Phonon-phonon interactions in carbon nanotubes

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Mechanical losses in nanoscale systems are difficult to control experimentally and challenging to understand theoretically. In this talk, we present calculations of phonon lifetimes due to phonon-phonon interactions in semiconducting carbon nanotubes. These intrinsic phonon decay processes determine a fundamental lower bound to experimental losses.

In our calculations, we make use of an elastic continuum description of a carbon nanotube with elastic constants obtained from *ab initio* calculations of deformed graphene sheets and nanotubes. The resulting theory yields both harmonic elastic properties, such as phonon dispersions, and anharmonic properties, such as Grueneisen parameters, in good agreement with explicit atomistic approaches. We then quantize the theory and use many-body Green function techniques to obtain phonon lifetimes for the radial breathing mode and the fundamental flexural mode. The lifetime of the latter mode is closely related to the nanotube's quality factor, which is of great importance to technologically relevant carbon nanotube nano-electromechanical systems, such as nanotube mass sensors.