## MAGIC23 Workshop (Matter, Astrophysics, Gravitation, Ions and Cosmology)



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## On characterizing the leptonic phase diagram in early Universe

The lattice QCD simulations predict a slow cross-over from parton to hadron matter, especially at small baryon densities. When attempting to apply this to the early universe, we find that the latest non-leptonic phase transition would not account for the large-scale structure of the universe. In the early epochs of the evolution of the universe, it is conjectured that the baryonic density, especially after the era of quark-gluon plasma, is negligibly small. On the other hand, the leptonic degrees of freedom likely survive the strong parton-hadron phase transition. Accordingly, the lepton chemical potential apparently remains finite, while the baryon chemical potential is nearly vanishing. In a thermal model with the entire PDG compilation, we analysed how the temperature varies with the lepton density. The dependence of the critical temperature on the lepton density maps out a richly structured phase diagram that might contribute to understanding the large-scale structure of the universe.

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