19th International Conference on QCD in Extreme Conditions (XQCD 2023)

Contribution ID: **30** Type: **Talk**

# Nontrivial topology in QCD, the Vacuum Energy and Large scale magnetic field of the Universe

*Thursday 27 July 2023 16:00 (25 minutes)*

We discuss the dynamics of the topologically nontrivial sectors with non-trivial holonomy in strongly coupled QCD in the background of the expanding universe characterized by the Hubble scale $H \ll \Lambda_{QCD}$. We argue that the vacuum energy and the de Sitter phase emerge dynamically with the scale $\rho_{DE} \approx H\Lambda^3_{QCD} \approx (10^{-3}eV)^4$, which is amazingly close to the observed value. We argue that the key element for this idea to work is the presence of nontrivial holonomy in strongly coupled gauge theories. The effect is global in nature and cannot be formulated in terms of a gradient expansion in an effective local field theory. We also argue that anomalous coupling of the dark energy with electromagnetism generates the large cosmological magnetic field correlated on the scale of the visible Universe as observed. We test these ideas with solvable models for QCD being formulated on Hyperbolic space. We also comment on some lattice QCD results when the system is formulated on a curved background modelling the expanding Universe with nonzero $H$.

The talk is based on several recent papers:

1.Ariel Zhitnitsky, "Cosmological Magnetic Field and Dark Energy", Phys. Rev. D 99 (2019) 103518 , e-Print: 1902.07737

2.Ariel Zhitnitsky,"Dynamical de Sitter phase and nontrivial holonomy in strongly coupled gauge theories in an expanding universe,"
Phys. Rev. D 92, 043512 (2015), e-Print: 1505.05151

**Primary author:** ZHITNITSKY, Ariel

**Presenter:** ZHITNITSKY, Ariel

**Session Classification:** Parallel session A