Re-entrant topological order due to Rashba spin-orbit coupling in topological superconductors

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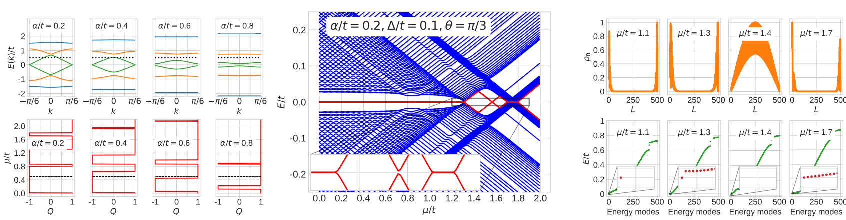
Topological superconductivity is one of the extensively researched field due to its predicted application in quantum computing. There are several proposals for synthesizing topological superconductors, both in 1D and 2D materials; among them hetero-structures of 1D nanowire with Rashba spin orbit coupling (RSOC) on 2D s-wave superconductors under an external magnetic field have been promising. The Majorana Fermions (MF) are generated at the two ends of the wire. However, it is preferable to design systems without magnetic field, as magnetic field: (i) is deterimental to the s-wave superconductivity, (ii) don't allow for miniaturization of the system, (iii) applies restriction on material to be used. There are several proposals to synthesize systems without magnetic field. One of the proposal is to use strongly correlated 1D nanowire on the extended s-wave superconductors proposed by the authors [**?**]. We further investigated this system by inclusion of the RSOC in the strongly correlated nanowire. The phase diagram of the system with spiral spin field has a re-entrant behavior, it is due to the gaped energy spectrum. The numerical calculations also give the same result.



(a) (b) (c)

Figure 1: (a) Energy spectrum in reduced BZ for $\theta = \pi/3$. The BZ boundary is at $\pi/6$ as periodicity of $\tilde{t}_i$ is six. Depending on α, the μ may be present inside the band or outside of it (in the bandgap), e.g. $\mu/t = 0.5$ (dotted, black) is inside the band for $\alpha/t = 0.2$, however, it is in the bandgap for $\alpha/t = 0.8$. (b,c) Numerical calculations of zero modes.