MAR07-2006-000147

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Externally driven magnetic granular layers at a liquid/air interface: self-organization, flows and magnetic order

ALEXEY SNEZHKO, Argonne National Laboratory

Collective dynamics and pattern formation in ensembles of magnetic microparticles suspended at the liquid/air interface and subjected to an alternating magnetic field are studied. Experiments reveal a new type of nontrivially ordered dynamic self-assembled structures ("snakes") emerging in such systems in a certain range of field magnitudes and frequencies. These remarkable structures are directly related to surface waves in the liquid generated by the collective response of magnetic microparticles to the alternating magnetic field. In addition, a large-scale vortex flows are induced in the vicinity of the dynamic structures. Some features of the self-localized snake structures can be understood in the framework of an amplitude equation for parametric waves coupled to the conservation law equation describing the evolution of the magnetic particle density. Self-assembled snakes have a complex magnetic order: the segments of the snake exhibit long-range antiferromagnetic ordering mediated by the surface wave, while each segment is composed of ferromagnetically aligned chains of microparticles. A phenomenological model describing magnetic behavior of the magnetic snakes in external magnetic fields is proposed.