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New experimental results concerning the nematic state in Fe-based superconductors

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The nature of the nematic state in FeSe and Ba122 systems is studied using a variety of experimental probes. In particular, we use a new technique, in which a considerable uniaxial strain is applied to the crystals by glueing them to a substrate with a large anisotropic thermal expansion, to measure the in-plane anisotropy of the uniform magnetic susceptibility and the resistivity under large strains [1]. We discuss the scaling of these quantities for both Ba122 and FeSe. Further, we study the shear-modulus response of the C4-reentrant phase in Na - doped Ba122 using a three-point bending technique. Surprisingly, we still find a sizeable nematic susceptibility in this phase, which further increases upon entering the superconducting state, in strong contrast to the behavior of optimally doped crystals. This is likely related to the strong competition between superconductivity with the double-Q state, as our previous studies have shown [2,3]. Finally, we study the coupling between nematicity and superconductivity of FeSe crystals using thermal expansion, magnetostriction and heat capacity. Surprisingly, the orthorhombic distortion is enhanced by superconductivity in S-substituted FeSe [4]. Heat capacity data point to a nodal superconducting gap structure. [1] M. He, L. Wang, F. Ahn, F. Hardy, T. Wolf, P. Adelmann, J. Schmalian, I. Eremin, and C. Meingast, arXiv:1610.05575. [2] A. E. Boehmer, F. Hardy, L. Wang, T. Wolf, P. Schweiss, and C. Meingast, Nat. Commun. 6, 7611 (2015). [3] L. Wang, F. Hardy, A. E. Boehmer, T. Wolf, P. Schweiss, and C. Meingast, PRB 93, 014514 (2016). [4] L. Wang, F. Hardy, T. Wolf, P. Adelmann, R. Fromknecht, P. Schweiss, and C. Meingast, physica status solidi (b) 1-6 (2016), 10.1002/pssb.201600153.