Moving glass theory of driven lattices with disorder

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Abstract

When periodic lattices, such as vortex lattices in type II superconductors are driven by an external force, it is now known that, due to periodicity in the direction transverse to motion, the effects of static disorder persist even at large velocity [T. Giamarchi and P. Le Doussal Phys. Rev. Lett. **76** 3408 (1996)], leading to a new phase: the moving glass. Using a renormalization group procedure, it is possible to study in details the dynamical properties. This allows to derive the creep formula from first principles [P. Chauve, T. Giamarchi and P. Le Doussal cond-mat 9804190, submitted to Europhys. Lett.] and to obtain in details the physical properties of the moving glass phase [P. Le Doussal and T. Giamarchi cond-mat 9708085, Phys. Rev. B. **57** 11356 (1998)] both for zero and non-zero temperature. We review here these properties, in particular the $I-V$ characteristics, the conditions on which topological order exists in the moving phase, the issue of the existence of a plastic flow at the depinning transition, the existence of transverse barriers leading to a transverse critical current. We describe the complete phase diagram(s) as a function of disorder, temperature and force both in $d = 2$ and $d = 3$. These properties will be compared with recent decoration and transport experiments performed on vortex and wigner crystal systems.