Shmuel Weinberger (University of Chicago),
Computational complexity, entropy, and moduli spaces

(joint work with Alex Nabutovsky, University of Toronto). We will consider the moduli space of Riemannian metrics on a compact manifold with curvature between -1 and 1, up to reparametrization (as arises in some models of quantum gravity) and shall show that there are different regions within this space with very different geometric terrains (as measured by their "phantom homologies" and filling functions). The method plays off the computational complexity of certain algorithmic problems against the covering entropy of the moduli space. Essentially, every Turing machine will pick out a (perhaps empty, although usually infinite!) sequence of regions in moduli space, whose properties reflect the computations of the machine. This leads to a "coarse fractal structure" on the moduli space as well as the "antifractal" phenomena mentioned above.

Similar methods apply to finding local minima and other critical points for other riemannian variational problems, and also to moduli spaces of other classes of metrics, and of embeddings (such as knots).

If there's time, I'll try to discuss the extent to which these results are (in)sensitive to the difeomorphism type of the underlying manifold and to dimension.