Title: "Paired Electron Pockets in the Hole-Doped Cuprates"

Abstract:
A two-fluid model of the pseudogap phase in the hole-doped high-temperature cuprates is developed, which includes a vortex liquid coming from a strongly-paired electron pocket and a Fermi liquid of holes. It is argued that the electron pocket appears naturally via Brillouin zone folding either due to a 2D long-range antiferromagnetic order or in the presence of a magnetic "liquid" phase without a LRO, but with strong AF correlations. The initial description of the antiferromagnetic metal includes bosonic spinons, and spinless electron- and hole-like excitations in the antinodal and nodal regions respectively. In addition, a gauge-field degree of freedom emerges, which is shown to be the pairing glue that naturally yields a strong s-wave pairing in the electron pocket and a weak p-wave pairing in the hole-pocket, which in turn translate into a d-wave pairing for the physical electrons. The recent quantum oscillation experiments in strong fields are interpreted as the effect of orbital deparing of spinless electrons, which reveals the ghost electron pockets. A simple estimate based on standard BCS theory for the upper critical field, shows that the onset of oscillations at 50T corresponds to the superconducting gap of ~200K (with the Fermi temperature for the electron pocket being ~700K). Therefore, the electron pocket is strongly paired and remains a "ghost" that can not be clearly visualized in photoemission experiments, unless the pairing is suppressed. However, it strongly contributes to transverse transport, competing with the Fermi-liquid-like contributions of the holes, and may naturally lead to the electron-like sign in the Hall response and an anomalous Nernst effect as well. It is argued that much of the cuprate phenomenology can be understood based on the proposed picture.