Anomalous Heat Conduction in Low Dimensional Systems: the 1-D Hard Particle Gas and Dimensional Crossover from 2 to 1 Dimensions in the FPU Model

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We first present simulation results for the heat conduction in rectangular FPU lattices with periodic transverse boundary conditions. For small widths we find the well known power law divergence with system size of 1-d FPU chains. For aspect ratios <= 1 (aspect ratio = length/width) we do not observe the expected logarithmic increase of the conductivity, but also a power law, presumably due to finite size effects. The dimensional cross-over between both regimes happens at aspect ratios which diverge with system size. We discuss the relevance of this for heat conduction through single-walled carbon nanotubes.

In the second part of the talk we discuss whether the divergence of the heat conductivity in d=1 is universal, and whether it is related to hydrodynamic behaviour of the 1-d phonon gas. The latter would predict $\kappa \sim L^{1/3}$. We first show that this is in agreement with large scale simulations of a diatomic hard-point gas. But it is not in agreement with the results from FPU chains. We discuss whether this could be related to the fact that the hard-point gas is not chaotic, while the FPU chain is.

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