Contribution ID: **1441** Type: **Poster (Student, In Competition) / Affiche (Étudiant(e), inscrit à la compétition)**

Monte Carlo studies of the pseudogap regime in the cuprate superconductors

Tuesday 14 June 2016 19:08 (2 minutes)

We present a theory that describes the pseudogap regime of the hole-doped cuprate superconductors by incorporating the competing effects of superconducting and charge density wave orders into six-dimensional degrees of freedom on a two-dimensional lattice [Science 343, 1336 (2014)]. Using Monte Carlo simulations, we calculate the charge order correlations and diamagnetic susceptibility [PRB 90, 094515 (2014)] associated with this O(6) model. We demonstrate that the structure factors calculated using our theory agree qualitatively with recent X-ray scattering experiments on hole-doped $YBa_2Cu_3O_{6+x}$ for a wide range of temperatures about the superconducting transition. We also study the effects of incorporating into our model interlayer coupling and disorder [PRB 92, 174505 (2015)]. In the presence of disorder, we find that our theory can reproduce experimental structure factors in the zero temperature limit.

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Session Classification: DCMMP Poster Session with beer / Session d'affiches, avec bière DPMCM

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)