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Hopf–Galois coextension and SAYD modules

Cyclic (co)homology theory as any other cohomology theory is based on (co)chain together with (co)boundary operator. The cochain that we consider are simplicial cochains which are also cyclic. In some interesting case we can define a (co)simplicial structure over a module. The most natural simplicial structure happens in geometry. One also associates simplicial structure to tensor algebra of any algebra or coalgebra. The result is cyclic module associated to the algebra or the coalgebra. Now one considers an ordinary space and makes an algebra out of that space by means of smooth functions. The beautiful theorem of Alain Connes says that the deRham cohomology of the space in question and the cyclic cohomology of the algebra of smooth function on the space coincide. We now study a situation a bit more interesting by letting the coefficients also play some role. The new coefficients here are called SAYD modules. The new theory in addition to an algebra or coalgebra needs a source of symmetry which is usually provided by an action of a Hopf algebra. Stable Anti Yetter Drinfeld (SAYD) modules are special type of a module and comodule over a Hopf algebra with AYD and Stability conditions. By taking advantage of a SAYD module one can define cyclic or cocyclic object. To any Hopf–Galois coextensions a SAYD module is associated such that the Hopf cyclic cohomology of the Hopf algebra with coefficients in the SAYD module coincides with the cohomology of the coextension. In other words in the level of cohomology symmetry and the quotient are the only important objects in an extension.