Hierarchical structure and topological content of entanglement of free fermions

Abhirup Mukherjee, Siddhartha Patra, Siddhartha Lal

Department of Physical Sciences, IISER Kolkata, Mohanpur

June 16, 2022

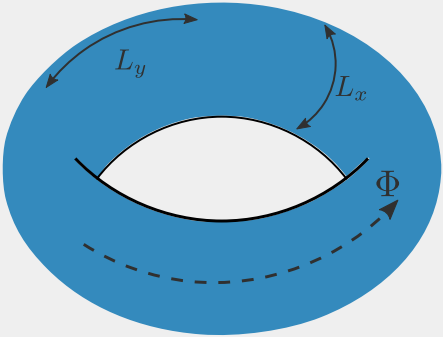
Introduction

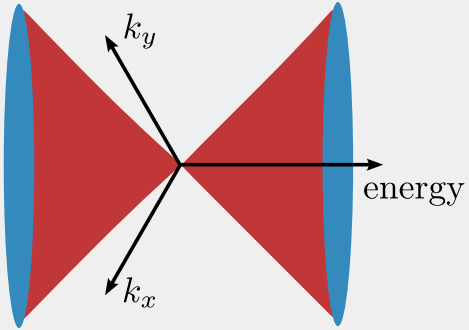
Massless Dirac fermions on a 2-torus

$$\mathcal{L} = i \int \mathrm{d}x\, \mathrm{d}y\, \overline{\psi} \gamma_\mu \partial_\mu \psi$$

In presence of an Aharonov-Bohm flux

$$\mathcal{L} = \int \mathrm{d}x\, \mathrm{d}y\, \overline{\psi} \left(i\gamma_\mu + eA_\mu \right) \partial_\mu \psi$$



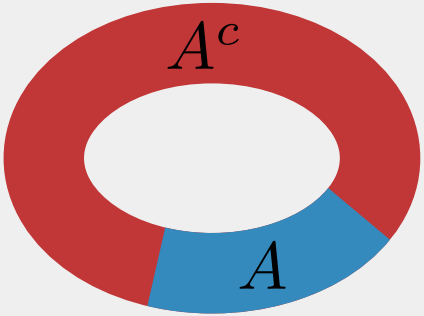


Measures of entanglement I

$\rho = |\Psi\rangle \langle\Psi| \longrightarrow$ density matrix

$\rho_A =$ partial trace over system A
$\longrightarrow$ reduced DM

$S(A) = -\mathrm{Tr}\left[\rho_A \ln \rho_A\right]$
$\longrightarrow$ entanglement entropy of A



References I