# Unequal Role of Electronic Correlations on Different Fermi Surfaces in Multi-band Superconductors

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## Introduction

A whole large group of metals and inter-metallic compounds with the large value of the Sommerfeld coefficient for the linear in temperature specific heat in the normal state manifest a number of uncommon features below the temperature of transition into the superconducting phase. Among them are very high values of the upper critical magnetic field, Hc2 and the observation of quantum oscillations (QO), such as the de Haas-van Alphen (dHvA) and Shubnikov-de Haas (SdH) oscillations, in the vortex state of a superconductor (for list of such materials, see [1]). Persistence of QO below Hc2 seemingly signals that the superconducting gap is destroyed below Hc2. Meanwhile, by the definition, the upper critical field has meaning of the field below which the normal state becomes unstable.

## Results and Discussion

We addressed this conundrum by taking into account the multi-band character of the electronic spectrum in this group of materials. The large value of the Sommerfeld coefficient is habitually associated with strong electron-electron interactions in the system. Our suggestion is that responsible for the phenomenon of superconductivity in these materials not all, but only some group of the bands or the Fermi surfaces: in the heavy fermions (HF), for instance, most important seem to be the heavy bands built upon the 5f-wave functions; in case of superconductors containing the transition metals elements same role belongs to the 4-5d-orbital. In particular, we succeeded in explaining in these terms the "gapless" superconductivity on a small pocket (even without magnetic field) in underdoped *ortho-II* YBCO and such HF as CeCoIn5[1]. Superconductivity driven by strong interactions on several leading Fermi surfaces creates the proximity gaps on the other. The gap transferred on a small-sized pocket from larger Fermi surfaces is small. In case of unconventional pairing symmetry the induced gap is proportional to the ratio of oscillations' frequencies for small and large Fermi surfaces. The gap is in inverse proportion to the mass enhancement on the latter.

## Conclusions

We share the view that small pockets in themselves exist as a certain band feature among all Fermi surfaces [1]. It is possible to reconcile the high upper critical fields with the large mass' values that determine the Sommerfeld coefficient [2].

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## References

[1] Gor'kov, L. P., Phys. Rev. B **86**, 060501(R) (2012).
[2] Gor'kov, L. P. (Manuscript in preparation, 2012).