Squeezing out field-induced reentrant hidden-order in URu_2Si_2

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Keywords: heavy-fermion, hidden-order, antiferromagnetism, high pressure, intense pulsed magnetic fields

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The mystery of the hidden-order phase in the correlated-electron paramagnet URu_2Si_2 is still resisting after decades of experimental and theoretical assaults. It is now well-established that long-range ordering can be stabilized in this metal under pressure (antiferromagnetism) or magnetic field applied along the easy magnetic axis c (spin-density wave). However, the full borderlines of the hidden-order phase in the pressure-magnetic field plane had not been extracted yet.

Here, we benefited from the recent development of a specifically designed anvil-type cell for the pulsed magnetic fields [1,2] to extract the complete three-dimensional (3D) magnetic field – pressure – temperature phase diagram of URu_2Si_2 from magnetoresistivity measurements in magnetic fields up to 60 T combined with pressures up to 4 GPa.

After an introduction to our pressure cell, which was designed to allow routine resistivity experiments under intense pulsed magnetic fields, our experimental results on URu_2Si_2 will be presented. The boundaries of the hidden-order, antiferromagnetic and spin-density-wave phases will be discussed, indicating an opulent and complex 3D phase diagram. Interestingly, a large part of the phase diagram is controlled by the field- and pressure-dependences of a single parameter, the effective mass. These results constitute new constraints for theories aiming to model URu_2Si_2 and its hidden-order phase.

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Acknowledgments: This work at the LNCMI was supported by the 'Programme Investissements d' Avenir' under the project NEXTREME / NEXT (program ANR-11-IDEX-0002-02, reference ANR-10-LABX-0037-NEXT), and the Program for Advancing Strategic International Networks to Accelerate the Circulation of Talented Researchers from JSPS (R2705).

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