Critical wetting out of equilibrium: from high to low system dimensionalities

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Much scientific effort has been devoted to the study of equilibrium wetting since the idea that wetting can be described as a phase transition was introduced by Cahn in the late seventies. Nonequilibrium wetting, however, has only been recently addressed. Here, critical wetting transitions under nonequilibrium conditions are studied by analyzing Kardar-Parisi-Zhang (KPZ) interfaces in the presence of a binding substrate. In the case of high system dimensionalties, a self-consistent mean-field method is used. For a positive KPZ nonlinearity, a single (Gaussian) regime is found. On the contrary, interfaces corresponding to negative nonlinearities lead to three different regimes of critical behavior for the surface order-parameter: (i) a trivial Gaussian regime, (ii) a weak-fluctuation regime with a trivially located critical point and nontrivial exponents, and (iii) a highly nontrivial strong-fluctuation regime, for which we provide a full solution[1].

Low system dimensionalites are investigated by studying numerically one dimensional systems with a negative KPZ nonlinear coefficient, which are characterized in detail by providing the critical exponents for both the average height and the surface order-parameter. Evidence is shown that the presence of a potential well induces an anomalous scaling of the slopes which is not present in the complete wetting scenario[2].

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[1] Critical wetting of a class of nonequilibrium interfaces: A mean-field picture, F. de los Santos, E. Romera, O. Al Hammal, and M.A. Muñoz, Phys. Rev. E 75, 031105 (2007).

[2] Critical wetting of a class of nonequilibrium interfaces: A computer simulation study, E. Romera, F. de los Santos, O. Al Hammal, and M.A. Muñoz. submitted.