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A transformation identifying the Caldeira-Leggett model with the linear Vlasov-Poisson system GEORGE HAGSTROM, PHILIP MORRISON — The Caldeira-Leggett model is a Hamiltonian system that describes a simple harmonic oscillator coupled to a continuous spectrum of simple harmonic oscillators. It was invented to study quantum tunnelling in dissipative systems. We show that the damping mechanism in the Caldeira-Leggett model is analogous to Landau damping and derive an integral transformation from solutions of the Caldeira-Leggett model to solutions of the linearized Vlasov-Poisson equation. This establishes the equivalence of the two models and provides an example of a transformation that diagonalizes a Hamiltonian systems with a continuous spectrum[1]. We let the discrete oscillator have negative energy and derive an analog of the Penrose criterion for the stability of solutions. We extend our proof of Krein's theorem for the linearized Vlasov-Poisson equation[2] to the Caldeira-Leggett model.

[1]P. J. Morrison. Hamiltonian description of Vlasov dynamics: Action-angle variables for the continuous spectrum. Trans. Theory and Stat. Phys., 29:397-414, 2000.
[2]G. I. Hagstrom and P. J. Morrison. On Krein-like theorems for noncanonical Hamiltonian systems with continuous spectra: application to Vlasov-Poisson. arXiv:1002.1039. To appear in Trans. Theory and Stat. Phys.

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