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Orientational Ordering, Buckling, and Dynamic Transitions for Vortices Interacting with a Periodic Quasi-One Dimensional Substrate 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. For weaker substrate strengths we find that the vortices retain triangular ordering but can show changes in the orientation of the triangular lattice with respect to the substrate. 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 discuss how these results are related to recent experiments by I. Guilamon et al, Nature Physics 10, 751 (2014), for vortices interacting on quasi-one-dimensional periodic modulated substrates.

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