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Evolution of a photon gas in the nonlinear QED vacuum[1] SHELDON WU, FREDERIC HARTEMANN, Lawrence Livermore National Laboratory — Thermally induced vacuum polarization stemming from QED radiative corrections to the electromagnetic field equations is studied. The physics of thermal radiation in the nonlinear vacuum first described by Heisenberg and Euler is a problem of some theoretical importance, in view of its relation to the cosmic microwave background, early universe evolution, and Hawking-Unruh radiation. In particular, the questions of the evolution toward equilibrium, stability, and invariance of thermal radiation under such conditions are of great interest. While nonlinear vacuum polarization effects in the photon gas had been previously studied, our analysis is presented in the framework of quantum kinetic theory. Within the context of the Euler-Heisenberg nonlinear QED vacuum, it is shown that a homogeneous, isotropic photon gas with arbitrary spectral distribution evolves toward an equilibrium state with a Bose-Einstein distribution. The transient evolution toward equilibrium of a gas of photons undergoing photon-photon scattering is described by the Boltzmann transport equation.

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