Report on research visit by Anton Bovier to Paris 6

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During my visit at the university Paris 6 from Februry 19-March 6, 2005, I was working with Irina Kurkova on the proof of the so-called "local REM conjecture" of Bauke and Mertens and on its extensions. This is a continuation of the originally proposed study of the k-partitioning problem, that we had been able to finish before my visit [BK1]. The REM conjecture states that in "any" natural disordered spin system with discrete spin space, for any fixed "central" value, E, of the energy (i.e. energies of modulus smaller than the root of the volume), the energy levels of the system very close to this value form, asymptotically, a Poisson point process. Moreover, the spin configurations realising these energies, are uniformly distributed on the configuration space. In brief, these properties are exactly those that would hold in the random energy model.

In a paper [BK2] that we finished essentially during my visit, we proved a general theorem that provides necesarry conditions for this behaviour. They could be verified in a wide class of short range spin glasses, and in all mean field spin glasses of SK type. In the case of Gaussion interactions, the theorem even allows to cover much higher energies, provided they remain sub-extensive.

In a secon paper [BK3] we investigate what happens in the case of extensive energies in the example of Derrida's generalized rndom energy model. We find that there are several thresholds at which the behaviour becomes more and more complex, with the simple Poisson point process being replaced by cluster point process of increasing complexity.

[BK1] (with I. Kurkova): *"Poisson convergence in the k-number partitioning problem"*, submitted to Random Proc. Alg. (2004).

[BK2] (with I. Kurkova): *"Local energy statistics in disordered systems: a proof of the local REM conjecture"*, submitted to Commun. Math. Phys. (2005).

[BK3] (with I. Kurkova): *"A tomography of the GREM:beyond the REM conjecture"*, submitted to Commun. Math. Phys. (2005).