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Spectrum of the Energy Laplacian on the Sierpinski Gasket

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Abstract of Report Talk: One of the central topics in analysis on fractals is the analogue of Laplacians, defined by Kigami, on a class of self-similar fractals, including the Sierpinski gasket(SG). Among the different Laplacians on SG, it is believed that the energy Laplacian Δ_ν (where ν is the Kusuoka measure) is more well-behaved than others, as evidenced by Teplyaev's results which relate Δ_ν to second derivatives in the Euclidean sense by means of the harmonic coordinate map. In our project (joint with Prof. Robert Strichartz and undergraduate student Naotaka Kajino), we investigate the behaviour of eigenvalues and eigenfunctions of Δ_ν subject to the Dirichlet and Neumann boundary conditions, using the finite element method and a method that involves discretizing the pointwise formula for Δ_ν. We find that the eigenvalue counting function $N(x)$ obeys the asymptotic behaviour predicted by Weyl's theorem, and we conjecture that the limit of the Weyl ratio exists, which is not the case for the standard Laplacian Δ_μ on SG. We also conjecture from the numerical results that the multiplicities of the eigenvalues are either 1 or 2, in stark contrast to the high multiplicities of eigenvalues of Δ_μ. Moreover, we note certain symmetries displayed by the eigenfunctions, which are closely related to the multiplicities of the corresponding eigenvalues, and the existence of eigenfunctions that satisfy both Dirichlet and Neumann boundary conditions. [FA13152759]

[Joint work with Prof. Robert Strichartz and Naotaka Kajino]

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