**Existence and geometric structure of metrics on surfaces which extremize eigenvalues**

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**Abstract:**
Finding sharp eigenvalue bounds and characterizing the extremals is a basic problem in geometric analysis. We will describe the structure of metrics which are obtained by maximizing the first eigenvalue over all metrics on a surface (either closed or with boundary). It turns out that the extremals are related to minimal surfaces, and in some cases it is possible to use minimal surface theory to characterize the extremal metrics.