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Novel forms of colloidal self-organization in temporally and spatially varying external fields: from low-density network-forming fluids to spincoated crystals[1]

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External fields affect self-organization in Brownian colloidal suspensions in many different ways [1]. High-frequency time varying a.c. electric fields can induce effectively quasi-static dipolar inter-particle interactions. While dipolar interactions can provide access to multiple open equilibrium crystal structures [2] whose origin is now reasonably well understood, they can also give rise to competing interactions on short and long length scales that produce unexpected low-density ordered phases [3]. Farther from equilibrium, competing external fields are active in colloid spincoating. Drying colloidal suspensions on a spinning substrate produces a "perfect polycrystal" - tiny polycrystalline domains that exhibit long-range inter-domain orientational order [4] with resultant spectacular optical effects that are decoupled from single-crystallinity. High-speed movies of drying crystals yield insights into mechanisms of structure formation. Phenomena arising from multiple spatially- and temporally-varying external fields can give rise to further control of order and disorder, with potential application as patterned (photonic and magnetic) materials.

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