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Wheeled pro(p)file of Batalin-Vilkovisky formalism and BF theory of unimodular Poisson structures

Abstract: Using technique of wheeled props we establish a correspondence between the homotopy theory of unimodular Lie 1-bialgebras and the famous Batalin-Vilkovisky formalism. Solutions of the so called quantum master equation satisfying certain boundary conditions are proven to be in 1-1 correspondence with representations of a wheeled dg prop which, on the one hand, is isomorphic to the cobar construction of the prop of unimodular Lie 1-bialgebras and, on the other hand, is quasi-isomorphic to the dg wheeled prop of unimodular Poisson structures. These results allow us to apply properadic methods for computing formulae for a homotopy transfer of a unimodular Lie 1-bialgebra structure on an arbitrary complex to the associated quantum master function on its cohomology.

It is shown that Losev-Mnev's simplicial BF theory for unimodular Lie algebras can be naturally extended to the case of unimodular Lie 1-bialgebras (and, eventually, to the case of unimodular Poisson structures). Using a finite-dimensional version of the Batalin-Vilkovisky quantization formalism it is rigorously proven that the Feynman integrals computing the effective action of this new BF theory describe precisely homotopy transfer formulae obtained withing the wheeled properadic approach to the quantum master equation. Quantum corrections (which are present to all orders of the Planck constant in our BF model) correspond precisely to what are often called "higher Massey products" in the homological algebra.