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A better space of generalized connections

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Given a base manifold M and a Lie group G, we define $\widetilde{calA}_M$ a space of generalized G-connections on M with the following properties:

- The space of smooth connections $calA_M^\infty = \sqcup_\pi calA_\pi^\infty$ is densely embedded in $\widetilde{calA}_M = \sqcup_\pi \widetilde{calA}_\pi^\infty$; moreover, in contrast with the usual space of generalized connections, the embedding preserves topological sectors.
- $\widetilde{calA}_M$ is a homogeneous diffeological covering space for the standard space of generalized connections of loop quantization $\overline{calA}_M$.
- $\widetilde{calA}_M$ is a measurable space that can be constructed as an inverse limit of of spaces of connections with a cutoff, much like $\overline{calA}_M$. At each level of the cutoff, a Haar measure, a "BF measure" and heat kernel measures can be defined. For compact gauge groups and for each topological sector, the Haar measure has finite volume and induces a measure in the inverse limit.
- The topological charge of generalized connections on closed manifolds $Q = \int Tr(F)$ in 2d, $Q = \int Tr(F \wedge F)$ in 4d, etc, is defined.
- The space of generalized connections on a manifold that is subdivided can be calculated in terms of the spaces of generalized connections associated to the pieces. This property holds even when the subdivision generates corners. Thus, spaces of boundary connections can be computed from spaces of connections associated to faces.
- The soul of our generalized connections is a notion of higher homotopy parallel transport defined for smooth connections. We recover standard generalized connections by forgetting its higher levels.

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