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Title: An Unexpected Rational Blowdown

Abstract: The rational blowdown operation in 4-manifold topology replaces a neighborhood of a configuration of spheres by a rational homology ball. Such configurations typically arise from resolutions of surface singularities that admit rational homology disk smoothings. Conjecturally, all such singularities must be weighted homogeneous and belong to certain specific families: Stipsicz-Szabó–Wahl constructed QHD smoothings for these families and used Donaldson's theorem to obtain very restrictive necessary conditions on the resolution graphs for singularities with this property. In particular, these results, as well as subsequent work of Bhupal-Stipsicz, show that for certain resolution graphs, the canonical contact structure on the link of the singularity cannot admit a QHD symplectic filling. By contrast, we exhibit Stein rational homology disk fillings for the contact links of an infinite family of rational singularities that are *not* weighted homogeneous, producing a new symplectic rational blowdown. Inspiration for our construction comes from de Jong-van Straten's description of Milnor fibers of sandwiched singularities; we use the symplectic analog of de Jong-van Straten theory developed by the second and third authors. The unexpected Stein fillings are built using spinal open books and nearly Lefschetz fibrations.