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Graph complexes in algebra and geometry - recent advances

Graph complexes have been introduced by Maxim Kontsevich in early 90s as a purely combinatorial tool for computing very important invariants in geometry and algebra (e.g., cohomology groups of moduli spaces of algebraic curves with punctures, universal obstructions to a perturbative quantization of Poisson structures, etc.). His works on graph complexes attracted much attention but, unfortunately, did not lead immediately to really new results – it turned out to be very hard to compute the cohomology of that new "simple" gadgets – the graph complexes.

Recently there was a huge progress in computations of cohomology groups of graph complexes due to Thomas Willwacher and his collaborators. This progress lead us to a complete classification of universal quantizations of Poisson structures and Lie bialgebras, and give us a surprisingly clean picture of how the mysterious Grothendieck-Teichmueller groups acts as symmetries on polyvector fields, on Lie bialgebras, etc.

The main purpose of my two lectures is to give an introduction to the theory to graph complexes. The plan includes: 1) basic definitions; 2) operadic compositions of graphs; 3) the definition of the differential on ordinary and ribbon graph complexes; 4) outline (without proofs) some recent applications of the theory of graph complexes in algebra and geometry.
