Diagrams and algebraic expressions at order 2 in PBMBPT

The ADG Dev Team

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Valid diagrams: 37
2N valid diagrams: 37
2N canonical diagrams for the energy: 8
2N canonical diagrams for a generic operator only: 12
2N non-canonical diagrams: 17

Contents

1 Time-structure diagrams

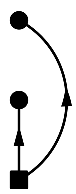
1.1 Tree diagrams

Time-structure diagram T1:

$$\mathrm{T1} = \frac{1}{(a_1 + a_2)a_2} \tag{1}$$

Resummation power: 1
Number of related Feynman diagrams: 21.
Related Feynman diagrams: 8.1, 8.7, 8.8, 4.1, 3.1, 2.1, 2.2, 1.1, 1.2, 8.6, 7.1, 7.2, 7.3, 2.5, 2.6, 1.5, 1.6, 5.1, 5.2, 4.4, 3.4.

Time-structure diagram T2:



$$\mathrm{T2} = \frac{1}{a_1 a_2} \tag{2}$$

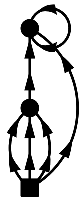
Resummation power: 2
Number of related Feynman diagrams: 16.
Related Feynman diagrams: 8.2, 8.4, 6.1, 6.3, 4.2, 3.2, 2.3, 1.3, 8.3, 7.4, 2.4, 1.4, 6.2, 5.3, 4.3, 3.3.

2 Two-body diagrams

2.1 Two-body energy canonical diagrams

Diagram 3.4:

$$
\begin{aligned}
\text{PO2.3.4} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_2k_3}\Omega^{04}_{k_5k_4k_6k_7}R^{--}_{k_7k_6}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)\theta(\tau_2-\tau_2)e^{-\tau_1\epsilon^{k_5}_{k_1k_2k_3}}e^{-\tau_2\epsilon_{k_4k_5k_6k_7}} \\
&= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_2k_3}\Omega^{04}_{k_5k_4k_6k_7}R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_3k_4k_7k_6}\ \epsilon_{k_4k_5k_7k_6}} \qquad (3)
\end{aligned}
$$

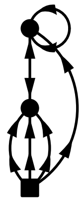
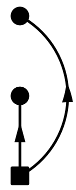
 $\rightarrow$ T1: 

$$
\text{T1} = \frac{1}{(a_1+a_2)a_2} \qquad (4)
$$

$$
\begin{aligned}
a_1 &= \epsilon^{k_5}_{k_1k_2k_3} \\
a_2 &= \epsilon_{k_4k_5k_6k_7}
\end{aligned}
$$

Diagram 3.3:

$$
\begin{aligned}
\text{PO2.3.3} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{04}_{k_1k_2k_3k_5}\Omega^{04}_{k_6k_4k_7k_8}R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)\theta(\tau_2-\tau_2)e^{-\tau_1\epsilon_{k_1k_2k_3k_6}}e^{-\tau_2\epsilon_k} \\
&= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{04}_{k_1k_2k_3k_5}\Omega^{04}_{k_6k_4k_7k_8}R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)}{\epsilon_{k_1k_2k_3k_5}\ \epsilon_{k_4k_8k_7k_6}} \qquad (5)
\end{aligned}
$$

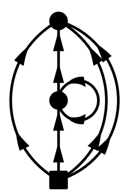
 $\rightarrow$ T2: 

$$
\text{T2} = \frac{1}{a_1a_2} \qquad (6)
$$

$$
\begin{aligned}
a_1 &= \epsilon_{k_1k_2k_3k_6} \\
a_2 &= \epsilon_{k_4k_5k_7k_8}
\end{aligned}
$$

Diagram 4.4:

$$
\begin{aligned}
\text{PO2.4.4} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_6k_7}\Omega^{04}_{k_5k_2k_3k_4}R^{--}_{k_7k_6}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_1-\tau_1)\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_5}_{k_1k_6k_7}}e^{-\tau_2\epsilon_{k_2k_3k_4k_5}} \\
&= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_6k_7}\Omega^{04}_{k_5k_2k_3k_4}R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_3k_4k_7k_6}\ \epsilon_{k_2k_3k_4k_5}} \qquad (7)
\end{aligned}
$$

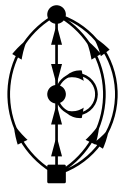
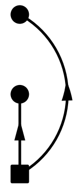
 $\rightarrow$ T1: 

$$\mathrm{T1} = \frac{1}{(a_1 + a_2)a_2} \tag{8}$$

$$a_1 = \epsilon^{k_5}_{k_1 k_6 k_7}$$
$$a_2 = \epsilon_{k_2 k_3 k_4 k_5}$$

Diagram 4.3:

$$\begin{aligned} \mathrm{PO2.4.3} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_7 k_8 k_5} \Omega^{04}_{k_6 k_2 k_3 k_4} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_1 - \tau_1)\theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon_{k_1 k_7 k_6 k_8}} e^{-\tau_2 \epsilon_{k}} \\ &= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_7 k_8 k_5} \Omega^{04}_{k_6 k_2 k_3 k_4} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi)}{\epsilon_{k_1 k_8 k_7 k_5}\ \epsilon_{k_2 k_3 k_4 k_6}} \end{aligned} \tag{9}$$

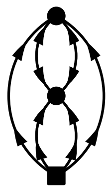
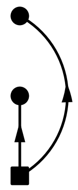
 $\rightarrow$ T2: 

$$\mathrm{T2} = \frac{1}{a_1 a_2} \tag{10}$$

$$a_1 = \epsilon_{k_1 k_7 k_6 k_8}$$
$$a_2 = \epsilon_{k_2 k_3 k_4 k_5}$$

Diagram 5.3:

$$\begin{aligned} \mathrm{PO2.5.3} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^3} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_2 k_5 k_7} \Omega^{04}_{k_8 k_6 k_3 k_4} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon_{k_1 k_2 k_6 k_8}} e^{-\tau_2 \epsilon_{k_3 k_4 k_5 k_7}} \\ &= \frac{(-1)^2}{(2!)^3} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_2 k_5 k_7} \Omega^{04}_{k_8 k_6 k_3 k_4} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi)}{\epsilon_{k_1 k_2 k_5 k_7}\ \epsilon_{k_3 k_4 k_6 k_8}} \end{aligned} \tag{11}$$

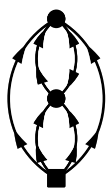
 $\rightarrow$ T2: 

$$\mathrm{T2} = \frac{1}{a_1 a_2} \tag{12}$$

$$a_1 = \epsilon_{k_1 k_2 k_6 k_8}$$
$$a_2 = \epsilon_{k_3 k_4 k_5 k_7}$$

Diagram 5.2:

$$\begin{aligned} \mathrm{PO2.5.2} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{13}_{k_5 k_1 k_2 k_6} \Omega^{04}_{k_5 k_7 k_3 k_4} R^{--}_{k_7 k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_5}_{k_1 k_2 k_7}} e^{-\tau_2 \epsilon_{k_3 k_4 k_5 k_6}} \\ &= \frac{(-1)^2}{(2!)^2} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{13}_{k_5 k_1 k_2 k_6} \Omega^{04}_{k_5 k_7 k_3 k_4} R^{--}_{k_7 k_6}(\varphi)}{\epsilon_{k_1 k_2 k_3 k_4 k_7 k_6}\ \epsilon_{k_3 k_4 k_5 k_7}} \end{aligned} \tag{13}$$

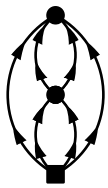
 $\rightarrow$ T1: 

$$\mathrm{T1} = \frac{1}{(a_1 + a_2)a_2} \tag{14}$$

$$a_1 = \epsilon^{k_5}_{k_1 k_2 k_7}$$
$$a_2 = \epsilon_{k_3 k_4 k_5 k_6}$$

Diagram 5.1:

$$\begin{aligned}\mathrm{PO2.5.1} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^3} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{22}_{k_5 k_6 k_1 k_2} \Omega^{04}_{k_5 k_6 k_3 k_4} \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_5 k_6}_{k_1 k_2}} e^{-\tau_2 \epsilon_{k_3 k_4 k_5 k_6}} \\ &= \frac{(-1)^2}{(2!)^3} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{22}_{k_5 k_6 k_1 k_2} \Omega^{04}_{k_5 k_6 k_3 k_4}}{\epsilon_{k_1 k_2 k_3 k_4}\ \epsilon_{k_3 k_4 k_5 k_6}} \end{aligned} \tag{15}$$



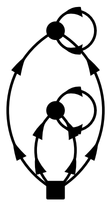
$\rightarrow$ T1:

$$\mathrm{T1} = \frac{1}{(a_1 + a_2)a_2} \tag{16}$$

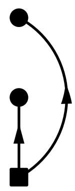
$$a_1 = \epsilon^{k_5 k_6}_{k_1 k_2}$$
$$a_2 = \epsilon_{k_3 k_4 k_5 k_6}$$

Diagram 6.2:

$$\begin{aligned}\mathrm{PO2.6.2} &= \lim_{\tau\to\infty} \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_2 k_5 k_6} \Omega^{04}_{k_3 k_4 k_7 k_8} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_1 - \tau_1) \theta(\tau_2 - \tau_2) e^{-\tau_1 \epsilon_{k_1 k_2 k_5 k_6}} e^{-\tau_2 \epsilon_{k}} \\ &= \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_2 k_5 k_6} \Omega^{04}_{k_3 k_4 k_7 k_8} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi)}{\epsilon_{k_1 k_2 k_6 k_5}\ \epsilon_{k_3 k_4 k_8 k_7}} \end{aligned} \tag{17}$$



$\rightarrow$ T2:



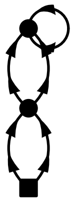
$$\mathrm{T2} = \frac{1}{a_1 a_2} \tag{18}$$

$$a_1 = \epsilon_{k_1 k_2 k_5 k_6}$$
$$a_2 = \epsilon_{k_3 k_4 k_7 k_8}$$

2.2 Two-body canonical diagrams for a generic operator only

Diagram 1.6:

$$\begin{aligned}\mathrm{PO2.1.6} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{22}_{k_3 k_4 k_1 k_2} \Omega^{04}_{k_3 k_4 k_5 k_6} R^{--}_{k_6 k_5}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) \theta(\tau_2 - \tau_2) e^{-\tau_1 \epsilon^{k_3 k_4}_{k_1 k_2}} e^{-\tau_2 \epsilon_{k_3 k_4 k_5 k_6}} \\ &= \frac{(-1)^2}{(2!)^2} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{22}_{k_3 k_4 k_1 k_2} \Omega^{04}_{k_3 k_4 k_5 k_6} R^{--}_{k_6 k_5}(\varphi)}{\epsilon_{k_1 k_2 k_6 k_5}\ \epsilon_{k_3 k_4 k_6 k_5}} \end{aligned} \tag{19}$$



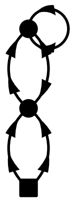
$\rightarrow$ T1:

$$\mathrm{T1} = \frac{1}{(a_1 + a_2)a_2} \tag{20}$$

$$a_1 = \epsilon^{k_3k_4}_{k_1k_2}$$
$$a_2 = \epsilon_{k_3k_4k_5k_6}$$

Diagram 1.5:

$$\begin{aligned}
\mathrm{PO2.1.5} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_2k_4}\Omega^{04}_{k_3k_5k_6k_7}R^{--}_{k_5k_4}(\varphi)R^{--}_{k_7k_6}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)\theta(\tau_2-\tau_2)e^{-\tau_1\epsilon^{k_3}_{k_1k_2k_5}}e^{-\tau_2\epsilon_{k_3k_4k_6k_7}} \\
&= \frac{(-1)^2}{(2!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_2k_4}\Omega^{04}_{k_3k_5k_6k_7}R^{--}_{k_5k_4}(\varphi)R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_5k_4k_7k_6}\ \epsilon_{k_3k_7k_6k_5}}
\end{aligned} \tag{21}$$



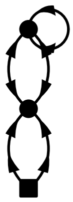
$\rightarrow$ T1:

$$\mathrm{T1} = \frac{1}{(a_1 + a_2)a_2} \tag{22}$$

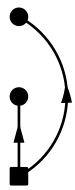
$$a_1 = \epsilon^{k_3}_{k_1k_2k_5}$$
$$a_2 = \epsilon_{k_3k_4k_6k_7}$$

Diagram 1.4:

$$\begin{aligned}
\mathrm{PO2.1.4} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_2k_3k_5}\Omega^{04}_{k_6k_4k_7k_8}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)\theta(\tau_2-\tau_2)e^{-\tau_1\epsilon_{k_1k_2k_4k_6}}e \\
&= \frac{(-1)^2}{(2!)^2} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_2k_3k_5}\Omega^{04}_{k_6k_4k_7k_8}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)}{\epsilon_{k_1k_2k_3k_5}\ \epsilon_{k_8k_7k_4k_6}}
\end{aligned} \tag{23}$$



$\rightarrow$ T2:

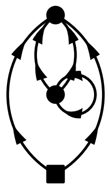


$$\mathrm{T2} = \frac{1}{a_1a_2} \tag{24}$$

$$a_1 = \epsilon_{k_1k_2k_4k_6}$$
$$a_2 = \epsilon_{k_3k_5k_7k_8}$$

Diagram 2.6:

$$\mathrm{PO2.2.6} = \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{22}_{k_3 k_4 k_5 k_6} \Omega^{04}_{k_3 k_4 k_1 k_2} R^{--}_{k_6 k_5}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_1 - \tau_1)\theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_3 k_4}_{k_5 k_6}} e^{-\tau_2 \epsilon_{k_1 k_2 k_3 k_4}}$$
$$= \frac{(-1)^2}{(2!)^2} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{22}_{k_3 k_4 k_5 k_6} \Omega^{04}_{k_3 k_4 k_1 k_2} R^{--}_{k_6 k_5}(\varphi)}{\epsilon_{k_1 k_2 k_6 k_5} \ \epsilon_{k_1 k_2 k_3 k_4}} \tag{25}$$

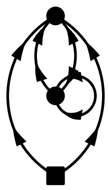
 $\rightarrow$ T1: 

$$\mathrm{T1} = \frac{1}{(a_1 + a_2) a_2} \tag{26}$$

$$a_1 = \epsilon^{k_3 k_4}_{k_5 k_6}$$
$$a_2 = \epsilon_{k_1 k_2 k_3 k_4}$$

Diagram 2.5:

$$\mathrm{PO2.2.5} = \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{13}_{k_3 k_6 k_7 k_4} \Omega^{04}_{k_3 k_5 k_1 k_2} R^{--}_{k_5 k_4}(\varphi) R^{--}_{k_7 k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_1 - \tau_1)\theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_3}_{k_6 k_5 k_7}} e^{-\tau_2 \epsilon_{k_1 k_2 k_3 k}}$$
$$= \frac{(-1)^2}{(2!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{13}_{k_3 k_6 k_7 k_4} \Omega^{04}_{k_3 k_5 k_1 k_2} R^{--}_{k_5 k_4}(\varphi) R^{--}_{k_7 k_6}(\varphi)}{\epsilon_{k_1 k_2 k_7 k_6 k_5 k_4} \ \epsilon_{k_1 k_2 k_3 k_5}} \tag{27}$$

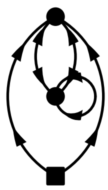
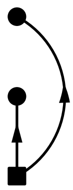
 $\rightarrow$ T1: 

$$\mathrm{T1} = \frac{1}{(a_1 + a_2) a_2} \tag{28}$$

$$a_1 = \epsilon^{k_3}_{k_6 k_5 k_7}$$
$$a_2 = \epsilon_{k_1 k_2 k_3 k_4}$$

Diagram 2.4:

$$\mathrm{PO2.2.4} = \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{04}_{k_7 k_8 k_3 k_5} \Omega^{04}_{k_6 k_4 k_1 k_2} R^{--}_{k_4 k_3}(\varphi) R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_1 - \tau_1)\theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon_{k_7 k_4 k_6 k_8}} e$$
$$= \frac{(-1)^2}{(2!)^2} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{04}_{k_7 k_8 k_3 k_5} \Omega^{04}_{k_6 k_4 k_1 k_2} R^{--}_{k_4 k_3}(\varphi) R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi)}{\epsilon_{k_8 k_7 k_3 k_5} \ \epsilon_{k_1 k_2 k_4 k_6}} \tag{29}$$

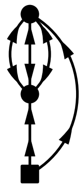
 $\rightarrow$ T2: 

$$\mathrm{T2} = \frac{1}{a_1 a_2} \tag{30}$$

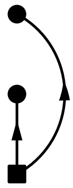
$$a_1 = \epsilon_{k_7 k_4 k_6 k_8}$$
$$a_2 = \epsilon_{k_1 k_2 k_3 k_5}$$

Diagram 7.4:

$$\begin{aligned}
\mathrm{PO2.7.4} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_3k_5k_7}\Omega^{04}_{k_8k_6k_4k_2} R^{--}_{k_4k_3}(\varphi) R^{--}_{k_6k_5}(\varphi) R^{--}_{k_8k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2-\tau_1) e^{-\tau_1 \epsilon_{k_1k_4k_6k_8}} e^{-\tau_2 \epsilon_{k_2k_3k_5}} \\
&= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_3k_5k_7}\Omega^{04}_{k_8k_6k_4k_2} R^{--}_{k_4k_3}(\varphi) R^{--}_{k_6k_5}(\varphi) R^{--}_{k_8k_7}(\varphi)}{\epsilon_{k_1k_3k_5k_7}\ \epsilon_{k_2k_4k_6k_8}} \qquad (31)
\end{aligned}$$



$\rightarrow$ T2:

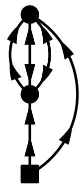


$$\mathrm{T2} = \frac{1}{a_1 a_2} \qquad (32)$$

$$\begin{aligned}
a_1 &= \epsilon_{k_1k_4k_6k_8} \\
a_2 &= \epsilon_{k_2k_3k_5k_7}
\end{aligned}$$

Diagram 7.3:

$$\begin{aligned}
\mathrm{PO2.7.3} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_6}\Omega^{04}_{k_3k_7k_5k_2} R^{--}_{k_5k_4}(\varphi) R^{--}_{k_7k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2-\tau_1) e^{-\tau_1 \epsilon^{k_3}_{k_1k_5k_7}} e^{-\tau_2 \epsilon_{k_2k_3k_4k_6}} \\
&= \frac{(-1)^2}{(2!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_6}\Omega^{04}_{k_3k_7k_5k_2} R^{--}_{k_5k_4}(\varphi) R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_5k_4k_7k_6}\ \epsilon_{k_2k_3k_5k_7}} \qquad (33)
\end{aligned}$$



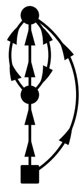
$\rightarrow$ T1:

$$\mathrm{T1} = \frac{1}{(a_1+a_2)a_2} \qquad (34)$$

$$\begin{aligned}
a_1 &= \epsilon^{k_3}_{k_1k_5k_7} \\
a_2 &= \epsilon_{k_2k_3k_4k_6}
\end{aligned}$$

Diagram 7.2:

$$\begin{aligned}
\mathrm{PO2.7.2} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{22}_{k_3k_4k_1k_5}\Omega^{04}_{k_3k_4k_6k_2} R^{--}_{k_6k_5}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2-\tau_1) e^{-\tau_1 \epsilon^{k_3k_4}_{k_1k_6}} e^{-\tau_2 \epsilon_{k_2k_3k_4k_5}} \\
&= \frac{(-1)^2}{(2!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{22}_{k_3k_4k_1k_5}\Omega^{04}_{k_3k_4k_6k_2} R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_2k_6k_5}\ \epsilon_{k_2k_3k_4k_6}} \qquad (35)
\end{aligned}$$



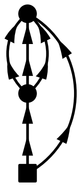
$\rightarrow$ T1:

$$\mathrm{T1} = \frac{1}{(a_1+a_2)a_2} \qquad (36)$$

$$\begin{aligned}
a_1 &= \epsilon^{k_3k_4}_{k_1k_6} \\
a_2 &= \epsilon_{k_2k_3k_4k_5}
\end{aligned}$$

Diagram 7.1:

$$\begin{aligned}\text{PO2.7.1} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{31}_{k_3k_4k_5k_1}\Omega^{04}_{k_3k_4k_5k_2} \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2-\tau_1) e^{-\tau_1 \epsilon^{k_3k_4k_5}_{k_1}} e^{-\tau_2 \epsilon_{k_2k_3k_4k_5}} \\ &= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{31}_{k_3k_4k_5k_1}\Omega^{04}_{k_3k_4k_5k_2}}{\epsilon_{k_1k_2}\ \epsilon_{k_2k_3k_4k_5}} \end{aligned} \tag{37}$$

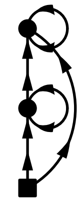
 $\rightarrow$ T1: 

$$\text{T1} = \frac{1}{(a_1+a_2)a_2} \tag{38}$$

$$a_1 = \epsilon^{k_3k_4k_5}_{k_1}$$
$$a_2 = \epsilon_{k_2k_3k_4k_5}$$

Diagram 8.6:

$$\begin{aligned}\text{PO2.8.6} &= \lim_{\tau\to\infty} (-1)^2 \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_5}\Omega^{04}_{k_3k_2k_6k_7} R^{--}_{k_5k_4}(\varphi) R^{--}_{k_7k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_1-\tau_1)\theta(\tau_2-\tau_1)\theta(\tau_2-\tau_2) e^{-\tau_1 \epsilon^{k_3}_{k_1k_4k_5}} e^{-} \\ &= (-1)^2 \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_5}\Omega^{04}_{k_3k_2k_6k_7} R^{--}_{k_5k_4}(\varphi) R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_5k_4k_7k_6}\ \epsilon_{k_2k_3k_7k_6}} \end{aligned} \tag{39}$$

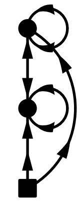
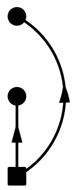
 $\rightarrow$ T1: 

$$\text{T1} = \frac{1}{(a_1+a_2)a_2} \tag{40}$$

$$a_1 = \epsilon^{k_3}_{k_1k_4k_5}$$
$$a_2 = \epsilon_{k_2k_3k_6k_7}$$

Diagram 8.3:

$$\begin{aligned}\text{PO2.8.3} &= \lim_{\tau\to\infty} (-1)^2 \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_5k_6k_3}\Omega^{04}_{k_4k_2k_7k_8} R^{--}_{k_4k_3}(\varphi) R^{--}_{k_6k_5}(\varphi) R^{--}_{k_8k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_1-\tau_1)\theta(\tau_2-\tau_1)\theta(\tau_2-\tau_2) e^{-\tau_1} \\ &= (-1)^2 \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_5k_6k_3}\Omega^{04}_{k_4k_2k_7k_8} R^{--}_{k_4k_3}(\varphi) R^{--}_{k_6k_5}(\varphi) R^{--}_{k_8k_7}(\varphi)}{\epsilon_{k_1k_6k_5k_3}\ \epsilon_{k_2k_8k_7k_4}} \end{aligned} \tag{41}$$

 $\rightarrow$ T2: 

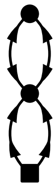
$$\text{T2} = \frac{1}{a_1a_2} \tag{42}$$

$$a_1 = \epsilon_{k_1k_5k_4k_6}$$
$$a_2 = \epsilon_{k_2k_3k_7k_8}$$

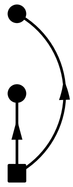
2.3 Two-body non-canonical diagrams

Diagram 1.3:

$$\begin{aligned}\text{PO2.1.3} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_2k_3k_5}\Omega^{02}_{k_6k_4}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon_{k_1k_2k_4k_6}}e^{-\tau_2\epsilon_{k_3k_5}} \\ &= \frac{(-1)^2}{(2!)^2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_2k_3k_5}\Omega^{02}_{k_6k_4}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_2k_3k_5}\ \epsilon_{k_4k_6}}\end{aligned} \tag{43}$$



$\rightarrow$ T2:

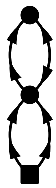


$$\text{T2} = \frac{1}{a_1a_2} \tag{44}$$

$$a_1 = \epsilon_{k_1k_2k_4k_6}$$
$$a_2 = \epsilon_{k_3k_5}$$

Diagram 1.2:

$$\begin{aligned}\text{PO2.1.2} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_2k_4}\Omega^{02}_{k_3k_5}R^{--}_{k_5k_4}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_1k_2k_5}}e^{-\tau_2\epsilon_{k_3k_4}} \\ &= \frac{(-1)^2}{(2!)}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_2k_4}\Omega^{02}_{k_3k_5}R^{--}_{k_5k_4}(\varphi)}{\epsilon_{k_1k_2k_5k_4}\ \epsilon_{k_3k_5}}\end{aligned} \tag{45}$$



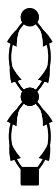
$\rightarrow$ T1:

$$\text{T1} = \frac{1}{(a_1+a_2)a_2} \tag{46}$$

$$a_1 = \epsilon^{k_3}_{k_1k_2k_5}$$
$$a_2 = \epsilon_{k_3k_4}$$

Diagram 1.1:

$$\begin{aligned}\text{PO2.1.1} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{22}_{k_3k_4k_1k_2}\Omega^{02}_{k_3k_4}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3k_4}_{k_1k_2}}e^{-\tau_2\epsilon_{k_3k_4}} \\ &= \frac{(-1)^2}{(2!)^2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{22}_{k_3k_4k_1k_2}\Omega^{02}_{k_3k_4}}{\epsilon_{k_1k_2}\ \epsilon_{k_3k_4}}\end{aligned} \tag{47}$$



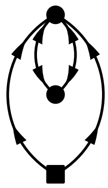
$\rightarrow$ T1:

$$\text{T1} = \frac{1}{(a_1+a_2)a_2} \tag{48}$$

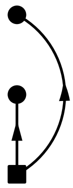
$$a_1 = \epsilon^{k_3k_4}_{k_1k_2}$$
$$a_2 = \epsilon_{k_3k_4}$$

Diagram 2.3:

$$
\begin{aligned}
\mathrm{PO2.2.3} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(2!)^2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_3k_5}\Omega^{04}_{k_6k_4k_1k_2}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon_{k_4k_6}}e^{-\tau_2\epsilon_{k_1k_2k_3k_5}} \\
&= \frac{(-1)^2}{(2!)^2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_3k_5}\Omega^{04}_{k_6k_4k_1k_2}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_3k_5}\ \epsilon_{k_1k_2k_4k_6}}
\end{aligned} \tag{49}
$$



$\rightarrow$ T2:

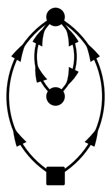


$$
\mathrm{T2} = \frac{1}{a_1a_2} \tag{50}
$$

$$
\begin{aligned}
a_1 &= \epsilon_{k_4k_6} \\
a_2 &= \epsilon_{k_1k_2k_3k_5}
\end{aligned}
$$

Diagram 2.2:

$$
\begin{aligned}
\mathrm{PO2.2.2} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(2!)}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_4}\Omega^{04}_{k_3k_5k_1k_2}R^{--}_{k_5k_4}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_5}}e^{-\tau_2\epsilon_{k_1k_2k_3k_4}} \\
&= \frac{(-1)^2}{(2!)}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_4}\Omega^{04}_{k_3k_5k_1k_2}R^{--}_{k_5k_4}(\varphi)}{\epsilon_{k_1k_2k_5k_4}\ \epsilon_{k_1k_2k_3k_5}}
\end{aligned} \tag{51}
$$



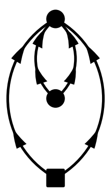
$\rightarrow$ T1:

$$
\mathrm{T1} = \frac{1}{(a_1+a_2)a_2} \tag{52}
$$

$$
\begin{aligned}
a_1 &= \epsilon^{k_3}_{k_5} \\
a_2 &= \epsilon_{k_1k_2k_3k_4}
\end{aligned}
$$

Diagram 2.1:

$$
\begin{aligned}
\mathrm{PO2.2.1} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(2!)^2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{20}_{k_3k_4}\Omega^{04}_{k_3k_4k_1k_2}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3k_4}}e^{-\tau_2\epsilon_{k_1k_2k_3k_4}} \\
&= \frac{(-1)^2}{(2!)^2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{20}_{k_3k_4}\Omega^{04}_{k_3k_4k_1k_2}}{\epsilon_{k_1k_2}\ \epsilon_{k_1k_2k_3k_4}}
\end{aligned} \tag{53}
$$



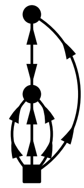
$\rightarrow$ T1:

$$
\mathrm{T1} = \frac{1}{(a_1+a_2)a_2} \tag{54}
$$

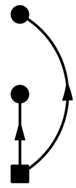
$$
\begin{aligned}
a_1 &= \epsilon^{k_3k_4} \\
a_2 &= \epsilon_{k_1k_2k_3k_4}
\end{aligned}
$$

Diagram 3.2:

$$
\begin{aligned}
\mathrm{PO2.3.2} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{04}_{k_1k_2k_3k_5}\Omega^{02}_{k_6k_4}R^{--}_{k_6k_5}(\varphi) \int_0^{\tau} \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon_{k_1k_2k_3k_6}}e^{-\tau_2\epsilon_{k_4k_5}} \\
&= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{04}_{k_1k_2k_3k_5}\Omega^{02}_{k_6k_4}R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_2k_3k_5}\ \epsilon_{k_4k_6}}
\end{aligned} \tag{55}
$$



$\rightarrow$ T2:

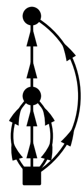


$$
\mathrm{T2} = \frac{1}{a_1a_2} \tag{56}
$$

$$
\begin{aligned}
a_1 &= \epsilon_{k_1k_2k_3k_6} \\
a_2 &= \epsilon_{k_4k_5}
\end{aligned}
$$

Diagram 3.1:

$$
\begin{aligned}
\mathrm{PO2.3.1} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_2k_3}\Omega^{02}_{k_5k_4} \int_0^{\tau} \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_5}_{k_1k_2k_3}}e^{-\tau_2\epsilon_{k_4k_5}} \\
&= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_2k_3}\Omega^{02}_{k_5k_4}}{\epsilon_{k_1k_2k_3k_4}\ \epsilon_{k_4k_5}}
\end{aligned} \tag{57}
$$



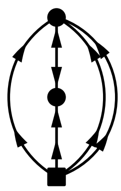
$\rightarrow$ T1:

$$
\mathrm{T1} = \frac{1}{(a_1+a_2)a_2} \tag{58}
$$

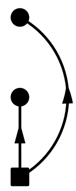
$$
\begin{aligned}
a_1 &= \epsilon^{k_5}_{k_1k_2k_3} \\
a_2 &= \epsilon_{k_4k_5}
\end{aligned}
$$

Diagram 4.2:

$$
\begin{aligned}
\mathrm{PO2.4.2} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_5}\Omega^{04}_{k_6k_2k_3k_4}R^{--}_{k_6k_5}(\varphi) \int_0^{\tau} \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon_{k_1k_6}}e^{-\tau_2\epsilon_{k_2k_3k_4k_5}} \\
&= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_5}\Omega^{04}_{k_6k_2k_3k_4}R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_5}\ \epsilon_{k_2k_3k_4k_6}}
\end{aligned} \tag{59}
$$



$\rightarrow$ T2:

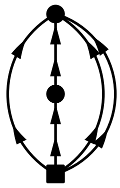


$$
\mathrm{T2} = \frac{1}{a_1a_2} \tag{60}
$$

$$
\begin{aligned}
a_1 &= \epsilon_{k_1k_6} \\
a_2 &= \epsilon_{k_2k_3k_4k_5}
\end{aligned}
$$

Diagram 4.1:

$$\begin{aligned}\text{PO2.4.1} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{11}_{k_5k_1}\Omega^{04}_{k_5k_2k_3k_4} \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_5}_{k_1}}e^{-\tau_2\epsilon_{k_2k_3k_4k_5}} \\ &= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{11}_{k_5k_1}\Omega^{04}_{k_5k_2k_3k_4}}{\epsilon_{k_1k_2k_3k_4}\ \epsilon_{k_2k_3k_4k_5}}\end{aligned} \tag{61}$$



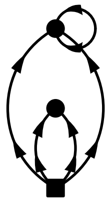
$\rightarrow$ T1:

$$\text{T1} = \frac{1}{(a_1+a_2)a_2} \tag{62}$$

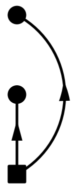
$$a_1 = \epsilon^{k_5}_{k_1}$$
$$a_2 = \epsilon_{k_2k_3k_4k_5}$$

Diagram 6.3:

$$\begin{aligned}\text{PO2.6.3} &= \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_2}\Omega^{04}_{k_3k_4k_5k_6}R^{--}_{k_6k_5}(\varphi) \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_2)e^{-\tau_1\epsilon_{k_1k_2}}e^{-\tau_2\epsilon_{k_3k_4k_5k_6}} \\ &= \frac{(-1)^2}{(2!)^2} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_2}\Omega^{04}_{k_3k_4k_5k_6}R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_2}\ \epsilon_{k_3k_4k_6k_5}}\end{aligned} \tag{63}$$



$\rightarrow$ T2:

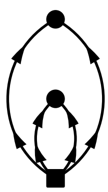


$$\text{T2} = \frac{1}{a_1a_2} \tag{64}$$

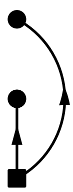
$$a_1 = \epsilon_{k_1k_2}$$
$$a_2 = \epsilon_{k_3k_4k_5k_6}$$

Diagram 6.1:

$$\begin{aligned}\text{PO2.6.1} &= \lim_{\tau\to\infty} \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_2}\Omega^{02}_{k_3k_4} \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_1k_2}}e^{-\tau_2\epsilon_{k_3k_4}} \\ &= \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_2}\Omega^{02}_{k_3k_4}}{\epsilon_{k_1k_2}\ \epsilon_{k_3k_4}}\end{aligned} \tag{65}$$



$\rightarrow$ T2:

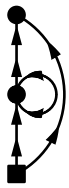


$$\text{T2} = \frac{1}{a_1a_2} \tag{66}$$

$$a_1 = \epsilon_{k_1k_2}$$
$$a_2 = \epsilon_{k_3k_4}$$

Diagram 8.8:

$$\mathrm{PO2.8.8} = \lim_{\tau\to\infty}(-1)^2 \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_5}\Omega^{02}_{k_3k_2}R^{--}_{k_5k_4}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_1-\tau_1)\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_1k_4k_5}}e^{-\tau_2\epsilon_{k_2k_3}}$$
$$= (-1)^2\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_5}\Omega^{02}_{k_3k_2}R^{--}_{k_5k_4}(\varphi)}{\epsilon_{k_1k_2k_5k_4}\ \epsilon_{k_2k_3}} \tag{67}$$



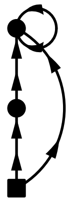
$\rightarrow$ T1:

$$\mathrm{T1} = \frac{1}{(a_1+a_2)a_2} \tag{68}$$

$$a_1 = \epsilon^{k_3}_{k_1k_4k_5}$$
$$a_2 = \epsilon_{k_2k_3}$$

Diagram 8.7:

$$\mathrm{PO2.8.7} = \lim_{\tau\to\infty}(-1)^2 \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_1}\Omega^{04}_{k_3k_2k_4k_5}R^{--}_{k_5k_4}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)\theta(\tau_2-\tau_2)e^{-\tau_1\epsilon^{k_3}_{k_1}}e^{-\tau_2\epsilon_{k_2k_3k_4k_5}}$$
$$= (-1)^2\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_1}\Omega^{04}_{k_3k_2k_4k_5}R^{--}_{k_5k_4}(\varphi)}{\epsilon_{k_1k_2k_5k_4}\ \epsilon_{k_2k_3k_5k_4}} \tag{69}$$



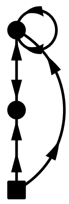
$\rightarrow$ T1:

$$\mathrm{T1} = \frac{1}{(a_1+a_2)a_2} \tag{70}$$

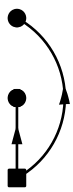
$$a_1 = \epsilon^{k_3}_{k_1}$$
$$a_2 = \epsilon_{k_2k_3k_4k_5}$$

Diagram 8.4:

$$\mathrm{PO2.8.4} = \lim_{\tau\to\infty}(-1)^2 \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_1k_3}\Omega^{04}_{k_4k_2k_5k_6}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)\theta(\tau_2-\tau_2)e^{-\tau_1\epsilon_{k_1k_4}}e^{-\tau_2\epsilon_{k_2k_3k_5k_6}}$$
$$= (-1)^2\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_1k_3}\Omega^{04}_{k_4k_2k_5k_6}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_3}\ \epsilon_{k_2k_6k_5k_4}} \tag{71}$$



$\rightarrow$ T2:

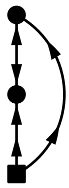


$$\mathrm{T2} = \frac{1}{a_1a_2} \tag{72}$$

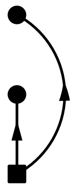
$$a_1 = \epsilon_{k_1k_4}$$
$$a_2 = \epsilon_{k_2k_3k_5k_6}$$

Diagram 8.2:

$$\begin{aligned}
\text{PO2.8.2} &= \lim_{\tau\to\infty}(-1)^2\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_1k_3}\Omega^{02}_{k_4k_2}R^{--}_{k_4k_3}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon_{k_1k_4}}e^{-\tau_2\epsilon_{k_2k_3}} \\
&= (-1)^2\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_1k_3}\Omega^{02}_{k_4k_2}R^{--}_{k_4k_3}(\varphi)}{\epsilon_{k_1k_3}\ \epsilon_{k_2k_4}}
\end{aligned} \tag{73}$$



$\rightarrow$ T2:

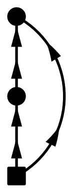


$$\text{T2} = \frac{1}{a_1a_2} \tag{74}$$

$$\begin{aligned}
a_1 &= \epsilon_{k_1k_4} \\
a_2 &= \epsilon_{k_2k_3}
\end{aligned}$$

Diagram 8.1:

$$\begin{aligned}
\text{PO2.8.1} &= \lim_{\tau\to\infty}(-1)^2\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_1}\Omega^{02}_{k_3k_2}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_1}}e^{-\tau_2\epsilon_{k_2k_3}} \\
&= (-1)^2\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_1}\Omega^{02}_{k_3k_2}}{\epsilon_{k_1k_2}\ \epsilon_{k_2k_3}}
\end{aligned} \tag{75}$$



$\rightarrow$ T1:

$$\text{T1} = \frac{1}{(a_1+a_2)a_2} \tag{76}$$

$$\begin{aligned}
a_1 &= \epsilon^{k_3}_{k_1} \\
a_2 &= \epsilon_{k_2k_3}
\end{aligned}$$