physikalisches Kolloquium

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Exotic phase transitions in disordered magnets, superconductors, and ultracold gases

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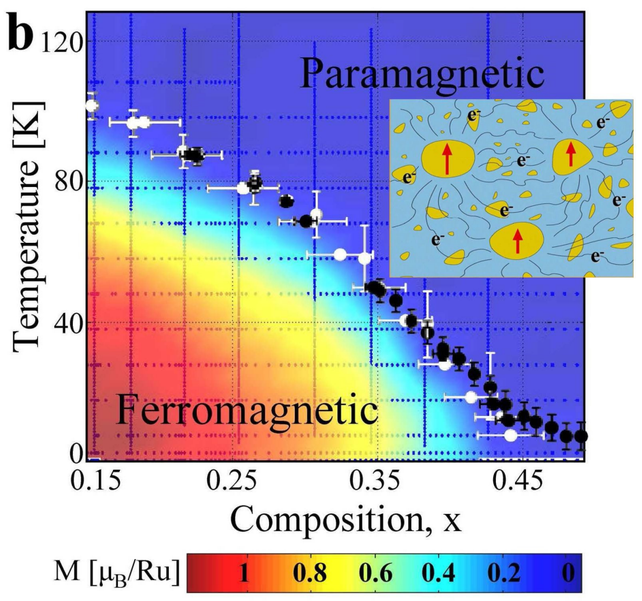
Phase transitions are ubiquitous phenomena with applications ranging from cosmology to biological systems and to quantum matter at low temperatures.

Many systems that undergo phase transitions contain impurities, defects and other forms of disorder. Recent research has shown that even weak disorder can have dramatic effects on the properties of phase transitions. Often, rare disorder fluctuations and rare spatial regions completely dominate the physics close to the transition.

This talk discusses several examples of exotic behavior arising at disordered phase transitions. These include the quantum Griffiths phases in nickel-vanadium alloys, infinite-randomness criticality in superconducting thin films, as well as the elusive sliding phase realized in ultracold gases.

In some cases, disorder can completely destroy the phase transition by “smearing”, as has been observed, e.g., in strontium-calcium ruthanate.



Randomly substituting Sr atoms by Ca in $SrRuO_3$ suppresses the ferromagnetic phase and leads to a smeared quantum phase transition where rare magnetic regions exist in a nonmagnetic bulk.

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