Far-infrared spectrum of few-electron concentric quantum rings

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Using an exact diagonalization technique [1], we address the far-infrared response of nanoscopic few-electron concentric double quantum rings (CDQR) [2-3].

We show that, in the presence of a perpendicularly applied magnetic field, CDQR display radially and azimuthally localized many-electron states whose fingerprint is the appearance of a very soft mode in the dipole infrared response at an energy that roughly corresponds to the absorption of a photon by a rigidly-rotating *N*-electron molecule [4]. This mode should be experimentally observable in CDQR far-infrared absorption spectroscopy [5].

The ground state energy as a function of the total angular momentum of the system (yrast line), two-electron densities (Fig. 1) and dipole infrared absorption spectra (Fig. 2) are discussed in detail for highly-symmetric configurations made of $N = 4$ and 6 fully-polarized electrons. We also discuss the charge-density response corresponding to monopole and quadrupole excitations, and show the existence in the quadrupole channel of excited states that can be identified with vibrational states arising in the *N*-electron molecule, thus strengthening the picture of an underlying electron-localized configuration.

References:

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Figures:

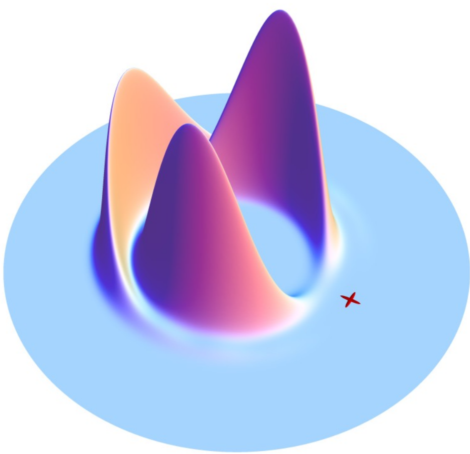

Figure 1: Two-body density for a circularly-symmetric state of four electrons. The position of one of the electrons is fixed at the point marked by the cross.

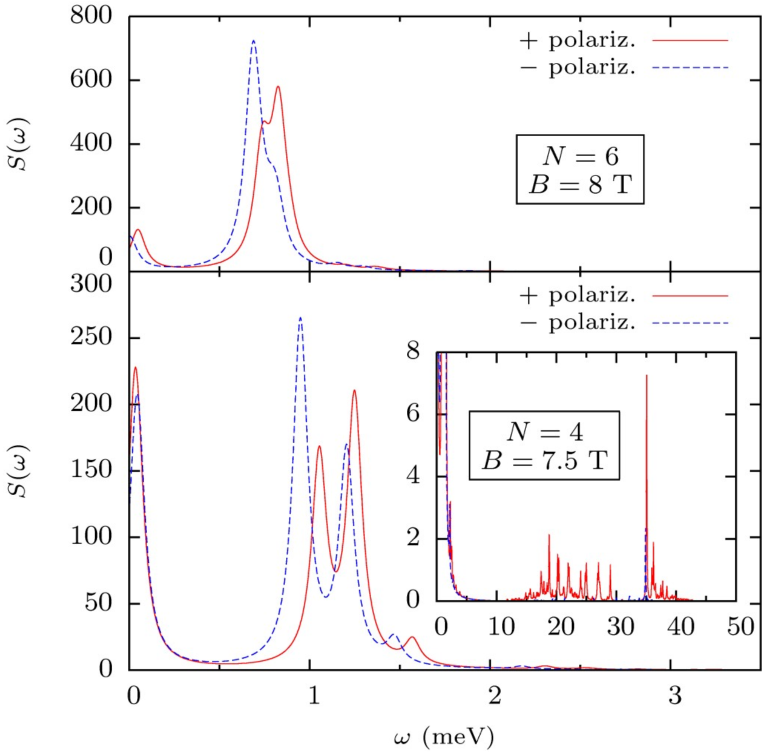

Figure 2: Low-energy dipole absorption spectrum (in arbitrary units), for CDQR ground states with N = 4 (bottom panel) and N = 6 (top panel) electrons. The inset in the bottom panel displays the whole spectrum (up to a 97% of the Thomas-Reiche-Kuhn sum rule). Peaks are represented by Lorentzians of 0.1 meV full width at half maximum.