

Holonomy and Spectral Inverse Problems

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Abstract: Let (M, g) be a closed Riemannian manifold and (E, ∇) be a vector bundle over M equipped with connection ∇ . The holonomy inverse problem asks if the traces of parallel transports along closed geodesics in M , the holonomy trace map, determine the connection ∇ up to gauge equivalence. Under the assumption that (M, g) has negative curvature, I will explain how to construct a conjugacy on the level of the geodesic flow between connections having the same holonomy trace map, and how this implies 1) local determination of connections from the holonomy trace map; and 2) global determination under a low-rank assumption. We will also discuss the striking application to the inverse spectral problem of globally determining ∇ from the spectrum of the connection Laplacian $\nabla^* \nabla$ (this question is analogous to Kac's isospectral problem). Techniques involve hyperbolic dynamics, Fourier analysis, and algebraic geometry. Based on joint work with Thibault Lefeuvre.