Diagrams and algebraic expressions at order 4 in MBPT

RDL, JR, PA, MD, AT, TD, JPE

May 24, 2018

Valid diagrams: 39
Singles: 4
Doubles: 12
Triples: 16
Quadruples: 7
Quintuples and higher excitation levels: 0

Contents

1 Singles

Diagram 1:

$$\frac{1}{4}\sum \frac{v_{abij}v_{ijak}v_{kclm}v_{lmbc}}{\epsilon_{ab}^{ij}\ \epsilon_{b}^{k}\ \epsilon_{bc}^{lm}} \tag{1}$$

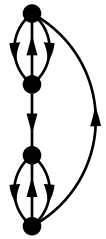


Diagram 2: Complex conjugate diagram: 3

$$-\frac{1}{4}\sum \frac{v_{abij}v_{ijak}v_{cdbl}v_{klcd}}{\epsilon_{ab}^{ij}\ \epsilon_{b}^{k}\ \epsilon_{cd}^{kl}} \tag{2}$$

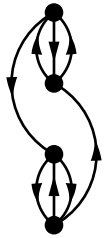


Diagram 3: Complex conjugate diagram: 2

$$-\frac{1}{4}\sum \frac{v_{abij}v_{icab}v_{jdkl}v_{klcd}}{\epsilon_{ab}^{ij}\ \epsilon_{c}^{j}\ \epsilon_{cd}^{kl}} \tag{3}$$

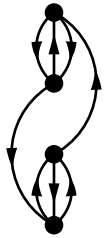
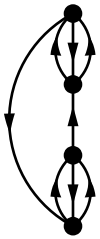


Diagram 4:

$$\frac{1}{4}\sum \frac{v_{abij}v_{icab}v_{deck}v_{jkde}}{\epsilon_{ab}^{ij}\ \epsilon_{c}^{j}\ \epsilon_{de}^{jk}} \tag{4}$$



2 Doubles

Diagram 5:

$$\frac{1}{16}\sum \frac{v_{abij}v_{ijkl}v_{klmn}v_{mnab}}{\epsilon_{ab}^{ij}\ \epsilon_{ab}^{kl}\ \epsilon_{ab}^{mn}} \tag{5}$$

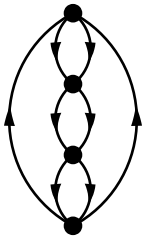


Diagram 6: Complex conjugate diagram: 8

$$\frac{1}{2}\sum \frac{v_{abij}v_{ijkl}v_{kcam}v_{lmbc}}{\epsilon_{ab}^{ij}\ \epsilon_{ab}^{kl}\ \epsilon_{bc}^{lm}} \tag{6}$$

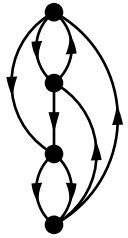


Diagram 7: Complex conjugate diagram: 14

$$\frac{1}{16}\sum \frac{v_{abij}v_{ijkl}v_{cdab}v_{klcd}}{\epsilon_{ab}^{ij}\ \epsilon_{ab}^{kl}\ \epsilon_{cd}^{kl}} \tag{7}$$

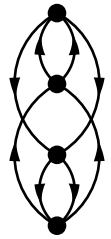


Diagram 8: Complex conjugate diagram: 6

$$\frac{1}{2}\sum \frac{v_{abij}v_{icak}v_{jklm}v_{lmbc}}{\epsilon_{ab}^{ij}\ \epsilon_{bc}^{jk}\ \epsilon_{bc}^{lm}} \tag{8}$$

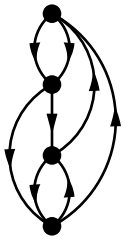


Diagram 9:

$$\sum \frac{v_{abik}v_{icaj}v_{jdcl}v_{klbd}}{\epsilon_{ab}^{ik}\ \epsilon_{cb}^{jk}\ \epsilon_{bd}^{kl}} \tag{9}$$

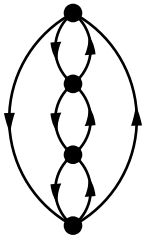


Diagram 10:

$$-\sum \frac{v_{abij}v_{icak}v_{jdcl}v_{klbd}}{\epsilon_{ab}^{ij}\ \epsilon_{cb}^{jk}\ \epsilon_{bd}^{kl}} \tag{10}$$

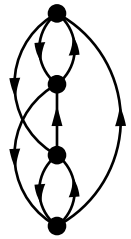


Diagram 11:

$$-\sum \frac{v_{abik}v_{icaj}v_{jdbl}v_{klcd}}{\epsilon_{ab}^{ik}\ \epsilon_{bc}^{jk}\ \epsilon_{cd}^{kl}} \tag{11}$$

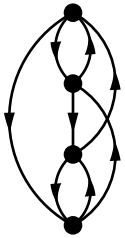


Diagram 12:

$$\sum \frac{v_{abij}v_{icak}v_{jdbl}v_{klcd}}{\epsilon_{ab}^{ij}\ \epsilon_{bc}^{jk}\ \epsilon_{cd}^{kl}} \tag{12}$$

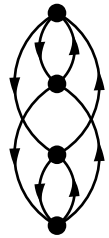


Diagram 13: Complex conjugate diagram: 15

$$\frac{1}{2}\sum \frac{v_{abij}v_{icak}v_{debc}v_{jkde}}{\epsilon_{ab}^{ij}\ \epsilon_{bc}^{jk}\ \epsilon_{de}^{jk}} \tag{13}$$

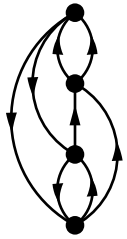


Diagram 14: Complex conjugate diagram: 7

$$\frac{1}{16}\sum \frac{v_{abij}v_{cdab}v_{ijkl}v_{klcd}}{\epsilon_{ab}^{ij}\ \epsilon_{cd}^{ij}\ \epsilon_{cd}^{kl}} \tag{14}$$

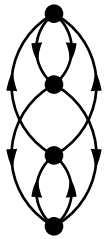


Diagram 15: Complex conjugate diagram: 13

$$\frac{1}{2}\sum \frac{v_{abij}v_{cdab}v_{ieck}v_{jkde}}{\epsilon_{ab}^{ij}\ \epsilon_{cd}^{ij}\ \epsilon_{de}^{jk}} \tag{15}$$

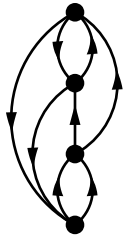
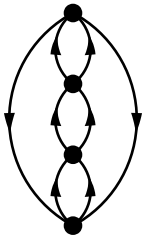


Diagram 16:

$$\frac{1}{16}\sum \frac{v_{abij}v_{cdab}v_{efcd}v_{ijef}}{\epsilon_{ab}^{ij}\ \epsilon_{cd}^{ij}\ \epsilon_{ef}^{ij}} \tag{16}$$



3 Triples

Diagram 17:

$$\frac{1}{4}\sum \frac{v_{abil}v_{icjk}v_{jkcm}v_{lmab}}{\epsilon_{ab}^{il}\ \epsilon_{cab}^{jkl}\ \epsilon_{ab}^{lm}} \tag{17}$$

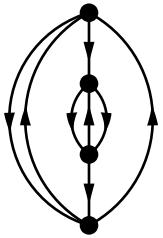


Diagram 18:

$$\frac{1}{2}\sum \frac{v_{abij}v_{ickl}v_{jkcm}v_{lmab}}{\epsilon_{ab}^{ij}\ \epsilon_{cab}^{jkl}\ \epsilon_{ab}^{lm}} \tag{18}$$

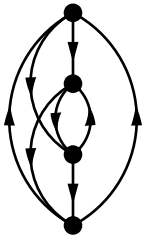


Diagram 19:

$$\frac{1}{2}\sum \frac{v_{abil}v_{icjk}v_{jkam}v_{lmbc}}{\epsilon_{ab}^{il}\ \epsilon_{abc}^{jkl}\ \epsilon_{bc}^{lm}} \tag{19}$$

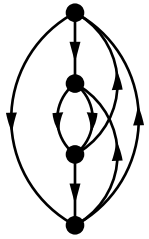


Diagram 20:

$$\sum \frac{v_{abij}v_{ickl}v_{jkam}v_{lmbc}}{\epsilon_{ab}^{ij}\ \epsilon_{abc}^{jkl}\ \epsilon_{bc}^{lm}} \tag{20}$$

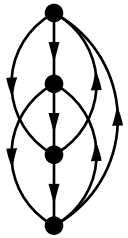


Diagram 21: Complex conjugate diagram: 25

$$-\sum \frac{v_{abik}v_{icjl}v_{jdac}v_{klbd}}{\epsilon_{ab}^{ik}\ \epsilon_{acb}^{jkl}\ \epsilon_{bd}^{kl}} \tag{21}$$

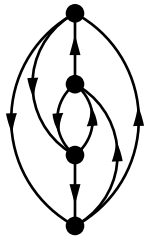


Diagram 22: Complex conjugate diagram: 26

$$\frac{1}{2}\sum \frac{v_{abij}v_{ickl}v_{jdac}v_{klbd}}{\epsilon_{ab}^{ij}\ \epsilon_{acb}^{jkl}\ \epsilon_{bd}^{kl}} \tag{22}$$

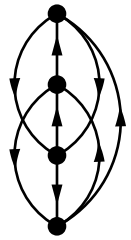


Diagram 23: Complex conjugate diagram: 29

$$\frac{1}{2}\sum \frac{v_{abik}v_{icjl}v_{jdab}v_{klcd}}{\epsilon_{ab}^{ik}\ \epsilon_{abc}^{jkl}\ \epsilon_{cd}^{kl}} \tag{23}$$

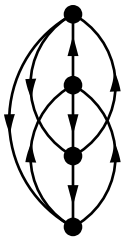


Diagram 24: Complex conjugate diagram: 30

$$-\frac{1}{4}\sum \frac{v_{abij}v_{ickl}v_{jdab}v_{klcd}}{\epsilon_{ab}^{ij}\ \epsilon_{abc}^{jkl}\ \epsilon_{cd}^{kl}} \tag{24}$$

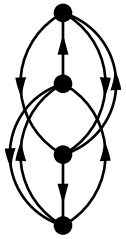


Diagram 25: Complex conjugate diagram: 21

$$-\sum \frac{v_{abik} v_{cdaj} v_{ijcl} v_{klbd}}{\epsilon_{ab}^{ik}\ \epsilon_{cbd}^{ijk}\ \epsilon_{bd}^{kl}} \tag{25}$$

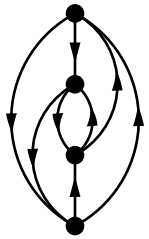


Diagram 26: Complex conjugate diagram: 22

$$\frac{1}{2}\sum \frac{v_{abij} v_{cdak} v_{ijcl} v_{klbd}}{\epsilon_{ab}^{ij}\ \epsilon_{cbd}^{ijk}\ \epsilon_{bd}^{kl}} \tag{26}$$

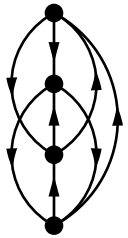


Diagram 27:

$$\frac{1}{4}\sum \frac{v_{abjk} v_{cdai} v_{iecd} v_{jkbe}}{\epsilon_{ab}^{jk}\ \epsilon_{cdb}^{ijk}\ \epsilon_{be}^{jk}} \tag{27}$$

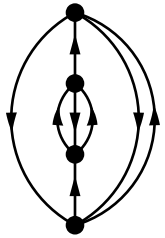


Diagram 28:

$$\frac{1}{2}\sum \frac{v_{abij}v_{cdak}v_{iecd}v_{jkbe}}{\epsilon_{ab}^{ij}\ \epsilon_{cdb}^{ijk}\ \epsilon_{be}^{jk}} \tag{28}$$

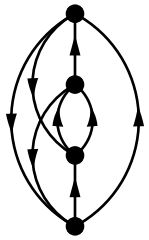


Diagram 29: Complex conjugate diagram: 23

$$\frac{1}{2}\sum \frac{v_{abik}v_{cdaj}v_{ijbl}v_{klcd}}{\epsilon_{ab}^{ik}\ \epsilon_{bcd}^{ijk}\ \epsilon_{cd}^{kl}} \tag{29}$$

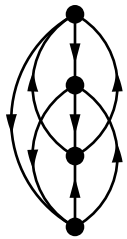


Diagram 30: Complex conjugate diagram: 24

$$-\frac{1}{4}\sum \frac{v_{abij}v_{cdak}v_{ijbl}v_{klcd}}{\epsilon_{ab}^{ij}\ \epsilon_{bcd}^{ijk}\ \epsilon_{cd}^{kl}} \tag{30}$$

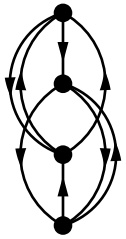


Diagram 31:

$$\frac{1}{2}\sum \frac{v_{abjk}v_{cdai}v_{iebc}v_{jkde}}{\epsilon_{ab}^{jk}\ \epsilon_{bcd}^{ijk}\ \epsilon_{de}^{jk}} \tag{31}$$

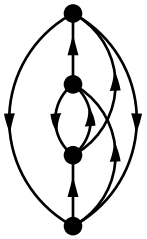
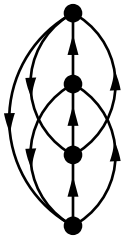


Diagram 32:

$$\sum \frac{v_{abij}v_{cdak}v_{iebc}v_{jkde}}{\epsilon_{ab}^{ij}\ \epsilon_{bcd}^{ijk}\ \epsilon_{de}^{jk}} \tag{32}$$



4 Quadruples

Diagram 33:

$$-\frac{1}{4}\sum \frac{v_{abik}v_{cdjl}v_{ijcd}v_{klab}}{\epsilon_{ab}^{ik}\ \epsilon_{cdab}^{ijkl}\ \epsilon_{ab}^{kl}} \tag{33}$$

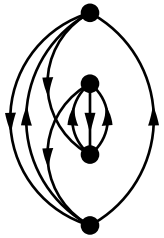


Diagram 34:

$$\frac{1}{16}\sum \frac{v_{abij}v_{cdkl}v_{ijcd}v_{klab}}{\epsilon_{ab}^{ij}\ \epsilon_{cdab}^{ijkl}\ \epsilon_{ab}^{kl}} \tag{34}$$

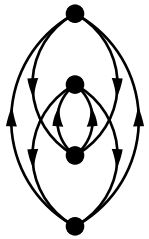


Diagram 35:

$$-\frac{1}{4}\sum \frac{v_{abkl}v_{cdij}v_{ijac}v_{klbd}}{\epsilon_{ab}^{kl}\ \epsilon_{acbd}^{ijkl}\ \epsilon_{bd}^{kl}} \tag{35}$$

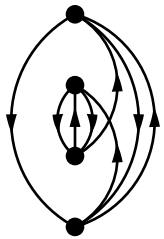


Diagram 36:

$$\sum \frac{v_{abik}v_{cdjl}v_{ijac}v_{klbd}}{\epsilon_{ab}^{ik}\ \epsilon_{acbd}^{ijkl}\ \epsilon_{bd}^{kl}} \tag{36}$$

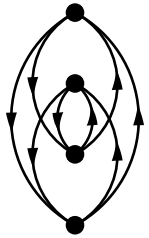


Diagram 37:

$$-\frac{1}{4}\sum \frac{v_{abij}v_{cdkl}v_{ijac}v_{klbd}}{\epsilon_{ab}^{ij}\ \epsilon_{acbd}^{ijkl}\ \epsilon_{bd}^{kl}} \tag{37}$$

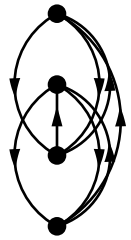


Diagram 38:

$$\frac{1}{16}\sum \frac{v_{abkl}v_{cdij}v_{ijab}v_{klcd}}{\epsilon_{ab}^{kl}\ \epsilon_{abcd}^{ijkl}\ \epsilon_{cd}^{kl}} \tag{38}$$

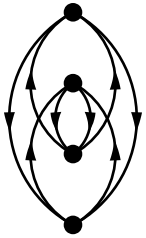


Diagram 39:

$$-\frac{1}{4}\sum \frac{v_{abik}v_{cdjl}v_{ijab}v_{klcd}}{\epsilon_{ab}^{ik}\ \epsilon_{abcd}^{ijkl}\ \epsilon_{cd}^{kl}} \tag{39}$$