Charge and spin correlations in high temperature superconductors\(^1\)

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The cuprate high temperatures superconductors are characterised by numerous competing, and in some cases, co-existing broken symmetries. A important question is to what extent such additional ordered states exist for compositions with high superconducting transition temperatures. I will discuss high-energy X-ray diffraction measurements which show that a charge density wave state (CDW) develops at zero field in the normal state of superconducting YBa\(_2\)Cu\(_3\)O\(_{6.67}\) (\(T_c = 67\) K). This material has a hole doping of 0.12 per copper and a well-ordered oxygen chain superstructure. Below \(T_c\), the application of a magnetic field suppresses superconductivity and enhances the CDW. We find that the CDW and superconductivity are competing orders with similar energy scales, and the high-\(T_c\) superconductivity forms from a pre-existing CDW environment. Our results provide a mechanism for the formation of small Fermi surface pockets which can explain the negative Hall and Seebeck effects and the \(T_c\) plateau in this material.