

General Relativity and Quantum Cosmology

Gauging away Physics

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We consider the recent argument by Higuchi, Marolf and Morrison [1] that a nonlocal gauge transformation can be used to eliminate the infrared divergence of the graviton propagator, when evaluated in Bunch-Davies vacuum on the open coordinate submanifold of de Sitter space in transverse-traceless-synchronous gauge. Because the transformation is not local, the equal time commutator of undifferentiated fields no longer vanishes. From explicit examination of the Wightman function we demonstrate that the transformation adds anti-sources in the far future which cancel the bad infrared behavior but also change the propagator equation. The same problem exists in the localized version of the recent argument. Adding such anti-sources does not seem to be legitimate and could be used to eliminate the infrared divergence of the massless, minimally coupled scalar. The addition of such anti-sources in flat space QED could be effected by an almost identical gauge transformation, and would seem to eliminate the well known infrared divergences which occur in loop corrections to exclusive amplitudes.

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