

## Research plan

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The smooth manifolds with trivial invariants are the main classical hard problems on 4-dimensional topology. Especially the following two conjectures are important: the smooth unknotting conjecture for surface knots saying that a smooth surface knot whose complement has abelian fundamental group is unknotted and the smooth 4-dimensional Poincare conjecture saying that a smooth 4-manifold homotopic to 4-sphere is diffeomorphic to 4-sphere.

I use 2-dimensional braid theory cultivated by Seiichi Kamada. In fact, when the complement of a given smooth 2-knot has an abelian fundamental group, there is a 1-parameter family of maps from the 2-sphere into the 4-space admitting only cusp birth and death as singularities connecting the given knot and the trivial knot. Moreover we transform it into a 1-parameter family of surface braids. To do so we need a generalized Markov type theorem which is applicable to the case admitting nodes. Kamada is preparing a general paper with details.

Using the fact that each 2-dimensional braid is described by a 1-dimensional chart on 2-space, its 1-parameter family is described in the 3-space adding the time axis. Take a cusp birth with the maximum label and raise its label 2 times more we can make the cusp birth to go down near the bottom which is a trivial 2-dimensional braid. Then there is no other double points in the levels between the cusp birth and death. Analyzing this situation by the braid group and local description of cusps, two ends of this part are isotopic after making connected sum with trivial torus for example. So, by induction the given knot becomes a trivial torus after making connected sum with a trivial torus. This is a result obtained assuming the Markov type theorem. Recently we got big events Akio Kawauchi submitted his hard preprints to arXiv.

He gave his proof of the smooth unknotting conjecture for surface knots and moreover the smooth 4-dimensional Poincare conjecture. The notion of orthogonal 2-handle pair is useful but still difficult to understand the whole proof. We started a study meeting with Kamada, Kawauchi himself and others.

But now Kawauchi admits that his proof is not complete. Look at his HP.