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Broken rotational and translational symmetries in the pseudogap phase of cuprates¹

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A large in-plane anisotropy of the Nernst coefficient in YBCO is found to set in precisely at the pseudogap temperature T^* throughout the doping phase diagram [1]. This implies that the pseudogap phase is an electronic state that breaks the four-fold rotational symmetry of the copper-oxide planes. At a somewhat lower temperature, of order $T^*/2$, the positive Hall and Seebeck coefficients of YBCO start dropping, and they reach large negative values at $T = 0$, in the normal state accessed by applying high magnetic fields [2,3]. We interpret this in terms of an electron pocket forming in the Fermi surface of YBCO as a result of a Fermi-surface reconstruction caused by some order which breaks the translational symmetry of the lattice. Because very similar transport anomalies are observed in Eu-LSCO [4], where they coincide with the onset of stripe order, we infer that some form of stripe order is also at play in YBCO, and argue that the pseudogap phase is a precursor region of stripe (or spin-density-wave) fluctuations [5].

[1] R. Daou *et al.*, Nature **463**, 519 (2010).

[2] J. Chang *et al.*, Physical Review Letters **104**, 057005 (2010).

[3] D. LeBoeuf, arXiv:1009.2078.

[4] O. Cyr-Choinière *et al.*, Nature **458**, 743 (2009).

[5] L. Taillefer, Annual Review of Condensed Matter Physics **1**, 51 (2010); arXiv:1003.2972.

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