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Modeling transport phenomena in mesoscopic quantum systems

Tuesday, 10 November 2015 11:55 (15 minutes)

We overview a series of results on transport and nonlinear phenomena in mesoscopic quantum systems with focus on the use of the Gross-Pitaevskii equation for the dynamics of Bose-Einstein condensed gases and the Boltzmann-Vlasov equation for transport phenomena in nuclear matter. Our results on the dynamics of Bose-Einstein condensates (BECs) focus on the emergence of density waves through patter-forming instability and rely on both numerical and analytical results, while the results on the collective modes of nuclear matter focus on the pygmy and giant dipole resonances. The investigations focused on BECs address single-component and binary condensates with both homogeneous and inhomogeneous two-body interactions, in both stationary configurations and their dynamical evolution. The pygmy dipole resonance, in turn, is studied extensively by numerical means and we derive the dipolar response and extract several informations such as the position of energy centroid and the energy-weighted sum rule exhausted below the giant dipole resonance. Finally, the presentation describes the state-of-art in terms of computing solutions for both problems under scrutiny.

Additional information

The presentation overviews a series of scientific results and describes the in detail the computing needs and outlines a series of directions of future research in parallel and distributed computing.

The first author, Alexandru Nicolin, will present the part dedicated to nuclear physics, while the second author, Mihaela Carina Raportaru, will present the part dedicated to Bose-Einstein condensates.

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