
SIDHANTH MOHANTY, University of California, Berkeley

On the relationship between spectra, girth and vertex expansion in regular graphs

1. For every $d = p + 1$, prime p and infinitely many n , we exhibit an n -vertex d -regular graph with girth $\Omega(\log_{d-1} n)$ and vertex expansion of sublinear sized sets bounded by $(d + 1)/2$ whose nontrivial eigenvalues are bounded in magnitude by $2\sqrt{d-1} + O(1/\log n)$.
2. In any near-Ramanujan graph with girth $C \log n$, sets of size bounded by $n^{0.99C/4}$ have near-lossless vertex expansion $(1 - o_d(1))d$.

Our tools include the nonbacktracking operator of an infinite graph, the Ihara-Bass formula, a Bordenave inspired trace moment method, and a method of Kahale to study dispersion of eigenvalues of perturbed graphs.

Joint with Theo McKenzie (<https://arxiv.org/abs/2007.13630>).