

Tetrakis(triphenylphosphane- κP)silver(I) tetrafluoridoborate

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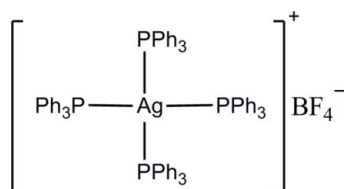
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Key indicators: single-crystal X-ray study; $T = 298$ K; mean $\sigma(\text{C}-\text{C}) = 0.010$ Å; disorder in solvent or counterion; R factor = 0.063; wR factor = 0.160; data-to-parameter ratio = 13.0.

The title complex, $[\text{Ag}(\text{C}_{18}\text{H}_{15}\text{P})_4]\text{BF}_4$, was prepared by the reaction of silver(I) tetrafluoridoborate and triphenylphosphane in the presence of 1,2-bis(pyridin-2-yl)ethylene. The Ag^{I} atom is tetrahedrally coordinated by four P atoms from triphenylphosphane (PPh_3) ligands. Due to symmetry, the tetrafluoridoborate anion is disordered over three positions (each with one third occupancy). The tetrafluoridoborate anion does not coordinate to the Ag^{I} atom.

Related literature

For background to silver(I) complexes, see: Bowmaker *et al.* (1993); Cui, Hu *et al.* (2010); Cui, Jin *et al.* (2010); Jin, Hu *et al.* (2010); Jin, Song *et al.* (2010); Meijboom *et al.* (2009). For related structures, see: Engelhardt *et al.* (1985); Wen *et al.* (2011).



Experimental

Crystal data

$[\text{Ag}(\text{C}_{18}\text{H}_{15}\text{P})_4]\text{BF}_4$

$M_r = 1243.76$

Trigonal, $R\bar{3}$
 $a = 14.2445$ (12) Å
 $c = 51.591$ (4) Å
 $V = 9065.7$ (12) Å³
 $Z = 6$

Mo $K\alpha$ radiation
 $\mu = 0.50$ mm⁻¹
 $T = 298$ K
 $0.30 \times 0.18 \times 0.15$ mm

Data collection

Bruker SMART 1000 CCD diffractometer
 Absorption correction: multi-scan (*SADABS*; Bruker, 2007)
 $T_{\text{min}} = 0.866$, $T_{\text{max}} = 0.930$

15472 measured reflections
 3548 independent reflections
 2167 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.092$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.063$
 $wR(F^2) = 0.160$
 $S = 1.07$
 3548 reflections
 272 parameters

1 restraint
 H-atom parameters constrained
 $\Delta\rho_{\text{max}} = 1.34$ e Å⁻³
 $\Delta\rho_{\text{min}} = -0.52$ e Å⁻³

Data collection: *SMART* (Bruker, 2007); cell refinement: *SAINT-Plus* (Bruker, 2007); data reduction: *SAINT-Plus*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXTL*.

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: EZ2286).

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supplementary materials

Acta Cryst. (2012). E68, m706 [doi:10.1107/S1600536812018247]

Tetrakis(triphenylphosphane- κ P)silver(I) tetrafluoridoborate

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Comment

The coordination chemistry of silver(I) is of considerable interest because of the luminescence properties and potential applications of silver(I) complexes in catalysis, cyanide, photography antimicrobial activities and electrochemical processes (Bowmaker *et al.*, 1993; Cui, Hu *et al.*, 2010; Cui, Jin *et al.*, 2010; Jin, Hu *et al.*, 2010; Jin, Song *et al.*, 2010; Meijboom *et al.*, 2009). In our previous work, we obtained an Ag^I complex containing triphenylphosphane and trifluoromethanesulfonate ligands [Ag(PPh₃)₄(SO₃CF₃)] (Wen *et al.*, 2011). In this paper, we report a similar new silver(I) compound [Ag(P(C₆H₅)₃)₄](BF₄).

The title compound is isomorphous with both [Ag(PPh₃)₄]ClO₄ (Engelhardt *et al.*, 1985) and [Ag(PPh₃)₄](SO₃CF₃) (Wen *et al.*, 2011). The silver atom is coordinated by four P atoms from four triphenylphosphane ligands to form a tetrahedral geometry around the silver atom.

In [Ag(P(C₆H₅)₃)₄](BF₄), the Ag—P bond lengths are in the range 2.633 (2)–2.6774 (13) Å, which agrees with those in the compound [Ag(PPh₃)₄(SO₃CF₃)] (Wen *et al.*, 2011). The distorted P—Ag—P bite angles [P2—Ag1—P1 = 109.45 (3)°, P1—Ag1—P1 = 109.49 (3)°] are similar to the corresponding values for [Ag(PPh₃)₄(SO₃CF₃)] (Wen *et al.*, 2011), too.

Experimental

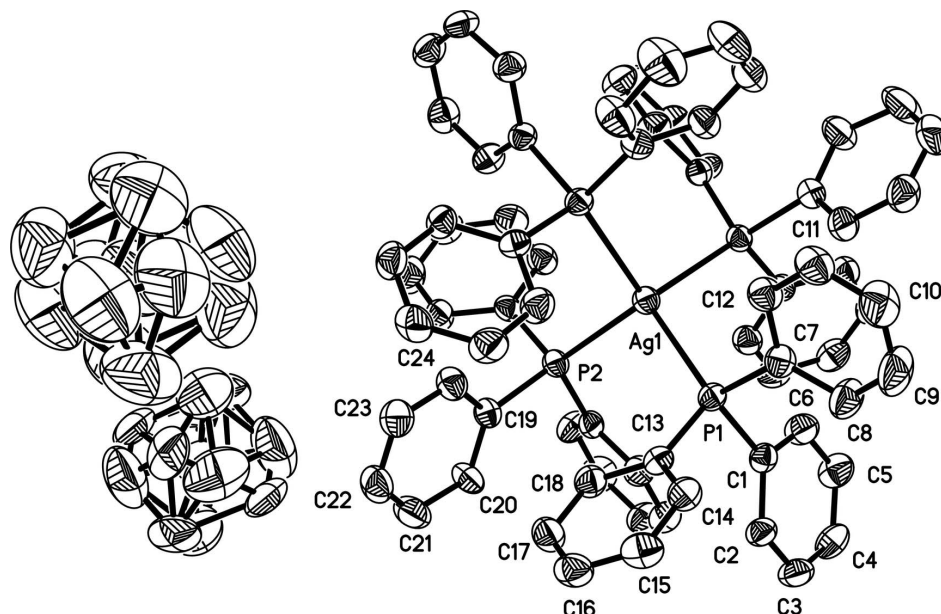
A mixture of silver(I) tetrafluoridoborate and triphenylphosphane (PPh₃) (molar ratio 1:1) and 1,2-di(2-pyridyl)ethylene (0.2 mmol) in the mixed solution of CH₃OH (5 ml)/CH₂Cl₂ (5 ml) was stirred for 6 h at ambient temperature. The insoluble residues were removed by filtration, and the filtrate was evaporated slowly at room temperature for about three days to yield colorless crystals. Crystals suitable for single-crystal X-ray diffraction were selected directly from the sample as prepared.

Refinement

H-atoms were positioned and refined using a riding model, with aromatic C—H = 0.93 Å, and the displacement parameters set for phenyl, H atoms at $U_{\text{iso}}(\text{H})=1.2U_{\text{eq}}(\text{C})$.

Computing details

Data collection: *SMART* (Bruker, 2007); cell refinement: *SAINTE-Plus* (Bruker, 2007); data reduction: *SAINTE-Plus* (Bruker, 2007); program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXTL* (Sheldrick, 2008).


Figure 1

The molecular entities of the title compound, showing the atom-numbering scheme and with displacement ellipsoids drawn at the 50% probability level.

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Crystal data

[Ag(C₁₈H₁₅P)₄]BF₄
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 Trigonal, $R\bar{3}$
 $a = 14.2445$ (12) Å
 $c = 51.591$ (4) Å
 $V = 9065.7$ (12) Å³
 $Z = 6$
 $F(000) = 3840$

$D_x = 1.367$ Mg m⁻³
 Mo $K\alpha$ radiation, $\lambda = 0.71073$ Å
 Cell parameters from 2109 reflections
 $\theta = 2.4$ – 18.9°
 $\mu = 0.50$ mm⁻¹
 $T = 298$ K
 White, block
 $0.30 \times 0.18 \times 0.15$ mm

Data collection

Bruker SMART 1000 CCD
 diffractometer
 Radiation source: fine-focus sealed tube
 Graphite monochromator
 phi and ω scans
 Absorption correction: multi-scan
 (SADABS; Bruker, 2007)
 $T_{\min} = 0.866$, $T_{\max} = 0.930$

15472 measured reflections
 3548 independent reflections
 2167 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.092$
 $\theta_{\max} = 25.0^\circ$, $\theta_{\min} = 2.3^\circ$
 $h = -16 \rightarrow 16$
 $k = -15 \rightarrow 16$
 $l = -61 \rightarrow 40$

Refinement

Refinement on F^2
 Least-squares matrix: full
 $R[F^2 > 2\sigma(F^2)] = 0.063$
 $wR(F^2) = 0.160$
 $S = 1.07$
 3548 reflections
 272 parameters

1 restraint
 Primary atom site location: structure-invariant
 direct methods
 Secondary atom site location: difference Fourier
 map
 Hydrogen site location: inferred from
 neighbouring sites

H-atom parameters constrained
 $w = 1/[\sigma^2(F_o^2) + (0.0699P)^2]$
 where $P = (F_o^2 + 2F_c^2)/3$

$(\Delta/\sigma)_{\max} = 0.001$
 $\Delta\rho_{\max} = 1.34 \text{ e } \text{\AA}^{-3}$
 $\Delta\rho_{\min} = -0.52 \text{ e } \text{\AA}^{-3}$

Special details

Geometry. All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted R -factor wR and goodness of fit S are based on F^2 , conventional R -factors R are based on F , with F set to zero for negative F^2 . The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating R -factors(gt) *etc.* and is not relevant to the choice of reflections for refinement. R -factors based on F^2 are statistically about twice as large as those based on F , and R -factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (\AA^2)

	<i>x</i>	<i>y</i>	<i>z</i>	$U_{\text{iso}}^*/U_{\text{eq}}$	Occ. (<1)
Ag1	0.6667	0.3333	0.081276 (13)	0.0476 (3)	
P1	0.80962 (10)	0.53162 (10)	0.06400 (3)	0.0464 (4)	
P2	0.6667	0.3333	0.13231 (4)	0.0475 (6)	
F1	0.364 (3)	0.600 (2)	0.1780 (6)	0.112 (6)	0.33
F2	0.273 (4)	0.604 (2)	0.1863 (5)	0.166 (11)	0.33
F3	0.021 (3)	0.921 (2)	0.0089 (5)	0.140 (6)	0.33
F4	-0.023 (4)	1.036 (3)	0.0208 (3)	0.146 (9)	0.33
B1	0.3333	0.6667	0.1667	0.113 (9)	
B2	0.0000	1.0000	0.0000	0.130 (10)	
C1	0.9477 (4)	0.5677 (4)	0.07293 (10)	0.0490 (13)	
C2	1.0219 (4)	0.6654 (4)	0.08427 (11)	0.0575 (14)	
H2	1.0038	0.7192	0.0865	0.069*	
C3	1.1221 (5)	0.6841 (5)	0.09236 (13)	0.0707 (17)	
H3	1.1708	0.7502	0.0999	0.085*	
C4	1.1502 (5)	0.6060 (5)	0.08940 (13)	0.0742 (18)	
H4	1.2170	0.6179	0.0953	0.089*	
C5	1.0794 (5)	0.5100 (5)	0.07767 (14)	0.0774 (19)	
H5	1.0994	0.4578	0.0749	0.093*	
C6	0.9783 (5)	0.4904 (5)	0.06992 (12)	0.0702 (17)	
H6	0.9299	0.4239	0.0625	0.084*	
C7	0.8161 (4)	0.5488 (4)	0.02889 (11)	0.0566 (15)	
C8	0.9121 (5)	0.6150 (6)	0.01588 (12)	0.083 (2)	
H8	0.9780	0.6462	0.0246	0.099*	
C9	0.9082 (6)	0.6344 (7)	-0.01077 (15)	0.111 (3)	
H9	0.9714	0.6824	-0.0195	0.133*	
C10	0.8122 (7)	0.5829 (7)	-0.02380 (14)	0.097 (2)	
H10	0.8104	0.5951	-0.0415	0.117*	
C11	0.7195 (6)	0.5142 (6)	-0.01119 (13)	0.0782 (18)	
H11	0.6550	0.4776	-0.0204	0.094*	
C12	0.7192 (5)	0.4979 (5)	0.01485 (11)	0.0648 (16)	
H12	0.6543	0.4528	0.0233	0.078*	
C13	0.8024 (4)	0.6496 (4)	0.07541 (10)	0.0486 (13)	
C14	0.8377 (4)	0.7441 (4)	0.06072 (12)	0.0626 (15)	

H14	0.8596	0.7463	0.0436	0.075*
C15	0.8401 (5)	0.8340 (5)	0.07156 (14)	0.0731 (18)
H15	0.8654	0.8973	0.0619	0.088*
C16	0.8049 (5)	0.8295 (5)	0.09661 (15)	0.0754 (19)
H16	0.8075	0.8905	0.1039	0.090*
C17	0.7665 (5)	0.7372 (5)	0.11083 (12)	0.0705 (17)
H17	0.7405	0.7345	0.1275	0.085*
C18	0.7660 (4)	0.6478 (5)	0.10054 (11)	0.0612 (15)
H18	0.7410	0.5854	0.1105	0.073*
C19	0.6357 (4)	0.4300 (4)	0.14761 (10)	0.0493 (13)
C20	0.6937 (5)	0.4944 (5)	0.16853 (11)	0.0652 (16)
H20	0.7538	0.4923	0.1749	0.078*
C21	0.6615 (6)	0.5616 (5)	0.17986 (13)	0.085 (2)
H21	0.6982	0.6021	0.1944	0.101*
C22	0.5770 (6)	0.5693 (5)	0.17011 (14)	0.0799 (19)
H22	0.5571	0.6161	0.1777	0.096*
C23	0.5210 (5)	0.5077 (5)	0.14904 (13)	0.0760 (18)
H23	0.4633	0.5131	0.1423	0.091*
C24	0.5495 (5)	0.4394 (5)	0.13809 (12)	0.0641 (16)
H24	0.5106	0.3978	0.1239	0.077*

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Ag1	0.0492 (3)	0.0492 (3)	0.0444 (5)	0.02459 (16)	0.000	0.000
P1	0.0451 (8)	0.0450 (7)	0.0468 (9)	0.0208 (6)	0.0015 (6)	0.0032 (6)
P2	0.0519 (9)	0.0519 (9)	0.0387 (13)	0.0260 (4)	0.000	0.000
F1	0.124 (15)	0.082 (12)	0.163 (18)	0.076 (10)	-0.001 (18)	0.001 (14)
F2	0.16 (3)	0.12 (2)	0.17 (2)	0.038 (15)	0.014 (19)	0.048 (16)
F3	0.158 (18)	0.134 (19)	0.14 (2)	0.081 (14)	0.01 (2)	0.020 (17)
F4	0.17 (3)	0.15 (3)	0.098 (12)	0.066 (18)	0.02 (2)	-0.027 (17)
B1	0.094 (15)	0.094 (15)	0.15 (3)	0.047 (7)	0.000	0.000
B2	0.14 (2)	0.14 (2)	0.10 (4)	0.071 (12)	0.000	0.000
C1	0.048 (3)	0.045 (3)	0.054 (3)	0.024 (3)	0.005 (3)	0.006 (3)
C2	0.043 (3)	0.054 (3)	0.074 (4)	0.022 (3)	-0.003 (3)	-0.005 (3)
C3	0.053 (4)	0.060 (4)	0.087 (5)	0.019 (3)	-0.011 (3)	-0.011 (3)
C4	0.041 (3)	0.085 (5)	0.095 (5)	0.030 (4)	-0.003 (3)	0.008 (4)
C5	0.060 (4)	0.071 (4)	0.111 (6)	0.040 (4)	-0.001 (4)	-0.001 (4)
C6	0.058 (4)	0.062 (4)	0.088 (5)	0.028 (3)	-0.004 (3)	-0.004 (3)
C7	0.059 (4)	0.059 (4)	0.052 (3)	0.030 (3)	0.002 (3)	0.006 (3)
C8	0.062 (4)	0.109 (5)	0.061 (4)	0.030 (4)	0.005 (3)	0.019 (4)
C9	0.092 (6)	0.147 (8)	0.071 (5)	0.043 (5)	0.027 (5)	0.035 (5)
C10	0.105 (6)	0.138 (7)	0.054 (4)	0.065 (6)	-0.003 (5)	0.015 (5)
C11	0.087 (5)	0.096 (5)	0.061 (4)	0.054 (4)	-0.013 (4)	-0.004 (4)
C12	0.071 (4)	0.070 (4)	0.054 (4)	0.036 (3)	-0.005 (3)	-0.001 (3)
C13	0.044 (3)	0.044 (3)	0.054 (3)	0.019 (3)	0.000 (3)	0.004 (3)
C14	0.065 (4)	0.059 (4)	0.063 (4)	0.031 (3)	0.003 (3)	0.006 (3)
C15	0.084 (5)	0.052 (4)	0.092 (5)	0.040 (4)	-0.010 (4)	0.007 (4)
C16	0.074 (4)	0.058 (4)	0.100 (6)	0.037 (4)	-0.009 (4)	-0.012 (4)
C17	0.069 (4)	0.078 (5)	0.072 (4)	0.042 (4)	-0.002 (3)	-0.014 (4)

C18	0.061 (4)	0.053 (3)	0.066 (4)	0.025 (3)	0.007 (3)	0.005 (3)
C19	0.057 (3)	0.057 (3)	0.039 (3)	0.032 (3)	0.000 (3)	0.003 (3)
C20	0.079 (4)	0.074 (4)	0.061 (4)	0.051 (4)	-0.015 (3)	-0.023 (3)
C21	0.095 (5)	0.087 (5)	0.074 (5)	0.047 (4)	-0.015 (4)	-0.026 (4)
C22	0.092 (5)	0.075 (4)	0.088 (5)	0.053 (4)	0.011 (4)	-0.008 (4)
C23	0.076 (4)	0.081 (4)	0.082 (5)	0.048 (4)	0.001 (4)	0.001 (4)
C24	0.070 (4)	0.075 (4)	0.054 (4)	0.042 (3)	-0.002 (3)	-0.004 (3)

Geometric parameters (Å, °)

Ag1—P2	2.633 (2)	B2—F3 ^{viii}	1.38 (2)
Ag1—P1 ⁱ	2.6772 (13)	B2—F3 ^{ix}	1.38 (2)
Ag1—P1	2.6772 (13)	B2—F3 ^x	1.38 (2)
Ag1—P1 ⁱⁱ	2.6772 (13)	B2—F3 ^{xi}	1.38 (2)
P1—C7	1.824 (6)	C1—C6	1.380 (7)
P1—C1	1.826 (5)	C1—C2	1.388 (7)
P1—C13	1.831 (5)	C2—C3	1.379 (7)
P2—C19 ⁱ	1.822 (5)	C2—H2	0.9300
P2—C19 ⁱⁱ	1.822 (5)	C3—C4	1.367 (8)
P2—C19	1.822 (5)	C3—H3	0.9300
F1—F2 ⁱⁱⁱ	0.97 (4)	C4—C5	1.369 (8)
F1—B1	1.37 (2)	C4—H4	0.9300
F1—F2	1.39 (5)	C5—C6	1.382 (8)
F1—F2 ^{iv}	1.66 (2)	C5—H5	0.9300
F1—F1 ^{iv}	1.70 (4)	C6—H6	0.9300
F1—F1 ^v	1.70 (4)	C7—C8	1.386 (8)
F2—F1 ^{vi}	0.97 (4)	C7—C12	1.398 (8)
F2—B1	1.34 (3)	C8—C9	1.409 (9)
F2—F2 ⁱⁱⁱ	1.52 (4)	C8—H8	0.9300
F2—F2 ^{vi}	1.52 (4)	C9—C10	1.363 (10)
F2—F1 ^v	1.66 (2)	C9—H9	0.9300
F3—F4 ^{vii}	1.16 (4)	C10—C11	1.353 (9)
F3—B2	1.38 (2)	C10—H10	0.9300
F3—F4 ^{viii}	1.42 (5)	C11—C12	1.363 (8)
F3—F3 ^{ix}	1.59 (3)	C11—H11	0.9300
F3—F3 ^x	1.59 (3)	C12—H12	0.9300
F3—F4 ^{xi}	1.65 (3)	C13—C18	1.392 (7)
F4—F3 ^{viii}	1.16 (4)	C13—C14	1.401 (7)
F4—F4 ^{vii}	1.27 (4)	C14—C15	1.382 (8)
F4—F4 ^{viii}	1.27 (4)	C14—H14	0.9300
F4—B2	1.301 (18)	C15—C16	1.376 (9)
F4—F3 ^{vii}	1.42 (5)	C15—H15	0.9300
F4—F3 ^{xi}	1.65 (3)	C16—C17	1.359 (8)
B1—F2 ^{iv}	1.34 (3)	C16—H16	0.9300
B1—F2 ^{xii}	1.34 (3)	C17—C18	1.377 (8)
B1—F2 ^v	1.34 (3)	C17—H17	0.9300
B1—F2 ^{vi}	1.34 (3)	C18—H18	0.9300
B1—F2 ⁱⁱⁱ	1.34 (3)	C19—C24	1.389 (7)
B1—F1 ^{iv}	1.37 (2)	C19—C20	1.390 (7)
B1—F1 ^v	1.37 (2)	C20—C21	1.381 (8)

B1—F1 ^{vi}	1.37 (2)	C20—H20	0.9300
B1—F1 ⁱⁱⁱ	1.37 (2)	C21—C22	1.360 (9)
B1—F1 ^{xii}	1.37 (2)	C21—H21	0.9300
B2—F4 ^{viii}	1.301 (18)	C22—C23	1.374 (9)
B2—F4 ^{vii}	1.301 (18)	C22—H22	0.9300
B2—F4 ^{xi}	1.301 (18)	C23—C24	1.352 (8)
B2—F4 ^x	1.301 (18)	C23—H23	0.9300
B2—F4 ^{ix}	1.301 (18)	C24—H24	0.9300
B2—F3 ^{vii}	1.38 (2)		
P2—Ag1—P1 ⁱ	109.45 (3)	F1 ^{vi} —B1—F1 ^{xii}	76.9 (13)
P2—Ag1—P1	109.45 (3)	F1 ⁱⁱⁱ —B1—F1 ^{xii}	76.9 (13)
P1 ⁱ —Ag1—P1	109.49 (3)	F1—B1—F1 ^{xii}	179.994 (18)
P2—Ag1—P1 ⁱⁱ	109.45 (3)	F4 ^{viii} —B2—F4 ^{vii}	58.5 (15)
P1 ⁱ —Ag1—P1 ⁱⁱ	109.49 (3)	F4 ^{viii} —B2—F4	58.5 (15)
P1—Ag1—P1 ⁱⁱ	109.49 (3)	F4 ^{vii} —B2—F4	58.5 (15)
C7—P1—C1	103.8 (2)	F4 ^{viii} —B2—F4 ^{xi}	121.5 (15)
C7—P1—C13	102.6 (2)	F4 ^{vii} —B2—F4 ^{xi}	121.5 (15)
C1—P1—C13	102.0 (2)	F4—B2—F4 ^{xi}	180.0 (8)
C7—P1—Ag1	115.64 (18)	F4 ^{viii} —B2—F4 ^x	121.5 (15)
C1—P1—Ag1	110.91 (16)	F4 ^{vii} —B2—F4 ^x	180 (2)
C13—P1—Ag1	119.93 (17)	F4—B2—F4 ^x	121.5 (15)
C19 ⁱ —P2—C19 ⁱⁱ	102.6 (2)	F4 ^{xi} —B2—F4 ^x	58.5 (15)
C19 ⁱ —P2—C19	102.6 (2)	F4 ^{viii} —B2—F4 ^{ix}	180.0 (8)
C19 ⁱⁱ —P2—C19	102.6 (2)	F4 ^{vii} —B2—F4 ^{ix}	121.5 (15)
C19 ⁱ —P2—Ag1	115.66 (17)	F4—B2—F4 ^{ix}	121.5 (15)
C19 ⁱⁱ —P2—Ag1	115.66 (17)	F4 ^{xi} —B2—F4 ^{ix}	58.5 (15)
C19—P2—Ag1	115.66 (17)	F4 ^x —B2—F4 ^{ix}	58.5 (15)
F2 ⁱⁱⁱ —F1—B1	67 (3)	F4 ^{viii} —B2—F3 ^{vii}	51 (2)
F2 ⁱⁱⁱ —F1—F2	78 (3)	F4 ^{vii} —B2—F3 ^{vii}	104.3 (14)
B1—F1—F2	58.1 (14)	F4—B2—F3 ^{vii}	64 (2)
F2 ⁱⁱⁱ —F1—F2 ^{iv}	111 (4)	F4 ^{xi} —B2—F3 ^{vii}	116 (2)
B1—F1—F2 ^{iv}	51.4 (15)	F4 ^x —B2—F3 ^{vii}	75.7 (14)
F2—F1—F2 ^{iv}	92 (2)	F4 ^{ix} —B2—F3 ^{vii}	129 (2)
F2 ⁱⁱⁱ —F1—F1 ^{iv}	71 (2)	F4 ^{viii} —B2—F3 ^{viii}	104.3 (14)
B1—F1—F1 ^{iv}	51.5 (7)	F4 ^{vii} —B2—F3 ^{viii}	64 (2)
F2—F1—F1 ^{iv}	109.3 (15)	F4—B2—F3 ^{viii}	51 (2)
F2 ^{iv} —F1—F1 ^{iv}	49 (2)	F4 ^{xi} —B2—F3 ^{viii}	129 (2)
F2 ⁱⁱⁱ —F1—F1 ^v	118 (3)	F4 ^x —B2—F3 ^{viii}	116 (2)
B1—F1—F1 ^v	51.5 (7)	F4 ^{ix} —B2—F3 ^{viii}	75.7 (14)
F2—F1—F1 ^v	64.0 (10)	F3 ^{vii} —B2—F3 ^{viii}	109.5 (10)
F2 ^{iv} —F1—F1 ^v	33.5 (15)	F4 ^{viii} —B2—F3 ^{ix}	75.7 (14)
F1 ^{iv} —F1—F1 ^v	78 (2)	F4 ^{vii} —B2—F3 ^{ix}	116 (2)
F1 ^{vi} —F2—B1	71 (3)	F4—B2—F3 ^{ix}	129 (2)
F1 ^{vi} —F2—F1	130 (5)	F4 ^{xi} —B2—F3 ^{ix}	51 (2)
B1—F2—F1	60 (2)	F4 ^x —B2—F3 ^{ix}	64 (2)
F1 ^{vi} —F2—F2 ⁱⁱⁱ	117 (3)	F4 ^{ix} —B2—F3 ^{ix}	104.3 (14)
B1—F2—F2 ⁱⁱⁱ	55.4 (9)	F3 ^{vii} —B2—F3 ^{ix}	70.5 (10)
F1—F2—F2 ⁱⁱⁱ	39 (2)	F3 ^{viii} —B2—F3 ^{ix}	180 (2)

F1 ^{vi} —F2—F2 ^{vi}	63 (3)	F4 ^{viii} —B2—F3 ^x	129 (2)
B1—F2—F2 ^{vi}	55.4 (9)	F4 ^{vii} —B2—F3 ^x	75.7 (14)
F1—F2—F2 ^{vi}	95 (2)	F4—B2—F3 ^x	116 (2)
F2 ⁱⁱⁱ —F2—F2 ^{vi}	60.000 (9)	F4 ^{xi} —B2—F3 ^x	64 (2)
F1 ^{vi} —F2—F1 ^v	76 (3)	F4 ^x —B2—F3 ^x	104.3 (14)
B1—F2—F1 ^v	53.0 (11)	F4 ^{ix} —B2—F3 ^x	51 (2)
F1—F2—F1 ^v	67 (3)	F3 ^{vii} —B2—F3 ^x	180 (2)
F2 ⁱⁱⁱ —F2—F1 ^v	93.8 (19)	F3 ^{viii} —B2—F3 ^x	70.5 (10)
F2 ^{vi} —F2—F1 ^v	105.2 (11)	F3 ^{ix} —B2—F3 ^x	109.5 (10)
F4 ^{vii} —F3—B2	61.0 (17)	F4 ^{viii} —B2—F3	64 (2)
F4 ^{vii} —F3—F4 ^{viii}	58 (2)	F4 ^{vii} —B2—F3	51 (2)
B2—F3—F4 ^{viii}	55.5 (14)	F4—B2—F3	104.3 (14)
F4 ^{vii} —F3—F3 ^{ix}	110.8 (16)	F4 ^{xi} —B2—F3	75.7 (14)
B2—F3—F3 ^{ix}	54.7 (5)	F4 ^x —B2—F3	129 (2)
F4 ^{viii} —F3—F3 ^{ix}	66.1 (12)	F4 ^{ix} —B2—F3	116 (2)
F4 ^{vii} —F3—F3 ^x	71.6 (15)	F3 ^{vii} —B2—F3	109.5 (10)
B2—F3—F3 ^x	54.7 (5)	F3 ^{viii} —B2—F3	109.5 (10)
F4 ^{viii} —F3—F3 ^x	106.9 (14)	F3 ^{ix} —B2—F3	70.5 (10)
F3 ^{ix} —F3—F3 ^x	90 (2)	F3 ^x —B2—F3	70.5 (10)
F4 ^{vii} —F3—F4 ^{xi}	107 (3)	F4 ^{viii} —B2—F3 ^{xi}	116 (2)
B2—F3—F4 ^{xi}	50.0 (13)	F4 ^{vii} —B2—F3 ^{xi}	129 (2)
F4 ^{viii} —F3—F4 ^{xi}	95 (3)	F4—B2—F3 ^{xi}	75.7 (14)
F3 ^{ix} —F3—F4 ^{xi}	41.9 (19)	F4 ^{xi} —B2—F3 ^{xi}	104.3 (14)
F3 ^x —F3—F4 ^{xi}	52 (2)	F4 ^x —B2—F3 ^{xi}	51 (2)
F3 ^{viii} —F4—F4 ^{vii}	71 (4)	F4 ^{ix} —B2—F3 ^{xi}	64 (2)
F3 ^{viii} —F4—F4 ^{viii}	121 (3)	F3 ^{vii} —B2—F3 ^{xi}	70.5 (10)
F4 ^{vii} —F4—F4 ^{viii}	60.000 (6)	F3 ^{viii} —B2—F3 ^{xi}	70.5 (10)
F3 ^{viii} —F4—B2	67.9 (19)	F3 ^{ix} —B2—F3 ^{xi}	109.5 (10)
F4 ^{vii} —F4—B2	60.7 (7)	F3 ^x —B2—F3 ^{xi}	109.5 (10)
F4 ^{viii} —F4—B2	60.7 (7)	F3—B2—F3 ^{xi}	180 (2)
F3 ^{viii} —F4—F3 ^{vii}	122 (3)	C6—C1—C2	117.4 (5)
F4 ^{vii} —F4—F3 ^{vii}	104 (3)	C6—C1—P1	118.2 (4)
F4 ^{viii} —F4—F3 ^{vii}	51 (3)	C2—C1—P1	124.2 (4)
B2—F4—F3 ^{vii}	60.8 (19)	C3—C2—C1	121.2 (5)
F3 ^{viii} —F4—F3 ^{xi}	66.5 (14)	C3—C2—H2	119.4
F4 ^{vii} —F4—F3 ^{xi}	111.3 (13)	C1—C2—H2	119.4
F4 ^{viii} —F4—F3 ^{xi}	102 (2)	C4—C3—C2	120.3 (6)
B2—F4—F3 ^{xi}	54.3 (9)	C4—C3—H3	119.8
F3 ^{vii} —F4—F3 ^{xi}	62.1 (16)	C2—C3—H3	119.8
F2 ^{iv} —B1—F2 ^{xii}	69.2 (18)	C3—C4—C5	119.5 (6)
F2 ^{iv} —B1—F2 ^v	69.2 (18)	C3—C4—H4	120.2
F2 ^{xii} —B1—F2 ^v	69.2 (18)	C5—C4—H4	120.2
F2 ^{iv} —B1—F2 ^{vi}	180.0 (15)	C4—C5—C6	120.2 (6)
F2 ^{xii} —B1—F2 ^{vi}	110.8 (18)	C4—C5—H5	119.9
F2 ^v —B1—F2 ^{vi}	110.8 (18)	C6—C5—H5	119.9
F2 ^{iv} —B1—F2	110.8 (18)	C1—C6—C5	121.3 (6)
F2 ^{xii} —B1—F2	179.995 (13)	C1—C6—H6	119.3
F2 ^v —B1—F2	110.8 (18)	C5—C6—H6	119.3
F2 ^{vi} —B1—F2	69.2 (18)	C8—C7—C12	118.9 (5)

F2 ^{iv} —B1—F2 ⁱⁱⁱ	110.8 (18)	C8—C7—P1	122.6 (5)
F2 ^{xii} —B1—F2 ⁱⁱⁱ	110.8 (18)	C12—C7—P1	118.3 (4)
F2 ^v —B1—F2 ⁱⁱⁱ	179.994 (19)	C7—C8—C9	119.0 (6)
F2 ^{vi} —B1—F2 ⁱⁱⁱ	69.2 (18)	C7—C8—H8	120.5
F2—B1—F2 ⁱⁱⁱ	69.2 (18)	C9—C8—H8	120.5
F2 ^{iv} —B1—F1 ^{iv}	62 (2)	C10—C9—C8	120.2 (7)
F2 ^{xii} —B1—F1 ^{iv}	42.0 (17)	C10—C9—H9	119.9
F2 ^v —B1—F1 ^{iv}	104.4 (11)	C8—C9—H9	119.9
F2 ^{vi} —B1—F1 ^{iv}	118 (2)	C11—C10—C9	120.3 (7)
F2—B1—F1 ^{iv}	138.0 (17)	C11—C10—H10	119.8
F2 ⁱⁱⁱ —B1—F1 ^{iv}	75.6 (11)	C9—C10—H10	119.8
F2 ^{iv} —B1—F1 ^v	42.0 (18)	C10—C11—C12	121.1 (7)
F2 ^{xii} —B1—F1 ^v	104.4 (11)	C10—C11—H11	119.5
F2 ^v —B1—F1 ^v	62 (2)	C12—C11—H11	119.5
F2 ^{vi} —B1—F1 ^v	138.0 (17)	C11—C12—C7	120.3 (6)
F2—B1—F1 ^v	75.6 (11)	C11—C12—H12	119.9
F2 ⁱⁱⁱ —B1—F1 ^v	118 (2)	C7—C12—H12	119.9
F1 ^{iv} —B1—F1 ^v	103.1 (13)	C18—C13—C14	118.2 (5)
F2 ^{iv} —B1—F1 ^{vi}	118 (2)	C18—C13—P1	118.3 (4)
F2 ^{xii} —B1—F1 ^{vi}	138.0 (17)	C14—C13—P1	123.4 (4)
F2 ^v —B1—F1 ^{vi}	75.6 (11)	C15—C14—C13	120.1 (6)
F2 ^{vi} —B1—F1 ^{vi}	62 (2)	C15—C14—H14	119.9
F2—B1—F1 ^{vi}	42.0 (17)	C13—C14—H14	119.9
F2 ⁱⁱⁱ —B1—F1 ^{vi}	104.4 (11)	C16—C15—C14	119.8 (6)
F1 ^{iv} —B1—F1 ^{vi}	179.996 (10)	C16—C15—H15	120.1
F1 ^v —B1—F1 ^{vi}	76.9 (13)	C14—C15—H15	120.1
F2 ^{iv} —B1—F1 ⁱⁱⁱ	138.0 (17)	C17—C16—C15	120.8 (6)
F2 ^{xii} —B1—F1 ⁱⁱⁱ	75.6 (11)	C17—C16—H16	119.6
F2 ^v —B1—F1 ⁱⁱⁱ	118 (2)	C15—C16—H16	119.6
F2 ^{vi} —B1—F1 ⁱⁱⁱ	42.0 (18)	C16—C17—C18	120.0 (6)
F2—B1—F1 ⁱⁱⁱ	104.4 (11)	C16—C17—H17	120.0
F2 ⁱⁱⁱ —B1—F1 ⁱⁱⁱ	62 (2)	C18—C17—H17	120.0
F1 ^{iv} —B1—F1 ⁱⁱⁱ	76.9 (13)	C17—C18—C13	120.8 (6)
F1 ^v —B1—F1 ⁱⁱⁱ	180.0 (11)	C17—C18—H18	119.6
F1 ^{vi} —B1—F1 ⁱⁱⁱ	103.1 (13)	C13—C18—H18	119.6
F2 ^{iv} —B1—F1	75.6 (11)	C24—C19—C20	118.3 (5)
F2 ^{xii} —B1—F1	118 (2)	C24—C19—P2	118.6 (4)
F2 ^v —B1—F1	138.1 (17)	C20—C19—P2	123.1 (4)
F2 ^{vi} —B1—F1	104.4 (11)	C21—C20—C19	119.5 (6)
F2—B1—F1	62 (2)	C21—C20—H20	120.3
F2 ⁱⁱⁱ —B1—F1	42.0 (17)	C19—C20—H20	120.3
F1 ^{iv} —B1—F1	76.9 (13)	C22—C21—C20	120.9 (6)
F1 ^v —B1—F1	76.9 (13)	C22—C21—H21	119.5
F1 ^{vi} —B1—F1	103.1 (13)	C20—C21—H21	119.5
F1 ⁱⁱⁱ —B1—F1	103.1 (13)	C21—C22—C23	119.8 (6)
F2 ^{iv} —B1—F1 ^{xii}	104.4 (11)	C21—C22—H22	120.1
F2 ^{xii} —B1—F1 ^{xii}	62 (2)	C23—C22—H22	120.1
F2 ^v —B1—F1 ^{xii}	42.0 (17)	C24—C23—C22	120.2 (6)
F2 ^{vi} —B1—F1 ^{xii}	75.6 (11)	C24—C23—H23	119.9

F2—B1—F1 ^{xii}	118 (2)	C22—C23—H23	119.9
F2 ⁱⁱⁱ —B1—F1 ^{xii}	138.0 (17)	C23—C24—C19	121.3 (6)
F1 ^{iv} —B1—F1 ^{xii}	103.1 (13)	C23—C24—H24	119.3
F1 ^v —B1—F1 ^{xii}	103.1 (13)	C19—C24—H24	119.3
P2—Ag1—P1—C7	-177.16 (19)	F3 ^{viii} —F4—B2—F4 ^{xi}	65 (100)
P1 ⁱ —Ag1—P1—C7	62.9 (2)	F4 ^{vii} —F4—B2—F4 ^{xi}	145 (100)
P1 ⁱⁱ —Ag1—P1—C7	-57.2 (2)	F4 ^{viii} —F4—B2—F4 ^{xi}	-145 (100)
P2—Ag1—P1—C1	65.07 (18)	F3 ^{vii} —F4—B2—F4 ^{xi}	-86 (100)
P1 ⁱ —Ag1—P1—C1	-54.9 (2)	F3 ^{xi} —F4—B2—F4 ^{xi}	-11 (100)
P1 ⁱⁱ —Ag1—P1—C1	-174.96 (18)	F3 ^{viii} —F4—B2—F4 ^x	100 (4)
P2—Ag1—P1—C13	-53.4 (2)	F4 ^{vii} —F4—B2—F4 ^x	180.000 (11)
P1 ⁱ —Ag1—P1—C13	-173.35 (19)	F4 ^{viii} —F4—B2—F4 ^x	-110.1 (6)
P1 ⁱⁱ —Ag1—P1—C13	66.6 (2)	F3 ^{vii} —F4—B2—F4 ^x	-51 (3)
P1 ⁱ —Ag1—P2—C19 ⁱ	57.77 (18)	F3 ^{xi} —F4—B2—F4 ^x	24 (4)
P1—Ag1—P2—C19 ⁱ	-62.23 (18)	F3 ^{viii} —F4—B2—F4 ^{ix}	30 (4)
P1 ⁱⁱ —Ag1—P2—C19 ⁱ	177.77 (18)	F4 ^{vii} —F4—B2—F4 ^{ix}	110.1 (6)
P1 ⁱ —Ag1—P2—C19 ⁱⁱ	-62.23 (18)	F4 ^{viii} —F4—B2—F4 ^{ix}	180.000 (14)
P1—Ag1—P2—C19 ⁱⁱ	177.77 (18)	F3 ^{vii} —F4—B2—F4 ^{ix}	-121 (3)
P1 ⁱⁱ —Ag1—P2—C19 ⁱⁱ	57.77 (18)	F3 ^{xi} —F4—B2—F4 ^{ix}	-46 (4)
P1 ⁱ —Ag1—P2—C19	177.77 (18)	F3 ^{viii} —F4—B2—F3 ^{vii}	151.3 (19)
P1—Ag1—P2—C19	57.77 (18)	F4 ^{vii} —F4—B2—F3 ^{vii}	-129 (3)
P1 ⁱⁱ —Ag1—P2—C19	-62.23 (18)	F4 ^{viii} —F4—B2—F3 ^{vii}	-59 (3)
F2 ⁱⁱⁱ —F1—F2—F1 ^{vi}	84 (6)	F3 ^{xi} —F4—B2—F3 ^{vii}	75.0 (10)
B1—F1—F2—F1 ^{vi}	13 (4)	F4 ^{vii} —F4—B2—F3 ^{viii}	80 (4)
F2 ^{iv} —F1—F2—F1 ^{vi}	-27 (4)	F4 ^{viii} —F4—B2—F3 ^{viii}	150 (4)
F1 ^{iv} —F1—F2—F1 ^{vi}	20 (6)	F3 ^{vii} —F4—B2—F3 ^{viii}	-151.3 (19)
F1 ^v —F1—F2—F1 ^{vi}	-46 (3)	F3 ^{xi} —F4—B2—F3 ^{viii}	-76.3 (9)
F2 ⁱⁱⁱ —F1—F2—B1	71 (3)	F3 ^{viii} —F4—B2—F3 ^{ix}	180.000 (2)
F2 ^{iv} —F1—F2—B1	-40.6 (18)	F4 ^{vii} —F4—B2—F3 ^{ix}	-100 (4)
F1 ^{iv} —F1—F2—B1	6 (2)	F4 ^{viii} —F4—B2—F3 ^{ix}	-30 (4)
F1 ^v —F1—F2—B1	-59.2 (9)	F3 ^{vii} —F4—B2—F3 ^{ix}	28.7 (19)
B1—F1—F2—F2 ⁱⁱⁱ	-71 (3)	F3 ^{xi} —F4—B2—F3 ^{ix}	103.7 (9)
F2 ^{iv} —F1—F2—F2 ⁱⁱⁱ	-111 (4)	F3 ^{viii} —F4—B2—F3 ^x	-28.7 (19)
F1 ^{iv} —F1—F2—F2 ⁱⁱⁱ	-65 (2)	F4 ^{vii} —F4—B2—F3 ^x	51 (3)
F1 ^v —F1—F2—F2 ⁱⁱⁱ	-130 (4)	F4 ^{viii} —F4—B2—F3 ^x	121 (3)
F2 ⁱⁱⁱ —F1—F2—F2 ^{vi}	25 (3)	F3 ^{vii} —F4—B2—F3 ^x	180.000 (8)
B1—F1—F2—F2 ^{vi}	-45.4 (10)	F3 ^{xi} —F4—B2—F3 ^x	-105.0 (10)
F2 ^{iv} —F1—F2—F2 ^{vi}	-86 (2)	F3 ^{viii} —F4—B2—F3	-103.7 (9)
F1 ^{iv} —F1—F2—F2 ^{vi}	-39 (2)	F4 ^{vii} —F4—B2—F3	-24 (4)
F1 ^v —F1—F2—F2 ^{vi}	-104.6 (15)	F4 ^{viii} —F4—B2—F3	46 (4)
F2 ⁱⁱⁱ —F1—F2—F1 ^v	130 (4)	F3 ^{vii} —F4—B2—F3	105.0 (10)
B1—F1—F2—F1 ^v	59.2 (9)	F3 ^{xi} —F4—B2—F3	180.00 (2)
F2 ^{iv} —F1—F2—F1 ^v	18.6 (17)	F3 ^{viii} —F4—B2—F3 ^{xi}	76.3 (9)
F1 ^{iv} —F1—F2—F1 ^v	65 (3)	F4 ^{vii} —F4—B2—F3 ^{xi}	156 (4)
F1 ^{vi} —F2—B1—F2 ^{iv}	-110 (4)	F4 ^{viii} —F4—B2—F3 ^{xi}	-134 (4)
F1—F2—B1—F2 ^{iv}	59.5 (19)	F3 ^{vii} —F4—B2—F3 ^{xi}	-75.0 (10)
F2 ⁱⁱⁱ —F2—B1—F2 ^{iv}	105.2 (9)	F4 ^{vii} —F3—B2—F4 ^{viii}	70 (2)
F2 ^{vi} —F2—B1—F2 ^{iv}	180.000 (12)	F3 ^{ix} —F3—B2—F4 ^{viii}	-83.3 (15)

F1 ^v —F2—B1—F2 ^{iv}	-23 (3)	F3 ^x —F3—B2—F4 ^{viii}	156.6 (18)
F1 ^{vi} —F2—B1—F2 ^{xii}	72 (6)	F4 ^{xi} —F3—B2—F4 ^{viii}	-137 (3)
F1—F2—B1—F2 ^{xii}	-119 (6)	F4 ^{viii} —F3—B2—F4 ^{vii}	-70 (2)
F2 ⁱⁱⁱ —F2—B1—F2 ^{xii}	-74 (8)	F3 ^{ix} —F3—B2—F4 ^{vii}	-153 (2)
F2 ^{vi} —F2—B1—F2 ^{xii}	1 (8)	F3 ^x —F3—B2—F4 ^{vii}	87.1 (16)
F1 ^v —F2—B1—F2 ^{xii}	158 (5)	F4 ^{xi} —F3—B2—F4 ^{vii}	154 (3)
F1 ^{vi} —F2—B1—F2 ^v	-35 (4)	F4 ^{vii} —F3—B2—F4	26 (3)
F1—F2—B1—F2 ^v	134 (2)	F4 ^{viii} —F3—B2—F4	-43 (3)
F2 ⁱⁱⁱ —F2—B1—F2 ^v	180.005 (4)	F3 ^{ix} —F3—B2—F4	-127 (2)
F2 ^{vi} —F2—B1—F2 ^v	-105.2 (9)	F3 ^x —F3—B2—F4	113 (3)
F1 ^v —F2—B1—F2 ^v	52 (3)	F4 ^{xi} —F3—B2—F4	180.00 (2)
F1 ^{vi} —F2—B1—F2 ^{vi}	70 (4)	F4 ^{vii} —F3—B2—F4 ^{xi}	-154 (3)
F1—F2—B1—F2 ^{vi}	-120.5 (19)	F4 ^{viii} —F3—B2—F4 ^{xi}	137 (3)
F2 ⁱⁱⁱ —F2—B1—F2 ^{vi}	-74.8 (9)	F3 ^{ix} —F3—B2—F4 ^{xi}	53 (2)
F1 ^v —F2—B1—F2 ^{vi}	157 (3)	F3 ^x —F3—B2—F4 ^{xi}	-67 (3)
F1 ^{vi} —F2—B1—F2 ⁱⁱⁱ	145 (4)	F4 ^{vii} —F3—B2—F4 ^x	180.000 (15)
F1—F2—B1—F2 ⁱⁱⁱ	-46 (2)	F4 ^{viii} —F3—B2—F4 ^x	110 (2)
F2 ^{vi} —F2—B1—F2 ⁱⁱⁱ	74.8 (9)	F3 ^{ix} —F3—B2—F4 ^x	27 (2)
F1 ^v —F2—B1—F2 ⁱⁱⁱ	-128 (3)	F3 ^x —F3—B2—F4 ^x	-92.9 (16)
F1 ^{vi} —F2—B1—F1 ^{iv}	179.994 (11)	F4 ^{xi} —F3—B2—F4 ^x	-26 (3)
F1—F2—B1—F1 ^{iv}	-11 (3)	F4 ^{vii} —F3—B2—F4 ^{ix}	-110 (2)
F2 ⁱⁱⁱ —F2—B1—F1 ^{iv}	35 (4)	F4 ^{viii} —F3—B2—F4 ^{ix}	180.000 (12)
F2 ^{vi} —F2—B1—F1 ^{iv}	110 (4)	F3 ^{ix} —F3—B2—F4 ^{ix}	96.7 (15)
F1 ^v —F2—B1—F1 ^{iv}	-93.6 (19)	F3 ^x —F3—B2—F4 ^{ix}	-23.4 (18)
F1 ^{vi} —F2—B1—F1 ^v	-86.4 (19)	F4 ^{xi} —F3—B2—F4 ^{ix}	43 (3)
F1—F2—B1—F1 ^v	82.7 (17)	F4 ^{vii} —F3—B2—F3 ^{vii}	92.9 (16)
F2 ⁱⁱⁱ —F2—B1—F1 ^v	128 (3)	F4 ^{viii} —F3—B2—F3 ^{vii}	23.4 (18)
F2 ^{vi} —F2—B1—F1 ^v	-157 (3)	F3 ^{ix} —F3—B2—F3 ^{vii}	-60 (3)
F1—F2—B1—F1 ^{vi}	169 (3)	F3 ^x —F3—B2—F3 ^{vii}	180.000 (2)
F2 ⁱⁱⁱ —F2—B1—F1 ^{vi}	-145 (4)	F4 ^{xi} —F3—B2—F3 ^{vii}	-113 (3)
F2 ^{vi} —F2—B1—F1 ^{vi}	-70 (4)	F4 ^{vii} —F3—B2—F3 ^{viii}	-27 (2)
F1 ^v —F2—B1—F1 ^{vi}	86.4 (19)	F4 ^{viii} —F3—B2—F3 ^{viii}	-96.7 (15)
F1 ^{vi} —F2—B1—F1 ⁱⁱⁱ	93.6 (19)	F3 ^{ix} —F3—B2—F3 ^{viii}	180.000 (9)
F1—F2—B1—F1 ⁱⁱⁱ	-97.3 (17)	F3 ^x —F3—B2—F3 ^{viii}	60 (3)
F2 ⁱⁱⁱ —F2—B1—F1 ⁱⁱⁱ	-52 (3)	F4 ^{xi} —F3—B2—F3 ^{viii}	127 (2)
F2 ^{vi} —F2—B1—F1 ⁱⁱⁱ	23 (3)	F4 ^{vii} —F3—B2—F3 ^{ix}	153 (2)
F1 ^v —F2—B1—F1 ⁱⁱⁱ	179.998 (10)	F4 ^{viii} —F3—B2—F3 ^{ix}	83.3 (15)
F1 ^{vi} —F2—B1—F1	-169 (3)	F3 ^x —F3—B2—F3 ^{ix}	-120 (3)
F2 ⁱⁱⁱ —F2—B1—F1	46 (2)	F4 ^{xi} —F3—B2—F3 ^{ix}	-53 (2)
F2 ^{vi} —F2—B1—F1	120.5 (19)	F4 ^{vii} —F3—B2—F3 ^x	-87.1 (16)
F1 ^v —F2—B1—F1	-82.7 (17)	F4 ^{viii} —F3—B2—F3 ^x	-156.6 (18)
F1 ^{vi} —F2—B1—F1 ^{xii}	11 (3)	F3 ^{ix} —F3—B2—F3 ^x	120 (3)
F1—F2—B1—F1 ^{xii}	180.00 (2)	F4 ^{xi} —F3—B2—F3 ^x	67 (3)
F2 ⁱⁱⁱ —F2—B1—F1 ^{xii}	-134 (2)	F4 ^{vii} —F3—B2—F3 ^{xi}	-131 (3)
F2 ^{vi} —F2—B1—F1 ^{xii}	-59.5 (19)	F4 ^{viii} —F3—B2—F3 ^{xi}	159 (4)
F1 ^v —F2—B1—F1 ^{xii}	97.3 (17)	F3 ^{ix} —F3—B2—F3 ^{xi}	76 (4)
F2 ⁱⁱⁱ —F1—B1—F2 ^{iv}	147 (4)	F3 ^x —F3—B2—F3 ^{xi}	-44 (4)
F2—F1—B1—F2 ^{iv}	-124 (2)	F4 ^{xi} —F3—B2—F3 ^{xi}	22 (4)
F1 ^{iv} —F1—B1—F2 ^{iv}	64 (3)	C7—P1—C1—C6	-81.1 (5)

F1 ^v —F1—B1—F2 ^{iv}	-43.2 (18)	C13—P1—C1—C6	172.5 (5)
F2 ⁱⁱⁱ —F1—B1—F2 ^{xii}	90 (4)	Ag1—P1—C1—C6	43.7 (5)
F2—F1—B1—F2 ^{xii}	180.00 (2)	C7—P1—C1—C2	103.6 (5)
F2 ^{iv} —F1—B1—F2 ^{xii}	-56 (2)	C13—P1—C1—C2	-2.8 (5)
F1 ^{iv} —F1—B1—F2 ^{xii}	7 (2)	Ag1—P1—C1—C2	-131.6 (4)
F1 ^v —F1—B1—F2 ^{xii}	-99.5 (11)	C6—C1—C2—C3	-0.4 (8)
F2 ⁱⁱⁱ —F1—B1—F2 ^v	-179.993 (15)	P1—C1—C2—C3	174.9 (5)
F2—F1—B1—F2 ^v	-90 (4)	C1—C2—C3—C4	-0.2 (9)
F2 ^{iv} —F1—B1—F2 ^v	33 (4)	C2—C3—C4—C5	1.8 (10)
F1 ^{iv} —F1—B1—F2 ^v	97.2 (17)	C3—C4—C5—C6	-2.8 (10)
F1 ^v —F1—B1—F2 ^v	-10 (3)	C2—C1—C6—C5	-0.6 (9)
F2 ⁱⁱⁱ —F1—B1—F2 ^{vi}	-33 (4)	P1—C1—C6—C5	-176.3 (5)
F2—F1—B1—F2 ^{vi}	56 (2)	C4—C5—C6—C1	2.3 (10)
F2 ^{iv} —F1—B1—F2 ^{vi}	180.00 (5)	C1—P1—C7—C8	-22.7 (6)
F1 ^{iv} —F1—B1—F2 ^{vi}	-116 (3)	C13—P1—C7—C8	83.2 (6)
F1 ^v —F1—B1—F2 ^{vi}	136.8 (19)	Ag1—P1—C7—C8	-144.4 (5)
F2 ⁱⁱⁱ —F1—B1—F2	-90 (4)	C1—P1—C7—C12	161.1 (4)
F2 ^{iv} —F1—B1—F2	124 (2)	C13—P1—C7—C12	-93.0 (5)
F1 ^{iv} —F1—B1—F2	-173 (2)	Ag1—P1—C7—C12	39.5 (5)
F1 ^v —F1—B1—F2	80.5 (11)	C12—C7—C8—C9	3.9 (10)
F2—F1—B1—F2 ⁱⁱⁱ	90 (4)	P1—C7—C8—C9	-172.2 (6)
F2 ^{iv} —F1—B1—F2 ⁱⁱⁱ	-147 (4)	C7—C8—C9—C10	-4.2 (12)
F1 ^{iv} —F1—B1—F2 ⁱⁱⁱ	-82.9 (17)	C8—C9—C10—C11	1.1 (13)
F1 ^v —F1—B1—F2 ⁱⁱⁱ	170 (3)	C9—C10—C11—C12	2.4 (12)
F2 ⁱⁱⁱ —F1—B1—F1 ^{iv}	82.9 (17)	C10—C11—C12—C7	-2.7 (10)
F2—F1—B1—F1 ^{iv}	173 (2)	C8—C7—C12—C11	-0.5 (9)
F2 ^{iv} —F1—B1—F1 ^{iv}	-64 (3)	P1—C7—C12—C11	175.7 (5)
F1 ^v —F1—B1—F1 ^{iv}	-107 (2)	C7—P1—C13—C18	162.0 (4)
F2 ⁱⁱⁱ —F1—B1—F1 ^v	-170 (3)	C1—P1—C13—C18	-90.7 (5)
F2—F1—B1—F1 ^v	-80.5 (11)	Ag1—P1—C13—C18	32.2 (5)
F2 ^{iv} —F1—B1—F1 ^v	43.2 (18)	C7—P1—C13—C14	-22.0 (5)
F1 ^{iv} —F1—B1—F1 ^v	107 (2)	C1—P1—C13—C14	85.3 (5)
F2 ⁱⁱⁱ —F1—B1—F1 ^{vi}	-97.1 (17)	Ag1—P1—C13—C14	-151.8 (4)
F2—F1—B1—F1 ^{vi}	-7 (2)	C18—C13—C14—C15	2.6 (8)
F2 ^{iv} —F1—B1—F1 ^{vi}	116 (3)	P1—C13—C14—C15	-173.4 (4)
F1 ^{iv} —F1—B1—F1 ^{vi}	180.00 (2)	C13—C14—C15—C16	-1.7 (9)
F1 ^v —F1—B1—F1 ^{vi}	73 (2)	C14—C15—C16—C17	-0.8 (10)
F2 ⁱⁱⁱ —F1—B1—F1 ⁱⁱⁱ	10 (3)	C15—C16—C17—C18	2.3 (9)
F2—F1—B1—F1 ⁱⁱⁱ	99.5 (11)	C16—C17—C18—C13	-1.4 (9)
F2 ^{iv} —F1—B1—F1 ⁱⁱⁱ	-136.8 (18)	C14—C13—C18—C17	-1.1 (8)
F1 ^{iv} —F1—B1—F1 ⁱⁱⁱ	-73 (2)	P1—C13—C18—C17	175.1 (4)
F1 ^v —F1—B1—F1 ⁱⁱⁱ	179.995 (15)	C19 ⁱ —P2—C19—C24	171.7 (4)
F2 ⁱⁱⁱ —F1—B1—F1 ^{xii}	-50 (5)	C19 ⁱⁱ —P2—C19—C24	-82.0 (6)
F2—F1—B1—F1 ^{xii}	40 (4)	Ag1—P2—C19—C24	44.9 (5)
F2 ^{iv} —F1—B1—F1 ^{xii}	164 (3)	C19 ⁱ —P2—C19—C20	-8.8 (5)
F1 ^{iv} —F1—B1—F1 ^{xii}	-133 (4)	C19 ⁱⁱ —P2—C19—C20	97.5 (4)
F1 ^v —F1—B1—F1 ^{xii}	120 (4)	Ag1—P2—C19—C20	-135.7 (4)
F3 ^{viii} —F4—B2—F4 ^{viii}	-150 (4)	C24—C19—C20—C21	2.8 (9)
F4 ^{vii} —F4—B2—F4 ^{viii}	-69.9 (6)	P2—C19—C20—C21	-176.7 (5)

F3 ^{vii} —F4—B2—F4 ^{viii}	59 (3)	C19—C20—C21—C22	-3.0 (10)
F3 ^{xi} —F4—B2—F4 ^{viii}	134 (4)	C20—C21—C22—C23	1.5 (11)
F3 ^{viii} —F4—B2—F4 ^{vii}	-80 (4)	C21—C22—C23—C24	0.3 (10)
F4 ^{viii} —F4—B2—F4 ^{vii}	69.9 (6)	C22—C23—C24—C19	-0.4 (10)
F3 ^{vii} —F4—B2—F4 ^{vii}	129 (3)	C20—C19—C24—C23	-1.1 (9)
F3 ^{xi} —F4—B2—F4 ^{vii}	-156 (4)	P2—C19—C24—C23	178.4 (5)

Symmetry codes: (i) $-x+y+1, -x+1, z$; (ii) $-y+1, x-y, z$; (iii) $-y+1, x-y+1, z$; (iv) $x-y+2/3, x+1/3, -z+1/3$; (v) $y-1/3, -x+y+1/3, -z+1/3$; (vi) $-x+y, -x+1, z$; (vii) $-y+1, x-y+2, z$; (viii) $-x+y-1, -x+1, z$; (ix) $x-y+1, x+1, -z$; (x) $y-1, -x+y, -z$; (xi) $-x, -y+2, -z$; (xii) $-x+2/3, -y+4/3, -z+1/3$.