

QUESTIONS POSED IN THE PROGRAM WEDNESDAY
AFTERNOON DISCUSSION SESSIONS

*CRITICAL ISSUES IN HIGHER TEMPERATURE
SUPERCONDUCTORS*

1.0 Discussion of the Fe-superconductors (D. Scalapino)

1.1 Are the Fe materials strongly, intermediately or weakly coupled?

1.2 How should one understand the magnetic and structural phase transitions: J1-J2 models, Fermi surface nesting, orbital ordering, ... ?

1.3 Resistivity (similarities between the pnictides, the cuprates and the organics).

1.4 Is there strange metal behavior in the Fe materials? Does quantum criticality play an important role in these materials?

2.0 Ba_{1-x}KxBiO₃ Revisited: Discussion Topics (M.Rice)

2.1 Origin of CDW order in BiBaO₃ with Bi³⁺ & Bi⁵⁺ local sites: Coulomb (Varma) or Lattice Forces (Franchini et al PRL`09)? Bi is a Valence Skipper.

2.2 Mechanism of Superconductivity with T_c = 30K in BKBO : Negative U or Strong Coupling EI-Phonon?

2.3 Similarities and Contrasts between the two Phase Diagrams e.g. SC T_c & Doping Range: BKBO (30K & x > 0.4) Cuprates(130K & x > 0.04).

2.4 Anomalous Normal State of BKBO => Low Energy Model ?

2.5 What can we learn from BKBO about the prospects for a useful High Temperature Superconductor?

3.0 Discussion of Strange Metal State (S. Sondhi)

3.1 What are the facts in need of explanation?

- There is a Fermi surface but without (Fermi liquid scaling) of quasiparticles. Anisotropic lifetimes (different powers?)
- Power laws in transport. Different ranges for longitudinal and Hall resistances
- Nothing dramatic in low frequency susceptibilities that correlates with transport scaling and T . But various instabilities at 400K and below
- Thermodynamics featureless

3.2 Top down explanation (cf FL theory)

- Consider the Hubbard model (or something like it). Start at bandwidth and carry out exact RG towards the FS where low energy objects live. Arrive near unstable fixed point by 1000K.
- Unstable fixed point. Must be building up singular and/or retarded couplings –else get FL behavior. Contain multiple growing susceptibilities. Exist in other materials? Allow doping dependent termination of strange metal regime to be understood in a natural way.
- DMFT is producing growing retardation. Strange metal already in k independent self energy? Can one import RG into DMFT?
- Stable phase too much? (D-wave Bose liquid)

3.3 Bottom up explanation

- Quantum critical point between $T=0$ phases leads to a quantum critical funnel
- Needed: Criticality over most of Fermi surface –else hot spots shorted by cold spots. Explanation for why a single power in transport lifetime. Doubled critical Fermi surface if transition between Fermi surfaces. Fluctuations at small q (Spin chirality, nematic, phase fluctuations). Explanation of modest susceptibilities and small corrections to scaling, including in the scaling variable choice.