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On manifolds with low Lusternik-Schnirelmann category

A topological space X has the (normalized) Lusternik-Scnirelmann category at most n, $cat_{LS}X \leq n$, if it admits a cover by $n+1$ open subsets $\{U_i\}_{0\leq i\leq n}$ such that each U_i is contractible to a point in X. Clearly, every space X with $cat_{LS}X = 0$ is contractible. It is known that every closed n-manifold M with $cat_{LS}M = 1$ is homeomorphic to S^n.

THEOREM 1. *Every closed n-manifold M, $n > 2$ with $cat_{LS}M = 2$ has the fundamental group necessarily free.*

THEOREM 2. *If a finitely presented group G is not free, then there exists a closed 4-manifold M with the fundamental group G and $cat_{LS}M = 3$.*

*This is a joint work with M. Katz and Yu. Rudyak