



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 04:12 PM UTC

PDB ID : 8BQL / pdb_00008bql
Title : W-formate dehydrogenase from *Desulfovibrio vulgaris* - Co-crystallized with Formate and Reoxidized by exposure to air for 12 min
Authors : Vilela-Alves, G.; Mota, C.; Oliveira, A.R.; Manuel, R.R.; Pereira, I.C.; Romao, M.J.
Deposited on : 2022-11-21
Resolution : 1.91 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 Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
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	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

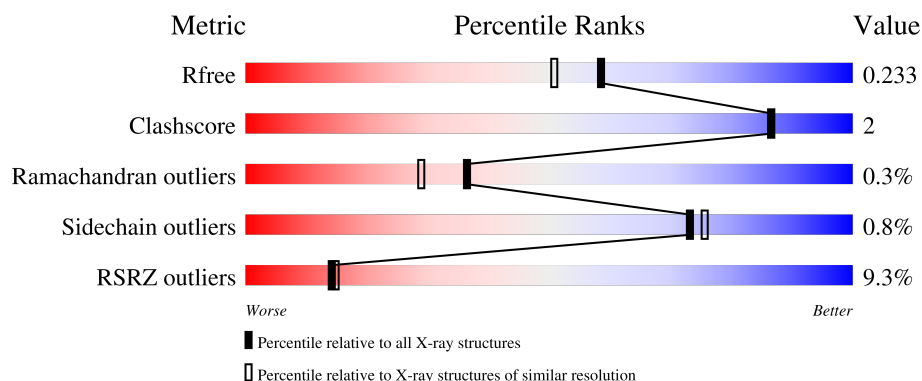
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.91 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	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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 $\leq 5\%$. 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	10% 89% 6% 5%
2	B	236	2% 86% 5% 9%

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 9769 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
1	A	967	Total	C	N	O	S	Se	0	0	0
			7570	4825	1320	1383	41	1			

There are 43 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	initiating methionine	UNP Q72EJ1
A	2	THR	-	expression tag	UNP Q72EJ1
A	3	VAL	-	expression tag	UNP Q72EJ1
A	4	THR	-	expression tag	UNP Q72EJ1
A	5	ARG	-	expression tag	UNP Q72EJ1
A	6	ARG	-	expression tag	UNP Q72EJ1
A	7	HIS	-	expression tag	UNP Q72EJ1
A	8	PHE	-	expression tag	UNP Q72EJ1
A	9	LEU	-	expression tag	UNP Q72EJ1
A	10	LYS	-	expression tag	UNP Q72EJ1
A	11	LEU	-	expression tag	UNP Q72EJ1
A	12	SER	-	expression tag	UNP Q72EJ1
A	13	ALA	-	expression tag	UNP Q72EJ1
A	14	GLY	-	expression tag	UNP Q72EJ1
A	15	ALA	-	expression tag	UNP Q72EJ1
A	16	ALA	-	expression tag	UNP Q72EJ1
A	17	VAL	-	expression tag	UNP Q72EJ1
A	18	ALA	-	expression tag	UNP Q72EJ1
A	19	GLY	-	expression tag	UNP Q72EJ1
A	20	ALA	-	expression tag	UNP Q72EJ1
A	21	PHE	-	expression tag	UNP Q72EJ1
A	22	THR	-	expression tag	UNP Q72EJ1
A	23	GLY	-	expression tag	UNP Q72EJ1
A	24	LEU	-	expression tag	UNP Q72EJ1
A	25	GLY	-	expression tag	UNP Q72EJ1
A	26	LEU	-	expression tag	UNP Q72EJ1

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Chain	Residue	Modelled	Actual	Comment	Reference
A	27	SER	-	expression tag	UNP Q72EJ1
A	28	LEU	-	expression tag	UNP Q72EJ1
A	29	ALA	-	expression tag	UNP Q72EJ1
A	30	PRO	-	expression tag	UNP Q72EJ1
A	31	THR	-	expression tag	UNP Q72EJ1
A	32	VAL	-	expression tag	UNP Q72EJ1
A	33	ALA	-	expression tag	UNP Q72EJ1
A	34	ARG	-	expression tag	UNP Q72EJ1
A	35	ALA	-	expression tag	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
2	B	214	Total	C	N	O	S	0	0	0
			1664	1041	291	316	16			

There are 22 discrepancies between the modelled and reference sequences:

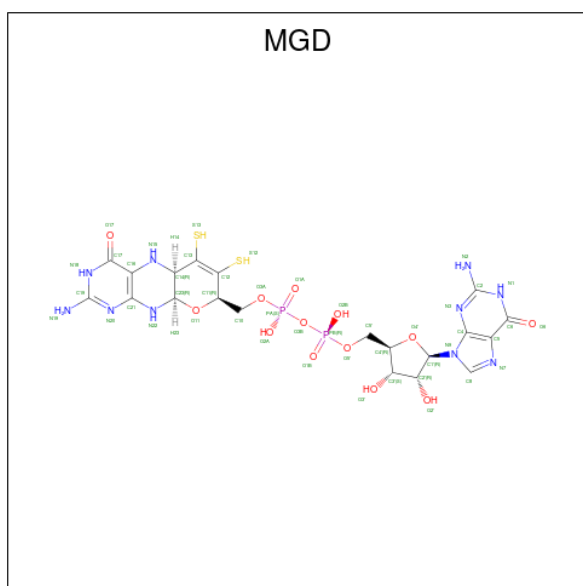
Chain	Residue	Modelled	Actual	Comment	Reference
B	1	MET	-	initiating methionine	UNP Q72EJ0
B	216	ASP	-	expression tag	UNP Q72EJ0
B	217	LEU	-	expression tag	UNP Q72EJ0
B	218	ALA	-	expression tag	UNP Q72EJ0
B	219	PRO	-	expression tag	UNP Q72EJ0
B	220	SER	-	expression tag	UNP Q72EJ0
B	221	MET	-	expression tag	UNP Q72EJ0
B	222	MET	-	expression tag	UNP Q72EJ0
B	223	THR	-	expression tag	UNP Q72EJ0
B	224	ARG	-	expression tag	UNP Q72EJ0
B	225	GLN	-	expression tag	UNP Q72EJ0
B	226	GLN	-	expression tag	UNP Q72EJ0
B	227	LEU	-	expression tag	UNP Q72EJ0
B	228	PHE	-	expression tag	UNP Q72EJ0
B	229	ALA	-	expression tag	UNP Q72EJ0

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Chain	Residue	Modelled	Actual	Comment	Reference
B	230	ARG	-	expression tag	UNP Q72EJ0
B	231	LEU	-	expression tag	UNP Q72EJ0
B	232	PHE	-	expression tag	UNP Q72EJ0
B	233	ARG	-	expression tag	UNP Q72EJ0
B	234	PRO	-	expression tag	UNP Q72EJ0
B	235	ARG	-	expression tag	UNP Q72EJ0
B	236	ALA	-	expression tag	UNP Q72EJ0

- 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: C₂₀H₂₆N₁₀O₁₃P₂S₂) (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: Fe₄S₄) (labeled as "Ligand of Interest" by depositor).

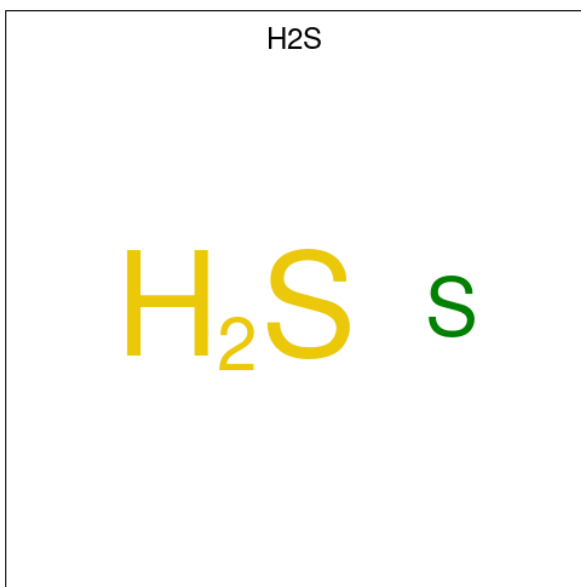


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	Fe	S	0	0
			8	4	4		
4	B	1	Total	Fe	S	0	0
			8	4	4		
4	B	1	Total	Fe	S	0	0
			8	4	4		
4	B	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 5 is TUNGSTEN ION (CCD ID: W) (formula: W) (labeled as "Ligand of Interest" by depositor).

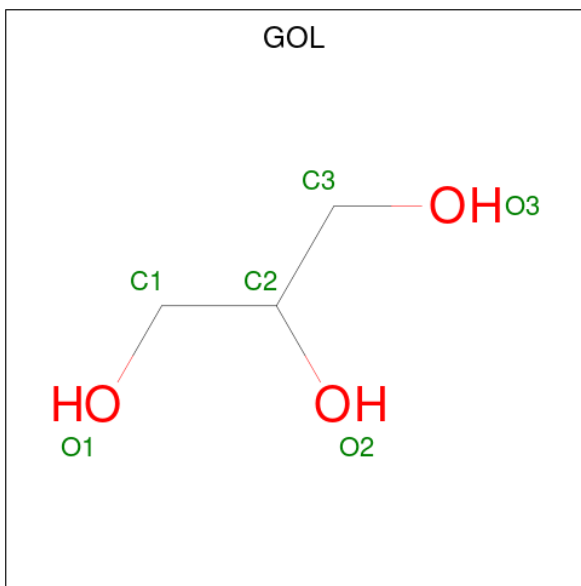
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	W	0	0
			1	1		

- Molecule 6 is HYDROSULFURIC ACID (CCD ID: H2S) (formula: H₂S) (labeled as "Ligand of Interest" by depositor).



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

- Molecule 7 is GLYCEROL (CCD ID: GOL) (formula: C₃H₈O₃).



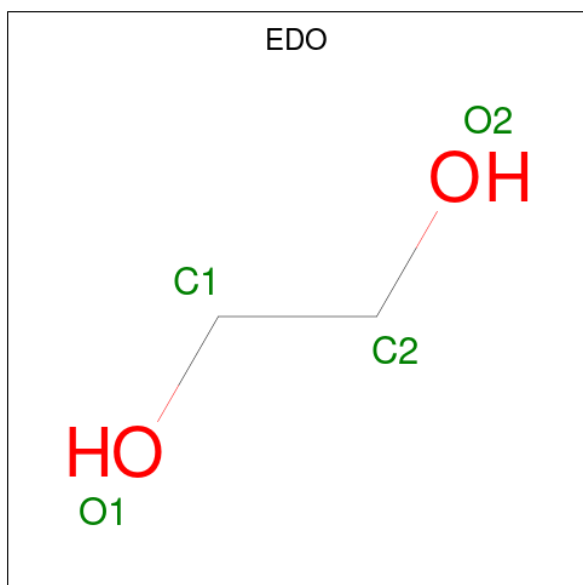
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	O	0	0
			6	3	3		
7	A	1	Total	C	O	0	0
			6	3	3		
7	A	1	Total	C	O	0	0
			6	3	3		

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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 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



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

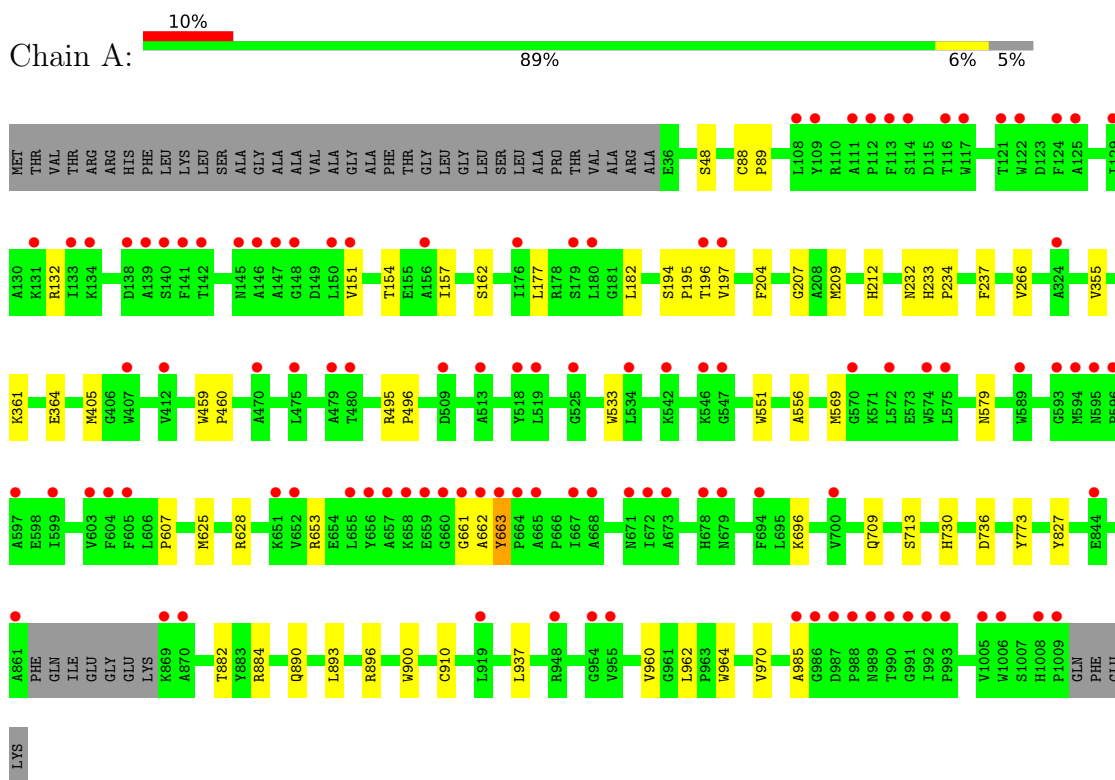
- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	293	Total	O	0	0
			293	293		
9	B	80	Total	O	0	0
			80	80		

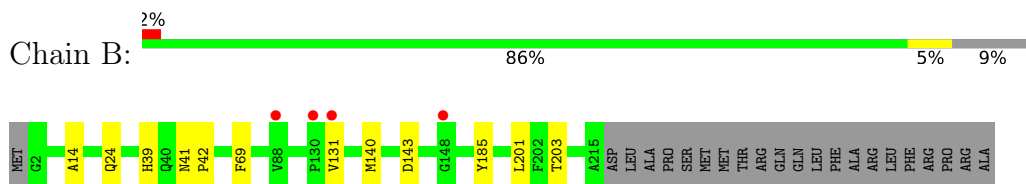
3 Residue-property plots [i](#)

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



- Molecule 2: Formate dehydrogenase, beta subunit, putative



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	64.80Å 127.59Å 148.62Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	97.00 – 1.91 96.81 – 1.91	Depositor EDS
% Data completeness (in resolution range)	85.0 (97.00-1.91) 85.0 (96.81-1.91)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.30 (at 1.91Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.188 , 0.225 0.196 , 0.233	Depositor DCC
R_{free} test set	4045 reflections (4.17%)	wwPDB-VP
Wilson B-factor (Å ²)	28.4	Xtriage
Anisotropy	0.041	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 31.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	9769	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.08% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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

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	0.97	0/7774	1.32	3/10548 (0.0%)
2	B	0.98	0/1699	1.31	0/2302
All	All	0.97	0/9473	1.32	3/12850 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	196	THR	CA-C-N	5.58	125.78	120.43
1	A	196	THR	C-N-CA	5.58	125.78	120.43
1	A	661	GLY	CA-C-O	-5.06	117.36	121.76

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

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	7570	0	7395	32	0
2	B	1664	0	1633	7	0
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

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	A	1	0	0	0	0
7	A	30	0	40	3	0
8	B	4	0	6	0	0
9	A	293	0	0	0	0
9	B	80	0	0	0	0
All	All	9769	0	9118	38	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 (38) 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:157:ILE:HG22	1:A:182:LEU:HD21	1.89	0.54
2:B:41:ASN:HA	2:B:42:PRO:C	2.33	0.53
1:A:910:CYS:SG	1:A:960:VAL:HG13	2.49	0.53
2:B:140:MET:O	2:B:140:MET:HG2	2.08	0.53
1:A:556:ALA:HB2	1:A:569:MET:HE1	1.91	0.51
1:A:361:LYS:O	1:A:364:GLU:HG2	2.12	0.49
1:A:88:CYS:HB2	1:A:89:PRO:HD2	1.94	0.49
2:B:201:LEU:C	2:B:201:LEU:HD23	2.38	0.47
1:A:937:LEU:C	1:A:937:LEU:HD12	2.40	0.47
1:A:709:GLN:HG3	1:A:736:ASP:OD2	2.15	0.47
1:A:355:VAL:HG13	1:A:827:TYR:HB2	1.98	0.46
1:A:232:ASN:HA	3:A:1101:MGD:N20	2.31	0.46
1:A:405:MET:HE1	1:A:884:ARG:HH12	1.80	0.46
1:A:893:LEU:C	1:A:893:LEU:HD23	2.41	0.46
2:B:14:ALA:HB2	2:B:69:PHE:CG	2.51	0.46
1:A:48:SER:HA	1:A:628:ARG:HB2	1.97	0.46
7:A:1107:GOL:H12	2:B:39:HIS:NE2	2.31	0.45
1:A:896:ARG:HD2	1:A:970:VAL:O	2.16	0.45
1:A:162:SER:HB2	1:A:551:TRP:O	2.18	0.44
1:A:266:VAL:HA	7:A:1109:GOL:H32	1.99	0.44
1:A:884:ARG:HH22	3:A:1102:MGD:H15	1.64	0.44
1:A:890:GLN:HA	1:A:964:TRP:CH2	2.52	0.44
1:A:197:VAL:HG13	1:A:207:GLY:HA3	2.00	0.43
1:A:209:MET:HE2	1:A:212:HIS:HA	2.00	0.43
1:A:625:MET:HE3	1:A:730:HIS:CE1	2.53	0.43
1:A:882:THR:HA	1:A:962:LEU:O	2.19	0.43
1:A:266:VAL:HA	7:A:1109:GOL:C3	2.50	0.42
1:A:579:ASN:O	1:A:607:PRO:HA	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:233:HIS:N	1:A:234:PRO:HD3	2.34	0.42
1:A:177:LEU:HD22	1:A:182:LEU:HD22	2.01	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:900:TRP:CH2	2:B:24:GLN:HA	2.55	0.41
1:A:709:GLN:CG	1:A:736:ASP:OD2	2.69	0.41
2:B:185:TYR:CD1	2:B:203:THR:HB	2.55	0.41
1:A:459:TRP:HB3	1:A:460:PRO:HD2	2.03	0.40
1:A:204:PHE:HB3	1:A:773:TYR:CZ	2.56	0.40
1:A:495:ARG:N	1:A:496:PRO:CD	2.85	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	962/1013 (95%)	931 (97%)	28 (3%)	3 (0%)	36	29
2	B	212/236 (90%)	204 (96%)	7 (3%)	1 (0%)	24	16
All	All	1174/1249 (94%)	1135 (97%)	35 (3%)	4 (0%)	36	29

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	131	VAL
1	A	533	TRP
1	A	985	ALA
1	A	663	TYR

5.3.2 Protein sidechains ⓘ

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	786/819 (96%)	779 (99%)	7 (1%)	70	73
2	B	185/204 (91%)	184 (100%)	1 (0%)	81	84
All	All	971/1023 (95%)	963 (99%)	8 (1%)	73	75

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	132	ARG
1	A	151	VAL
1	A	154	THR
1	A	237	PHE
1	A	653	ARG
1	A	696	LYS
1	A	713	SER
2	B	143	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	214	ASN
1	A	383	GLN
1	A	409	GLN
1	A	410	HIS
1	A	855	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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 monoatomic and 1 is modelled with single atom - 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	$\# Z > 2$
7	GOL	A	1108	-	5,5,5	0.11	0	5,5,5	0.27	0
4	SF4	A	1103	1	0,12,12	-	-	-		
8	EDO	B	304	-	3,3,3	0.08	0	2,2,2	0.13	0
3	MGD	A	1101	5	47,52,52	0.63	1 (2%)	58,81,81	0.97	4 (6%)
7	GOL	A	1106	-	5,5,5	0.14	0	5,5,5	0.40	0
3	MGD	A	1102	5	47,52,52	0.67	1 (2%)	58,81,81	0.95	5 (8%)
7	GOL	A	1110	-	5,5,5	0.10	0	5,5,5	0.37	0
4	SF4	B	301	2	0,12,12	-	-	-		
4	SF4	B	302	2	0,12,12	-	-	-		
7	GOL	A	1107	-	5,5,5	0.09	0	5,5,5	0.40	0
4	SF4	B	303	2	0,12,12	-	-	-		
7	GOL	A	1109	-	5,5,5	0.10	0	5,5,5	0.36	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
7	GOL	A	1108	-	-	0/4/4/4	-
4	SF4	A	1103	1	-	-	0/6/5/5
8	EDO	B	304	-	-	1/1/1/1	-
4	SF4	B	302	2	-	-	0/6/5/5
3	MGD	A	1101	5	-	2/22/66/66	0/6/6/6
7	GOL	A	1106	-	-	0/4/4/4	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	MGD	A	1102	5	-	4/22/66/66	0/6/6/6
7	GOL	A	1110	-	-	4/4/4/4	-
4	SF4	B	301	2	-	-	0/6/5/5
7	GOL	A	1107	-	-	4/4/4/4	-
4	SF4	B	303	2	-	-	0/6/5/5
7	GOL	A	1109	-	-	2/4/4/4	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1102	MGD	C23-C14	3.21	1.56	1.53
3	A	1101	MGD	PB-O3B	2.11	1.61	1.59

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1101	MGD	C19-N20-C21	3.02	118.69	113.36
3	A	1102	MGD	C19-N20-C21	2.85	118.40	113.36
3	A	1101	MGD	C23-C14-N15	2.77	110.59	107.87
3	A	1101	MGD	O11-C23-C14	2.71	110.77	108.96
3	A	1102	MGD	C23-C14-N15	2.47	110.29	107.87
3	A	1102	MGD	O11-C23-C14	2.13	110.38	108.96
3	A	1101	MGD	C17-C16-N15	2.09	121.98	116.27
3	A	1102	MGD	O4'-C1'-C2'	-2.06	102.20	106.62
3	A	1102	MGD	C17-C16-N15	2.04	121.83	116.27

There are no chirality outliers.

All (17) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1102	MGD	C5'-O5'-PB-O1B
3	A	1102	MGD	C4'-C5'-O5'-PB
7	A	1107	GOL	O1-C1-C2-C3
7	A	1107	GOL	C1-C2-C3-O3
7	A	1107	GOL	O2-C2-C3-O3
7	A	1109	GOL	O1-C1-C2-C3
7	A	1110	GOL	O1-C1-C2-C3
7	A	1107	GOL	O1-C1-C2-O2
7	A	1110	GOL	O1-C1-C2-O2
3	A	1102	MGD	O4'-C4'-C5'-O5'

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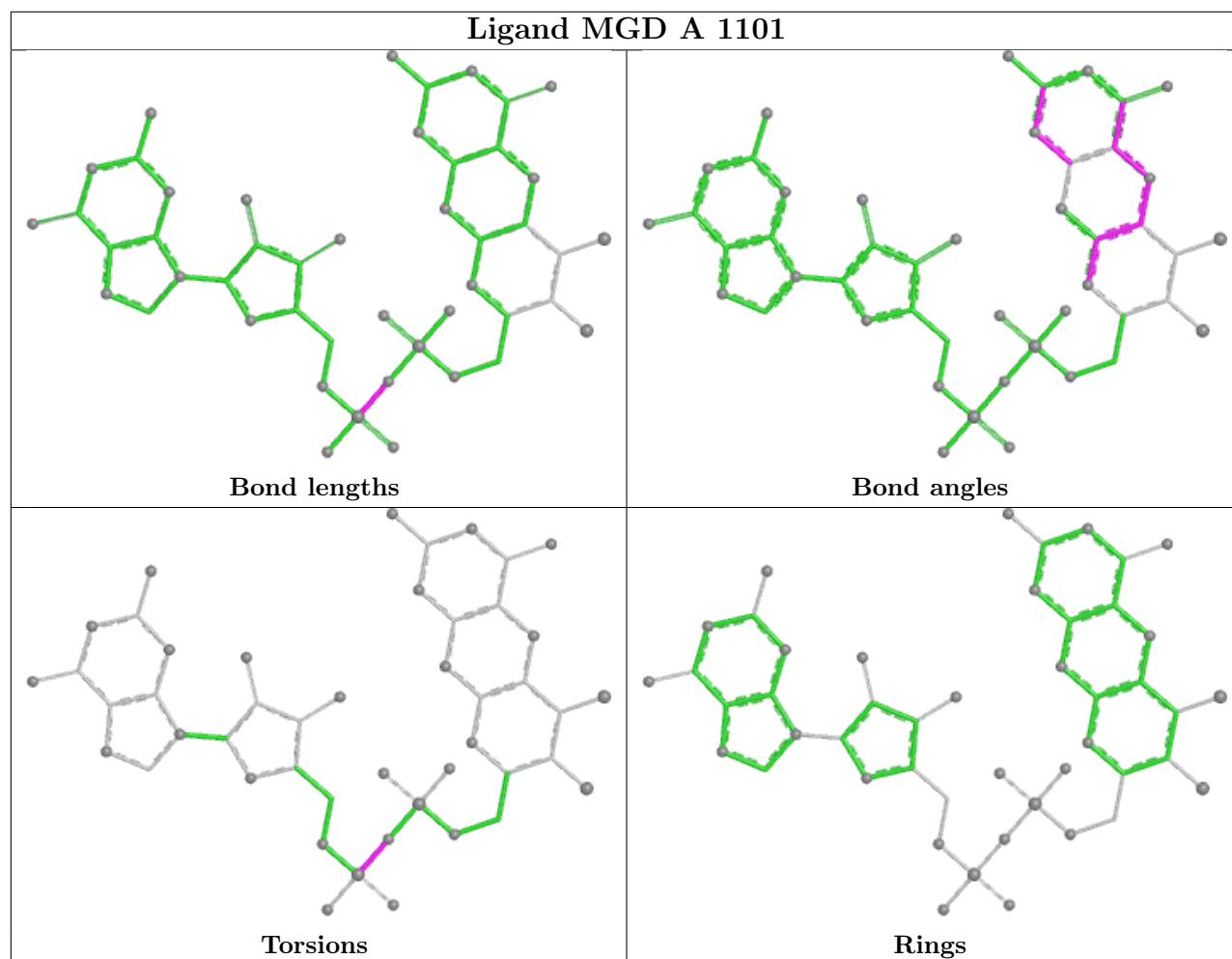
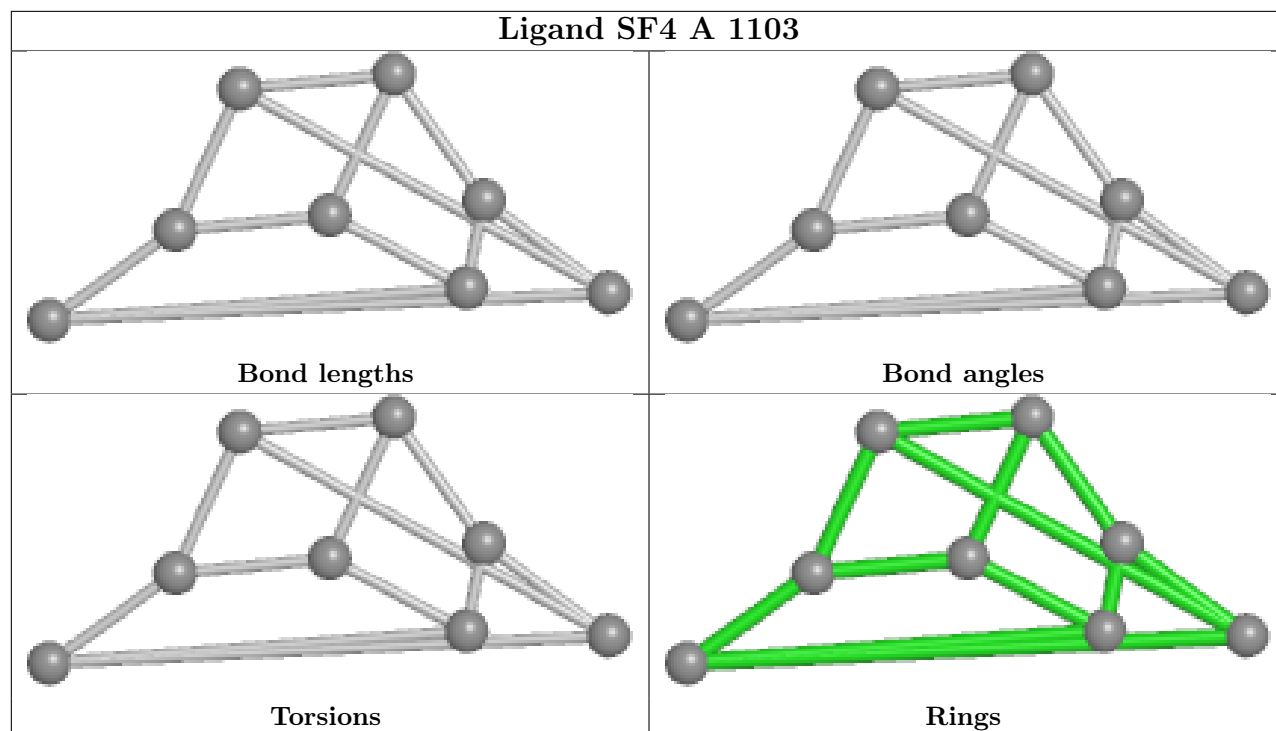
Mol	Chain	Res	Type	Atoms
3	A	1102	MGD	C3'-C4'-C5'-O5'
7	A	1110	GOL	C1-C2-C3-O3
7	A	1109	GOL	O1-C1-C2-O2
3	A	1101	MGD	PA-O3B-PB-O5'
7	A	1110	GOL	O2-C2-C3-O3
8	B	304	EDO	O1-C1-C2-O2
3	A	1101	MGD	PA-O3B-PB-O2B

There are no ring outliers.

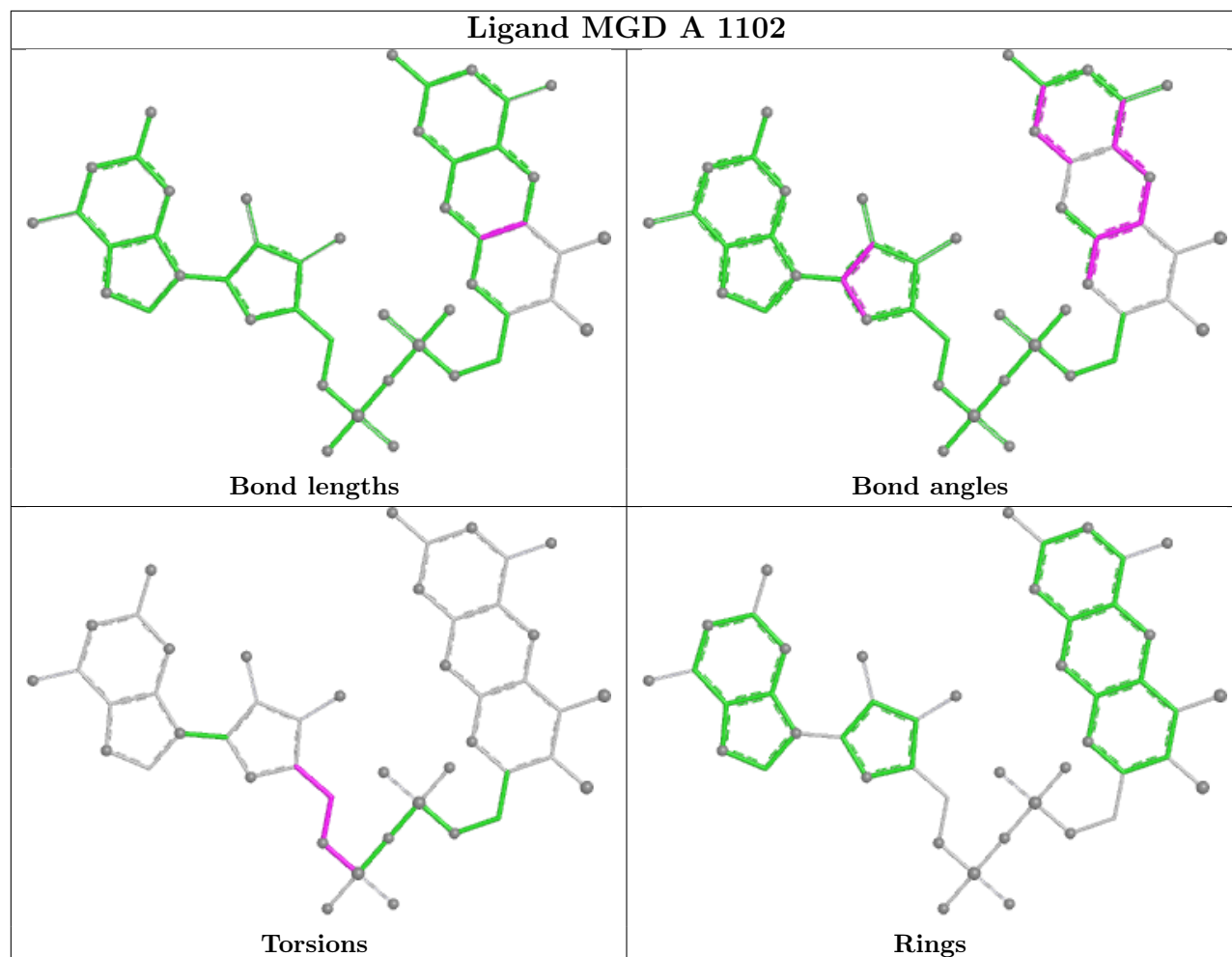
4 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1101	MGD	1	0
3	A	1102	MGD	1	0
7	A	1107	GOL	1	0
7	A	1109	GOL	2	0

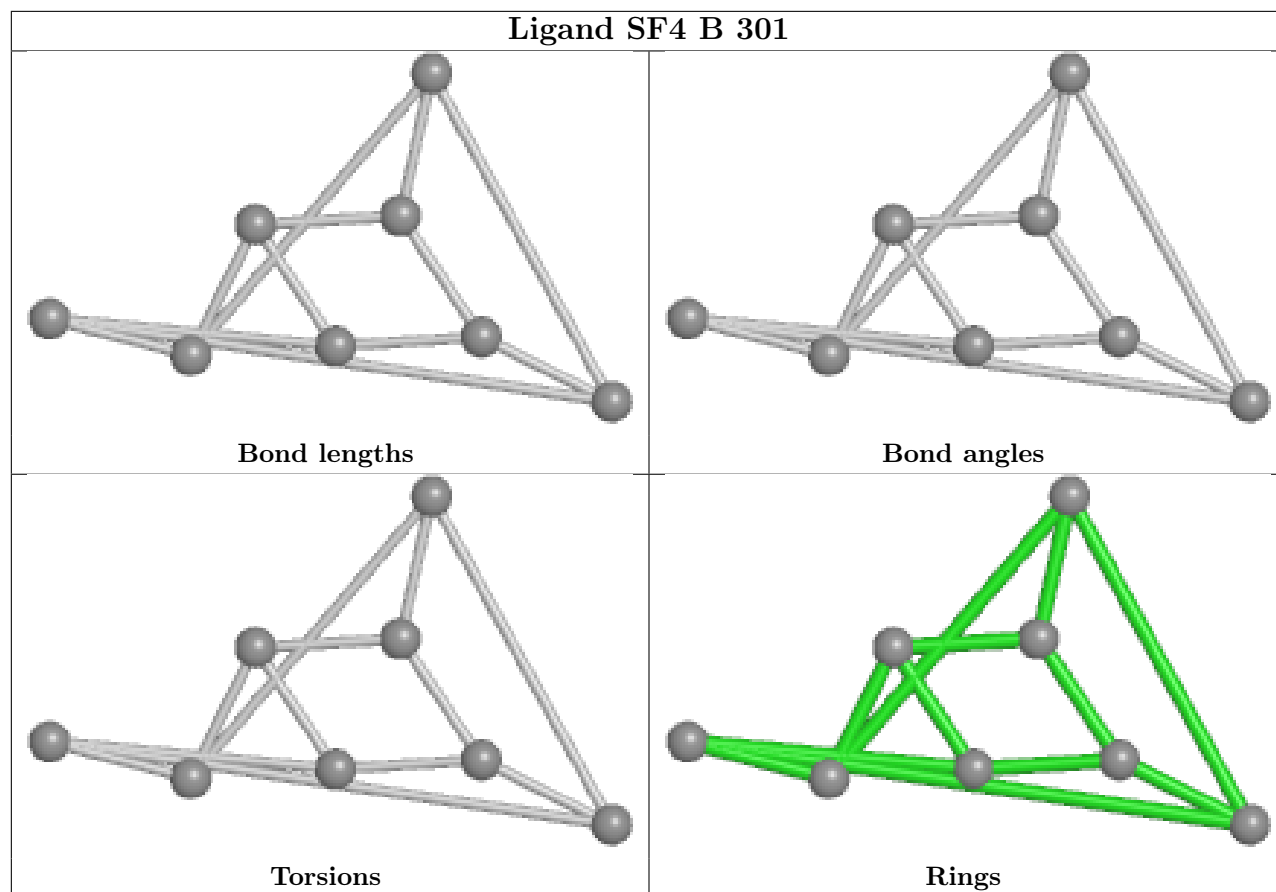
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 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.



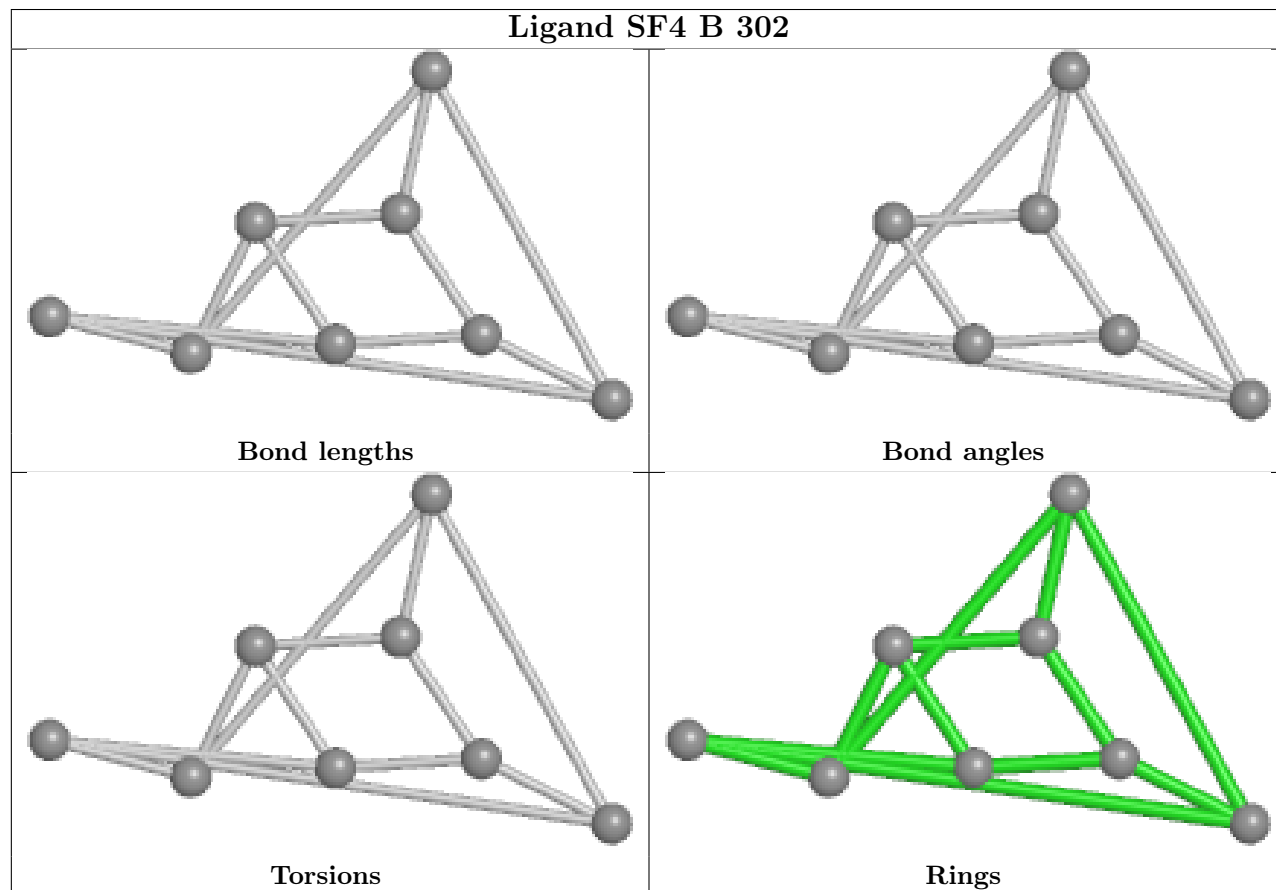
Ligand MGD A 1102

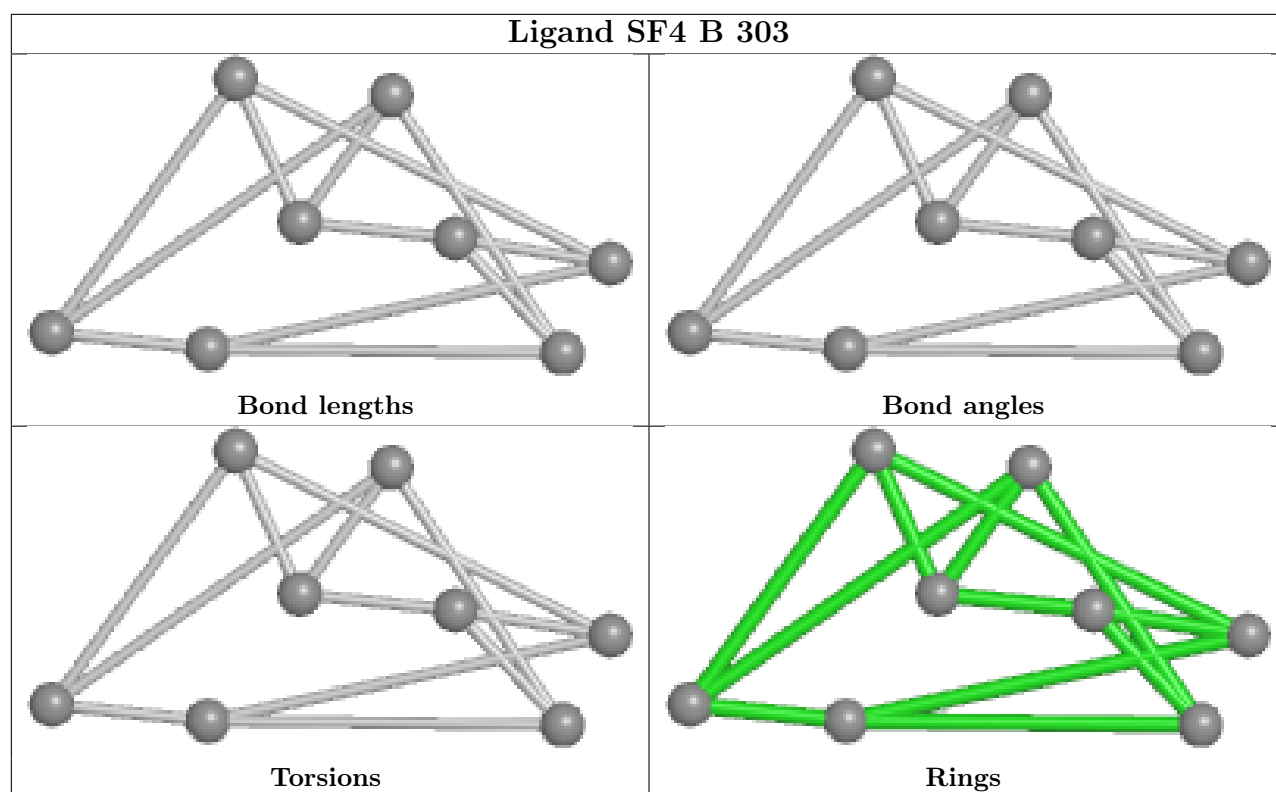


Ligand SF4 B 301



Ligand SF4 B 302





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, 95th 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	966/1013 (95%)	0.64	106 (10%) 10 11	18, 33, 60, 98	0
2	B	214/236 (90%)	0.40	4 (1%) 66 70	20, 33, 53, 67	0
All	All	1180/1249 (94%)	0.60	110 (9%) 14 15	18, 33, 59, 98	0

All (110) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	985	ALA	6.4
1	A	1006	TRP	6.3
1	A	993	PRO	5.1
1	A	992	ILE	5.1
1	A	988	PRO	5.1
1	A	660	GLY	4.7
1	A	661	GLY	4.1
1	A	146	ALA	4.1
1	A	150	LEU	4.0
1	A	597	ALA	3.7
1	A	151	VAL	3.6
1	A	197	VAL	3.6
1	A	655	LEU	3.5
1	A	125	ALA	3.5
1	A	407	TRP	3.4
1	A	986	GLY	3.3
1	A	991	GLY	3.3
1	A	700	VAL	3.2
1	A	869	LYS	3.2
2	B	88	VAL	3.2
1	A	662	ALA	3.1
1	A	652	VAL	3.1
1	A	574	TRP	3.1
1	A	667	ILE	3.0

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Mol	Chain	Res	Type	RSRZ
1	A	109	TYR	3.0
1	A	113	PHE	3.0
1	A	673	ALA	3.0
1	A	133	ILE	3.0
1	A	990	THR	2.9
1	A	129	ILE	2.9
2	B	131	VAL	2.9
1	A	142	THR	2.9
1	A	1005	VAL	2.9
1	A	989	ASN	2.9
1	A	664	PRO	2.8
1	A	141	PHE	2.8
1	A	948	ARG	2.8
2	B	130	PRO	2.8
1	A	122	TRP	2.8
1	A	658	LYS	2.7
1	A	844	GLU	2.7
1	A	196	THR	2.7
1	A	570	GLY	2.7
1	A	593	GLY	2.7
1	A	124	PHE	2.7
1	A	604	PHE	2.7
1	A	324	ALA	2.7
1	A	657	ALA	2.7
1	A	665	ALA	2.7
1	A	525	GLY	2.7
1	A	140	SER	2.7
1	A	131	LYS	2.7
1	A	176	ILE	2.7
1	A	861	ALA	2.6
1	A	1009	PRO	2.6
1	A	156	ALA	2.6
1	A	663	TYR	2.6
1	A	954	GLY	2.6
1	A	139	ALA	2.6
1	A	111	ALA	2.5
1	A	147	ALA	2.5
1	A	668	ALA	2.5
1	A	955	VAL	2.5
1	A	659	GLU	2.5
1	A	694	PHE	2.5
1	A	672	ILE	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	470	ALA	2.5
1	A	519	LEU	2.5
1	A	599	ILE	2.5
1	A	589	TRP	2.5
2	B	148	GLY	2.4
1	A	180	LEU	2.4
1	A	479	ALA	2.4
1	A	114	SER	2.4
1	A	179	SER	2.4
1	A	534	LEU	2.4
1	A	603	VAL	2.4
1	A	546	LYS	2.4
1	A	116	THR	2.4
1	A	575	LEU	2.3
1	A	595	ASN	2.3
1	A	547	GLY	2.3
1	A	572	LEU	2.3
1	A	518	TYR	2.3
1	A	134	LYS	2.3
1	A	679	ASN	2.3
1	A	108	LEU	2.3
1	A	594	MET	2.3
1	A	919	LEU	2.3
1	A	605	PHE	2.2
1	A	656	TYR	2.2
1	A	138	ASP	2.2
1	A	412	VAL	2.2
1	A	513	ALA	2.2
1	A	121	THR	2.2
1	A	987	ASP	2.2
1	A	596	PRO	2.2
1	A	870	ALA	2.2
1	A	651	LYS	2.2
1	A	678	HIS	2.1
1	A	145	ASN	2.1
1	A	509	ASP	2.1
1	A	148	GLY	2.1
1	A	542	LYS	2.1
1	A	112	PRO	2.1
1	A	671	ASN	2.1
1	A	480	THR	2.1
1	A	117	TRP	2.0

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Mol	Chain	Res	Type	RSRZ
1	A	475	LEU	2.0
1	A	1008	HIS	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](#)

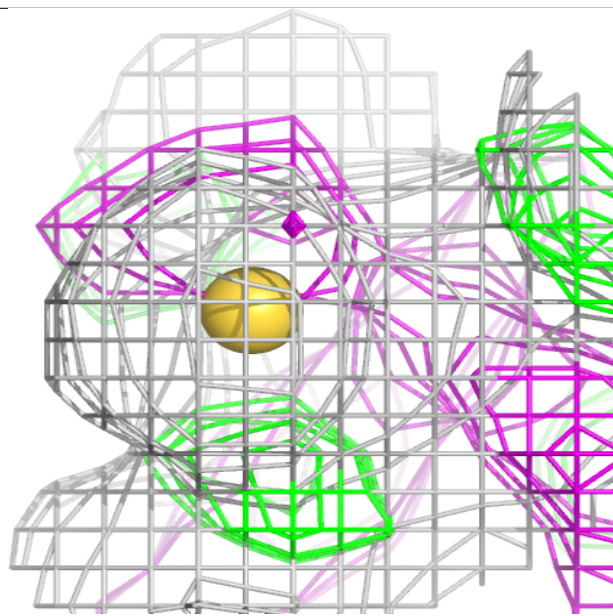
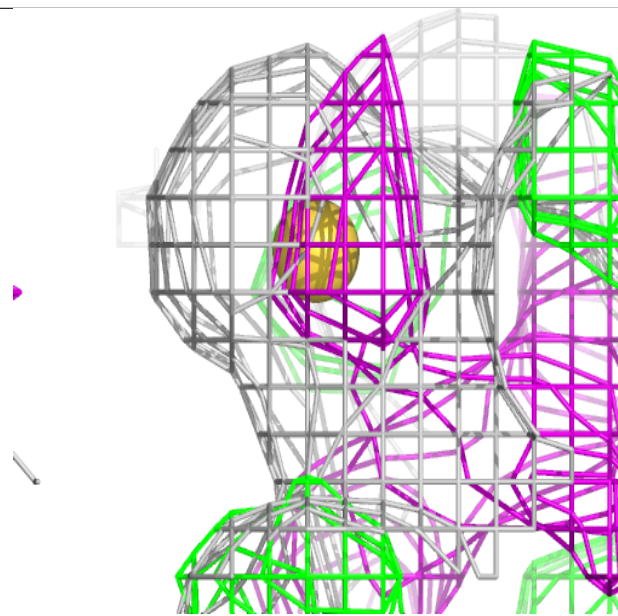
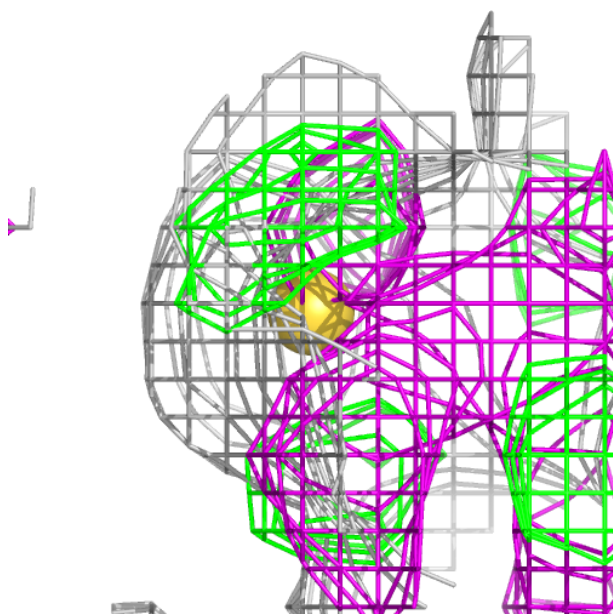
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q<0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
7	GOL	A	1109	6/6	0.77	0.17	48,52,60,65	0
8	EDO	B	304	4/4	0.87	0.15	33,39,45,47	0
7	GOL	A	1110	6/6	0.89	0.12	30,45,46,57	0
7	GOL	A	1107	6/6	0.91	0.12	23,31,33,35	0
7	GOL	A	1108	6/6	0.93	0.09	30,38,38,39	0
7	GOL	A	1106	6/6	0.94	0.09	36,38,39,39	0
6	H2S	A	1105	1/1	0.96	0.10	26,26,26,26	0
3	MGD	A	1102	47/47	0.97	0.06	22,26,31,33	0
3	MGD	A	1101	47/47	0.97	0.05	16,20,24,25	0
4	SF4	B	302	8/8	0.98	0.04	28,31,34,35	0
4	SF4	A	1103	8/8	0.99	0.02	18,19,20,20	0
4	SF4	B	303	8/8	0.99	0.03	24,25,26,27	0
4	SF4	B	301	8/8	0.99	0.02	20,21,22,23	0
5	W	A	1104	1/1	1.00	0.03	24,24,24,24	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.

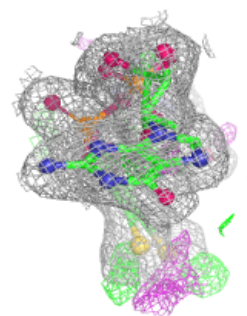
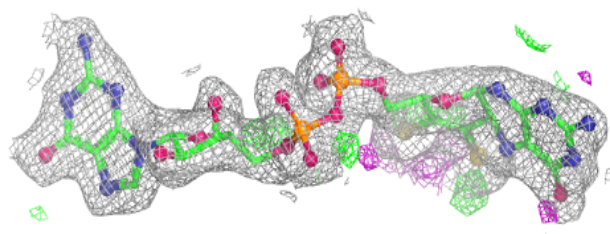
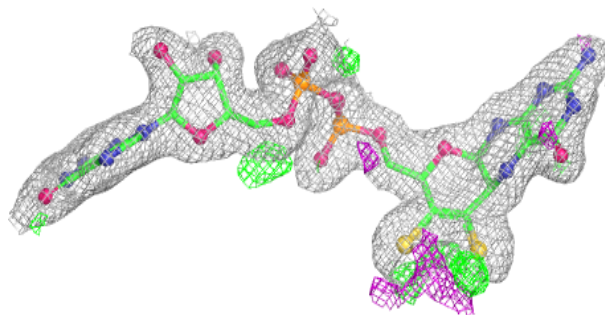
Electron density around H2S A 1105:

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

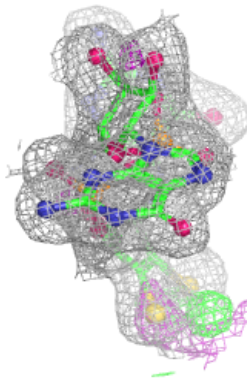
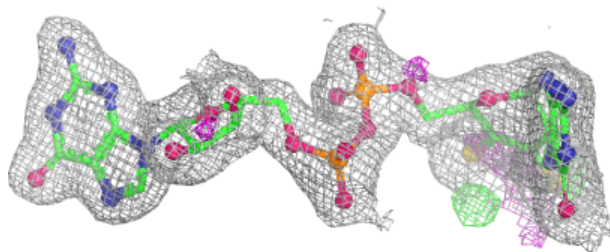
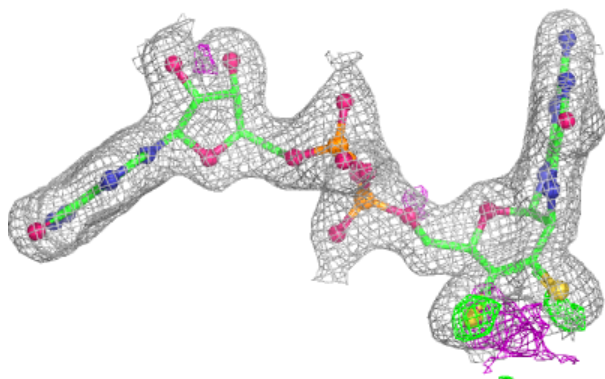


Electron density around MGD A 1102:

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

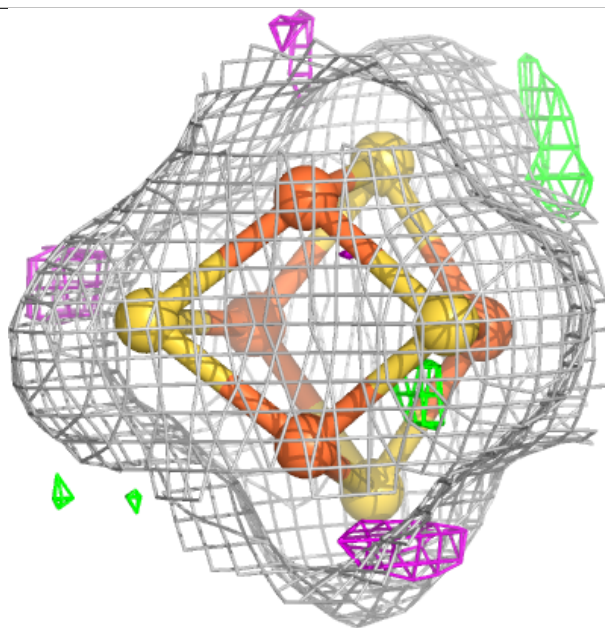
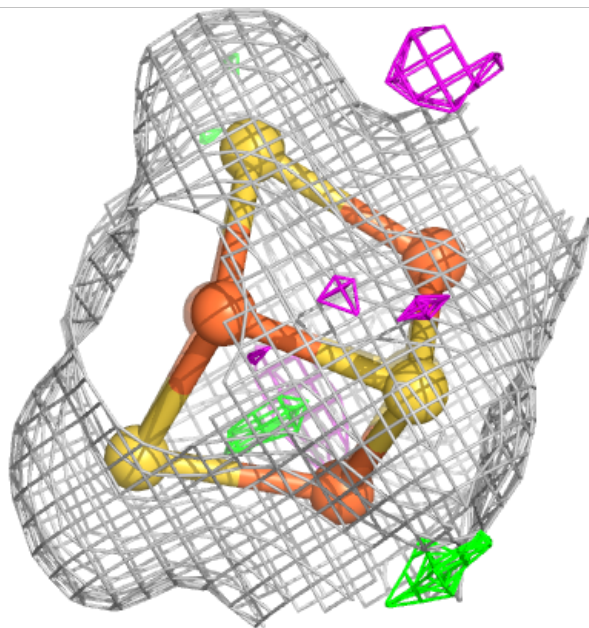
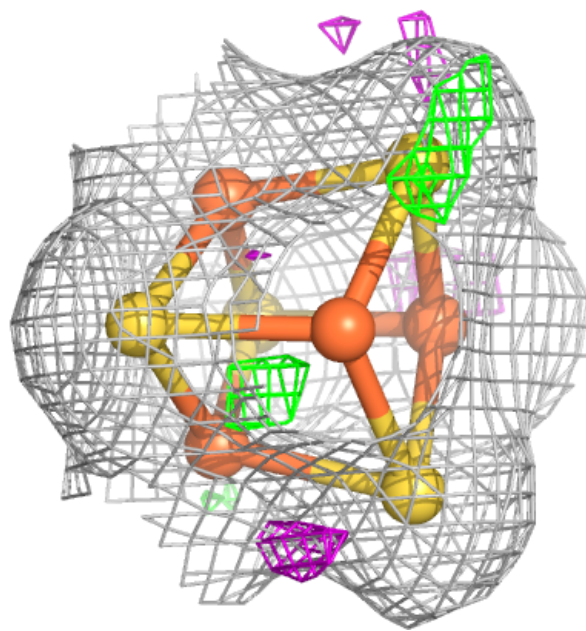
**Electron density around MGD A 1101:**

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



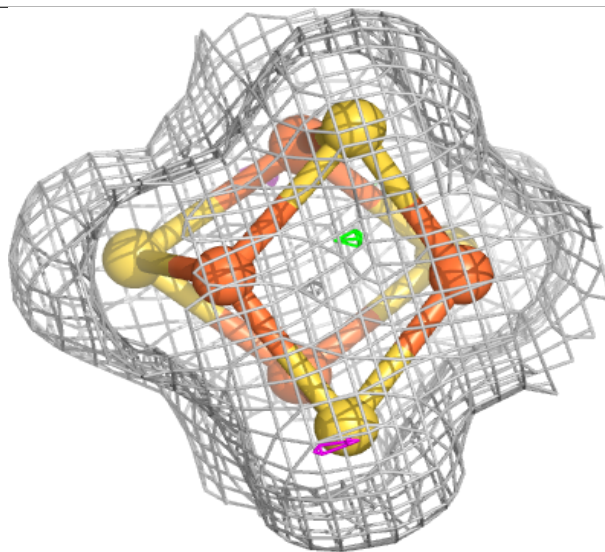
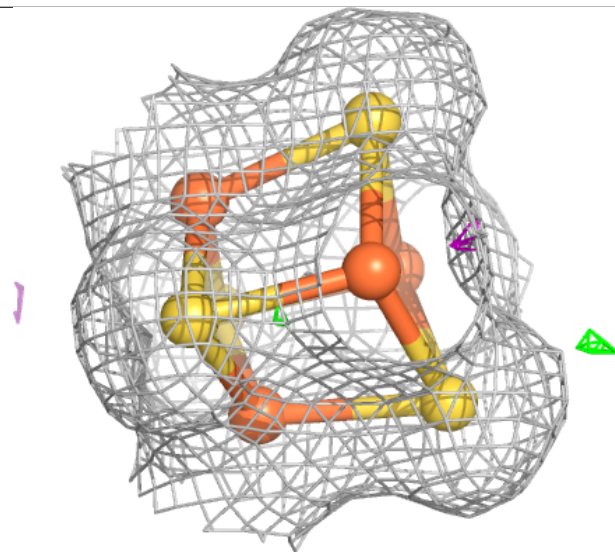
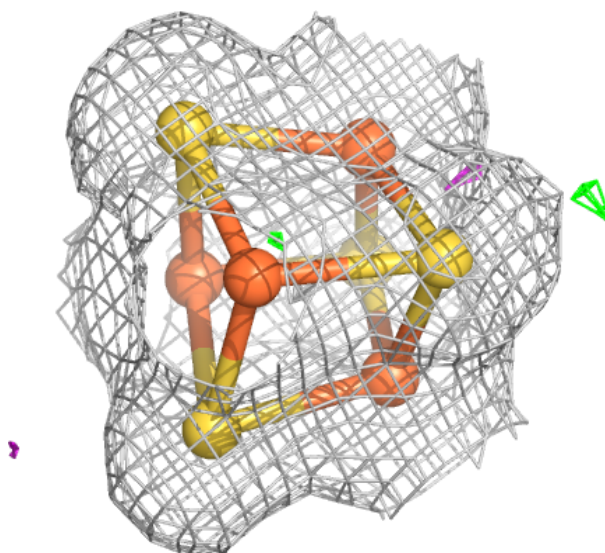
Electron density around SF4 B 302:

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



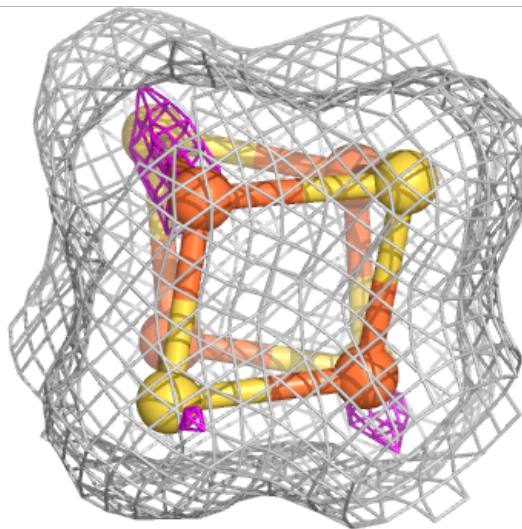
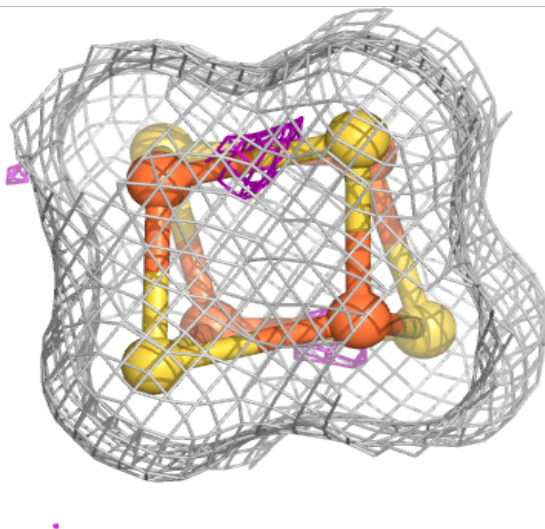
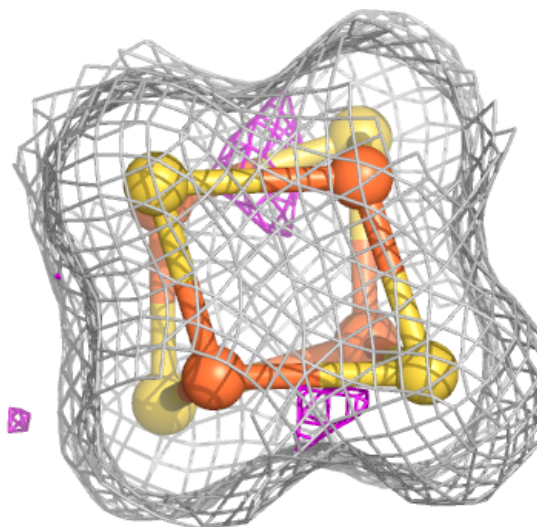
Electron density around SF4 A 1103:

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



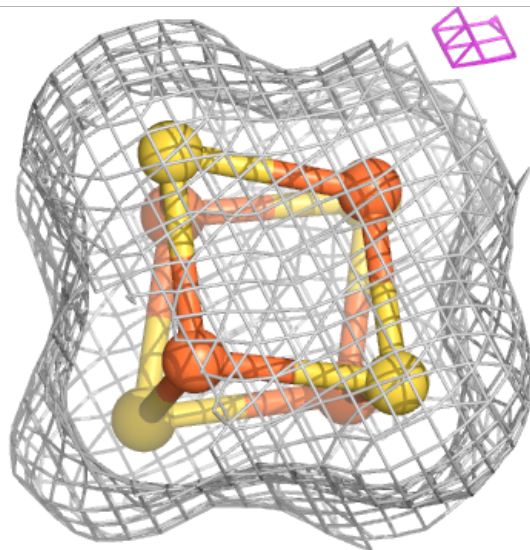
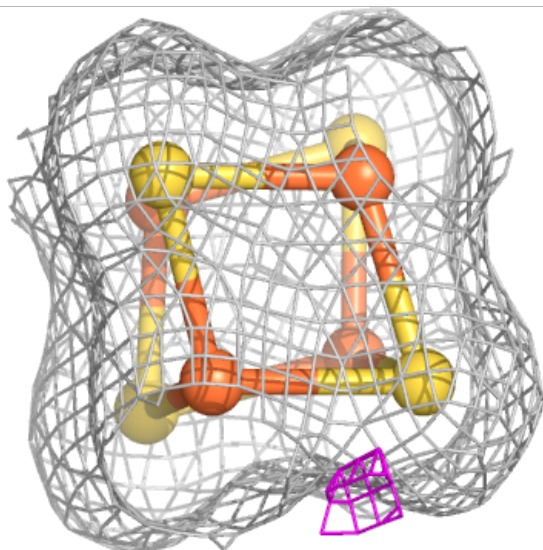
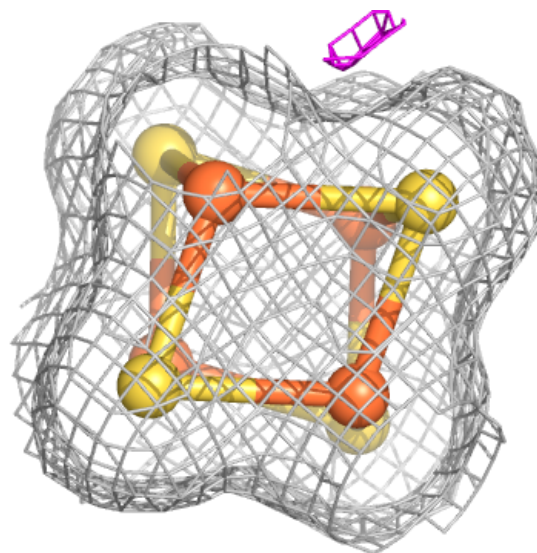
Electron density around SF4 B 303:

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



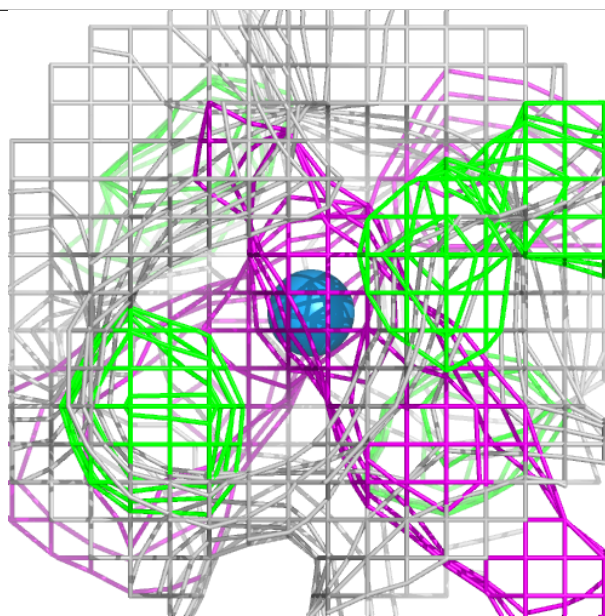
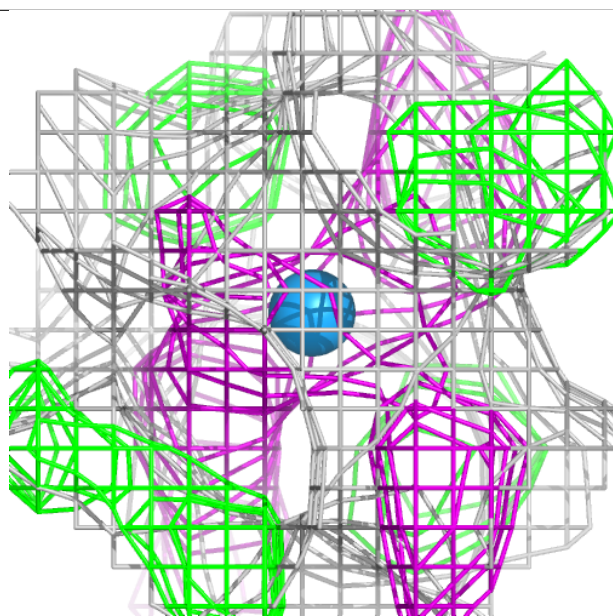
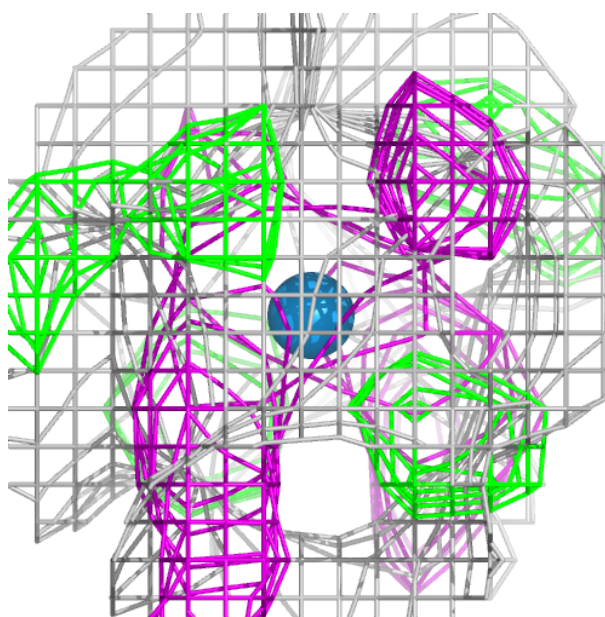
Electron density around SF4 B 301:

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



Electron density around W A 1104:

$2mF_o-DF_c$ (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.