Walther-Meißner-Institut
Bayerische Akademie der Wissenschaften

SS 2024

Walther-Meißner-Seminar

Walther-Meißner-Institute, Seminar Room 143

Date: **Friday, 27 September 2024, 11:15 h**

Speaker: **Dr. I Sheikin**

Laboratoire National des Champs Magnétiques Intenses, (LNCMI-EMFL), Grenoble, France

Title: **The mystery of $CeRhIn_5$ in high magnetic fields**

Abstract:
Antiferromagnetic $CeRhIn_5$, discovered some two decades ago, is now one of the best-studied Ce-based heavy-fermion compounds. Yet, it continues to attract a lot of attention from the scientific community due to its unique behaviour in high magnetic fields. When the magnetic field is applied along, or close to, the *c* axis, a new phase characterized by a pronounced in-plane electronic anisotropy emerges at $B^* \approx 30$ T, well below the critical field, $B_c \simeq 50$ T, to suppress the antiferromagnetic order. The exact origin of this new phase, originally suggested to be either a density-wave phase [1] or an electronic-nematic state [2], remains elusive. It was further suggested that a field-induced Fermi-surface reconstruction corresponding to the delocalization of the *f* electrons occurs at B^* [3].

In my talk, I will present our recent results of the high-field de Haas-van Alphen (dHvA) effect, specific heat, ultrasound velocity, and NMR measurements in $CeRhIn_5$. Our comprehensive dHvA measurements in fields up to 70 T unambiguously suggest that the Ce 4*f* electrons in $CeRhIn_5$ remain localized over the whole field range. This finding rules out any Fermi-surface reconstruction, either at the suggested nematic phase transition at $B^* \approx 30$ T or at the putative quantum critical point at $B_c \simeq 50$ T [4]. Our specific heat measurements in fields applied along the *c* axis revealed a small but distinct anomaly at B^*, which we discuss in terms of a field-induced transition, probably weakly first-order. We further suggest that the transition corresponds to a change in magnetic structure [5]. This hypothesis is supported by our ultrasound velocity [6] and NMR measurements [7] performed in magnetic fields slightly tilted away from the *c*-axis.

References

1. P. J. W. Moll et al., Nat. Commun. **6**, 6663 (2015).
2. F. Ronning et al., Nature **548**, 313 (2017).
3. L. Jiao et al., Proc. Natl. Acad. Sci. USA **112**, 673 (2015).
4. S. Mishra et al., Phys. Rev. Lett. **126**, 016403 (2021).
5. S. Mishra et al., Phys. Rev. B **103**, 045110 (2021).
6. S. Mishra et al., to Phys. Rev. B **103**, 165124 (2021).
7. S Mishra et al., unpublished.

gez:
M. Kartsovnik (Host)