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The singlet-triplet gap structure of the noncentrosymmetric superconductor Ru7B3

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Noncentrosymmetric (NCS) materials present an interesting environment for superconductivity, as parity is no longer a conserved quantity, leading to the possibility of superconducting systems with a superposition of s-wave and p-wave states. Such systems are predicted to have unusual properties, such as large Pauli limiting fields and 'helical'vortex states. The dependence of the superfluid density on temperature is determined by the gap function, and therefore measuring this is one method to probe the presence of mixed superconducting states predicted for NCS superconductors. We have used small-angle neutron scattering from the vortex lattice on the SANS-I instrument at MLZ to investigate this in the NCS superconductor Ru7B3, a system which has already demonstrated highly unusual vortex behaviour where the structure of the vortex lattice shows a dependence on the field-history of the system in a manner not explicable by any established theory or through a mechanism such as vortex pinning. Our measurement of the temperature dependence of the superfluid density indicates that Ru7B3 is not a pure s-wave superconductor, and in-fact demonstrates the predicted s-wave and p-wave admixture from a recent theoretical model which has shown success in describing other NCS superconductors.

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