1062-58-223 **Joe P Chen*** (jpc64@cornell.edu), Department of Physics, Cornell University, Ithaca, NY 14853, and **Robert S Strichartz** (str@math.cornell.edu), Department of Mathematics, Cornell University, Ithaca, NY 14853. *Spectral Asymptotics on Three-Dimensional Fractal Sponges.* Preliminary report.

Weyl's asymptotic formula states that the eigenvalue counting function $N(s)$ for the Laplacian $-\Delta$ on a compact d-dimensional Riemannian manifold satisfies $N(s) \sim s^{d/2}$ as $s \to \infty$. Defining the Weyl ratio as $W(s) := N(s)s^{-d/2}$, we have $W(s) \sim 1$. The situation is very different on fractals: d is replaced by the spectral dimension, and $W(s)$ might not have a limit. Recent asymptotic studies have focused on post-critically finite fractals and generalized Sierpinski carpets.

In this talk we will present results on 3-dimensional infinitely ramified fractals, including fully symmetric sponges (e.g. Menger sponge), homogeneous hierarchical sponges, and random hierarchical sponges. Using the finite element method, we numerically computed the Neumann Laplacian spectrum on each sponge. In every case, we found that the Weyl ratio $W(s)$ was segmented into distinct log periods: Notably, $W(s)$ restricted to the m-th period ("sounds of the drum") correlated strongly with the geometry of the m-th level construction of the fractal ("shape of the drum"). We will describe this so-called spectral segmentation heuristic, discuss its connection to Varadhan's asymptotics for the heat kernel, and comment on sub-Gaussian diffusion in sponges. (Received August 10, 2010)