Time-resolved spectroscopy reveals the momentum-selective Mottness of the pseudo gap state of the cuprates.

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The intrinsic nature of the pseudo gap phase of the cuprates has proved hard to identify experimentally despite decades of intensive activity and remains one of the key puzzles i the cuprate phase diagram.

Non-equilibrium spectroscopies provide us with a new tool to solve this issue. Time-resolved optical spectroscopy and photoemission highlight a clear experimental line. This boundary delimits a pseudogap-like region in which the pump pulses create a transient non-thermal population, with excess excitations in the regions close to the k=(¬±œÄ,0), (0,¬±œÄ) points of the Brillouin zone (antinodes).

Strikingly, the scattering rate of this pump-induced non-thermal transient state is smaller than that measured at equilibrium. We show that this non-equilibrium physics finds a natural explanation in terms of the Hubbard model treated in Cluster Dynamical Mean-Field Theory, in which short-ranged correlations lead to a k-space differentiation between antinodal Mott-like excitations and nodal quasiparticles in doped Mott insulators.

As the energy is non-thermally pumped in the system, the antinodal Mottness is partially quenched and antinodal states evolve into more mobile ones thereby reducing their scattering rate. The Mott-like suppression of antinodal charge fluctuations makes this universal correlated ground state naturally prone to the ordered phases that have been hitherto measured in the pseudogap by conventional spectroscopies. However, a proper account of electronic correlations is necessary to study the appearance and stability of these phases.