Weyl Disks

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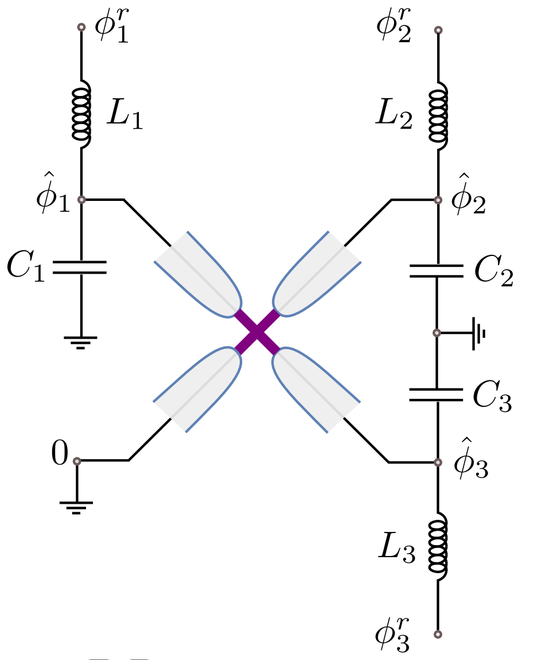
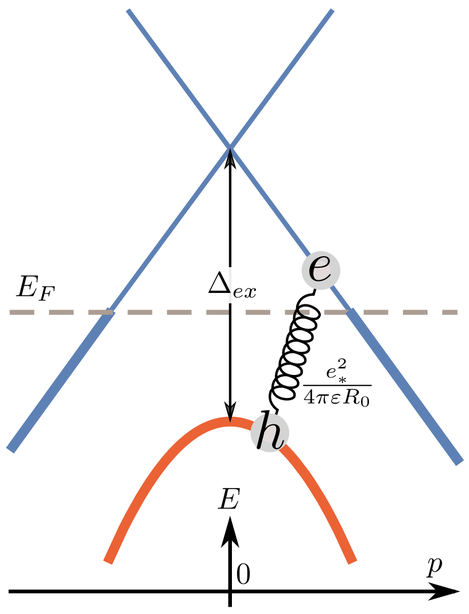
$$\mathbf{H} = \sigma \cdot \phi + \frac{1}{2}(\phi - \phi_0) \cdot \mathbf{G} \cdot (\phi - \phi_0) + V(\mathbf{q})$$

$$[\mathbf{q}, \phi] = i, \quad \mathbf{G} = diag(g_1 > g_2 > g_3)$$

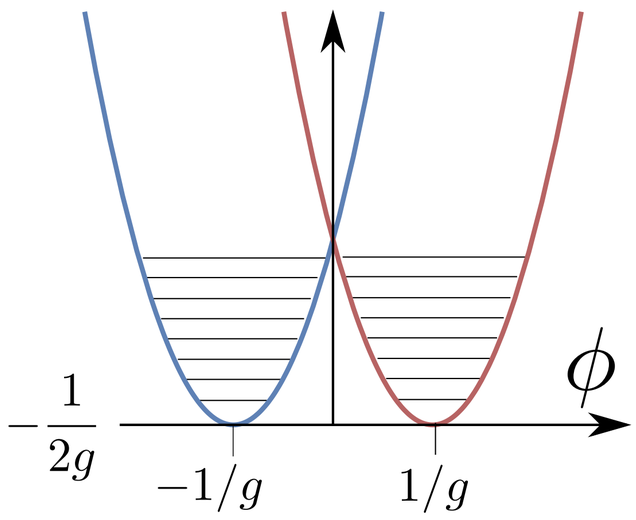
Motivation



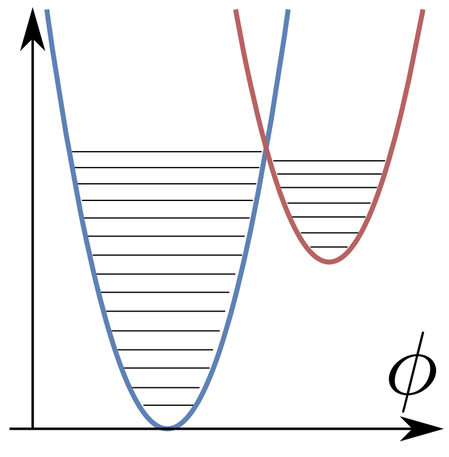


Kinetic Term

$$\sigma \cdot \phi + \phi \cdot \mathbf{G} \cdot \phi$$



$$\phi_0 > 0$$

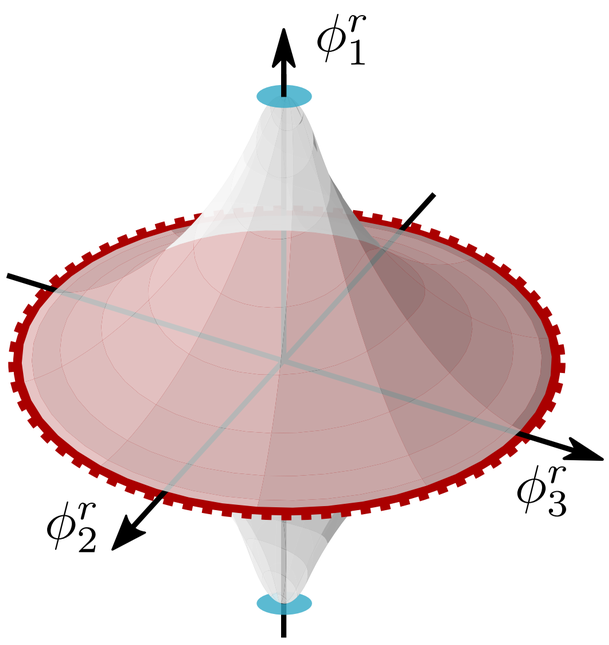


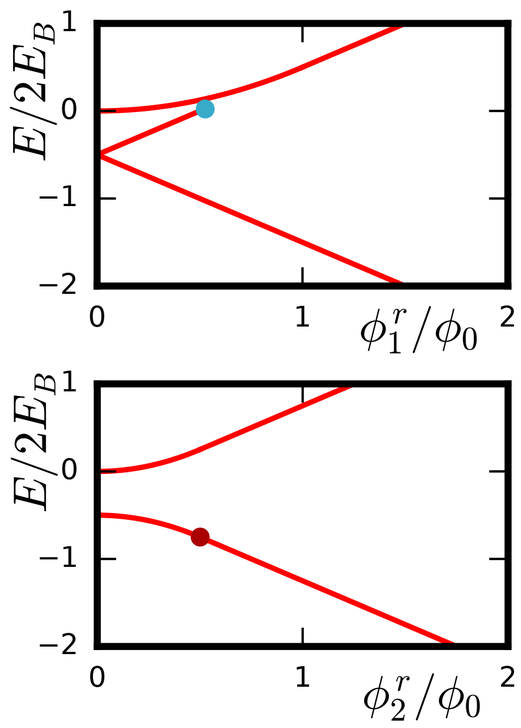
- Preferred direction for ϕ will be one with the smallest g and thus with largest seperation
- Thus we expect that wave function is centered around minima of kinetic term
- For large ϕ_0 we would only see one type of spin states

Quasiclassical

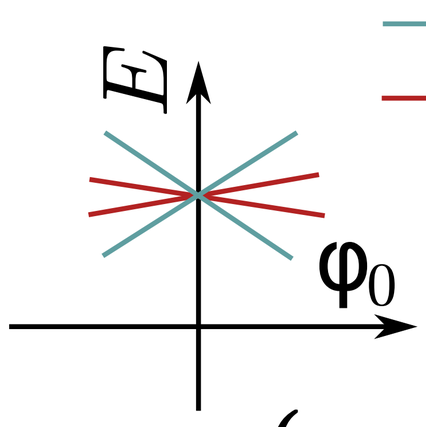
$$E = \pm|\phi| + \frac{1}{2}(\phi - \phi_0) \cdot \mathbf{G} \cdot (\phi - \phi_0)$$

where ϕ is a minimum for E





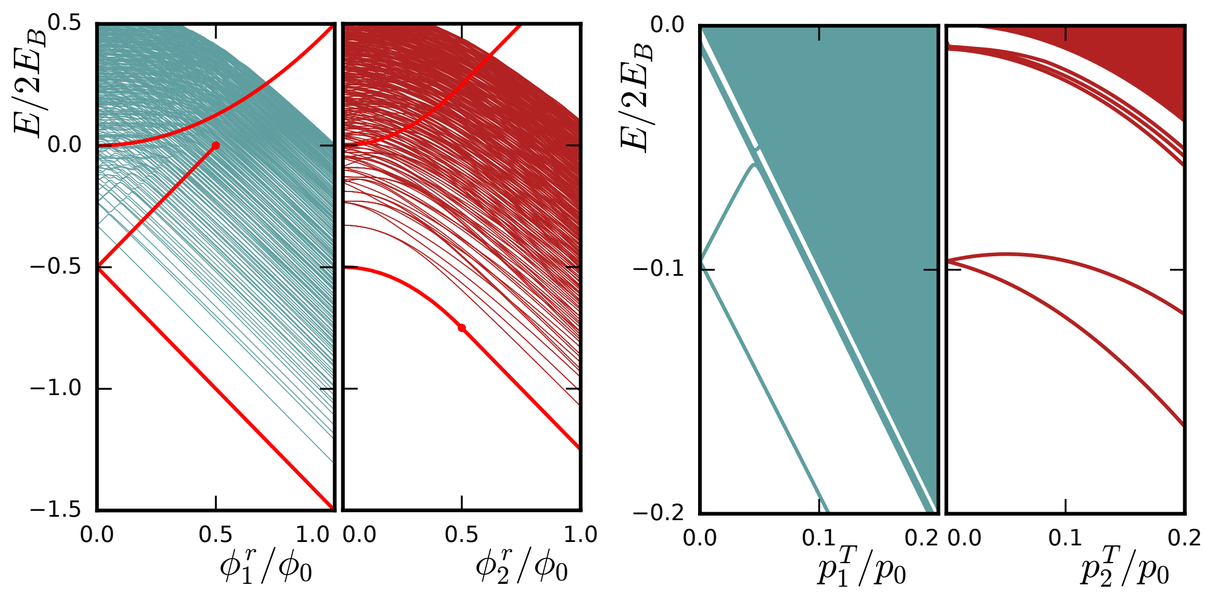
Quantum



$$\left|\frac{\partial E_0}{\partial \phi_{03}}\right| = 1$$

$$\left|\frac{\partial E_0}{\partial \phi_{01,2}}\right| = \begin{cases} V = \frac{\alpha}{|\mathbf{q}|} & : \quad \frac{8\alpha^3}{g_3} \\ V = \alpha|\mathbf{q}|^2 & : \quad e^{-\frac{1}{\sqrt{2\alpha g_3^3}}} \end{cases}$$

$$V = \alpha|\mathbf{q}|^2 \qquad V = \alpha/|\mathbf{q}|$$



- Energy level splitting can be approximately calculated without Weyl term
- Ground state energy is roughly a kinetic term minima plus ground state without Weyl term
- Crossings and avoidances can be explained by symmetries

Conclusion

- Contact effects cause energy level splitting
- Tip of a Weyl point is unaffected in the easy direction but is smeared in orthognal ones (disc)

References

- R.-P. Riwar, M. Houzet, J. S. Meyer & Yuli V. Nazarov, Nat. Commun. 7, 11167 (2016) and its references
- Erdmanis, J., Lukács,Á., & Nazarov, Y. V. (2018). Weyl disks: Theoretical prediction. Physical Review B, 98(24).