Full wwPDB X-ray Structure Validation Report ⓘ

Nov 11, 2026 – 03:33 pm GMT

PDB ID	:	30PB / pdb_000030pb
Title	:	W-formate dehydrogenase Q409A from Nitratidesulfovibrio vulgaris (Desulfovibrio vulgaris)
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	:	2.19 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:

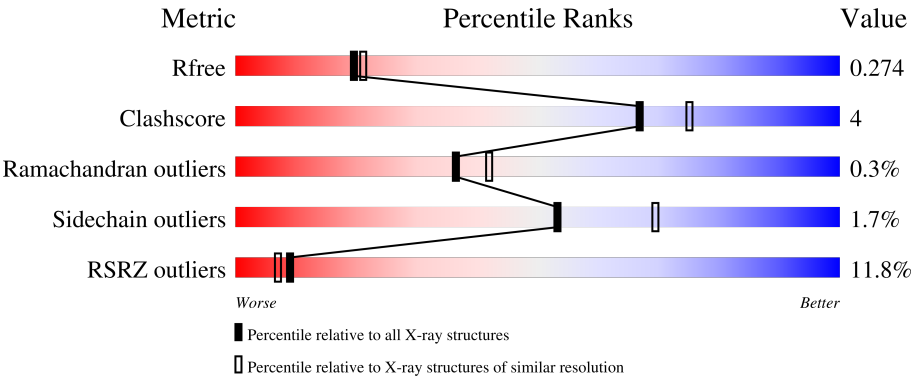
MolProbity	:	4-5-2 with Phenix2.2
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.2
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal 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 2.19 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	6164 (2.20-2.20)
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (2.20-2.20)

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	9% 84% 11% 5%
2	B	215	20% 92% 8%

2 Entry composition (i)

There are 10 unique types of molecules in this entry. The entry contains 9447 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	7529	4798	1312	1377	41	1	0	0	0

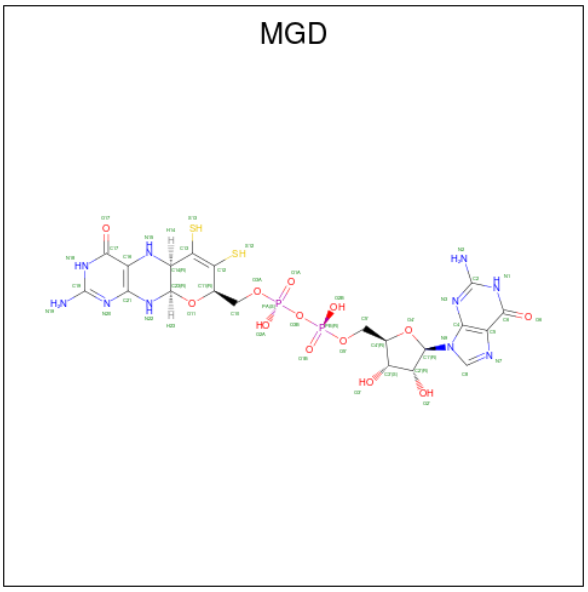
There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	409	ALA	GLN	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.

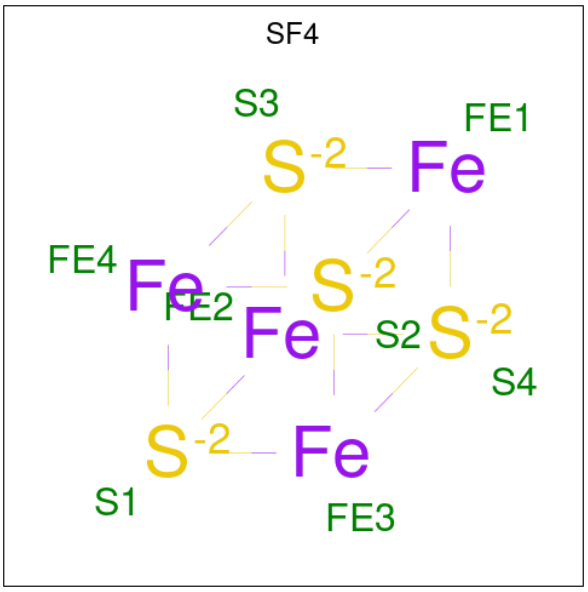
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	214	1664	1041	291	316	16	0	0	0

- 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).



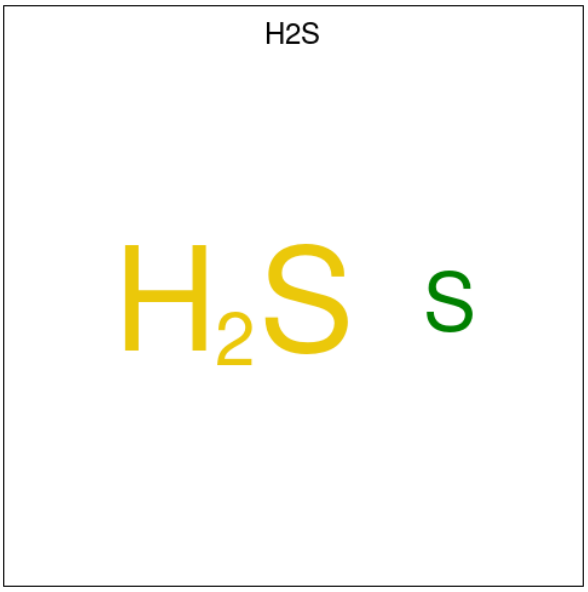
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	Fe	S	0	0
			8	4	4		

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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).

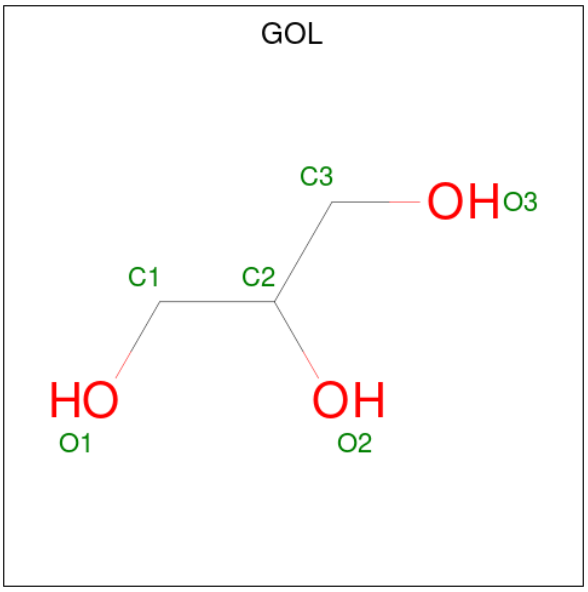


Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total S 1 1	0	0

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

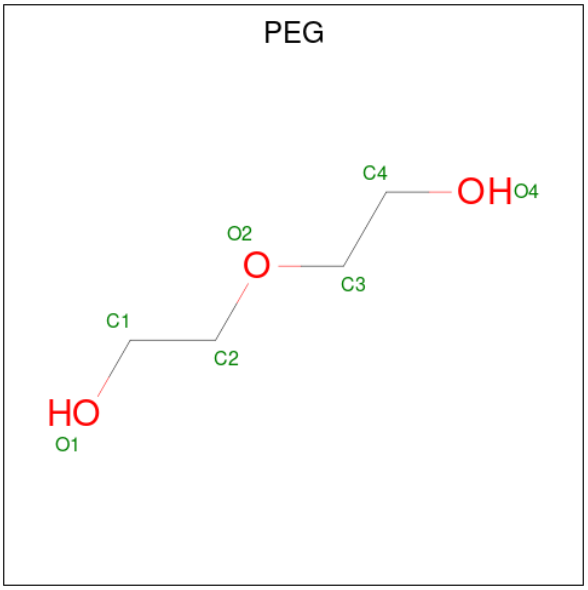
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total W 1 1	0	0

- Molecule 7 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



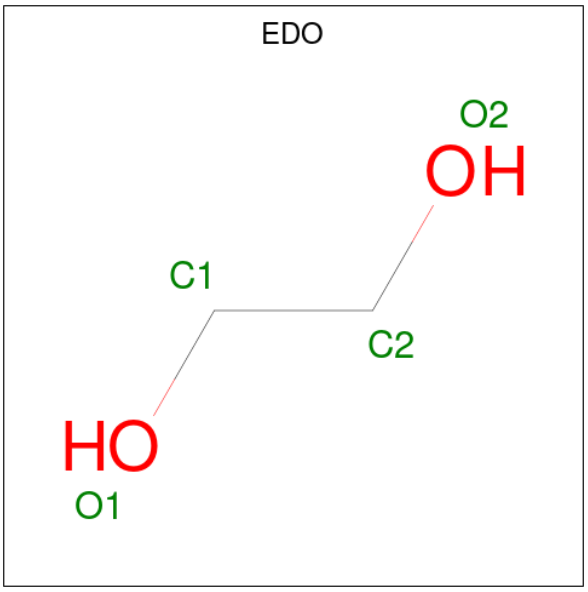
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	O	0	0
			6	3	3		
7	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 8 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



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

- Molecule 9 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



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

- Molecule 10 is water.

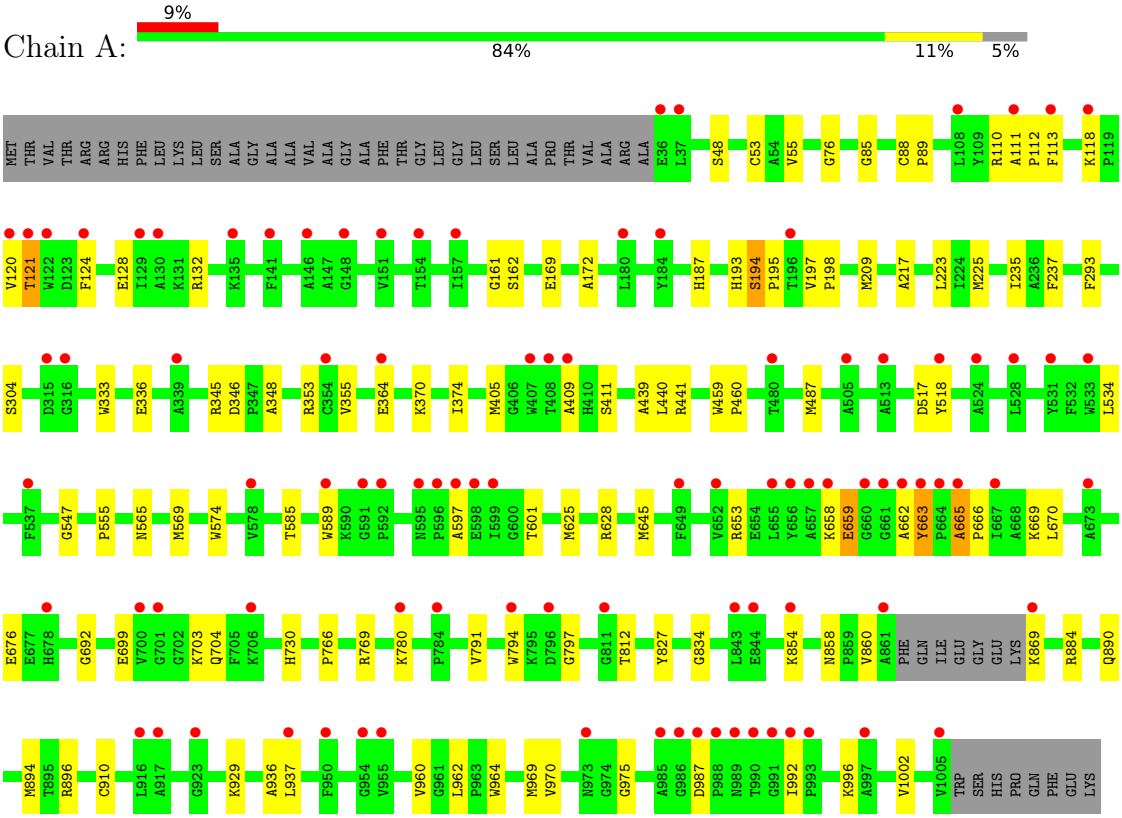
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
10	A	81	Total O 81 81	0	0
10	B	14	Total O 14 14	0	0

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.

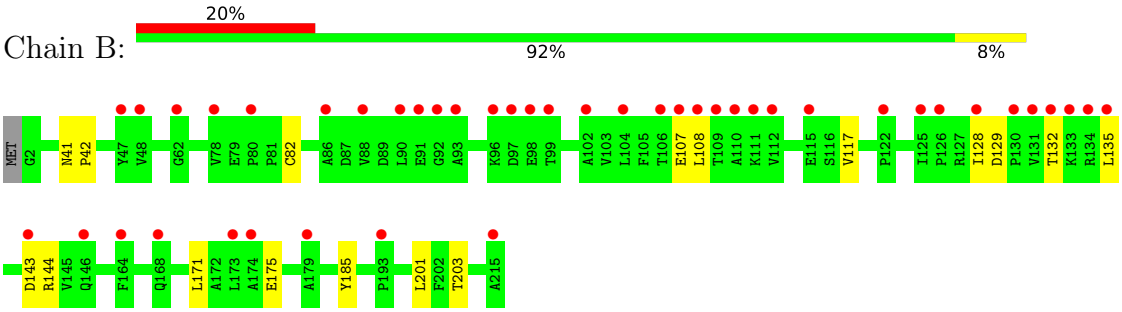
• Molecule 1: Formate dehydrogenase, alpha subunit, selenocysteine-containing

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	65.05Å 128.24Å 149.22Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	97.26 – 2.19 97.26 – 2.19	Depositor EDS
% Data completeness (in resolution range)	65.9 (97.26-2.19) 65.9 (97.26-2.19)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.11 (at 2.18Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.218 , 0.267 0.227 , 0.274	Depositor DCC
R_{free} test set	2180 reflections (3.35%)	wwPDB-VP
Wilson B-factor (Å^2)	32.9	Xtriage
Anisotropy	0.058	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 22.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	9447	wwPDB-VP
Average B, all atoms (Å^2)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.45% 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: PEG, EDO, SEC, SF4, MGD, W, GOL, H2S

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	0/7729	1.37	7/10485 (0.1%)
2	B	1.01	0/1699	1.41	0/2302
All	All	0.99	0/9428	1.38	7/12787 (0.1%)

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	975	GLY	CA-C-O	-6.65	117.66	122.45
1	A	293	PHE	CA-C-N	5.46	127.91	120.54
1	A	293	PHE	C-N-CA	5.46	127.91	120.54
1	A	791	VAL	N-CA-C	-5.41	106.42	111.45
1	A	187	HIS	CA-C-N	5.16	127.50	120.54
1	A	187	HIS	C-N-CA	5.16	127.50	120.54
1	A	692	GLY	CA-C-O	-5.15	118.87	122.22

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	7529	0	7363	60	0
2	B	1664	0	1633	9	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	94	0	44	2	0
4	A	8	0	0	0	0
4	B	24	0	0	0	0
5	A	1	0	0	0	0
6	A	1	0	0	0	0
7	A	12	0	16	0	0
8	A	7	0	10	1	0
9	B	12	0	18	0	0
10	A	81	0	0	0	0
10	B	14	0	0	0	0
All	All	9447	0	9084	69	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 4.

All (69) 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:665:ALA:O	1:A:669:LYS:HG2	1.88	0.73
1:A:569:MET:HE1	1:A:585:THR:HG23	1.76	0.67
1:A:653:ARG:NH2	1:A:670:LEU:O	2.32	0.63
1:A:665:ALA:HB3	1:A:666:PRO:HD3	1.84	0.59
1:A:194:SER:N	1:A:195:PRO:CD	2.69	0.56
1:A:209:MET:CE	1:A:440:LEU:HD23	2.36	0.55
1:A:223:LEU:HD21	1:A:225:MET:CE	2.36	0.55
1:A:439:ALA:O	1:A:441:ARG:NH1	2.39	0.55
2:B:129:ASP:CG	2:B:132:THR:HG22	2.33	0.54
1:A:197:VAL:HG22	1:A:198:PRO:HD3	1.90	0.53
1:A:169:GLU:O	1:A:645:MET:HE1	2.09	0.53
1:A:197:VAL:N	1:A:198:PRO:CD	2.72	0.53
2:B:41:ASN:HA	2:B:42:PRO:C	2.34	0.53
2:B:82:CYS:O	2:B:117:VAL:HG23	2.09	0.52
1:A:405:MET:HE1	1:A:884:ARG:HH12	1.75	0.51
1:A:355:VAL:HG13	1:A:827:TYR:HB2	1.92	0.51
1:A:625:MET:HE3	1:A:730:HIS:CE1	2.45	0.51
1:A:209:MET:HE1	1:A:440:LEU:HD23	1.93	0.51
2:B:201:LEU:C	2:B:201:LEU:HD23	2.36	0.51
1:A:518:TYR:HB3	1:A:666:PRO:HB3	1.92	0.50
1:A:110:ARG:NH1	1:A:601:THR:O	2.44	0.50
1:A:405:MET:HE3	1:A:996:LYS:NZ	2.26	0.50
1:A:929:LYS:HE2	1:A:936:ALA:HB1	1.94	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:172:ALA:HB3	1:A:645:MET:CE	2.41	0.50
1:A:896:ARG:HD2	1:A:970:VAL:O	2.11	0.50
1:A:409:ALA:O	1:A:992:ILE:HD11	2.12	0.50
1:A:217:ALA:HB3	8:A:1108:PEG:H21	1.94	0.50
1:A:120:VAL:HG11	1:A:124:PHE:CD1	2.49	0.48
1:A:193:HIS:C	1:A:195:PRO:HD2	2.37	0.48
1:A:658:LYS:O	1:A:659:GLU:HB2	2.13	0.48
2:B:128:ILE:HA	2:B:135:LEU:HD23	1.96	0.48
1:A:555:PRO:HD2	1:A:585:THR:HG21	1.95	0.47
1:A:88:CYS:HB2	1:A:89:PRO:HD2	1.96	0.47
1:A:894:MET:SD	3:A:1102:MGD:H2'	2.55	0.47
1:A:336:GLU:OE1	1:A:353:ARG:NH2	2.48	0.47
1:A:370:LYS:O	1:A:374:ILE:HG22	2.16	0.46
1:A:487:MET:HG2	1:A:812:THR:O	2.15	0.46
2:B:143:ASP:OD1	2:B:144:ARG:N	2.49	0.45
1:A:113:PHE:O	1:A:597:ALA:HA	2.17	0.45
1:A:565:ASN:O	1:A:569:MET:HG3	2.17	0.45
1:A:858:ASN:OD1	1:A:860:VAL:HG22	2.17	0.45
1:A:333:TRP:CH2	1:A:834:GLY:HA2	2.52	0.44
1:A:209:MET:HE1	1:A:440:LEU:CD2	2.47	0.44
1:A:662:ALA:O	1:A:663:TYR:C	2.59	0.44
1:A:699:GLU:HA	1:A:703:LYS:O	2.18	0.44
1:A:346:ASP:OD1	1:A:348:ALA:HB3	2.18	0.44
1:A:665:ALA:HB3	1:A:666:PRO:CD	2.45	0.44
1:A:534:LEU:HD23	1:A:534:LEU:HA	1.88	0.44
1:A:118:LYS:O	1:A:120:VAL:HG23	2.18	0.43
1:A:459:TRP:HB3	1:A:460:PRO:HD2	2.00	0.43
1:A:53:CYS:SG	1:A:55:VAL:HG23	2.58	0.43
1:A:304:SER:OG	1:A:345:ARG:HD2	2.18	0.43
1:A:890:GLN:HA	1:A:964:TRP:CH2	2.53	0.43
2:B:107:GLU:OE1	2:B:107:GLU:N	2.51	0.43
1:A:547:GLY:HA3	1:A:574:TRP:CZ2	2.54	0.42
1:A:48:SER:HA	1:A:628:ARG:HB2	2.00	0.42
1:A:110:ARG:HG3	1:A:589:TRP:CZ2	2.54	0.42
1:A:111:ALA:O	1:A:112:PRO:C	2.63	0.42
1:A:910:CYS:SG	1:A:960:VAL:HG13	2.60	0.42
2:B:171:LEU:O	2:B:175:GLU:HG2	2.20	0.42
1:A:128:GLU:O	1:A:132:ARG:HG2	2.20	0.42
1:A:161:GLY:HA2	1:A:162:SER:HA	1.88	0.41
1:A:794:TRP:CZ2	1:A:797:GLY:HA2	2.55	0.41
1:A:937:LEU:C	1:A:937:LEU:HD12	2.45	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:76:GLY:HA3	1:A:85:GLY:O	2.20	0.41
1:A:405:MET:HE1	3:A:1102:MGD:O17	2.20	0.41
1:A:120:VAL:HG12	1:A:121:THR:O	2.22	0.40
1:A:766:PRO:HG2	1:A:769:ARG:HD2	2.02	0.40
2:B:185:TYR:CD2	2:B:203:THR:HB	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%)	908 (95%)	46 (5%)	4 (0%)	30	34
2	B	212/215 (99%)	201 (95%)	11 (5%)	0	100	100
All	All	1170/1228 (95%)	1109 (95%)	57 (5%)	4 (0%)	36	42

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	659	GLU
1	A	663	TYR
1	A	665	ALA
1	A	987	ASP

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	781/818 (96%)	766 (98%)	15 (2%)	50 66
2	B	185/186 (100%)	184 (100%)	1 (0%)	81 90
All	All	966/1004 (96%)	950 (98%)	16 (2%)	53 69

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	121	THR
1	A	194	SER
1	A	235	ILE
1	A	237	PHE
1	A	364	GLU
1	A	411	SER
1	A	517	ASP
1	A	676	GLU
1	A	704	GLN
1	A	780	LYS
1	A	854	LYS
1	A	869	LYS
1	A	962	LEU
1	A	969	MET
1	A	1002	VAL
2	B	108	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	68	GLN
1	A	367	ASN
2	B	24	GLN

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 14 ligands modelled in this entry, 1 is modelled with single atom and 1 is monoatomic - leaving 12 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	$\#\|Z\| > 2$
4	SF4	A	1103	1	0,12,12	-	-	-		
4	SF4	B	1404	2	0,12,12	-	-	-		
9	EDO	B	1405	-	3,3,3	0.10	0	2,2,2	0.28	0
4	SF4	B	1402	2	0,12,12	-	-	-		
9	EDO	B	1401	-	3,3,3	0.09	0	2,2,2	0.16	0
3	MGD	A	1102	6	45,52,52	0.50	0	54,81,81	0.81	2 (3%)
4	SF4	B	1403	2	0,12,12	-	-	-		
8	PEG	A	1108	-	6,6,6	0.13	0	5,5,5	0.09	0
7	GOL	A	1106	-	5,5,5	0.10	0	5,5,5	0.32	0
7	GOL	A	1107	-	5,5,5	0.11	0	5,5,5	0.34	0
3	MGD	A	1101	6	45,52,52	0.47	0	54,81,81	0.97	2 (3%)
9	EDO	B	1406	-	3,3,3	0.08	0	2,2,2	0.26	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
4	SF4	A	1103	1	-	-	0/6/5/5
4	SF4	B	1404	2	-	-	0/6/5/5
9	EDO	B	1405	-	-	1/1/1/1	-
4	SF4	B	1402	2	-	-	0/6/5/5
9	EDO	B	1401	-	-	1/1/1/1	-
3	MGD	A	1102	6	-	3/22/66/66	0/6/6/6

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	SF4	B	1403	2	-	-	0/6/5/5
8	PEG	A	1108	-	-	2/4/4/4	-
7	GOL	A	1106	-	-	2/4/4/4	-
7	GOL	A	1107	-	-	2/4/4/4	-
3	MGD	A	1101	6	-	3/22/66/66	0/6/6/6
9	EDO	B	1406	-	-	0/1/1/1	-

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	1101	MGD	PA-O3B-PB	3.14	143.61	132.83
3	A	1101	MGD	C19-N20-C21	2.96	118.77	113.43
3	A	1102	MGD	C19-N20-C21	2.80	118.47	113.43
3	A	1102	MGD	C17-C16-N15	2.06	122.28	116.76

There are no chirality outliers.

All (14) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1101	MGD	PA-O3B-PB-O5'
3	A	1102	MGD	C4'-C5'-O5'-PB
7	A	1106	GOL	O1-C1-C2-O2
7	A	1106	GOL	O1-C1-C2-C3
7	A	1107	GOL	C1-C2-C3-O3
3	A	1102	MGD	O4'-C4'-C5'-O5'
8	A	1108	PEG	O1-C1-C2-O2
7	A	1107	GOL	O2-C2-C3-O3
3	A	1102	MGD	C3'-C4'-C5'-O5'
9	B	1405	EDO	O1-C1-C2-O2
8	A	1108	PEG	O2-C3-C4-O4
9	B	1401	EDO	O1-C1-C2-O2
3	A	1101	MGD	PA-O3B-PB-O1B
3	A	1101	MGD	C5'-O5'-PB-O1B

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1102	MGD	2	0

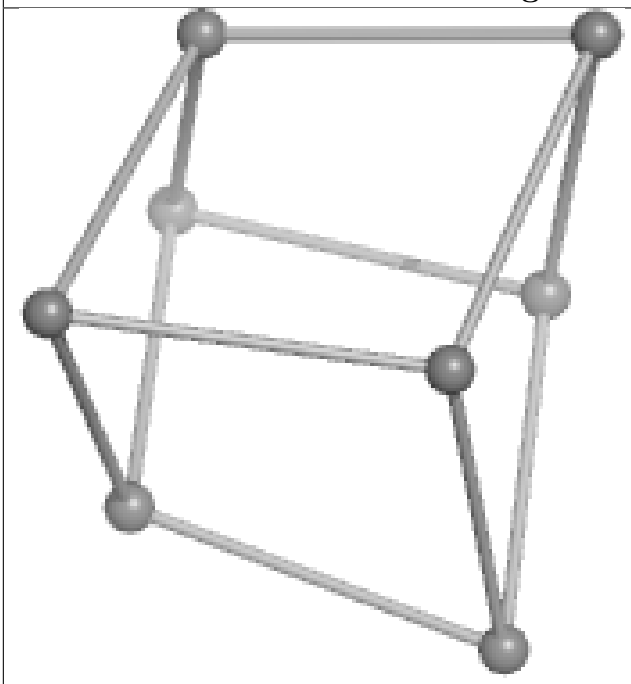
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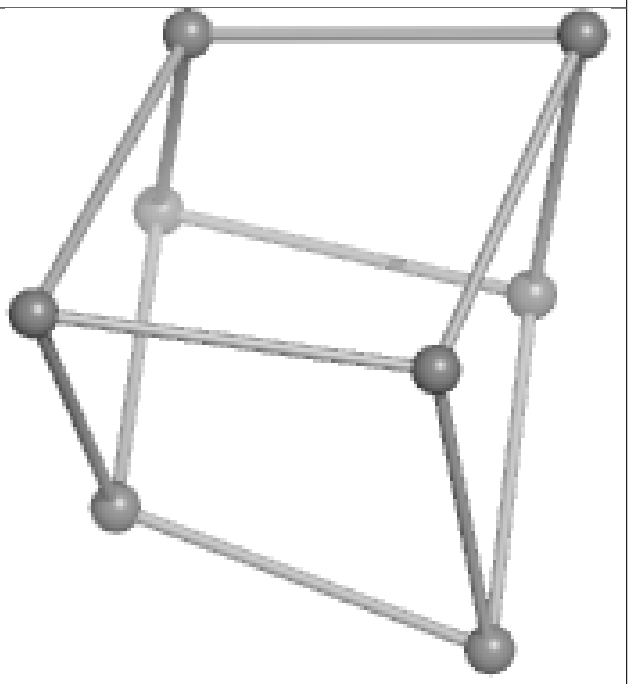
Mol	Chain	Res	Type	Clashes	Symm-Clashes
8	A	1108	PEG	1	0

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.

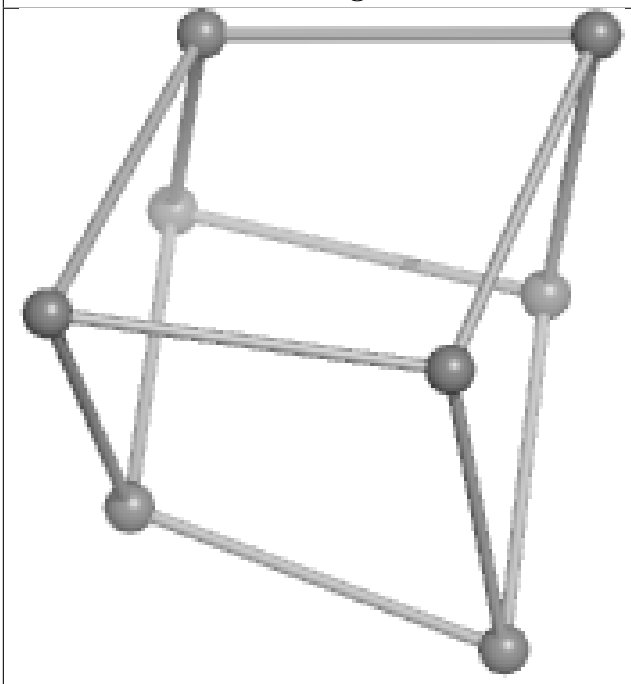
Ligand SF4 A 1103



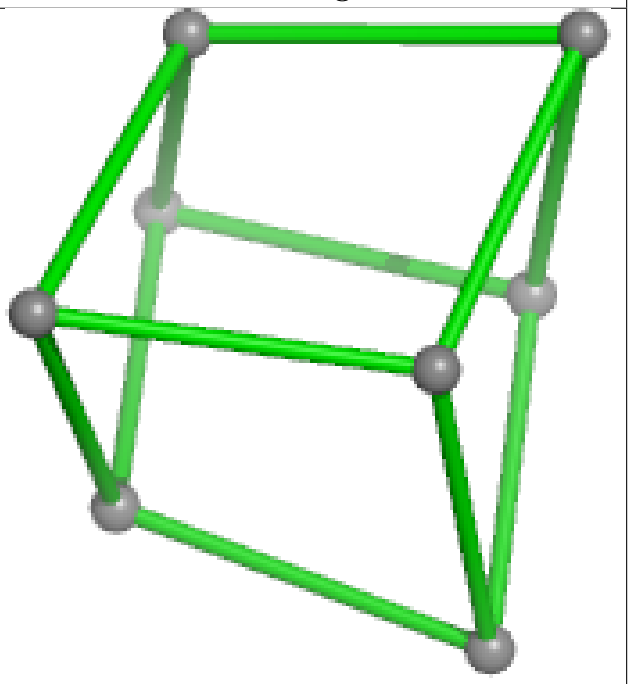
Bond lengths



Bond angles

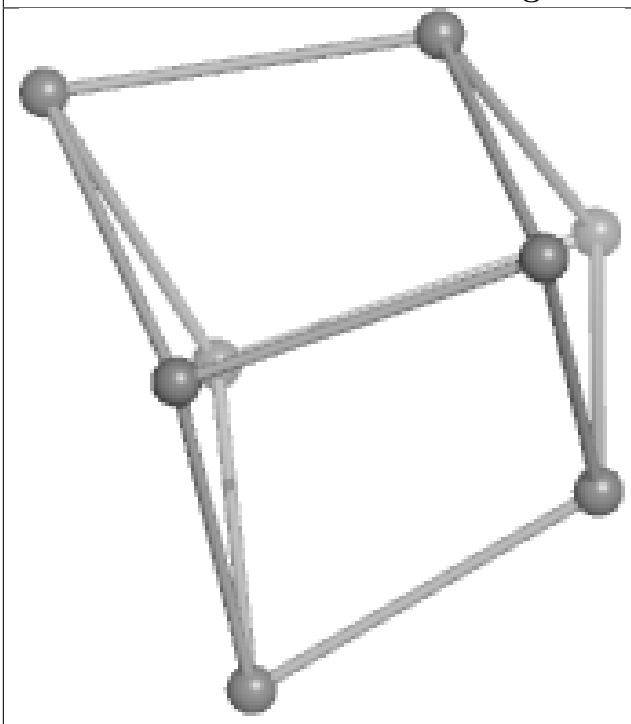


Torsions

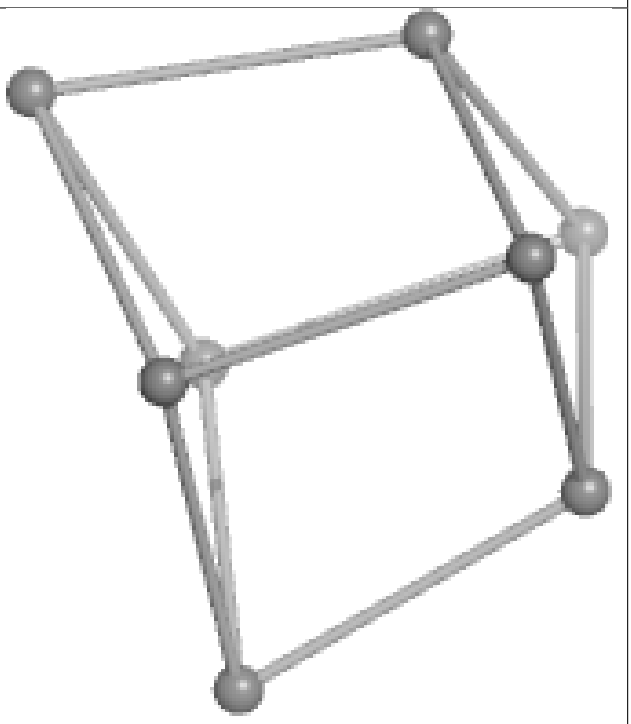


Rings

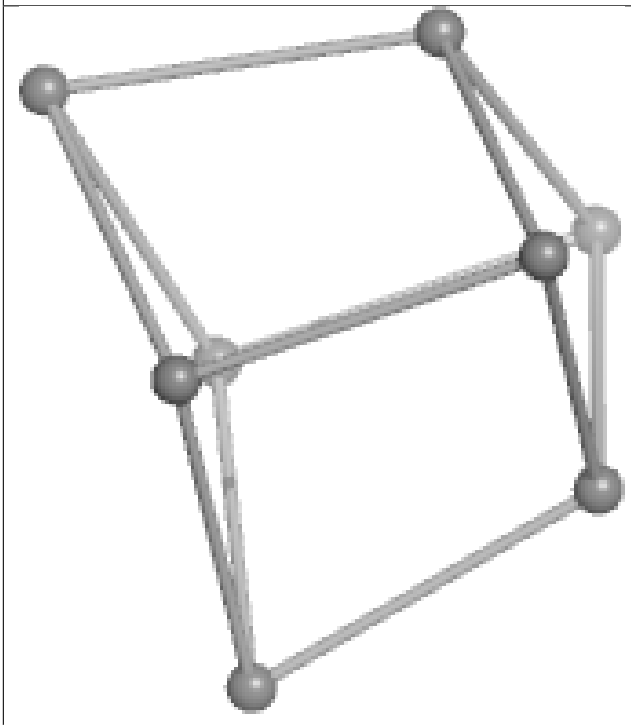
Ligand SF4 B 1404



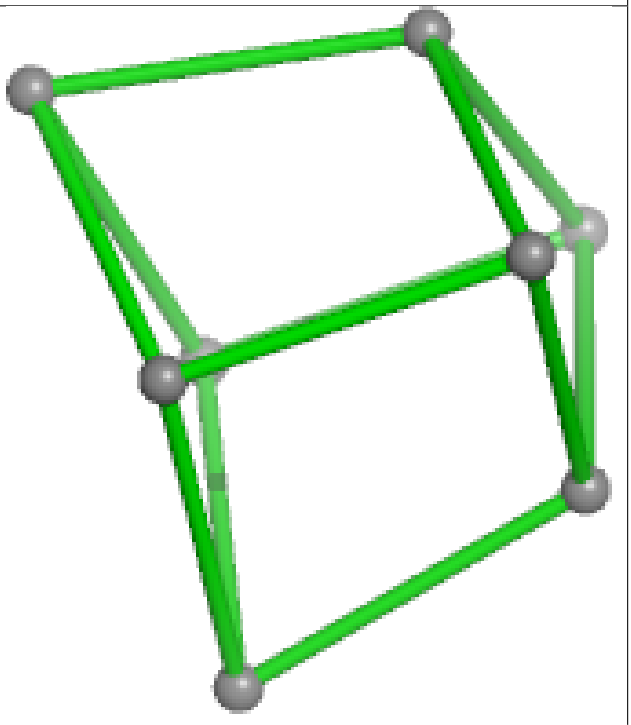
Bond lengths



Bond angles

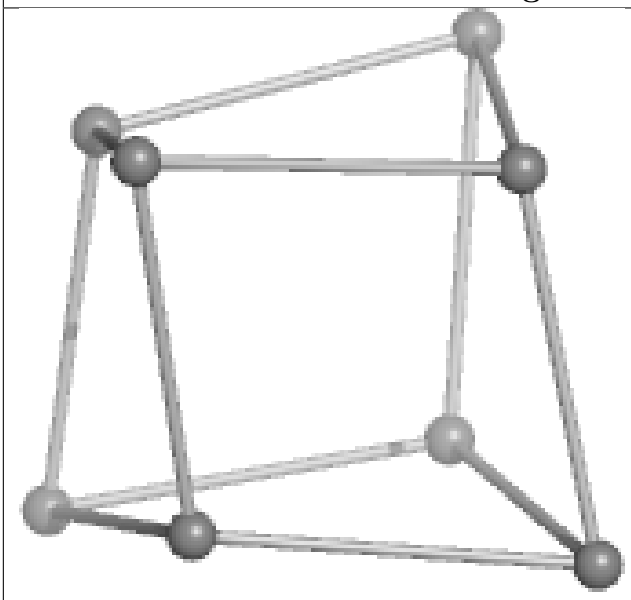


Torsions

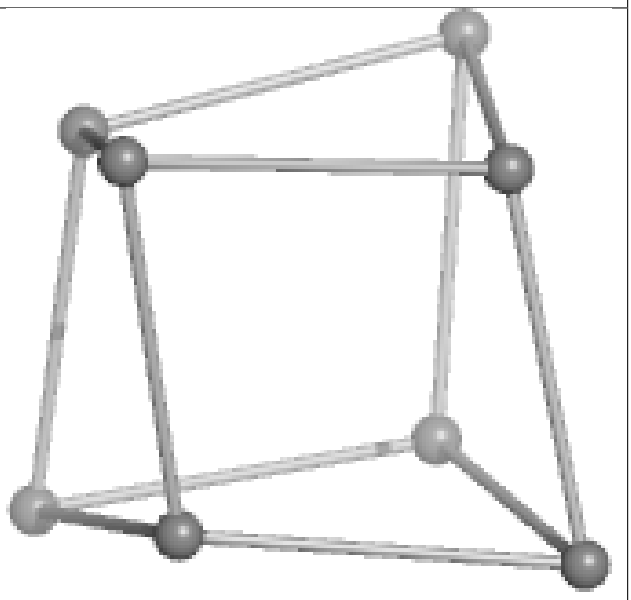


Rings

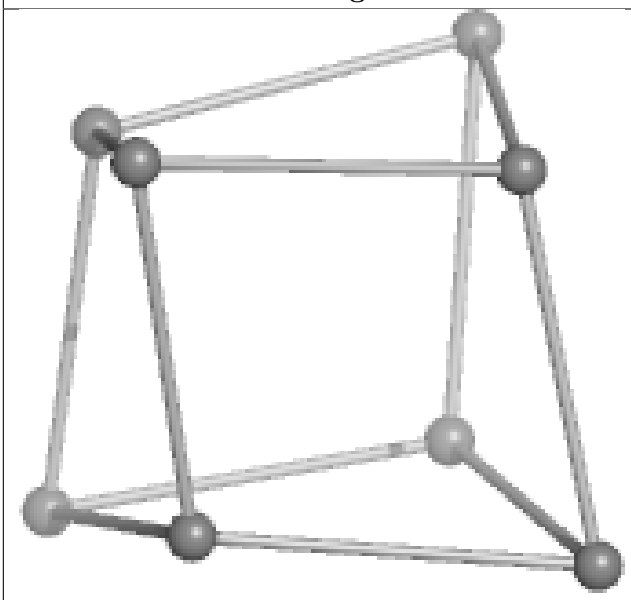
Ligand SF4 B 1402



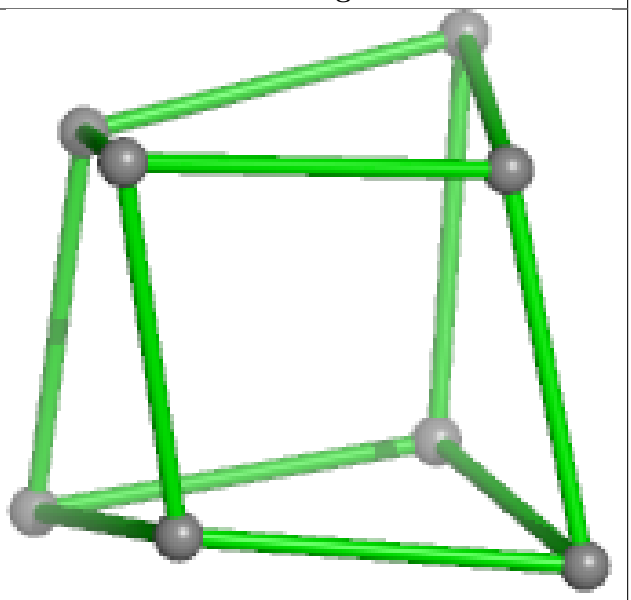
Bond lengths



Bond angles

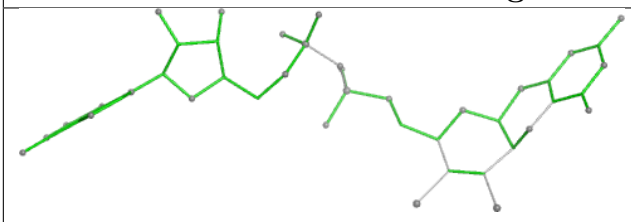


Torsions

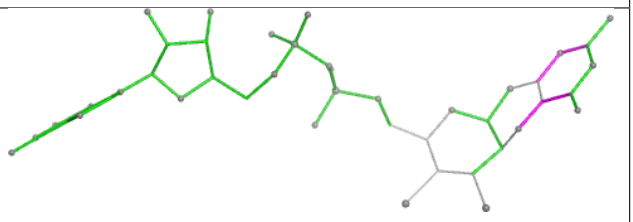


Rings

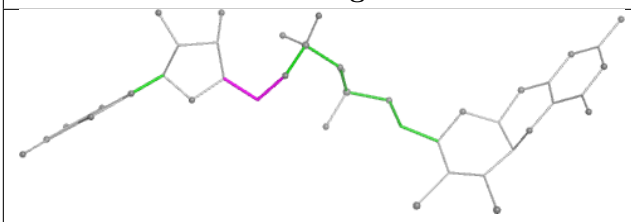
Ligand MGD A 1102



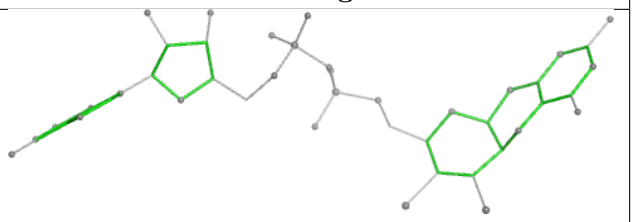
Bond lengths



Bond angles

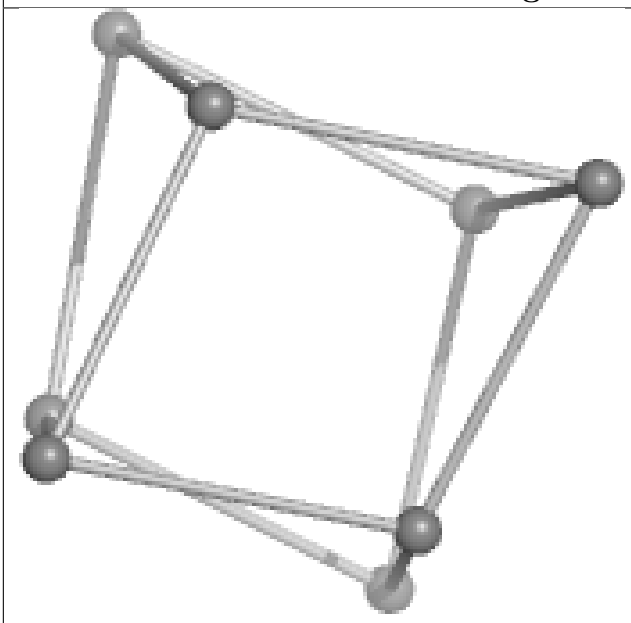


Torsions

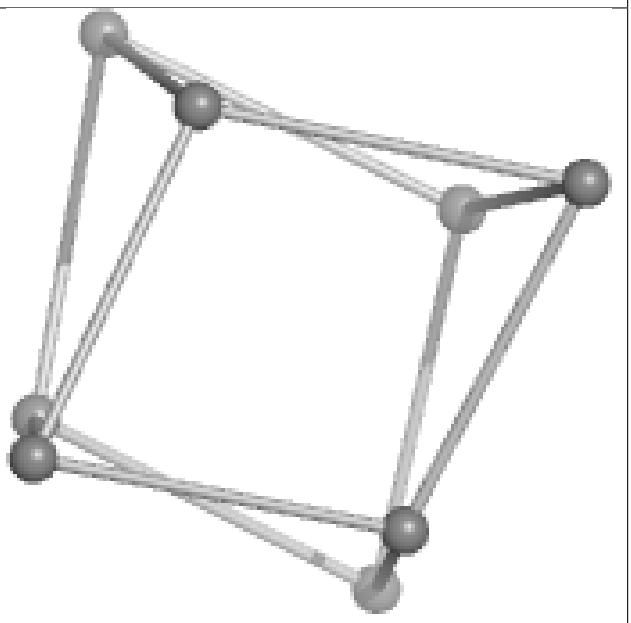


Rings

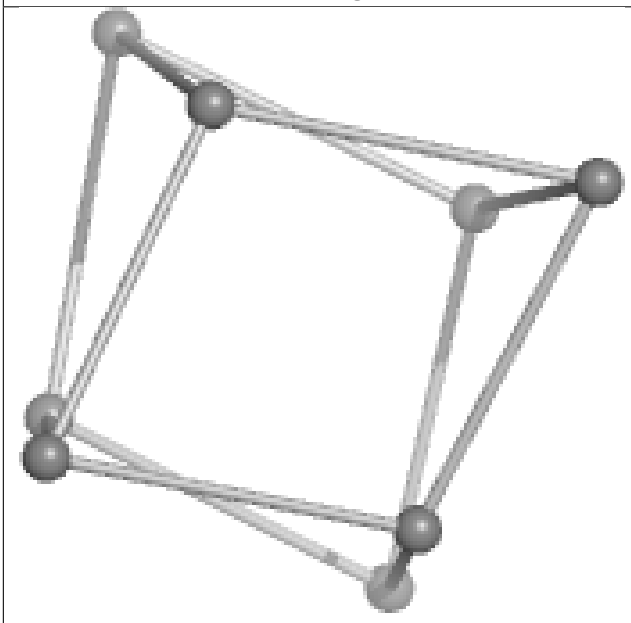
Ligand SF4 B 1403



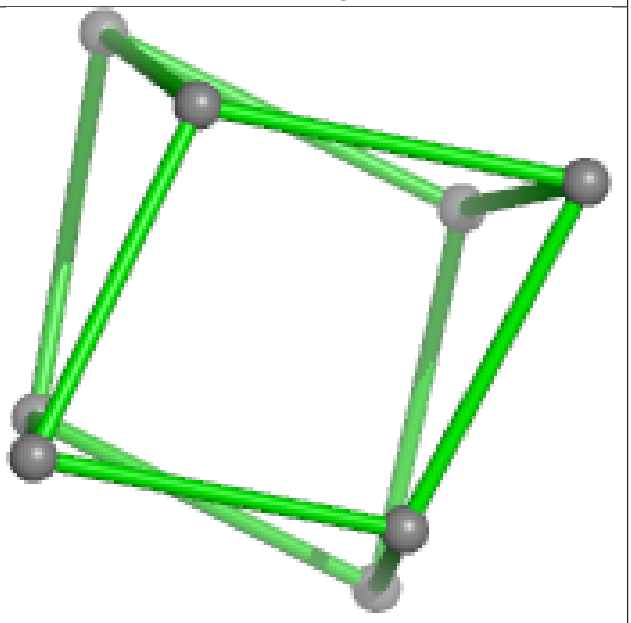
Bond lengths



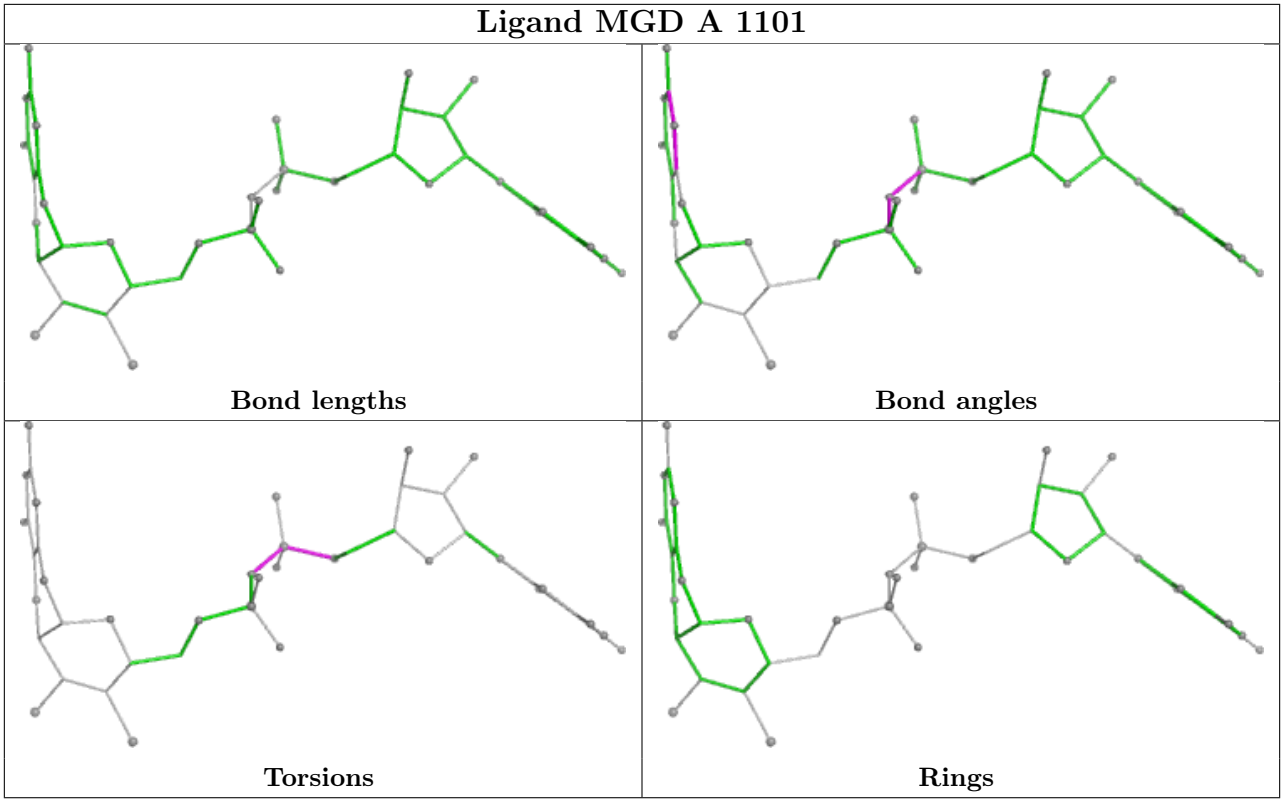
Bond angles



Torsions



Rings



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%)	0.80	95 (9%) 13 10	20, 34, 52, 86	0
2	B	214/215 (99%)	1.18	44 (20%) 2 2	26, 43, 67, 74	0
All	All	1176/1228 (95%)	0.87	139 (11%) 9 7	20, 35, 56, 86	0

All (139) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	988	PRO	6.8
1	A	990	THR	5.8
2	B	110	ALA	5.4
2	B	131	VAL	5.2
1	A	661	GLY	5.2
1	A	986	GLY	5.2
1	A	989	ASN	4.7
1	A	987	ASP	4.5
2	B	130	PRO	4.4
2	B	88	VAL	4.3
1	A	1005	VAL	4.2
1	A	597	ALA	4.1
1	A	660	GLY	4.0
1	A	146	ALA	3.9
2	B	90	LEU	3.9
2	B	132	THR	3.8
2	B	102	ALA	3.8
1	A	991	GLY	3.8
1	A	950	PHE	3.5
1	A	595	ASN	3.5
1	A	596	PRO	3.5
1	A	657	ALA	3.5
1	A	985	ALA	3.5
1	A	954	GLY	3.4

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Mol	Chain	Res	Type	RSRZ
1	A	869	LYS	3.4
2	B	108	LEU	3.4
1	A	409	ALA	3.3
1	A	36	GLU	3.3
2	B	128	ILE	3.2
2	B	135	LEU	3.2
1	A	316	GLY	3.2
1	A	364	GLU	3.2
1	A	589	TRP	3.2
2	B	146	GLN	3.2
1	A	407	TRP	3.1
1	A	315	ASP	3.1
1	A	120	VAL	3.1
1	A	992	ILE	3.1
2	B	126	PRO	3.0
1	A	122	TRP	3.0
1	A	124	PHE	3.0
2	B	168	GLN	3.0
1	A	157	ILE	3.0
2	B	86	ALA	2.9
1	A	993	PRO	2.9
1	A	794	TRP	2.9
1	A	121	THR	2.8
1	A	700	VAL	2.8
2	B	106	THR	2.8
1	A	408	THR	2.8
1	A	537	PHE	2.7
1	A	37	LEU	2.7
1	A	196	THR	2.7
1	A	664	PRO	2.7
1	A	524	ALA	2.7
2	B	133	LYS	2.7
1	A	339	ALA	2.6
2	B	98	GLU	2.6
2	B	125	ILE	2.6
1	A	973	ASN	2.6
1	A	652	VAL	2.6
1	A	130	ALA	2.6
2	B	115	GLU	2.5
1	A	599	ILE	2.5
2	B	92	GLY	2.5
2	B	47	TYR	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	592	PRO	2.5
1	A	937	LEU	2.5
1	A	518	TYR	2.5
1	A	113	PHE	2.5
1	A	665	ALA	2.4
1	A	108	LEU	2.4
1	A	141	PHE	2.4
2	B	93	ALA	2.4
2	B	111	LYS	2.4
2	B	174	ALA	2.4
2	B	179	ALA	2.4
2	B	143	ASP	2.4
1	A	354	CYS	2.4
1	A	854	LYS	2.4
1	A	662	ALA	2.4
1	A	916	LEU	2.4
2	B	48	VAL	2.4
1	A	513	ALA	2.3
1	A	655	LEU	2.3
1	A	796	ASP	2.3
1	A	706	LYS	2.3
2	B	96	LYS	2.3
2	B	134	ARG	2.3
2	B	112	VAL	2.3
1	A	656	TYR	2.3
1	A	663	TYR	2.3
1	A	923	GLY	2.3
2	B	99	THR	2.3
1	A	673	ALA	2.3
1	A	811	GLY	2.3
2	B	193	PRO	2.2
1	A	111	ALA	2.2
1	A	180	LEU	2.2
1	A	528	LEU	2.2
1	A	649	PHE	2.2
2	B	109	THR	2.2
1	A	843	LEU	2.2
2	B	173	LEU	2.2
1	A	118	LYS	2.2
1	A	154	THR	2.2
2	B	122	PRO	2.2
1	A	844	GLU	2.1

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Mol	Chain	Res	Type	RSRZ
2	B	107	GLU	2.1
2	B	164	PHE	2.1
2	B	78	VAL	2.1
1	A	148	GLY	2.1
1	A	598	GLU	2.1
1	A	784	PRO	2.1
1	A	533	TRP	2.1
1	A	667	ILE	2.1
1	A	151	VAL	2.1
1	A	658	LYS	2.1
2	B	91	GLU	2.1
2	B	97	ASP	2.1
1	A	480	THR	2.1
1	A	129	ILE	2.1
1	A	701	GLY	2.1
1	A	578	VAL	2.1
1	A	135	LYS	2.1
1	A	780	LYS	2.1
2	B	104	LEU	2.1
1	A	184	TYR	2.1
1	A	678	HIS	2.1
1	A	591	GLY	2.1
1	A	955	VAL	2.1
1	A	861	ALA	2.1
2	B	215	ALA	2.1
1	A	531	TYR	2.0
2	B	62	GLY	2.0
1	A	505	ALA	2.0
1	A	917	ALA	2.0
1	A	997	ALA	2.0
2	B	80	PRO	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)

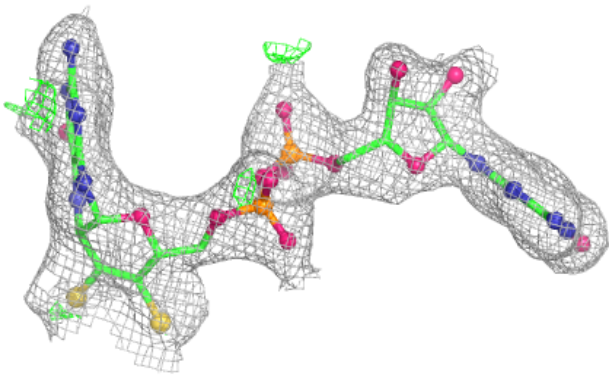
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9'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

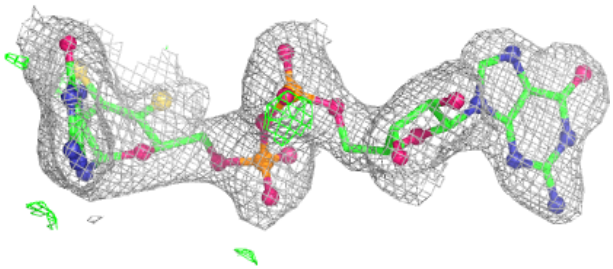
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
8	PEG	A	1108	7/7	0.73	0.20	53,55,56,56	0
9	EDO	B	1405	4/4	0.84	0.15	47,47,47,48	0
9	EDO	B	1401	4/4	0.85	0.14	43,44,44,45	0
7	GOL	A	1107	6/6	0.85	0.17	44,45,45,45	0
9	EDO	B	1406	4/4	0.86	0.16	45,45,46,46	0
7	GOL	A	1106	6/6	0.93	0.10	29,30,30,30	0
3	MGD	A	1101	47/47	0.96	0.07	23,24,27,27	0
3	MGD	A	1102	47/47	0.96	0.07	25,25,27,28	0
4	SF4	B	1403	8/8	0.96	0.06	55,56,56,56	0
4	SF4	B	1402	8/8	0.97	0.04	30,30,31,31	0
4	SF4	B	1404	8/8	0.97	0.05	48,49,50,51	0
4	SF4	A	1103	8/8	0.99	0.02	23,24,24,24	0
5	H2S	A	1104	1/1	0.99	0.07	23,23,23,23	0
6	W	A	1105	1/1	1.00	0.02	25,25,25,25	0

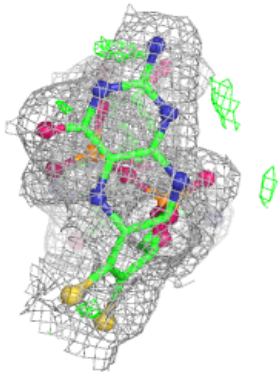
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around 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)

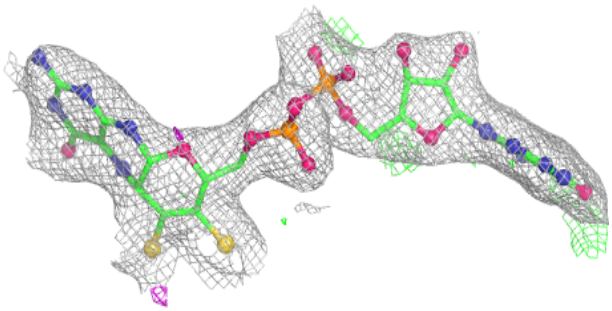


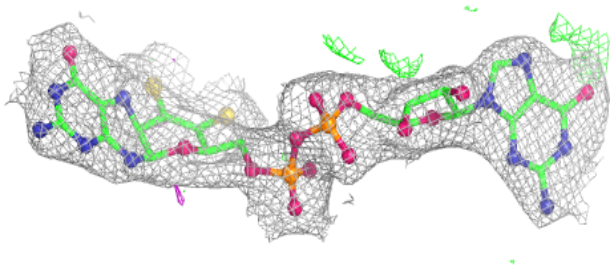


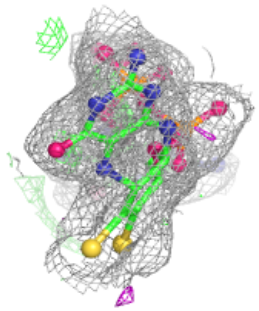


Electron density around MGD A 1102:

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

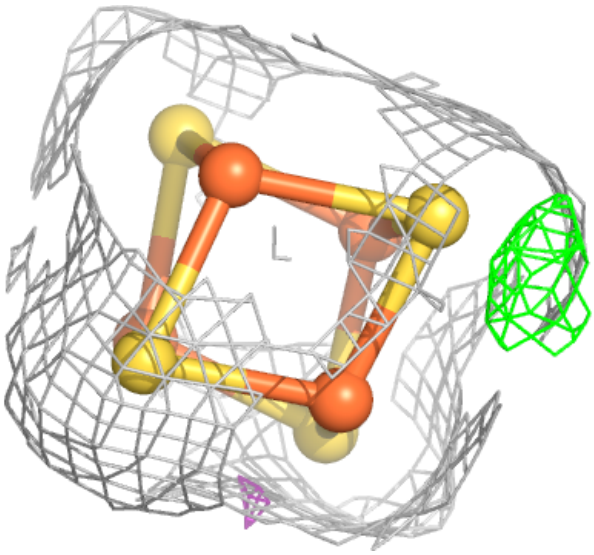


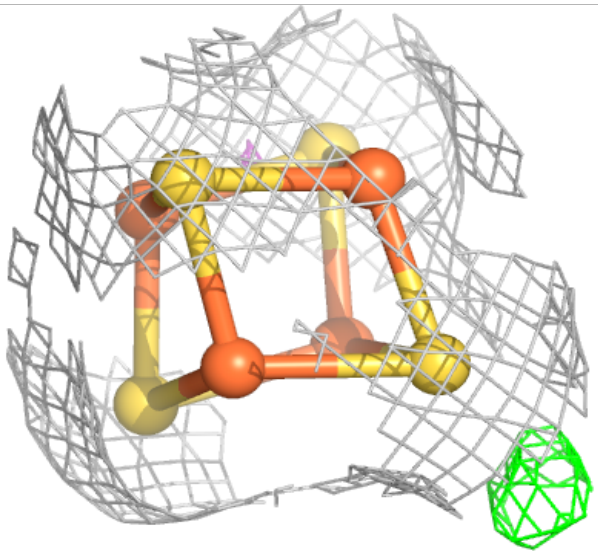


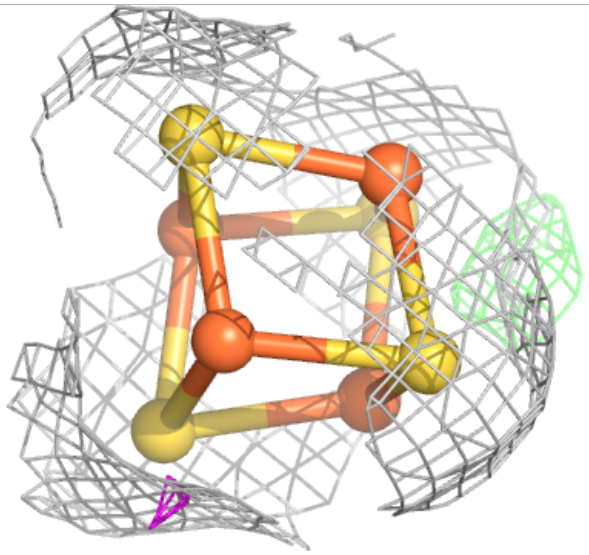


Electron density around SF4 B 1403:

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

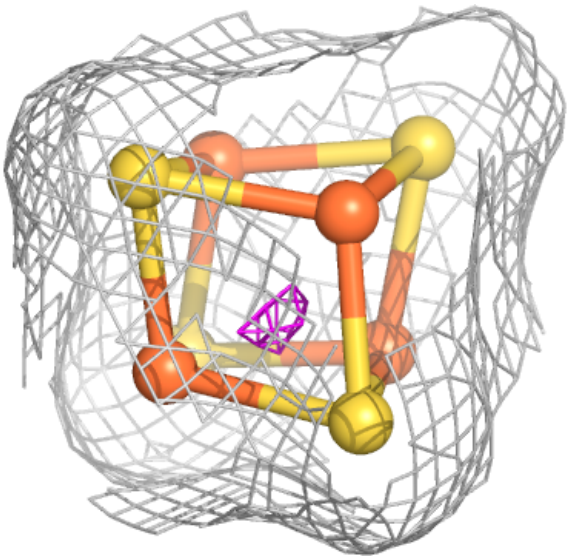


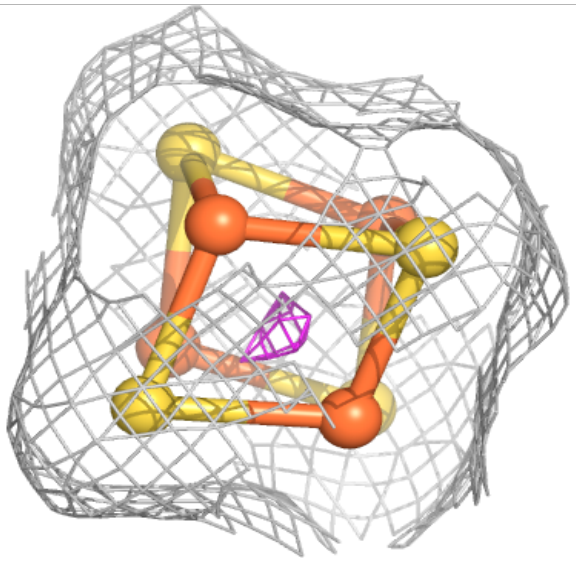


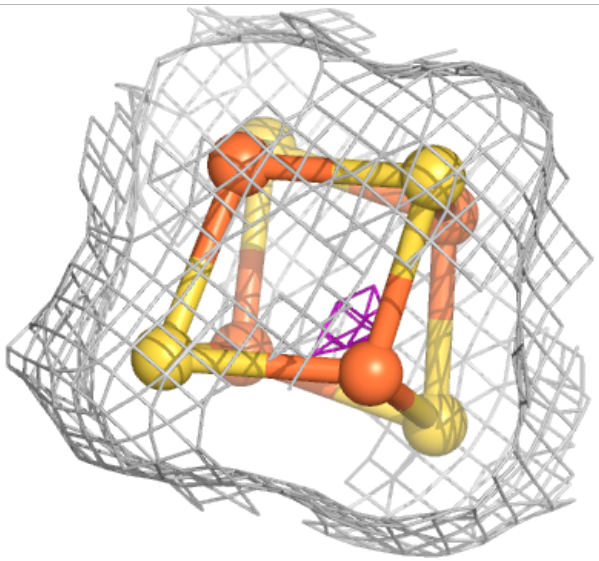


Electron density around SF4 B 1402:

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

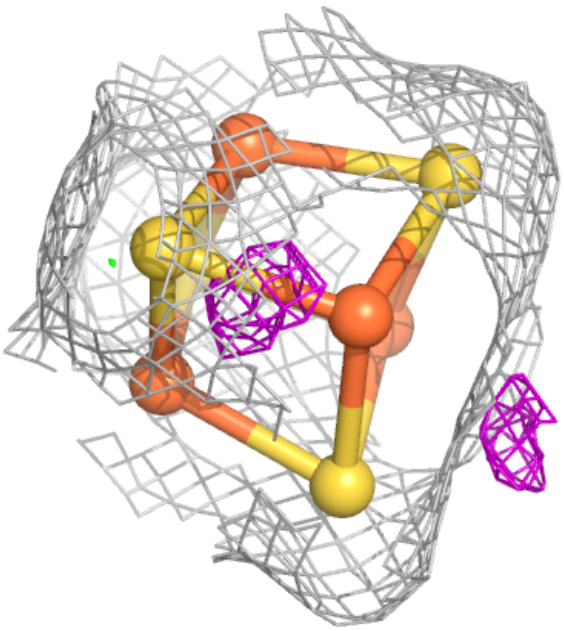


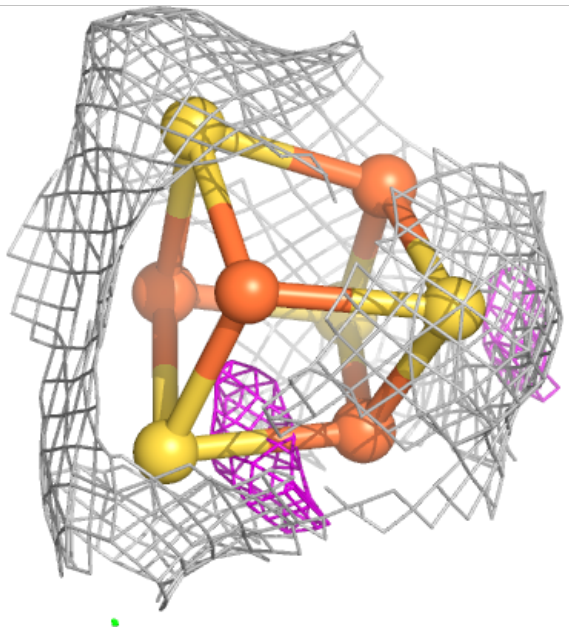


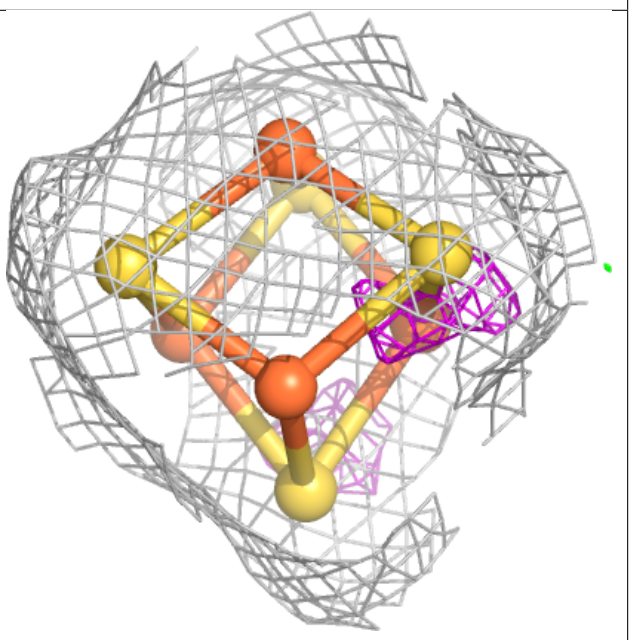


Electron density around SF4 B 1404:

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

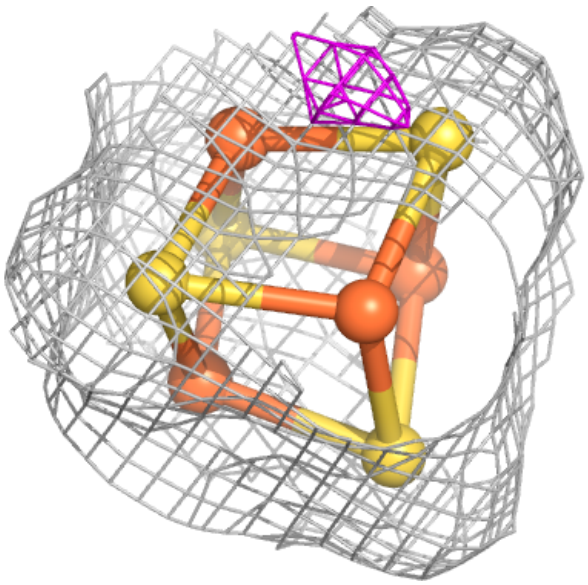


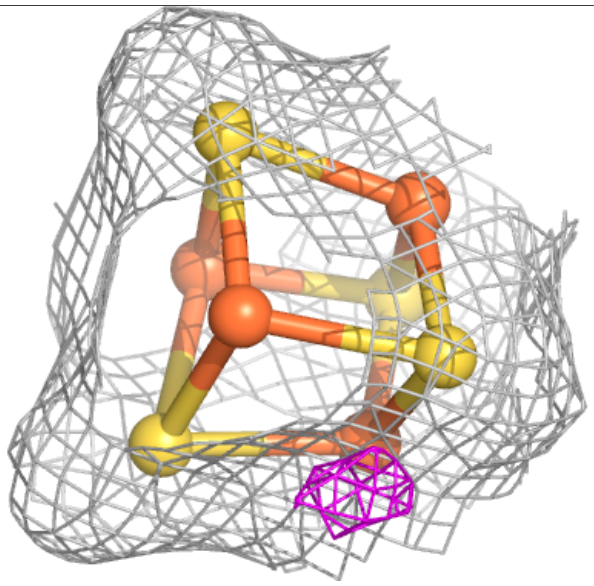


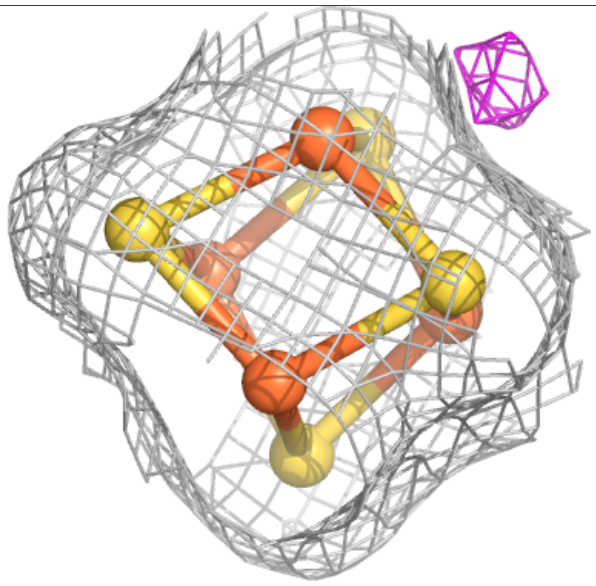


Electron density around SF4 A 1103:

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

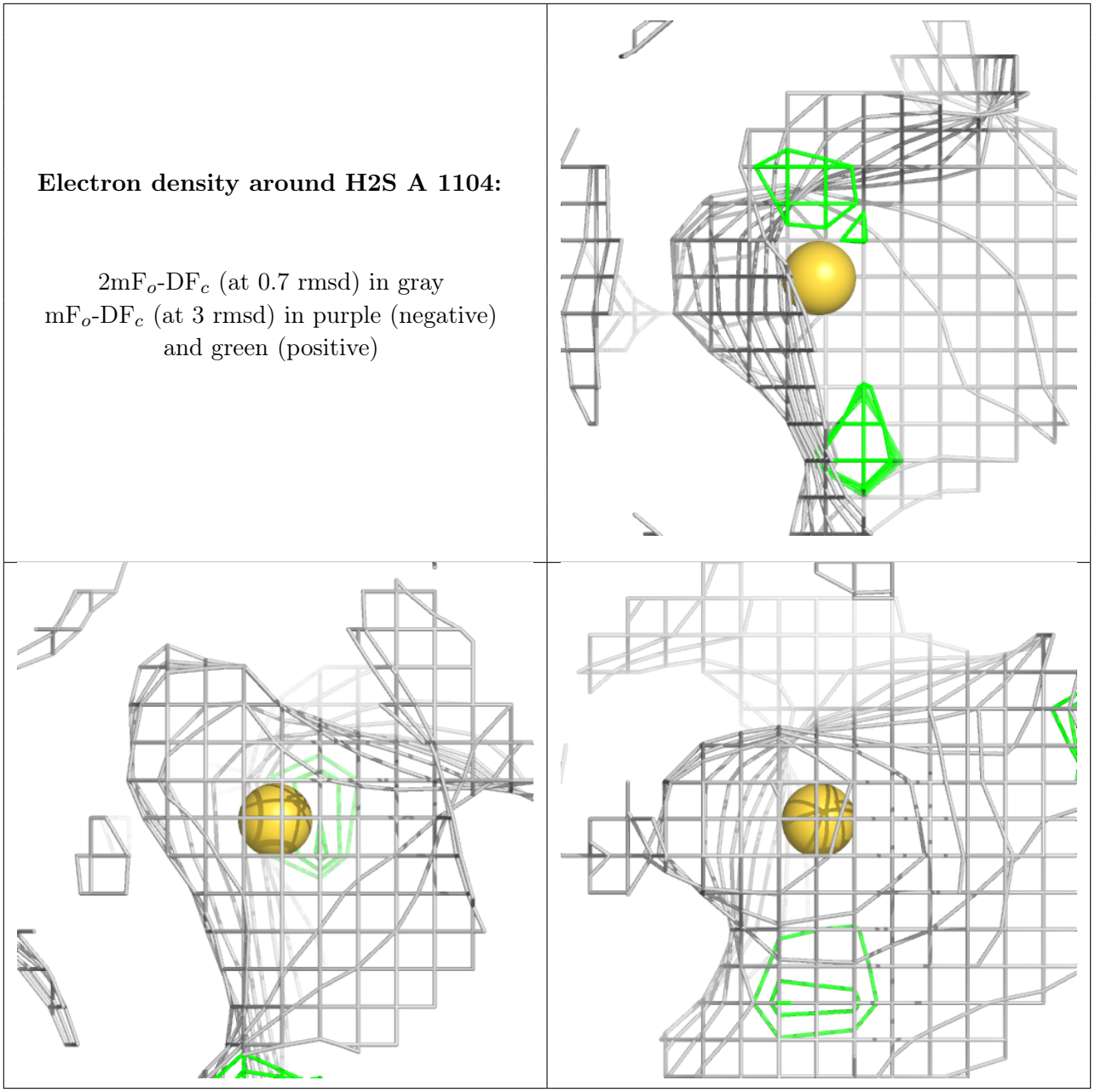






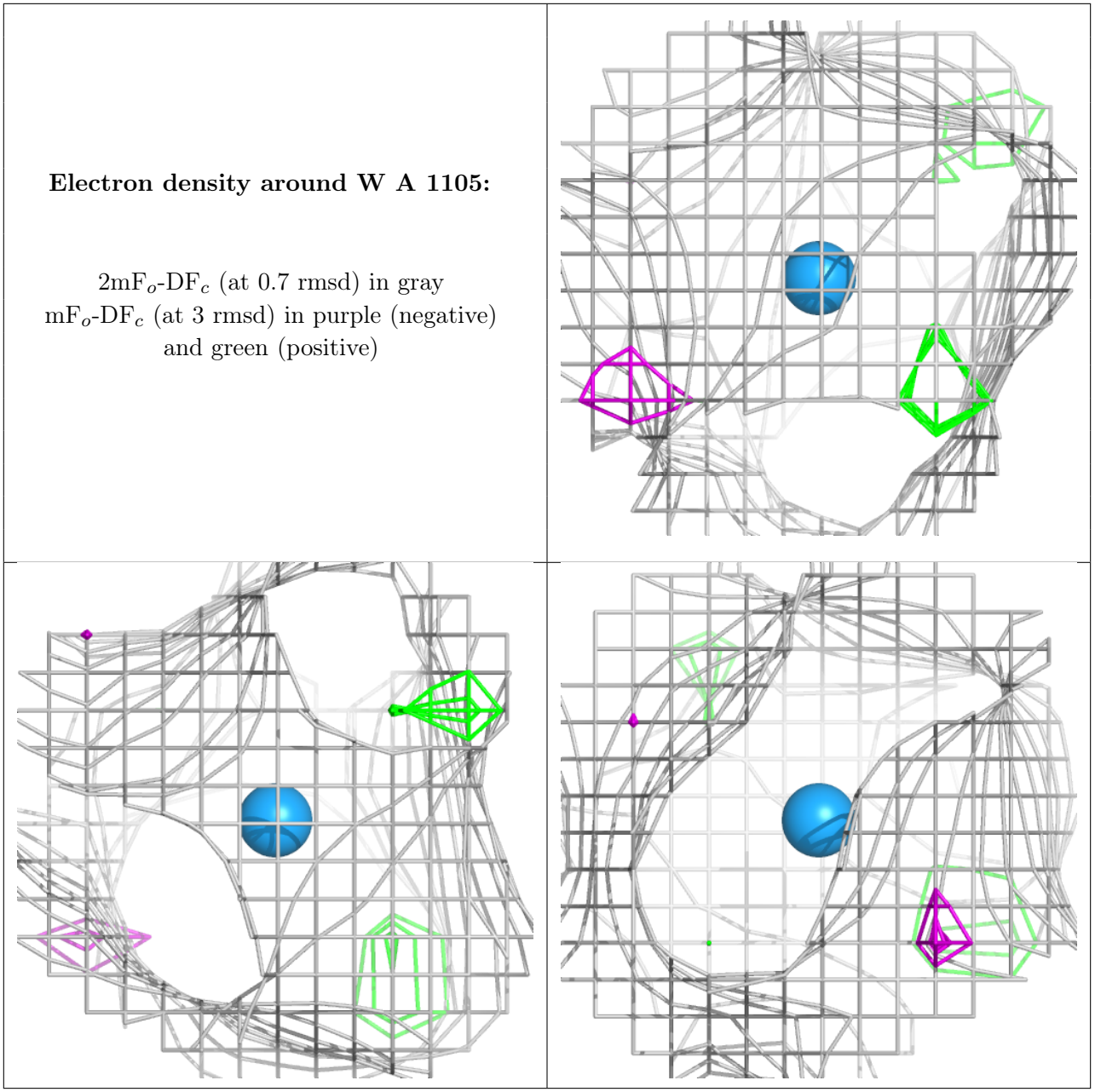
Electron density around H2S A 1104:

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



Electron density around 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

There are no such residues in this entry.