

LAUDATIO FOR GIOVANNI GALLAVOTTI

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It is a great pleasure to be here in Montreal and participate to the celebration of Giovanni Gallavotti, who is honored today with the Poincaré Prize.

It is likely that each of you has immediately clear some outstanding contributions of him, for which the attribution of this prize is rather obvious. However, the number of his achievements is so wide and belonging to so many different areas, that probably each one of you will think to a different result.

Experts in statistical physics will think probably to his classical work on critical interfaces and large fluctuations of the Ising model; if you work in kinetic theory what you will have in mind are his influential results on linear Boltzmann equation; if you are an expert in dynamical systems the results on billiards and Bernoulli schemes, or KAM and Arnold's diffusion will be your choice; people interested in Quantum Field Theory will think to the famous Gallavotti-Nicolo' tree expansion and his rigorous approach to Renormalization; experts in condensed matter remember that he was among the first introducing the Renormalization Group approach to interacting fermions with extended Fermi surfaces; who is interested in non equilibrium statistical physics knows his fundamental Gallavotti-Cohen fluctuation theorem; and I could continue this list up to the end of my presentation. This amplitude is also witnessed, for instance, by his series of books which is a sort of new Landau-Lifshits series, including *The elements of mechanics*, *Fluid mechanics*, *Statistical Mechanics*, *Renormalization Group*, *Ergodic Theory*, *Nonequilibrium and irreversibility*; or by the series of seminars he organized for decades at the University of Rome, named *Seminar of Mechanics*, including all kinds of mechanics (classical, quantum, fluid, rational, statistical...). I could also mention his innovative results on history of science, in particular on Greek mathematics.

The beginning of scientific career of Gallavotti are in the late '60 an age which (among other things) saw the foundation of *Rigorous Statistical Mechanics*. Giovanni early joined to this enterprise working at IHES (1966-1968), where David Ruelle was present. Among his early results are the ones with Miracle-Sole' (CMP '67,68), on infinite volume correlations by cluster expansion. Then he moved to Rockefeller University (1968-1970), where he worked on surface tension, XY models with impurities, phase transition in binary lattice gases: his collaborators in these days were among others Abraham, Barouch, Ginibre, Lebowitz, Martin-Lof. In 1972 Gallavotti (CMP 1972) published an important result on large fluctuations of interfaces in the 2D Ising model; the same year he provided also the first

derivation of a *linear Boltzmann* equation from the deterministic Lorentz model; both works were very influential for later developments.

Back in Italy, around 1975, Gallavotti developed his celebrated approach to renormalization in Quantum Field Theory using Wilson's ideas. This led to an understanding of renormalization which is both mathematically and physically perfectly clear and effective; in this approach no unnatural "cancellation of infinities" are present, but a sequence of effective theories appear living at different energy scales, with a very natural connection with probabilistic concepts. Giovanni and his collaborators (G. Benfatto, M. Cassandro, F. Nicolò, F. Olivieri, E. Presutti..) were able to prove renormalizability at all orders ($n!$ -bounds) in several QFT models, and in several cases to provide a non-perturbative construction and prove the ultraviolet stability. A crucial tool was the identification of a combinatorial structure known as the *Gallavotti-Nicolò trees*; they are a combinatorial structure hidden in most series for physical observables and appearing naturally in Wilson's RG approach. These achievements were summarized in a milestone Rev. Mod. Phys. (1985).

Later on, Gallavotti and Giosi Benfatto were among the first to develop a Renormalization Group approach to condensed matter, and in particular to the problem of the Fermi surface in more than one dimension.

Using an approach inspired by his QFT results, he then proved using Renormalization Group the convergence of Lindstedt series for KAM tori, a very classical mathematical problem dating from the time of Poincaré'. This provided a new proof of the celebrated KAM theorem representing in Feynman graphs classical series and was the starting point of the theory of the resummation of several divergent series for the low dimensional KAM tori, and their Borel summability (developed with G. Gentile, G. Giuliani, O. Costin).

In the same times Giovanni and E.G.D. Cohen published their work on non equilibrium statistical physics (Phys. Rev. Lett.1995) and they introduced the *chaotic hypothesis*. In reversible systems, it implies that *fluctuations* should be severely constrained through the *Fluctuation theorem*. Being one of the very few predictions in non equilibrium statistical physics without free parameters, this has generated a great interest for understanding systems throughout physics, biology and chemistry; in particular for small biological motors which operate away from equilibrium.

It is also nice to mention his interest in Greek science, which was very influential in the developing of a new point of view of Greek civilizations, as well as his study on Lagrange and Boltzmann. As service to the community, it is worth to recall that he was president of this association in 2006-2008.

Giovanni Gallavotti was born and lives in a very intellectual family, his father Carlo being an international expert of ancient Greek language and civilization;

this origin was not forgotten and nowadays you can easily find Giovanni in his office reading and translating ancient mathematical texts, like the *Almagestum* of Ptolomeus. His wife Daniela is a well known Art Historian and his daughter Barbara is a successful science journalist.

Let me conclude, as time is running, that the interests of Giovanni are still enlarging and it is likely that if another laudatio will be done in next 3 years from now several new achievements would be present.