CONVERGENCE OF AN ENTROPIC
SEMI-DISCRETIZATION FOR NONLINEAR
FOKKER-PLANCK EQUATIONS IN $\mathbb{R}^d$

J. A. Carrillo, M. P. Gualdani, and A. Jüngel

Abstract

A nonlinear degenerate Fokker-Planck equation in the whole space is analyzed. The existence of solutions to the corresponding implicit Euler scheme is proved, and it is shown that the semi-discrete solution converges to a solution of the continuous problem. Furthermore, the discrete entropy decays monotonically in time and the solution to the continuous problem is unique. The nonlinearity is assumed to be of porous-medium type. For the (given) potential, either a less than quadratic growth condition at infinity is supposed or the initial datum is assumed to be compactly supported. The existence proof is based on regularization and maximum principle arguments. Upper bounds for the tail behavior in space at infinity are also derived in the at-most-quadratic growth case.

2000 Mathematics Subject Classification. 35K65, 35B40.

Key words. Fokker-Planck equation, drift-diffusion equation, degenerate parabolic equation, existence of weak solutions, uniqueness of solutions, nonnegativity, implicit Euler scheme, relative entropy.