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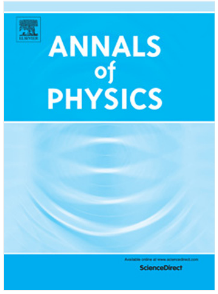


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# Viscosity bound versus the universal relaxation bound

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## Abstract

For gauge theories with an Einstein gravity dual, the AdS/CFT correspondence predicts a universal value for the ratio of the shear viscosity to the entropy density, $\eta/s = 1/4\pi$. The holographic calculations have motivated the formulation of the celebrated KSS conjecture, according to which all fluids conform to the lower bound $\eta/s \geq 1/4\pi$. The bound on $\eta/s$ may be regarded as a lower bound on the *relaxation* properties of perturbed fluids and it has been the focus of much recent attention. In particular, it was argued that for a class of field theories with Gauss-Bonnet gravity dual, the shear viscosity to entropy density ratio, $\eta/s$, could violate the conjectured KSS bound. In the present paper we argue that the proposed violations of the KSS bound are strongly constrained by Bekenstein's generalized second law (GSL) of thermodynamics. In particular, it is shown that physical consistency of the Gauss-Bonnet theory with the GSL requires its coupling constant to be bounded by $\lambda_{GB} \lesssim 0.063$. We further argue that the genuine physical bound on the relaxation properties of physically consistent fluids is $\Im\omega(k > 2\pi T) > \pi T$, where $\omega$ and $k$ are respectively the proper frequency and the wavenumber of a perturbation mode in the fluid.