ESF Research Networking Programmes Short Visit 6407
C. Van den Broeck ENS Lyon 30.01-02.02.2014

Scientific report

The topic of our research visit was broader then what was originally announced. We discussed 3 different scientific problems, 1. the problem of nonequilibrium noise in electric networks with S. Ciliberto (the announced subject), 2. the fluctuation theorem in an experiment with granular matter with A. Naert, and 3. problems of large deviation, especially when 2 small parameters are present, with F. Bouchet. These discussions were very interesting and productive, and will at least contribute to one paper with EPSD acknowledgment. We also gave an introductory talk on stochastic thermodynamics which was attended by a large number of younger graduate students and seems to have been well received.

We briefly review the 3 topics.

1. **Noise in electric networks: the problem of 3 resistors at different temperature can be solved. We however discussed other interesting or promising subjects. The case of nonlinear electric components (like diode) would allow to check experimentally the old issue concerning the validity or the lack of validity of nonlinear Langevin equations (cf. the famous Van Kampen 1/omega expansion). To perform such an experiment we however need a strong nonlinearity close to zero voltage, which is not readily available. A recent system of a nanotube attached to a cantilever might however provide a promising alernative. We also discussed the possibility of making Brownian refrigerators in electric networks driven by current source or capacity modulation, but unfortunately we did not yet come up with a concrete implementation. This collaboration exchange will be continued.**
2. **Granular matter: A. Naert verified in a very nice experiment with granular baths that the injected power obeys a fluctuation relation. Since this the bath are dissipative, we do not expect such a relation to hold and we discussed the possible explanations: it could be just the beginning of a Taylor expansion, or alternatively the result of a a central limit theorem with a Gaussian distribution that always satisfies a fluctuation relation with an effective T. It could however also be that the granular velocities in the horizontal plane have little dissipation and are close to Maxwellian, so that one has an effective equilibrium heat bath. One will try to verify whether this is the case in future experiments as well as equipartition of the unit that is**

driven by the granular gas.

3. We have been working on the large deviations of heat and work close to the macroscopic limit. This entails two large (or small) parameters: large system size and large time. F Bouchet has been looking at similar problems in a totally different context (low damping and large times) and found that in some cases the limits commute. We are preparing a manuscript on this issue and will acknowledge ESPD for the input.