

Scientific Report of exchange visit

(grantee: Alexander Drewitz, host: Wolfgang König)

- Proposal Title: Brownian interlacements and cycle percolation in Bose-Einstein condensation
- Application reference number: 4669

1 Purpose of the visit

The purpose of this visit was the initiation of obtaining a deeper insight into Bose-Einstein condensation, and in particular into the structure of the long cycles occurring in the underlying system of random permutations at low temperature / high particle density.

2 Description of the work carried out during the visit

We have started by investigating the free energy of a system of interacting Bosons. When approaching this problem via the Laplace-Varadhan method, we first tried to take advantage of LDPs for the stationary empirical field that have already been developed in [GZ93]. For this purpose, it would have been necessary to find a good approximation of the Hamiltonian that is local, in the sense that it could be expressed to sufficient accuracy by considering only those cycles of the underlying system of random permutations that are centered at points not too far away from each other. It turned out, however, that since long cycles do occur in the random permutations, this was a major obstacle in the planned approach.

Therefore, we started to develop an independent LDP for the stationary empirical field that is tailor-made to our purposes, i.e., in particular it should provide an appropriate treatment of the long cycles. Due to the latter this involves quite some technical machinery. We have discussed how such an LDP can then be used in order to derive a variational formula for the free energy. In fact, we would still have to introduce various truncation parameters to the system, and would then hope to be able to apply the LDP via the Laplace-Varadhan method to the truncated free energies in order to obtain the desired variational formulas.

3 Future collaboration with the host

The host will be visiting the grantee at Columbia University in December this year, which will hopefully contribute to a further advancement of the collaboration on the above project.

4 Projected publications

We are confident that our efforts will result in a publication; it may, however, still take some time to overcome a couple of difficulties and to formulate the results in the right form.

References

- [GZ93] Hans-Otto Georgii and Hans Zessin. Large deviations and the maximum entropy principle for marked point random fields. *Probab. Theory Related Fields*, 96(2):177–204, 1993. URL: <http://dx.doi.org/10.1007/BF01192132>, doi:10.1007/BF01192132.