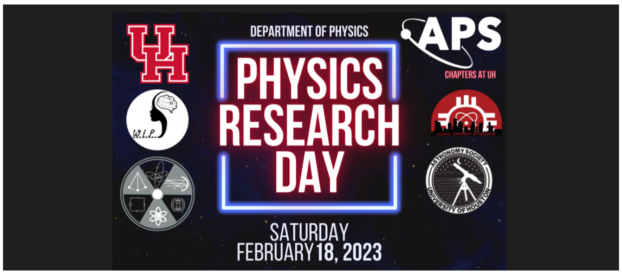

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Conventional superconductivity at the surface of a Type-I Weyl Semimetal

Saturday 18 February 2023 13:30 (15 minutes)

Recent experiments have seen surface superconductivity in Weyl semimetals, which raises the question of whether Fermi arcs can support superconductivity without any proximity effect from the bulk. This question is of further interest as the 2D surface is lower in dimensionality but has a finite density of states. In contrast, the 3D bulk is higher in dimensionality, but the density of states is zero due to the point-like Fermi surface. Thus, it is interesting to ask which of the two competing effects will win. A conclusive answer to this question is hindered by the absence of a well-defined surface Hamiltonian since the Fermi arcs merge with the bulk states at their endpoints. We circumvent this issue by adopting an alternate, Green's functions-based approach tailored to a layering model from which arbitrary Fermi arcs can be obtained by tuning phenomenological parameters. We find that Fermi arcs, indeed, can support a standard Cooper instability, while their leakage into the bulk has a negligible effect on the nature of the superconducting state for low doping around the Weyl nodes. Within the mean-field theory, we realise a peculiar situation where the surface of a system orders while the bulk is disordered, even though the latter has higher dimensionality. Another question raised is whether the leakage into the bulk protects the superconductivity from being destroyed by fluctuations. The calculation of fluctuation yields the result that thermal fluctuations destroy superconductivity similar to a 2D metal, and the resultant superconductivity is presumably due to a Kosterlitz-Thouless phase.

Academic year

4th year

Research Advisor

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