Prolegomenon to renormalisation methods

(starting on April 8th)

Prof. Dr. S. Paycha, University of Potsdam

Mathematics department of the University of Potsdam
Monday 12.15-13.45 House 22 Room 1.22.1.28
Tuesday 10.15-11.45 House 8 Room 1.08.0.59

Note: The first two lectures will expceptionally be held by Ali Shojaei-Fard.

In this course addressed to master level students, we shall present mathematical aspects of renormalisation methods borrowed from physics, with applications in mathematics. In particular, they will be used to count integer points on cones, to extend the Euler-Maclaurin formula to cones and to renormalise multizeta functions at poles. On the grounds of such examples borrowed from various areas of mathematics, we will get a sense of the manifold of questions related to   renormalisation, yet touching on this issue only in its most elementary aspects. This serves as a modest prolegomenon to the otherwise broad and complex renormalisation issue.

The following topics will be addressed

-Gaussian measure and Wick's theorem
- Feynman Integrals seen as Integrals with affine constraints
- Birkhoff-Hopf factorisation
- Renormalised multizetavalues
 -Renormalised sums and integrals on cones
 -The Euler-Maclaurin formula on cones
 - Renormalised Integrals with linear constraints

Some useful references:
-A. Barvinok, Integer points in polyhedra, Zürich Lectures in Advances Mathematics, EMS (2008)
- R. Bertlmann, Anomalies in quantum field theory, International Series of Monographs on Physics, Oxford Science Publications 2000
- P. Cartier, An introduction to zeta functions, in "From number theory to physics", ed. M. Waldschmidt et al. 1992
- J. Collins, An Introduction to Renormalization,   Cambridge Monographs on Mathematical Physics, 1986
- J. Glimm, A. Jaffe, Quantum Physics, A functional integral point of view, Springer Verlag, "nd Edition 1987
- G. Hardy, Divergent series, Oxford University Press, 1967
- D. Manchon,   Hopf algebras, from basics to applications to renormalization,   Comptes-rendus des Rencontres mathematiques de Glanon 2001 (2003) ;Hopf algebras in renormalisation, Handbook of algebra, Vol. 5 (M. Hazewinkel ed.) (2008)
-V. Smirnov, Analytic tools for Feynman integrals, Springer Tracts in Modern Physics 20, Springer Verlag 2012
 - G. Ziegler, Lectures on polytopes, Graduate Texts in Mathematics, Springer Verlag, 2nd edition 1994

Prerequisites: Complex Analysis, Integration theory