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Title: New families of rational homology 3-spheres bounding rationally acyclic 4-manifolds

Abstract: Problem 4.5 on Kirby's list of important problems in low-dimensional topology asks which rational homology 3-spheres bound rationally acyclic 4-manifolds. This question cannot be answered in full generality, but there exist partial answers for some families of 3-manifolds, including lens spaces (Lisca, 2007) and integral surgeries on positive torus knots (Aceto, Golla, Larson, Lecuona, 2020). An important method used in these classifications is lattice embeddings, whose non-existence obstructs the existence of a rationally acyclic filling. Determining if a lattice embedding exists for any manifold in a family often amounts to difficult combinatorics.

Using a computer, Aceto, Golla, Larson and Lecuona found a particularly difficult-to-guess family of integral surgeries on iterated torus knots that bound rationally acyclic manifolds. In my recent work, I explain why this family is not that strange, but is in fact simply the intersection between a large, new and natural family of boundaries of rationally acyclic 4-manifolds and the integral surgeries on positive torus knots.