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Zero Modes from Massive Fermions and Axion Strings

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In recent years, there has been renewed interest in the physics of axion strings since they naturally arise in axion models and can have a dramatic impact on cosmological observations. It is well- known that axion strings superconduct since massless chiral excitations can propagate along them. Aside from anomaly inflow, a common explanation for why these modes exist is that a bulk fermion becomes massless in the core of the string, and so excitations can propagate at the speed of light as long as they are confined to this region. In this talk, we reexamine this intuition and show such zero modes exist even when the fermion remains massive in the core of the string. Counterintuitively, these zero modes become less and less localized around the string the higher this mass is, up until a critical value in which case the zero modes disappear.

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