Full wwPDB X-ray Structure Validation Report ⓘ

Nov 11, 2026 – 03:35 pm GMT

PDB ID	:	30OY / pdb_000030oy
Title	:	W-formate dehydrogenase H193M from Nitratidesulfovibrio vulgaris (Desulfovibrio vulgaris) - Formate reduced
Authors	:	Vilela-Alves, G.; Manuel, R.R.; Oliveira, A.R.; Martins, G.; Pereira, I.C.; Romao, M.J.; Mota, C.
Deposited on	:	2026-05-06
Resolution	:	2.06 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references ⓘ) were used in the production of this report:

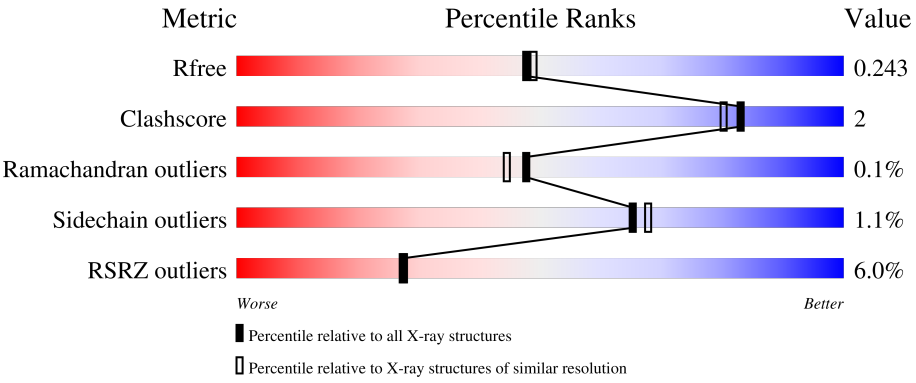
MolProbity	:	4-5-2 with Phenix2.2
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.2
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.51

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.06 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	3774 (2.08-2.04)
Clashscore	190562	3883 (2.08-2.04)
Ramachandran outliers	187476	3860 (2.08-2.04)
Sidechain outliers	187428	3860 (2.08-2.04)
RSRZ outliers	180081	3775 (2.08-2.04)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5% The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	1013	5% 89% 6% 5%
2	B	215	8% 93% 7%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
10	EDO	B	305	-	-	X	-

2 Entry composition (i)

There are 12 unique types of molecules in this entry. The entry contains 9515 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Formate dehydrogenase, alpha subunit, selenocysteine-containing.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	963	7531	4799	1311	1378	42	1	0	0	0

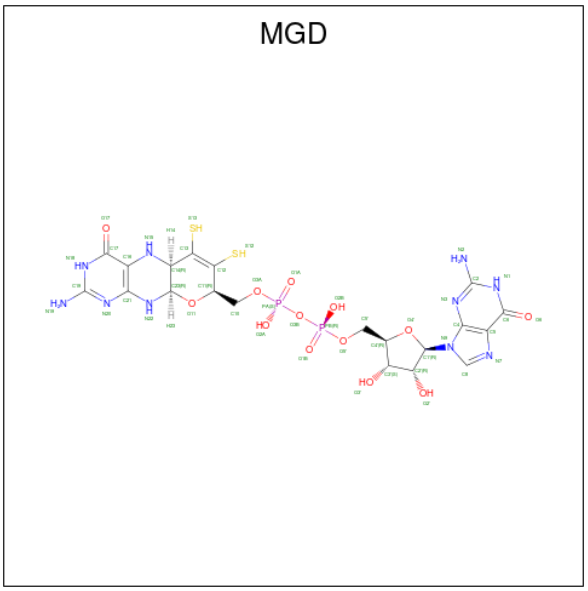
There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	193	MET	HIS	engineered mutation	UNP Q72EJ1
A	1006	TRP	-	expression tag	UNP Q72EJ1
A	1007	SER	-	expression tag	UNP Q72EJ1
A	1008	HIS	-	expression tag	UNP Q72EJ1
A	1009	PRO	-	expression tag	UNP Q72EJ1
A	1010	GLN	-	expression tag	UNP Q72EJ1
A	1011	PHE	-	expression tag	UNP Q72EJ1
A	1012	GLU	-	expression tag	UNP Q72EJ1
A	1013	LYS	-	expression tag	UNP Q72EJ1

- Molecule 2 is a protein called Formate dehydrogenase, beta subunit, putative.

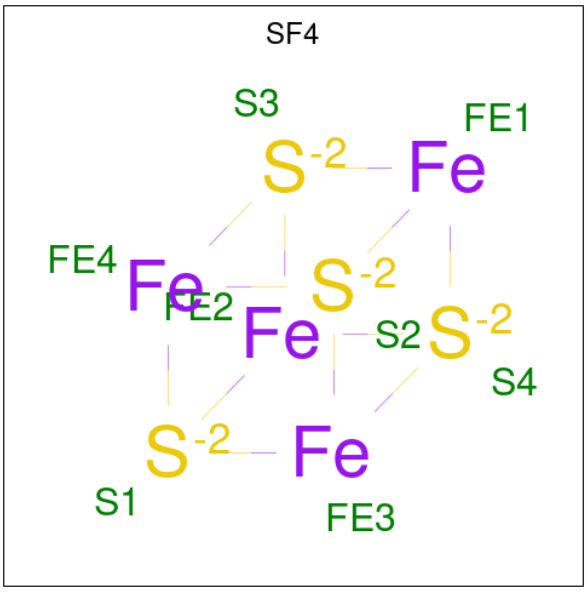
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	214	1664	1041	291	316	16	0	0	0

- Molecule 3 is 2-AMINO-5,6-DIMERCAPTO-7-METHYL-3,7,8A,9-TETRAHYDRO-8-OXA-1,3,9,10-TETRAAZA-ANTHRACEN-4-ONE GUANOSINE DINUCLEOTIDE (CCD ID: MGD) (formula: $C_{20}H_{26}N_{10}O_{13}P_2S_2$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	S	0	0
			47	20	10	13	2	2		
3	A	1	Total	C	N	O	P	S	0	0
			47	20	10	13	2	2		

- Molecule 4 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4) (labeled as "Ligand of Interest" by depositor).



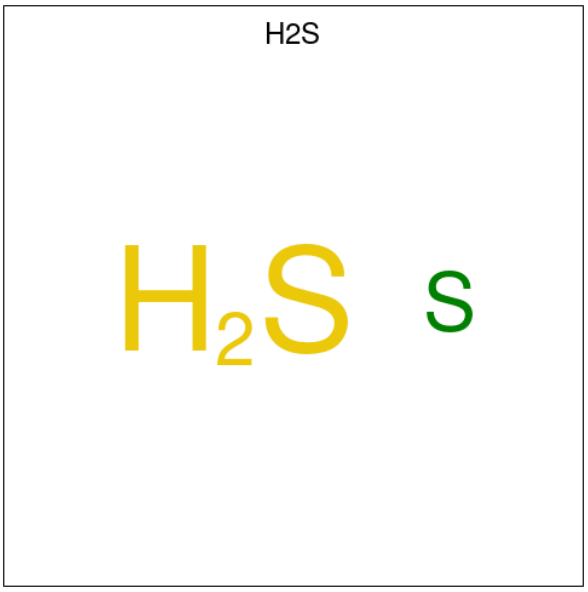
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	Fe	S	0	0
			8	4	4		

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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	B	1	Total Fe S 8 4 4	0	0
4	B	1	Total Fe S 8 4 4	0	0
4	B	1	Total Fe S 8 4 4	0	0

- Molecule 5 is HYDROSULFURIC ACID (CCD ID: H2S) (formula: H_2S) (labeled as "Ligand of Interest" by depositor).

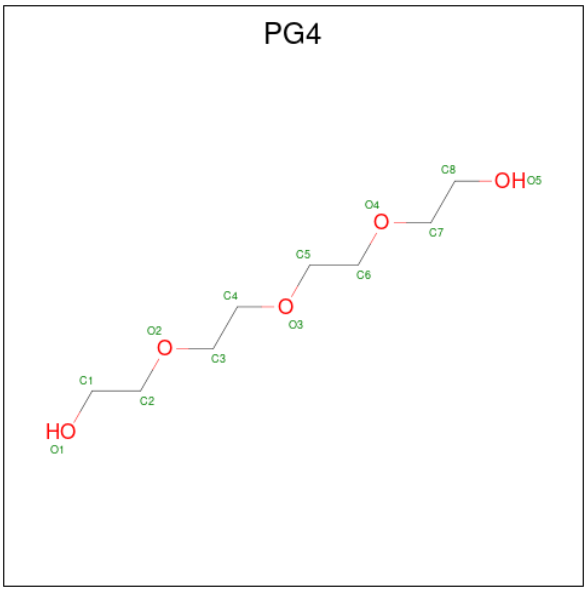


Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total S 1 1	0	0

- Molecule 6 is TUNGSTEN ION (CCD ID: W) (formula: W) (labeled as "Ligand of Interest" by depositor).

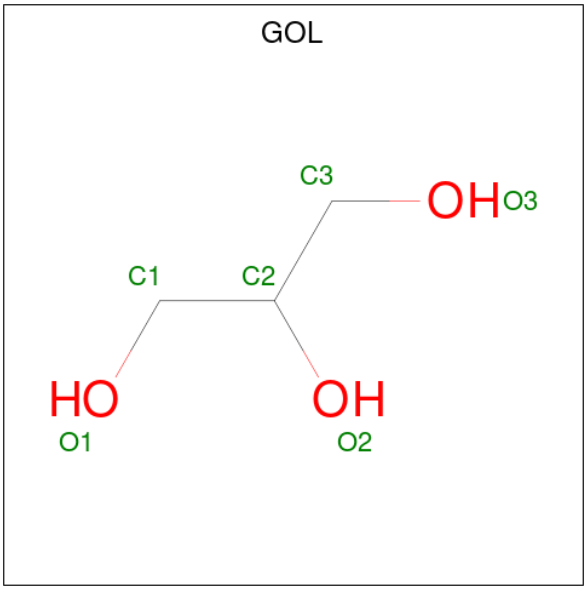
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total W 1 1	0	0

- Molecule 7 is TETRAETHYLENE GLYCOL (CCD ID: PG4) (formula: $C_8H_{18}O_5$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	1	Total C O 13 8 5	0	0

- Molecule 8 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



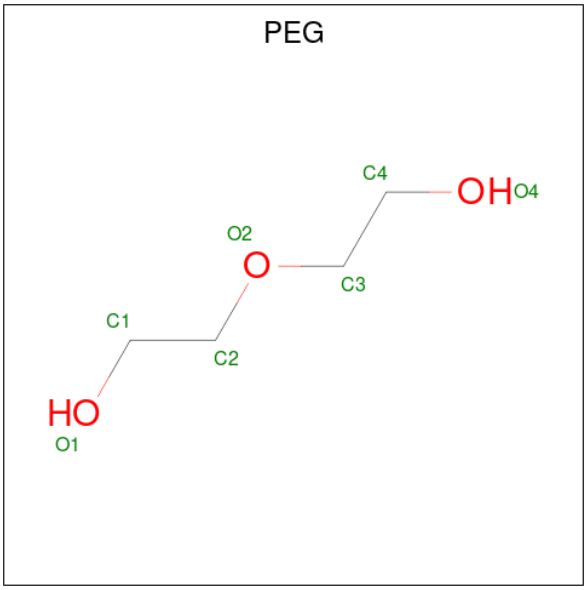
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	1	Total C O 6 3 3	0	0
8	A	1	Total C O 6 3 3	0	0
8	A	1	Total C O 6 3 3	0	0

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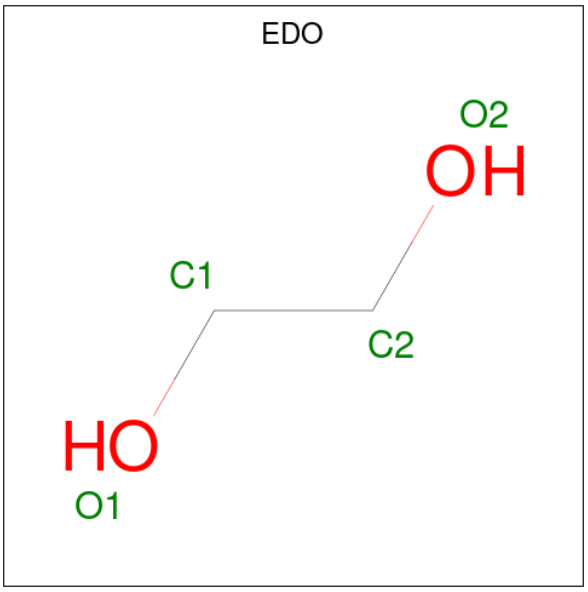
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	1	Total C O 6 3 3	0	0

- Molecule 9 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



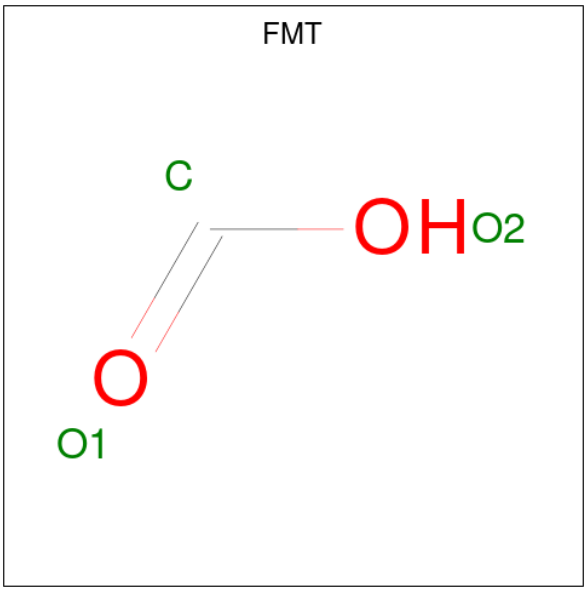
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
9	A	1	Total C O 7 4 3	0	0
9	A	1	Total C O 7 4 3	0	0

- Molecule 10 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
10	A	1	Total	C	O	0	0
			4	2	2		
10	B	1	Total	C	O	0	0
			4	2	2		
10	B	1	Total	C	O	0	0
			4	2	2		

- Molecule 11 is FORMIC ACID (CCD ID: FMT) (formula: CH_2O_2) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
11	A	1	Total C O 3 1 2	0	0
11	A	1	Total C O 3 1 2	0	0

- Molecule 12 is water.

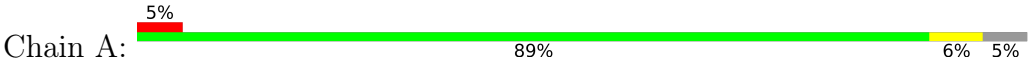
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
12	A	104	Total O 104 104	0	0
12	B	19	Total O 19 19	0	0

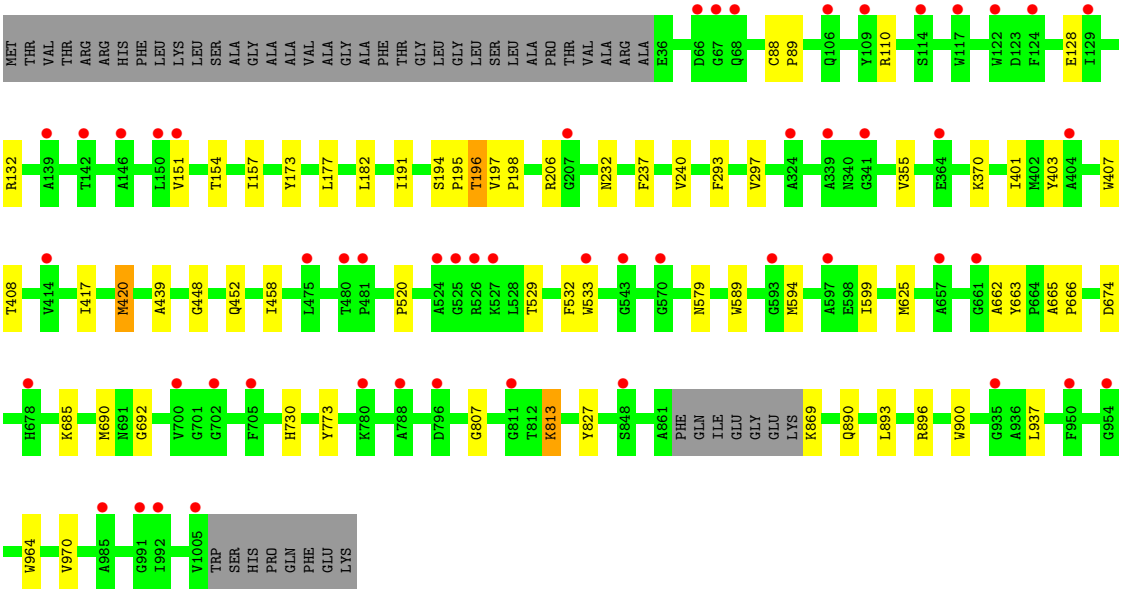
3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

• Molecule 1: Formate dehydrogenase, alpha subunit, selenocysteine-containing

Chain A:

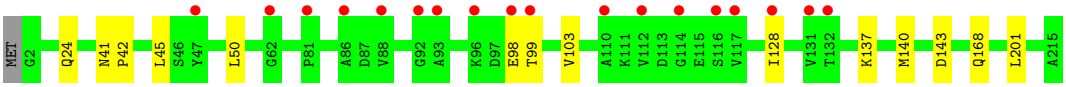




• Molecule 2: Formate dehydrogenase, beta subunit, putative

Chain B:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	123.87Å 149.89Å 64.91Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	74.94 – 2.06 74.94 – 2.06	Depositor EDS
% Data completeness (in resolution range)	73.9 (74.94-2.06) 71.2 (74.94-2.06)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.52 (at 2.07Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.207 , 0.238 0.217 , 0.243	Depositor DCC
R_{free} test set	2783 reflections (3.70%)	wwPDB-VP
Wilson B-factor (Å^2)	31.1	Xtriage
Anisotropy	0.091	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.37 , 33.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	9515	wwPDB-VP
Average B, all atoms (Å^2)	37.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.46% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SEC, EDO, H2S, FMT, W, PG4, MGD, GOL, SF4, PEG

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\#\|Z\| > 5$	RMSZ	$\#\|Z\| > 5$
1	A	0.99	0/7730	1.37	3/10485 (0.0%)
2	B	0.99	0/1699	1.38	0/2302
All	All	0.99	0/9429	1.37	3/12787 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	692	GLY	CA-C-O	-5.43	118.69	122.22
1	A	196	THR	CA-C-N	5.05	124.37	120.33
1	A	196	THR	C-N-CA	5.05	124.37	120.33

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	7531	0	7368	37	0
2	B	1664	0	1633	9	0
3	A	94	0	44	4	0
4	A	8	0	0	0	0
4	B	24	0	0	0	0
5	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	A	1	0	0	0	0
7	A	13	0	18	0	0
8	A	24	0	32	0	0
9	A	14	0	20	0	0
10	A	4	0	6	0	0
10	B	8	0	12	4	0
11	A	6	0	2	0	0
12	A	104	0	0	0	0
12	B	19	0	0	0	0
All	All	9515	0	9135	45	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 2.

All (45) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:579:ASN:OD1	3:A:1102:MGD:O2'	2.15	0.61
1:A:890:GLN:OE1	3:A:1101:MGD:S13	2.60	0.60
2:B:45:LEU:HD13	10:B:305:EDO:C2	2.32	0.58
1:A:401:ILE:HG21	1:A:420:MET:HG3	1.85	0.57
1:A:191:ILE:HG21	3:A:1102:MGD:H14	1.89	0.55
2:B:41:ASN:HA	2:B:42:PRO:C	2.33	0.54
2:B:45:LEU:HD13	10:B:305:EDO:H22	1.90	0.54
1:A:407:TRP:CD1	1:A:408:THR:HG23	2.43	0.54
1:A:196:THR:HA	1:A:417:ILE:HD13	1.89	0.53
1:A:355:VAL:HG13	1:A:827:TYR:HB2	1.94	0.50
1:A:88:CYS:HB2	1:A:89:PRO:HD2	1.95	0.48
1:A:896:ARG:HD2	1:A:970:VAL:O	2.14	0.48
1:A:173:TYR:CE2	1:A:177:LEU:HD11	2.48	0.48
2:B:45:LEU:HD13	10:B:305:EDO:H21	1.95	0.48
1:A:401:ILE:HG21	1:A:420:MET:CG	2.45	0.46
2:B:201:LEU:C	2:B:201:LEU:HD23	2.41	0.46
1:A:196:THR:HG23	1:A:403:TYR:OH	2.14	0.46
1:A:665:ALA:N	1:A:666:PRO:HD2	2.32	0.45
1:A:448:GLY:O	1:A:452:GLN:HG2	2.17	0.45
1:A:807:GLY:O	1:A:813:LYS:HD2	2.17	0.44
1:A:625:MET:HE3	1:A:730:HIS:CE1	2.52	0.43
1:A:690:MET:HE2	1:A:730:HIS:CE1	2.54	0.43
2:B:103:VAL:O	2:B:137:LYS:NZ	2.49	0.43
1:A:196:THR:HG21	1:A:439:ALA:HB1	2.00	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:237:PHE:HA	1:A:240:VAL:HB	2.01	0.43
1:A:401:ILE:HD13	1:A:420:MET:SD	2.59	0.43
1:A:151:VAL:O	1:A:520:PRO:HA	2.19	0.42
2:B:50:LEU:O	10:B:305:EDO:H12	2.19	0.42
1:A:206:ARG:HB2	1:A:773:TYR:OH	2.19	0.42
1:A:232:ASN:HA	3:A:1101:MGD:N20	2.34	0.42
1:A:529:THR:HA	1:A:532:PHE:CD2	2.55	0.42
1:A:194:SER:N	1:A:195:PRO:CD	2.83	0.42
1:A:662:ALA:O	1:A:663:TYR:C	2.63	0.42
1:A:594:MET:HE3	1:A:599:ILE:CD1	2.50	0.42
1:A:890:GLN:HA	1:A:964:TRP:CH2	2.55	0.42
2:B:140:MET:O	2:B:140:MET:HG2	2.19	0.42
1:A:293:PHE:O	1:A:297:VAL:HG23	2.20	0.41
1:A:128:GLU:O	1:A:132:ARG:HG2	2.21	0.41
1:A:900:TRP:CH2	2:B:24:GLN:HA	2.55	0.41
1:A:893:LEU:C	1:A:893:LEU:HD23	2.45	0.41
1:A:197:VAL:N	1:A:198:PRO:CD	2.84	0.41
1:A:937:LEU:C	1:A:937:LEU:HD12	2.45	0.41
1:A:674:ASP:O	1:A:685:LYS:HB3	2.21	0.41
1:A:157:ILE:HG22	1:A:182:LEU:HD21	2.03	0.40
1:A:110:ARG:HG3	1:A:589:TRP:CZ2	2.56	0.40

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	958/1013 (95%)	930 (97%)	27 (3%)	1 (0%)	48 44
2	B	212/215 (99%)	202 (95%)	10 (5%)	0	100 100
All	All	1170/1228 (95%)	1132 (97%)	37 (3%)	1 (0%)	48 44

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	533	TRP

5.3.2 Protein sidechains (i)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	782/819 (96%)	776 (99%)	6 (1%)	73	77
2	B	185/186 (100%)	180 (97%)	5 (3%)	39	35
All	All	967/1005 (96%)	956 (99%)	11 (1%)	65	68

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	154	THR
1	A	370	LYS
1	A	420	MET
1	A	458	ILE
1	A	813	LYS
1	A	869	LYS
2	B	98	GLU
2	B	99	THR
2	B	128	ILE
2	B	143	ASP
2	B	168	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	41	GLN
1	A	45	GLN
1	A	410	HIS
1	A	493	GLN
1	A	671	ASN

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Mol	Chain	Res	Type
2	B	24	GLN
2	B	147	ASN
2	B	212	HIS

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

Of 20 ligands modelled in this entry, 1 is modelled with single atom and 1 is monoatomic - leaving 18 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
3	MGD	A	1101	6	45,52,52	0.47	0	54,81,81	0.91	2 (3%)
4	SF4	B	303	2	0,12,12	-	-	-		
3	MGD	A	1102	6	45,52,52	0.55	1 (2%)	54,81,81	0.87	3 (5%)
10	EDO	A	1113	-	3,3,3	0.06	0	2,2,2	0.14	0
8	GOL	A	1108	-	5,5,5	0.11	0	5,5,5	0.30	0
4	SF4	B	301	2	0,12,12	-	-	-		
4	SF4	A	1103	1	0,12,12	-	-	-		
9	PEG	A	1111	-	6,6,6	0.12	0	5,5,5	0.05	0
8	GOL	A	1110	-	5,5,5	0.11	0	5,5,5	0.29	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
9	PEG	A	1112	-	6,6,6	0.18	0	5,5,5	0.17	0
7	PG4	A	1106	-	12,12,12	0.19	0	11,11,11	0.14	0
4	SF4	B	302	2	0,12,12	-	-	-		
11	FMT	A	1115	-	2,2,2	0.29	0	1,1,1	0.16	0
11	FMT	A	1114	-	2,2,2	0.29	0	1,1,1	0.15	0
8	GOL	A	1107	-	5,5,5	0.07	0	5,5,5	0.25	0
8	GOL	A	1109	-	5,5,5	0.09	0	5,5,5	0.31	0
10	EDO	B	304	-	3,3,3	0.11	0	2,2,2	0.37	0
10	EDO	B	305	-	3,3,3	0.12	0	2,2,2	0.42	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	MGD	A	1101	6	-	1/22/66/66	0/6/6/6
10	EDO	B	305	-	-	0/1/1/1	-
3	MGD	A	1102	6	-	4/22/66/66	0/6/6/6
10	EDO	A	1113	-	-	0/1/1/1	-
8	GOL	A	1108	-	-	2/4/4/4	-
9	PEG	A	1112	-	-	1/4/4/4	-
4	SF4	A	1103	1	-	-	0/6/5/5
9	PEG	A	1111	-	-	2/4/4/4	-
8	GOL	A	1110	-	-	1/4/4/4	-
4	SF4	B	301	2	-	-	0/6/5/5
7	PG4	A	1106	-	-	4/10/10/10	-
4	SF4	B	303	2	-	-	0/6/5/5
4	SF4	B	302	2	-	-	0/6/5/5
8	GOL	A	1107	-	-	2/4/4/4	-
8	GOL	A	1109	-	-	4/4/4/4	-
10	EDO	B	304	-	-	0/1/1/1	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1102	MGD	C23-C14	2.31	1.55	1.53

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	1102	MGD	C19-N20-C21	3.00	118.84	113.43
3	A	1101	MGD	C19-N20-C21	2.96	118.78	113.43
3	A	1102	MGD	O11-C23-C14	2.77	110.81	108.96
3	A	1101	MGD	C4'-O4'-C1'	-2.09	104.87	109.47
3	A	1102	MGD	C17-C16-N15	2.06	122.30	116.76

There are no chirality outliers.

All (21) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1102	MGD	C4'-C5'-O5'-PB
8	A	1107	GOL	O1-C1-C2-C3
8	A	1109	GOL	O1-C1-C2-C3
3	A	1102	MGD	O4'-C4'-C5'-O5'
3	A	1102	MGD	C3'-C4'-C5'-O5'
7	A	1106	PG4	O3-C5-C6-O4
8	A	1108	GOL	O1-C1-C2-C3
8	A	1109	GOL	C1-C2-C3-O3
8	A	1107	GOL	O1-C1-C2-O2
8	A	1109	GOL	O1-C1-C2-O2
9	A	1111	PEG	O2-C3-C4-O4
8	A	1108	GOL	O1-C1-C2-O2
3	A	1101	MGD	PA-O3B-PB-O5'
9	A	1111	PEG	C4-C3-O2-C2
7	A	1106	PG4	C4-C3-O2-C2
8	A	1110	GOL	C1-C2-C3-O3
9	A	1112	PEG	C4-C3-O2-C2
7	A	1106	PG4	C3-C4-O3-C5
3	A	1102	MGD	C10-O3A-PA-O3B
7	A	1106	PG4	O2-C3-C4-O3
8	A	1109	GOL	O2-C2-C3-O3

There are no ring outliers.

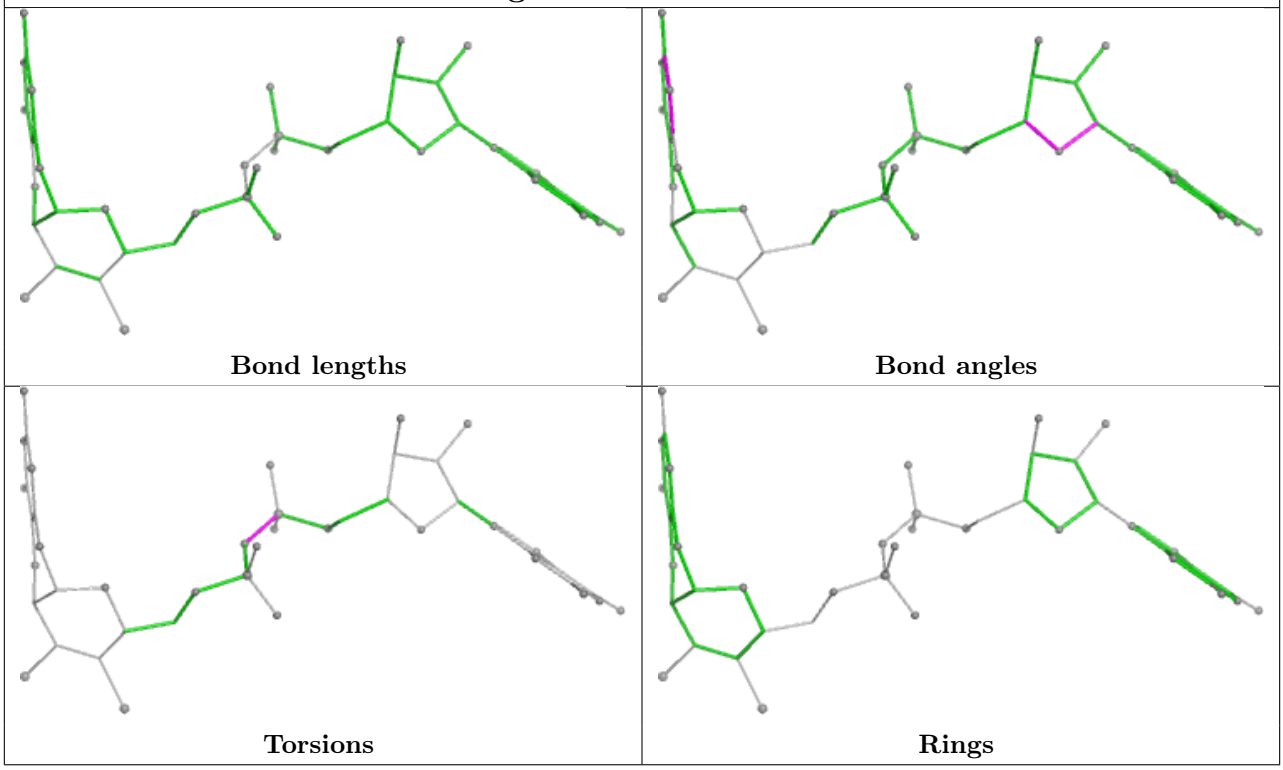
3 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1101	MGD	2	0
3	A	1102	MGD	2	0
10	B	305	EDO	4	0

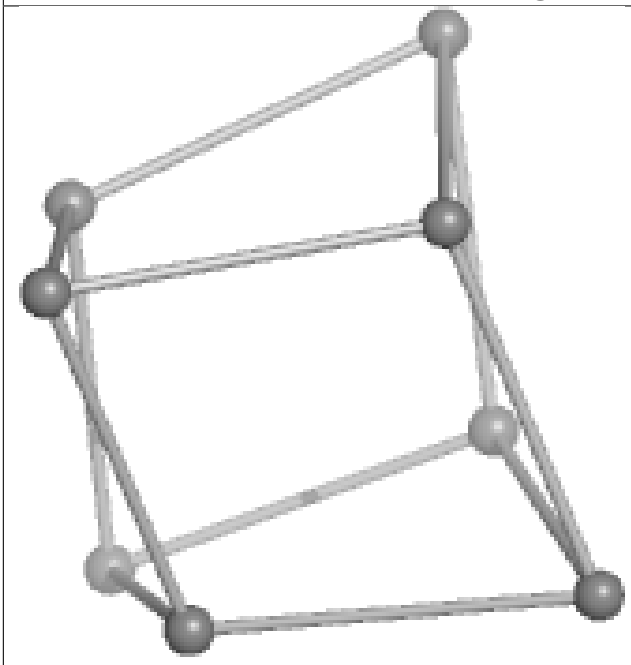
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In

addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

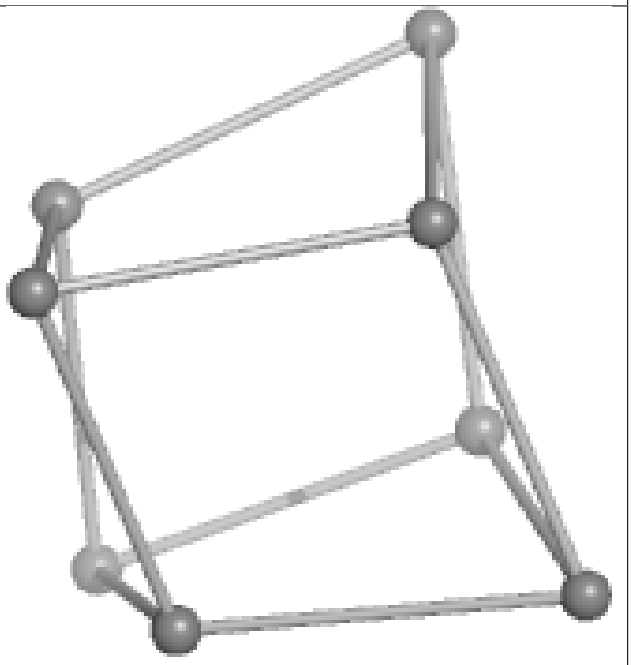
Ligand MGD A 1101



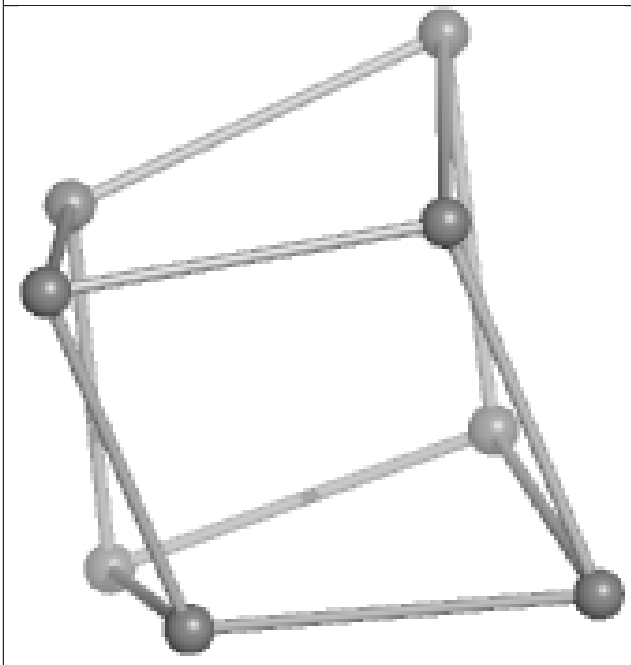
Ligand SF4 B 303



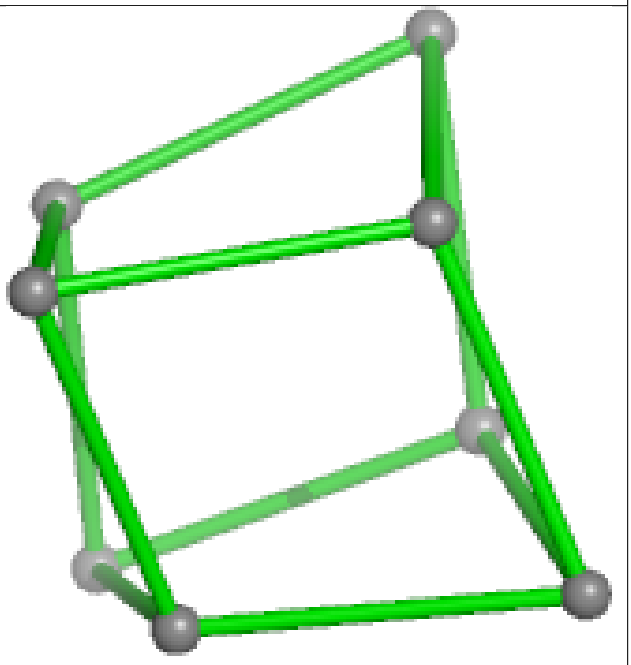
Bond lengths



Bond angles

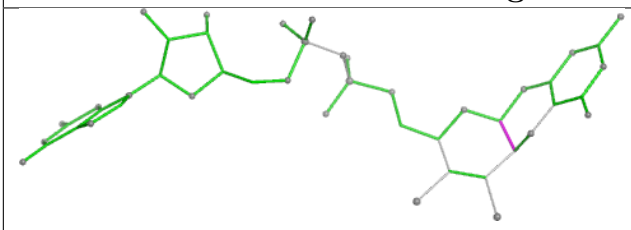


Torsions

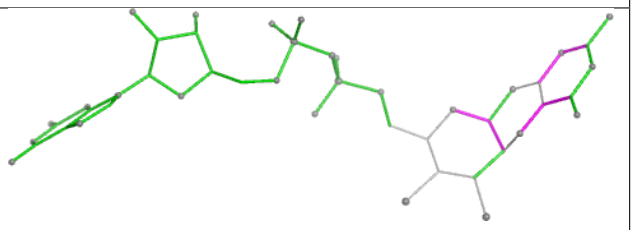


Rings

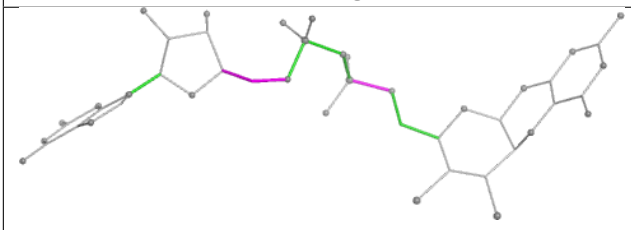
Ligand MGD A 1102



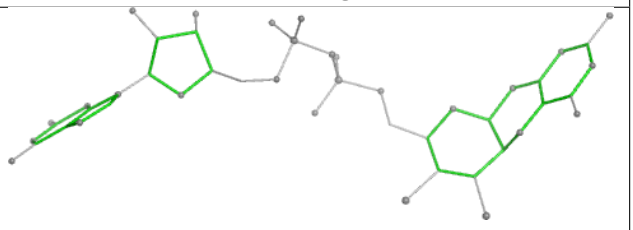
Bond lengths



Bond angles

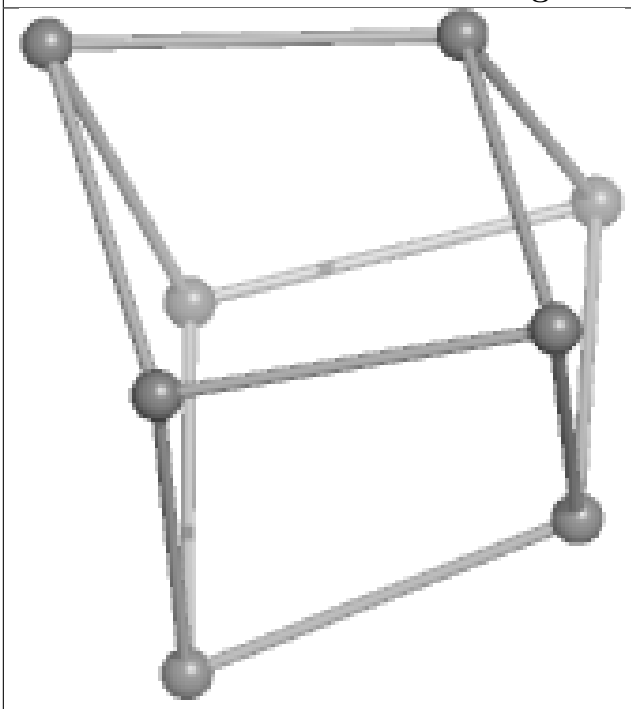


Torsions

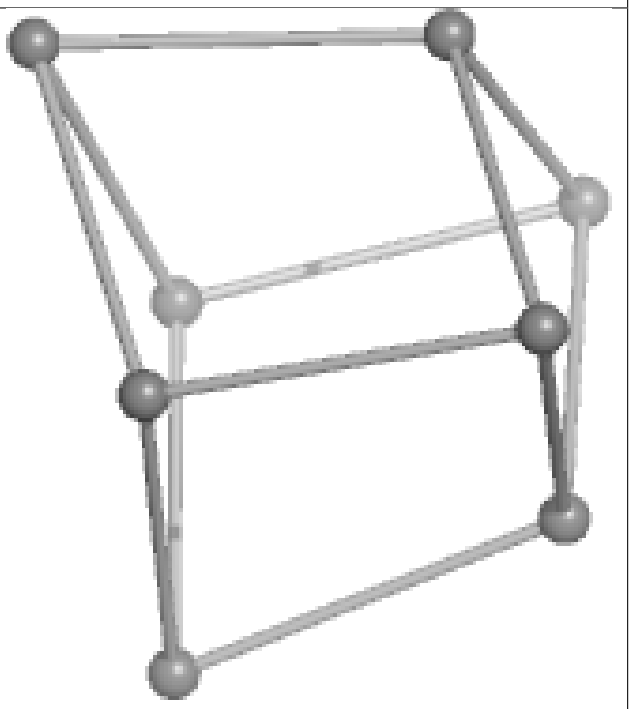


Rings

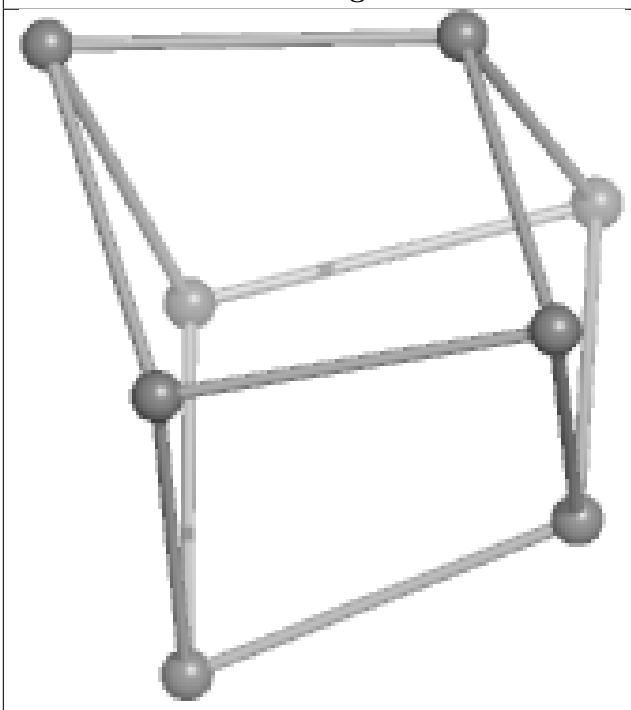
Ligand SF4 B 301



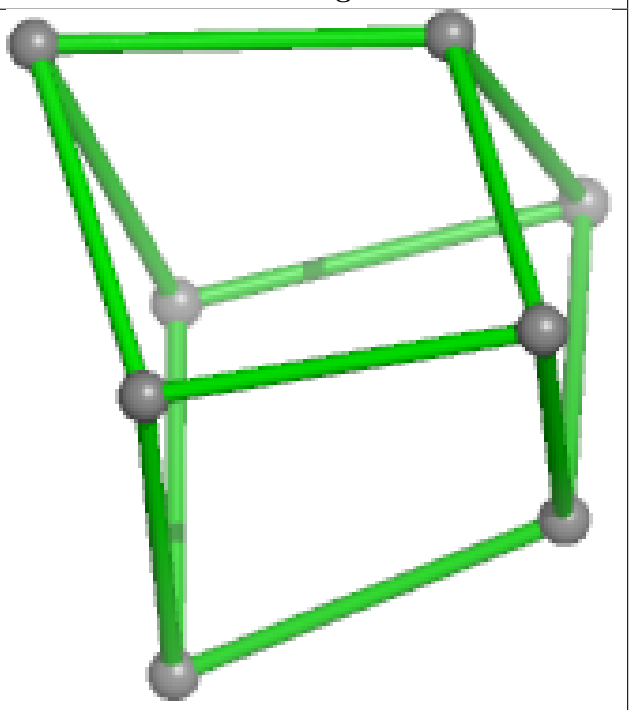
Bond lengths



Bond angles

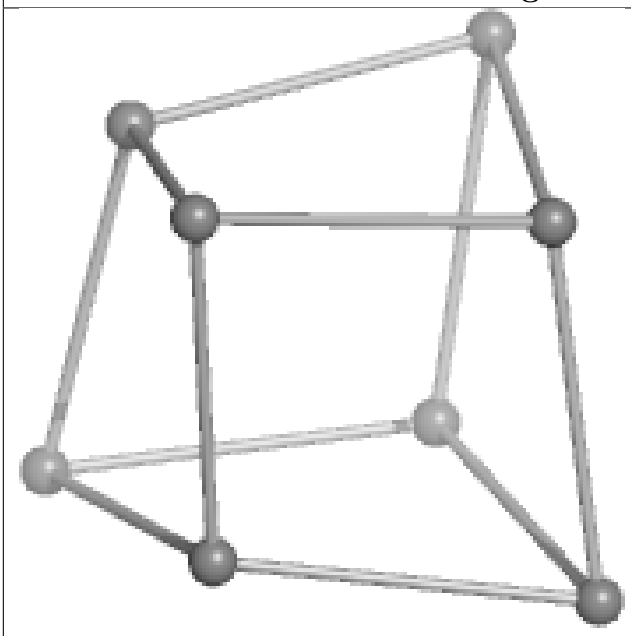


Torsions

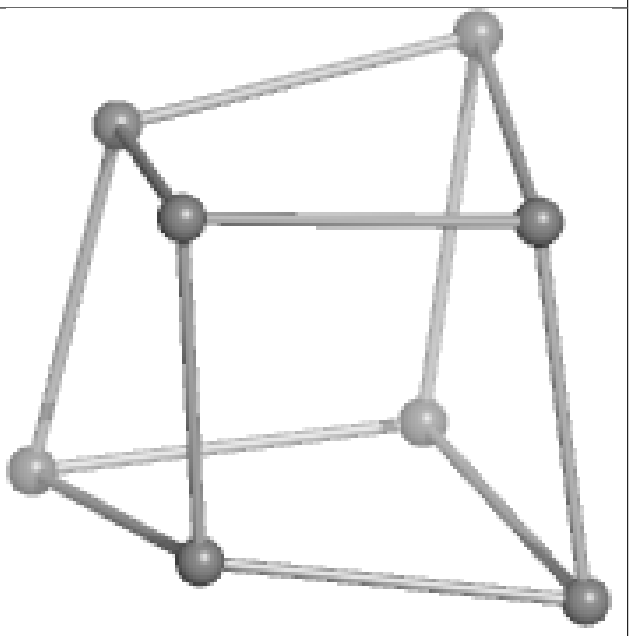


Rings

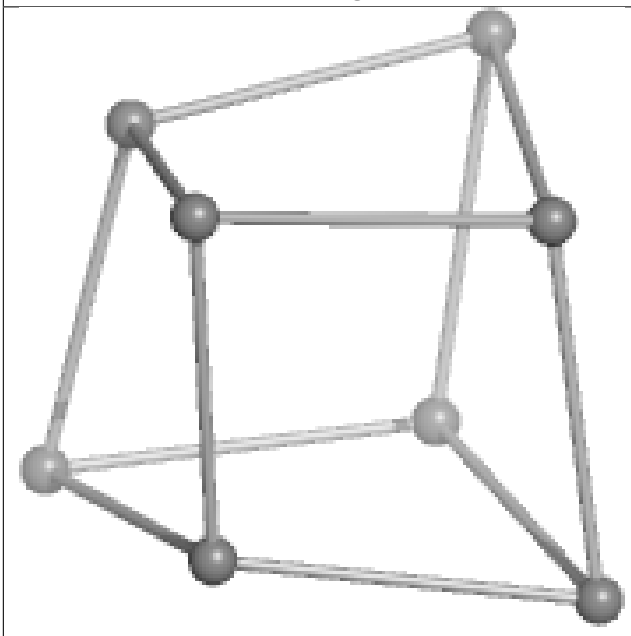
Ligand SF4 A 1103



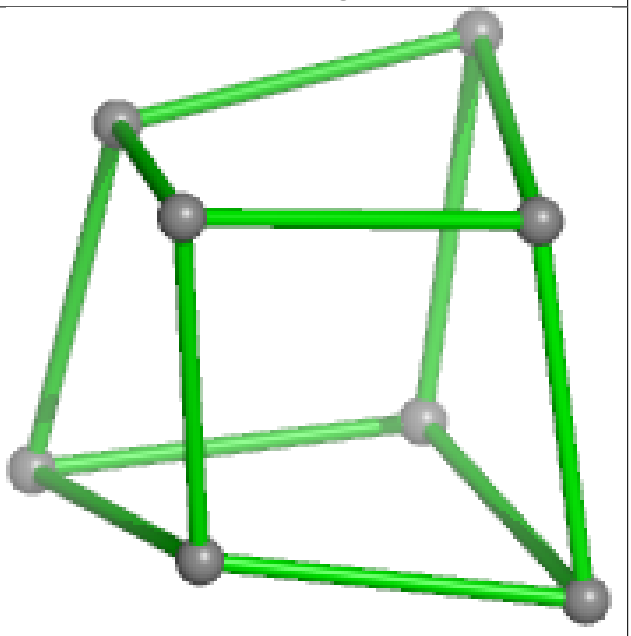
Bond lengths



Bond angles

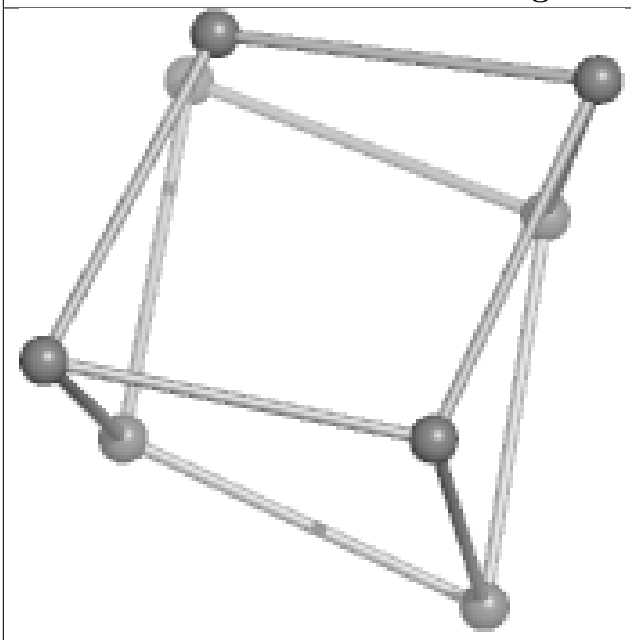


Torsions

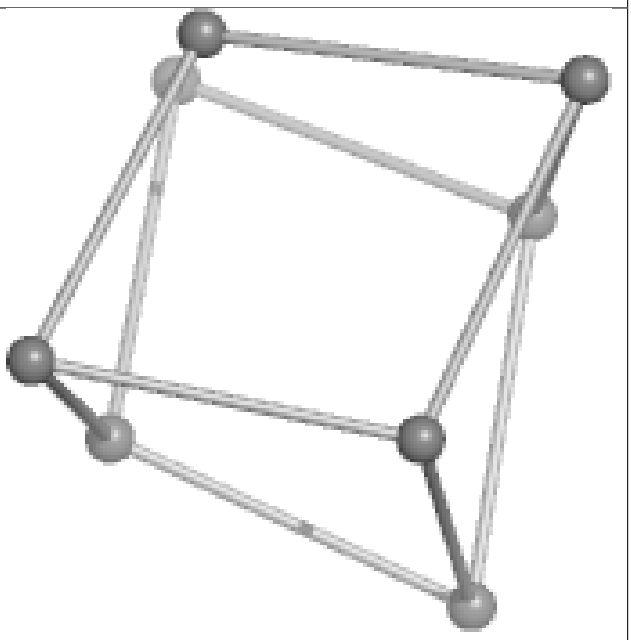


Rings

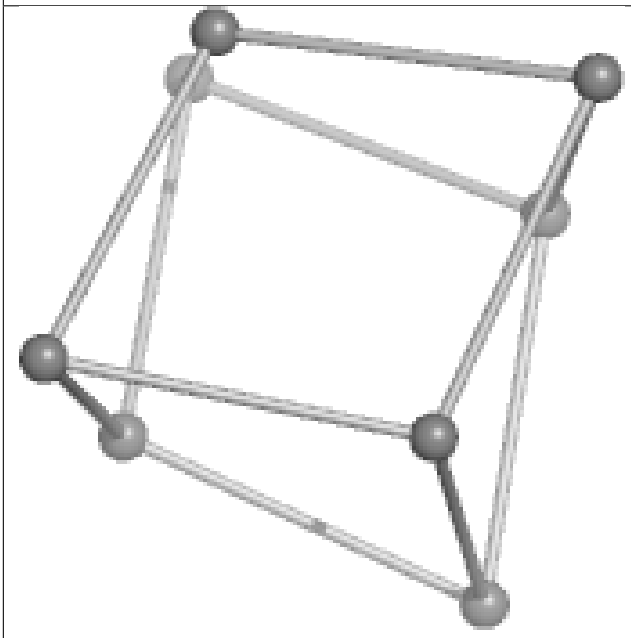
Ligand SF4 B 302



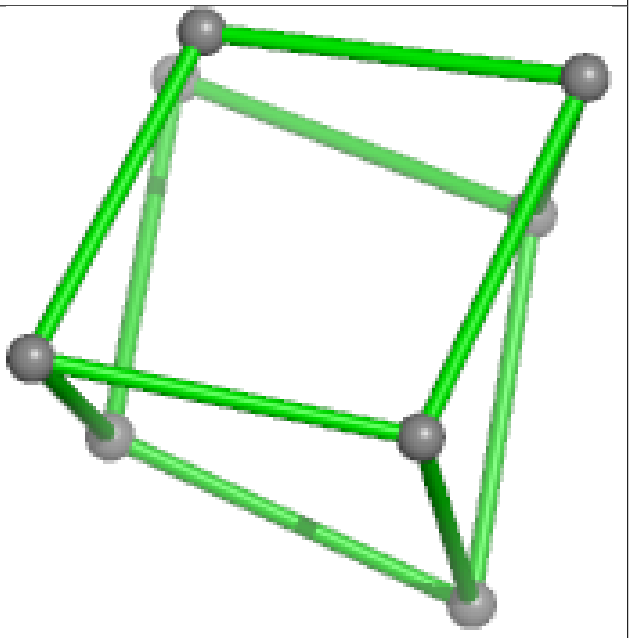
Bond lengths



Bond angles

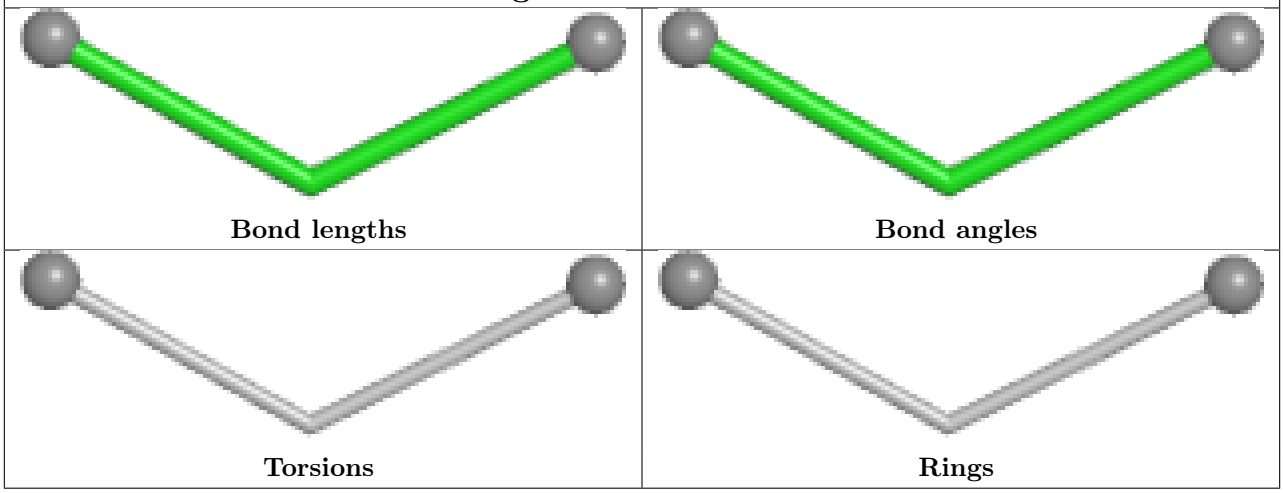


Torsions

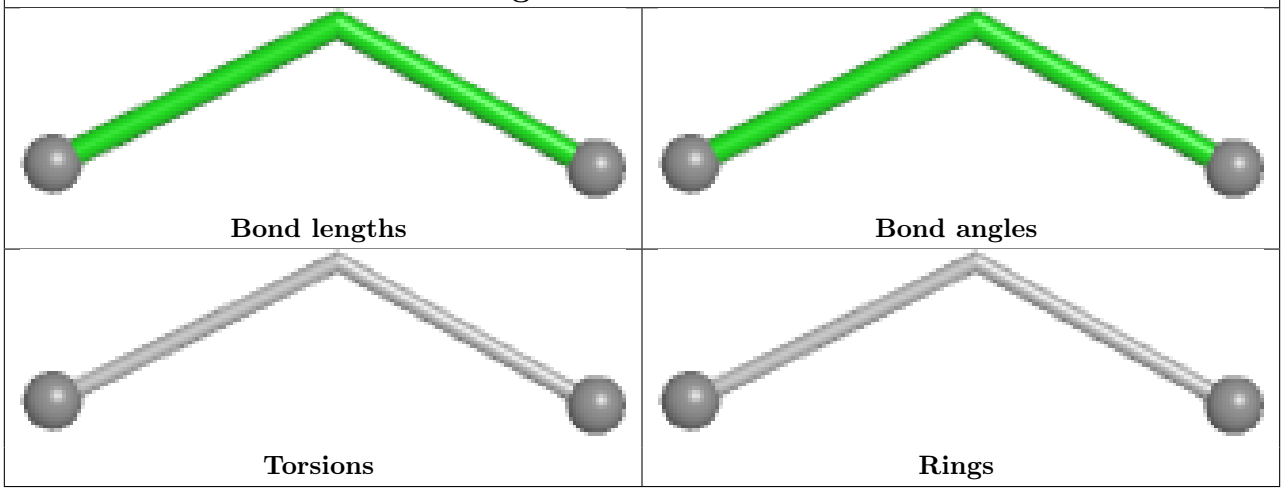


Rings

Ligand FMT A 1115



Ligand FMT A 1114



5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95^{th} percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2			OWAB(Å^2)	Q<0.9
1	A	962/1013 (94%)	0.53	52 (5%)	31	31	20, 35, 57, 78	0
2	B	214/215 (99%)	0.69	18 (8%)	17	17	22, 39, 61, 70	0
All	All	1176/1228 (95%)	0.56	70 (5%)	27	27	20, 36, 57, 78	0

All (70) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	985	ALA	5.0
1	A	207	GLY	4.4
1	A	597	ALA	3.8
2	B	88	VAL	3.8
2	B	131	VAL	3.7
1	A	481	PRO	3.5
2	B	114	GLY	3.4
1	A	339	ALA	3.3
1	A	950	PHE	3.2
1	A	525	GLY	3.2
2	B	92	GLY	3.2
1	A	954	GLY	3.1
1	A	702	GLY	3.0
1	A	480	THR	3.0
1	A	146	ALA	3.0
1	A	67	GLY	2.9
1	A	593	GLY	2.9
1	A	811	GLY	2.9
1	A	533	TRP	2.8
1	A	661	GLY	2.8
2	B	62	GLY	2.7
1	A	151	VAL	2.7
1	A	935	GLY	2.6
2	B	116	SER	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	1005	VAL	2.6
2	B	47	TYR	2.6
1	A	991	GLY	2.6
1	A	404	ALA	2.6
1	A	364	GLU	2.5
1	A	139	ALA	2.5
1	A	150	LEU	2.5
2	B	93	ALA	2.4
1	A	414	VAL	2.4
1	A	705	PHE	2.4
1	A	848	SER	2.4
1	A	527	LYS	2.4
1	A	796	ASP	2.4
1	A	992	ILE	2.4
1	A	142	THR	2.4
2	B	99	THR	2.4
2	B	81	PRO	2.4
1	A	114	SER	2.3
2	B	132	THR	2.3
1	A	68	GLN	2.3
1	A	657	ALA	2.3
1	A	341	GLY	2.3
1	A	570	GLY	2.3
2	B	86	ALA	2.3
1	A	129	ILE	2.2
2	B	96	LYS	2.2
2	B	128	ILE	2.2
2	B	117	VAL	2.2
1	A	543	GLY	2.2
1	A	678	HIS	2.2
1	A	475	LEU	2.2
1	A	122	TRP	2.2
1	A	700	VAL	2.1
2	B	112	VAL	2.1
1	A	324	ALA	2.1
1	A	526	ARG	2.1
1	A	780	LYS	2.1
2	B	98	GLU	2.1
1	A	66	ASP	2.1
1	A	117	TRP	2.1
1	A	124	PHE	2.1
1	A	524	ALA	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	106	GLN	2.1
2	B	110	ALA	2.1
1	A	788	ALA	2.0
1	A	109	TYR	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates (i)

There are no oligosaccharides in this entry.

6.4 Ligands (i)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
11	FMT	A	1114	3/3	0.76	0.17	55,55,56,60	0
8	GOL	A	1109	6/6	0.77	0.17	55,57,59,60	0
9	PEG	A	1112	7/7	0.80	0.15	61,64,66,67	0
9	PEG	A	1111	7/7	0.80	0.14	42,45,49,52	0
8	GOL	A	1110	6/6	0.85	0.12	38,43,45,48	0
10	EDO	B	305	4/4	0.88	0.20	42,42,43,46	0
10	EDO	A	1113	4/4	0.88	0.14	45,46,47,48	0
7	PG4	A	1106	13/13	0.92	0.11	38,42,46,47	0
11	FMT	A	1115	3/3	0.92	0.10	46,46,47,50	0
10	EDO	B	304	4/4	0.93	0.09	22,26,32,34	0
8	GOL	A	1108	6/6	0.94	0.08	34,36,37,37	0
8	GOL	A	1107	6/6	0.94	0.08	30,31,33,34	0
3	MGD	A	1101	47/47	0.97	0.06	20,24,28,29	0
3	MGD	A	1102	47/47	0.97	0.07	21,26,32,35	0
5	H2S	A	1104	1/1	0.97	0.06	25,25,25,25	0
4	SF4	B	302	8/8	0.98	0.05	36,38,42,42	0
4	SF4	B	303	8/8	0.98	0.03	29,30,32,34	0
4	SF4	A	1103	8/8	0.98	0.03	22,22,23,23	0
4	SF4	B	301	8/8	0.99	0.03	23,25,26,27	0

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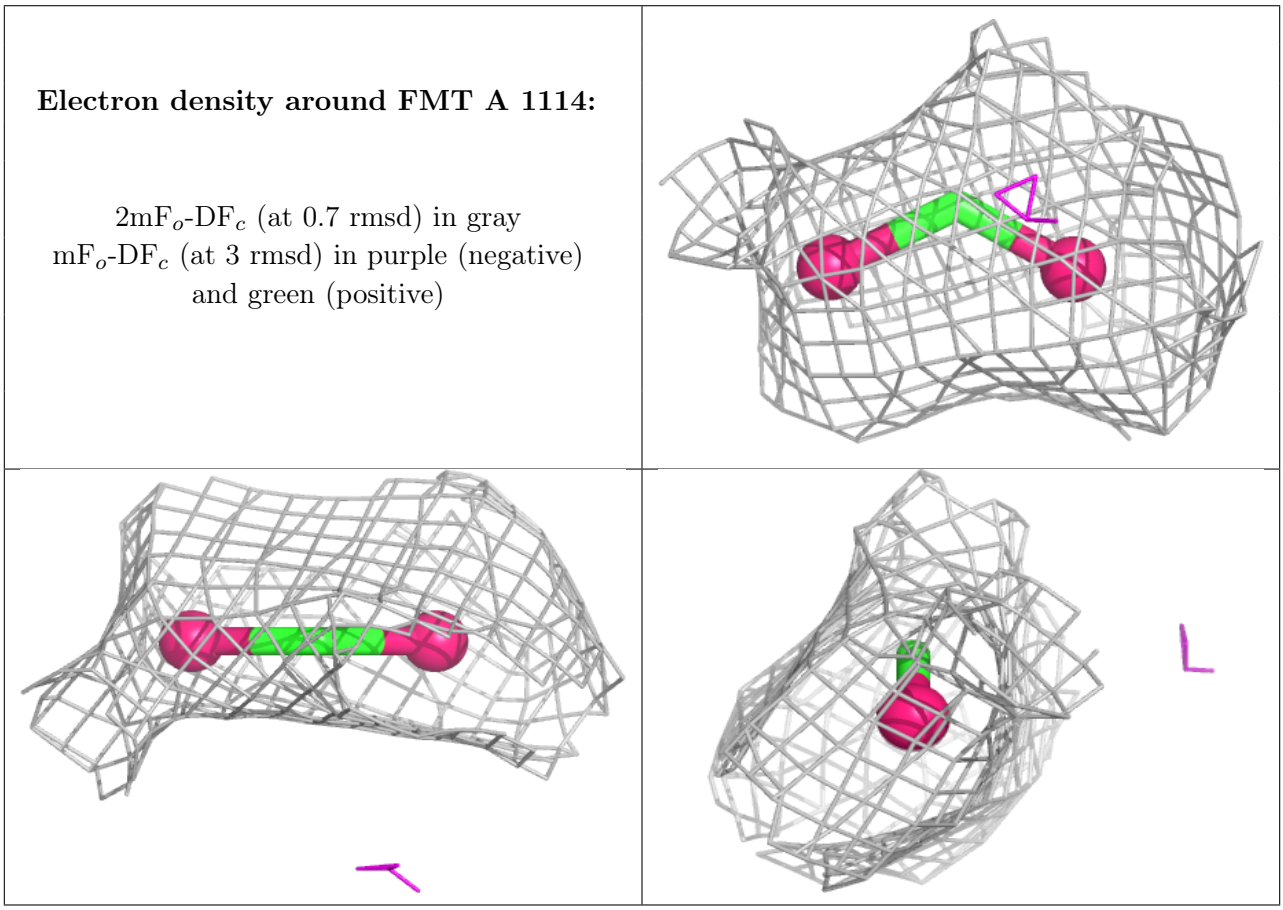
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
6	W	A	1105	1/1	0.99	0.01	25,25,25,25	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

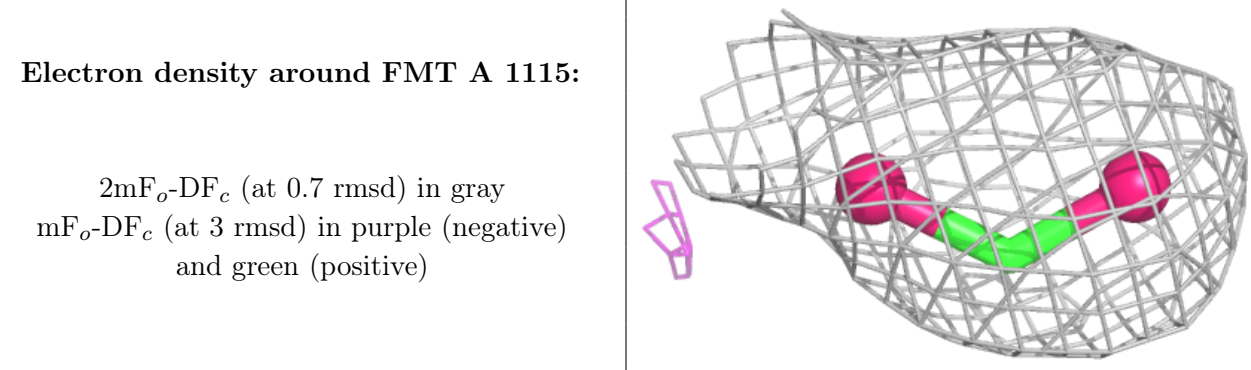
Electron density around FMT A 1114:

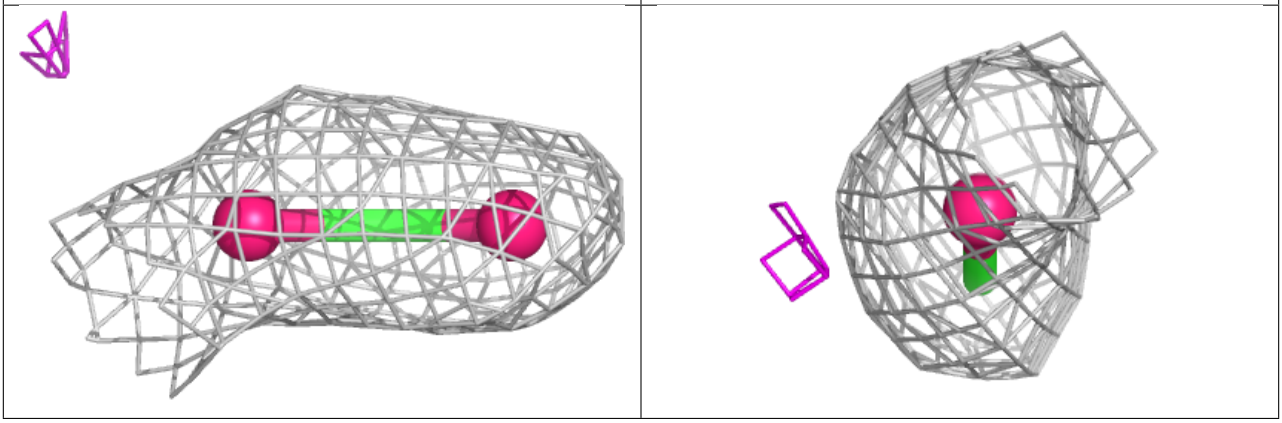
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)



Electron density around FMT A 1115:

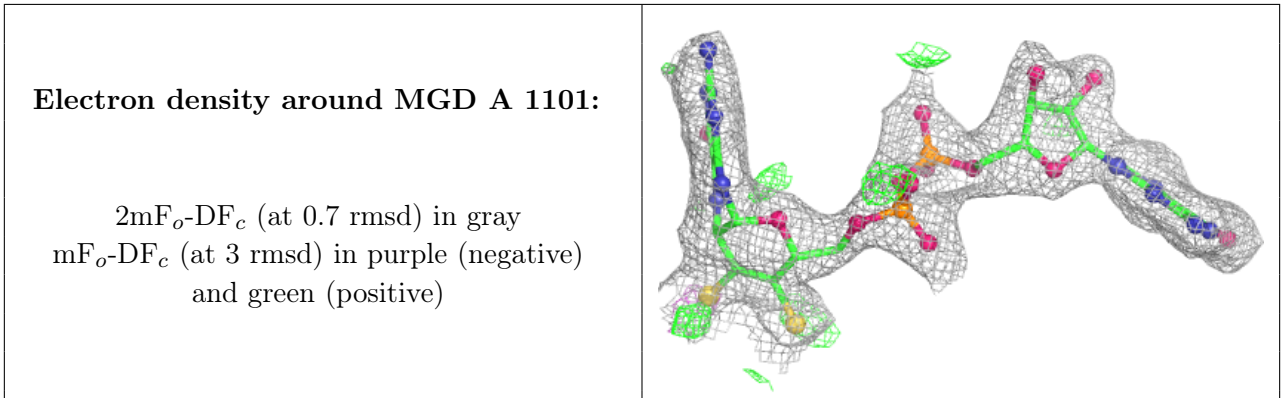
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

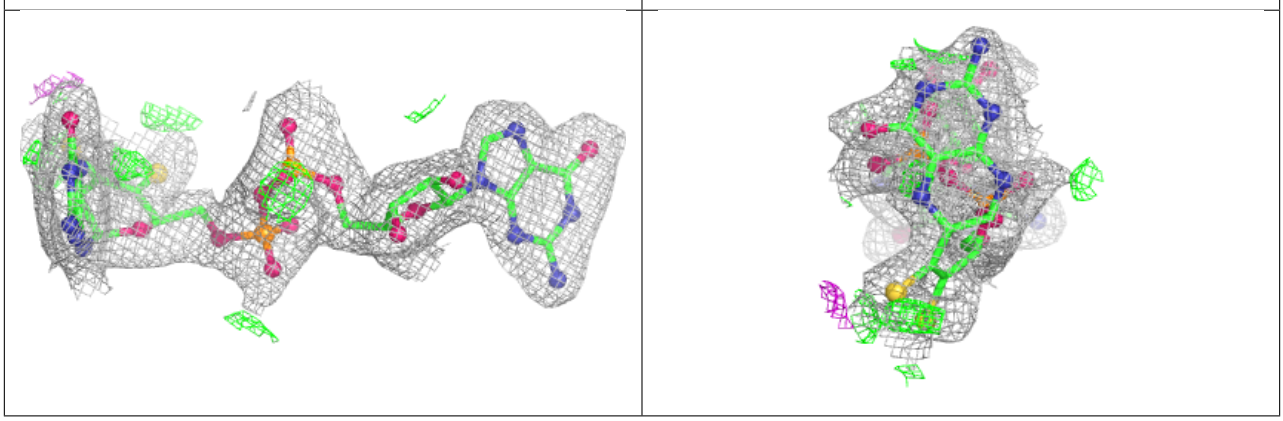




Electron density around MGD A 1101:

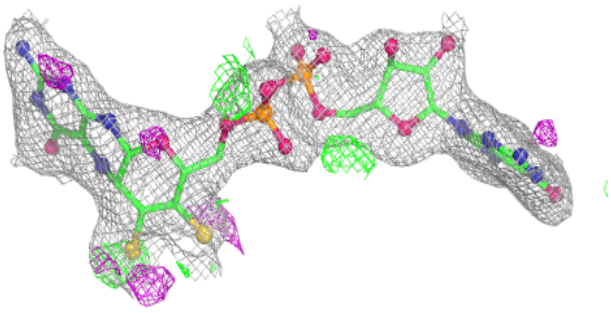
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

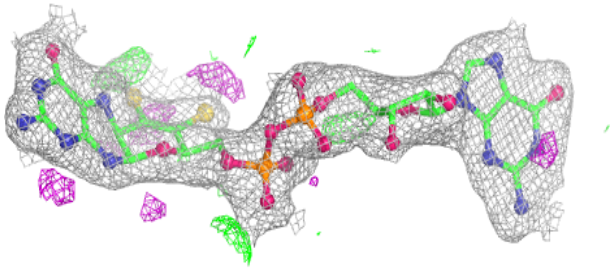


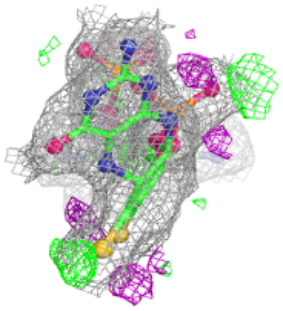


Electron density around MGD A 1102:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

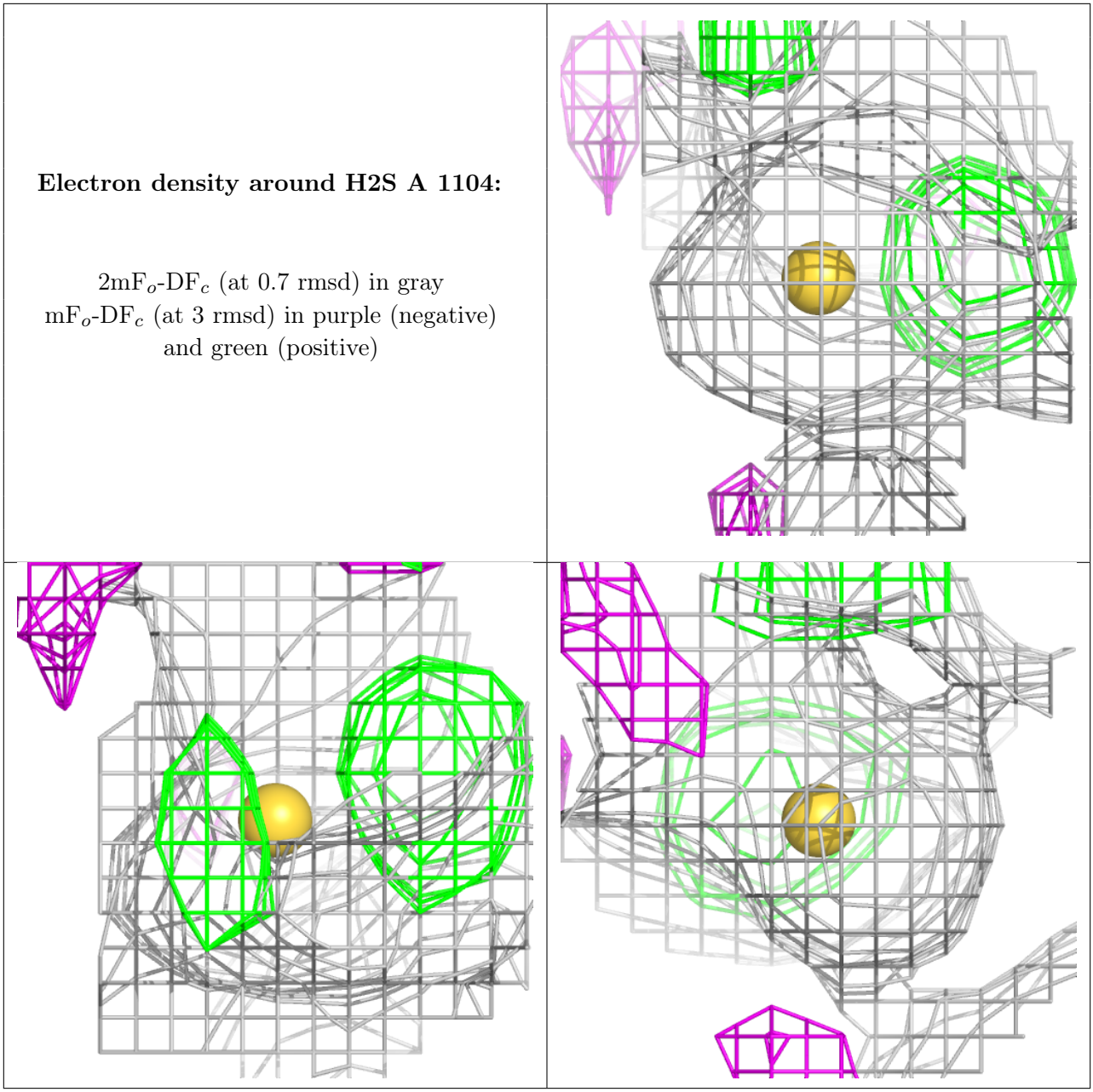






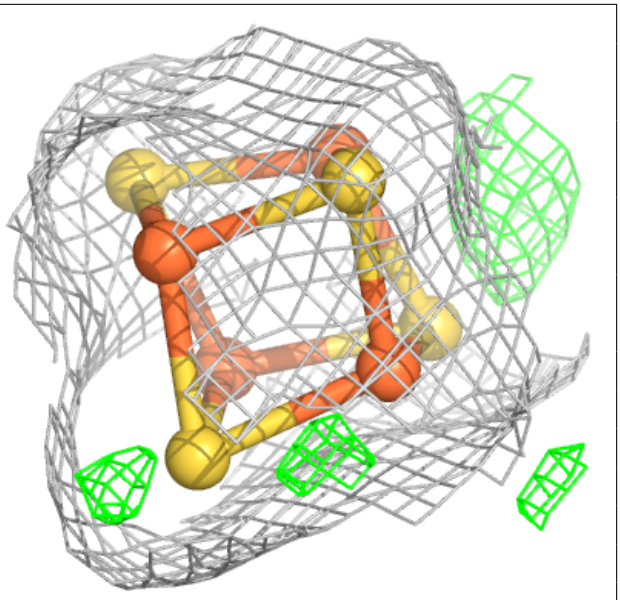
Electron density around H2S A 1104:

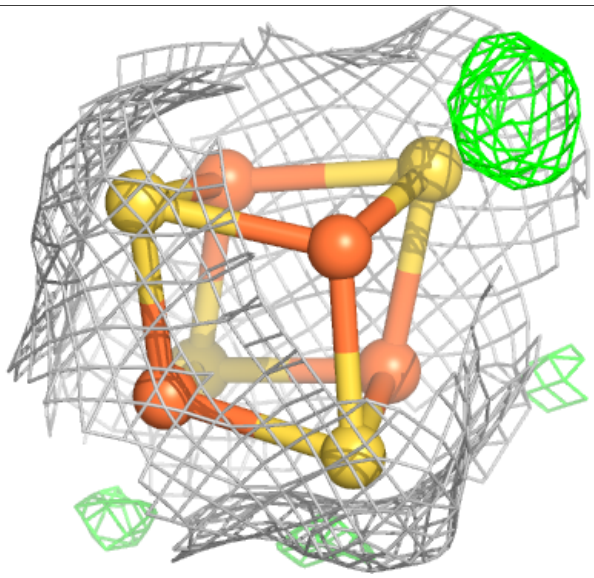
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

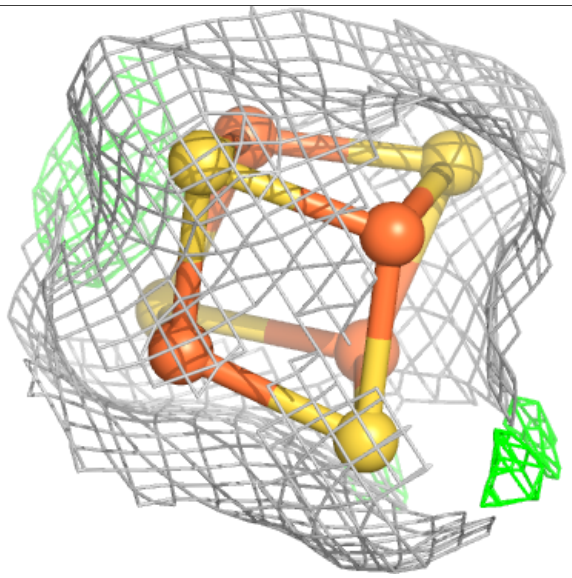


Electron density around SF4 B 302:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

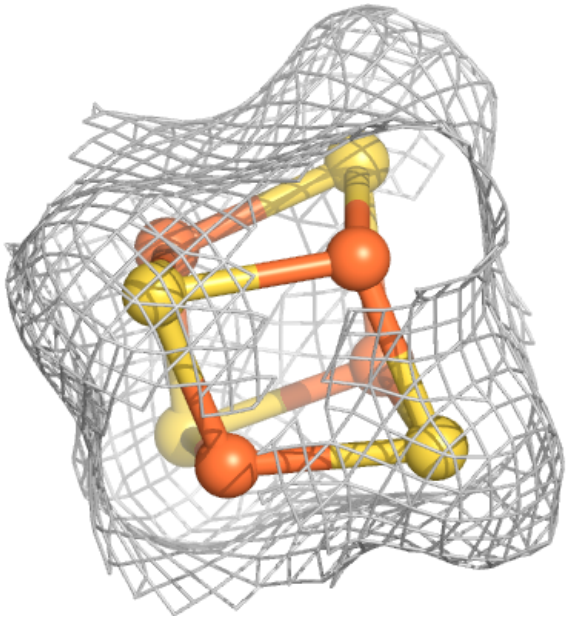


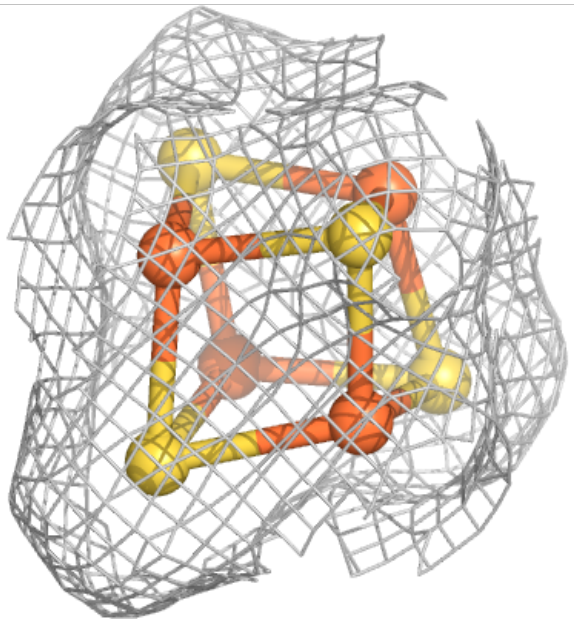


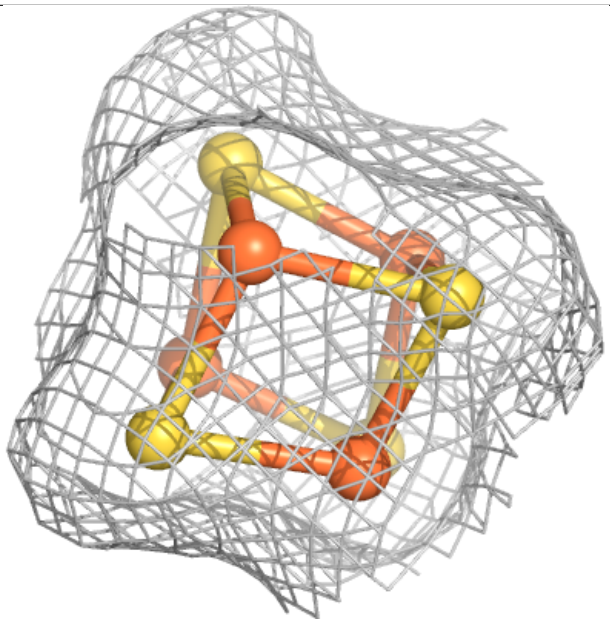


Electron density around SF4 B 303:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

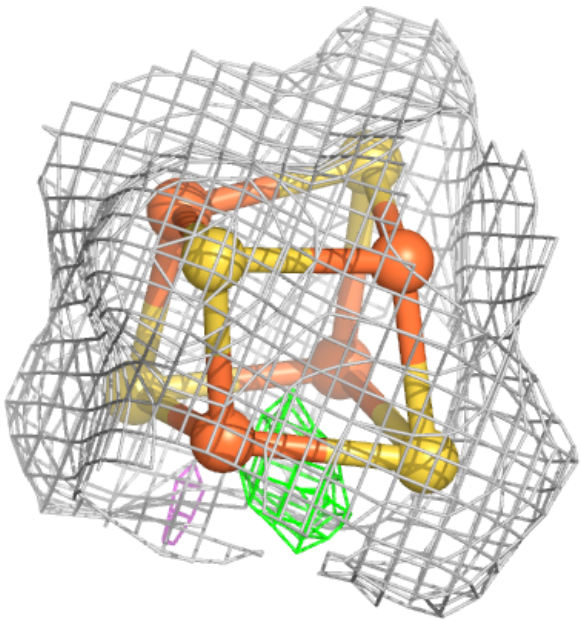


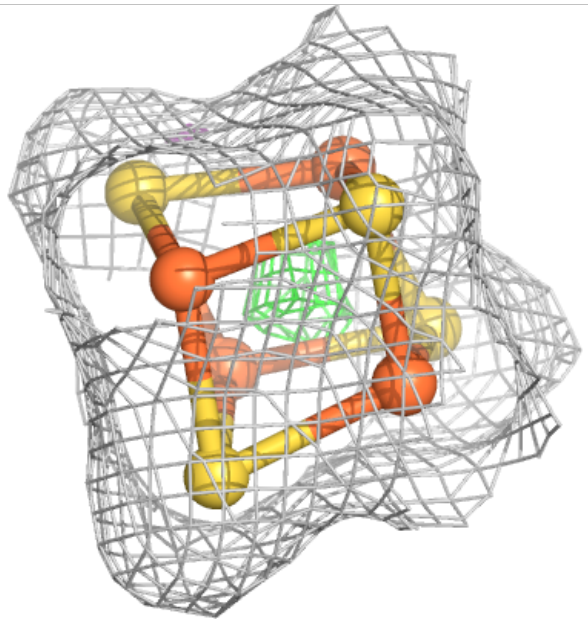


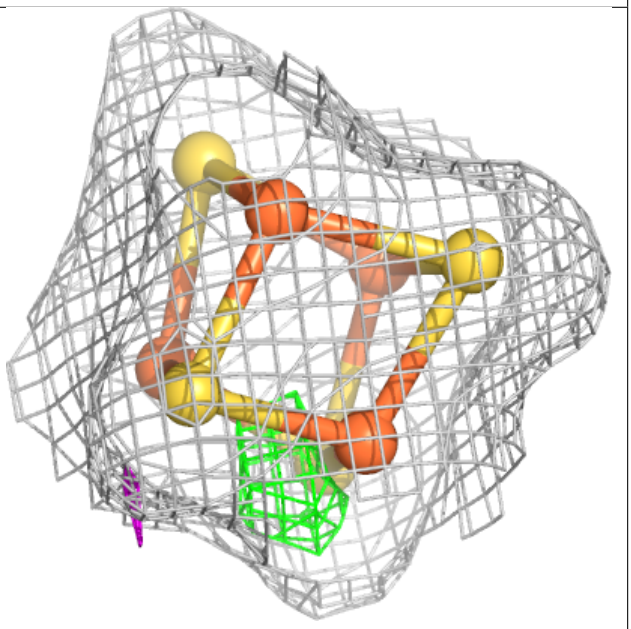


Electron density around SF4 A 1103:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

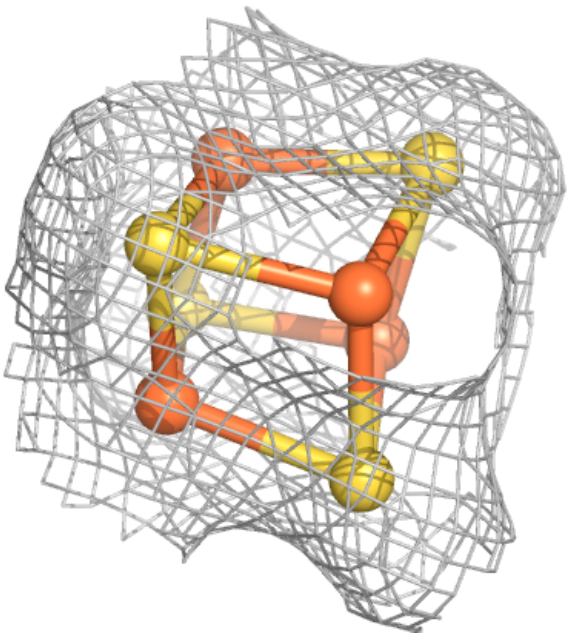


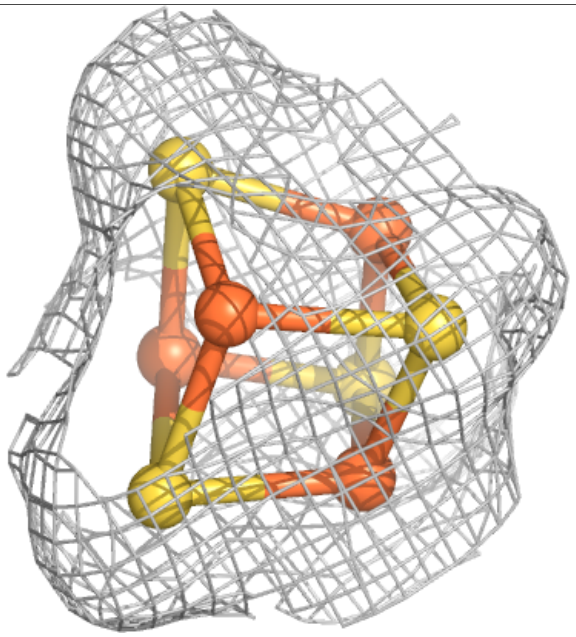


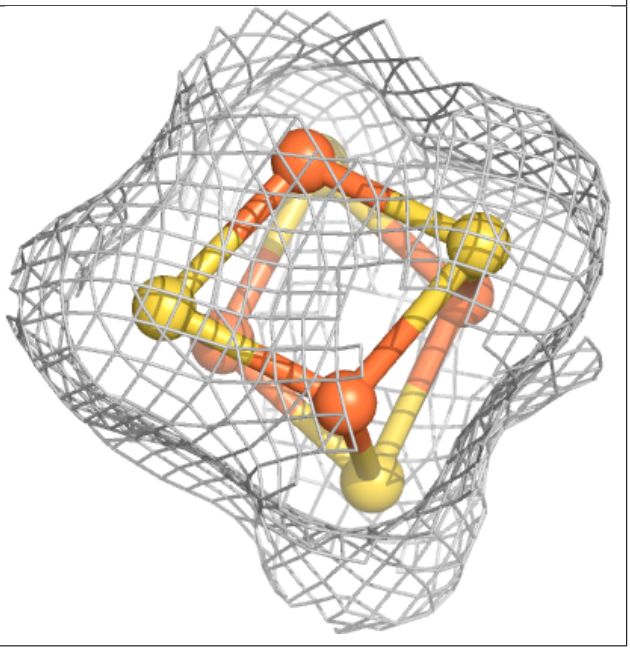


Electron density around SF4 B 301:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

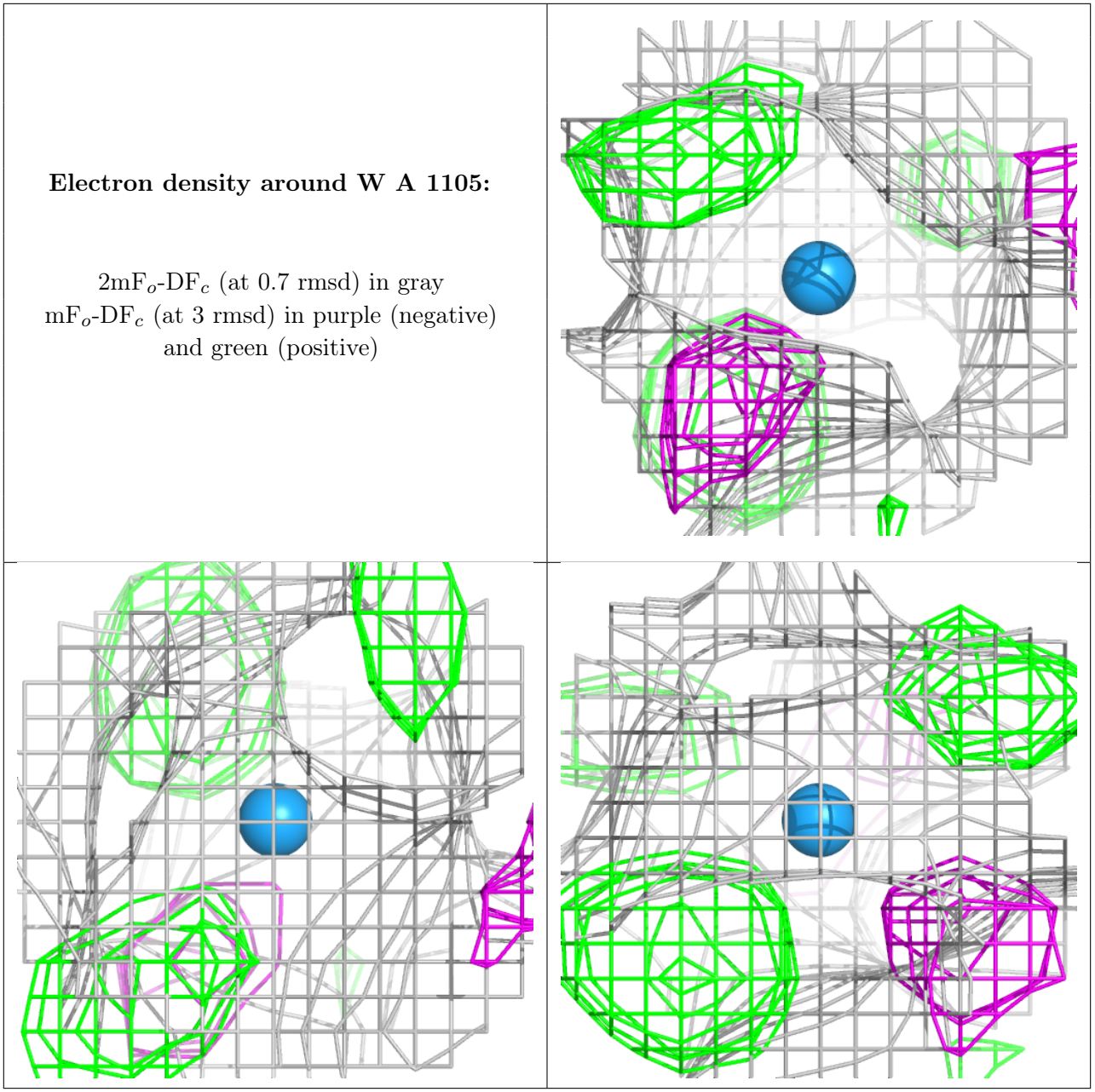






Electron density around W A 1105:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)



6.5 Other polymers (i)

There are no such residues in this entry.