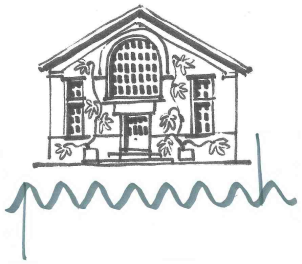

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Vendredi 4 juillet 2014, 11h00-12h00

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Directing colloidal self-assembly with toggled fields

Suspensions of polarizable colloids are expected to form crystalline equilibrium phases when exposed to a steady, uniform field. However, when colloids become localized this field-induced phase transition arrests and the suspension persists indefinitely as a kinetically trapped, percolated structure. The accompanying fluid-solid transition makes polarizable suspensions useful as tunable shock absorbers or as haptic controllers and tactile displays in micro-electronics devices. However, kinetic arrest ultimately prevents the formation of equilibrium phases encoded by the colloidal interactions and particle shape. We show that by toggling the applied field on and off, gels formed in magnetically polarizable fluids can be annealed. There is a stark boundary as a function of magnetic field strength and toggle frequency that distinguishes arrested structures from phase separation. A key advantage of self-assembly in toggled fields is the relatively large range of field-strengths (effective temperatures) that lead to phase separation. Finally, we demonstrate that such directed self-assembly can be used to create colloidal crystals of uniform size. These results demonstrate how kinetic barriers to a colloidal phase transition are subverted through measured, periodic variation of driving forces.