Stability for a class of three tori with small negative scalar curvature

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When one encounters curvature in any of its forms on a manifold, it is natural to wonder how this quantity determines the geometry of the manifold. One formulates this in terms of a comparison to some model space. For example, manifolds whose sectional curvatures are bounded below by zero are compared to Euclidean space, which has zero sectional curvature. Such comparisons are often accompanied by some form of rigidity statement.

For example, simply connected manifolds with zero sectional curvature are isometric to Euclidean space.

In the hierarchy of curvatures, knowledge of sectional curvature implies the strongest control over geometry. On the other end of the spectrum is scalar curvature. Despite only being a function, it does have some influence over geometry. For example, one has the celebrated Torus Rigidity Theorem, which says that a torus with non-negative scalar curvature must actually be flat. Once the hard work of establishing such a rigidity statement has been accomplished, it is natural to ask the stability question: is a torus with small negative scalar curvature nearly flat? Because scalar curvature has such weak control over the geometry, we can expect the answer to be quite complicated. In this talk I will present joint work with Lizhi Chen in which we show that for a flexible family of metrics on the torus, small negative scalar curvature does imply that the metric is nearly flat in a certain sense.