Geometry, Physics, and Representation Theory
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A symplectic analogue of the Johnson homomorphism coming from quantum Massey products

Abstract. Mathematicians often try to study an object by considering its group of automorphisms. Therefore, it only seems natural that given a symplectic manifold (M, ω), we would like to understand $\pi_0\mathrm{Symp}(M, \omega)$. To make the problem nontrivial, we focus on those isotopy classes which act trivially on cohomology. When $M = \Sigma_g$ is a surface, the group of such symplectomorphism is well known to low-dimensional topologists: it is the Torelli group, an important but poorly understood subgroup with many interesting connections to other areas of mathematics. In the early 1980's, Dennis Johnson revolutionized the study of this group by introducing a sequence of homomorphisms τ_k detecting delicate intersection-theoretic information.

We show that the definition of the Johnson homomorphisms can be recast in terms of the Morse A_∞-algebra on the mapping tori M_ϕ, and then extended to higher dimensional symplectic manifolds using quantum Massey products. As a sample application, we construct an S^1-family of embedded surfaces $C \subset \mathbb{P}^3$ whose monodromy is a seperating Dehn twist. Forming a parametrized blowup of the mapping tori, we obtain a six-dimensional symplectic manifold $X = Bl_C\mathbb{P}^3$, and a symplectomorphism $\phi : X \to X$. We then use the quantum Johnson homomorphism to show that ϕ is an "exotic" symplectomorphism.