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Hopf Crossed-Module Coalgebras and Scalar Invariants of Maps from 3-Manifolds to 2-Types

In this talk, I will describe joint work with Alexis Virelizier that extends Kuperberg's 3-manifold invariant to the setting of 3-dimensional Homotopy Quantum Field Theories with 2-type targets. Crossed modules serve as algebraic models for connected 2-types; building on them, we develop involutory Hopf χ-coalgebras and the corresponding crossed-module-graded monoidal categories. These structures support a state-sum HQFT whose numerical output is a scalar invariant of a map $f\colon M \to B\chi$ from a closed, oriented 3-manifold to the classifying space of a crossed module χ. The construction reproduces Kuperberg's invariant when f is homotopic to the constant map and specializes to Virelizier's flat-bundle invariant when the source of χ is trivial. I will outline the algebraic ingredients, explain how they feed into the state-sum formalism, and discuss ongoing directions for comparing this new invariant with other quantum invariants.