PAUL SCHERRER INSTITUT

CONDENSED MATTER THEORY SEMINAR

Dissecting Metallic Quantum Matter Using Ultra-High-Resolution Neutron Spectroscopy

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WHGA/121 (PSI-West)

Abstract:

Strongly correlated metals near magnetic quantum phase transitions are well-established hunting grounds for novel quantum matter states. Because the conduction electrons carry both charge and spin degrees of freedom the abundance of magnetic quantum fluctuations originating at quantum phase transitions entail strong electronic correlations with new characteristic energy scales, as well as the formation of novel states of matter, where unconventional superconductivity may be the most prominent example. The outstanding challenge is that the underlying characteristic energy scales that drive new quantum matter states are tiny compared to typical electronic energy scales in solids, and are, in turn, notoriously difficult to measure. Here we discuss some of our recent results to showcase how current advances in the resolution of neutron and resonant x-ray spectroscopy methods now offer a fresh opportunity to obtain detailed insights in strongly correlated quantum states. Notably, using the novel Modulated IntEnsity by Zero Effort (MIEZE) technique implemented at the neutron spectrometer RESEDA in Munich, we achieve ultra-high energy resolution of 1 eV and reveal that the spin fluctuations in UGe_2 exhibit a dual nature arising from the interplay of localized and itinerant electronic degrees of freedom in consistent with spin-triplet superconductivity proposed for this material [1].

References

[1] F. Haslbeck, S. Subert, M. Seifert, C. Franz, M. Schulz, A. Heinemann, T. Keller, P. Das, J. D. Thompson, E. D. Bauer, C. Pfleiderer, and M. Janoschek, Phys. Rev. B 99, 014429 (2019).

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