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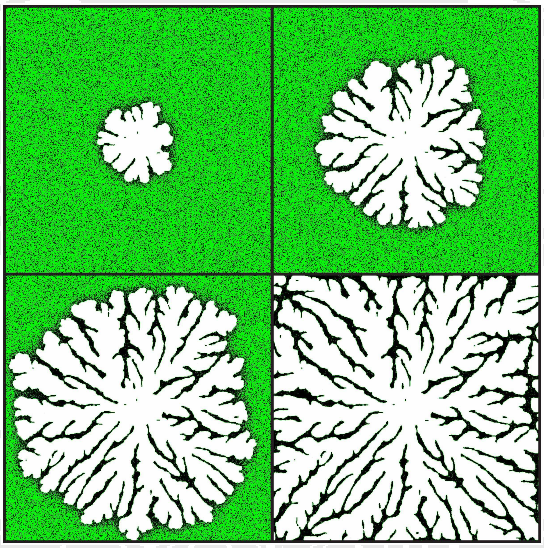

Snapshot of the unstable growth of a nucleated hole in a film of nanoparticle solution.
For details see Vancea et al, Phys. Rev. E 78, 041601 (2008).
doi:10.1103/PhysRevE.78.041601

THE RUGGED BEAUTY OF DEPOSITION PATTERNS AT RECEDING CONTACT LINES

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A phenomenon well known in our daily life is the coffee stain effect, i.e., the fact that an evaporating drop of coffee leaves behind a ring and not a homogenous stain. Such effects become very prominent on small scales where they may result in a rich variety of beautiful patterns ranging from regular and irregular lines to networks and wildly branched structures (see picture). In general, their formation is still poorly understood. The talk first reviews a number of recent experiments that all study evaporating and dewetting films or drops of particle suspensions or polymer solutions. After mentioning a kinetic Monte Carlo model (KMC), we discuss more extensively microscale and mesoscale continuum descriptions based on dynamical density functional theory (DDFT) and thin film hydrodynamics, respectively.
The DDFT and KMC is able to describe the formation of polygonal networks, spinodal patterns and branched structures in an ultrathin layer, whereas the thin film model allows us to discuss the self-pinning depinning cycles of a contact line related to the emergence of periodic deposit structures. In this way we identify three mechanisms for contact line instabilities. In passing we point out similarities to the Langmuir-Blodgett transfer of surfactant monolayers.
In the concluding part, we summarise the limits of the DDFT and thin film approaches and propose a 'thermodynamic' re-formulation of the hydrodynamic thin film model that allows for an easy incorporation of several additional physical effects.