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Melting of Vortex Lattice in Bose-Einstein Condensate in Presence of Disorder[1] BISHWAJYOTI DEY, Department of Physics, SP Pune University, Pune 411007, India. — We study the vortex lattice dynamics in Bose-Einstein condensate (BEC) in presence of single impurity as well as random impurities or disorder. The single impurity is modeled by a Gaussian function while disorder is introduced in the system by a uniform random potential. Such potentials can be created experimentally by lasers. We solve the time-dependent Gross-Pitaevskii equation in two-dimensions using split-step Crank-Nicolson method. We first show that a single vortex can be pinned by an impurity. We then show that even a single impurity can distort the vortex lattice. For sufficiently strong impurity potential, the vortex lattice gets pinned to the impurity. We also show that a new type of giant hole with hidden vortices inside it can be created in the vortex lattice by a cluster of impurities. In presence of random impurity potential or disorder, the vortices get pinned at random positions leading to melting of the vortex lattice. We further show that the vortex lattice melting can also be induced by the pseudorandom potential generated by the superposition of two optical lattices. The absence of long-range order in the melted vortex lattice is demonstrated from the structure factor profile and the histogram of the distance between each pair of vortices.

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