

Excitations in One-Dimensional Supersolids

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This talk will explore the excitation spectra of supersolids - materials that remarkably manifest both lattice structure and superfluidity. We focus on an ultracold dilute gas exhibiting one-dimensional crystal structure with two gapless excitation branches. Two distinct supersolid systems are examined: a one dimensional Bose-Einstein condensate with softcore interactions, and a three dimensional dipolar Bose Einstein condensate confined within an infinitely long tube-shape potential.

We adopt a hydrodynamic approach based on an effective Lagrangian, which depends upon three fields, corresponding to lattice deformations, defect density current, the global phase fluctuations and four elastic parameters. This description of the supersolid allows for the determination of low-energy excitations, as well as the behaviour of the associated density and phase fluctuations of the two gapless branches. We validate our predictions for the low energy excitations by comparison to results from directly solving the Bogoliubov-de-Gennes equations, finding excellent agreement.

This talk will provide a deeper understanding of the different types of supersolid systems, and how their low-energy behaviour depends upon their characteristic elastic energy scales.