Integrable particle systems in mathematical physics

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Abstract : Consider a random system of size N, for example a random walk of length N... One could qualify the problem as belonging to the "Gaussian universality class" as fluctuations scale as $N^{\frac{1}{2}}$ and have Gaussian behavior. The central limit theorem is the prototypical example.

Recently, a tremendous amount of research has been focusing on a new class called the "KPZ universality class" and where fluctuations are of size $N^{\frac{1}{3}}$ (See [Cor] for an overview). Physical situations expected to fall in the "KPZ universality class" include : random matrices, polymers, bacterial-growth, heavy traffic and fire-fronts. An ideal model consists in exclusion processes i.e particle systems where particles cannot occupy the same position.

The goal of this course is to serve as an introduction to the KPZ universality class by presenting a complete treatment of a few integrable particle systems. By "integrable" models, one needs to understand that many exact formulas exist, allowing for a complete description. In the most general situation, it is still an open problem.

The course content matches that of the online book by Timo Seppäläinen [S]. A streamlined version is in preparation [C], specifically tailored for the class.

Requirements : Prerequisites are minimal. We will use basic probability theory, combinatorics and determinantal identities.

Références

[C] Reda Chhaibi. Lecture Notes. In preparation.

[Cor] Ivan Corwin. Kardar-Parisi-Zhang Universality. Notices of the AMS. Volume 63, Number 3

[S] Timo Seppäläinen. Lecture Notes on the Corner Growth Model. `https://www.math.wisc.edu/~seppalai/cornergrowth-book/ajo.pdf`

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