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Scanning superconducting quantum interference device measurements of variations in superconducting transition temperature of two-dimensionally doped $SrTiO_3$[1]

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Mapping the spatial variation of the transition temperature, T_c, in unconventional superconducting materials can yield valuable insight into the nature of the superconducting state. In particular, many such materials have structural instabilities or transitions in their phase diagrams, and their superconducting state may therefore be particularly sensitive to local variations in the lattice. Such perturbations may manifest as local variations in T_c. I will discuss a recent application of scanning superconducting quantum interference device (SQUID) susceptometry to the study of superconductivity. By mapping the diamagnetic susceptibility of a superconductor as a function of temperature, we can observe the spatial distribution of T_c on micron lengthscales. In two-dimensionally doped strontium titanate, we found that T_c varies by $\gtrsim$10% in a pattern set by twin structure. By comparing the magnitude of the variation in T_c to quantities that could be tuned by the twinning, we inferred that T_c was tuned by local variation in the dielectric constant. This new imaging modality, when combined with a controlled, symmetry-breaking field such as strain, will help us to study the interplay between structural inhomogeneity and the superconducting state, while recent improvements in the fabrication of our SQUID susceptometers will allow us to push the spatial resolution of such measurements to lengthscales below a micron in certain cases.

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