UNED Facultad de Ciencias

SEMINARIOS DEL DEPARTAMENTO DE FÍSICA FUNDAMENTAL

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"Diffusive Transport by Thermal Velocity Fluctuations"

Joint work with John Bell (Lawrence Berkeley National Labs) and Alejandro Garcia (San Jose State University)

I will describe our recent and ongoing research focused on fluid mechanics in regimes where thermal fluctuations are important. Thermal fluctuations play an important role in the hydrodynamics of small-scale systems, such as flows at micro and nano scales typical of new microfluidic, nanofluidic and microelectromechanical devices; biological systems such as lipid membranes, Brownian molecular motors, nanopores; and others.

Thermal fluctuations in non-equilibrium systems in which a constant (temperature, concentration, velocity) gradient is imposed externally exhibit remarkable behavior compared to equilibrium systems. The solution of the linearized equations of fluctuating hydrodynamics shows that concentration and density fluctuations exhibit long-ranged correlations in the presence of a macroscopic concentration gradient. These correlations lead to an enhancement of the concentration fluctuations and renormalization of the effective diffusion coefficient.

The enhancement of the diffusive transport depends on the system size L and grows as ln(L/L_0) in quasi-two dimensional systems, while in three dimensions it grows as L_0^{-1}-L^{-1}. The predictions of a simple fluctuating hydrodynamics theory are compared to results from particle simulations and a finite-volume solver and excellent agreement is observed. We elucidate the direct connection to the long-time tail of the velocity autocorrelation function in finite systems, as well as finite-size corrections employed in molecular dynamics calculations.

Martes, 11 de octubre de 2011, 11:00h

Sala 214 (Seminario Miguel Giménez), Facultad de Ciencias, UNED

Pº de la Senda del Rey, 11. (Puente de los Franceses)