NOBEL SYMPOSIA SERIES

Fluctuation Relations

Professor Erik Aurell

Professor of Theoretical Biological Physics at Royal Institute of Technology at Stockholm (KTH)

Why it is difficult to find something if you do not know what you are looking for

Professor Luca Gammaitoni

Director of the Noise in Physical System Laboratory (NiPS Lab) at the Physics Department of the Università di Perugia, Italy.

NOBEL IN AFRICA
A STIAS INITIATIVE

Tuesday, 1 November 2022 | 10:00-12:00
3rd Floor Seminar Room, Physics Building, Westville Campus, UKZN

BIOGRAPHY

Erik Aurell started his scientific career as a mathematical physicist, receiving his PhD at Goteborg University in Sweden in 1989, and did a postdoc 1989-90 at the Observatoire de Nice, France. He has held the chair of Theorical Biological Physics at KTH since 2003. Previous positions include Finland Distinguished Professor at the Academy of Finland (2008-2013) and shorter guest professorships in Finland, China and France. Since 2021, he has served as a Board Member of the European Physical Society Statistical and Nonlinear Physics Division. Aurell has worked on nonlinear dynamics, turbulence models, biological physics/ systems biology and related inference problems, stochastic thermodynamics and open quantum systems.

ABSTRACTS

Erik Aurell's lecture:

A corner-stone of statistical physics is the fluctuation-dissipation theorem (FDT) which relates reponse to an external perturbation to equilibrium correlations. Over the last two decades it has emerged that FDT can be seen as a limit of equalities that hold also far from equilibrium, and which collectively are called fluctuation relations (FR). The most famous FR is Jarzynski's equality (JE) which relates an average of exponentiated work to exponentiated free energy differences. I will describe a paradigm where FRs are derived from time reversals of (classical) open systems, and how JE and other FRs then for many physically relevant models follow as simple consequences. I will also discuss the limits of this paradigm, in particular as to describe quantum FRs. I will further describe recent developments, applications to experiments, and open questions.

Luca Gammaitoni's lecture:

In this colloquium, we discuss the ambition of Artificial Intelligence to introduce a new method for modelling physical systems and predicting the future. We will show that, in general, the role of fluctuations in modelling physical systems cannot be ignored and very often learning to ask interesting questions is much more useful than rummaging through abundantly available answers. Consequences in Artificial Intelligence applications, fundamental limits in the physics of computing and the very fabric of space-time are also briefly addressed.

BIOGRAPHY

Luca Gammaitoni is Professor of Experimental Physics at the University of Perugia, in Italy and the director of the Noise in Physical Systems (NiPS) Laboratory. He is also the founder of Wisepower srl, a university spin-off company. He graduated at the University of Perugia and obtained a PhD in Physics from the University of Pisa in 1990. Since then he has developed a wide international experience with collaborations in Europe, Japan and the USA. His scientific interests span from noise phenomena in physical systems to non-equilibrium thermodynamics and energy transformations at micro and nanoscale, including the Physics of computing.

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