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The non-linear wave equation in high dimensions: existence, Hölder-continuity and Itô-Taylor expansion

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Time and Place: Friday March 6, 2009; 3:00–4:00 p.m.; LCB 219

The main topic of this talk is the non-linear stochastic wave equation in spatial dimension greater than 3 driven by spatially homogeneous Gaussian noise that is white in time.

In dimensions greater than 3, the fundamental solution of the wave equation is neither a function nor a non-negative measure, but a general Schwartz distribution. Hence, we first develop an extension of the Dalang-Walsh stochastic integral that makes it possible to integrate a wide class of Schwartz distributions. This class contains the fundamental solution of the wave equation.

With this extended stochastic integral, we establish existence of a square-integrable random-field solution to the non-linear stochastic wave equation in any dimension. Uniqueness of the solution is established within a specific class of processes.

In the case of affine multiplicative noise, we obtain a series representation of the solution and estimates on the *p*-th moments of the solution $(p \ge 1)$. From this, we deduce Hlder-continuity of the solution. The Hölder exponent that we obtain is optimal.

For the case of general multiplicative noise, we construct a framework for working with appropriate iterated stochastic integrals and then derive a truncated Itô-Taylor expansion for the solution of the stochastic wave equation. The convergence of this expansion remains an open problem. (This is joint work with Robert C. Dalang, Swiss Federal Institute of Technology)