Probability and Stochastic Processes 098418

Directed Polymers, Random Geodesics and Burgers Turbulence
Spring Semester 2007-2008

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First Meeting   Wednesday, May 21 at 16:30 in 310 IE& M/Bloomfield

The purpose of the course is to try to understand and to discuss recent developments and (plenty of) common open mathematical problems which arise in such ostensibly diverse areas as e.g.

1. Directed polymers and First passage percolation.
2. Hamilton-Jacobi equations with random forcing and Burgers turbulence.
3. Kinetic roughening of growing surfaces (Kardar-Parisi-Zhang equation) and Scaling limits of interacting particle systems.

All of the above models describe evolutions in various random environments, and all of them feature random geodesics which, depending on the dimension and the strength of the environment, might have either diffusive or super-diffusive order of fluctuations. A probabilistic characterization of the super-diffusive phase is a major open problem.

The first lecture will be devoted to an exposition of various models, inter-links, known results and open questions. For the moment the plan is to go through parts of the following review and research papers:

[1] Bec, Jeremie; Khanin, Konstantin *Burgers turbulence*. Phys. Rep. 447 (2007), no. 1-2, 1–66.

[2] Gomes, Diogo; Iturriaga, Renato; Khanin, Konstantin; Padilla, Pablo *Viscosity limit of stationary distributions for the random forced Burgers equation*. Mosc. Math. J. 5 (2005), no. 3, 613–631, 743.

[3] Comets, Francis; Shiga, Tokuzo; Yoshida, Nobuo *Probabilistic analysis of directed polymers in a random environment: a review*. Stochastic analysis on large scale interacting systems, 115–142, Adv. Stud. Pure Math., 39, Math. Soc. Japan, Tokyo, 2004.

[4] Licea, C.; Newman, C. M.; Piza, M. S. T. *Superdiffusivity in first-passage percolation*. Probab. Theory Related Fields 106 (1996), no. 4, 559–591.

[5] Licea, Cristina; Newman, Charles M. *Geodesics in two-dimensional first-passage percolation*. Ann. Probab. 24 (1996), no. 1, 399–410.

[6] Bertini, Lorenzo; Giacomin, Giambattista *Stochastic Burgers and KPZ equations from particle systems*. Comm. Math. Phys. 183 (1997), no. 3, 571–607.

Short crash courses on relevant chapters of the HJ theory, SPDE, Percolation and Interacting particle systems are anticipated.

The grades will be given for reading and understanding of a research paper of choice.