

FeSe discussion - Intertwined 17

FeSe = 9K SC - why is it interesting?

OUTLINE

- ① High T_c : pressure intercalation, deposition of monolayer on STO, ...
- ② No LR magn. order, unlike "canonical" pnictides
- ③ Tiny $E_F \Rightarrow$ BEC? $\mu(T)$
- ④ Strong nematic order below 90K
- ⑤ Unusual phase diagrams!
pressure, S-doping, K-doping
- ⑥ Superconducting state - highly anisotropic

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① pressure, intercalation, depos. on STO \rightarrow HTS

pressure $T_S \downarrow T_C \uparrow$ - competition of nem + SC?

induces SDW - proximity to SDW order.

intercalation - more 2D
also e^- doping

LiOH intercalate - no hole pockets*

Monolayer FeSe on STO

- e^- doping from Vacancies
STO

- role of apical O phonon
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- ARPES replicas
+ forward scatt. phonon

- no hole pockets*

* what becomes of usual S_{\pm} SC?

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② Unlike "canonical" pnictides, no LR mag order

- "proximity" to SDW
pressure phase diagram,
extra floct → linear T resistivity
strong $\pi, 0$ (and π, π) floct.

N.B. $(\pi, 0)$, (π, π) weights strongly
T-dependent

π, π dominant at high T, W

- origin of SDW suppression,
connection to nematic order

i) quantum paramagnet
- Wang et al $J_1, -J_2$ $S=1$ para. phase
- Glasbrenner et al
frustration of different mag. configs.
(DFT & classical MC)

ii) quadrupole order
Si Nevidomskyy

iii) orbital order - Kontani

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③ Tiny $\bar{E}_F \rightarrow$ BEC? $\mu(T)$
separate trivial small \bar{E}_F effects from interaction-driven

Matsuda, Shibauchi:

High-T diamagnetic fluctuations deduced from magnetoresistance, Seebeck

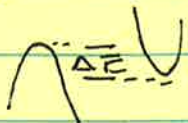
but - no evidence in Thermodynamics, e.g. $C(T)$

2-band Theory (Erenin, Chubukov):

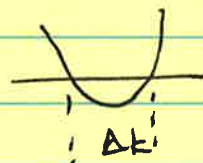
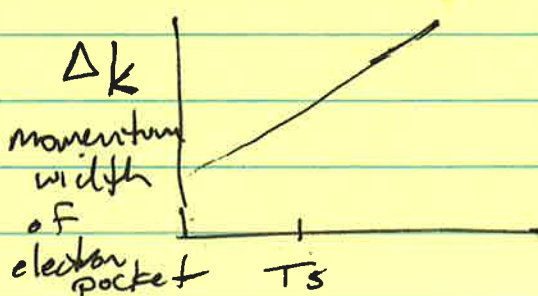
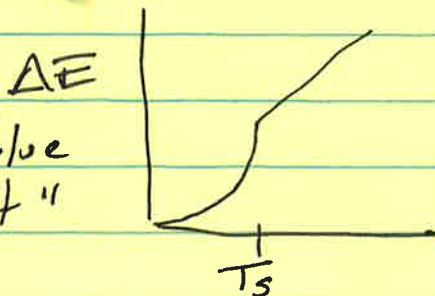
BCS state more robust in compensated case

Doped systems: small band energies, $\mu(T)$ T dependence observable in ARPES (Broët)

Borisenko: High-T band structure $\xrightarrow{\text{"relaxes"}}$ DFT result



"red-blue shift"



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- ④ Strong nematic order below 90K
- origin:
 - spin fluctuations
 - orbital fluctuations
 - phonons

chicken
+
egg

- differences from classic 122 story

- opposite ρ anisotropy (Coldea)

- no change in $\delta \equiv a-b$ at T_c

- Nematic fluctuations

- Raman - strong, die below T_S

- How is degeneracy between $(\pi, 0)$ $(0, \pi)$ broken in INS? - need determined expts

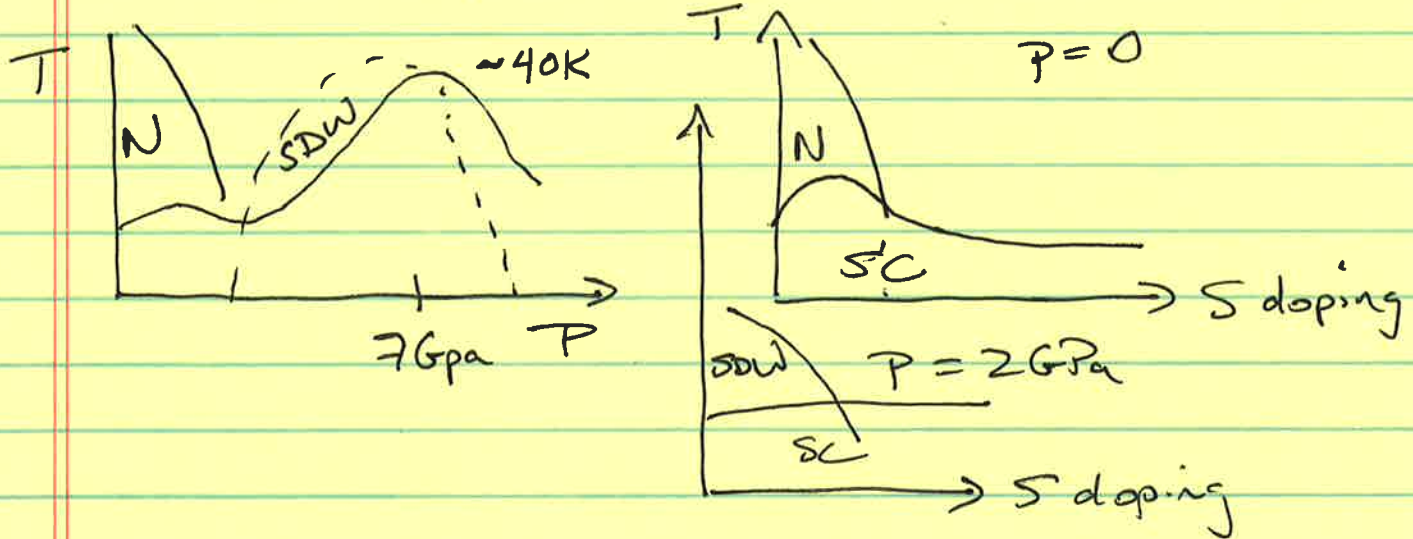
- Nem. fluctuations + SC
Does χ_{nem} diverge at T_S ?

I. Paul: no, due to lattice

- reason for lack of T_c max near $T_S \rightarrow 0$?

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(E) Unusual phase diagrams



- Why does pressure produce large jump in T_c ? (usually p suppresses SDW so w/o LRO, expect $T_c \downarrow$)

- Glasbrenner - p removes degeneracy among competing mag. orders, favors $(\pi, 0)$ fluctuations
- Kortani - p drives HTS state found in monolayers (spin fluc)

- Difference betw. effect of p + S-doping on T_c ?

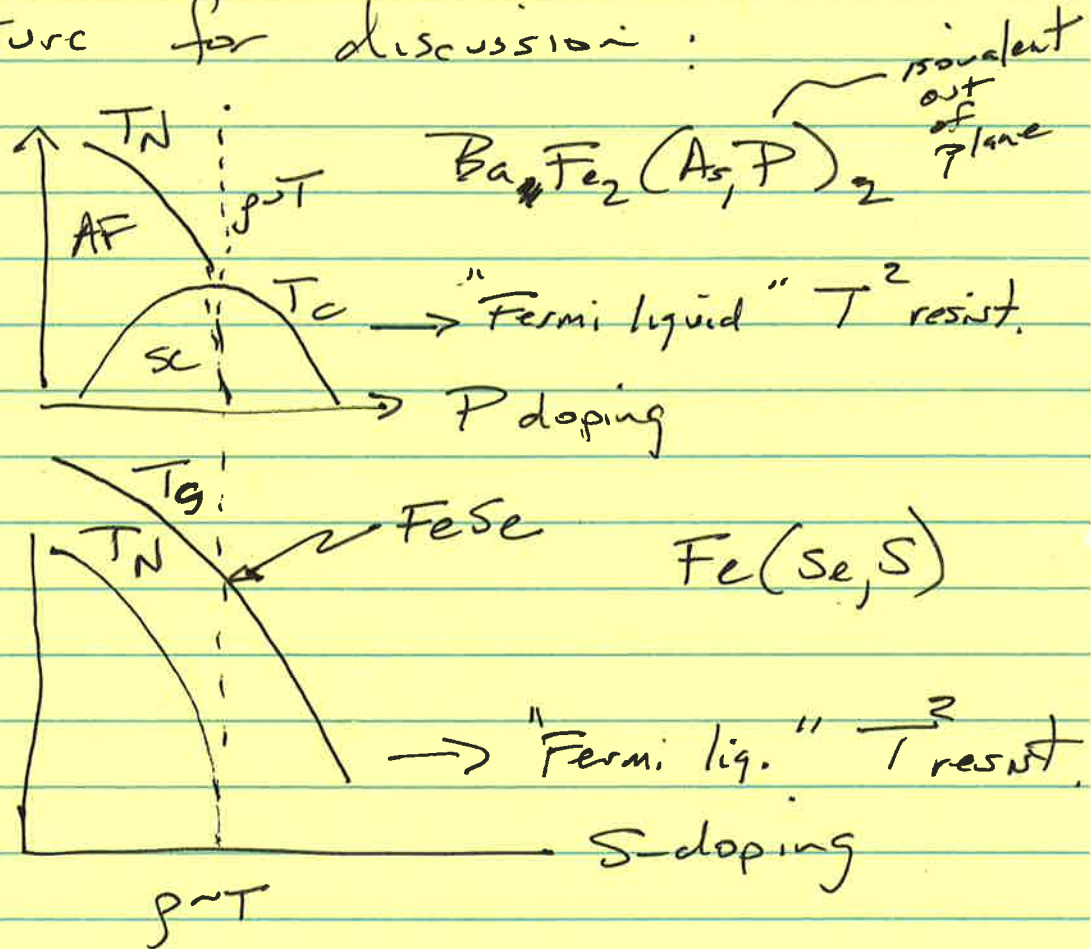
Shibauchi: change in Se ion height behavior

⑤ Phase diag. cont'd

Are sf very stray due to proximity of LRO phase?

Colder

Conjecture for discussion:



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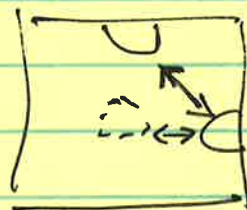
⑥ - what is $\Delta(k)$ in FeSe?

- How is it related to $\Delta(k)$ in HTS FeSe monolayers?

- How can "s.f." mechanism apply in absence of hole pockets?

• d-wave?

• inipient band?



- Possible "orbital selectivity" in pairing (Sprau et al Science 14)
Use g.p. weight factors Z_i as fit parameters, find results similar to DMFT, expt.

- Relevance of twin bdris in bulk FeSe?

• nodes far from bdris, full gap nearby.
• origin of different $\rho - T$ results?

- why no competition/cooperation w/ nematicity?