Annihilation operators for 2D non-abelian anyons

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Abstract

2D non-abelian anyons are formalised in a diagrammatic formalism [1]. Topological quantum computing proposes to use these systems to encode quantum information. Such method obtains a natural shielding from decoherence [2]. We present a completely new perspective on these systems proposed in [3].

In this talk, we define annihilation operators for any 2D non-abelian anyon theory. Such characterization has been desired for many years. We explicitly construct the annihilation operators for Fibonacci anyons.

We express the Fibonacci-Hubbard Hamiltonian in terms of the Fibonacci annihilation operators and study their properties.

Very interestingly we find that any non-abelian anyon type has more than a single annihilation operator associated to it. The number of annihilation operators is linked to the possible fusion channels of the anyon type.

We discuss the implications of our findings for topological quantum computing and possible future realisations of non-abelian anyons in the lab.

References

[1] P. Bonderson. " Non-Abelian Anyons and Interferometry". Dissertation (Ph.D.) Caltech. (2007)

[2] A. Y. Kitaev. "Fault tolerant quantum computation by anyons". Annals Phys. 303. (2003) 2-30

[3] N. Tibau Vidal and L. Vilchez-Estevez. "Creation and annihilation operators for 2D non-abelian anyons". ArXiv. /abs/2304.10462 (2024). Sent to Phys. Rev. B

Figures

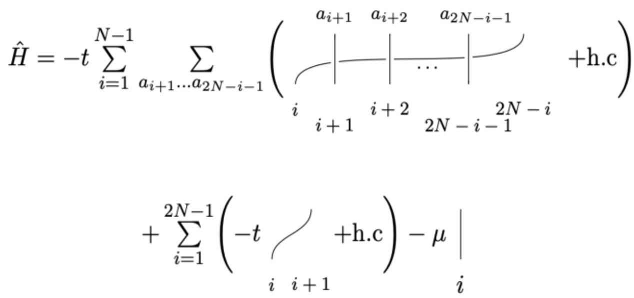

Figure 1: Fibonacci Hubbard model in the diagrammatic formalism.

$$\hat{H} = -t\sum_{i=1}^{N-1}\left(\alpha^\dagger_{2N-i+1}\alpha_i + \beta^\dagger_{2N-i+1}\beta_i\right) + \text{h.c.}$$
$$-t\sum_{i=1}^{2N-1}\left(\alpha^\dagger_{i+1}\alpha_i + \beta^\dagger_{i+1}\beta_i\right) + \text{h.c.}$$
$$-\mu\sum_{i=1}^{2N}\left(\alpha^\dagger_{i}\alpha_i + \beta^\dagger_{i}\beta_i\right)$$

Figure 2: Fibonacci Hubbard model with the annihilation operators a and β.

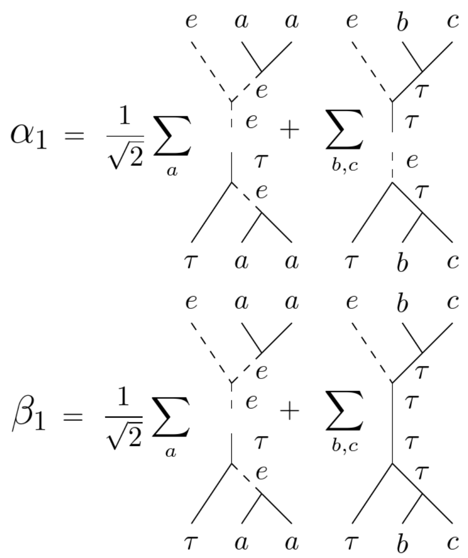

Figure 3: Fibonacci annihilation operators a and β on the first mode.