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5. Differential Geometry and Global Analysis

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The Topology of Noncompact Manifolds with Positive Ricci Curvature

Let M^n be a complete noncompact manifold. Cheeger and Gromoll proved that if M^n has nonnegative *sectional* curvature then it is diffeomorphic to the normal bundle over a compact totally geodesic submanifold (1972). If M^n has positive sectional curvature then it is diffeomorphic to R^n. However, if M^n only has positive *Ricci* curvature then it can have a nontrivial fundamental group (Nabonnand, 1980).
We will say that M^n has the *loops to infinity* property if given any noncontractible closed curve C, any ray and any compact set K, there exists a closed geodesic contained in $M\backslash K$ which is homotopic to C along the given ray. It is proven that if M^n has positive Ricci curvature then it has this *loops to infinity* property. Counter examples and a discussion of manifolds with nonnegative Ricci curvature will be presented as well.