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Inverse spectral problems with sparse data and applications to photo-acoustic tomography

We discuss recent results on inverse spectral problems with sparse data on compact Riemannian manifolds with or without boundary. The goal is to reconstruct a general second order linear elliptic self-adjoint differential operator on a manifold from the knowledge of only a portion of its discrete spectrum along with the restrictions of an associated set of linearly independent eigenfunctions to a (possibly small) observation set. We show that such reconstructions are possible under certain geometric assumptions on the observation set as well as the differential operator. As an application of our inverse spectral result, we provide generic uniqueness results for the inverse photo-acoustic problem as well as other types of inverse problems with passive measurements where the goal is to determine the coefficients in a PDE along with the initial data/source term from one passive measurement of its solution on the observation set.