Title: Vortex lattice theory: A particle interaction perspective
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Abstract: Recent experiments on the formation of vortex lattices in Bose-Einstein condensates has produced the need for a mathematical theory that is capable of predicting a broader class of lattice patterns, ones that are free of discrete-symmetries and can form in a random environment. In this talk, I will describe an N-particle based Hamiltonian theory which, if formulated in terms of the interparticle distances, leads to the analysis of a non-normal 'configuration' matrix whose nullspace structure determines the existence or non-existence of a lattice. The singular value decomposition of this matrix leads to a method in which all lattice patterns, in principle, can be identified and calculated by a random-walk scheme which systematically uses the m-smallest singular values as a ratchet mechanism to home in on lattices with many new properties, including a complete lack of discrete symmetries and heterogeneous particle strengths. We will describe properties of the lattice that the singular value distribution of its configuration matrix reveals, most notably its Shannon entropy (related to robustness), size (Frobenius norm), and distance between lattices (lattice density).