Power-law Nonlinear Fokker-Planck Equations with Forces not Arising from a Potential

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We have investigated nonlinear Fokker-Planck equations endowed with curl drift forces, and determined the conditions under which these evolution equations admit stationary solutions. When these stationary solutions exist, we found that the nonlinear Fokker-Planck equations satisfy an H-theorem in terms of a free-energy like quantity, involving the Sq entropy. A two dimensional model admitting analytical, time-dependent, q-Gaussian solutions is discussed in detail. This model describes a system of particles with short-range interactions, performing overdamped motion under drag effects, due to a rotating resisting medium. We discuss the relevance of the present developments to the study of complex systems in physics and neuroscience.