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On L-spaces and left-orderable fundamental groups

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Examples suggest that there is a correspondence between L-spaces and 3-manifolds whose fundamental groups cannot be left-ordered. In this paper we establish the equivalence of these conditions for several large classes of such manifolds. In particular, we prove that they are equivalent for any closed, connected, orientable, geometric 3-manifold that is non-hyperbolic, a family which includes all closed, connected, orientable Seifert fibred spaces. We also show that they are equivalent for the 2-fold branched covers of non-split alternating links. To do this we prove that the fundamental group of the 2-fold branched cover of an alternating link is left-orderable if and only if it is a trivial link with two or more components. We also show that this places strong restrictions on the representations of the fundamental group of an alternating knot complement with values in $\text{Homeo}_+(S^1)$.

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