RANDOM WALK ON A RANDOM SURFACE: RENORMALIZATION GROUP ANALYSIS OF STOCHASTIC MODEL

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We study a model of a random walk on a rough fluctuating surface. We consider the Fokker-Planck equation for a particle in a uniform gravitational field. The surface is modelled by the most popular non-linear Kardar-Parisi-Zhang (KPZ) stochastic equation for the height field. Using the general Martin-Siggia-Rose and de Dominicis-Janssen theorems, the original stochastic problem is reformulated as a certain field theoretic model. This allows one to apply the well-developed formalism of Feynman diagrammatic techniques, renormalization theory and renormalization group. It was found that from six possible fixed points only two are infrared-attractive. First one is Gaussian and corresponds to free theory. Second one corresponds to the pure KPZ model, where the coupling constant responsible for the interaction between fluctuation of the surface and random walks is equal to zero. Moreover, it was found that well-known non-pertrubal fixed point for KPZ model, followed from functional renormalization group analysis, is stable for the whole model (including random walks) too. This fixed point describes non-trivial scaling, in which all interactions are non-zero and take part in asymptotic behavior of correlation and structure functions.

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