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## **The Positive Mass Theorem, the Penrose Inequality and the Intrinsic Flat Distance**

The Schoen–Yau Positive Mass Theorem states that an asymptotically flat 3-manifold with nonnegative scalar curvature has positive ADM mass unless the manifold is Euclidean space. Here we examine sequences of such manifolds whose ADM mass is approaching 0. We assume the sequences have no interior minimal surfaces although we do allow them to have boundary if it is a minimal surface as is assumed in the Penrose inequality. It is known that such sequences need not converge in the smooth sense (as can be seen with a sequence of Schwarzschild spaces). Nor do they converge in the Gromov–Hausdorff sense (due to the possible existence of thin deep gravity wells). We conjecture that they do converge to Euclidean space in the pointed Intrinsic Flat sense for a well chosen sequence of points. The Intrinsic Flat Distance, introduced in work with Stefan Wenger (UIC), can be estimated using filling manifolds which allow one to control thin wells and small holes. Here we present joint work with Dan Lee (CUNY) constructing such filling manifolds explicitly and proving the conjecture in the rotationally symmetric case. We also discuss sequences of manifolds approaching equality in the Penrose Inequality, techniques that can be used to control the intrinsic flat distance, key examples in the nonrotationally symmetric case and open problems related to the conjecture stated above.