ELIASHBERG EQUATIONS AND SUPERCONDUCTIVITY IN FLAT BAND SURFACE STATES OF RHOMBOHEDRAL GRAPHITE

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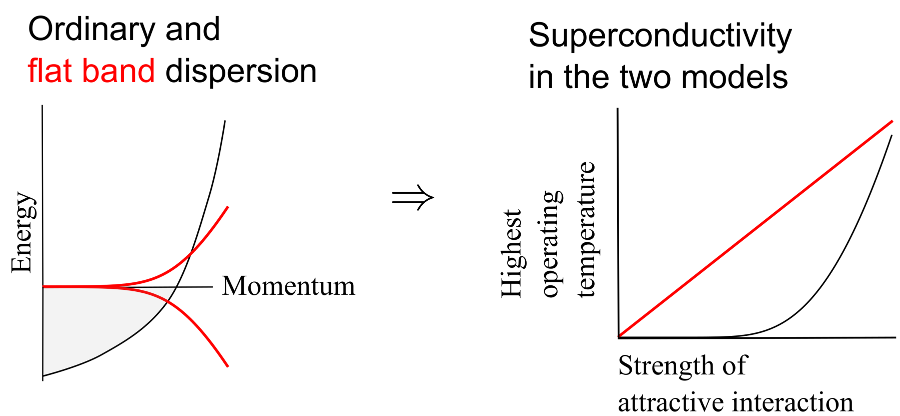
Signs of superconductivity in graphite have been observed even in high temperatures. A mechanism for graphite superconductivity has also been proposed, in which the superconductivity in graphite occurs only on interfaces.[1] On these interfaces the electronic dispersion has a flat band shape, as shown in the figure below. In this work, we study surface of rhombohedrally stacked graphite as an example of a flat band system.



As illustrated in the figure, critical temperature in conventional BCS superconductors is exponentially suppressed with respect to interaction strength: $T_c \sim e^{-1/g\nu}$, where g is the electron-phonon coupling constant and ν is the density of states at Fermi level. In contrast to this, a BCS-like model as applied to rhombohedral graphite predicts that the critical temperature T_c should scale linearly with respect to interaction strength: $T_c \sim g$.

This prediction we are now studying in more detail with Eliashberg theory, an extension of BCS model based on Green's functions.[2] Interactions can be be modelled more accurately in Eliashberg theory. For example, retardation of phonon-mediated interaction due to finite speed of sound is naturally described in this framework. It is also possible to study renormalization effects in electron dispersion and superconducting gap. These will influence the critical temperature, possibly reducing it from the BCS estimate.

[1] N. B. Kopnin, M. Ijäs, A. Harju, and T. T. Heikkilä, Phys. Rev. B 87, 140503 .

[2] G.M. Eliashberg, Sov. Phys. JETP 11.3 (1960), 696-702