Seminar of Probability and Stochastic Process

Thursday, 16th December, from 11h15 to 12h15
MAA 112, EPFL, Ecublens

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On the chaotic character of the stochastic heat equation, before the onset of intermittency

Abstract:

We consider a nonlinear stochastic heat heat equation
\[ \partial_t u = \frac{1}{2} \partial_{xx} u + \sigma(u) \partial_{xt} W, \]
where \( \partial_{xt} W \) denotes space-time white noise and \( \sigma : \mathbb{R} \to \mathbb{R} \) is Lipschitz continuous. We establish that, at every fixed time \( t > 0 \), the global behavior of the solution depends in a critical manner on the structure of the initial function \( u_0 \). Under suitable technical conditions on \( u_0 \) and \( \sigma \), \( \sup_{|x| \leq R} u_t(x) \) remains bounded in \( R \) when \( u_0 \) has compact support, whereas with probability one, \( \sup_{|x| \leq R} u_t(x) \geq \text{const} \cdot (\log R)^{1/6} \) as \( R \to \infty \) when \( u_0 \) is bounded uniformly away from zero. The mentioned sensitivity to the initial data of the stochastic heat equation is a way to state that the solution to the stochastic heat equation is chaotic at fixed times, well before the onset of intermittency.

This is a joint work with Davar Khoshnevisan and Mathew Joseph, University of Utah.

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