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Spontaneous symmetry breaking in linearly coupled disk-shaped Bose-Einstein condensates

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We study effects of tunnel coupling on a pair of parallel disk-shaped Bose-Einstein condensates with the self-attractive intrinsic nonlinearity. Each condensate is trapped in a combination of in-plane and transverse harmonic-oscillator potentials. It is shown that, depending on the self-interaction strength and tunneling coupling, the ground state of the system exhibits a phase transition which links three configurations: a symmetric one with equal numbers of atoms in the coupled condensates, an asymmetric configuration with a population imbalance (a manifestation of the macroscopic quantum self-trapping), and the collapsing state. A modification of the phase diagram of the system in the presence of vortices in the disk-shaped condensates is reported too. The study of dynamics around the stationary configurations reveals properties which strongly depend on the symmetry of the configuration.

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