Unveiling the phase diagram of a striped cuprate at high magnetic fields: Hidden order of Cooper pairs

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The interplay of charge orders with superconductivity in underdoped cuprates at high magnetic fields (H) is an open question, and even the value of the upper critical field (H_{c2}), a measure of the strength of superconductivity, has been the subject of a long-term debate. We combined three complementary transport techniques [1] on underdoped $La_{1.8-x}Eu_{0.2}Sr_xCuO_4$ with a "striped" charge order and a low H=0 transition temperature T_c^0, to establish the T-H phase diagram and reveal the ground states in CuO_2 planes: a superconductor, a wide regime of superconducting phase fluctuations (i.e. a vortex liquid), and a high-field normal state. The relatively high H_{c2} is consistent with the opening of a superconducting gap above T_c^0, but only at T~ (2-3) T_c^0, an order of magnitude below the pseudogap temperature. Within the vortex liquid, an unanticipated, insulatinglike region, but with strong superconducting correlations, begins to emerge already at T<~ T_c^0. The results suggest that the presence of stripes plays a crucial role in the freezing of Cooper pairs in this novel state. Our findings provide a fresh perspective on the pairing strength in underdoped cuprates, and introduce a new avenue for exploring the interplay of various orders.

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References

[1] Z. Shi, P. G. Baity, T. Sasagawa, D. Popović, *arXiv:*1801.06903 (2018).