Meissner Effect of Superconducting Dirac Electrons

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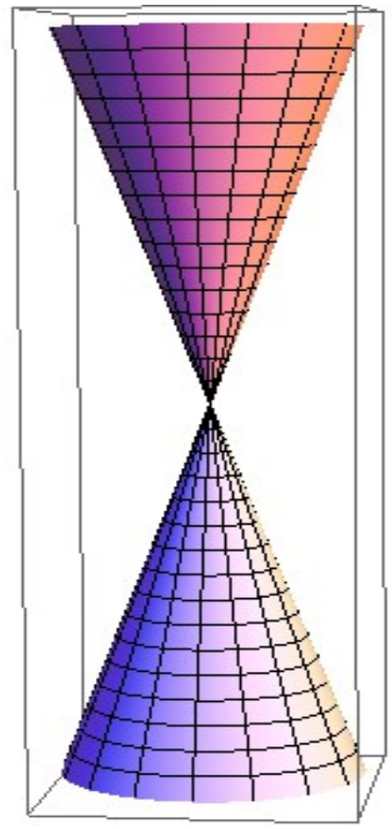
Dirac Electrons

- Linear dispersion relation
- 2-band system



=> Unique physical properties!

In superconducting state…

Meissner Effect

Electron gas (k^2-dispersion)

$$\hat{\mathbf{j}} = \sum_{\mathbf{k},\sigma} (\frac{\mathbf{k}}{m} + \frac{e}{c}\mathbf{A}) c^{\dagger}_{\mathbf{k},\sigma} c_{\mathbf{k},\sigma}$$

$$= \hat{\mathbf{j}}^{(0)} + \hat{\mathbf{j}}^{\mathrm{dia}}$$

Meissner effect due to $\hat{\mathbf{j}}^{\mathrm{dia}}$

Dirac electrons (Linear dispersion)

No $\hat{\mathbf{j}}^{\mathrm{dia}}$due to the linear dispersion.

Q: Meissner effect occurs in Dirac electron in SC state?

A: YES!

- 3D massive Dirac Hamiltonian+ s-wave pairing
- Meissner kernel derived by Kubo formula

Result

Meissner kernel becomes finite due to the inter-band effect!