Some results of one-loop reduction

Bo Feng

based on work with Binhong Wang, Tingfei Li, Xiaodi Li

May 14-17, 2021, Shanghai

Contents

Contents

Contents

- The perturbative calculation of scattering amplitude is crucial for higher energy physics. using Feynman diagrams.
- The tradition way to do the calculation is to use the Feynman diagrams, but it is well known now, this method is not efficient in many situations.
- In last thirty years, various techniques have been developed to speed the computation. Now one-loop computation is considered as solved problem and the frontier is the two loop and higher, as we will hear a lot in this workshop.
- However, in this talk, I will discuss some problems left in the one-loop calculation.

Some efficient one-loop computation algorithms:

- OPP method: [Ossola, Papadopoulos, Pittau, 2006]
- Unitarity cut method: [Bern, Dixon, Dunbar , Kosower, 1994][Britto, Buchbinder, Cachazo, B.F, 2005] [C. Anastasiou, R. Britto, B.F, Z. Kunszt, P. Mastrolia, 2006]
- Forde's method: [D. Forde, 2007]
- Generalized OPP method: [R.K. Ellis, W.T. Giele, Z. Kunszt, 2007]
- ACK method: [N. Arkani-Hammed, F. Cachazo, J. Kaplan, 2008]

- For one-loop computation, the well established method is the reduction method.
- Now we are all known that the reduction can be divided into two categories: the reduction at the integrand level and the reduction at the integral level.
- The reduction at the integrand level is nothing, but division and separation of polynomial, for which the powerful mathematical tool is the "computational algebraic geometry".

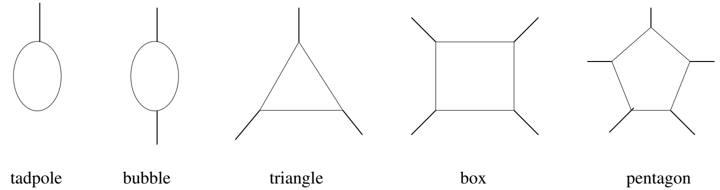
- One well known algorithm for reduction at the integrand level is the OPP method.
- OPP method has the advantage that it is easy to be implemented into program, both numerically and analytically.
- The disadvantage of OPP method is that we need to compute coefficients of spurious terms, although they do not contribute at the integral level. For practical applications, it is not a big problem since for the renormalizable theories, the spurious terms are not so much.

- However, from theoretical point of view, it is not satisfied, since the number of spurious terms increasing with the increasing of power of ℓ in numerator. Thus for arbitrary higher and higher power in numerator, there are more and more terms to be calculated, and the efficiency will be lost.

- For the reduction at the integral level, the typical algorithm is the celebrating PV-reduction method.
- For this method, we need to calculate the coefficients of masters only and the spurious terms will never show up.
- Although the algorithm of the original PV-reduction method is clear, its implement is not so easy.
- A better realization of reduction at the integral level is the **Unitarity cut method**.

PV reduction

- The mast basis are given by



- For massless inner line, there is no tadpole and massless bubble.

Unitary cut

Some facts regarding the one-loop amplitudes:

- The singular behavior of one-loop amplitudes is much more complicated than the tree-level: we have branch cuts as well as higher dimension singular surface.
- Under the expansion into basis, all branch cuts are given by scalar basis while coefficients are rational functions.
- Applying above observation we have unitarity cut method: taking imaginary part at both sides $\mathrm{Im}(I) = \sum_i c_i \mathrm{Im}(I_i)$ and comparing both sides we can get c_i if each $\mathrm{Im}(I_i)$ is unique.

Unitary cut

- The good point for this method is that the input is the multiplication of on-shell tree-level amplitudes of both sides. Especially when we combine the BCFW recursion relation.
- The difficulty is how to evaluate $\mathrm{Im}(I)$? This is solved by holomorphic anomaly: reducing integration into reading out residues of poles

  [Cachazo, Svrcek, Witten, 2004] [Britto, Buchbinder, Cachazo, Feng, 2005]
- Current status: Now we have well defined algebraic steps to extract coefficients from tree-level input.

- Example: Triangle

$$
\begin{aligned}
& \mathrm{Tri}[K_s, K] \\
= \quad & \frac{1}{2}\frac{(K^2)^{N+1}}{(-\beta\sqrt{1-u})^{N+1}(\sqrt{-4q_s^2K^2})^{N+1}}\frac{1}{(N+1)!\,\langle P_{s,1}\;P_{s,2}\rangle^{N+1}} \\
& \frac{d^{N+1}}{d\tau^{N+1}}\left(\frac{\langle\ell|K|\ell]^{N+1}}{(K^2)^{N+1}}\mathcal{T}^{(N)}(\widetilde{\ell})\cdot D_s(\widetilde{\ell})\Big|_{\begin{cases}|\ell] & \to & |Q_s(u)|\ell\rangle \\ |\ell\rangle & \to & |P_{s,1}-\tau P_{s,2}\rangle\end{cases}}\right. \\
& \left.+\{P_{s,1}\leftrightarrow P_{s,2}\}\right)\Big|_{\tau\to 0}
\end{aligned}
$$

- Advantage: (1) we can get the wanted coefficients without calculating the spurious terms; (2) we can deal with arbitrary higher power in numerator.

However, there are some unsatisfied parts of unitarity cut method. In this talk we will discuss following two aspects:

- (A) The unitarity cut for higher poles
- (B) The tadpole coefficients

We consider the reduction of

$$\mathcal{M}[\ell] \equiv \int \frac{d^D \ell}{(2\pi)^{D/2}} \frac{\mathcal{N}[\ell]}{\prod_{j=1}^{n}((\ell - K_j)^2 - m_j^2 + i\epsilon)^{a_j}}, \quad a_i \geq 1$$

- By general theory, we know that

$$\mathrm{Im}(\mathcal{M}[\ell]) = \sum_t c_t \mathrm{Im}(\mathcal{I}_t[\ell])$$

- The $\mathrm{Im}(\mathcal{I}_t[\ell])$ is known, so we need to find $\mathrm{Im}(\mathcal{M}[\ell])$

To use the unitarity cut method, we use a trick by noticing that

$$\int \frac{d^D\ell}{(2\pi)^{D/2}} \frac{\mathcal{N}[\ell]}{\prod_{j=1}^{n}((\ell-K_j)^2-m_j^2+i\epsilon)^{a_i}}$$
$$= \left\{\prod_{j=1}^{n} \frac{1}{(a_j-1)!} \frac{d^{a_j-1}}{d\eta_j^{a_j-1}} \int \frac{d^D\ell}{(2\pi)^{D/2}} \frac{\mathcal{N}[\ell]}{\prod_{j=1}^{n}((\ell-K_j)^2-m_j^2-\eta_j+i\epsilon)}\right\}|_{\eta_j\to 0}$$

thus

$$Re[L]+iIm[L]=\left\{\prod_{j=1}^{n} \frac{1}{(a_j-1)!} \frac{d^{a_j-1}}{d\eta_j^{a_j-1}}(Re[R]+iIm[R])\right\}|_{\eta_j\to 0}$$

Since the η_i's are real numbers, we have

$$Re[L] + iIm[L] = \left\{ \prod_{j=1}^{n} \frac{1}{(a_j-1)!} \frac{d^{a_j-1}}{d\eta_j^{a_j-1}} Re[R] \right\} |_{\eta_j \to 0}$$

$$+i \left\{ \prod_{j=1}^{n} \frac{1}{(a_j-1)!} \frac{d^{a_j-1}}{d\eta_j^{a_j-1}} Im[R] \right\} |_{\eta_j \to 0}$$

so finally

$$Im[L] = \left\{ \prod_{j=1}^{n} \frac{1}{(a_j-1)!} \frac{d^{a_j-1}}{d\eta_j^{a_j-1}} Im[R] \right\} |_{\eta_j \to 0}$$

- For general $\mathcal{N}[\ell]$, we know the expansion

$$Im[R] = \sum_t c_t Im(\mathcal{I}_t[\ell])$$

- The action of $\frac{d}{d\eta}$ will act on both c_t and $Im(\mathcal{I}_t[\ell])$.
- Since the analytic function c_t's are known, the unknown piece is the action of $\frac{d}{d\eta}$ on $Im(\mathcal{I}_t[\ell])$ and its expansion. In another words, we just need to consider the reduction of general power with $\mathcal{N}[\ell] = 1$ for $n \leq 5$.

Example I: bubble

$$\int \frac{d^{4-2\epsilon}p}{(2\pi)^{4-2\epsilon}} \frac{1}{(p^2 - M_1^2)^a((p-K)^2 - M_2^2)^b}$$

- The imaginary part is given by

$$\mathcal{C}[\mathcal{I}_2] = (K^2)^{-1+\epsilon}\Delta^{\frac{1}{2}-\epsilon}\int_0^1 \mathrm{d}u u^{-1-\epsilon}\sqrt{1-u}$$

where

$$\Delta[K; M_1, M_2] = (K^2)^2 + (M_1{}^2)^2 + (M_2{}^2)^2 \\ -2M_1{}^2M_2{}^2 - 2K^2M_1{}^2 - 2K^2M_2^2$$

- By our trick

$$\mathcal{C}[I_2(n+1,m+1)] = \frac{1}{m!n!}\left(\frac{\partial}{\partial M_2^2}\right)^m\left(\frac{\partial}{\partial M_1^2}\right)^n \mathcal{C}[I_2(1,1)]$$

thus

$$c_{2\to 2}(n+1,m+1) = \frac{1}{m!n!\Delta^{\frac{1}{2}-\epsilon}}\left(\frac{\partial}{\partial M_2^2}\right)^m\left(\frac{\partial}{\partial M_1^2}\right)^n \Delta^{\frac{1}{2}-\epsilon}$$

Recurrence relation:

$$I_3(1,1,n_3) = \frac{1}{(n_3-1)!}\frac{d^{n_3-1}}{d(m_1^2)^{n_3-1}} I_3(1,1,1)$$

$$= \frac{1}{(n_3-1)}\frac{d}{d(m_1^2)}\frac{1}{(n_3-2)!}\frac{d^{n_3-2}}{d(m_1^2)^{n_3-2}} I_3(1,1,1)$$

$$= \frac{1}{(n_3-1)}\frac{d}{d(m_1^2)} I_3(1,1,n_3-1)$$

$$= \frac{1}{(n_3-1)}\frac{d}{d(m_1^2)}\left\{c_{3\to 3}(1,1,n_3-1)\mathcal{I}_3 + \sum_{i=1}^{3} c_{3\to 2;\bar{i}}(1,1,n_3-1)\mathcal{I}_{2;\bar{i}} + \ldots\right\}$$

$$
\begin{aligned}
= \quad & \frac{1}{(n_3-1)}\frac{dc_{3\to 3}(1,1,n_3-1)}{d(m_1^2)}\mathcal{I}_3 + \frac{c_{3\to 3}(1,1,n_3-1)}{(n_3-1)} I_3(1,1,2) \\
& + \sum_{i=1}^{3} \frac{dc_{3\to 2;\bar{i}}(1,1,n_3-1)}{(n_3-1)d(m_1^2)}\mathcal{I}_{2;\bar{i}} \\
& + \frac{c_{3\to 2;\bar{1}}(1,1,n_3-1)}{(n_3-1)} I_{2;\bar{1}}(1,2) + \frac{c_{3\to 2;\bar{2}}(1,1,n_3-1)}{(n_3-1)} I_{2;\bar{2}}(2,1) + \ldots
\end{aligned}
$$

Thus we derive

$$
\begin{aligned}
c_3(1,1,n_3) &= \frac{1}{(n_3-1)}\frac{dc_{3\to 3}(1,1,n_3-1)}{d(m_1^2)} + \frac{c_{3\to 3}(1,1,n_3-1)}{(n_3-1)} c_{3\to 3}(1,1,2) \\
c_{3\to 2;\bar{1}}(1,1,n_3) &= \frac{c_{3\to 3}(1,1,n_3-1)}{(n_3-1)} c_{3\to 2;\bar{1}}(1,1,2) + \frac{1}{(n_3-1)}\frac{dc_{3\to 2;\bar{1}}(1,1,n_3-1)}{d(m_1^2)} \\
&\quad + \frac{c_{3\to 2;\bar{1}}(1,1,n_3-1)}{(n_3-1)} c_{2\to 2;\bar{1}}(1,2) \\
c_{3\to 2;\bar{2}}(1,1,n_3) &= \frac{c_{3\to 3}(1,1,n_3-1)}{(n_3-1)} c_{3\to 2;\bar{2}}(1,1,2) + \frac{1}{(n_3-1)}\frac{dc_{3\to 2;\bar{2}}(1,1,n_3-1)}{d(m_1^2)} \\
&\quad + \frac{c_{3\to 2;\bar{2}}(1,1,n_3-1)}{(n-1)} c_{2\to 2;\bar{2}}(2,1) \\
c_{3\to 2;\bar{3}}(1,1,n_3) &= \frac{c_{3\to 3}(1,1,n_3-1)}{(n_3-1)} c_{3\to 2;\bar{3}}(1,1,2) + \frac{1}{(n_3-1)}\frac{dc_{3\to 2;\bar{3}}(1,1,n_3-1)}{d(m_1^2)}
\end{aligned}
$$

Thus the key calculation is for scalar integral with one and only one propagator having power 2.

Further simplification—- The dihedral symmetry D_n:

- By momentum shifting $p \to p + K_1$ we get

$$\begin{aligned} & I_3(n_1, n_2, n_3)[K_1, K_2, K_3; M_1, M_2, m_1] \\ = & \int \frac{d^{4-2\epsilon}p^4}{(2\pi)^{4-2\epsilon}} \frac{1}{((p+K_1)^2 - M_1^2)^{n_1}(p^2 - M_2^2)^{n_2}((p-K_2)^2 - m_1^2)^{n_3}} \\ = & I_3(n_2, n_3, n_1)[K_2, K_3, K_1; M_2, m_1, M_1] \end{aligned}$$

- We can also consider the variable changing $p \to -p$ to get

$$\begin{aligned} & I_3(n_1, n_2, n_3)[K_1, K_2, K_3; M_1, M_2, m_1] \\ = & \int \frac{d^{4-2\epsilon}p}{(2\pi)^{4-2\epsilon}} \frac{1}{(p^2 - M_1^2)^{n_1}((p+K_1)^2 - M_2^2)^{n_2}((p-K_3)^2 - m_1^2)^{n_3}} \\ = & I_3(n_1, n_3, n_2)[K_3, K_2, K_1; M_1, m_1, M_2] \end{aligned}$$

- Thus only $I_n(1, ..., 1, 2)$ needed to be calculated.

For triangle, we need to compute only $I_3(1,1,2)$. Let us show the calculation for the cut K_1:

- $$\mathcal{C}_{K_1}(I_3(1,1,2)) = -\left(\frac{4K_1^2}{\Delta[K_1,M_1,M_2]}\right)^{\epsilon} \frac{1}{\sqrt{\Delta_{3;m=0}}} \frac{\partial}{\partial m_1^2} Tri^{(0)}(Z)$$

- With a little algebra we have

$$\frac{\partial}{\partial m_1^2} Tri^{(0)}(Z) = \frac{2K_1^2}{\sqrt{\Delta_{3;m=0}\Delta[K_1,M_1,M_2]}}\Big(\frac{2(1-2\epsilon)}{1-Z^2} Bub^{(0)} + \frac{2Z\epsilon}{1-Z^2} Tri^{(0)}(Z)\Big)$$

Thus

$$c_{3\to 3;K_1}(1,1,2) = \frac{4K_1^2}{\sqrt{\Delta_{3;m=0}\Delta[K_1,M_1,M_2]}}\frac{Z\epsilon}{1-Z^2}$$

and

$$c_{3\to 2;\bar{3};K_1}(1,1,2) = -\frac{4K_1^2}{\Delta[K_1,M_1,M_2]\Delta_{3;m=0}}\frac{1-2\epsilon}{1-Z^2}$$

- One of the big problem of unitarity cut method is that tadpole coefficients can not be found by this way.
- There are proposal using the single cut, but the calculation is still complicated.
- In this talk, I will present a method to give the analytic expression of tadpole coefficients

We want to find the tadpole coefficient of integral

$$I_{n+1}^{(m)}[R;\{K_i\};M_0,\{M_i\}] \equiv \int \frac{d^D\ell}{(2\pi)^D} \frac{(2\ell\cdot R)^m}{(\ell^2-M_0^2)\prod_{j=1}^n((\ell-K_j)^2-M_j^2)}$$

This expression is general

- If the numerator is $(2\ell\cdot R_1)(2\ell\cdot R_2)$, we can consider the reduction of $(2\ell\cdot R)^2$, then put $R=\alpha_1 R_1+\alpha_2 R_2$ and expand it, thus the coefficient of $2\alpha_1\alpha_2$ is the wanted reduction result for the original numerator.
- Similarly, if the numerator is $4\ell_\mu F^{\mu\nu}\ell_\nu$, we can consider the reduction of $(2\ell\cdot R_1)(2\ell\cdot R_2)$ first. Then for each pair of R_1, R_2, we replace $(K_1\cdot R)(K_2\cdot R)$ by $(K_1)_\mu F^{\mu\nu}(K_2)_\nu$ and $R_1\cdot R_2$ by $\eta_{\mu\nu}F^{\mu\nu}$ (please notice that $F^{\mu\nu}$ is symmetric tensor).

We will focus on

$$I_{n+1}^{(m)} = C_0(m, n+1) \int \frac{d^D\ell}{(2\pi)^D} \frac{1}{(\ell^2 - M_0^2)} + \ldots$$

and others can be obtained by momentum shifting.

- To find the C_0, we will use a trick, i.e., to establish some differential equations by using following differential operators:

$$\widehat{D}_i \equiv K_i \cdot \frac{\partial}{\partial R}, \; i = 1, \ldots, n; \qquad \widehat{T} \equiv \eta^{\mu\nu} \frac{\partial}{\partial R^\mu} \frac{\partial}{R^\nu}$$

- $$K_1^\mu \frac{\partial}{\partial R^\mu} I_{n+1}^{(m)} = \int \frac{d^D\ell}{(2\pi)^D} \frac{m(2\ell\cdot R)^{m-1}(2K_1\cdot\ell)}{(\ell^2-M_0^2)\prod_{j=1}^n((\ell-K_j)^2-M_j^2)}$$
$$= \int \frac{d^D\ell}{(2\pi)^D} \frac{m(2\ell\cdot R)^{m-1}}{\prod_{j=1}^n((\ell-K_j)^2-M_j^2)}$$
$$-\int \frac{d^D\ell}{(2\pi)^D} \frac{m(2\ell\cdot R)^{m-1}}{(\ell^2-M_0^2)\prod_{j=2}^n((\ell-K_j)^2-M_j^2)}$$
$$+ (M_0^2+K_1^2-M_1^2)\int \frac{d^D\ell}{(2\pi)^D} \frac{m(2\ell\cdot R)^{m-1}}{(\ell^2-M_0^2)\prod_{j=1}^n((\ell-K_j)^2-M_j^2)}$$
$$= m I_{n+1;\bar{0}}^{(m-1)} - m I_{n+1;\bar{1}}^{(m-1)} + m f_1 I_{n+1}^{(m-1)}$$

- Using

$$\widehat{D}_j I_{n+1}^{(m)} = \left\{ \widehat{D}_j C_0(m, n+1) \right\} \int \frac{d^D \ell}{(2\pi)^D} \frac{1}{(\ell^2 - M_0^2)} + \ldots$$

and comparing the tadpole coefficients, we have the equation

$$\widehat{D}_j C_0(m, n+1) = -m C_0(m-1, n+1; \bar{j}) + m f_j C_0(m-1, n+1)$$

- Similarly

$$\eta^{\mu\nu}\frac{\partial}{\partial R^\mu}\frac{\partial}{\partial R^\nu}I_{n+1}^{(m)} = \int\frac{d^D\ell}{(2\pi)^D}\frac{m(m-1)(2\ell\cdot R)^{m-2}(4\ell^2)}{(\ell^2-M_0^2)^2\prod_{j=1}^n((\ell-K_j)^2-M_j^2)}$$

$$= 4m(m-1)M_0^2\int\frac{d^D\ell}{(2\pi)^D}\frac{(2\ell\cdot R)^{m-2}}{(\ell^2-M_0^2)^2\prod_{j=1}^n((\ell-K_j)^2-M_j^2)}$$

$$+ \int\frac{d^D\ell}{(2\pi)^D}\frac{4m(m-1)(2\ell\cdot R)^{m-2}}{\prod_{j=1}^n((\ell-K_j)^2-M_j^2)}$$

$$= 4m(m-1)M_0^2 I_{n+1}^{(m-2)} + 4m(m-1)I_{n+1;\bar{0}}^{(m-2)}$$

thus

$$\widehat{T}C_0(m,n+1) = 4m(m-1)M_0^2 C_0(m-2,n+1)$$

- To continue the study, we are not solve the differential equations directly, but noticing that it can be expand as following

$$C_0(m,n+1) = (M_0^2)^{-n} \sum_{\{i_k\},k=0,\ldots,n}^{2i_0+\sum_{k=1}^{n} i_k = m} c^{(m)}_{i_0,i_1,i_2,i_3,\ldots i_n} (M_0^2)^{i_0} s_{00}^{i_0} \prod_{k=1}^{n} s_{0k}^{i_k}$$

Using this expansion, we transfer the differential equation to the algebraic recurrence relation

Example I: tadpole

- $$\begin{aligned} \widehat{T} C_0(m,1)[R;M_0] &= \widehat{T}\left(c^{(m)}(M_0^2)^{\frac{m}{2}} s_{00}^{\frac{m}{2}}\right) \\ &= c^{(m)}(M_0^2)^{\frac{m}{2}}(Dm + m(m-2)) s_{00}^{\frac{m-2}{2}} \\ &= 4m(m-1)M_0^2 C_0(m-2,1) = 4m(m-1)M_0^2 c^{(m-2)}(M_0^2)^{\frac{m-2}{2}} s_{00}^{\frac{m-2}{2}} \end{aligned}$$

  which leads to the recurrence relation

  $$c^{(m)} = \frac{4(m-1)}{(D+m-2)} c^{(m-2)}$$

  Using the initial condition $c^{(0)} = 1$, we get immediately for

  $$c^{(m=even)} = 2^m \frac{(m-1)!!}{\prod_{i=1}^{\frac{m}{2}}(D+2(i-1))}, \qquad c^{(m=odd)} = 0$$

Example II: bubble
With the expansion

$$C_0(m,2)=\sum_{i=0}^{\lfloor\frac{m}{2}\rfloor} c_i^{(m)} s_{00}^i (M_0^2)^{i-1} s_{01}^{m-2i}$$

we have

- By D_1, we get immediately than when $m=2r$

$$2(i+1)\beta_{11}c_{i+1}^{(m)}+(m-2i)c_i^{(m)}=m\alpha_1\beta_{11}c_i^{(m-1)},\ i=0,...,r-1$$

and when $m=2r+1$

$$2(i+1)\beta_{11}c_{i+1}^{(m)}+(m-2i)c_i^{(m)}=m\alpha_1\beta_{11}c_i^{(m-1)}\ i=0,.,r-1$$
$$c_r^{(m)}=-(2r+1)\beta_{11}c^{(2r)}+m\alpha_1\beta_{11}c_r^{(m-1)}$$

where $c^{(m)}$ is the tadpole expansion coefficients.

- By T, we have

$$2(i+1)(D+2m-4-2i)\beta_{11}c_{i+1}^{(m)}+(m-2i)(m-2i-1)c_i^{(m)}$$
$$=4m(m-1)\beta_{11}c_i^{(m-2)},\quad i=0,...,\lfloor\frac{m}{2}\rfloor-1$$

- For $m=2r+1$, using the second line, we solve immediately

$$c_r^{(2r+1)} = -(2r+1)\beta_{11}c^{(2r)}+(2r+1)\alpha_1\beta_{11}c_r^{(2r)}$$

Then using the first line, we have

$$c_i^{(2r+1)} = \frac{-2(i+1)\beta_{11}}{(2r+1-2i)}c_{i+1}^{(2r+1)}+\frac{(2r+1)}{(2r+1-2i)}\alpha_1\beta_{11}c_i^{(2r)}$$

recursively from $i=r-1$ to $i=0$.

- For $m = 2r$, there are $(r+1)$ unknown coefficients. Using T produce r equations. One more can be found using D with $i = r-1$.
- Using $i = r-1$ from T and $i = r-1$ from D, we can solve immediately

$$c_r^{(2r)} = \frac{(2r-1)}{(D+2r-3)}\left(\alpha_1\beta_{11}c^{(2r-2)} + (4-\alpha_1^2\beta_{11})c_{r-1}^{(2r-2)}\right)$$

- Having solved $c_r^{(2r)}$ we can use T relation to finally get

$$c_i^{(2r)} = \frac{8r(2r-1)\beta_{11}c_i^{(2r-2)} - 2(i+1)(D+4r-4-2i)\beta_{11}c_{i+1}^{(2r)}}{(2r-2i)(2r-2i-1)}$$

recursively from $i = r-1$ to $i = 0$.

Final remarks:

- Our method for tadpole is nothing, but the traditional PV-reduction method with a little deformation
- It can also be applied to find coefficients of other basis, such as bubble, triangle, box and pentagon.
- The generalization to higher loops is possible, but there are some technical difficulties.

Thanks a lot of your attention !