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Width Stability of Three-Manifolds

In the 1990's, researchers such as Colding and Petersen investigated the stability of invariants such as the radius, volume, and Laplace eigenvalues λ_k of closed Riemannian manifolds with $\mathrm{Ric}_g \geqslant (n-1)g$. They showed that almost maximality of either the radius or volume, or minimality of λ_{n+1} (listed with multiplicity), is equivalent to the closeness of the manifold of interest to the unit round sphere.

We contribute another invariant to this list in dimension $n = 3$, by studying the almost-rigid properties of the first Almgren-Pitts width $\omega_1(M^3, g)$ as a non-linear, minimal-surface-based analogue of Petersen's work with the Laplace spectrum. Our main techniques involve the Ricci flow and the convergence/compactness theory of minimal surfaces.