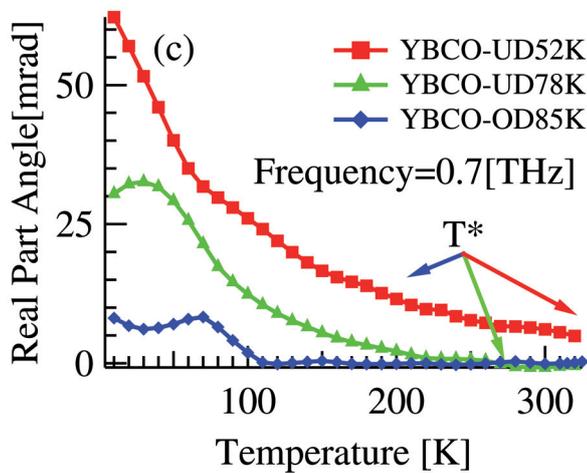


## Highlights from the previous volumes

### Another proof of loop-current order in high-temperature cuprate superconductors

It is by now clear that the heart of the solution of the cuprate problem is the physics of the strange-metal phase and the so-called pseudo-gap phase. A theoretical approach suggests that the strange-metal region as well the high-temperature  $d$ -wave superconductivity is due to the scattering of fermions from the quantum-critical fluctuations of a unique time-reversal breaking phase in the pseudo-gap region of the phase diagram. This phase has been observed by polarized neutron scattering in four different families of cuprates. A completely different kind of experiment is now reported: observation of large birefringence in three samples increasing below their pseudo-gap temperatures (see figure). This birefringence has very unusual features; it is observed in a twinned sample and the principal axes for the birefringence are rotated with respect to the crystalline axes. Calculations prove that such a behavior is precisely what is expected from the predicted phase, further confirming the validity of the theoretical approach.

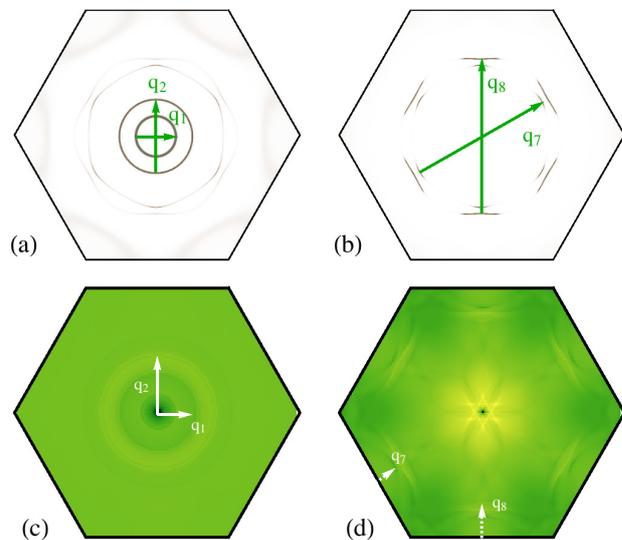


Large birefringence observed by Lubashevsky *et al.* (*Phys. Rev. Lett.*, **112** (2014) 147001) in three different dopings of a cuprate compound, always increasing at a temperature consistent with the pseudo-gap temperature for that doping.

Original article by VARMA C. M.  
[EPL, 106 \(2014\) 27001](#)

### Gap function of hexagonal pnictide superconductor SrPtAs from quasiparticle interference spectrum

The pnictide superconductor SrPtAs has a hexagonal layered structure that breaks in-plane inversion symmetry while overall the crystal is still centrosymmetric. This has peculiar consequences for the electronic structure as well as the Cooper pairing. It leads to a strong Rashba spin orbit coupling and splitting of quasi-2D  $5d$  Pt bands that dominate the Fermi surface. Although the superconducting gap functions are even or odd under inversion the in-plane pairing is nevertheless a mixture of singlet and triplet pairs due to the large Rashba coupling. Microscopic theories have obtained possible  $s + f$  and  $p + d$  wave candidates with unconventional nodal structure. We propose to apply the Bogoliubov quasiparticle interference (QPI) technique to SrPtAs which records the spectral density fluctuations at the surface due to impurities. We show that their analysis can give important clues on the nodal structure of the unknown SrPtAs gap function.



Top: quasiparticle equal energy ( $\omega$ ) surfaces for  $A_{1g}$  (a) and  $E_g$  (b) gap functions at  $\omega/\Delta_0 = 0.5$  ( $\Delta_0$  is the gap amplitude). Bottom: QPI spectrum ((c), (d)) for corresponding gap functions. The scattering vectors  $\mathbf{q}_i$  are characteristic for the nodal gap structure.

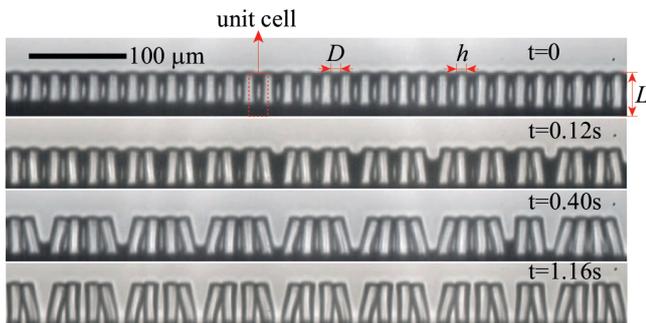
Original article by AKBARI ALIREZA and THALMEIER PETER  
[EPL, 106 \(2014\) 27006](#)

## Capillary collapse

Soft interfaces decorated by filaments and lamellae are commonly used to control mechanical properties (interfacial adhesion, friction, particle trapping), electrical properties (capacitance, conductivity), thermal properties (conductivity) etc. They also appear naturally in such instances as hairy surfaces. However, these surfaces are fragile when subject to humidity variations, as capillary forces cause the structures to collapse into clumps.

Inspired by experiments and observations of these hairy surfaces that form clumps, we have constructed a continuum theoretical framework that couples elasticity, capillarity and drying to explain the heterogeneous dynamics of elasto-capillary collapse, and captures the competition between coarsening and refining leading to a finite scale of patterning.

In addition to explaining the puzzles posed by the experimental patterns, our theory allows us to characterize the phase space of functional patterns and thus can be used to solve various inverse design problems.



Experiments showing drying-driven capillary coalescence of lamellae. (Figure: courtesy of H.-Y. Kim.)

## Terahertz transparency of optically opaque metallic films

It is highly desirable to make a metal transparent for electromagnetic waves, owing to many application requests for transparent metals in optoelectronics devices. However, it is well known that a high-conducting metal with a high electron density is generally opaque for electromagnetic waves, since the metal's permittivity is generally very negative at optical frequencies. Here, a free-standing transparent conducting device based on multilayer metamaterials is theoretically demonstrated at terahertz frequencies. It is realized by depositing periodic metallic patches on top and bottom of the subwavelength metallic mesh. The high transmission of the designed system is attributed to the impedance matching to the vacuum. This design of a transparent conducting device opens a high-transmission window within the technologically relevant THz frequency range. This device may find plenty of applications in optoelectronic electrodes, micro-electronic displays, and the miniaturization and integration of THz components, where both high electrical conductivity and high optical transmission are desirable.