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Trace Anomaly, Condensates and Cosmological Constant

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We explore the origin of the cosmological constant. One salient and intriguing property of the cosmological constant is that the associated pressure is the negative of its energy density. By analyzing the energy-momentum tensor form factors of hadrons, we find that the QCD trace anomaly balances the pressure from quarks and gluons, thereby playing a key role in hadron confinement. This anomaly originates from the gluon and quark condensates in the vacuum and exhibits the same pressure-energy density relation as the cosmological constant. A similar phenomenon is observed in type II superconductors, where the same pressure-energy density relation arises from the unpairing of Cooper pairs in the vortex core. In view of these analogies, it is suggested that the cosmological constant could arise from the trace anomaly of a vacuum condensate resulting from the spontaneous breaking conformal symmetry in quantity gravity. The presence of a condensate could resolve the issue of energy conservation.

References

K.F. Liu, Phys. Lett. B 849, 138418 (2024), doi:10.1016/j.physletb.2023.138418 [arXiv:2302.11600]

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