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Dynamics of multicomponent Bose-Einstein condensates on two- and three-dimensional optical lattices R. MARK BRADLEY, Dept. of Physics, Colorado State University, Fort Collins, CO 80523 USA, L.D. CARR, J.E. BERNARD, Dept. of Physics, Colorado School of Mines, Golden, CO 80401 USA —
Exact solutions to the mean field equations of motion are constructed for multicomponent Bose-Einstein condensates on square, rectangular and simple cubic optical lattices. For two condensates on a rectangular optical lattice, we find temporally-periodic solutions in which the optical lattice is divided into two sublattices, and the condensates oscillate back and forth between these sublattices. For a square optical lattice, a solution is found in which single condensate moves in a checkerboard vortex-antivortex array. We also obtain fascinating solutions for two condensates in which the square optical lattice is divided into a total of four sublattices, and the condensates move cyclically between these sublattices. Stationary solutions of high symmetry are constructed for two, three and four condensates on a simple cubic optical lattice. Finally, the stability of the solutions in two dimensions is probed thorough numerical integrations of the mean field equations of motion.

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