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The topology of low dimensional cohomogeneity one manifolds:

Some open problems

1. Which of the cohomogeneity one manifolds given by the group diagrams

$$\begin{aligned} S^3 \times S^3 \supset \{(e^{ip\theta}, e^{iq\theta})\}, \Delta S^3 \supset 1 \\ S^3 \times S^3 \supset \{(e^{ip\theta}, e^{iq\theta})\}, \pm \Delta S^3 \supset \mathbb{Z}_2 \end{aligned}$$

admit invariant metrics of non-negative sectional curvature?

2. (a) Find ‘interesting’ cohomogeneity one manifolds in higher dimensions.
(b) Which of these can be shown to admit metrics of non-negative sectional curvature?
(c) Which can be shown to not admit invariant metrics of non-negative sectional curvature?
3. Classify higher dimensional cohomogeneity one manifolds, possibly with certain topological restrictions.
4. Compute topological invariants of cohomogeneity one manifolds.