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Andreev reflection in scanning tunneling spectroscopy of unconventional superconductors

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Motivated by recent experimental observations of unconventional superconductivity in the twisted bilayer and trilayer graphene, we develop a theory of point-contact tunneling into superconductors with arbitrary gap structures and for arbitrary transmission coefficients of the contact. Exploiting the dependence of Andreev reflections on the position of the STM tip relative to lattice symmetry points, we show that the nature of the order parameter can be extracted by combining weak- and strong-tunneling limits of differential conductance. This provides complementary information about the superconducting gap structure beyond the tunneling density of states, strongly facilitating the ability to extract the gap symmetry and its relation to the underlying crystalline lattice. We use the developed theory to discuss recent experimental results on superconductivity in twisted bilayer graphene.

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