One-loop multi-leg calculations in gauge theories: Golem library

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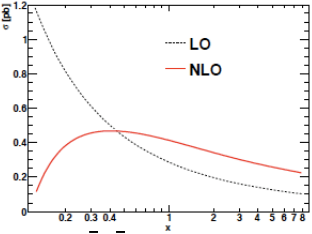
Why NLO?

- Calculating accurately signal and background for new physics
- Reducing the scale dependance



$q\bar{q} \to b\bar{b}b\bar{b}$(arXiv:1006.5339)

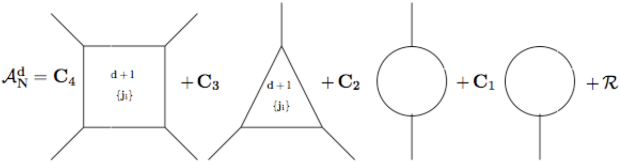
Why Golem?

- Automation of 1-loop multi-leg computation :: QCD, SM and BSM

What is golem95:

- Contains all building blocks of A_N^{1-loop} calculation
- Provides the numerical stability (if $\det(G) \to 0$)
- Computes IR divergent and IR finite integrals
- Calculates amplitudes with real or complex masses
- GoSam relies on the ability of golem95 to avoid $\det(G)$

- **One-loop reduction:**



- **Basis integrals or end points of integral reduction:**
  - $\left\{ I_2^d(j),\ I_3^d(j_1, \ldots, j_r),\ I_3^{d+2}(j_1),\ I_4^{d+2}(j_1, \ldots, j_r),\ I_4^{d+4}(j_1) \right\}$
  - $d = 4 - 2\,\epsilon$

- **Why this choice of set of basis?**
  - **The coefficients are free of** $1/\det(G)$
  - **IR divergences are isolated in** I_3^4

- **golem95 integral implementation**
  - **If** $\det(G)$ **large: Analytical mode**
  - **If** $\det(G)$ **small: Numerical mode (1-dim representation)**

Analytical vs Numerical calculation near $\det(G) = 0$