Dynamics of Vortices in Bose-Einstein Condensates: some recent developments

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Abstract.

In this talk, we 'll summarize some recent developments in the theme of vortices in Bose-Einstein condensates. Motivated by experiments in the lab of D. Hall on vortex dipoles, but also co-rotating sets of 2-, 3-, 4- or more vortices, we discuss a particle model involving the precession and interaction of the vortices that enables a systematic analysis of the relevant stationary or co-rotating states of a few vortices. The stability of such states presents various surprises including symmetry breaking bifurcations and the formation of asymmetric states, features that appear to also be supported in the experiments. In addition, some further features are discussed including a systematic analysis of the stability of an N-vortex ring and a state with N+1 vortices (N forming a ring and one at the center). These configurations are especially relevant for a small number of vortices (N). The opposite limit of large N will also be touched upon (time permitting) and the distribution in that limit will by obtained by means of coarse-graining techniques. Lastly, yet another intriguing mathematical approach will be developed involving generating functions that will enable in a number of cases to connect the vortex locations (in stationary or co-rotating states) to the roots of classical polynomials such as the Hermite polynomials.