Full wwPDB X-ray Structure Validation Report ⓘ

Feb 23, 2026 – 01:58 pm GMT

PDB ID	:	9RJZ / pdb_00009rjz
Title	:	W-formate dehydrogenase Q447A from Nitratidesulfovibrio vulgaris (Desulfovibrio vulgaris)
Authors	:	Vilela-Alves, G.; Manuel, R.R.; Martins, G.; Pereira, I.C.; Romao, M.J.; Mota, C.
Deposited on	:	2025-06-12
Resolution	:	2.12 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:

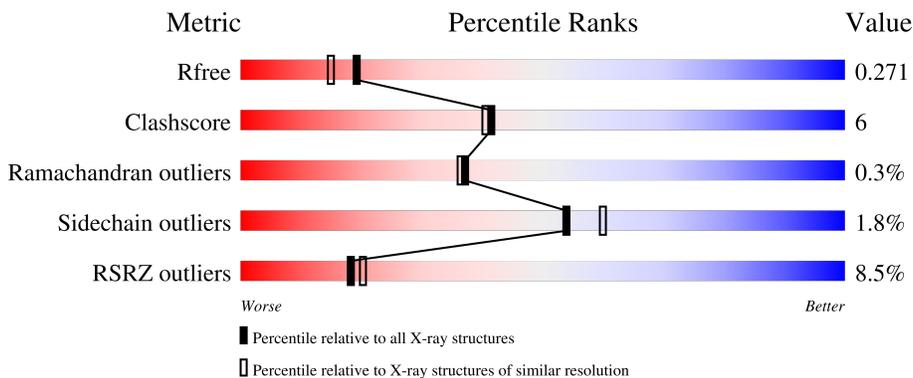|		
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.48.1

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 2.12 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	Percentile Ranks	Value
Rfree		0.271
Clashscore		6
Ramachandran outliers		0.3%
Sidechain outliers		1.8%
RSRZ outliers		8.5%

Worse   *Better*

▌ Percentile relative to all X-ray structures

▐ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	164625	7689 (2.14-2.10)
Clashscore	180529	8431 (2.14-2.10)
Ramachandran outliers	177936	8366 (2.14-2.10)
Sidechain outliers	177891	8367 (2.14-2.10)
RSRZ outliers	164620	7689 (2.14-2.10)

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	8% / 80% / 15% / 5%
2	B	214	11% / 90% / 9% / ·

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
7	GOL	B	304	-	-	X	-

2 Entry composition ⓘ

There are 11 unique types of molecules in this entry. The entry contains 9550 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.

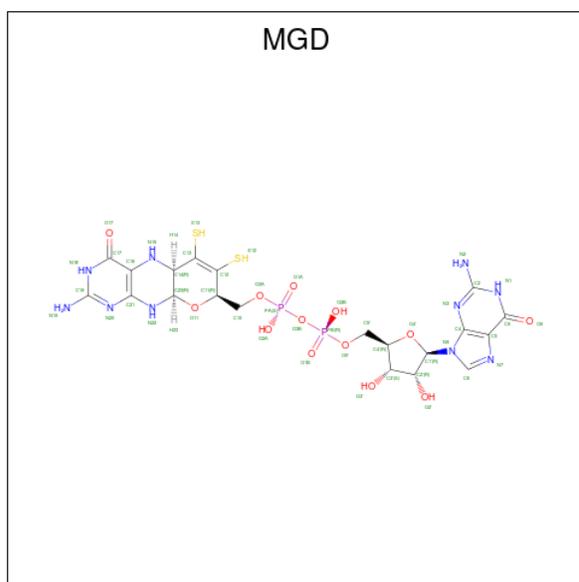| Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	961	Total 7514	C 4790	N 1309	O 1373	S 41	Se 1	0	0	0

There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	447	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
2	B	214	Total 1665	C 1041	N 291	O 317	S 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).

MGD

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).
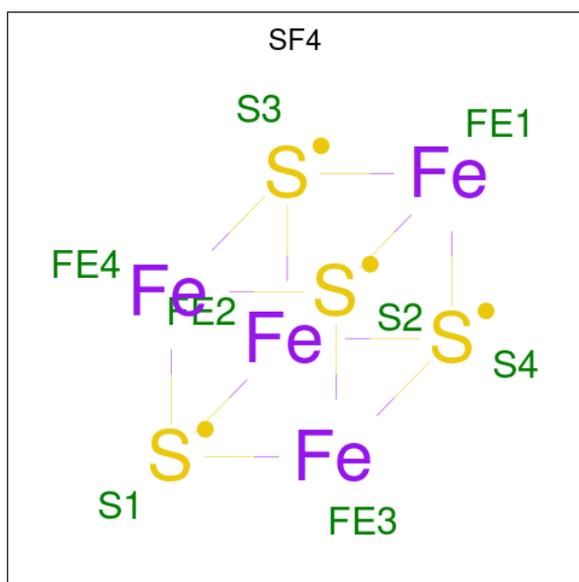
SF4

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 8	Fe 4	S 4	0	0
4	B	1	Total 8	Fe 4	S 4	0	0
4	B	1	Total 8	Fe 4	S 4	0	0

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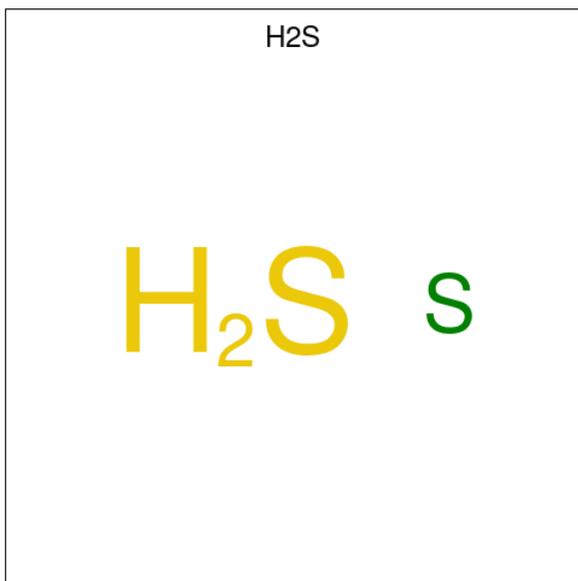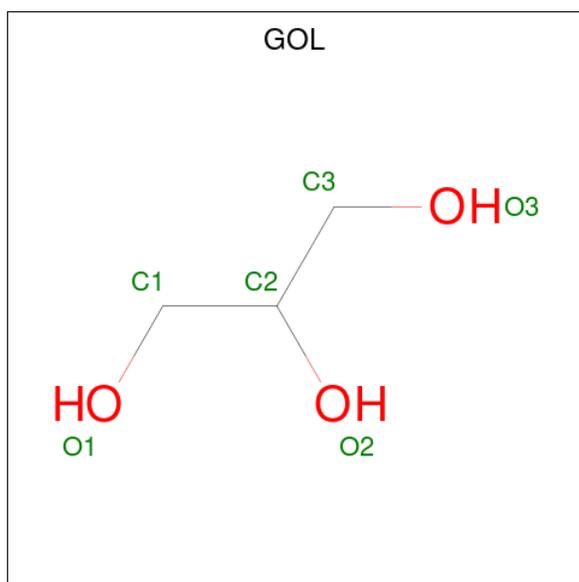

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total 1	S 1	0	0

- 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 1	W 1	0	0

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

GOL

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

- Molecule 8 is TRIETHYLENE GLYCOL (CCD ID: PGE) (formula: $C_6H_{14}O_4$).

PGE
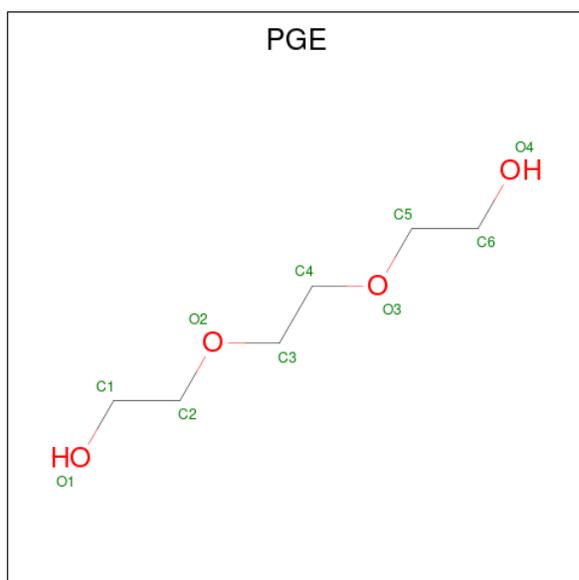
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	A	1	Total 10	C 6	O 4	0	0

- Molecule 9 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).
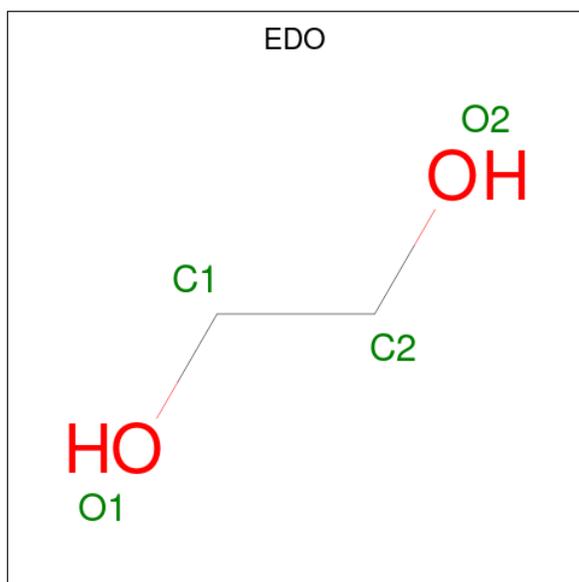
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	A	1	Total 4	C 2	O 2	0	0
9	B	1	Total 4	C 2	O 2	0	0

- Molecule 10 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).
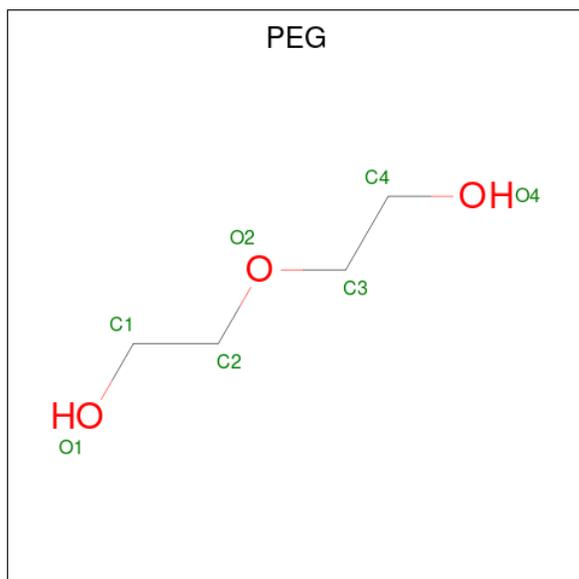
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
10	B	1	Total 7	C 4	O 3	0	0

- Molecule 11 is water.

| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	A	154	Total 154	O 154	0	0
11	B	34	Total 34	O 34	0	0

3 Residue-property plots ⓘ

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:
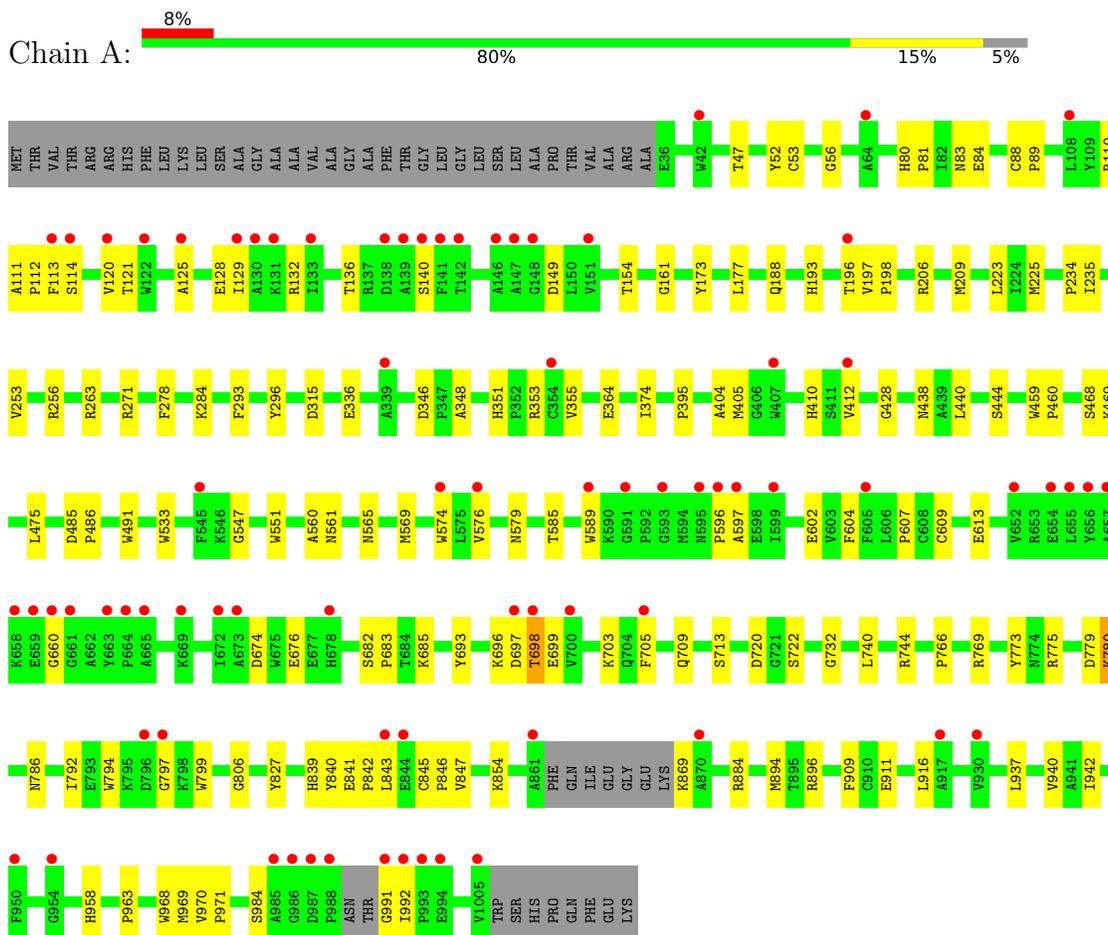
• Molecule 2: Formate dehydrogenase, beta subunit, putative

Chain B:
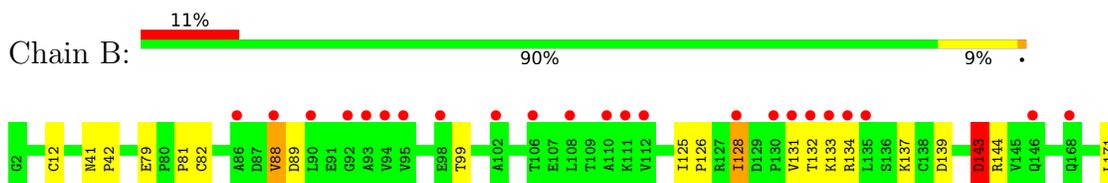
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	64.95Å 127.01Å 149.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	59.55 – 2.12 59.55 – 2.12	Depositor EDS
% Data completeness (in resolution range)	84.0 (59.55-2.12) 83.5 (59.55-2.12)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.47 (at 2.12Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.213 , 0.261 0.221 , 0.271	Depositor DCC
R_{free} test set	2920 reflections (3.79%)	wwPDB-VP
Wilson B-factor (Å^2)	28.1	Xtriage
Anisotropy	0.023	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 27.5	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	0.93	EDS
Total number of atoms	9550	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 4.75% of the height of the origin peak. No significant pseudotranslation is detected.*

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[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: GOL, H2S, W, SF4, PGE, MGD, PEG, EDO, 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	1.03	0/7713	1.37	2/10461 (0.0%)
2	B	1.02	0/1700	1.44	4/2302 (0.2%)
All	All	1.03	0/9413	1.39	6/12763 (0.0%)

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	82	CYS	CA-C-N	5.13	127.42	120.65
2	B	82	CYS	C-N-CA	5.13	127.42	120.65
2	B	143	ASP	CA-C-N	5.08	127.50	120.29
2	B	143	ASP	C-N-CA	5.08	127.50	120.29
1	A	293	PHE	CA-C-N	5.01	127.24	120.38
1	A	293	PHE	C-N-CA	5.01	127.24	120.38

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	7514	0	7349	101	0
2	B	1665	0	1633	16	0
3	A	94	0	44	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	8	0	0	1	0
4	B	24	0	0	0	0
5	A	1	0	0	0	0
6	A	1	0	0	0	0
7	A	24	0	32	1	0
7	B	6	0	8	5	0
8	A	10	0	14	2	0
9	A	4	0	6	0	0
9	B	4	0	6	0	0
10	B	7	0	10	0	0
11	A	154	0	0	1	0
11	B	34	0	0	0	0
All	All	9550	0	9102	116	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 6.

All (116) 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:780:LYS:H	1:A:780:LYS:HD3	1.25	1.01
1:A:132:ARG:O	1:A:136:THR:HG22	1.77	0.84
1:A:225:MET:HE2	1:A:253:VAL:HG11	1.68	0.75
1:A:223:LEU:HD11	1:A:225:MET:HE3	1.75	0.69
1:A:780:LYS:HD3	1:A:780:LYS:N	2.05	0.69
1:A:696:LYS:HE3	1:A:722:SER:OG	1.93	0.69
1:A:225:MET:HE1	1:A:278:PHE:CE1	2.29	0.68
1:A:780:LYS:H	1:A:780:LYS:CD	2.04	0.67
2:B:137:LYS:O	7:B:304:GOL:H32	1.99	0.63
2:B:137:LYS:O	7:B:304:GOL:C3	2.48	0.61
1:A:209:MET:CE	1:A:440:LEU:HD23	2.30	0.61
1:A:113:PHE:O	1:A:597:ALA:HA	2.02	0.59
1:A:916:LEU:HD12	1:A:958:HIS:HB3	1.84	0.59
1:A:896:ARG:HD2	1:A:970:VAL:O	2.02	0.59
1:A:336:GLU:OE1	1:A:353:ARG:NH2	2.35	0.58
1:A:561:ASN:HD22	1:A:984:SER:HB2	1.69	0.58
1:A:129:ILE:HD11	1:A:604:PHE:CG	2.39	0.58
1:A:698:THR:HG21	1:A:722:SER:HB3	1.86	0.58
1:A:132:ARG:NH2	1:A:602:GLU:OE2	2.39	0.56
1:A:732:GLY:O	1:A:740:LEU:HD12	2.05	0.56
1:A:676:GLU:O	1:A:685:LYS:NZ	2.30	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:128:GLU:O	1:A:132:ARG:HD3	2.07	0.55
1:A:937:LEU:C	1:A:937:LEU:HD12	2.32	0.54
1:A:569:MET:HE1	1:A:585:THR:HG23	1.89	0.54
1:A:405:MET:HE1	1:A:884:ARG:HH12	1.72	0.54
2:B:41:ASN:HA	2:B:42:PRO:C	2.32	0.54
1:A:720:ASP:OD1	1:A:720:ASP:C	2.49	0.53
1:A:346:ASP:OD1	1:A:348:ALA:HB3	2.10	0.52
1:A:991:GLY:N	1:A:992:ILE:HD12	2.23	0.52
1:A:225:MET:HE2	1:A:253:VAL:HG21	1.93	0.51
1:A:574:TRP:HA	1:A:602:GLU:O	2.10	0.51
1:A:459:TRP:HB3	1:A:460:PRO:HD2	1.92	0.51
1:A:780:LYS:N	1:A:780:LYS:CD	2.69	0.51
1:A:209:MET:HE1	1:A:440:LEU:CD2	2.42	0.50
2:B:143:ASP:OD1	2:B:144:ARG:N	2.43	0.50
1:A:845:CYS:HB2	1:A:846:PRO:HD3	1.94	0.49
1:A:225:MET:HE2	1:A:253:VAL:CG1	2.39	0.49
1:A:696:LYS:O	1:A:698:THR:HG22	2.12	0.49
1:A:916:LEU:O	1:A:916:LEU:HD23	2.13	0.48
1:A:284:LYS:HE2	1:A:364:GLU:O	2.14	0.48
1:A:125:ALA:O	1:A:129:ILE:HG12	2.13	0.48
1:A:485:ASP:OD1	1:A:486:PRO:HD2	2.13	0.48
1:A:136:THR:HG21	1:A:574:TRP:HE1	1.78	0.47
1:A:766:PRO:HG2	1:A:769:ARG:HD2	1.95	0.47
1:A:88:CYS:HB2	1:A:89:PRO:HD2	1.95	0.47
1:A:547:GLY:HA3	1:A:574:TRP:CZ2	2.50	0.47
1:A:225:MET:CE	1:A:253:VAL:HG21	2.45	0.47
2:B:88:VAL:HG12	2:B:89:ASP:OD1	2.15	0.46
1:A:161:GLY:HA3	1:A:551:TRP:O	2.16	0.46
1:A:263:ARG:HD2	2:B:12:CYS:O	2.16	0.46
1:A:560:ALA:O	1:A:565:ASN:ND2	2.49	0.46
1:A:209:MET:HE2	1:A:440:LEU:HD23	1.97	0.46
1:A:841:GLU:HG2	1:A:847:VAL:HG11	1.96	0.46
1:A:579:ASN:O	1:A:607:PRO:HA	2.16	0.46
1:A:193:HIS:O	1:A:196:THR:HB	2.16	0.45
1:A:296:TYR:CE1	1:A:428:GLY:HA2	2.52	0.45
1:A:225:MET:HG3	1:A:253:VAL:HB	1.97	0.45
2:B:143:ASP:OD1	2:B:144:ARG:HG3	2.16	0.45
1:A:129:ILE:HD12	1:A:576:VAL:CG2	2.47	0.45
1:A:491:TRP:CH2	8:A:1107:PGE:H32	2.52	0.45
1:A:188:GLN:HB3	3:A:1102:MGD:S12	2.56	0.45
1:A:47:THR:HG21	1:A:744:ARG:NH1	2.32	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:111:ALA:O	1:A:112:PRO:C	2.61	0.44
2:B:125:ILE:HB	2:B:126:PRO:HD3	1.98	0.44
1:A:315:ASP:CG	1:A:854:LYS:HE2	2.43	0.44
1:A:841:GLU:OE2	1:A:843:LEU:HB2	2.17	0.44
1:A:209:MET:HG3	1:A:438:ASN:HA	2.00	0.44
1:A:894:MET:SD	3:A:1102:MGD:H2'	2.58	0.44
1:A:206:ARG:HB2	1:A:773:TYR:OH	2.17	0.43
1:A:779:ASP:HB2	1:A:780:LYS:HD3	2.01	0.43
1:A:911:GLU:HG2	1:A:942:ILE:HB	2.00	0.43
2:B:128:ILE:CD1	2:B:133:LYS:HA	2.48	0.43
1:A:173:TYR:CZ	1:A:177:LEU:HD11	2.53	0.43
1:A:234:PRO:HD2	4:A:1103:SF4:S3	2.58	0.43
1:A:547:GLY:HA3	1:A:574:TRP:CE2	2.54	0.43
2:B:137:LYS:O	7:B:304:GOL:H31	2.18	0.43
1:A:693:TYR:HB2	1:A:709:GLN:O	2.19	0.43
1:A:970:VAL:CG2	1:A:971:PRO:HA	2.49	0.43
1:A:609:CYS:HB2	1:A:613:GLU:OE1	2.19	0.43
1:A:149:ASP:OD2	1:A:469:LYS:NZ	2.44	0.42
1:A:374:ILE:HD11	1:A:839:HIS:NE2	2.34	0.42
1:A:968:TRP:CH2	1:A:969:MET:HE3	2.53	0.42
1:A:256:ARG:HH21	3:A:1101:MGD:H3'	1.85	0.42
1:A:769:ARG:HH22	8:A:1107:PGE:C3	2.31	0.42
2:B:79:GLU:O	2:B:81:PRO:HD3	2.20	0.42
1:A:83:ASN:O	1:A:84:GLU:C	2.61	0.42
1:A:225:MET:HE2	1:A:253:VAL:CB	2.50	0.42
1:A:682:SER:O	1:A:683:PRO:C	2.63	0.42
1:A:841:GLU:HG2	1:A:847:VAL:CG1	2.50	0.42
1:A:56:GLY:HA2	11:A:1281:HOH:O	2.18	0.42
1:A:410:HIS:HE1	1:A:412:VAL:HG23	1.85	0.42
1:A:697:ASP:HA	1:A:705:PHE:O	2.19	0.42
2:B:132:THR:HG23	2:B:134:ARG:H	1.84	0.42
1:A:792:ILE:HD12	1:A:799:TRP:CE3	2.55	0.42
1:A:114:SER:O	1:A:596:PRO:HB3	2.20	0.41
1:A:775:ARG:HD2	1:A:806:GLY:O	2.20	0.41
1:A:355:VAL:HG13	1:A:827:TYR:HB2	2.03	0.41
1:A:140:SER:OG	1:A:154:THR:HG23	2.21	0.41
1:A:840:TYR:O	1:A:842:PRO:HD3	2.21	0.41
2:B:139:ASP:C	2:B:139:ASP:OD1	2.64	0.41
2:B:139:ASP:HB3	7:B:304:GOL:H31	2.02	0.41
1:A:110:ARG:HG3	1:A:589:TRP:CE2	2.56	0.41
2:B:171:LEU:O	2:B:175:GLU:HG2	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:395:PRO:O	1:A:786:ASN:HB2	2.20	0.41
1:A:351:HIS:CE1	1:A:353:ARG:HB2	2.56	0.41
1:A:197:VAL:HG11	7:A:1108:GOL:H12	2.03	0.41
1:A:794:TRP:CZ2	1:A:797:GLY:HA2	2.55	0.41
1:A:52:TYR:O	1:A:444:SER:N	2.50	0.41
1:A:197:VAL:HB	1:A:198:PRO:HD3	2.03	0.41
1:A:80:HIS:HA	1:A:81:PRO:HD3	1.88	0.41
1:A:699:GLU:HA	1:A:703:LYS:O	2.21	0.41
1:A:909:PHE:CE2	1:A:963:PRO:HG3	2.55	0.41
2:B:137:LYS:HG3	7:B:304:GOL:H11	2.02	0.41
1:A:404:ALA:HB3	3:A:1101:MGD:O2A	2.20	0.40
1:A:410:HIS:CE1	1:A:412:VAL:HG23	2.55	0.40
1:A:110:ARG:HG3	1:A:589:TRP:CZ2	2.57	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	954/1013 (94%)	901 (94%)	51 (5%)	2 (0%)	44	44
2	B	212/214 (99%)	202 (95%)	9 (4%)	1 (0%)	25	22
All	All	1166/1227 (95%)	1103 (95%)	60 (5%)	3 (0%)	37	36

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	533	TRP
2	B	143	ASP
1	A	660	GLY

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	779/818 (95%)	766 (98%)	13 (2%)	56	62
2	B	185/185 (100%)	181 (98%)	4 (2%)	47	51
All	All	964/1003 (96%)	947 (98%)	17 (2%)	54	60

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	53	CYS
1	A	120	VAL
1	A	121	THR
1	A	235	ILE
1	A	271	ARG
1	A	468	SER
1	A	475	LEU
1	A	674	ASP
1	A	698	THR
1	A	713	SER
1	A	780	LYS
1	A	869	LYS
1	A	940	VAL
2	B	88	VAL
2	B	99	THR
2	B	128	ILE
2	B	131	VAL

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	340	ASN
1	A	561	ASN
1	A	595	ASN
1	A	821	HIS
1	A	973	ASN

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 ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 17 ligands modelled in this entry, 1 is modelled with single atom and 1 is monoatomic - leaving 15 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	B	303	2	0,12,12	-	-	-		
7	GOL	A	1111	-	5,5,5	0.14	0	5,5,5	0.43	0
8	PGE	A	1107	-	9,9,9	0.46	0	8,8,8	0.32	0
4	SF4	B	302	2	0,12,12	-	-	-		
7	GOL	A	1110	-	5,5,5	0.18	0	5,5,5	0.32	0
9	EDO	A	1109	-	3,3,3	0.39	0	2,2,2	0.63	0
7	GOL	A	1108	-	5,5,5	0.14	0	5,5,5	0.39	0
7	GOL	B	304	-	5,5,5	0.20	0	5,5,5	0.54	0
9	EDO	B	306	-	3,3,3	0.14	0	2,2,2	0.13	0
10	PEG	B	305	-	6,6,6	0.29	0	5,5,5	0.21	0
7	GOL	A	1106	-	5,5,5	0.13	0	5,5,5	0.39	0
4	SF4	A	1103	1	0,12,12	-	-	-		
3	MGD	A	1101	6	41,52,52	0.98	3 (7%)	40,81,81	1.32	6 (15%)
4	SF4	B	301	2	0,12,12	-	-	-		
3	MGD	A	1102	6	41,52,52	0.85	1 (2%)	40,81,81	1.08	3 (7%)

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	B	303	2	-	-	0/6/5/5
7	GOL	A	1111	-	-	4/4/4/4	-
8	PGE	A	1107	-	-	5/7/7/7	-
4	SF4	B	302	2	-	-	0/6/5/5
7	GOL	A	1110	-	-	0/4/4/4	-
9	EDO	A	1109	-	-	0/1/1/1	-
7	GOL	A	1108	-	-	0/4/4/4	-
4	SF4	B	301	2	-	-	0/6/5/5
9	EDO	B	306	-	-	1/1/1/1	-
10	PEG	B	305	-	-	4/4/4/4	-
7	GOL	A	1106	-	-	2/4/4/4	-
4	SF4	A	1103	1	-	-	0/6/5/5
3	MGD	A	1101	6	-	3/18/66/66	0/6/6/6
7	GOL	B	304	-	-	4/4/4/4	-
3	MGD	A	1102	6	-	5/18/66/66	0/6/6/6

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1101	MGD	C23-C14	3.22	1.56	1.53
3	A	1101	MGD	C5-C6	-2.66	1.42	1.47
3	A	1102	MGD	C5-C6	-2.49	1.42	1.47
3	A	1101	MGD	C8-N7	-2.07	1.31	1.35

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	1101	MGD	O11-C23-C14	4.32	111.84	108.96
3	A	1101	MGD	PA-O3B-PB	3.01	143.16	132.83
3	A	1101	MGD	C19-N20-C21	2.92	118.71	113.43
3	A	1102	MGD	C19-N20-C21	2.58	118.09	113.43
3	A	1102	MGD	O4'-C1'-C2'	-2.52	103.24	106.93
3	A	1101	MGD	O4'-C1'-C2'	-2.52	103.24	106.93
3	A	1102	MGD	O6-C6-C5	2.39	129.04	124.37
3	A	1101	MGD	O6-C6-C5	2.13	128.53	124.37
3	A	1101	MGD	C17-C16-N15	2.02	122.18	116.76

There are no chirality outliers.
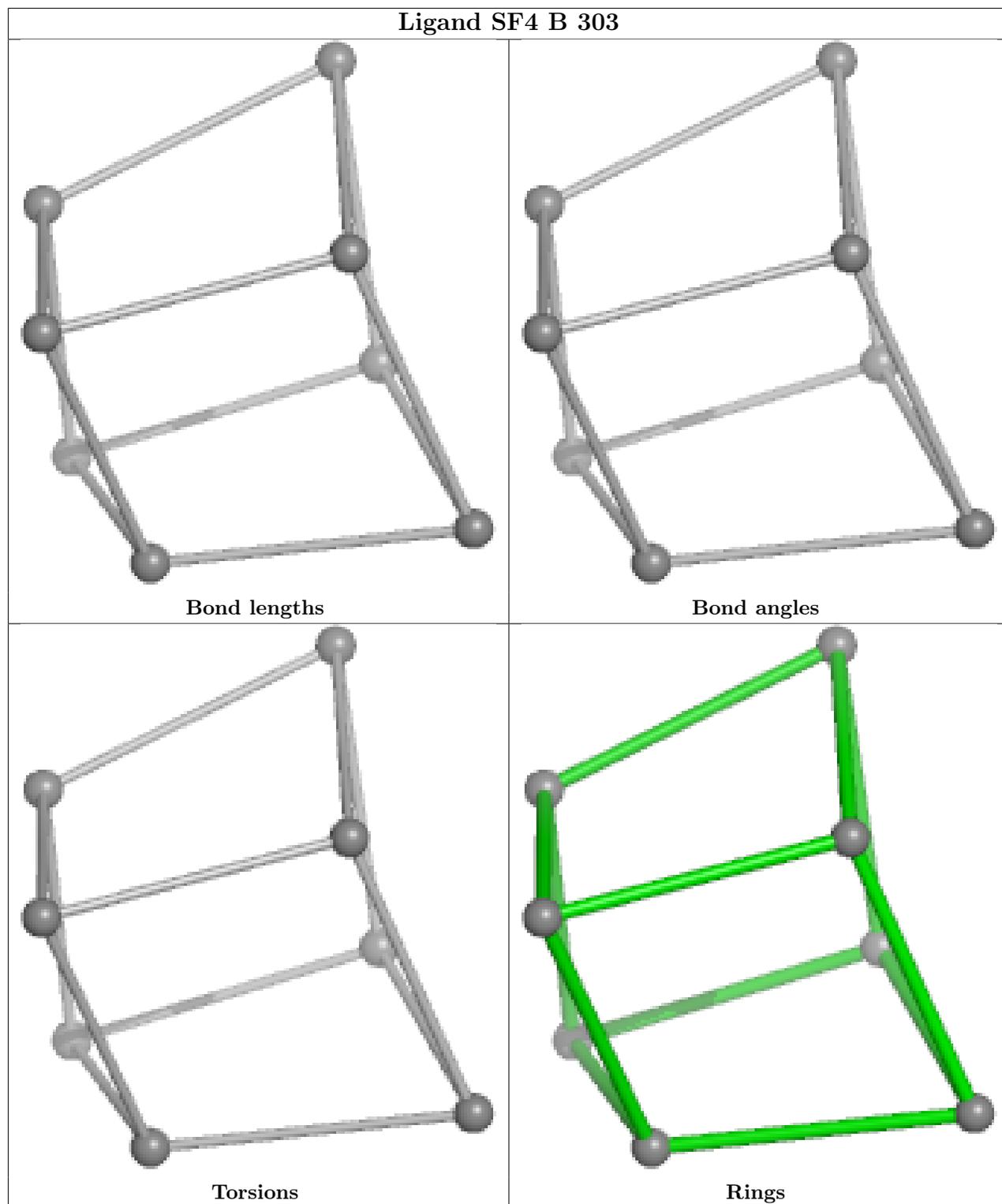
All (28) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1102	MGD	C5'-O5'-PB-O2B
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	1111	GOL	O1-C1-C2-C3
7	A	1111	GOL	C1-C2-C3-O3
7	B	304	GOL	C1-C2-C3-O3
3	A	1102	MGD	O4'-C4'-C5'-O5'
7	A	1111	GOL	O2-C2-C3-O3
8	A	1107	PGE	O2-C3-C4-O3
8	A	1107	PGE	O1-C1-C2-O2
7	B	304	GOL	O1-C1-C2-C3
10	B	305	PEG	O1-C1-C2-O2
7	A	1111	GOL	O1-C1-C2-O2
7	B	304	GOL	O1-C1-C2-O2
9	B	306	EDO	O1-C1-C2-O2
8	A	1107	PGE	O3-C5-C6-O4
3	A	1101	MGD	PA-O3B-PB-O5'
8	A	1107	PGE	C4-C3-O2-C2
10	B	305	PEG	C4-C3-O2-C2
3	A	1102	MGD	C5'-O5'-PB-O3B
10	B	305	PEG	C1-C2-O2-C3
3	A	1102	MGD	C5'-O5'-PB-O1B
7	B	304	GOL	O2-C2-C3-O3
3	A	1101	MGD	O3A-C10-C11-O11
10	B	305	PEG	O2-C3-C4-O4
3	A	1101	MGD	PA-O3B-PB-O1B
8	A	1107	PGE	C6-C5-O3-C4

There are no ring outliers.

6 monomers are involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
8	A	1107	PGE	2	0
7	A	1108	GOL	1	0
7	B	304	GOL	5	0
4	A	1103	SF4	1	0
3	A	1101	MGD	2	0
3	A	1102	MGD	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 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 B 303

Bond lengths

Bond angles

Torsions

Rings

Ligand SF4 B 302

Bond lengths

Bond angles

Torsions

Rings

Ligand SF4 A 1103

Bond lengths

Bond angles

Torsions

Rings

Ligand MGD A 1101

Bond lengths

Bond angles

Torsions

Rings

Ligand SF4 B 301

Bond lengths

Bond angles

Torsions

Rings

Ligand MGD A 1102

Bond lengths

Bond angles

Torsions

Rings
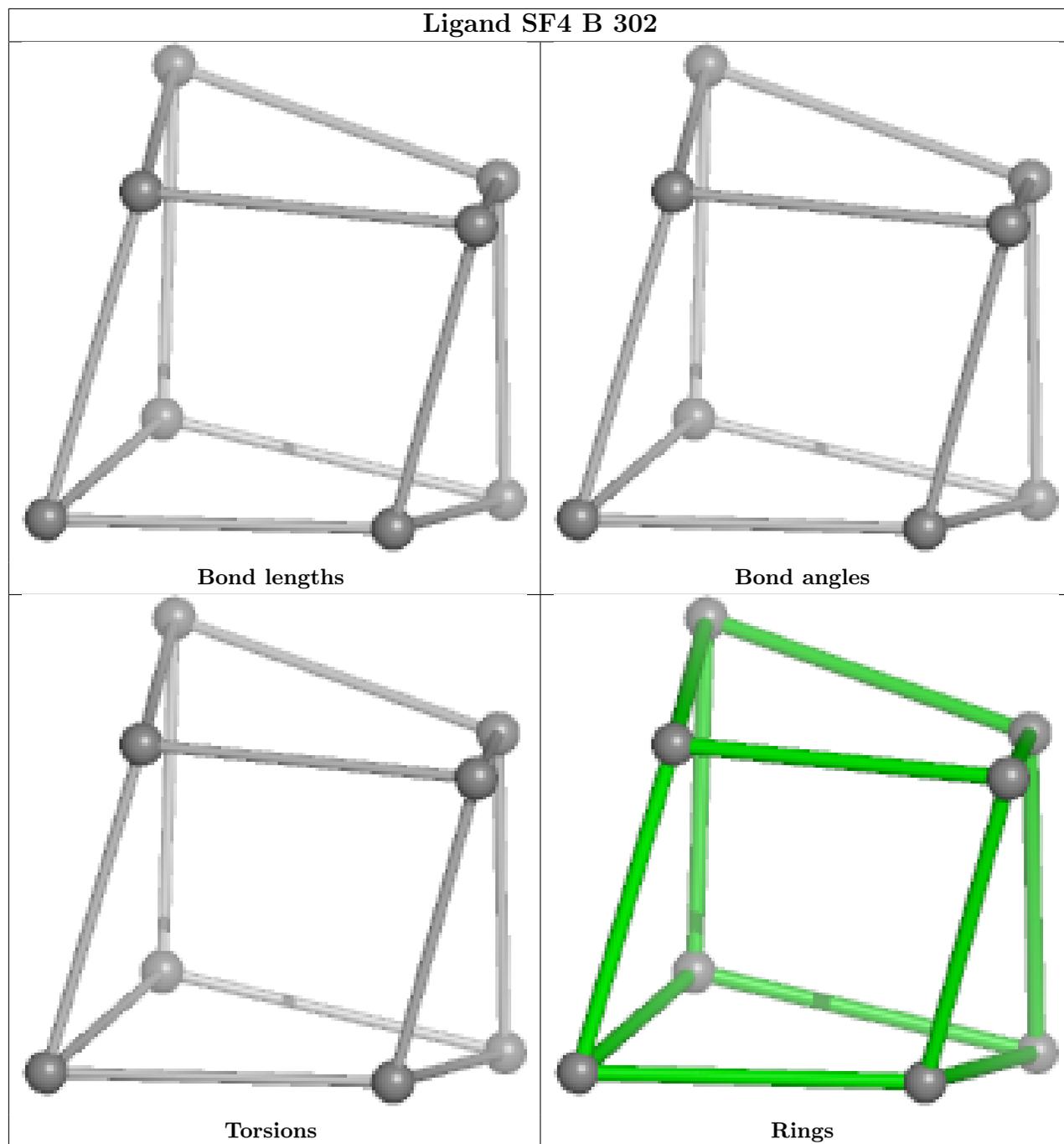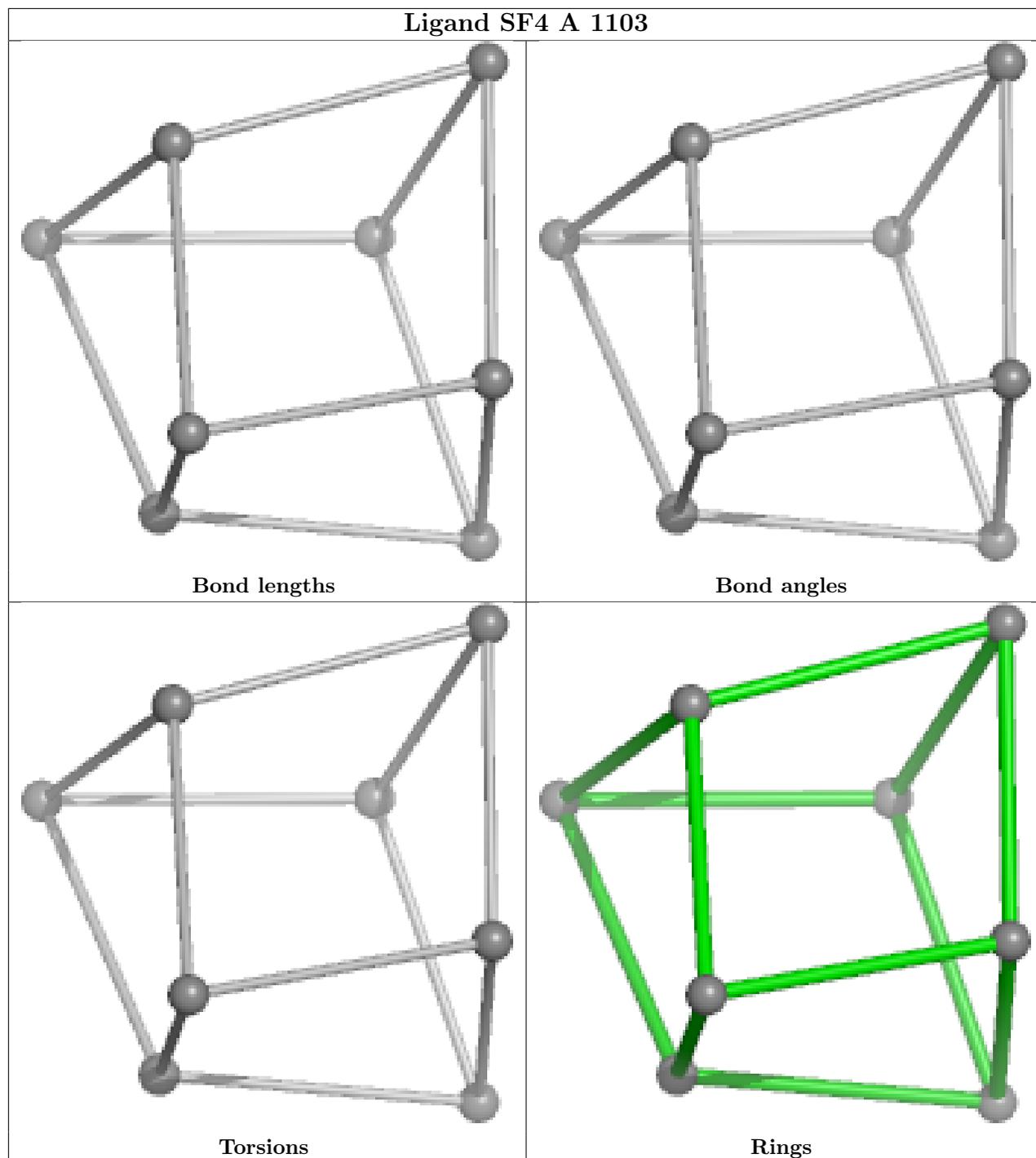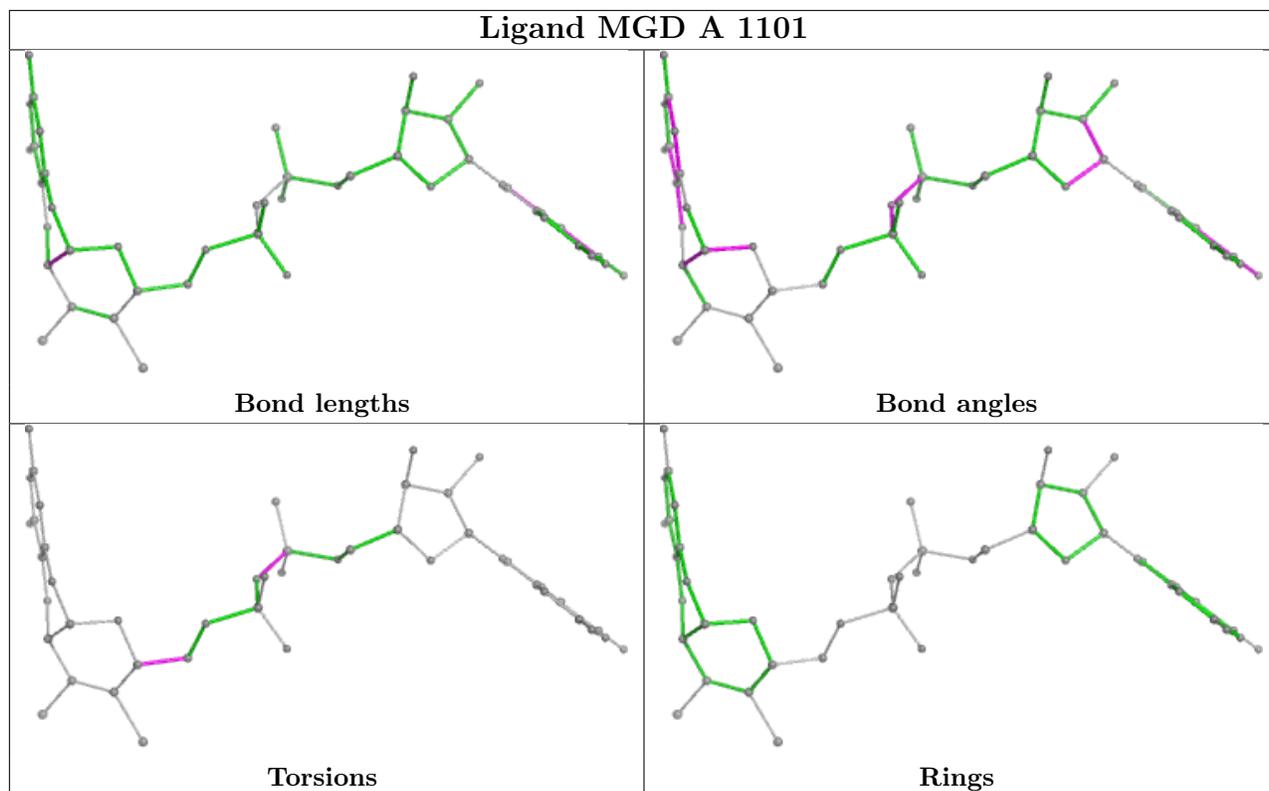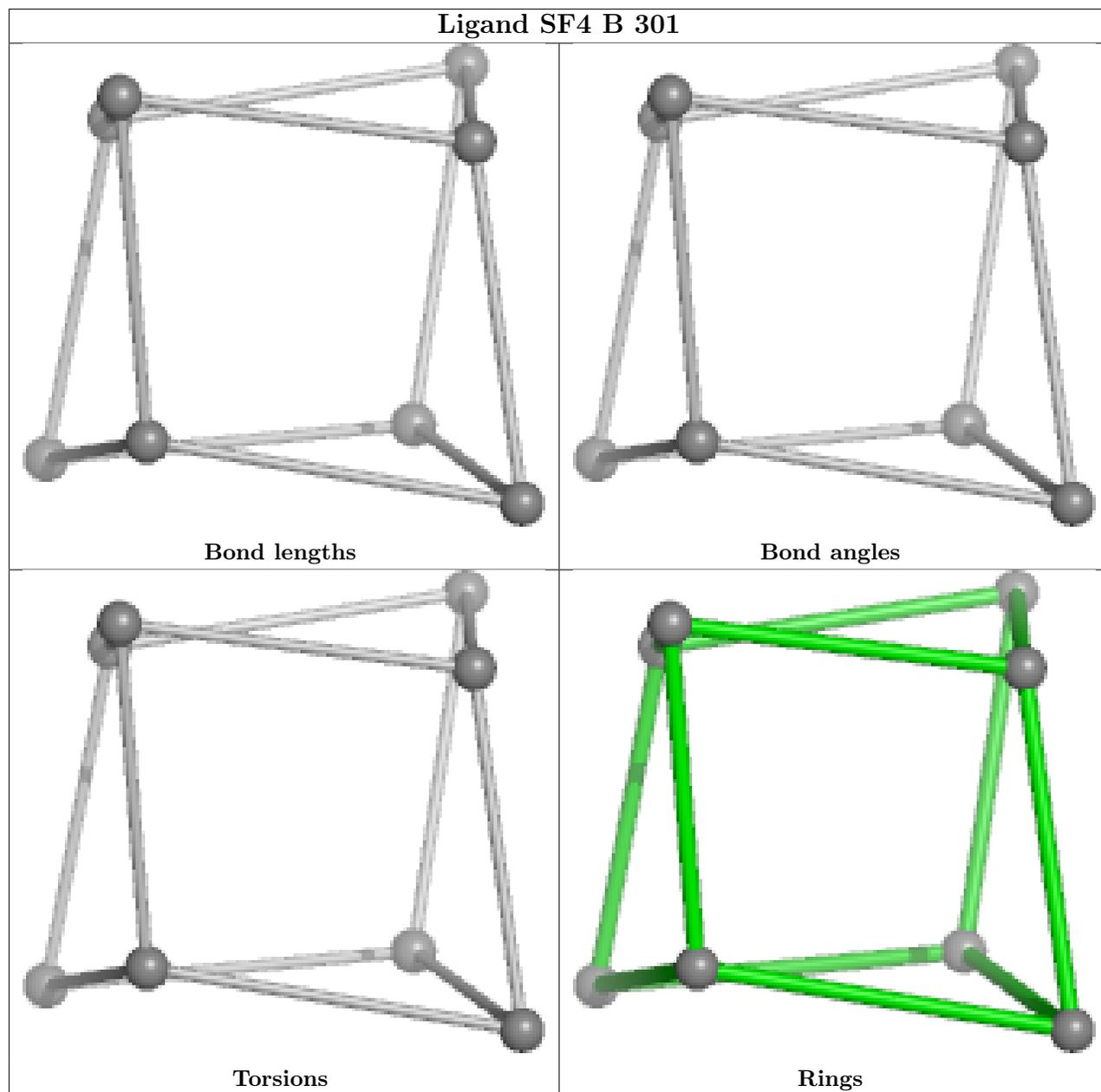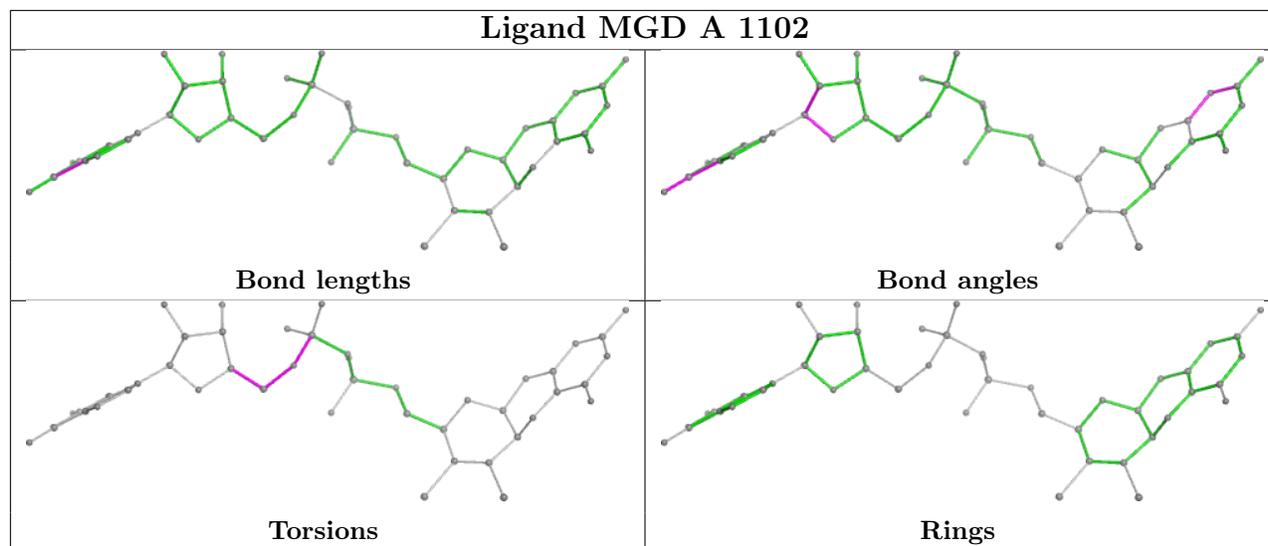
5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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	960/1013 (94%)	0.57	76 (7%)	20	22	16, 33, 54, 83	0
2	B	214/214 (100%)	0.72	24 (11%)	11	13	20, 38, 61, 70	0
All	All	1174/1227 (95%)	0.60	100 (8%)	18	20	16, 34, 56, 83	0

All (100) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	988	PRO	4.6
2	B	146	GLN	4.5
1	A	660	GLY	4.4
2	B	131	VAL	4.1
1	A	661	GLY	4.0
1	A	595	ASN	3.7
1	A	113	PHE	3.5
1	A	597	ALA	3.5
2	B	130	PRO	3.4
1	A	140	SER	3.4
2	B	132	THR	3.3
1	A	652	VAL	3.2
1	A	1005	VAL	3.2
1	A	992	ILE	3.2
1	A	993	PRO	3.1
1	A	991	GLY	3.0
1	A	146	ALA	3.0
1	A	129	ILE	3.0
1	A	672	ILE	2.9
1	A	407	TRP	2.9
1	A	574	TRP	2.9
1	A	954	GLY	2.9
2	B	88	VAL	2.9
2	B	112	VAL	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	987	ASP	2.9
2	B	93	ALA	2.9
2	B	92	GLY	2.8
2	B	168	GLN	2.8
1	A	589	TRP	2.8
2	B	108	LEU	2.7
1	A	131	LYS	2.7
1	A	130	ALA	2.7
1	A	985	ALA	2.7
1	A	122	TRP	2.7
1	A	141	PHE	2.7
1	A	986	GLY	2.7
1	A	108	LEU	2.6
1	A	663	TYR	2.6
1	A	148	GLY	2.6
1	A	655	LEU	2.6
1	A	593	GLY	2.5
2	B	215	ALA	2.5
1	A	596	PRO	2.5
1	A	664	PRO	2.5
1	A	705	PHE	2.5
2	B	98	GLU	2.5
2	B	90	LEU	2.5
1	A	139	ALA	2.5
1	A	120	VAL	2.5
1	A	605	PHE	2.4
1	A	114	SER	2.4
1	A	796	ASP	2.4
1	A	678	HIS	2.4
1	A	339	ALA	2.4
1	A	698	THR	2.4
1	A	125	ALA	2.4
2	B	135	LEU	2.3
1	A	147	ALA	2.3
1	A	133	ILE	2.3
1	A	64	ALA	2.3
1	A	354	CYS	2.2
1	A	656	TYR	2.2
1	A	659	GLU	2.2
1	A	576	VAL	2.2
2	B	111	LYS	2.2
2	B	128	ILE	2.2

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Mol	Chain	Res	Type	RSRZ
2	B	106	THR	2.2
2	B	110	ALA	2.2
1	A	658	LYS	2.2
1	A	412	VAL	2.2
1	A	545	PHE	2.2
1	A	843	LEU	2.2
1	A	142	THR	2.2
1	A	599	ILE	2.1
1	A	697	ASP	2.1
1	A	591	GLY	2.1
1	A	930	VAL	2.1
1	A	950	PHE	2.1
1	A	673	ALA	2.1
1	A	42	TRP	2.1
1	A	994	GLU	2.1
1	A	138	ASP	2.1
1	A	196	THR	2.1
1	A	665	ALA	2.1
1	A	861	ALA	2.1
1	A	870	ALA	2.1
1	A	654	GLU	2.1
1	A	151	VAL	2.1
2	B	94	VAL	2.1
1	A	669	LYS	2.1
2	B	133	LYS	2.1
1	A	917	ALA	2.0
1	A	844	GLU	2.0
2	B	134	ARG	2.0
1	A	700	VAL	2.0
2	B	95	VAL	2.0
1	A	797	GLY	2.0
1	A	657	ALA	2.0
2	B	86	ALA	2.0
2	B	102	ALA	2.0

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

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($Å^2$)	Q<0.9
10	PEG	B	305	7/7	0.73	0.21	46,50,53,53	0
7	GOL	A	1108	6/6	0.78	0.16	39,41,44,46	0
7	GOL	B	304	6/6	0.81	0.14	32,38,40,42	0
8	PGE	A	1107	10/10	0.83	0.16	50,51,53,53	0
9	EDO	A	1109	4/4	0.85	0.17	42,44,44,45	0
7	GOL	A	1111	6/6	0.88	0.14	34,36,37,37	0
7	GOL	A	1110	6/6	0.89	0.11	33,34,35,35	0
7	GOL	A	1106	6/6	0.89	0.10	34,34,35,36	0
9	EDO	B	306	4/4	0.90	0.12	39,39,40,40	0
3	MGD	A	1102	47/47	0.97	0.06	19,23,28,29	0
4	SF4	B	302	8/8	0.97	0.05	40,41,44,46	0
5	H2S	A	1104	1/1	0.97	0.13	27,27,27,27	0
3	MGD	A	1101	47/47	0.97	0.06	16,17,21,23	0
4	SF4	B	303	8/8	0.98	0.04	32,33,34,36	0
4	SF4	A	1103	8/8	0.99	0.03	17,18,19,20	0
4	SF4	B	301	8/8	0.99	0.03	21,23,23,23	0
6	W	A	1105	1/1	1.00	0.01	21,21,21,21	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.
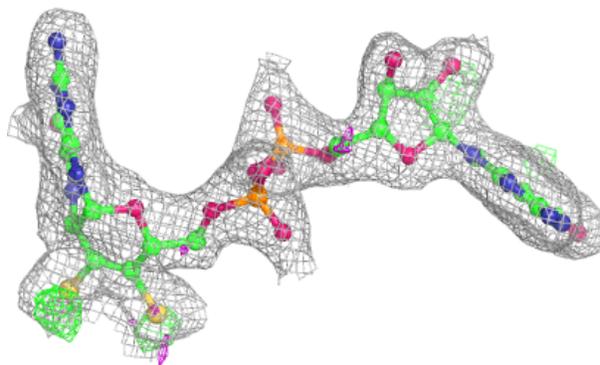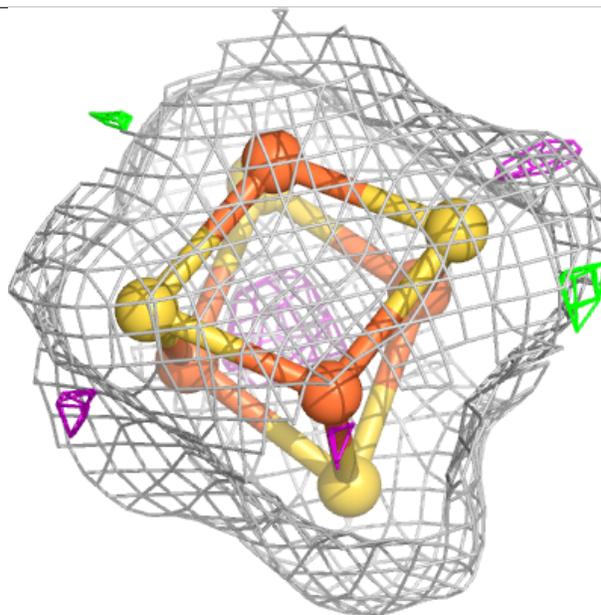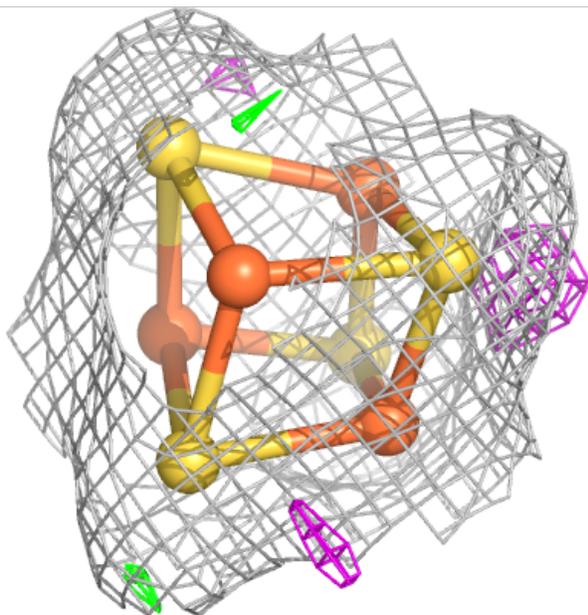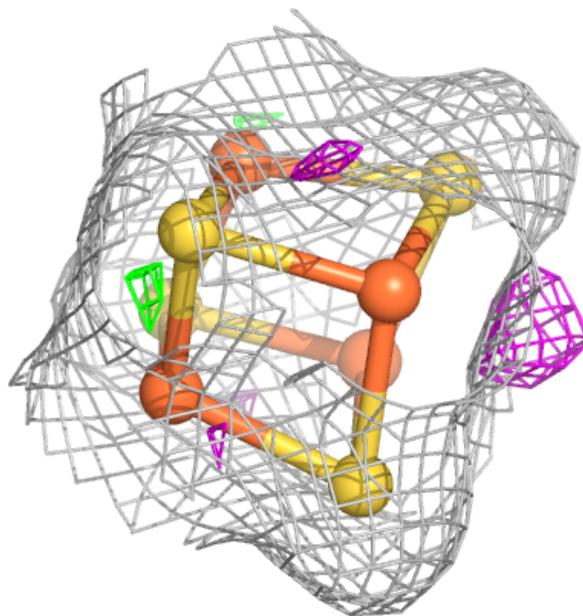
Electron density around MGD A 1102:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
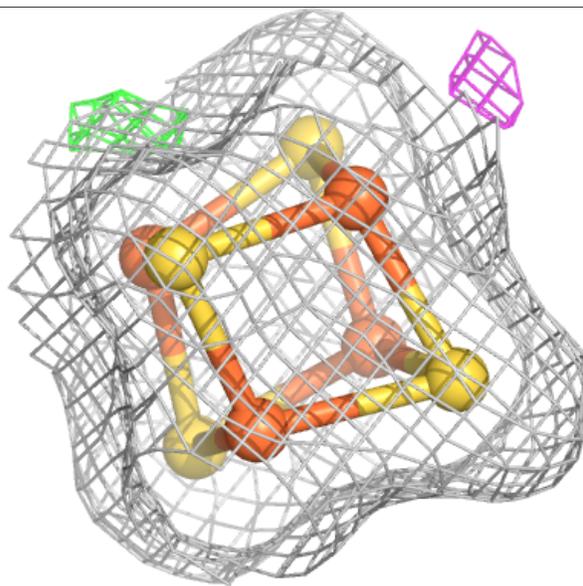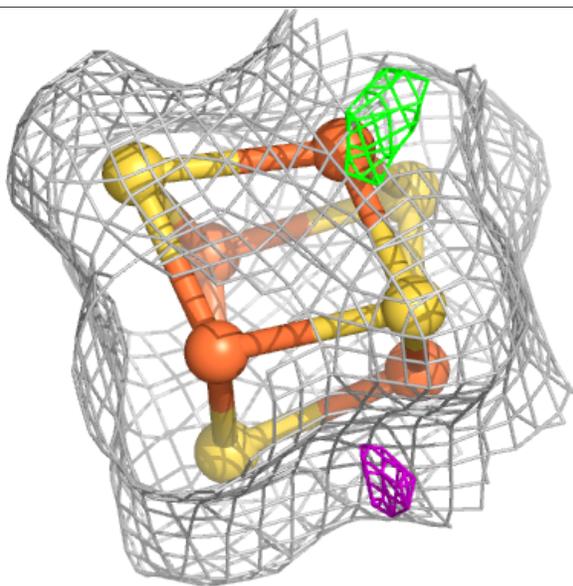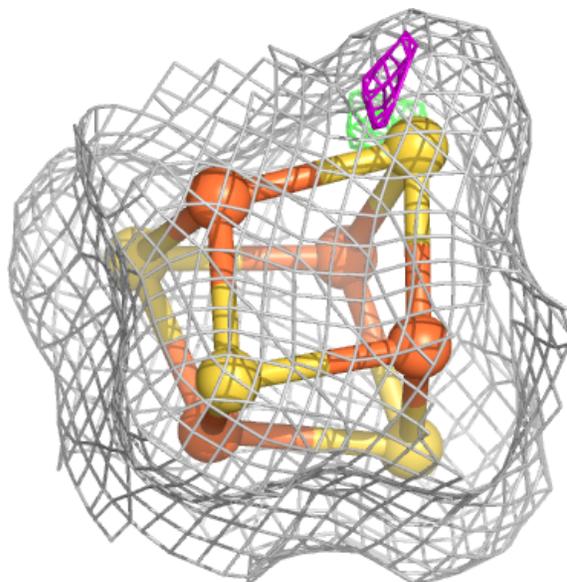mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
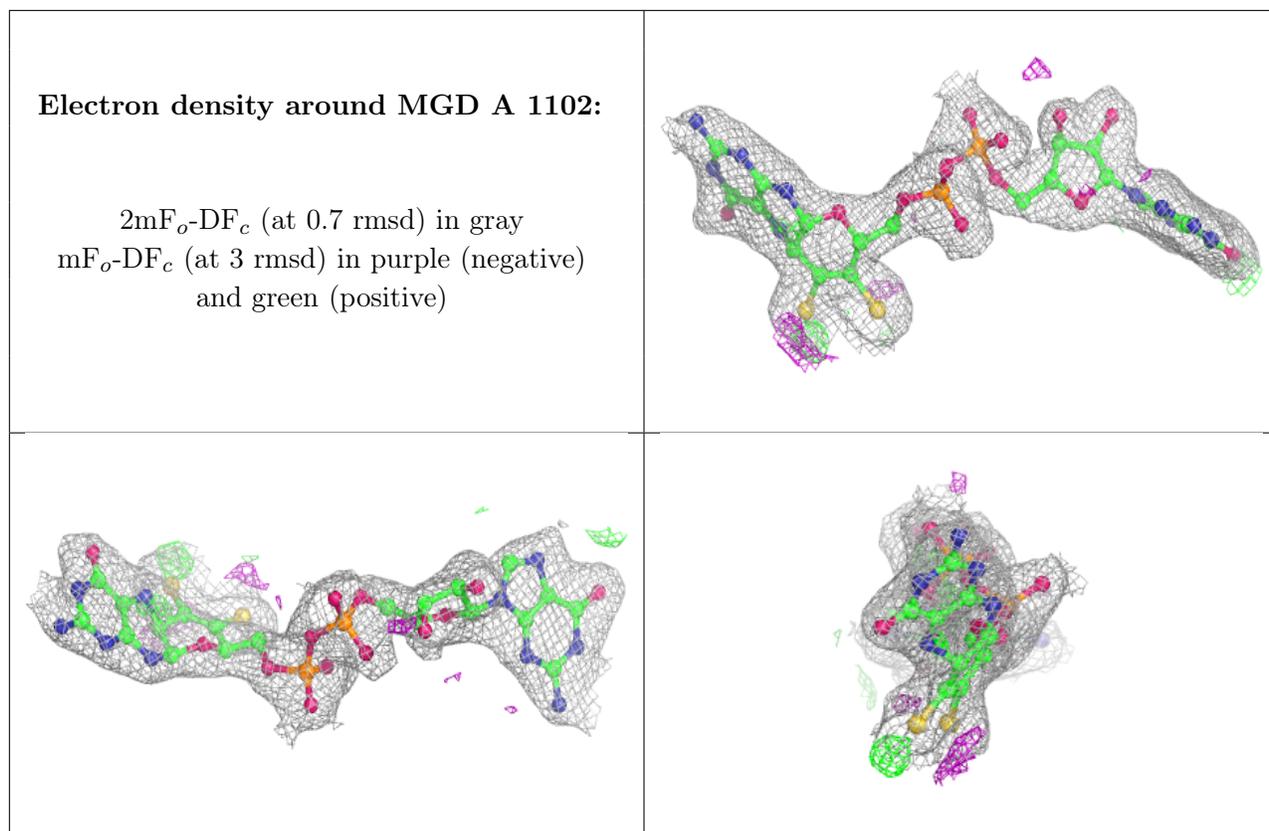
Electron density around SF4 B 302:

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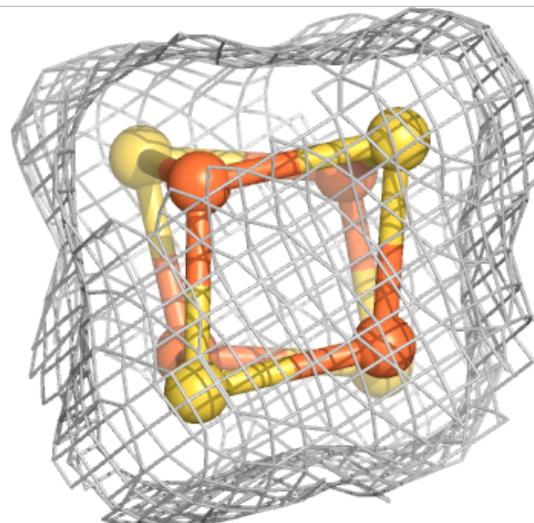and green (positive)

Electron density around H2S A 1104:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
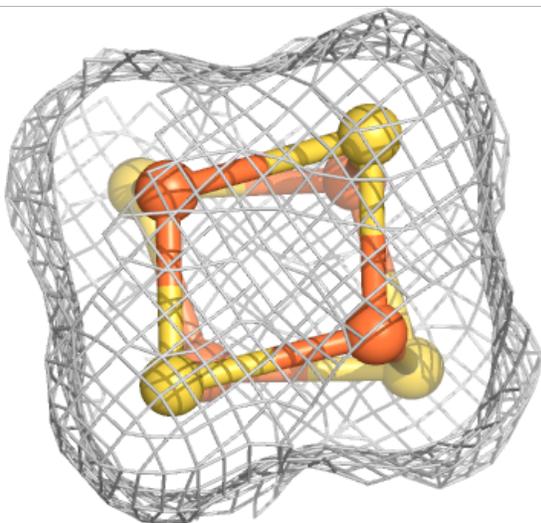$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)
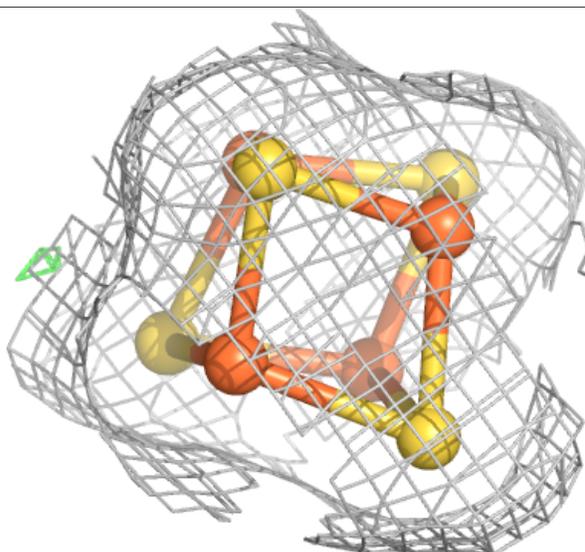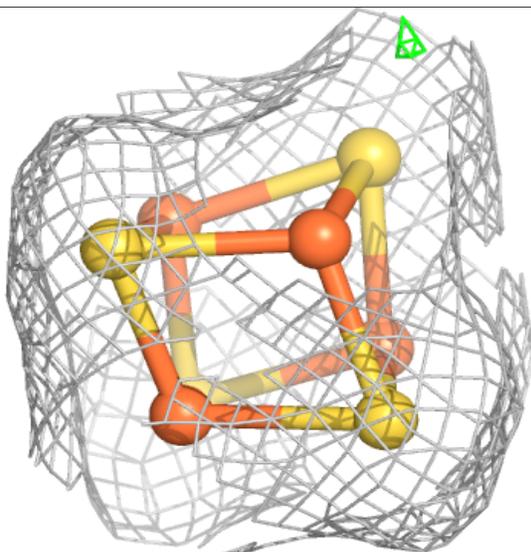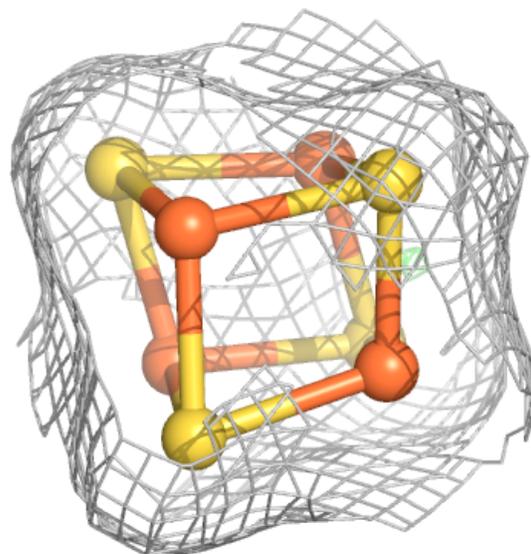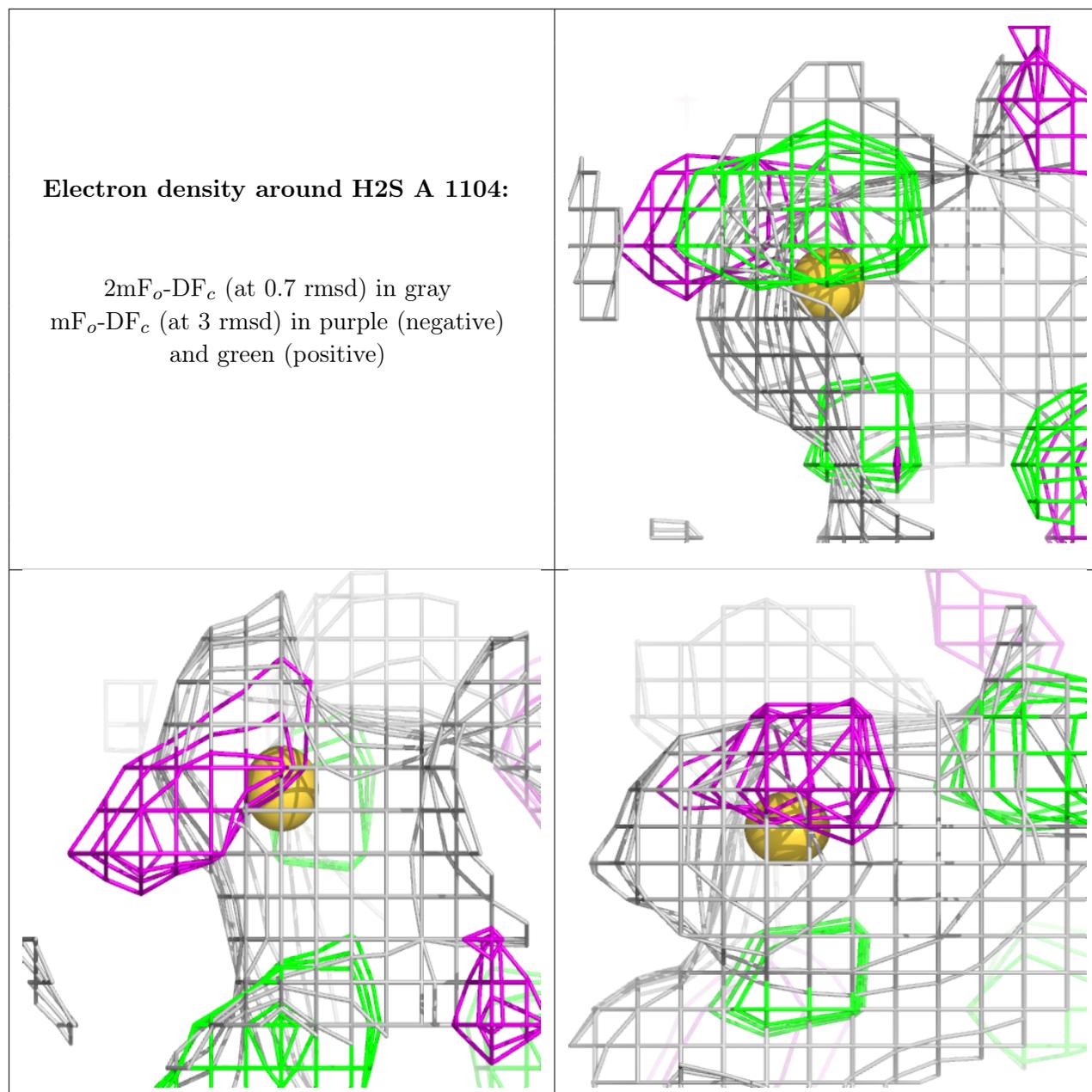
Electron density around MGD A 1101:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)
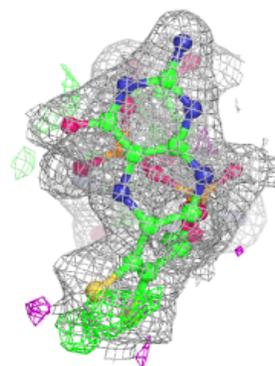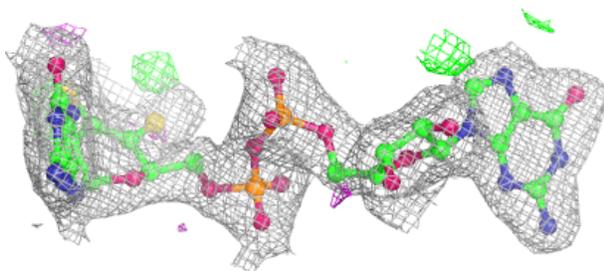
Electron density around SF4 B 303:

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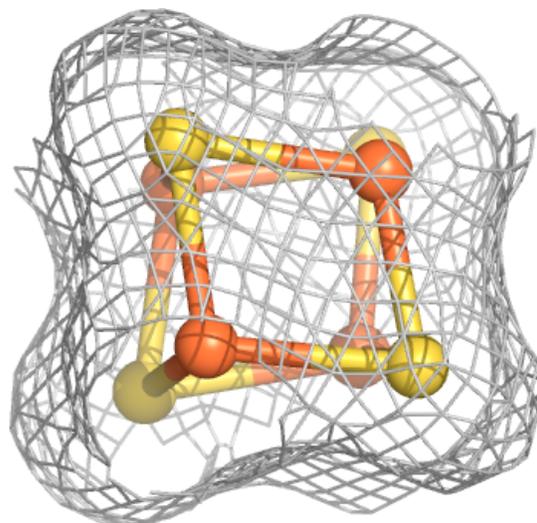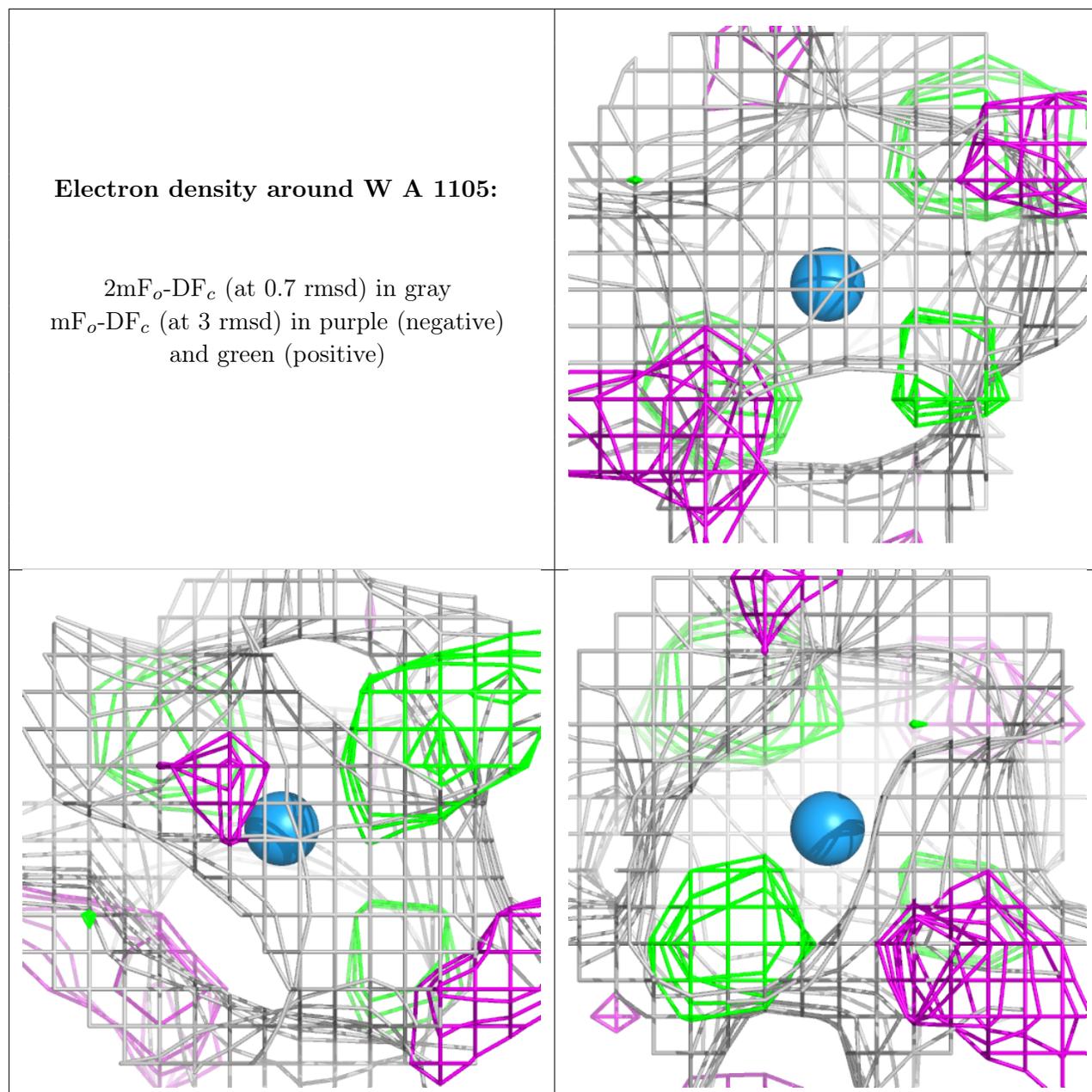mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around W A 1105:

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

6.5 Other polymers ⓘ

There are no such residues in this entry.