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Superconducting Vortices on a Periodic One-Dimensional Patterned Surface MINH QUAN LE THIEN, DANIELLE MCDERMOTT, Department of Physics, Wabash College, Crawfordsville, Indiana 47933 USA, CYNTHIA OLSON REICHHARDT, CHARLES REICHHARDT, Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 USA — We examine the statics and dynamics of vortices in the presence of a periodic quasi-one dimensional substrate, focusing on the limit where the vortex lattice constant is smaller than the substrate lattice period. As a function of the substrate strength and filling factor, within the pinned state we observe a series of order-disorder transitions associated with buckling phenomena in which the number of vortex rows that fit between neighboring substrate maxima increases. These transitions coincide with steps in the depinning threshold, jumps in the density of topological defects, and changes in the structure factor. At the buckling transition the vortices are disordered, while between the buckling transitions the vortices form a variety of crystalline and partially ordered states. Under an applied drive the system exhibits a rich variety of distinct dynamical phases, including plastic flow, a density-modulated moving crystal, and moving floating solid phases. We also find a dynamic smectic-to-smectic transition in which the smectic ordering changes from being aligned with the substrate to being aligned with the external drive. We discuss how these results are related to recent experiments on vortex ordering on quasi-one-dimensional periodic modulated substrates.

Minh Quan Le Thien
Wabash College

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