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Determining a Riemannian metric from areas of minimal surfaces

The classical boundary rigidity problem in Riemannian geometry asks whether it is possible to determine the Riemannian metric on a manifold with boundary from knowledge of the distance between any two boundary points. There has been considerable work on various special cases of this problem by Gromov, Michel, Croke, Burago and Ivanov, Pestov and Uhlmann, and most recently by Stefanov, Uhlmann and Vasy.

In this talk, we address an analogous problem with the data consisting of areas of minimal surfaces rather than of lengths of geodesics. More precisely, for any simple closed curve on the boundary, we are given the area of the area-minimizing surface(s) bounded by the curve. We show that for certain compact, connected Riemannian 3-manifolds with boundary this information uniquely determined the metric in the interior up to diffeomorphisms that fix the boundary. (joint work with S. Alexakis and A. Nachman.)