Nonequilibrium Green's Functions for Mathematicians

Claude-Alain Pillet (University of Toulon)

Abstract: Since the pioneering work of Schwinger, Baym and Kadanoff, and Keldysh in the early '60, the Greens function formalism became an invaluable tool for the calculation of nonequilibrium properties of many-body systems. However, the perturbative approach used in the formal derivation of the theory have concealed the underlying mathematical structure. I will report on a joint work with Horia Cornean and Valeriu Moldoveanu which aims at unveiling this structure. More precisely, in the context of electronic transport in open systems, I will show how to derive the Jauho-Meir-Wingreen formula for the time-dependent current through an interacting sample coupled to non-interacting leads. Our proof is non-perturbative and uses neither complex-time Keldysh contours nor Langreth rules of analytic continuation. We also discuss other technical identities (Langreth, Keldysh) involving various many-body Greens functions. Finally, we study the Dyson equation for the advanced/retarded interacting Greens function and we rigorously construct its (irreducible) self-energy, using the theory of Volterra operators.