PROBING SUPERFLUIDITY IN A QUASI TWO-DIMENSIONAL BOSE GAS THROUGH ITS LOCAL DYNAMICS

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ABSTRACT

A novel correlation analysis applied to a quasi-2D Bose gas allows us to locate the spatial boundary between the superfluid and the normal phases through their different dynamical response to a collective excitation.

KEYWORDS : *superfluidity ; quasi-2D Bose gas ; scissors mode ; dynamics ;*

Equilibrium properties of quantum gases are fully determined by the knowledge of the equation of state relating density to temperature and chemical potential. Inhomogeneous gases are therefore advantageous because they allow, within the local density approximation (LDA), to probe different regimes locally in a single realization of the experiment.

Until now LDA has been used to explore the physics of quantum gases at equilibrium [1]. Here we extend this approach to the dynamics of a quasi-two dimensional Bose gas by studying its response to the scissors excitation. The mode frequency is a signature of superfluidity.

Our observable for the scissors mode is $\langle xy \rangle$ [2], which is computed over an annulus of fixed radius r_a from the trap center. By varing the radius we are able to probe different regimes, from the superfluid core to the thermal wings of the cloud, and locate the boundary at which the BKT crossover occurs.

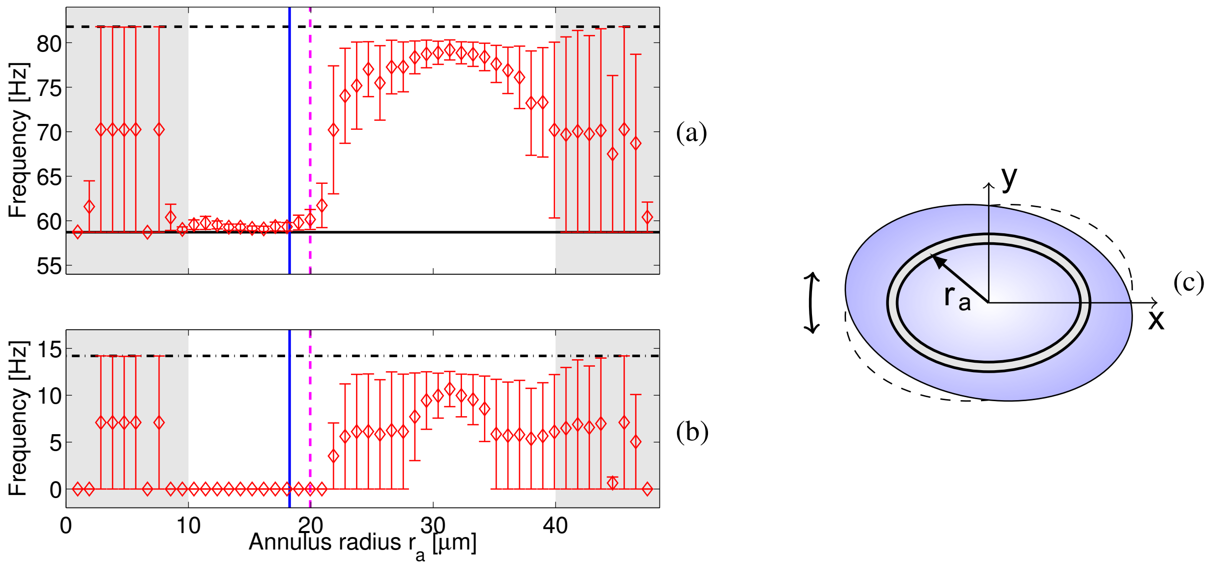

Figure 1 : Measured frequencies for $\langle xy \rangle_{r_a}$ computed over an annulus of width $\delta_r = 4$ pixels, sketched in (c), corresponding to the upper (a) and to the lower branch (b). The two vertical solid blue lines are estimates of the boundary between superfluid and normal phases based on LDA.

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