CRETE CENTER FOR QUANTUM COMPLEXITY AND NANOTECHNOLOGY

ΣΕΜΙΝΑΡΙΟ ΚΕΝΤΡΟΥ ΚΒΑΝΤΙΚΗΣ ΠΟΛΥΠΛΟΚΟΤΗΤΑΣ & ΝΑΝΟΤΕΧΝΟΛΟΓΙΑΣ/ CCQCN SEMINAR

Friday, 08 November 2013

11:00-12:00

3rd Floor Seminar Room

Anomalous Heat Diffusion

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Abstract

We consider generally anomalous, i.e. normal, sub-diffusive and super-diffusive energy spread in solid phases of the mean square deviation MSD, i.e. the MSD (t) = [< x^2(t)> - <x(t)$>^2$] grows as t^β upon increasing time, of the non-equilibrium energy excess distribution $\rho_E(x,t)$, as induced by a small excess energy perturbation distribution away from thermal equilibrium. The associated total thermal heat flux autocorrelation function C_{JJ} (t) is then shown to obey rigorously the intriguing relation: d^2 MSD(t)/dt^2 = 2 C_{JJ} (t) /($k_B T^2$ c), where c denotes the specific volumetric heat capacity. Its first integral then assumes a *time-local* Helfandmoment relation with a chosen cut-off time $t_{cut\text{-}off} = t_S$, which is determined by corresponding signal velocity for heat transfer. Given next the premise that the averaged heat flux is indeed also governed by anomalous heat conductivity, anomalous energy diffusion scaling determines a corresponding anomalous thermal conductivity *scaling* for its size-dependence. For normal diffusion the conductivity becomes size-independent (i.e. a Fourier Law) while for super-diffusion it approaches a vanishing heat conductivity with increasing size L.

Literature: arXiv:1103.2835v4