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## Computations and generation of elements on the Hopf algebra of Feynman graphs

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Two programs, feynngen and feyncop, are presented. feynngen is designed to generate high loop order Feynman graphs for Yang-Mills, QED and  $\phi^k$  theories. feyncop can compute the coproduct of these graphs on the underlying Hopf algebra of Feynman graphs.

The programs can be validated by exploiting zero dimensional field theory combinatorics and identities on the Hopf algebra which follow from the renormalizability of the theories.

### Summary

The Hopf algebra structure of Feynman graphs has been explored extensively in the last years. It proved to be valuable for the analytic computation of Feynman amplitudes by means of systematic parametric integration techniques and could lead to new non-perturbative results in the scope of Dyson-Schwinger equations. feynngen and feyncop were developed to provide input for the powerful new techniques. feynngen relies on the established nauty package by McKay for the fast generation of higher loop diagrams. feyncop can be used to calculate the coproduct of graphs on the Hopf algebra of Feynman graphs. This coproduct encodes the BPHZ algorithm necessary to evaluate the finite amplitude in a mathematically sound framework and fits well into the world of Dyson-Schwinger equations. In the framework of these equations certain identities can be obtained which were used to validate the two programs.

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