Quantum integrable systems, conformal field theories and stochastic processes

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Tiling models and their Arctic curves

Some models in two-dimensional statistical mechanics, in suitable domains, show the emergence of phase-separation phenomena, and in particular of an “arctic curve” separating a frozen and a liquid region. Models in this class are characterised by the presence of a conserved quantity, whose flow is directed (these 2D models are, in a hidden way, 1+1-dimensional).

Some of these models are either “fully” solvable (they are free-fermions, and local observables of certain fields form a determinantal processes), or are nonetheless solvable “up to a certain extent”, because they are Yang-Baxter integrable. In the first case, there are nowadays powerful techniques to determine the associated Arctic curves, mostly due to Kenyon and Okounkov, we will not discuss this at depth here. In the second case, a theory is moving its first steps. In some lucky cases, a simple strategy, that we (F. Colomo and myself) call “the Tangent Method”, allows to determine these curves.

It is based on the study of modified domains, in which one unit of flow of the conserved quantity has its endpoint on the boundary pinned away from its usual location. The resulting directed path has a simple behaviour in the frozen region, and the associated modified partition functions (called “boundary observables”) are often calculable. These ingredients can be mixed in several ways, to produce algebraic systems for the Arctic curve, in terms of the boundary observables. The various incarnations of this strategies are the main topic of the lectures, and are illustrated through a variety of examples.

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