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Linear Response Theory: An Analytic-Algebraic Approach

Linear response theory (LRT) is a tool with which one can study the response of systems that are driven out of equilibrium by external perturbations. In this talk I present a modern and systematic approach to LRT by combining analytic and algebraic ideas. The theory is robust and provides a tool to implement LRT for a wide array of systems like periodic and random systems in the discrete and the continuum. The mathematical framework of the theory is outlined firstly: the relevant von Neumann algebras, noncommutative L^p - and Sobolev spaces are introduced; the notion of isospectral perturbations and the associated dynamics and commutators are studied; their construction is then made explicit for various physical systems (quantum systems, classical waves). The final part is dedicated to a presentation of the proofs of the Kubo and Kubo-Streda formulas.