baryogenesis in a Parity Solution to the Strong CP Problem

Monday 8 May 2023 17:45 (15 minutes)

Space-time parity can solve the strong CP problem and introduces a spontaneously broken $SU(2)_R$ gauge symmetry. We investigate the possibility of baryogenesis from a first-order $SU(2)_R$ phase transition similar to electroweak baryogenesis. We consider a model with the minimal Higgs content, for which the strong CP problem is indeed solved without introducing extra symmetry beyond parity. Although the parity symmetry seems to forbid the $SU(2)_R$ anomaly of the $B-L$ symmetry, the structure of the fermion masses can allow for the $SU(2)_R$ sphaleron process to produce non-zero $B-L$ asymmetry of Standard Model particles so that the wash out by the $SU(2)_L$ sphaleron process is avoided. The setup predicts a new hyper-charged fermion whose mass is correlated with the $SU(2)_R$ symmetry breaking scale and hence with the $SU(2)_R$ gauge boson mass, and depending on the origin of CP violation, with an electron electric dipole moment. In a setup where CP violation and the first-order phase transition are assisted by a singlet scalar field, the singlet can be searched for at future colliders.

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Session Classification: Cosmology II