KONDO BREAKDOWN IN MULTI-ORBITAL ANDERSON LATTICES INDUCED BY DESTRUCTIVE HYBRIDIZATION INTERFERENCE

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- **motivation - towards a unified understanding of strange metals**
- **Kondo lattice and Kondo breakdown**
- **destructive hybridization interference in multi-orbital systems**

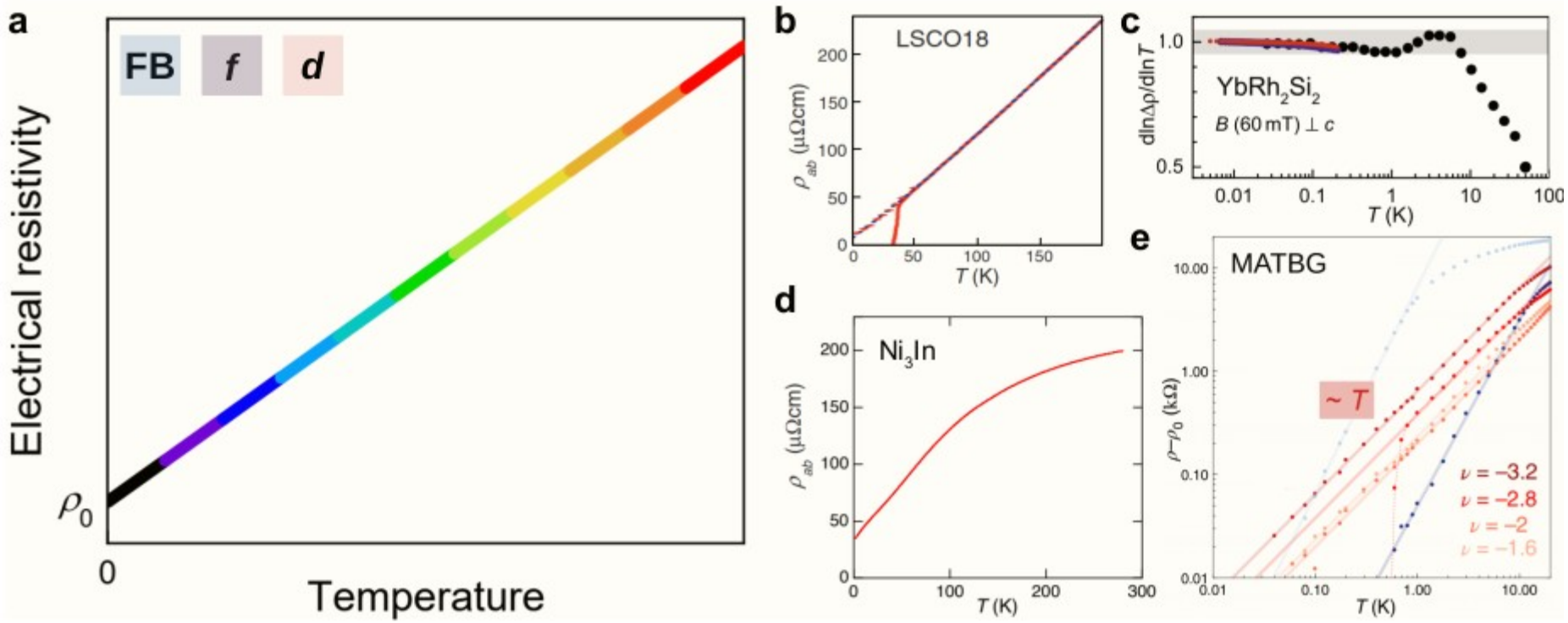
DLR

Towards a unified understanding of strange metals

strange-metal phenomena are observed across different material platforms

- linear-in-temperature electrical resistivity
- Fermi-volume jump at T=0
- dynamical scaling in optical conductivity ***and*** spin susceptibility

flat band systems
transition-metal compounds
f-based compounds



Joseph G. Checkelsky, B. Andrei Bernevig, Piers Coleman, Qimiao Si, Silke Paschen, ***arXiv:2312.10659***

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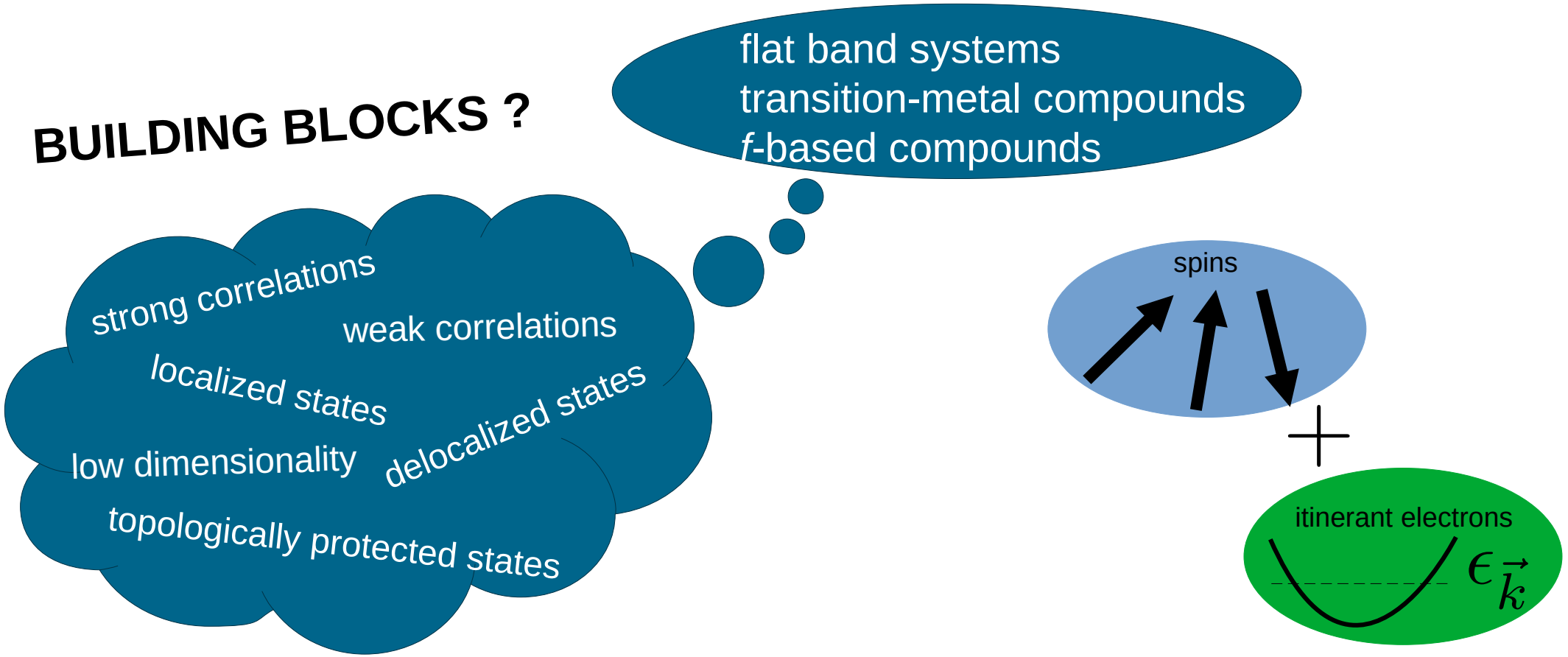
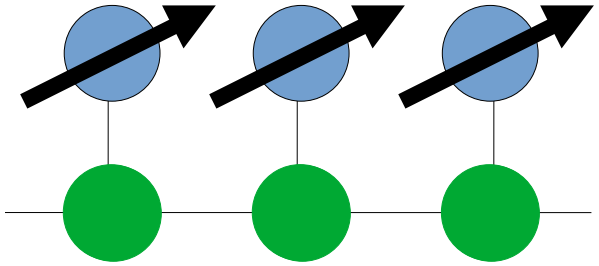


Lets put that on a lattice: PAM / KL



Lets put that on a lattice: PAM / KL

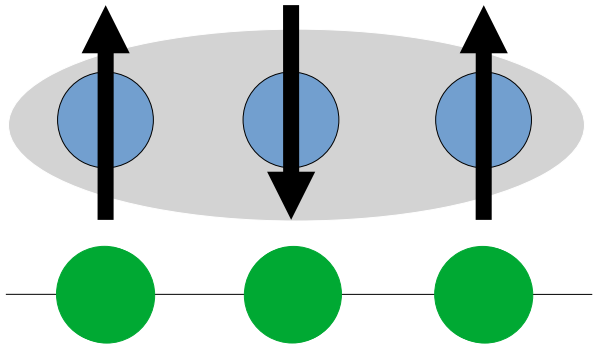
$T > T_0$ strong coupling $T < T_0$

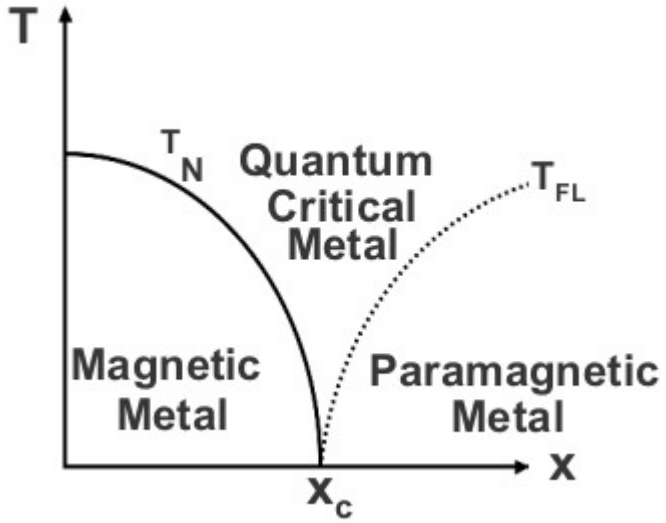
spins get eaten up by conduction band electrons

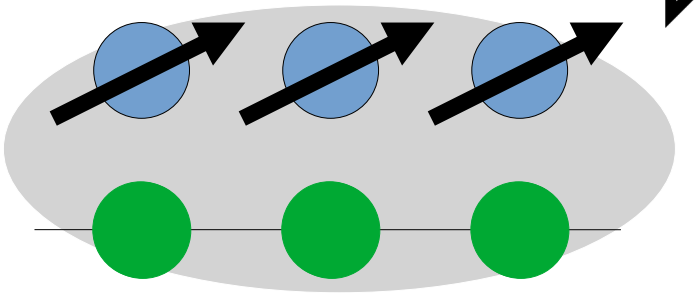
Kondo effect / emergence of heavy quasiparticles

can we break up these new quasiparticles?

Kondo breakdown / orbital-selective Mott transition







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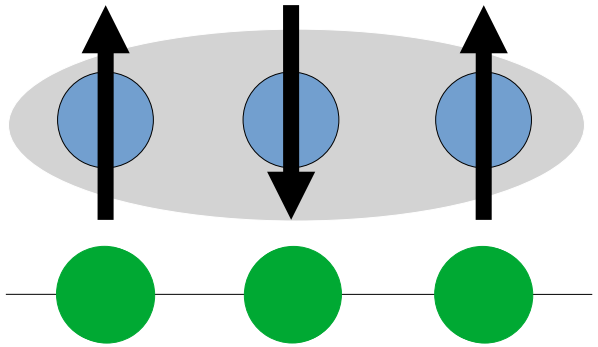
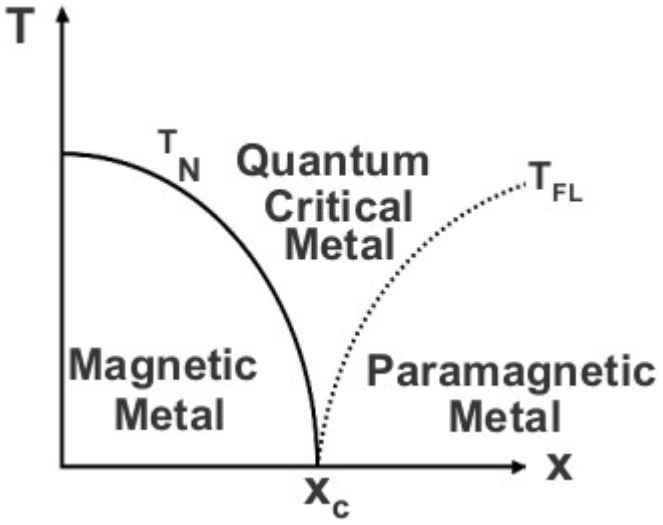
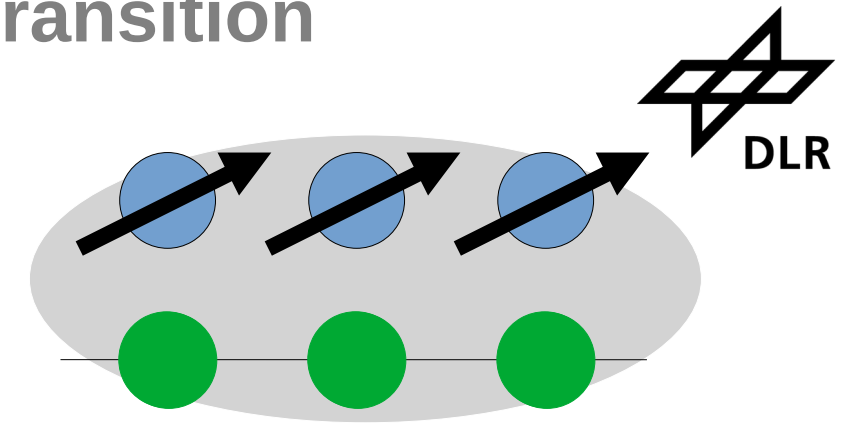
Kondo breakdown / orbital-selective Mott transition

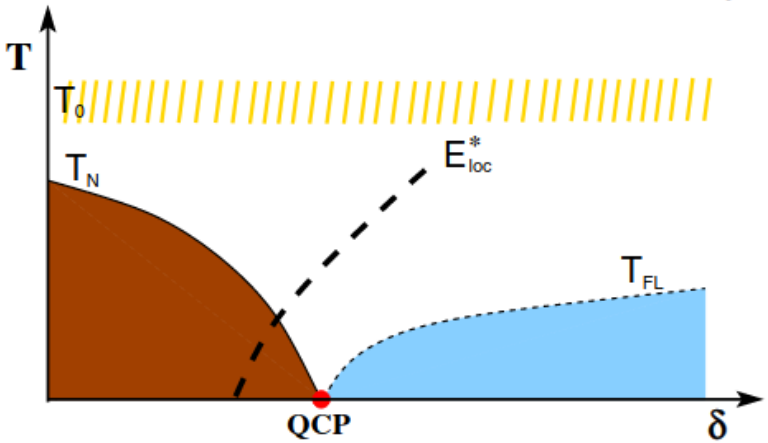






SDW – critical order parameter
magnetism-enforced transition

OSM – critical fermions
magnetism as a byproduct



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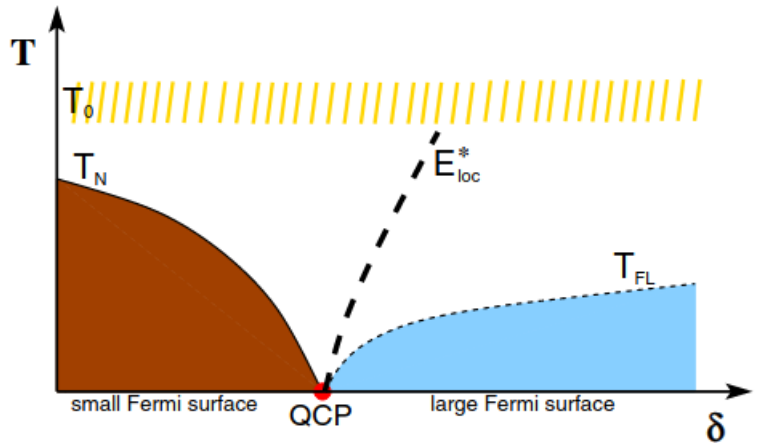
what becomes critical at QCP?

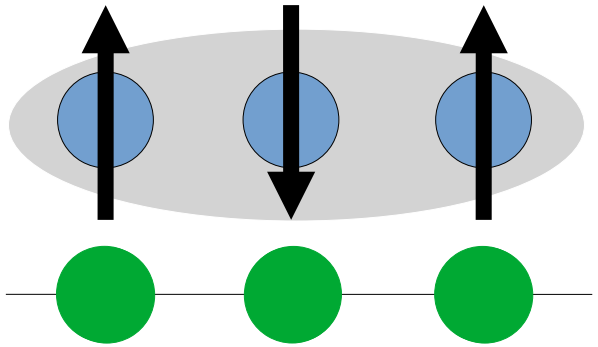
$$\mathrm{CeCu}_{6-0.1}\mathrm{Au}_{0.1}:$$

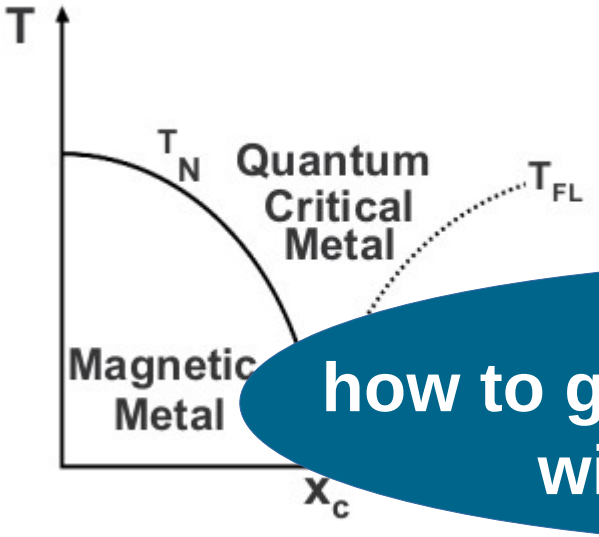
$$\chi_S^{-1}(q,\omega) \approx f(q) + \omega^{\alpha}$$

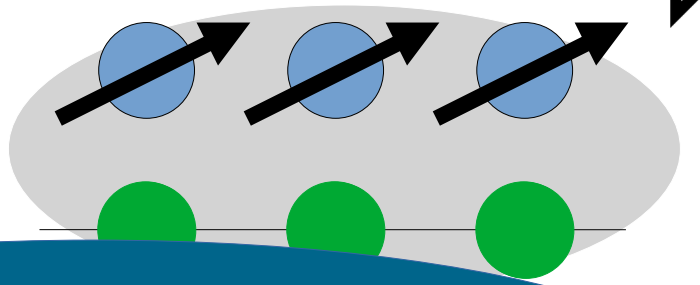
local criticality



Kondo breakdown / orbital-selective Mott transition







how to get rid of the Kondo effect without magnetism?

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magnetism enforced transition

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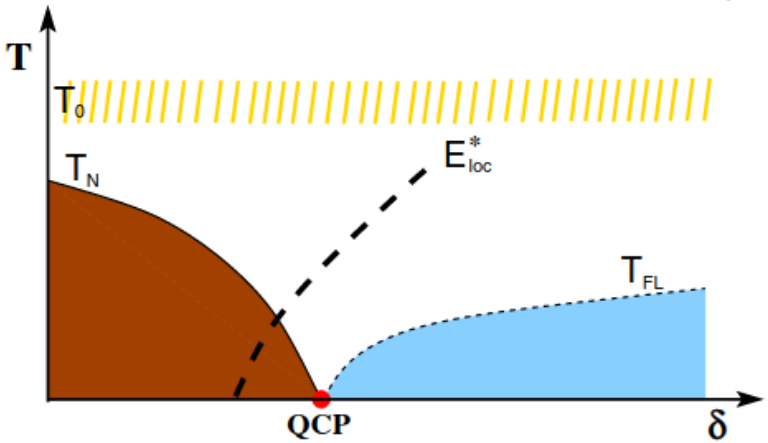

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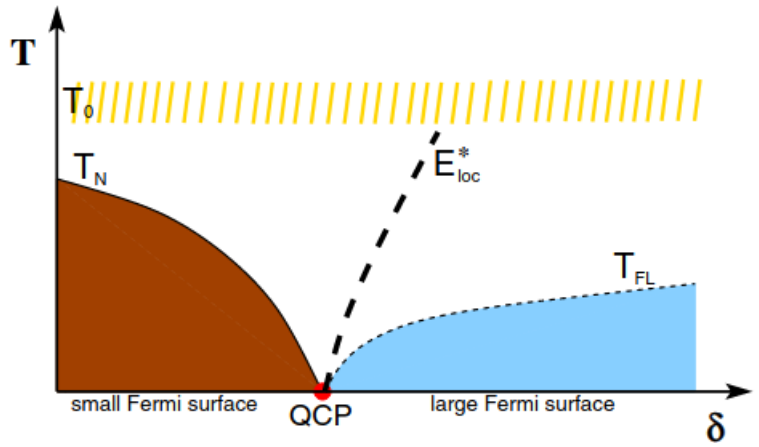
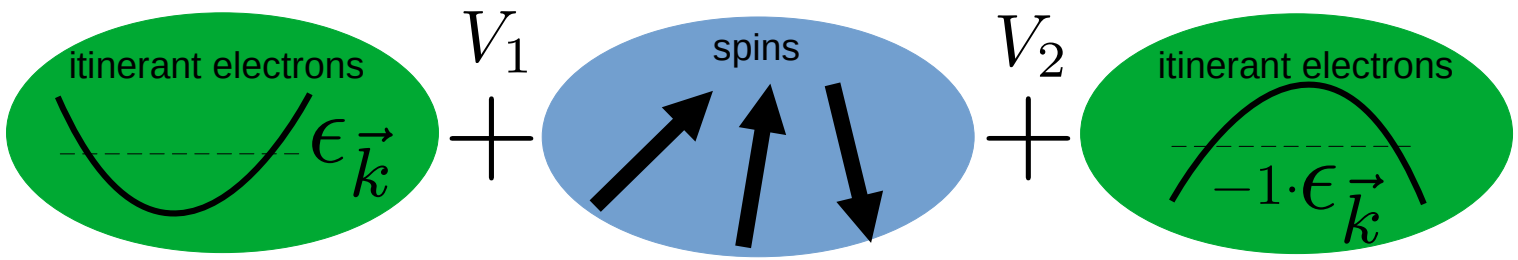


Kondo breakdown in multi-orbital extensions



$$\sum_k \epsilon_k (c_k^\dagger c_k - a_k^\dagger a_k)$$

$$\sum_k V_1 f_k^\dagger c_k + V_2 f_k^\dagger a_k + \text{h.c.}$$

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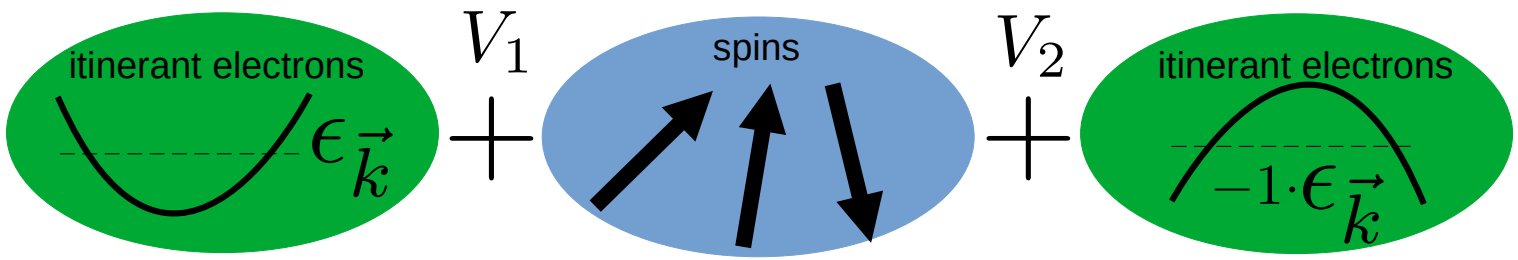

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why on earth…?

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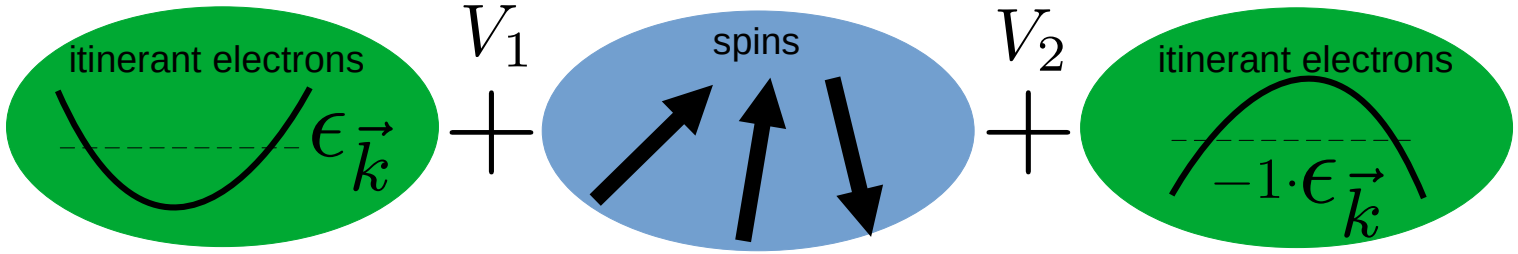

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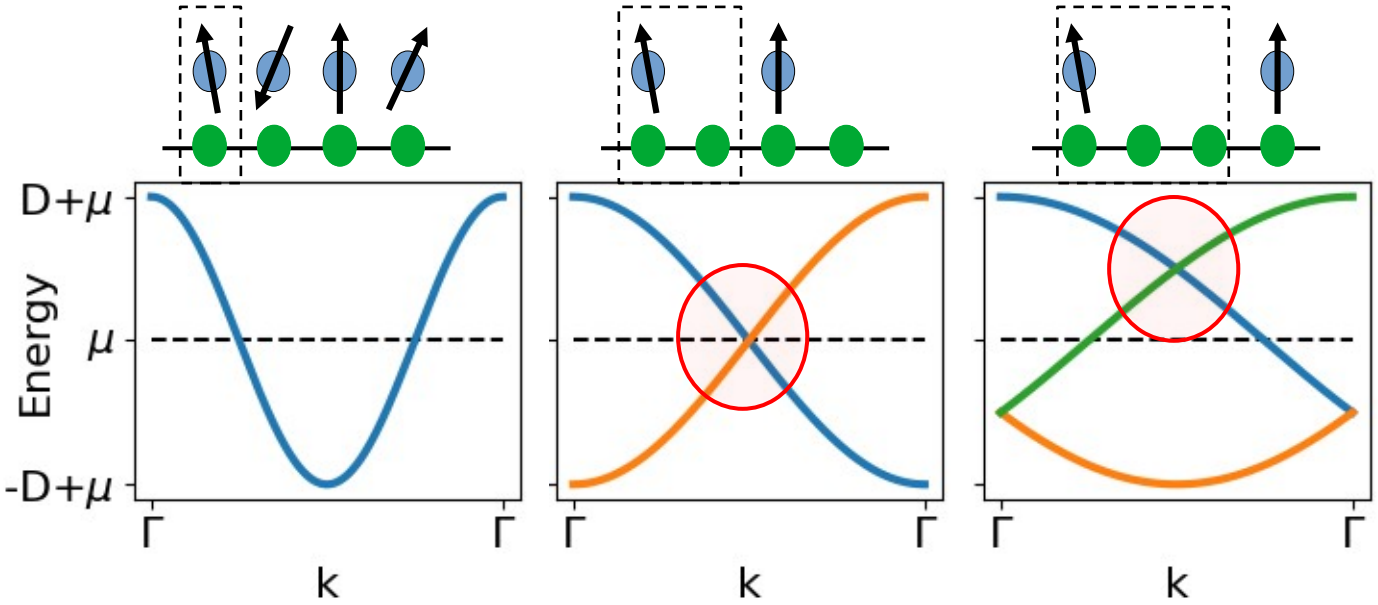
I. band folding due to larger unit cell



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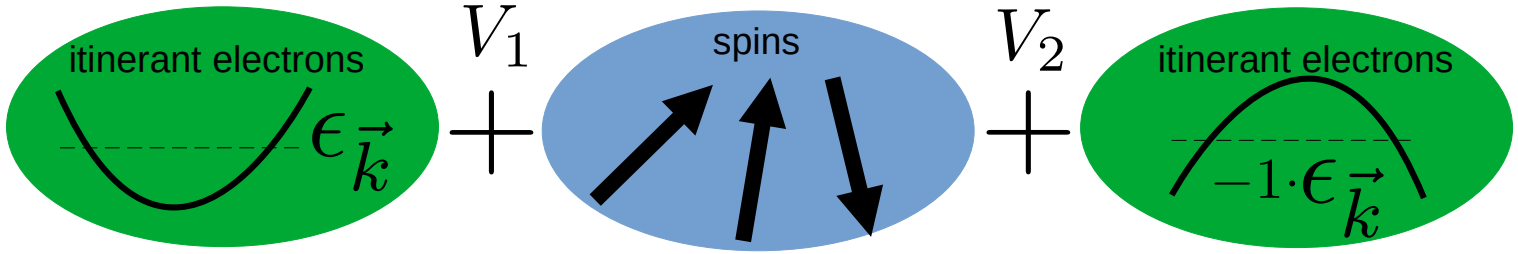

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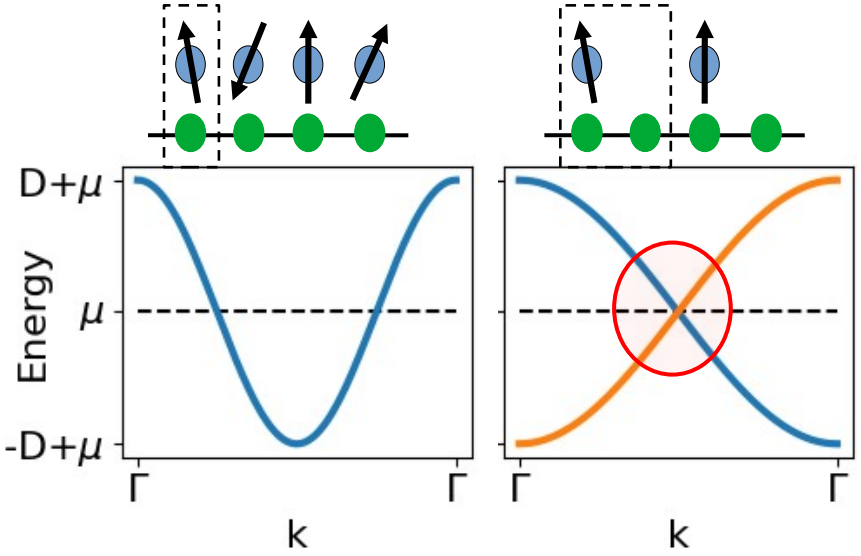
II. destructive hybridization interference?



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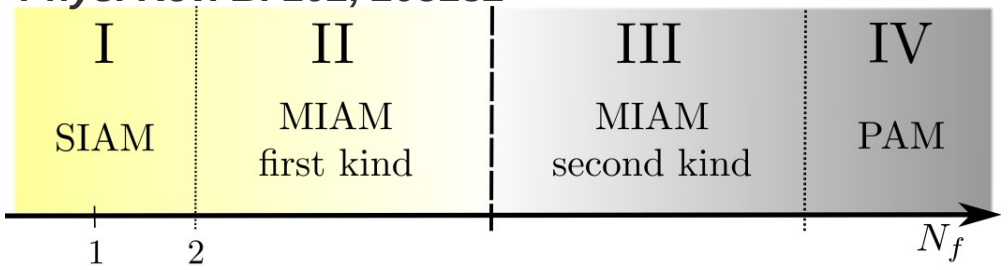

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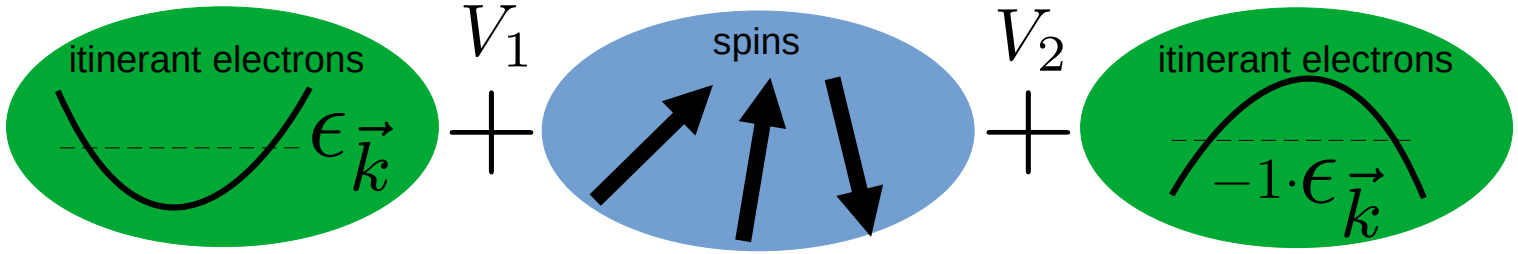

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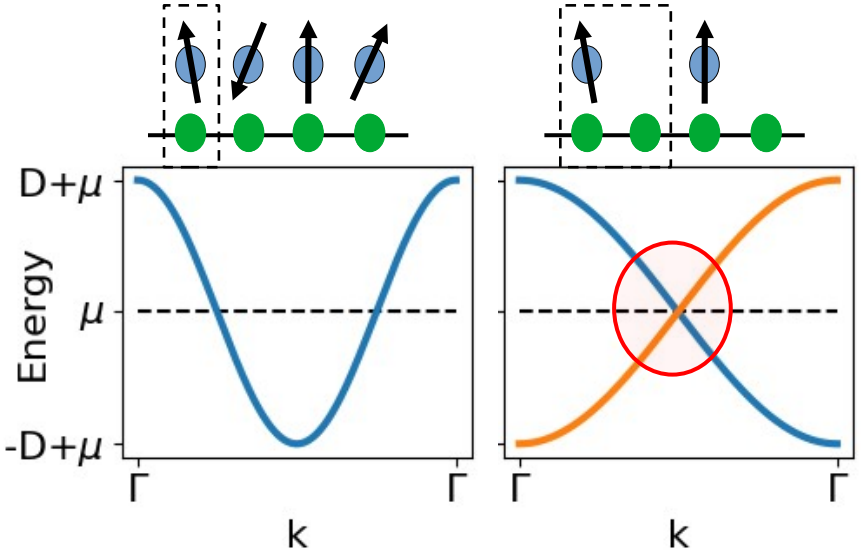

eff. hybridization

$$\tilde{\Delta} \propto \sum V_i^2 \Im\left[\mathcal{G}_k^i(0)\right]$$

fixed sign

constructive

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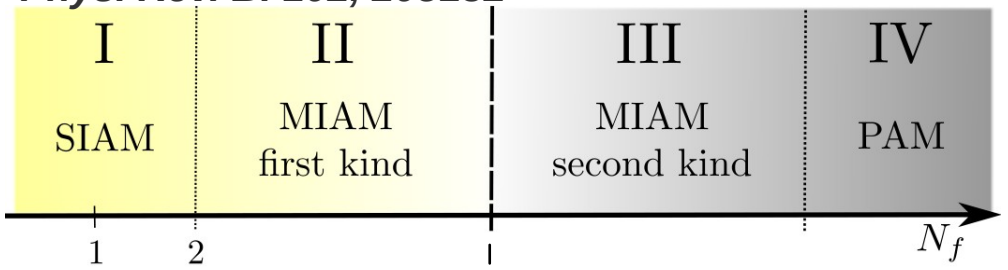


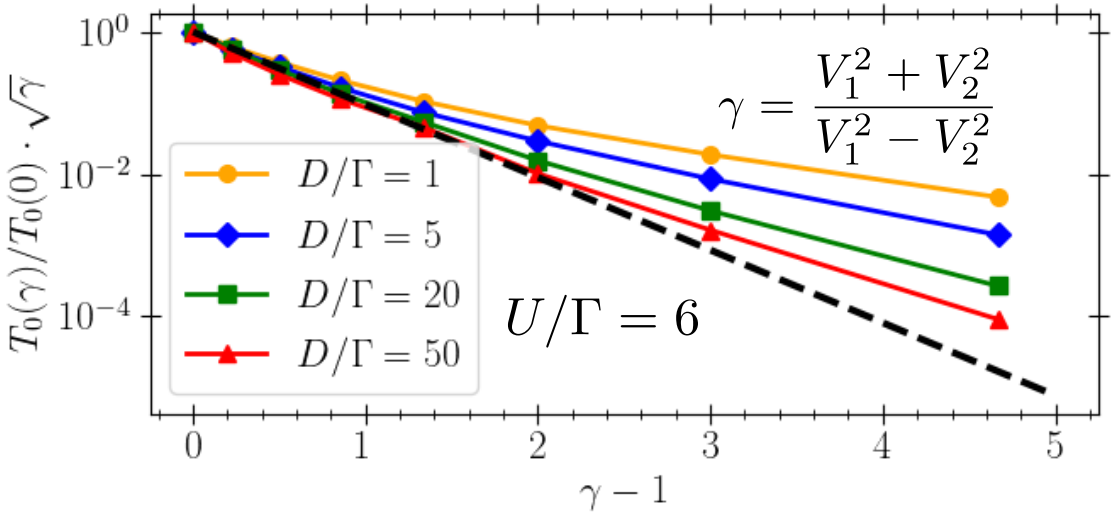
$$\sum V_i^2 \Re\left[\mathcal{G}_k^i(0)\right] = \sum V_i^2/\epsilon_k^i$$

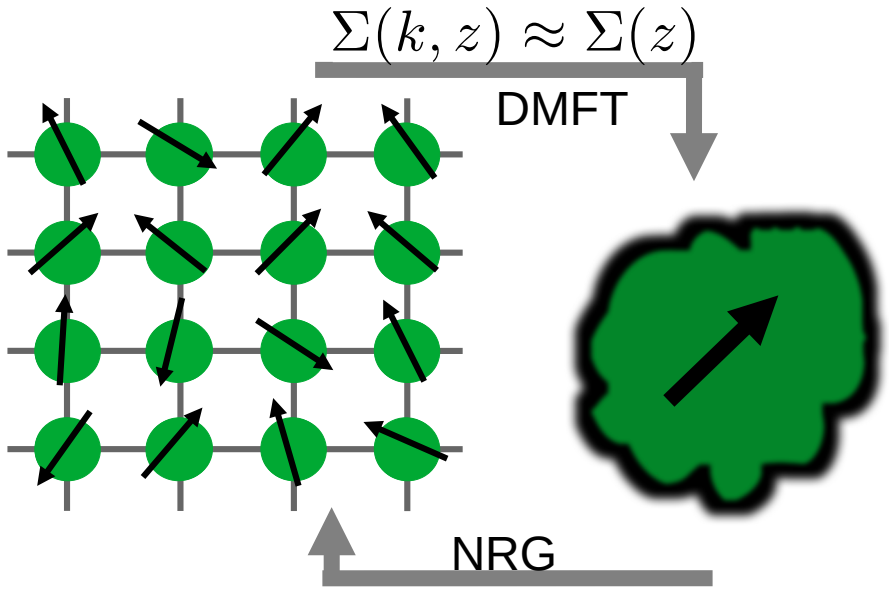
constructive or ***destructive***

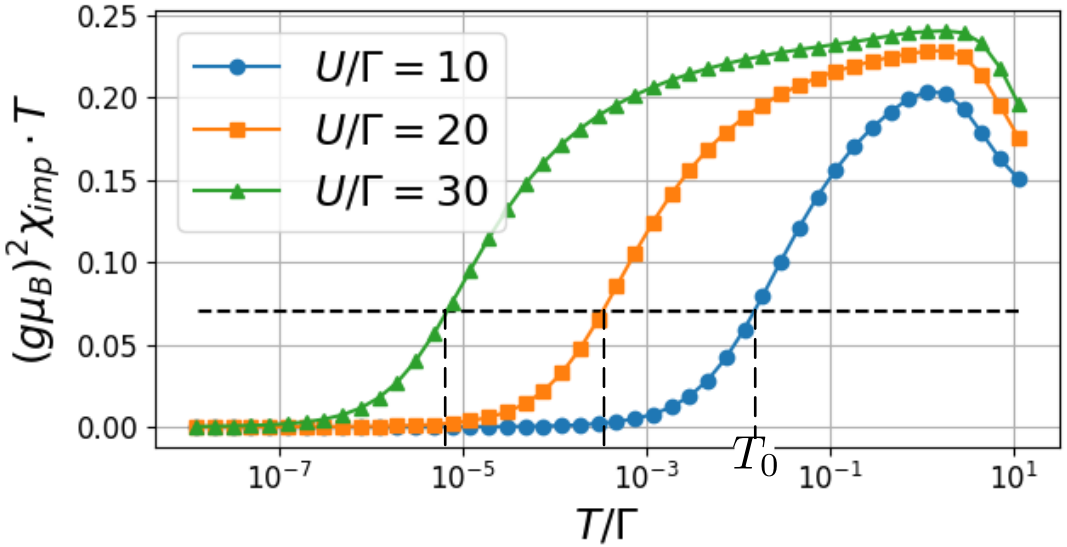
Kondo breakdown – DMFT(NRG)

results arXiv:2401.04540

- exponentially suppressed T_0 due to destructive interference
- ➔ generic effect in multi-orbital Kondo systems







Kondo breakdown – DMFT(NRG)

results arXiv:2401.04540

- exponentially suppressed T_0 due to destructive interference
  → generic effect in multi-orbital Kondo systems
- Kondo breakdown! - w/o the need of magnetism
  → non trivial pseudo-gap SIAM due to self consistency
- PH symmetry: universal power law scaling