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Cospectral constructions for the q-Laplacian matrix

Given a graph we consider the q-Laplacian matrix described as $qD + A$ where D is the diagonal matrix of degrees and A is the adjacency matrix. By proper selection of q we recover well known matrices ($q = 0$ is the adjacency; $q = 1$ is the signless Laplacian; $q = -1$ is, up to sign, the Laplacian).

It is known that there are graphs which are cospectral (same multiset of eigenvalues) for the q-Laplacian for arbitrary choice of q (any regular cospectral pair suffices, but regularity is not needed). The goal of this talk is to highlight some pair of graphs which are cospectral for the q-Laplacian for only some specific values of q and we show there are infinitely many values of which have a cospectral pair. One of our tools we will use is some generalization of Godsil-McKay switching.