Electronic Liquid Crystal Correlations in the Pseudogap States of High T_c Superconductors

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The nature of pseudogap phase of cuprate oxides has been one of the most debated topic in condensed matter physics. Recently, the peculiarities of the pseudogap states were beautifully captured by STM data on $Bi_2Sr_2CaCu_2O_{8+x}$ in the form of an inhomogenious spatial pattern of density of states. From these pseudogap patterns, we constructed liquid crystalline order parameter fields to quantify the symmetry breaking features[1]. These fields reveal two properties of the pseudogap phase: it has a net anisotropy (nematic order) over at least 100 nm length scales; the stripe-like smectic order in the patterns impacts the nematic order locally at dislocations in the tripe pattern. Further, we could construct a Ginzburg-Landau free energy of nematic and smectic order parameter fields that is minimally allowed by symmetry and capture these two properties[2]. Our results point towards important role of oxygen sites for microscopic models and open up opportunities to investigate the role these properties of pseudogap states play in superconductivity of high T_c cuprates.

[1]Lawler, Fujita et. al., Nature 466, 347 (2010).
[2]Mesaros, Fujita et. al., to appear in Science (2011)

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