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Geometric bounds on low Steklov eigenvalues

I will talk about joint work with R. Schoen on the relationship of the geometry of compact Riemannian manifolds with boundary to the first nonzero eigenvalue of the Dirichlet-to-Neumann map (Steklov eigenvalue). For surfaces with boundary we obtain an upper bound on the first Steklov eigenvalue in terms of the genus and the number of boundary components of the surface. This generalizes a result of Weinstock from 1954 for surfaces homeomorphic to the disk. We attempt to find the best constant in this inequality for annular surfaces. Motivated by the annulus case, we explore a connection between the Dirichlet-to-Neumann map and minimal submanifolds of the ball that are solutions to the free boundary problem. We prove general upper bounds for the first Steklov eigenvalue for conformal metrics on manifolds of any dimension which can be properly conformally immersed into the unit ball in terms of certain conformal volume quantities.