

Quadrupolar phase transitions and a new model for the crystal fields in UPd₃

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Quadrupolar order in a 5f electron system has recently been observed directly for the first time, using resonant x-ray scattering techniques [1]. In UPd₃, 2 sets of satellite peaks appear at low temperatures, and show resonant enhancement at the uranium M_{IV} edge. X-ray and neutron scattering, and bulk property measurements, reveal a total of 4 phase transitions in UPd₃ at temperatures below 8K, which we attribute to antiferroquadrupolar ordering with different order parameters.

UPd₃ is a well localised 5f² system. Previously it was thought to have crystal field singlet ground states on both the quasi-cubic and hexagonal sites of the double-hexagonal close-packed crystal structure. However, such a model cannot explain the existence of the 4 phase transitions, or

indeed the susceptibility of the quasi-cubic site U ions.

We have now developed a new model [2] for the quasi-cubic sites with a doublet ground state. We will show that this model enables us to explain the order parameters of the 4 quadrupolar phase transitions, and also the excitations in the ordered phases, as observed in our inelastic neutron scattering studies of UPd₃.

References:

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- [2] K.A. McEwen, J-G. Park, A.J. Gipson, G.A. Gehring, to be published in J.Phys: Condens. Matt. (2003)