Optical properties of the pseudogap state in deeply underdoped cuprates

ADAM POUND, University of Guelph, JULES CARBOTTE, McMaster University, ELISABETH NICOL, University of Guelph — Recent optical measurements of deeply underdoped cuprates have revealed that a coherent Drude response persists well below the end of the superconducting dome in the phase diagram[1]. We show that this observation is consistent with the resonating valence bond spin-liquid model proposed by Yang, Rice, and Zhang[2]. Within this model, we analyze the three elements that cause the overall reduction in optical conductivity in the approach to the Mott insulating state: a Gutzwiller factor associated with increased correlations, which causes a reduction in the coherent part of the carrier Green’s function; a shrinking of the Fermi surface defining the hole Luttinger contours; and an increase in optical effective mass. We show that each of these elements yields qualitative agreement with various experimental observations. Finally, we show how the increased magnitude of the pseudogap at low doping modifies the microwave conductivity and the Wiedemann-Franz law.