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Applications of Fokker-Planck equations in liquid crystal physics and quantum optics

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Fokker-Planck equations are partial differential equations that describe stochastic processes. Two applications will be discussed: liquid crystal physics and quantum optics. Liquid crystals can show different aggregate phases that can be used in commercial applications. These phases are self-organized equilibrium states and are characterized by order parameters such as the Maier-Saupe order parameter for nematic crystals. Using mean field theory, it is shown how the Fokker-Planck equation formalism can capture the self-organization character and the emergence of an order parameter. In the second application, it is illustrated how quantum optical systems can be described in terms of stochastic processes defined by Fokker-Planck equations. In this context, the quantum mechanical expectation values become expectation values of ordinary stochastic processes and can conveniently be determined by means of numerical simulations.

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