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Universal Signatures of Metamagnetic Quantum Criticality[1]

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The continuous quest for quantum critical materials is inspired by the exotic phases and unusual phenomena that can be observed close to a zero-temperature instability. An appealing realization of such a critical point is found in metamagnetic materials where the magnetization shows a finite step at a certain magnetic field that becomes more pronounced at low temperatures. The most striking advantages of this kind of quantum criticality are that the critical point is i) symmetric in the associated thermodynamic phase diagram and not accompanied by a symmetry-breaking ordered phase and ii) the tuning parameter magnetic field H can be adjusted continuously and makes a very detailed and comprehensive study of this so called quantum critical end-point (QCEP) possible. In the presented talk the qualitative features of a field-driven QCEP are discussed, which result from very basic thermodynamic relations and the two general assumptions that i) the differential magnetic susceptibility diverges at the critical field H_c by definition and ii) the QCEP has Ising symmetry. We present real examples of metamagnetic systems, where the characteristics can be found experimentally. Particular emphasis will be placed on the well-known intermetallic material $CeRu_2Si_2$. We argue that a QCEP is approximately realized in this compound and confirm our claims by the combination of new high-resolution thermal expansion, magnetostricion and specific heat results. Very similar behavior was found recently on the prominent material $Sr_3Ru_2O_7$ whose metamagnetic quantum criticality is masked by the appearance of a phase proposed to be of nematic electronic nature. We believe that our work will facilitate and promote the experimental identification of further metamagnetic systems for quantum criticality in the future.

[1] *Weickert et al.*, Phys. Rev. B, **81**, 134438 (2010).

[1]This work was carried out at the MPI for Chemical Physics of Solids in Dresden, Germany.