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A discretized Chern-Simons gauge theory on arbitrary graphs and the hydrodynamic theory of fraction Chern insulators KAI SUN, University of Michigan, KRISHNA KUMAR, EDUARDO FRADKIN, University of Illinois at Urbana-Champaign — In this talk, we study how to discretize the Chern-Simons gauge theory on generic planar lattices/graphs, with or without translational symmetries, embedded on arbitrary 2D closed orientable manifolds. We show that as long as a one-to-one correspondence between vertices and faces can be defined on the graph such that each face is paired up with a neighboring vertex (and vice versa), a discretized Chern-Simons theory can be constructed. We further verify that all the essential properties of the Chern-Simons gauge theory are preserved in the discretized setup. In addition, we find that the existence of such a one-to-one correspondence is not only a sufficient condition for discretizing a Chern-Simons gauge theory, but also a necessary one, if we want the discretized theory to be nonsingular and to preserve some key properties of this topological field theory. A specific example will then be provided, in which we discretize the Chern-Simons gauge theory on a tetrahedron. In addition, as one application of our discoveries, we present a hydrodynamic theory for (discrete) fractional Chern insulators.

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