Overlaps and Pathwise Localization in the Anderson Polymer Model

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(Submitted on 11 Jul 2011 (v1), last revised 20 Dec 2012 (this version, v3))

We consider large time behavior of typical paths under the Anderson polymer measure. If P is the measure induced by rate $\kappa,$ simple, symmetric random walk on Z^d started at $x,$ this measure is defined as $$ d\mu(X)= {Z^{-1} \exp\{\beta\int_0^T dW_{X(s)}(s)\}dP(X) $$ where $\{W_x:x\in Z^d\}$ is a field of iid standard, one-dimensional Brownian motions, $\beta>0, \kappa>0$ and Z the normalizing constant. We establish that the polymer measure gives a macroscopic mass to a small neighborhood of a typical path as $T \to \infty$, for parameter values outside the perturbative regime of the random walk, giving a pathwise approach to polymer localization, in contrast with existing results. The localization becomes complete as $\frac{\beta^2}{\kappa}\to\infty$ in the sense that the mass grows to 1. The proof makes use of the overlap between two independent samples drawn under the Gibbs measure μ, which can be estimated by the integration by parts formula for the Gaussian environment. Conditioning this measure on the number of jumps, we obtain a canonical measure which already shows scaling properties, thermodynamic limits, and decoupling of the parameters.

Subjects: **Probability (math.PR)**

Cite as: **arXiv:1107.2011 [math.PR]**

(or **arXiv:1107.2011v3 [math.PR]** for this version)

Submission history

From: Francis Comets [view email]

[v1] Mon, 11 Jul 2011 12:32:57 GMT (48kb)

[v2] Wed, 7 Mar 2012 20:34:50 GMT (48kb)

[v3] Thu, 20 Dec 2012 14:48:31 GMT (49kb)