Diagrams and algebraic expressions at order 2 in PBMBPT

The ADG Dev Team

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Valid diagrams: 33
2N valid diagrams: 33
2N canonical diagrams for the energy: 7
2N canonical diagrams for a generic operator only: 11
2N non-canonical diagrams: 15

Contents

1 Time-structure diagrams

1.1 Tree diagrams

Time-structure diagram T1:

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

Resummation power: 2
Number of related Feynman diagrams: 12.
Related Feynman diagrams: 4.3, 5.3, 6.2, 2.4, 7.4, 8.3, 2.3, 4.2, 6.3, 6.1, 8.4, 8.2.

Time-structure diagram T2:

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

Resummation power: 1
Number of related Feynman diagrams: 21.
Related Feynman diagrams: 3.4, 4.4, 5.2, 5.1, 1.6, 1.5, 2.6, 2.5, 7.3, 7.2, 7.1, 8.6, 1.2, 1.1, 2.2, 2.1, 3.1, 4.1, 8.7, 8.5, 8.1.

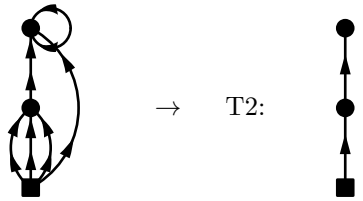
2 Two-body diagrams

2.1 Two-body energy canonical diagrams

Diagram 3.4:

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

$$= \frac{(-1)^2}{2(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_2k_3}\Omega^{04}_{k_5k_4k_6k_7}R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_3k_4k_7k_6}\ \epsilon_{k_4k_5k_7k_6}} \tag{3}$$



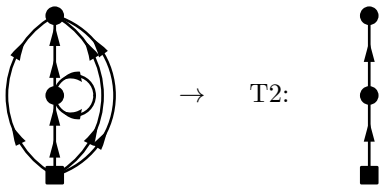
$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{4}$$

$$a_1 = \epsilon^{k_5}_{k_1k_2k_3}$$
$$a_2 = \epsilon_{k_4k_5k_7k_6}$$

Diagram 4.4:

$$\mathrm{PO2.4.4} = \lim_{\tau\to\infty} \frac{(-1)^2}{2(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_6k_7}\Omega^{04}_{k_5k_2k_3k_4}R^{--}_{k_7k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_5}_{k_1k_7k_6}}e^{-\tau_2\epsilon_{k_2k_3k_4k_5}}$$

$$= \frac{(-1)^2}{2(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_6k_7}\Omega^{04}_{k_5k_2k_3k_4}R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_3k_4k_7k_6}\ \epsilon_{k_2k_3k_4k_5}} \tag{5}$$



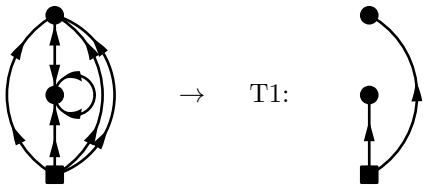
$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{6}$$

$$a_1 = \epsilon^{k_5}_{k_1k_7k_6}$$
$$a_2 = \epsilon_{k_2k_3k_4k_5}$$

Diagram 4.3:

$$\mathrm{PO2.4.3} = \lim_{\tau\to\infty} \frac{(-1)^2}{2(3!)} \sum_{k_i} \tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{04}_{k_1k_7k_8k_5}\Omega^{04}_{k_6k_2k_3k_4}R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_1k_8k_5k_7}}e^{-\tau_2\epsilon_{k_2k_3k_4k_6}}$$

$$= \frac{(-1)^2}{2(3!)} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{04}_{k_1k_7k_8k_5}\Omega^{04}_{k_6k_2k_3k_4}R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)}{\epsilon_{k_1k_8k_7k_5}\ \epsilon_{k_2k_3k_4k_6}} \tag{7}$$

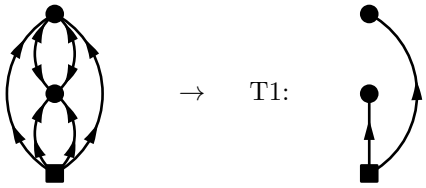


$$\mathrm{T1} = \frac{1}{a_1 a_2} \tag{8}$$

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

Diagram 5.3:

$$\mathrm{PO2.5.3} = \lim_{\tau\to\infty} \frac{(-1)^2}{2(2!)^3} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_2 k_5 k_7} \Omega^{04}_{k_8 k_6 k_3 k_4} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 e^{-\tau_1 \epsilon_{k_1 k_2 k_5 k_7}} e^{-\tau_2 \epsilon_{k_3 k_4 k_6 k_8}}$$
$$= \frac{(-1)^2}{2(2!)^3} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_2 k_5 k_7} \Omega^{04}_{k_8 k_6 k_3 k_4} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi)}{\epsilon_{k_1 k_2 k_5 k_7}\ \epsilon_{k_3 k_4 k_6 k_8}} \tag{9}$$



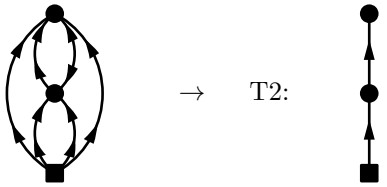
$\rightarrow$ T1:

$$\mathrm{T1} = \frac{1}{a_1 a_2} \tag{10}$$

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

Diagram 5.2:

$$\mathrm{PO2.5.2} = \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^2} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{13}_{k_5 k_1 k_2 k_6} \Omega^{04}_{k_5 k_7 k_3 k_4} R^{--}_{k_7 k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_5}_{k_1 k_2 k_6}} e^{-\tau_2 \epsilon_{k_3 k_4 k_5 k_7}}$$
$$= \frac{(-1)^2}{(2!)^2} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{13}_{k_5 k_1 k_2 k_6} \Omega^{04}_{k_5 k_7 k_3 k_4} R^{--}_{k_7 k_6}(\varphi)}{\epsilon_{k_1 k_2 k_3 k_4 k_7 k_6}\ \epsilon_{k_3 k_4 k_5 k_7}} \tag{11}$$



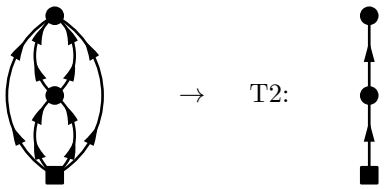
$\rightarrow$ T2:

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

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

Diagram 5.1:

$$\mathrm{PO2.5.1} = \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)^3} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{22}_{k_5 k_6 k_1 k_2} \Omega^{04}_{k_5 k_6 k_3 k_4} \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_5 k_6}_{k_1 k_2}} e^{-\tau_2 \epsilon_{k_3 k_4 k_5 k_6}}$$
$$= \frac{(-1)^2}{(2!)^3} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{22}_{k_5 k_6 k_1 k_2} \Omega^{04}_{k_5 k_6 k_3 k_4}}{\epsilon_{k_1 k_2 k_3 k_4}\ \epsilon_{k_3 k_4 k_5 k_6}} \tag{13}$$



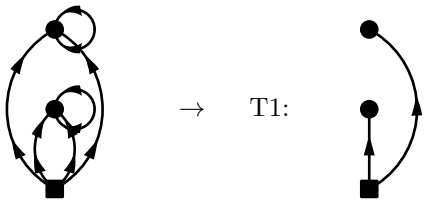
$\rightarrow$ T2:

$$\mathrm{T2} = \frac{1}{(a_1 + a_2)a_2} \tag{14}$$

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

Diagram 6.2:

$$\mathrm{PO2.6.2} = \lim_{\tau\to\infty} \frac{(-1)^2}{8(2!)^2} \sum_{k_i} \tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_2 k_5 k_6} \Omega^{04}_{k_3 k_4 k_7 k_8} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 e^{-\tau_1 \epsilon_{k_1 k_2 k_6 k_5}} e^{-\tau_2 \epsilon_{k_3 k_4 k_8 k_7}}$$
$$= \frac{(-1)^2}{8(2!)^2} \sum_{k_i} \frac{\tilde{O}^{40}_{k_1 k_2 k_3 k_4}(\varphi) \Omega^{04}_{k_1 k_2 k_5 k_6} \Omega^{04}_{k_3 k_4 k_7 k_8} R^{--}_{k_6 k_5}(\varphi) R^{--}_{k_8 k_7}(\varphi)}{\epsilon_{k_1 k_2 k_6 k_5}\ \epsilon_{k_3 k_4 k_8 k_7}} \tag{15}$$



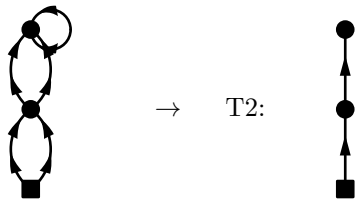
$$\mathrm{T1} = \frac{1}{a_1 a_2} \tag{16}$$

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

2.2 Two-body canonical diagrams for a generic operator only

Diagram 1.6:

$$\mathrm{PO2.1.6} = \lim_{\tau\to\infty} \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{22}_{k_3 k_4 k_1 k_2} \Omega^{04}_{k_3 k_4 k_5 k_6} R^{--}_{k_6 k_5}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_3 k_4}_{k_1 k_2}} e^{-\tau_2 \epsilon_{k_3 k_4 k_6 k_5}}$$
$$= \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{22}_{k_3 k_4 k_1 k_2} \Omega^{04}_{k_3 k_4 k_5 k_6} R^{--}_{k_6 k_5}(\varphi)}{\epsilon_{k_1 k_2 k_6 k_5}\ \epsilon_{k_3 k_4 k_6 k_5}} \tag{17}$$

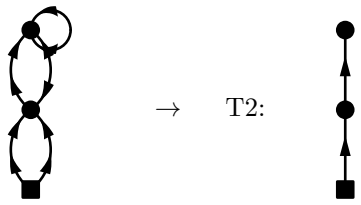


$$\mathrm{T2} = \frac{1}{(a_1 + a_2)a_2} \tag{18}$$

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

Diagram 1.5:

$$\mathrm{PO2.1.5} = \lim_{\tau\to\infty} \frac{(-1)^2}{2(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{13}_{k_3 k_1 k_2 k_4} \Omega^{04}_{k_3 k_5 k_6 k_7} R^{--}_{k_5 k_4}(\varphi) R^{--}_{k_7 k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_3}_{k_1 k_2 k_4}} e^{-\tau_2 \epsilon_{k_3 k_5 k_7 k_6}}$$
$$= \frac{(-1)^2}{2(2!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1 k_2}(\varphi) \Omega^{13}_{k_3 k_1 k_2 k_4} \Omega^{04}_{k_3 k_5 k_6 k_7} R^{--}_{k_5 k_4}(\varphi) R^{--}_{k_7 k_6}(\varphi)}{\epsilon_{k_1 k_2 k_5 k_4 k_7 k_6}\ \epsilon_{k_3 k_7 k_6 k_5}} \tag{19}$$



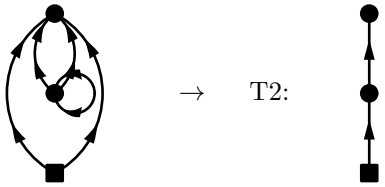
$$\rightarrow \quad \text{T2:}$$

$$\text{T2} = \frac{1}{(a_1 + a_2)a_2} \tag{20}$$

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

Diagram 2.6:

$$\text{PO2.2.6} = \lim_{\tau\to\infty} \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1 k_2}(\varphi)\Omega^{22}_{k_3 k_4 k_5 k_6}\Omega^{04}_{k_3 k_4 k_1 k_2} R^{--}_{k_6 k_5}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_3 k_4}_{k_6 k_5}} e^{-\tau_2 \epsilon_{k_1 k_2 k_3 k_4}}$$
$$= \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1 k_2}(\varphi)\Omega^{22}_{k_3 k_4 k_5 k_6}\Omega^{04}_{k_3 k_4 k_1 k_2} R^{--}_{k_6 k_5}(\varphi)}{\epsilon_{k_1 k_2 k_6 k_5}\ \epsilon_{k_1 k_2 k_3 k_4}} \tag{21}$$



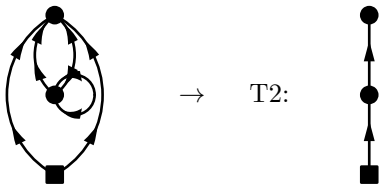
$$\rightarrow \quad \text{T2:}$$

$$\text{T2} = \frac{1}{(a_1 + a_2)a_2} \tag{22}$$

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

Diagram 2.5:

$$\text{PO2.2.5} = \lim_{\tau\to\infty} \frac{(-1)^2}{2(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1 k_2}(\varphi)\Omega^{13}_{k_3 k_6 k_7 k_4}\Omega^{04}_{k_3 k_5 k_1 k_2} R^{--}_{k_5 k_4}(\varphi) R^{--}_{k_7 k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1 \mathrm{d}\tau_2 \theta(\tau_2 - \tau_1) e^{-\tau_1 \epsilon^{k_3}_{k_7 k_4 k_6}} e^{-\tau_2 \epsilon_{k_1 k_2 k_3 k_5}}$$
$$= \frac{(-1)^2}{2(2!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1 k_2}(\varphi)\Omega^{13}_{k_3 k_6 k_7 k_4}\Omega^{04}_{k_3 k_5 k_1 k_2} R^{--}_{k_5 k_4}(\varphi) R^{--}_{k_7 k_6}(\varphi)}{\epsilon_{k_1 k_2 k_7 k_6 k_5 k_4}\ \epsilon_{k_1 k_2 k_3 k_5}} \tag{23}$$



$$\rightarrow \quad \text{T2:}$$

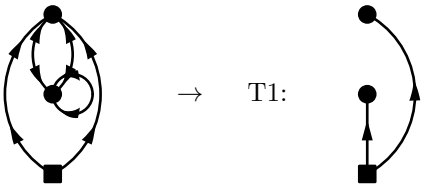
$$\text{T2} = \frac{1}{(a_1 + a_2)a_2} \tag{24}$$

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

Diagram 2.4:

$$\mathrm{PO2.2.4} = \lim_{\tau\to\infty} \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_7k_8k_3k_5}\Omega^{04}_{k_6k_4k_1k_2} R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi) \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_8k_3k_5k_7}} e^{-\tau_2\epsilon_{k_1k_2k_4k_6}}$$

$$= \frac{(-1)^2}{2(2!)^2} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_7k_8k_3k_5}\Omega^{04}_{k_6k_4k_1k_2} R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)}{\epsilon_{k_8k_7k_3k_5}\ \epsilon_{k_1k_2k_4k_6}} \tag{25}$$



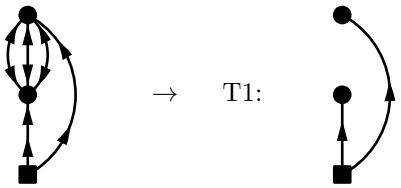
$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{26}$$

$$a_1 = \epsilon_{k_8k_3k_5k_7}$$
$$a_2 = \epsilon_{k_1k_2k_4k_6}$$

Diagram 7.4:

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

$$= \frac{(-1)^2}{2(3!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_3k_5k_7}\Omega^{04}_{k_8k_6k_4k_2} R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)}{\epsilon_{k_1k_3k_5k_7}\ \epsilon_{k_2k_4k_6k_8}} \tag{27}$$



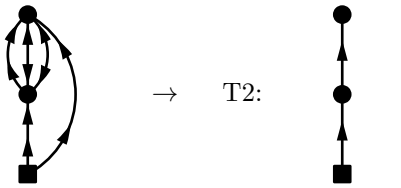
$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{28}$$

$$a_1 = \epsilon_{k_1k_3k_5k_7}$$
$$a_2 = \epsilon_{k_2k_4k_6k_8}$$

Diagram 7.3:

$$\mathrm{PO2.7.3} = \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_6}\Omega^{04}_{k_3k_7k_5k_2} R^{--}_{k_5k_4}(\varphi)R^{--}_{k_7k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 \theta(\tau_2-\tau_1) e^{-\tau_1\epsilon^{k_3}_{k_1k_4k_6}} e^{-\tau_2\epsilon_{k_2k_3k_5k_7}}$$

$$= \frac{(-1)^2}{(2!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_6}\Omega^{04}_{k_3k_7k_5k_2} R^{--}_{k_5k_4}(\varphi)R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_5k_4k_7k_6}\ \epsilon_{k_2k_3k_5k_7}} \tag{29}$$



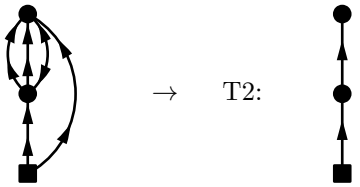
$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{30}$$

$$a_1 = \epsilon^{k_3}_{k_1k_4k_6}$$
$$a_2 = \epsilon_{k_2k_3k_5k_7}$$

Diagram 7.2:

$$\mathrm{PO2.7.2} = \lim_{\tau\to\infty} \frac{(-1)^2}{(2!)} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{22}_{k_3k_4k_1k_5}\Omega^{04}_{k_3k_4k_6k_2}R^{--}_{k_6k_5}(\varphi) \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3k_4}_{k_1k_5}}e^{-\tau_2\epsilon_{k_2k_3k_4k_6}}$$

$$= \frac{(-1)^2}{(2!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{22}_{k_3k_4k_1k_5}\Omega^{04}_{k_3k_4k_6k_2}R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_2k_6k_5}\ \epsilon_{k_2k_3k_4k_6}} \tag{31}$$



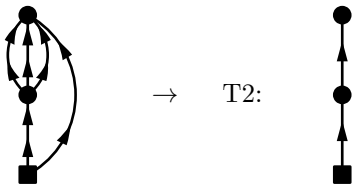
$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{32}$$

$$a_1 = \epsilon^{k_3k_4}_{k_1k_5}$$
$$a_2 = \epsilon_{k_2k_3k_4k_6}$$

Diagram 7.1:

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

$$= \frac{(-1)^2}{(3!)} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{31}_{k_3k_4k_5k_1}\Omega^{04}_{k_3k_4k_5k_2}}{\epsilon_{k_1k_2}\ \epsilon_{k_2k_3k_4k_5}} \tag{33}$$



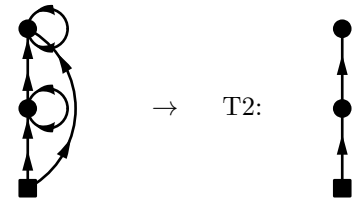
$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{34}$$

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

Diagram 8.6:

$$\mathrm{PO2.8.6} = \lim_{\tau\to\infty} \frac{(-1)^2}{4} \sum_{k_i} \tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_5}\Omega^{04}_{k_3k_2k_6k_7}R^{--}_{k_5k_4}(\varphi)R^{--}_{k_7k_6}(\varphi) \int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_1k_5k_4}}e^{-\tau_2\epsilon_{k_2k_3k_7k_6}}$$

$$= \frac{(-1)^2}{4} \sum_{k_i} \frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_5}\Omega^{04}_{k_3k_2k_6k_7}R^{--}_{k_5k_4}(\varphi)R^{--}_{k_7k_6}(\varphi)}{\epsilon_{k_1k_2k_5k_4k_7k_6}\ \epsilon_{k_2k_3k_7k_6}} \tag{35}$$

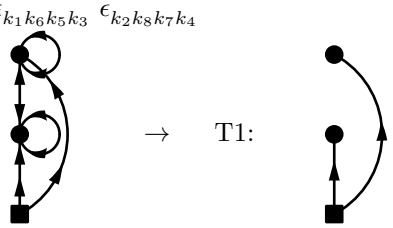


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{36}$$

$$a_1 = \epsilon^{k_3}_{k_1k_5k_4}$$
$$a_2 = \epsilon_{k_2k_3k_7k_6}$$

Diagram 8.3:

$$\begin{aligned}\mathrm{PO2.8.3} &= \lim_{\tau\to\infty}\frac{(-1)^2}{8}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_5k_6k_3}\Omega^{04}_{k_4k_2k_7k_8}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_1k_6k_3k_5}}e^{-\tau_2\epsilon_{k_2k_4k_8k_7}}\\ &= \frac{(-1)^2}{8}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{04}_{k_1k_5k_6k_3}\Omega^{04}_{k_4k_2k_7k_8}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)R^{--}_{k_8k_7}(\varphi)}{\epsilon_{k_1k_6k_5k_3}\ \epsilon_{k_2k_8k_7k_4}}\end{aligned} \tag{37}$$



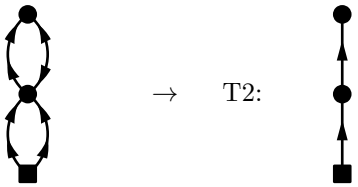
$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{38}$$

$$\begin{aligned}a_1 &= \epsilon_{k_1k_6k_3k_5}\\ a_2 &= \epsilon_{k_2k_4k_8k_7}\end{aligned}$$

2.3 Two-body non-canonical diagrams

Diagram 1.2:

$$\begin{aligned}\mathrm{PO2.1.2} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(2!)}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_2k_4}\Omega^{02}_{k_3k_5}R^{--}_{k_5k_4}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_1k_2k_4}}e^{-\tau_2\epsilon_{k_3k_5}}\\ &= \frac{(-1)^2}{(2!)}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_2k_4}\Omega^{02}_{k_3k_5}R^{--}_{k_5k_4}(\varphi)}{\epsilon_{k_1k_2k_5k_4}\ \epsilon_{k_3k_5}}\end{aligned} \tag{39}$$

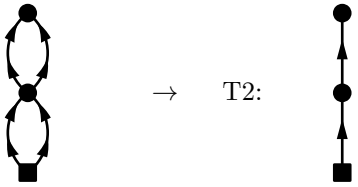


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{40}$$

$$\begin{aligned}a_1 &= \epsilon^{k_3}_{k_1k_2k_4}\\ a_2 &= \epsilon_{k_3k_5}\end{aligned}$$

Diagram 1.1:

$$\begin{aligned}\mathrm{PO2.1.1} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(2!)^2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{22}_{k_3k_4k_1k_2}\Omega^{02}_{k_3k_4}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3k_4}_{k_1k_2}}e^{-\tau_2\epsilon_{k_3k_4}}\\ &= \frac{(-1)^2}{(2!)^2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{22}_{k_3k_4k_1k_2}\Omega^{02}_{k_3k_4}}{\epsilon_{k_1k_2}\ \epsilon_{k_3k_4}}\end{aligned} \tag{41}$$

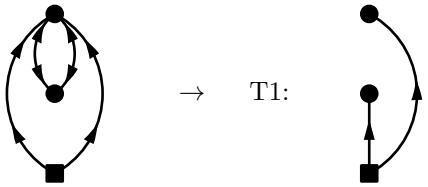


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{42}$$

$$\begin{aligned}a_1 &= \epsilon^{k_3k_4}_{k_1k_2}\\ a_2 &= \epsilon_{k_3k_4}\end{aligned}$$

Diagram 2.3:

$$\begin{aligned}\mathrm{PO2.2.3} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(2!)^2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_3k_5}\Omega^{04}_{k_6k_4k_1k_2}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_3k_5}}e^{-\tau_2\epsilon_{k_1k_2k_4k_6}}\\ &= \frac{(-1)^2}{(2!)^2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_3k_5}\Omega^{04}_{k_6k_4k_1k_2}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_3k_5}\ \epsilon_{k_1k_2k_4k_6}}\end{aligned} \tag{43}$$

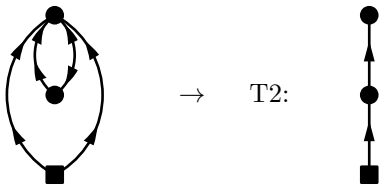


$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{44}$$

$$\begin{aligned}a_1 &= \epsilon_{k_3k_5}\\ a_2 &= \epsilon_{k_1k_2k_4k_6}\end{aligned}$$

Diagram 2.2:

$$\begin{aligned}\mathrm{PO2.2.2} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(2!)}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_4}\Omega^{04}_{k_3k_5k_1k_2}R^{--}_{k_5k_4}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_4}}e^{-\tau_2\epsilon_{k_1k_2k_3k_5}}\\ &= \frac{(-1)^2}{(2!)}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_4}\Omega^{04}_{k_3k_5k_1k_2}R^{--}_{k_5k_4}(\varphi)}{\epsilon_{k_1k_2k_5k_4}\ \epsilon_{k_1k_2k_3k_5}}\end{aligned} \tag{45}$$

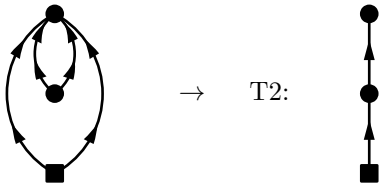


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{46}$$

$$\begin{aligned}a_1 &= \epsilon^{k_3}_{k_4}\\ a_2 &= \epsilon_{k_1k_2k_3k_5}\end{aligned}$$

Diagram 2.1:

$$\begin{aligned}\mathrm{PO2.2.1} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(2!)^2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{20}_{k_3k_4}\Omega^{04}_{k_3k_4k_1k_2}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3k_4}}e^{-\tau_2\epsilon_{k_1k_2k_3k_4}}\\ &= \frac{(-1)^2}{(2!)^2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{20}_{k_3k_4}\Omega^{04}_{k_3k_4k_1k_2}}{\epsilon_{k_1k_2}\ \epsilon_{k_1k_2k_3k_4}}\end{aligned} \tag{47}$$

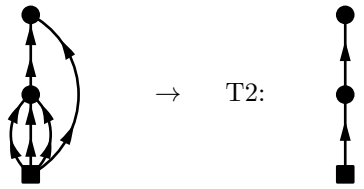


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{48}$$

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

Diagram 3.1:

$$\begin{aligned}\mathrm{PO2.3.1} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(3!)}\sum_{k_i}\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_2k_3}\Omega^{02}_{k_5k_4}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_5}_{k_1k_2k_3}}e^{-\tau_2\epsilon_{k_4k_5}}\\ &= \frac{(-1)^2}{(3!)}\sum_{k_i}\frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{13}_{k_5k_1k_2k_3}\Omega^{02}_{k_5k_4}}{\epsilon_{k_1k_2k_3k_4}\ \epsilon_{k_4k_5}}\end{aligned} \tag{49}$$

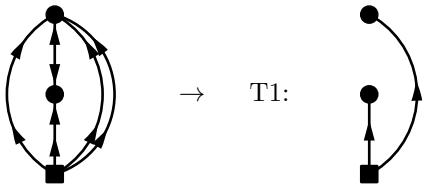


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{50}$$

$$a_1 = \epsilon^{k_5}_{k_1k_2k_3}$$
$$a_2 = \epsilon_{k_4k_5}$$

Diagram 4.2:

$$\begin{aligned}\mathrm{PO2.4.2} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(3!)}\sum_{k_i}\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_5}\Omega^{04}_{k_6k_2k_3k_4}R^{--}_{k_6k_5}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_1k_5}}e^{-\tau_2\epsilon_{k_2k_3k_4k_6}}\\ &= \frac{(-1)^2}{(3!)}\sum_{k_i}\frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_5}\Omega^{04}_{k_6k_2k_3k_4}R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_5}\ \epsilon_{k_2k_3k_4k_6}}\end{aligned} \tag{51}$$

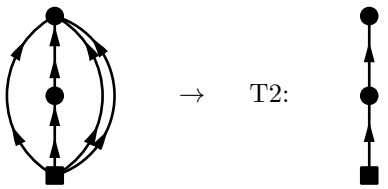


$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{52}$$

$$a_1 = \epsilon_{k_1k_5}$$
$$a_2 = \epsilon_{k_2k_3k_4k_6}$$

Diagram 4.1:

$$\begin{aligned}\mathrm{PO2.4.1} &= \lim_{\tau\to\infty}\frac{(-1)^2}{(3!)}\sum_{k_i}\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{11}_{k_5k_1}\Omega^{04}_{k_5k_2k_3k_4}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_5}_{k_1}}e^{-\tau_2\epsilon_{k_2k_3k_4k_5}}\\ &= \frac{(-1)^2}{(3!)}\sum_{k_i}\frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{11}_{k_5k_1}\Omega^{04}_{k_5k_2k_3k_4}}{\epsilon_{k_1k_2k_3k_4}\ \epsilon_{k_2k_3k_4k_5}}\end{aligned} \tag{53}$$

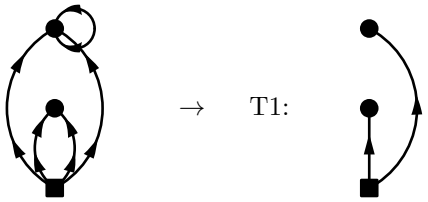


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{54}$$

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

Diagram 6.3:

$$\begin{aligned}\mathrm{PO2.6.3} &= \lim_{\tau\to\infty}\frac{(-1)^2}{2(2!)^2}\sum_{k_i}\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_2}\Omega^{04}_{k_3k_4k_5k_6}R^{--}_{k_6k_5}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_1k_2}}e^{-\tau_2\epsilon_{k_3k_4k_6k_5}}\\ &= \frac{(-1)^2}{2(2!)^2}\sum_{k_i}\frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_2}\Omega^{04}_{k_3k_4k_5k_6}R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_2}\ \epsilon_{k_3k_4k_6k_5}}\end{aligned} \tag{55}$$

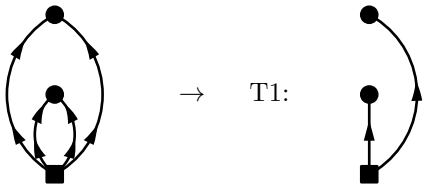


$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{56}$$

$$\begin{aligned}a_1 &= \epsilon_{k_1k_2}\\ a_2 &= \epsilon_{k_3k_4k_6k_5}\end{aligned}$$

Diagram 6.1:

$$\begin{aligned}\mathrm{PO2.6.1} &= \lim_{\tau\to\infty}\frac{(-1)^2}{2(2!)^2}\sum_{k_i}\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_2}\Omega^{02}_{k_3k_4}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_1k_2}}e^{-\tau_2\epsilon_{k_3k_4}}\\ &= \frac{(-1)^2}{2(2!)^2}\sum_{k_i}\frac{\tilde{O}^{40}_{k_1k_2k_3k_4}(\varphi)\Omega^{02}_{k_1k_2}\Omega^{02}_{k_3k_4}}{\epsilon_{k_1k_2}\ \epsilon_{k_3k_4}}\end{aligned} \tag{57}$$

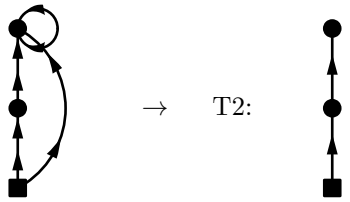


$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{58}$$

$$\begin{aligned}a_1 &= \epsilon_{k_1k_2}\\ a_2 &= \epsilon_{k_3k_4}\end{aligned}$$

Diagram 8.7:

$$\begin{aligned}\mathrm{PO2.8.7} &= \lim_{\tau\to\infty}\frac{(-1)^2}{2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_1}\Omega^{04}_{k_3k_2k_4k_5}R^{--}_{k_5k_4}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_1}}e^{-\tau_2\epsilon_{k_2k_3k_5k_4}}\\ &= \frac{(-1)^2}{2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_1}\Omega^{04}_{k_3k_2k_4k_5}R^{--}_{k_5k_4}(\varphi)}{\epsilon_{k_1k_2k_5k_4}\ \epsilon_{k_2k_3k_5k_4}}\end{aligned} \tag{59}$$

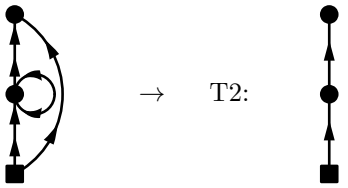


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{60}$$

$$\begin{aligned}a_1 &= \epsilon^{k_3}_{k_1}\\ a_2 &= \epsilon_{k_2k_3k_5k_4}\end{aligned}$$

Diagram 8.5:

$$\begin{aligned}\mathrm{PO2.8.5} &= \lim_{\tau\to\infty}\frac{(-1)^2}{2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_5}\Omega^{02}_{k_3k_2}R^{--}_{k_5k_4}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_1k_5k_4}}e^{-\tau_2\epsilon_{k_2k_3}}\\ &= \frac{(-1)^2}{2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{13}_{k_3k_1k_4k_5}\Omega^{02}_{k_3k_2}R^{--}_{k_5k_4}(\varphi)}{\epsilon_{k_1k_2k_5k_4}\ \epsilon_{k_2k_3}}\end{aligned} \tag{61}$$

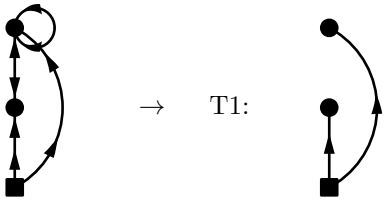


$$\mathrm{T2} = \frac{1}{(a_1+a_2)a_2} \tag{62}$$

$$\begin{aligned}a_1 &= \epsilon^{k_3}_{k_1k_5k_4}\\ a_2 &= \epsilon_{k_2k_3}\end{aligned}$$

Diagram 8.4:

$$\begin{aligned}\mathrm{PO2.8.4} &= \lim_{\tau\to\infty}\frac{(-1)^2}{2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_1k_3}\Omega^{04}_{k_4k_2k_5k_6}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_1k_3}}e^{-\tau_2\epsilon_{k_2k_4k_6k_5}}\\ &= \frac{(-1)^2}{2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_1k_3}\Omega^{04}_{k_4k_2k_5k_6}R^{--}_{k_4k_3}(\varphi)R^{--}_{k_6k_5}(\varphi)}{\epsilon_{k_1k_3}\ \epsilon_{k_2k_6k_5k_4}}\end{aligned} \tag{63}$$

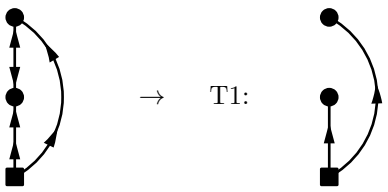


$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{64}$$

$$\begin{aligned}a_1 &= \epsilon_{k_1k_3}\\ a_2 &= \epsilon_{k_2k_4k_6k_5}\end{aligned}$$

Diagram 8.2:

$$\begin{aligned}\mathrm{PO2.8.2} &= \lim_{\tau\to\infty}\frac{(-1)^2}{2}\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_1k_3}\Omega^{02}_{k_4k_2}R^{--}_{k_4k_3}(\varphi)\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2 e^{-\tau_1\epsilon_{k_1k_3}}e^{-\tau_2\epsilon_{k_2k_4}}\\ &= \frac{(-1)^2}{2}\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{02}_{k_1k_3}\Omega^{02}_{k_4k_2}R^{--}_{k_4k_3}(\varphi)}{\epsilon_{k_1k_3}\ \epsilon_{k_2k_4}}\end{aligned} \tag{65}$$

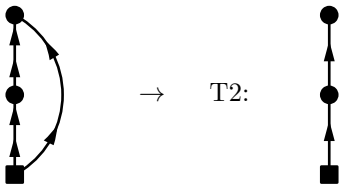


$$\mathrm{T1} = \frac{1}{a_1a_2} \tag{66}$$

$$\begin{aligned}a_1 &= \epsilon_{k_1k_3}\\ a_2 &= \epsilon_{k_2k_4}\end{aligned}$$

Diagram 8.1:

$$\begin{aligned}\text{PO2.8.1} &= \lim_{\tau\to\infty}(-1)^2\sum_{k_i}\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_1}\Omega^{02}_{k_3k_2}\int_0^\tau \mathrm{d}\tau_1\mathrm{d}\tau_2\theta(\tau_2-\tau_1)e^{-\tau_1\epsilon^{k_3}_{k_1}}e^{-\tau_2\epsilon_{k_2k_3}}\\ &= (-1)^2\sum_{k_i}\frac{\tilde{O}^{20}_{k_1k_2}(\varphi)\Omega^{11}_{k_3k_1}\Omega^{02}_{k_3k_2}}{\epsilon_{k_1k_2}\ \epsilon_{k_2k_3}}\end{aligned} \tag{67}$$



$$\text{T2} = \frac{1}{(a_1+a_2)a_2} \tag{68}$$

$$a_1 = \epsilon^{k_3}_{k_1}$$
$$a_2 = \epsilon_{k_2k_3}$$