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Moduli spaces of principal 2-group bundles and a categorification of the Freed--Quinn line bundle

A 2-group is a higher categorical analogue of a group, while a smooth 2-group is a higher categorical analogue of a Lie group. An important example is the string 2-group in the sense of Schommer-Pries. We study the notion of principal bundles for smooth 2-groups, and investigate the moduli "space" of such objects. In particular, in the case of flat principal bundles for a finite 2-group over a Riemann surface, we prove that the moduli space gives a categorification of the Freed--Quinn line bundle. This line bundle has as its global sections the state space of Chern--Simons theory for the underlying finite group. We can also use our results to better understand the notion of geometric string structures (as previously studied by Waldorf and Stolz--Teichner).