

Topological order in the color-flavor locked phase of (3+1)-dimensional $U(N)$ gauge-Higgs system

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We study a (3+1)-dimensional $U(N)$ gauge theory with N -flavor fundamental scalar fields, whose color-flavor locked (CFL) phase has topologically stable non-Abelian vortices. The $U(1)$ charge of the scalar fields must be $Nk+1$ for some integer k in order for them to be in the representation of $U(N)$ gauge group. This theory has a Z_{Nk+1} one-form symmetry, and it is spontaneously broken in the CFL phase, i.e., the CFL phase is topologically ordered if k is not 0. We also find that the world sheet of topologically stable vortices in CFL phase can generate this one-form symmetry.

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