Dynamical instability of multiply quantized vortices in Bose-Einstein condensates

The structure of vortices in Bose-Einstein condensates has been under intensive study especially since they were experimentally realized in 1999. Multiquantum vortices are in general energetically unstable and they tend to split into single quantum vortices. The splitting of a dynamically unstable doubly quantized vortex into two singly quantized vortices in dilute Bose-Einstein condensates was studied experimentally by Y. Shin *et al.* In particular, the splitting time as a function of the particle density was measured. We have carried out theoretical simulations which closely mimic the experimental setup. Our results are in good agreement with the experimental data, confirming that the combination of the gravitational and time-dependent trapping potentials yield a sufficient impetus to break the rotational symmetry of the system initiating the splitting process.

Recently, we have studied the dynamical stability of multiquantum vortices in one-component Bose-Einstein condensates with different trap geometries. We have shown that there are regions in the trap asymmetry and condensate interaction strength plane where the multiquantum state is dynamically stable. Hence, by carefully choosing the interaction strength and the geometry of the trapping potential, the splitting instability of these states can be significantly suppressed.

The numerical calculations are carried out using finite difference methods. Relaxation is used to calculate the ground state of the system for given potential and interaction strength. Time evolution of the system is solved using the Crank-Nicolson method. The non-Hermitian eigenvalue problem arising in the context of dynamical stability is solved, so far, using MATLAB's *eigs*-routine which uses ARPACK.