We calculate explicitly the spectrum of each of the finite graphs in a sequence that approximates the First Julia Fractal (the first non-smooth self-similar set appearing as an example in his treatise from 1918). The main tools are the associated iterated monodromy group, finite-dimensional representations corresponding to the action on the levels of the associated tree, Schur complements, and sufficient understanding of the dynamics of a certain 3-dimensional rational map. Laplacian for the fractal is obtained as the limit of the (rescaled) Laplacians of the finite graphs that approximate it. The same approach works equally well for other fractals in an infinite family related to the First Julia Fractal.

Joint work with R. Grigorchuk and V. Nekrashevych.