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Electronic spectroscopy of quantum materials in high magnetic fields –A proposal for an inter-facility Priority Action in the frame of LENS

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Neutron spectroscopy is a powerful tool to study magnetic excitations arising from correlation effects of electrons. Less well known is that neutrons can also be used to investigate directly electronic band structures in strongly correlated metallic quantum matter(1). Neutrons scatter electrons from occupied to unoccupied states with a probability given by the so-called Lindhard susceptibility. Although weak in nature, the recent progress in neutron optics on different spectrometers makes now such kind of spectroscopy accessible, as demonstrated e.g. on the strongly correlated metals URu₂Si₂ and Pu(2). Compared to ARPES, electronic neutron spectroscopy has the advantage of enhanced energetic resolution and can be combined with high magnetic fields.

In the frame of the recent inter neutron facility initiative LENS, The League of Advanced European Neutron Sources, we propose to combine electronic spectroscopy with up-to-date unreachd continuous magnetic fields on neutron spectrometers, based on all superconducting coils with split-coil geometry. For best signal-to-noise special focusing optics will be included into the magnetic design, optimized with latest Monte Carlo ray-tracing tools combined with finite element calculations. This project is planned as one out of several Priority Actions of LENS, aiming to push the neutron science in Europe to highest standards.

[1] J. F. Cooke et al., Phys Rev B 26, 4410 (1982).

[2] M. Janoschek et al., Sci Adv 1, e1500188 (2015).

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