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0(6) personaggi in cerca d'autore: Keywords in strongly correlated materials

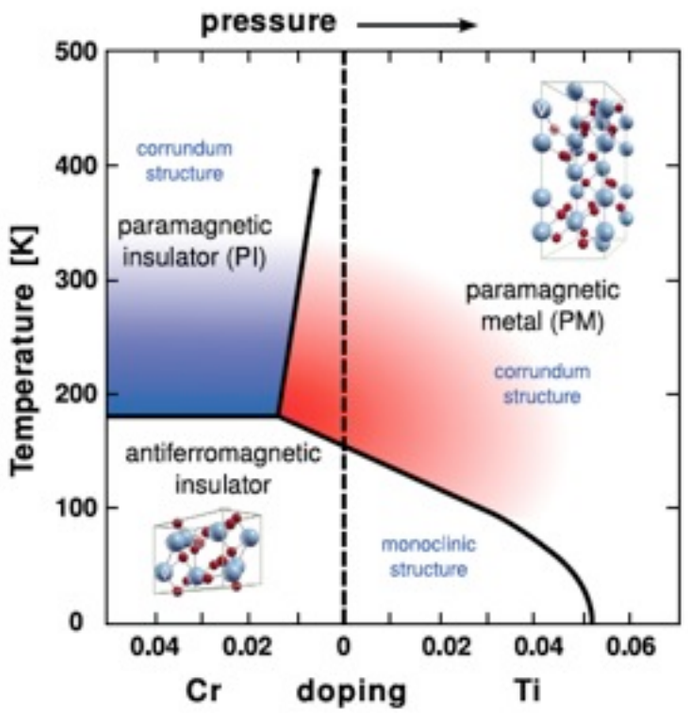
23rd December 2013

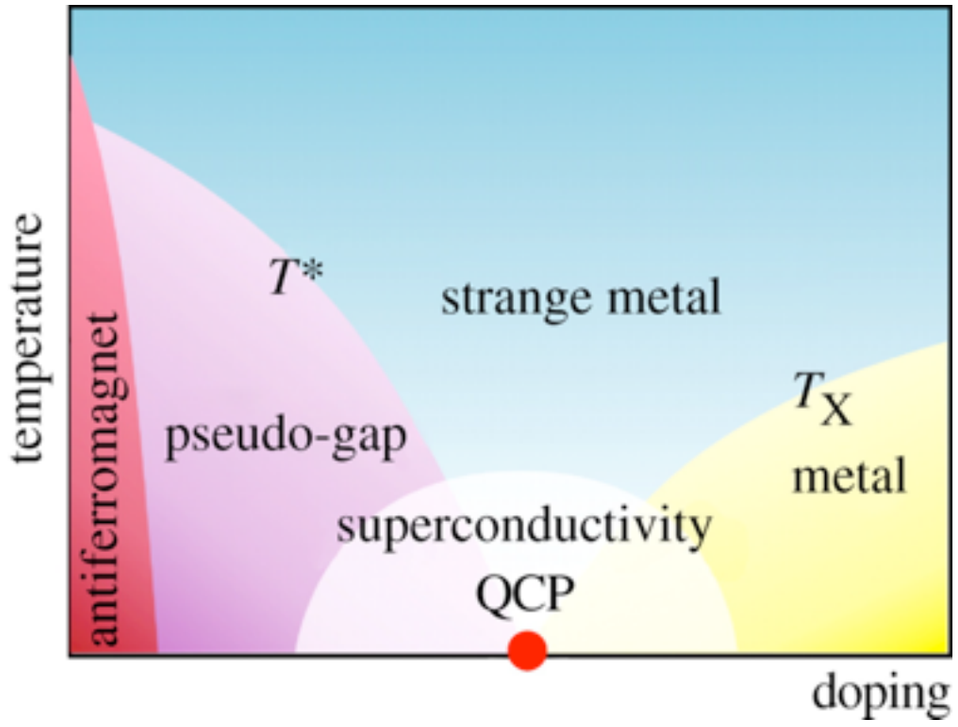
Xmas workshop **Bari**

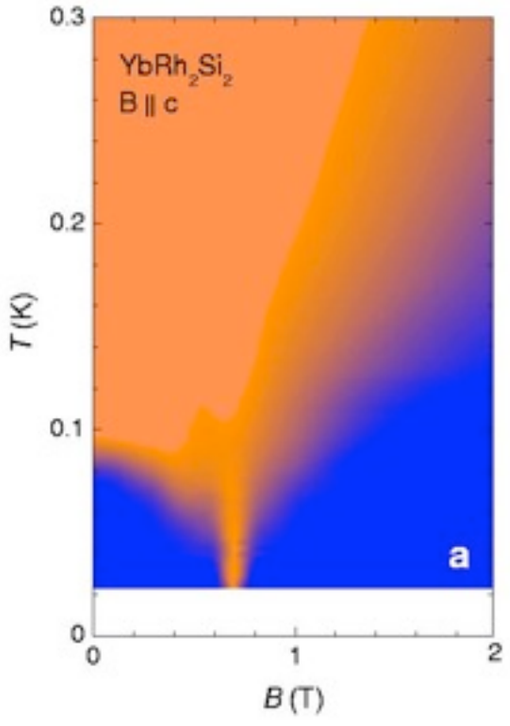
"Mache die Dinge einfach wie möglich-aber nicht einfacher"

"Make things as easy as possible -but not easier"

(A. Einstein)







What do we need to describe all these phenomena?

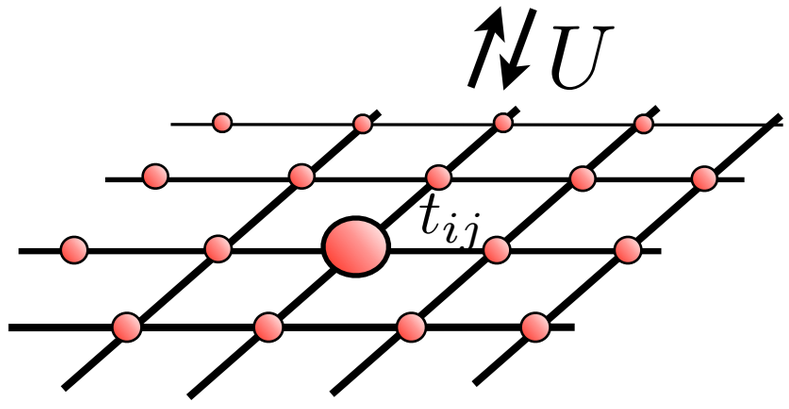
Main players

- Fermi surface properties (nesting, pockets)

- Strong correlation (MIT, nonFL, exchange)

- Multi orbitals (Hund's J, orbital selective)

$$H = -t \sum_{\langle ij \rangle \sigma} c^{\dagger}_{i\sigma} c_{j\sigma} + U \sum_{i} n_{i\uparrow} n_{i\downarrow}$$

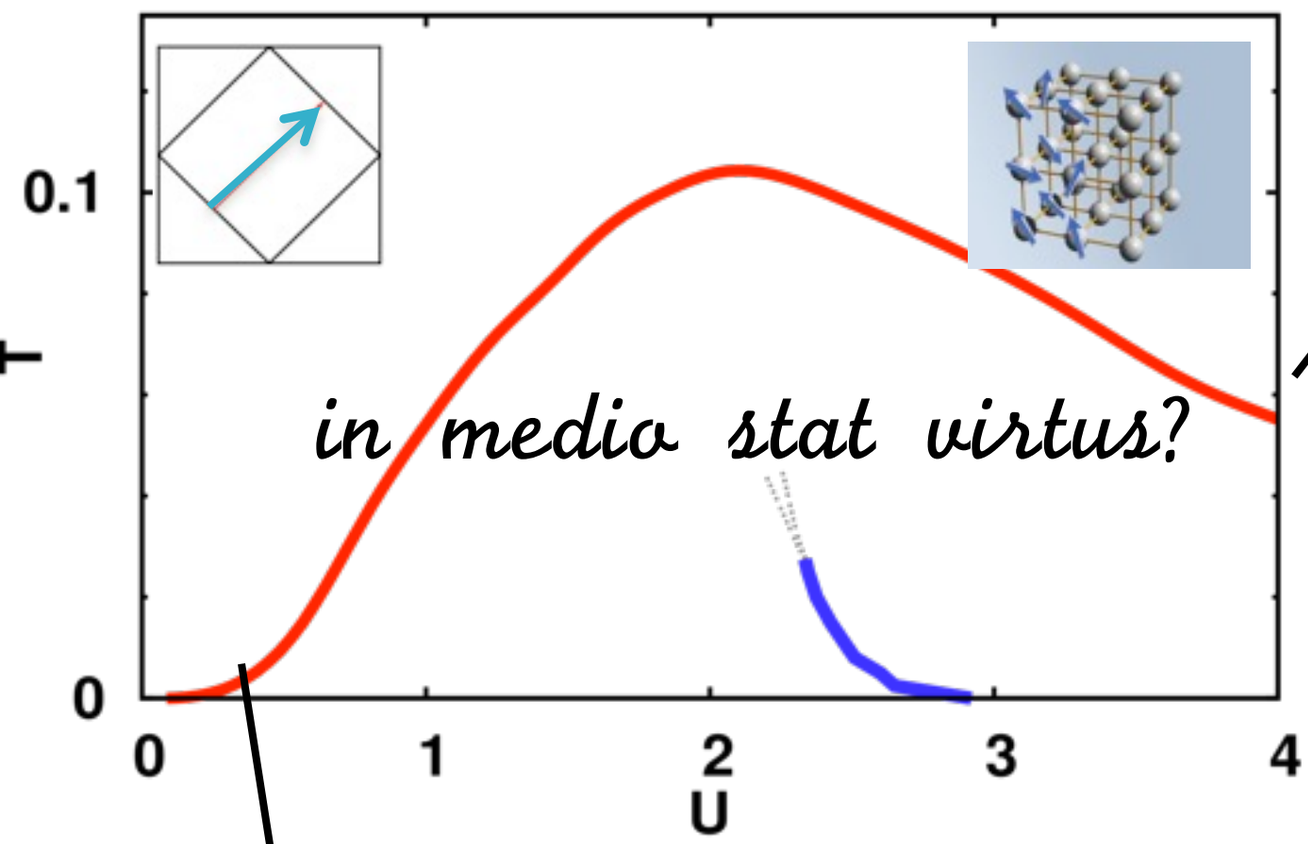


$$H = -\sum_{ij\alpha\beta\sigma} t_{ij} c^{\dagger}_{i\alpha\sigma} c_{j\beta\sigma} + \sum_{i\alpha\beta\gamma\delta\sigma\sigma'} U_{\alpha\beta\gamma\delta} c^{\dagger}_{i\alpha\sigma} c^{\dagger}_{i\beta\sigma'} c_{i\gamma\sigma'} c_{i\delta\sigma}$$

other players (what is their role?)

- Spin-orbit coupling?
- Phonons?
- Lattice details?
- Disorder and impurities?

Example 3d Hubbard model AF transition:

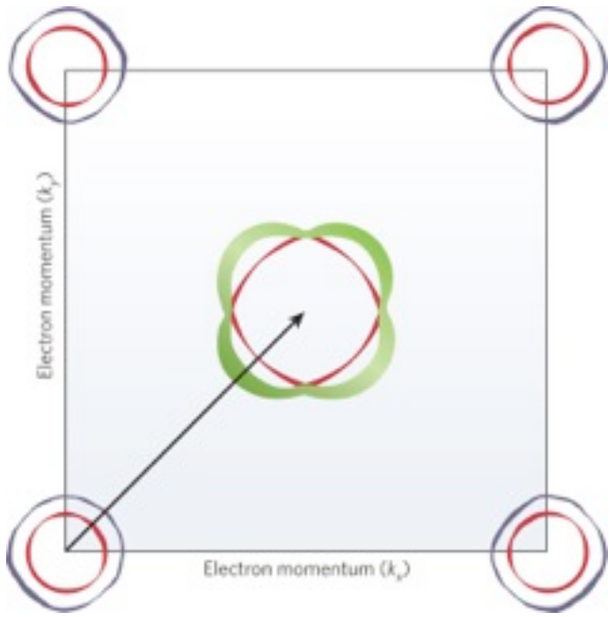


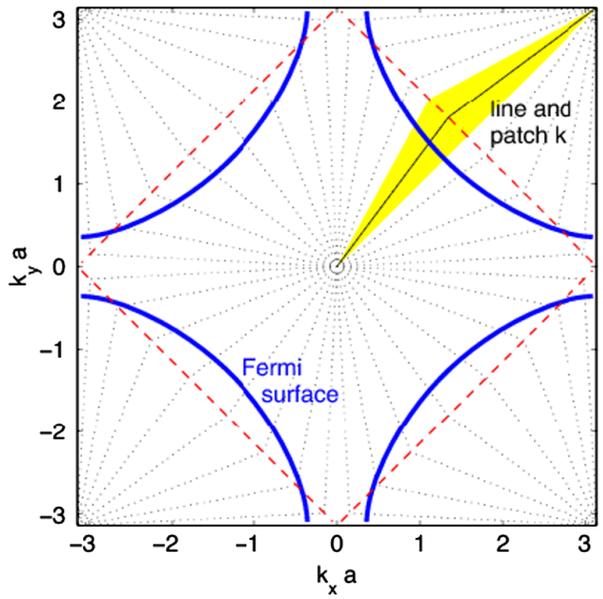
Very strong coupling:

$J=t^2/U$

new emerging energy scale: exchange interaction

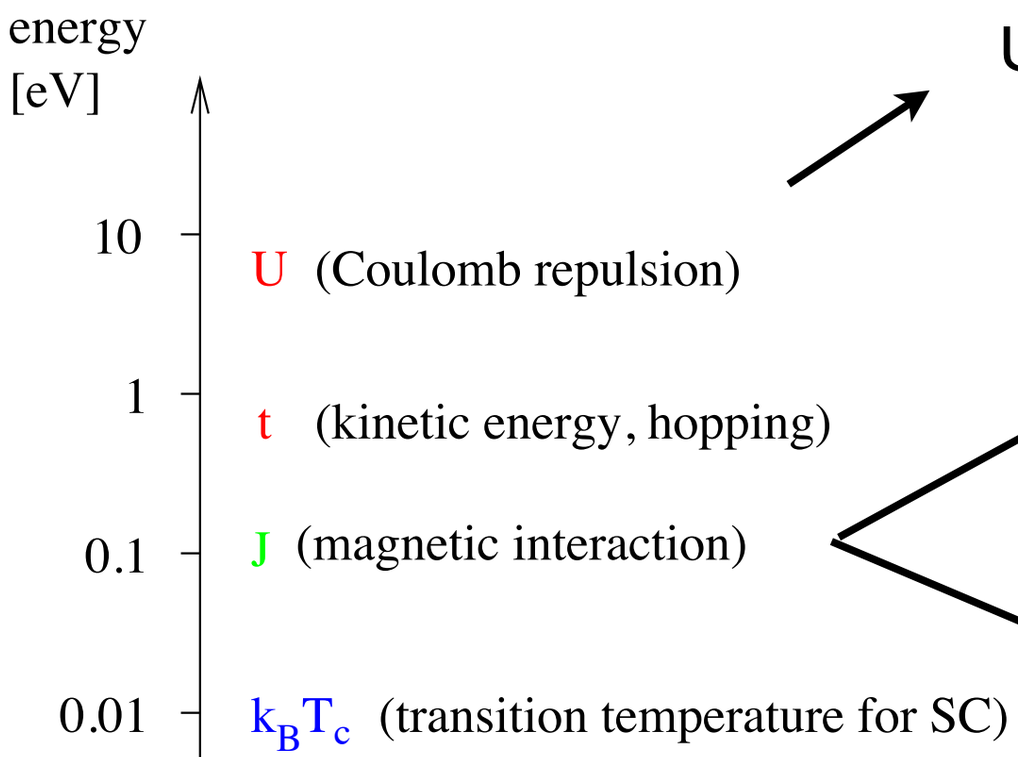
Weak coupling (BCS mean field)





(quasi-)nesting can support different instabilities

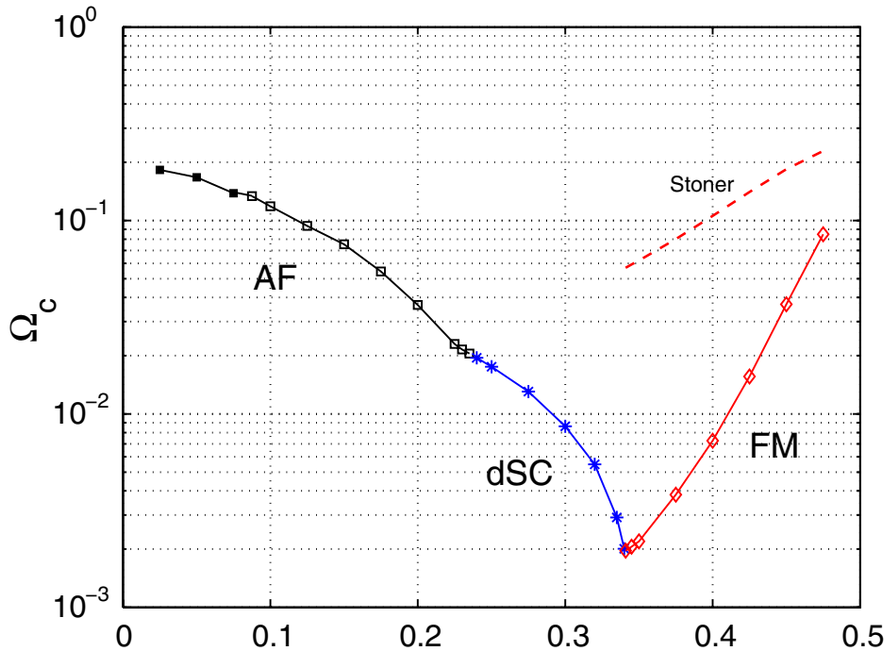
A problem of energy scales



Unscreened!

One band: exchange only
$J=t^2/U$
AF

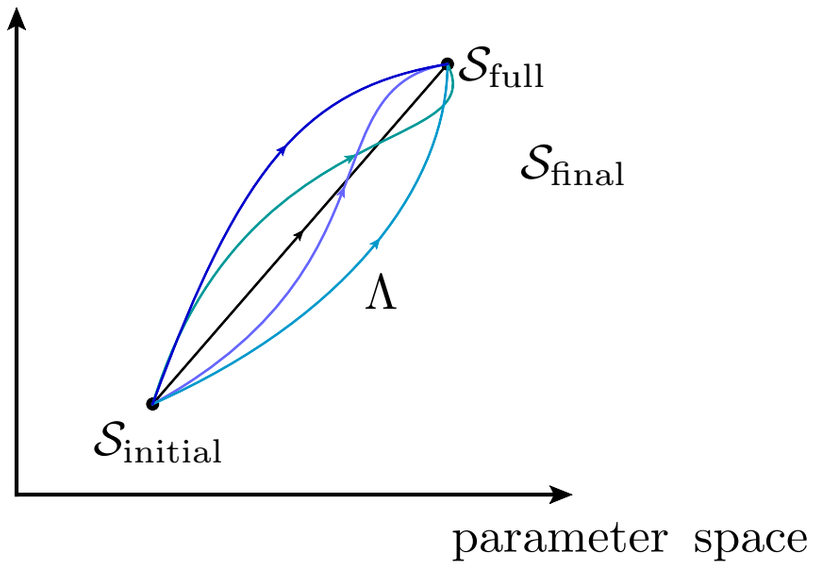
More bands:
(good old fashioned)
Hund's exchange (~0.5 eV)
FM



Multiple FS pockets

Interplay between the bands
plays a major role

My small garden fRG & DMFT

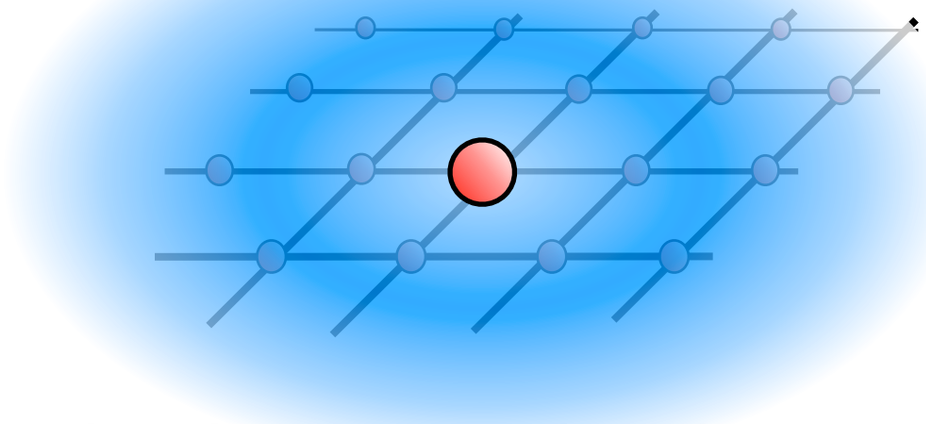


Renormalization group
enhanced perturbation theory

Uno, nessuno e centomila:

having many nearest neighbors is
like having none!

mapping on an **impurity** site



Local strong coupling physics

Can we combine them?
CT et al. arXiv:1307.3475

Buon Natale
(a casa!)