Contribution Title: KINETIC TRANSPORT IN CRYSTALS
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One of the central challenges in kinetic theory is the derivation of macroscopic evolution equations - describing, for example, the dynamics of an electron gas - from the underlying fundamental microscopic laws of classical or quantum mechanics. An iconic mathematical model in this research area is the Lorentz gas, which describes an ensemble of noninteracting point particles in an infinite array of spherical scatterers. In the case of a disordered scatterer configuration, the classical results by Gallavotti, Spohn and Boldrighini-Bunimovich-Sinai show that the time evolution of a macroscopic particle cloud is governed, in the limit of small scatterer density (Boltzmann–Grad limit), by the linear Boltzmann equation. In this lecture I will discuss the recent discovery that for a periodic configuration of scatterers the linear Boltzmann equation fails, and the random flight process that emerges in the Boltzmann–Grad limit is substantially more complicated. The key ingredient in the description of the limiting stochastic process is the renormalization dynamics on the space of lattices, a powerful technique that has recently been successfully applied also to other open problems in mathematical physics, including KAM theory and quantum chaos. This lecture is based on joint work with Andreas Strömbergsson, Uppsala.