



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 15, 2026 – 04:32 pm BST

PDB ID : 9SVN / pdb_00009svn
Title : Structure of dihydrofolate reductase from *Burkholderia thailandensis* (I99L variant) complexed with trimethoprim and dihydrofolate
Authors : Mechulam, Y.; Schmitt, E.; Lazennec-Schurdevin, C.
Deposited on : 2025-10-03
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 Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

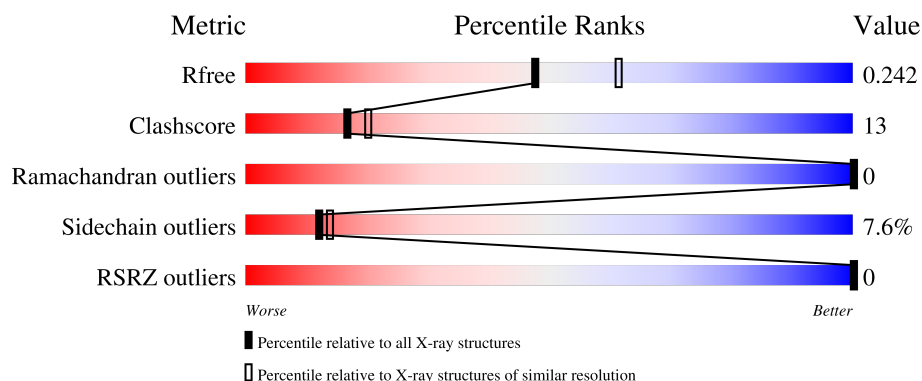
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 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 $\leq 5\%$. 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	169	
1	B	169	
1	C	169	
1	D	169	
1	E	169	

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
4	SO4	C	206	-	X	X	-

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 7104 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.

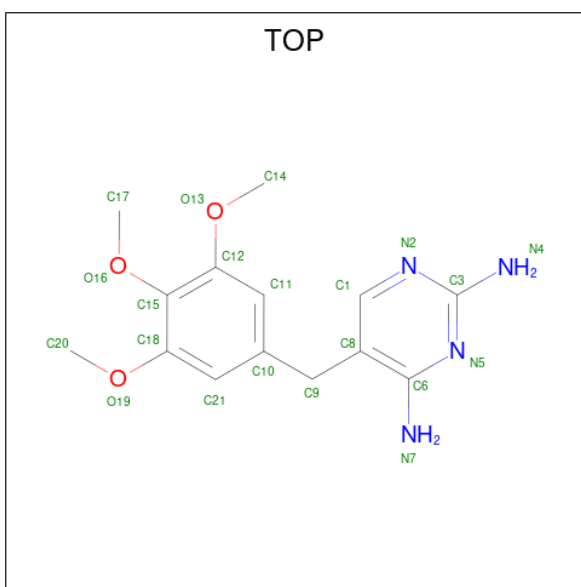
- Molecule 1 is a protein called Dihydrofolate reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	167	Total	C	N	O	S	0	0	0
			1291	808	244	235	4			
1	B	167	Total	C	N	O	S	0	0	0
			1291	808	244	235	4			
1	C	167	Total	C	N	O	S	0	0	0
			1291	808	244	235	4			
1	D	164	Total	C	N	O	S	0	0	0
			1270	796	238	232	4			
1	E	164	Total	C	N	O	S	0	0	0
			1270	796	238	232	4			

There are 15 discrepancies between the modelled and reference sequences:

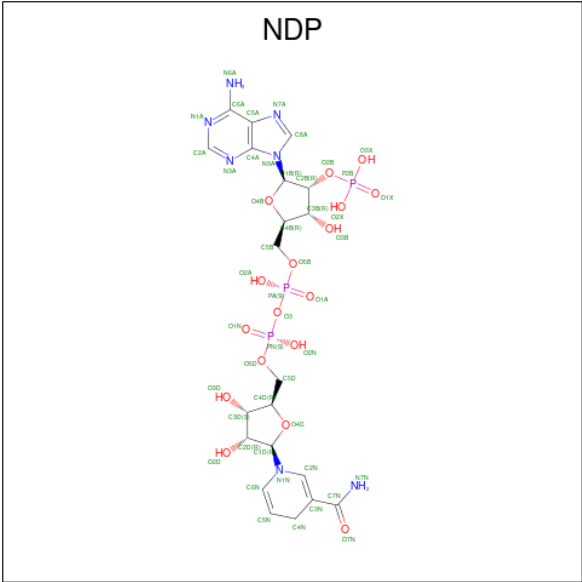
Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	expression tag	UNP A0AAW9D207
A	0	SER	-	expression tag	UNP A0AAW9D207
A	99	LEU	ILE	engineered mutation	UNP A0AAW9D207
B	-1	GLY	-	expression tag	UNP A0AAW9D207
B	0	SER	-	expression tag	UNP A0AAW9D207
B	99	LEU	ILE	engineered mutation	UNP A0AAW9D207
C	-1	GLY	-	expression tag	UNP A0AAW9D207
C	0	SER	-	expression tag	UNP A0AAW9D207
C	99	LEU	ILE	engineered mutation	UNP A0AAW9D207
D	-1	GLY	-	expression tag	UNP A0AAW9D207
D	0	SER	-	expression tag	UNP A0AAW9D207
D	99	LEU	ILE	engineered mutation	UNP A0AAW9D207
E	-1	GLY	-	expression tag	UNP A0AAW9D207
E	0	SER	-	expression tag	UNP A0AAW9D207
E	99	LEU	ILE	engineered mutation	UNP A0AAW9D207

- Molecule 2 is TRIMETHOPRIM (CCD ID: TOP) (formula: C₁₄H₁₈N₄O₃) (labeled as "Ligand of Interest" by depositor).



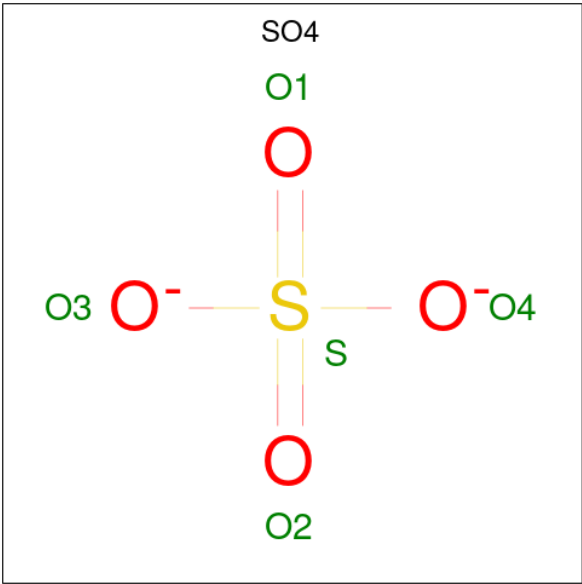
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			21	14	4	3		
2	B	1	Total	C	N	O	0	0
			21	14	4	3		
2	C	1	Total	C	N	O	0	0
			21	14	4	3		
2	D	1	Total	C	N	O	0	0
			21	14	4	3		
2	E	1	Total	C	N	O	0	0
			21	14	4	3		

- Molecule 3 is NADPH DIHYDRO-NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (CCD ID: NDP) (formula: C₂₁H₃₀N₇O₁₇P₃) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
3	B	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
3	C	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
3	D	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
3	E	1	Total	C	N	O	P	0	0
			48	21	7	17	3		

- Molecule 4 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total O S 5 4 1	0	0
4	A	1	Total O S 5 4 1	0	0
4	B	1	Total O S 5 4 1	0	0
4	C	1	Total O S 5 4 1	0	0
4	C	1	Total O S 5 4 1	0	0
4	C	1	Total O S 5 4 1	0	0
4	C	1	Total O S 5 4 1	0	0
4	D	1	Total O S 5 4 1	0	0
4	E	1	Total O S 5 4 1	0	0
4	E	1	Total O S 5 4 1	0	0
4	E	1	Total O S 5 4 1	0	0

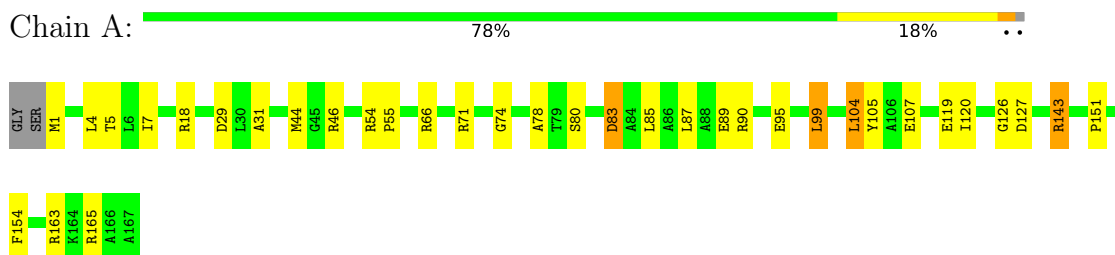
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	87	Total O 87 87	0	0
5	B	38	Total O 38 38	0	0
5	C	67	Total O 67 67	0	0
5	D	42	Total O 42 42	0	0
5	E	57	Total O 57 57	0	0

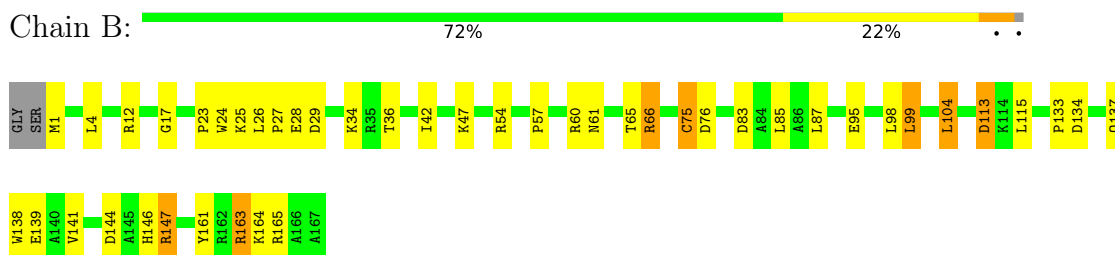
3 Residue-property plots

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.

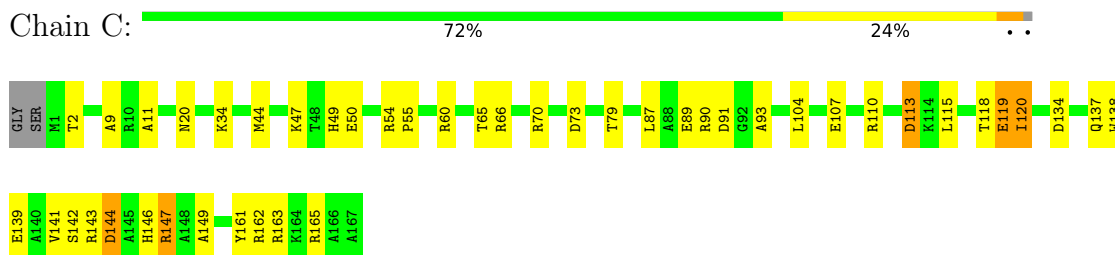
- Molecule 1: Dihydrofolate reductase



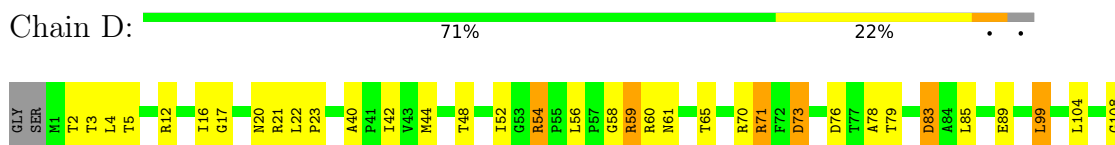
- Molecule 1: Dihydrofolate reductase



- Molecule 1: Dihydrofolate reductase



- Molecule 1: Dihydrofolate reductase





● Molecule 1: Dihydrofolate reductase



4 Data and refinement statistics

Property	Value	Source
Space group	P 3 1 2	Depositor
Cell constants a, b, c, α , β , γ	118.31Å 118.31Å 146.03Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.68 – 2.19 48.68 – 2.19	Depositor EDS
% Data completeness (in resolution range)	99.8 (48.68-2.19) 99.9 (48.68-2.19)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.11 (at 2.20Å)	Xtriage
Refinement program	PHENIX 1.18.2_3874	Depositor
R, R_{free}	0.217 , 0.247 0.211 , 0.242	Depositor DCC
R_{free} test set	3001 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	54.5	Xtriage
Anisotropy	0.235	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 26.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.479 for -h,-k,l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	7104	wwPDB-VP
Average B, all atoms (Å ²)	48.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.84% 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: SO4, NDP, TOP

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	0.34	0/1318	0.49	0/1786
1	B	0.31	0/1318	0.47	0/1786
1	C	0.30	0/1318	0.47	0/1786
1	D	0.30	0/1297	0.49	0/1758
1	E	0.30	0/1297	0.50	0/1758
All	All	0.31	0/6548	0.48	0/8874

There are no bond length outliers.

There are no bond angle outliers.

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	1291	0	1284	31	0
1	B	1291	0	1283	32	0
1	C	1291	0	1284	35	0
1	D	1270	0	1260	38	0
1	E	1270	0	1260	27	0
2	A	21	0	18	1	0
2	B	21	0	18	1	0
2	C	21	0	18	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	D	21	0	18	2	0
2	E	21	0	18	1	0
3	A	48	0	26	7	0
3	B	48	0	26	3	0
3	C	48	0	26	3	0
3	D	48	0	24	3	0
3	E	48	0	24	7	0
4	A	10	0	0	1	0
4	B	5	0	0	0	0
4	C	20	0	0	3	10
4	D	5	0	0	0	0
4	E	15	0	0	1	0
5	A	87	0	0	17	0
5	B	38	0	0	11	0
5	C	67	0	0	20	4
5	D	42	0	0	20	1
5	E	57	0	0	12	0
All	All	7104	0	6587	171	13

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 13.

All (171) 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:D:162:ARG:NH2	5:D:302:HOH:O	1.88	1.05
1:C:149:ALA:O	5:C:301:HOH:O	1.80	0.99
1:A:1:MET:SD	5:A:387:HOH:O	2.26	0.93
1:A:55:PRO:O	5:A:301:HOH:O	1.86	0.92
1:A:165:ARG:NH2	5:A:304:HOH:O	2.03	0.91
1:D:5:THR:OG1	5:D:301:HOH:O	1.87	0.91
1:C:44:MET:SD	5:C:351:HOH:O	2.34	0.86
1:E:30:LEU:O	5:E:301:HOH:O	1.93	0.85
1:C:50:GLU:OE1	5:C:303:HOH:O	1.96	0.83
1:B:75:CYS:O	5:B:302:HOH:O	1.96	0.81
1:E:89:GLU:OE2	5:E:302:HOH:O	2.01	0.79
1:C:66:ARG:NH2	5:C:310:HOH:O	2.12	0.79
1:D:2:THR:O	5:D:303:HOH:O	1.99	0.78
1:E:44:MET:SD	5:E:327:HOH:O	2.41	0.78
1:A:71:ARG:NE	5:A:309:HOH:O	2.14	0.77
1:B:95:GLU:O	5:B:303:HOH:O	2.01	0.77

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:125:GLU:OE1	5:E:304:HOH:O	2.03	0.76
1:C:162:ARG:NE	5:C:308:HOH:O	2.10	0.75
1:D:112:ALA:N	5:D:309:HOH:O	2.19	0.74
1:B:36:THR:O	5:B:304:HOH:O	2.04	0.74
1:C:142:SER:OG	5:C:304:HOH:O	2.06	0.73
1:A:74:GLY:O	5:A:305:HOH:O	2.07	0.72
1:C:113:ASP:OD2	5:C:305:HOH:O	2.06	0.72
1:C:146:HIS:ND1	4:C:206:SO4:O3	2.22	0.71
1:E:19:ASP:OD2	1:E:21:ARG:NH2	2.24	0.71
1:D:4:LEU:HD13	1:D:85:LEU:HD21	1.72	0.71
1:C:147:ARG:O	5:C:306:HOH:O	2.09	0.71
1:A:66:ARG:O	5:A:306:HOH:O	2.08	0.70
1:C:146:HIS:NE2	5:C:312:HOH:O	2.24	0.70
1:E:18:ARG:NH2	5:E:308:HOH:O	2.25	0.69
1:C:20:ASN:OD1	5:C:309:HOH:O	2.11	0.69
1:C:144:ASP:OD1	5:C:307:HOH:O	2.10	0.68
1:D:54:ARG:N	5:D:311:HOH:O	2.27	0.68
1:D:59:ARG:O	5:D:304:HOH:O	2.12	0.68
1:C:139:GLU:OE2	5:C:308:HOH:O	2.11	0.68
5:A:303:HOH:O	3:E:202:NDP:O3B	2.10	0.68
1:C:115:LEU:HB2	1:C:161:TYR:HB2	1.77	0.67
1:B:144:ASP:OD1	1:B:146:HIS:NE2	2.28	0.67
1:D:12:ARG:NH2	5:D:312:HOH:O	2.28	0.66
1:C:34:LYS:NZ	5:C:313:HOH:O	2.29	0.66
3:A:202:NDP:O3B	5:A:308:HOH:O	2.14	0.66
2:B:201:TOP:H91	3:B:202:NDP:H42N	1.76	0.66
1:A:44:MET:HE2	1:A:99:LEU:HD21	1.78	0.65
1:A:54:ARG:NH1	4:A:204:SO4:O1	2.24	0.65
1:B:139:GLU:HB3	1:B:164:LYS:HD3	1.78	0.65
1:C:54:ARG:NH1	4:C:203:SO4:O3	2.30	0.64
1:D:149:ALA:O	5:D:306:HOH:O	2.15	0.64
1:A:107:GLU:OE1	3:A:202:NDP:N6A	2.31	0.64
1:A:119:GLU:OE1	5:A:310:HOH:O	2.16	0.63
1:A:4:LEU:HD13	1:A:85:LEU:HD21	1.81	0.63
1:D:52:ILE:HG22	5:D:311:HOH:O	1.98	0.62
1:B:57:PRO:HG2	5:B:308:HOH:O	1.99	0.62
1:E:16:ILE:O	3:E:202:NDP:H2N	2.00	0.62
1:E:13:ASN:HB3	1:E:123:ASP:OD1	2.00	0.61
1:E:60:ARG:NH2	1:E:76:ASP:OD2	2.32	0.61
1:B:163:ARG:O	1:B:165:ARG:NH1	2.34	0.61
1:D:71:ARG:O	5:D:307:HOH:O	2.15	0.61

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:24:TRP:O	5:B:305:HOH:O	2.16	0.61
1:C:11:ALA:HA	1:C:120:ILE:HB	1.83	0.61
1:D:44:MET:HE2	1:D:99:LEU:HD21	1.82	0.60
1:A:7:ILE:O	1:A:105:TYR:OH	2.18	0.60
1:D:40:ALA:O	1:D:59:ARG:HB3	1.99	0.60
1:B:17:GLY:HA2	1:B:23:PRO:HD3	1.84	0.59
1:B:60:ARG:NH2	1:B:76:ASP:OD2	2.35	0.59
1:B:163:ARG:NH2	5:B:307:HOH:O	2.36	0.59
1:D:108:GLY:C	5:D:309:HOH:O	2.45	0.59
1:E:49:HIS:HA	5:E:327:HOH:O	2.02	0.59
1:C:119:GLU:OE1	1:C:143:ARG:NH1	2.33	0.58
1:C:162:ARG:NH1	5:C:308:HOH:O	2.36	0.57
1:D:20:ASN:O	5:D:308:HOH:O	2.16	0.57
1:B:4:LEU:HD13	1:B:85:LEU:HD21	1.86	0.57
1:C:2:THR:OG1	1:C:93:ALA:O	2.17	0.57
1:D:73:ASP:OD1	1:D:73:ASP:N	2.19	0.57
4:C:206:SO4:O4	5:C:306:HOH:O	2.16	0.57
1:A:107:GLU:CD	3:A:202:NDP:N6A	2.64	0.56
2:E:201:TOP:H91	3:E:202:NDP:H42N	1.87	0.56
1:C:20:ASN:HA	3:C:202:NDP:H3D	1.87	0.56
1:C:144:ASP:CG	5:C:307:HOH:O	2.49	0.55
1:C:70:ARG:NH2	5:C:302:HOH:O	1.90	0.55
1:A:151:PRO:HA	5:A:314:HOH:O	2.07	0.54
1:D:59:ARG:N	5:D:304:HOH:O	2.05	0.54
1:B:34:LYS:NZ	5:B:308:HOH:O	2.42	0.53
2:D:201:TOP:H91	3:D:202:NDP:H42N	1.90	0.53
1:C:162:ARG:CZ	5:C:308:HOH:O	2.56	0.53
1:E:1:MET:HG3	5:E:302:HOH:O	2.08	0.53
1:A:5:THR:OG1	1:A:95:GLU:OE1	2.22	0.52
1:C:65:THR:OG1	3:C:202:NDP:O2X	2.25	0.52
1:D:56:LEU:O	5:D:304:HOH:O	2.19	0.52
1:C:134:ASP:HB3	1:C:137:GLN:HB2	1.91	0.52
1:E:79:THR:O	3:E:202:NDP:H2A	2.10	0.52
1:E:147:ARG:O	5:E:305:HOH:O	2.19	0.52
1:D:16:ILE:O	3:D:202:NDP:H2N	2.10	0.52
1:D:65:THR:O	1:D:79:THR:HA	2.10	0.52
1:A:143:ARG:NH1	5:A:310:HOH:O	2.42	0.52
1:B:133:PRO:HG2	1:B:161:TYR:CE2	2.45	0.51
1:B:54:ARG:NH1	5:B:301:HOH:O	1.94	0.51
2:A:201:TOP:H91	3:A:202:NDP:H42N	1.93	0.51
1:B:61:ASN:O	1:B:75:CYS:HB3	2.13	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:80:SER:OG	1:A:83:ASP:HB2	2.13	0.49
1:A:90:ARG:HH12	1:C:90:ARG:HH12	1.59	0.49
1:A:151:PRO:C	5:A:314:HOH:O	2.55	0.49
1:C:9:ALA:HA	1:C:118:THR:HB	1.94	0.49
1:B:98:LEU:HD11	1:B:104:LEU:HB3	1.94	0.49
1:D:52:ILE:C	5:D:311:HOH:O	2.56	0.49
1:A:107:GLU:CD	3:A:202:NDP:H62A	2.21	0.48
1:A:163:ARG:O	1:A:165:ARG:NH1	2.46	0.48
1:B:134:ASP:HB3	1:B:137:GLN:HB2	1.95	0.48
1:C:138:TRP:HB3	1:C:161:TYR:HB3	1.94	0.48
1:B:138:TRP:HB3	1:B:161:TYR:HB3	1.95	0.48
1:D:146:HIS:HB2	1:D:156:TYR:CZ	2.49	0.48
1:C:55:PRO:HD3	5:C:314:HOH:O	2.13	0.48
1:D:48:THR:O	1:D:52:ILE:HG13	2.14	0.48
1:C:49:HIS:HA	5:C:351:HOH:O	2.14	0.47
1:E:49:HIS:HE1	4:E:205:SO4:O2	1.97	0.47
1:D:42:ILE:HD11	1:D:61:ASN:ND2	2.30	0.47
1:D:156:TYR:OH	5:D:305:HOH:O	2.12	0.47
1:A:18:ARG:HB2	1:A:126:GLY:HA2	1.96	0.47
1:A:71:ARG:NH1	5:A:302:HOH:O	1.95	0.47
1:D:17:GLY:HA2	1:D:23:PRO:HD3	1.97	0.47
1:B:165:ARG:NH2	5:B:310:HOH:O	2.48	0.46
1:A:78:ALA:HB1	1:A:83:ASP:HB3	1.97	0.46
1:E:2:THR:HA	5:E:320:HOH:O	2.16	0.46
1:E:65:THR:OG1	3:E:202:NDP:O2X	2.25	0.46
1:C:60:ARG:NE	1:C:91:ASP:OD2	2.49	0.45
1:B:47:LYS:HB3	1:B:47:LYS:HE3	1.79	0.45
1:B:25:LYS:O	1:B:27:PRO:HD3	2.16	0.45
1:A:31:ALA:HB1	5:A:366:HOH:O	2.16	0.45
1:A:127:ASP:OD1	5:A:311:HOH:O	2.21	0.45
1:D:20:ASN:HA	3:D:202:NDP:H3D	1.99	0.45
1:D:78:ALA:HB1	1:D:83:ASP:HB3	2.00	0.44
1:B:42:ILE:HB	1:B:99:LEU:CD2	2.48	0.44
1:B:26:LEU:HD23	1:B:29:ASP:HB2	1.99	0.44
2:C:201:TOP:H91	3:C:202:NDP:H42N	2.00	0.44
1:D:60:ARG:NE	1:D:76:ASP:OD2	2.51	0.44
1:C:65:THR:O	1:C:79:THR:HA	2.18	0.43
1:E:60:ARG:NE	5:E:319:HOH:O	2.50	0.43
1:D:56:LEU:HB2	1:D:61:ASN:HD21	1.83	0.43
1:B:54:ARG:HD2	5:B:301:HOH:O	2.18	0.43
1:E:133:PRO:HG2	1:E:161:TYR:CZ	2.54	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:164:LYS:HD2	1:B:165:ARG:H	1.83	0.43
2:D:201:TOP:H141	5:D:308:HOH:O	2.18	0.43
1:E:54:ARG:NH1	1:E:56:LEU:HD23	2.34	0.43
1:B:113:ASP:HB3	5:B:336:HOH:O	2.18	0.42
1:A:80:SER:HB2	1:E:66:ARG:HH21	1.84	0.42
1:A:120:ILE:HG23	1:A:154:PHE:CE1	2.55	0.42
1:B:66:ARG:HG3	3:B:202:NDP:H2A	2.01	0.42
3:A:202:NDP:H2B	5:A:321:HOH:O	2.19	0.42
1:D:138:TRP:HB3	1:D:161:TYR:HB3	2.02	0.42
1:B:28:GLU:OE1	1:B:28:GLU:N	2.43	0.41
1:E:66:ARG:HD3	3:E:202:NDP:O1X	2.19	0.41
1:C:163:ARG:HB2	1:C:165:ARG:HH12	1.85	0.41
1:E:2:THR:HB	1:E:89:GLU:HG3	2.02	0.41
1:D:70:ARG:HD2	5:D:307:HOH:O	2.20	0.41
1:B:65:THR:HA	3:B:202:NDP:H1B	2.03	0.41
1:B:115:LEU:HG	1:B:138:TRP:CZ3	2.55	0.41
1:D:21:ARG:HA	5:D:308:HOH:O	2.20	0.41
1:E:80:SER:HB2	5:E:318:HOH:O	2.21	0.41
1:D:20:ASN:C	5:D:308:HOH:O	2.61	0.41
1:C:47:LYS:HB3	1:C:47:LYS:HE3	1.79	0.41
1:D:22:LEU:HA	1:D:23:PRO:HD3	1.96	0.41
1:D:42:ILE:HB	1:D:99:LEU:HD23	2.03	0.41
1:D:58:GLY:C	1:D:59:ARG:HG3	2.46	0.41
1:E:35:ARG:NE	5:E:307:HOH:O	2.25	0.41
1:A:46:ARG:HD3	3:A:202:NDP:O2X	2.21	0.40
1:E:12:ARG:HD3	1:E:121:ASP:OD1	2.22	0.40
1:E:114:LYS:HE2	1:E:116:ILE:HD11	2.03	0.40
1:A:104:LEU:HD23	1:A:104:LEU:HA	1.83	0.40
1:B:147:ARG:HD3	1:B:147:ARG:HA	1.92	0.40
1:E:104:LEU:HD22	3:E:202:NDP:C8A	2.51	0.40
1:A:29:ASP:OD2	5:A:312:HOH:O	2.22	0.40
1:D:162:ARG:HH21	1:D:162:ARG:HD3	1.76	0.40

All (13) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:C:206:SO4:O2	4:C:206:SO4:O3[6_556]	1.02	1.18
4:C:206:SO4:O1	4:C:206:SO4:O4[6_556]	1.20	1.00
4:C:206:SO4:S	4:C:206:SO4:O3[6_556]	1.47	0.73

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:C:206:SO4:S	4:C:206:SO4:O4[6_556]	1.48	0.72
4:C:206:SO4:S	4:C:206:SO4:O2[6_556]	1.48	0.72
4:C:206:SO4:S	4:C:206:SO4:O1[6_556]	1.49	0.71
4:C:206:SO4:O2	4:C:206:SO4:O2[6_556]	1.66	0.54
4:C:206:SO4:O1	4:C:206:SO4:O1[6_556]	1.85	0.35
4:C:206:SO4:O3	4:C:206:SO4:O4[6_556]	1.92	0.28
5:C:318:HOH:O	5:C:363:HOH:O[6_556]	2.01	0.19
5:C:346:HOH:O	5:D:332:HOH:O[5_656]	2.03	0.17
4:C:206:SO4:O2	5:C:306:HOH:O[6_556]	2.09	0.11
5:C:307:HOH:O	5:C:307:HOH:O[5_656]	2.19	0.01

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	165/169 (98%)	163 (99%)	2 (1%)	0	100	100
1	B	165/169 (98%)	163 (99%)	2 (1%)	0	100	100
1	C	165/169 (98%)	160 (97%)	5 (3%)	0	100	100
1	D	162/169 (96%)	158 (98%)	4 (2%)	0	100	100
1	E	162/169 (96%)	161 (99%)	1 (1%)	0	100	100
All	All	819/845 (97%)	805 (98%)	14 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	127/128 (99%)	121 (95%)	6 (5%)	23	31
1	B	127/128 (99%)	115 (91%)	12 (9%)	8	9
1	C	127/128 (99%)	115 (91%)	12 (9%)	8	9
1	D	126/128 (98%)	115 (91%)	11 (9%)	9	10
1	E	126/128 (98%)	119 (94%)	7 (6%)	19	24
All	All	633/640 (99%)	585 (92%)	48 (8%)	12	14

All (48) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	83	ASP
1	A	87	LEU
1	A	89	GLU
1	A	99	LEU
1	A	104	LEU
1	A	143	ARG
1	B	1	MET
1	B	12	ARG
1	B	66	ARG
1	B	75	CYS
1	B	83	ASP
1	B	87	LEU
1	B	99	LEU
1	B	104	LEU
1	B	113	ASP
1	B	141	VAL
1	B	147	ARG
1	B	163	ARG
1	C	73	ASP
1	C	87	LEU
1	C	89	GLU
1	C	104	LEU
1	C	107	GLU
1	C	110	ARG
1	C	113	ASP
1	C	119	GLU
1	C	120	ILE
1	C	141	VAL
1	C	144	ASP
1	C	147	ARG
1	D	3	THR

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Mol	Chain	Res	Type
1	D	54	ARG
1	D	59	ARG
1	D	71	ARG
1	D	73	ASP
1	D	83	ASP
1	D	89	GLU
1	D	99	LEU
1	D	104	LEU
1	D	110	ARG
1	D	141	VAL
1	E	1	MET
1	E	61	ASN
1	E	71	ARG
1	E	85	LEU
1	E	104	LEU
1	E	110	ARG
1	E	141	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	111	HIS
1	B	152	ASN
1	C	111	HIS
1	D	61	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 ⓘ

21 ligands are modelled in this entry.

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
2	TOP	A	201	-	22,22,22	0.18	0	30,30,30	0.32	0
4	SO4	E	205	-	4,4,4	0.23	0	6,6,6	0.31	0
4	SO4	C	203	-	4,4,4	0.40	0	6,6,6	0.19	0
3	NDP	B	202	-	49,52,52	0.71	1 (2%)	66,80,80	0.50	0
4	SO4	C	206	-	4,4,4	0.43	0	6,6,6	2.87	4 (66%)
2	TOP	C	201	-	22,22,22	0.19	0	30,30,30	0.25	0
3	NDP	D	202	-	49,52,52	0.30	0	66,80,80	0.50	0
2	TOP	E	201	-	22,22,22	0.18	0	30,30,30	0.27	0
3	NDP	A	202	-	49,52,52	0.39	0	66,80,80	0.62	1 (1%)
4	SO4	E	203	-	4,4,4	0.20	0	6,6,6	0.08	0
3	NDP	E	202	-	49,52,52	0.32	0	66,80,80	0.65	1 (1%)
3	NDP	C	202	-	49,52,52	0.46	1 (2%)	66,80,80	0.59	1 (1%)
4	SO4	A	204	-	4,4,4	0.29	0	6,6,6	0.14	0
4	SO4	B	203	-	4,4,4	0.28	0	6,6,6	0.42	0
4	SO4	D	203	-	4,4,4	0.14	0	6,6,6	0.59	0
4	SO4	A	203	-	4,4,4	0.08	0	6,6,6	0.27	0
4	SO4	C	205	-	4,4,4	0.17	0	6,6,6	0.20	0
4	SO4	E	204	-	4,4,4	0.19	0	6,6,6	0.23	0
2	TOP	D	201	-	22,22,22	0.19	0	30,30,30	0.30	0
4	SO4	C	204	-	4,4,4	0.15	0	6,6,6	0.12	0
2	TOP	B	201	-	22,22,22	0.20	0	30,30,30	0.33	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	NDP	A	202	-	-	3/34/77/77	0/5/5/5
3	NDP	B	202	-	-	3/34/77/77	0/5/5/5

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	TOP	C	201	-	-	0/10/10/10	0/2/2/2
3	NDP	E	202	-	-	4/34/77/77	0/5/5/5
3	NDP	D	202	-	-	6/34/77/77	0/5/5/5
2	TOP	D	201	-	-	0/10/10/10	0/2/2/2
2	TOP	A	201	-	-	0/10/10/10	0/2/2/2
3	NDP	C	202	-	-	5/34/77/77	0/5/5/5
2	TOP	E	201	-	-	3/10/10/10	0/2/2/2
2	TOP	B	201	-	-	1/10/10/10	0/2/2/2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	202	NDP	P2B-O1X	4.38	1.64	1.50
3	C	202	NDP	C7N-C3N	-2.16	1.44	1.48

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	C	206	SO4	O3-S-O2	-4.29	86.93	109.31
4	C	206	SO4	O3-S-O1	3.43	127.19	109.31
4	C	206	SO4	O4-S-O3	2.91	121.50	109.06
4	C	206	SO4	O4-S-O1	-2.78	94.80	109.31
3	C	202	NDP	PN-O3-PA	2.34	140.85	132.83
3	E	202	NDP	PN-O3-PA	2.08	139.96	132.83
3	A	202	NDP	PN-O3-PA	2.05	139.87	132.83

There are no chirality outliers.

All (25) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	D	202	NDP	C2B-O2B-P2B-O1X
3	D	202	NDP	PA-O3-PN-O5D
3	E	202	NDP	C3B-C4B-C5B-O5B
3	E	202	NDP	PA-O3-PN-O5D
2	E	201	TOP	C15-C12-O13-C14
2	E	201	TOP	C11-C12-O13-C14
3	E	202	NDP	O4B-C4B-C5B-O5B
3	A	202	NDP	PA-O3-PN-O5D
3	B	202	NDP	PA-O3-PN-O5D
3	C	202	NDP	PA-O3-PN-O5D

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Mol	Chain	Res	Type	Atoms
3	A	202	NDP	O4D-C1D-N1N-C2N
3	C	202	NDP	O4D-C1D-N1N-C2N
3	E	202	NDP	O4D-C1D-N1N-C2N
3	A	202	NDP	C5D-O5D-PN-O1N
3	C	202	NDP	C5D-O5D-PN-O1N
3	D	202	NDP	C3B-C2B-O2B-P2B
3	B	202	NDP	C3D-C4D-C5D-O5D
3	B	202	NDP	O4D-C1D-N1N-C2N
3	D	202	NDP	O4D-C1D-N1N-C2N
3	D	202	NDP	C1B-C2B-O2B-P2B
3	C	202	NDP	C2B-O2B-P2B-O2X
3	C	202	NDP	C5D-O5D-PN-O3
3	D	202	NDP	C2B-O2B-P2B-O3X
2	B	201	TOP	C15-C12-O13-C14
2	E	201	TOP	C15-C18-O19-C20

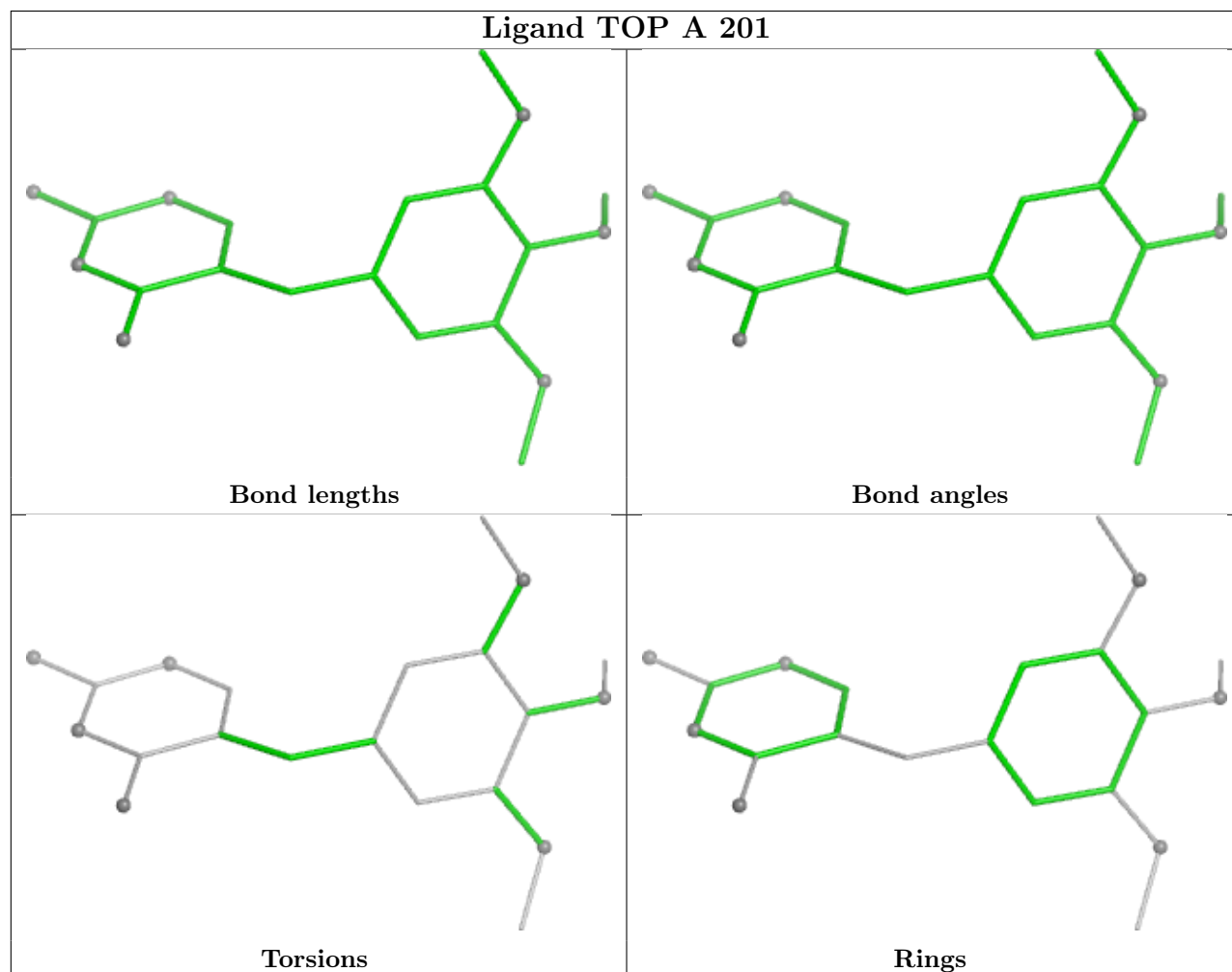
There are no ring outliers.

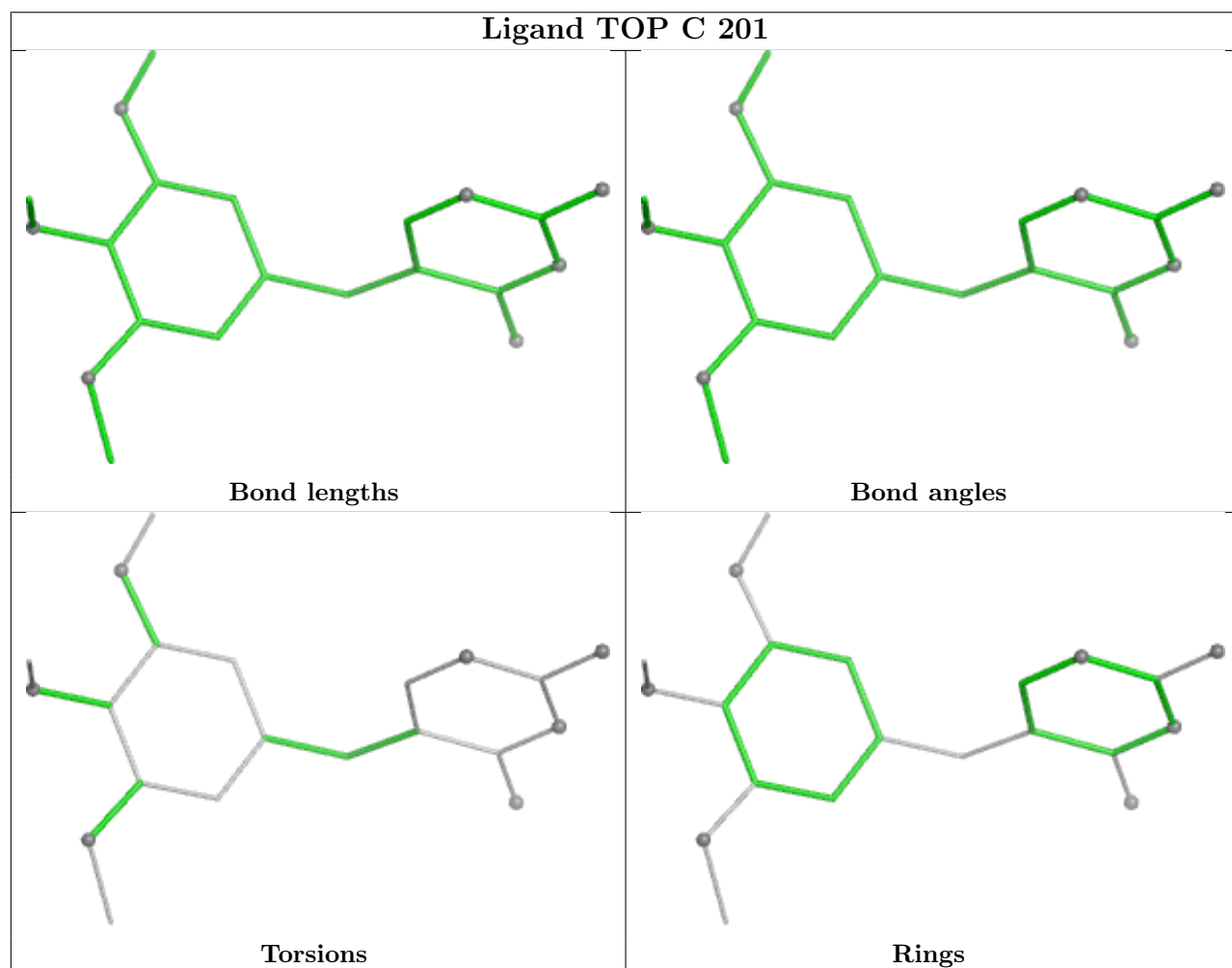
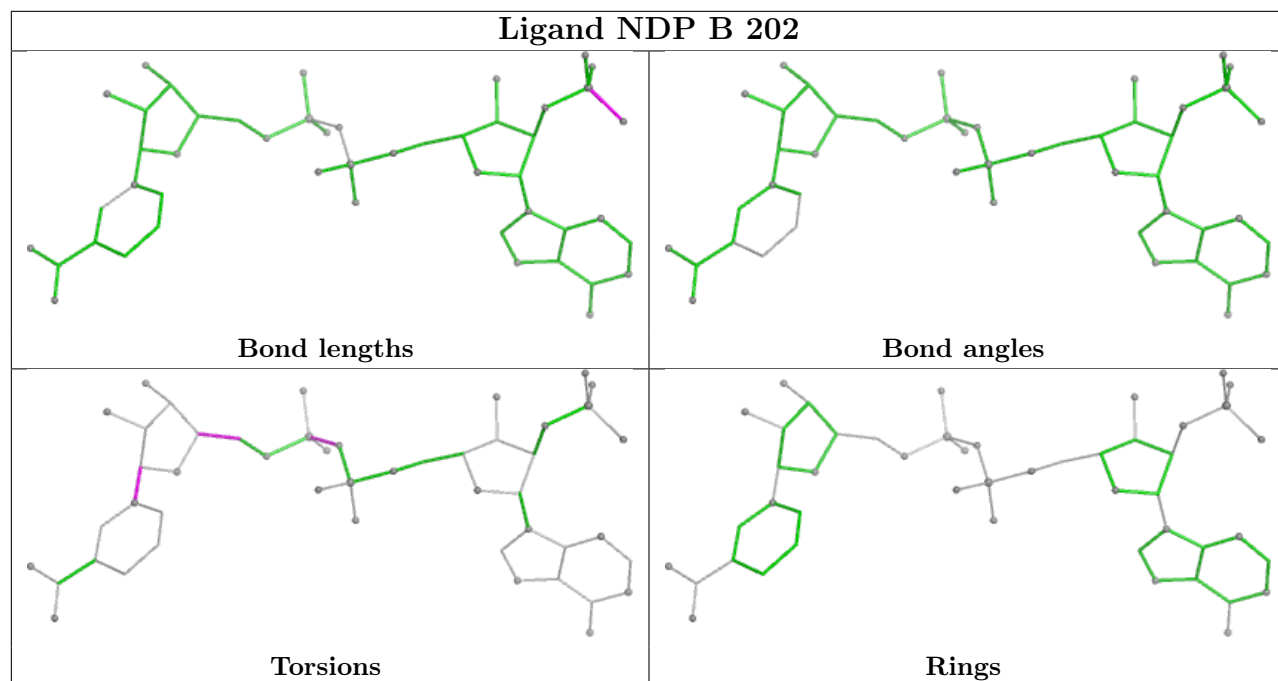
14 monomers are involved in 39 short contacts:

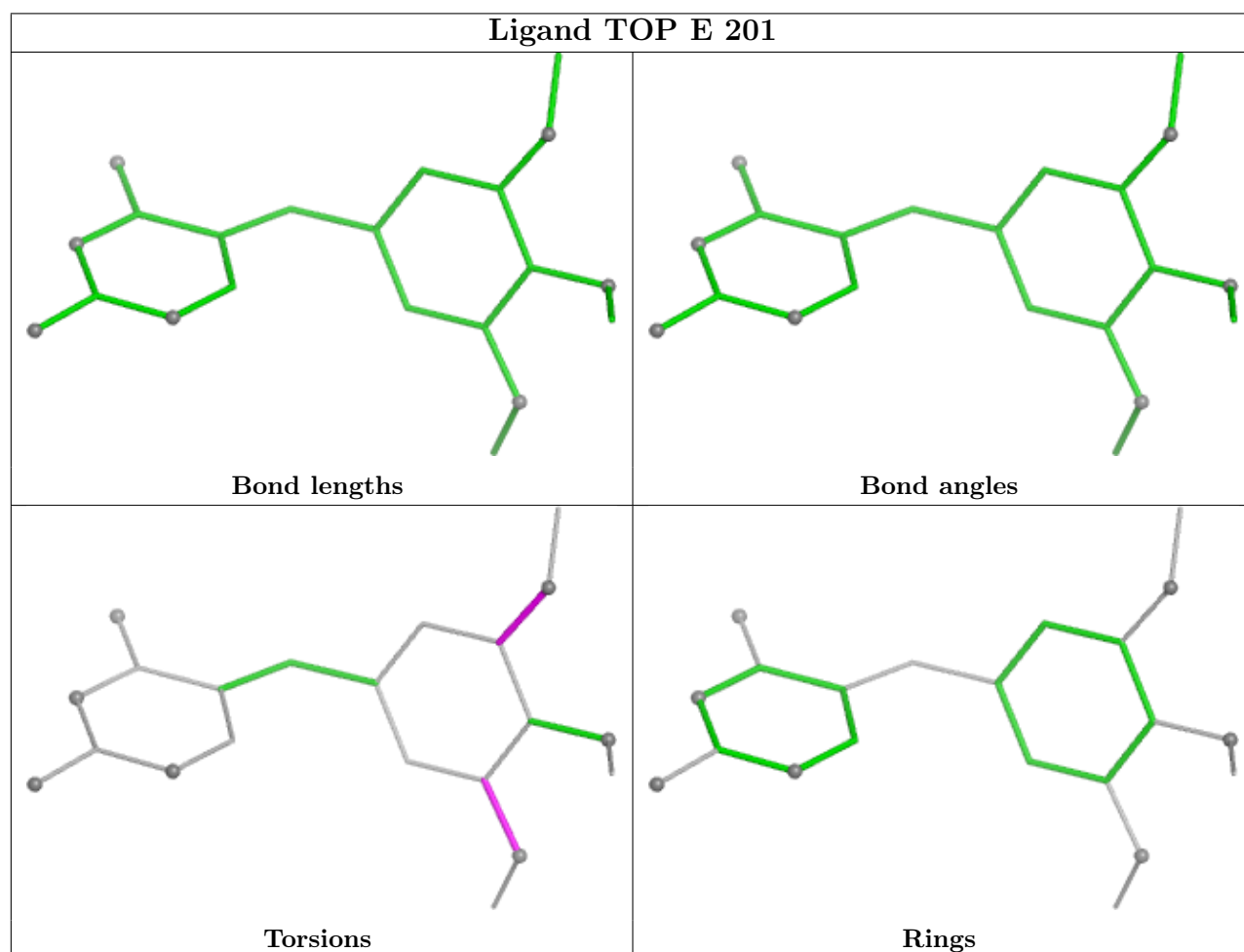
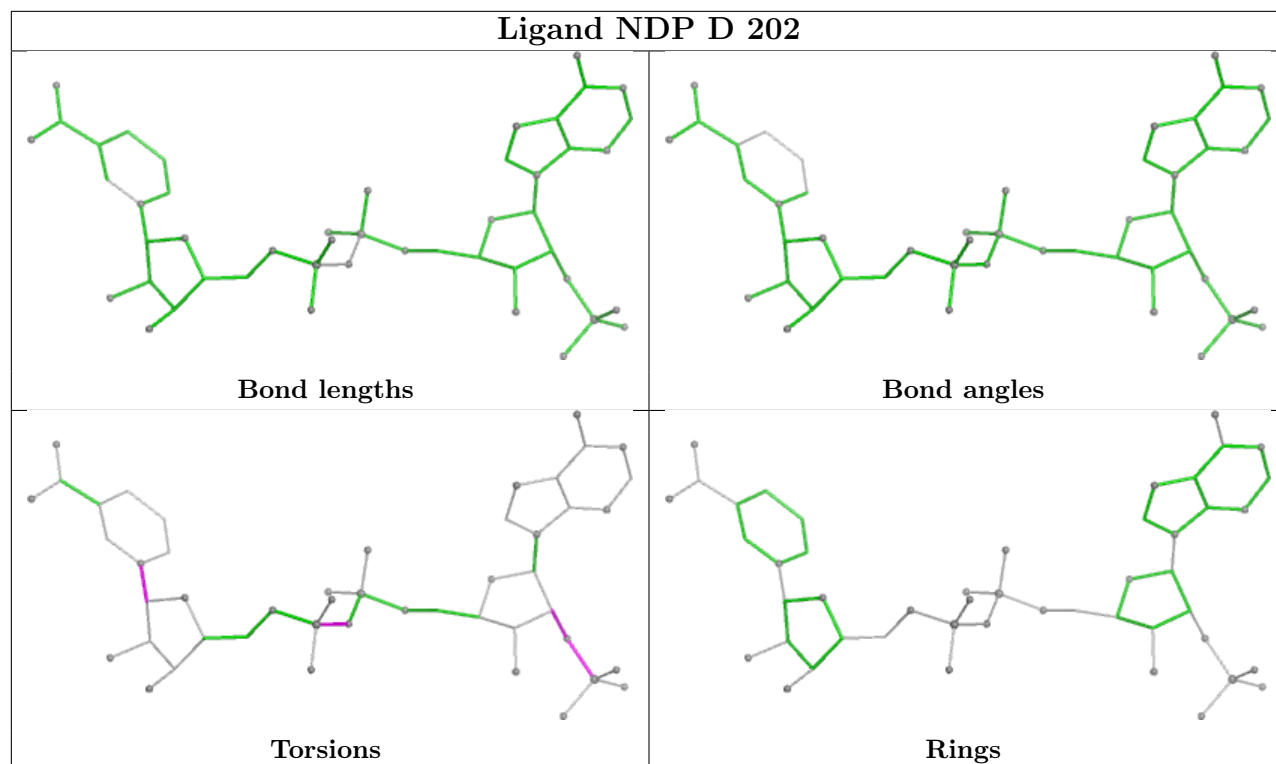
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	201	TOP	1	0
4	E	205	SO4	1	0
4	C	203	SO4	1	0
3	B	202	NDP	3	0
4	C	206	SO4	2	10
2	C	201	TOP	1	0
3	D	202	NDP	3	0
2	E	201	TOP	1	0
3	A	202	NDP	7	0
3	E	202	NDP	7	0
3	C	202	NDP	3	0
4	A	204	SO4	1	0
2	D	201	TOP	2	0
2	B	201	TOP	1	0

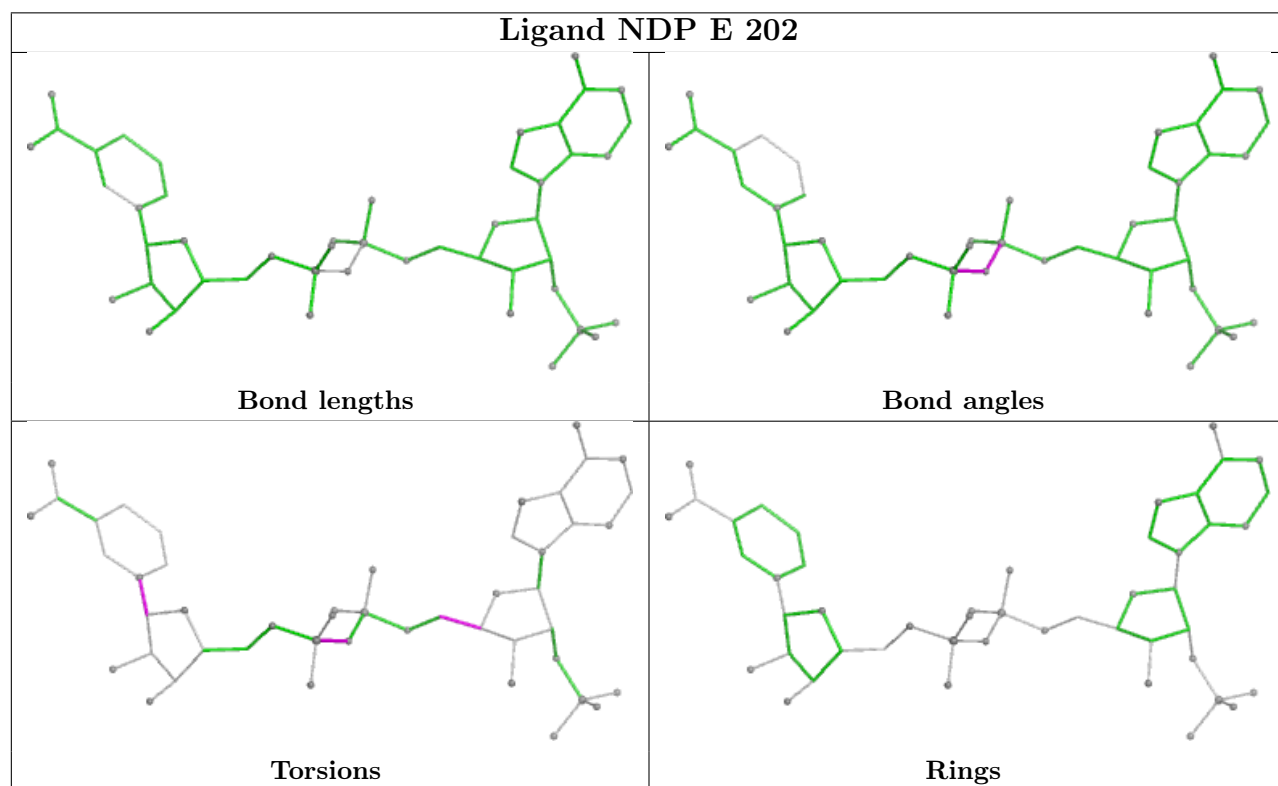
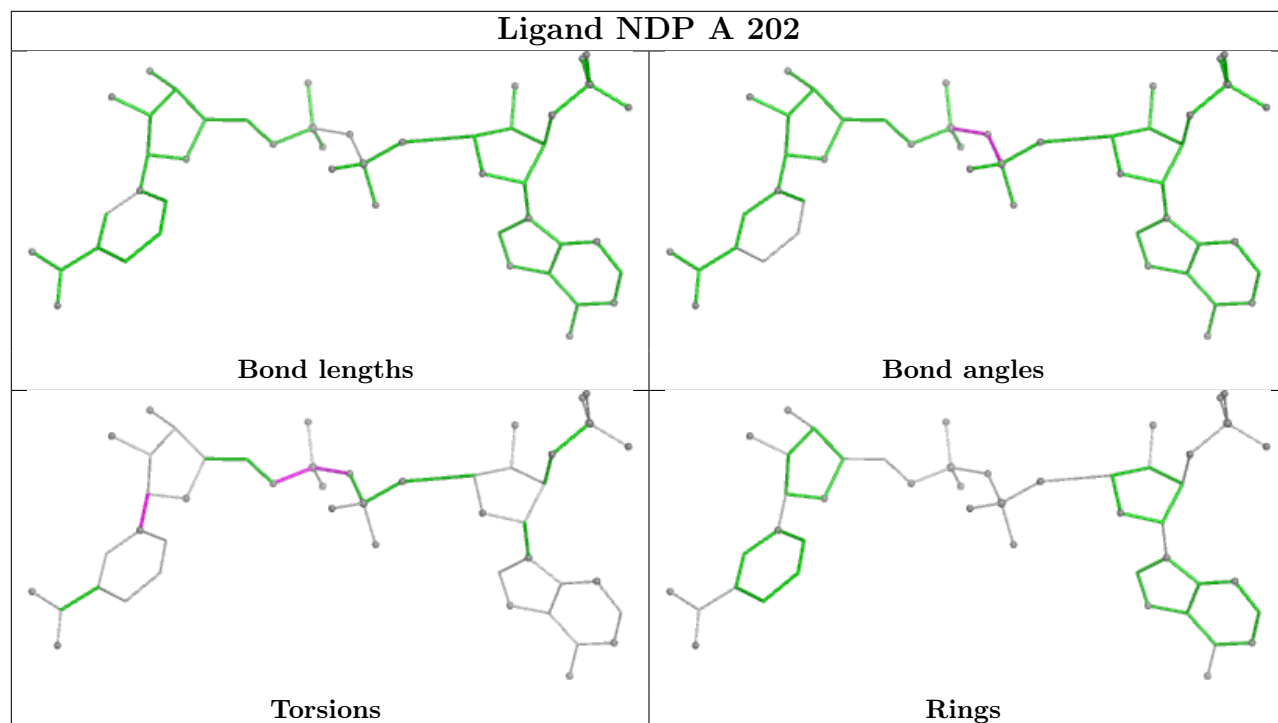
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

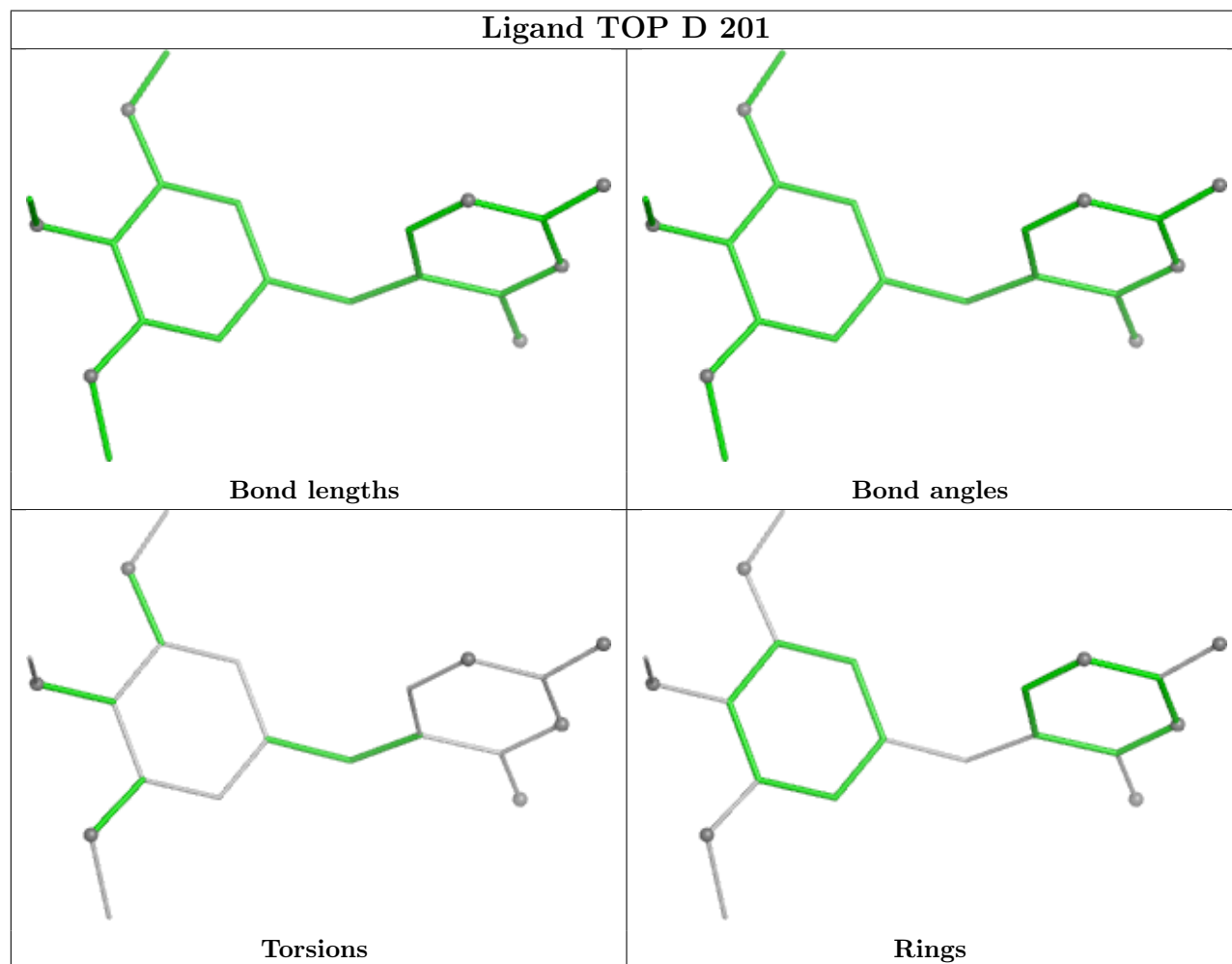
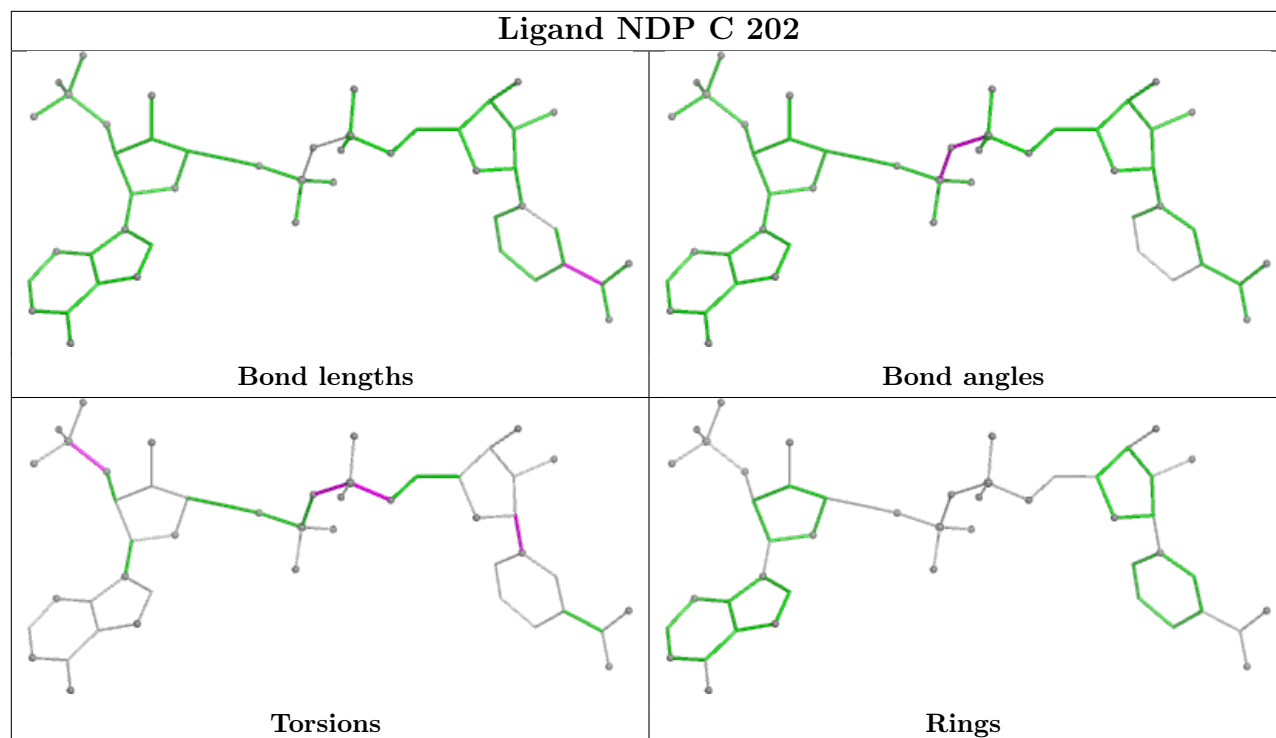
in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

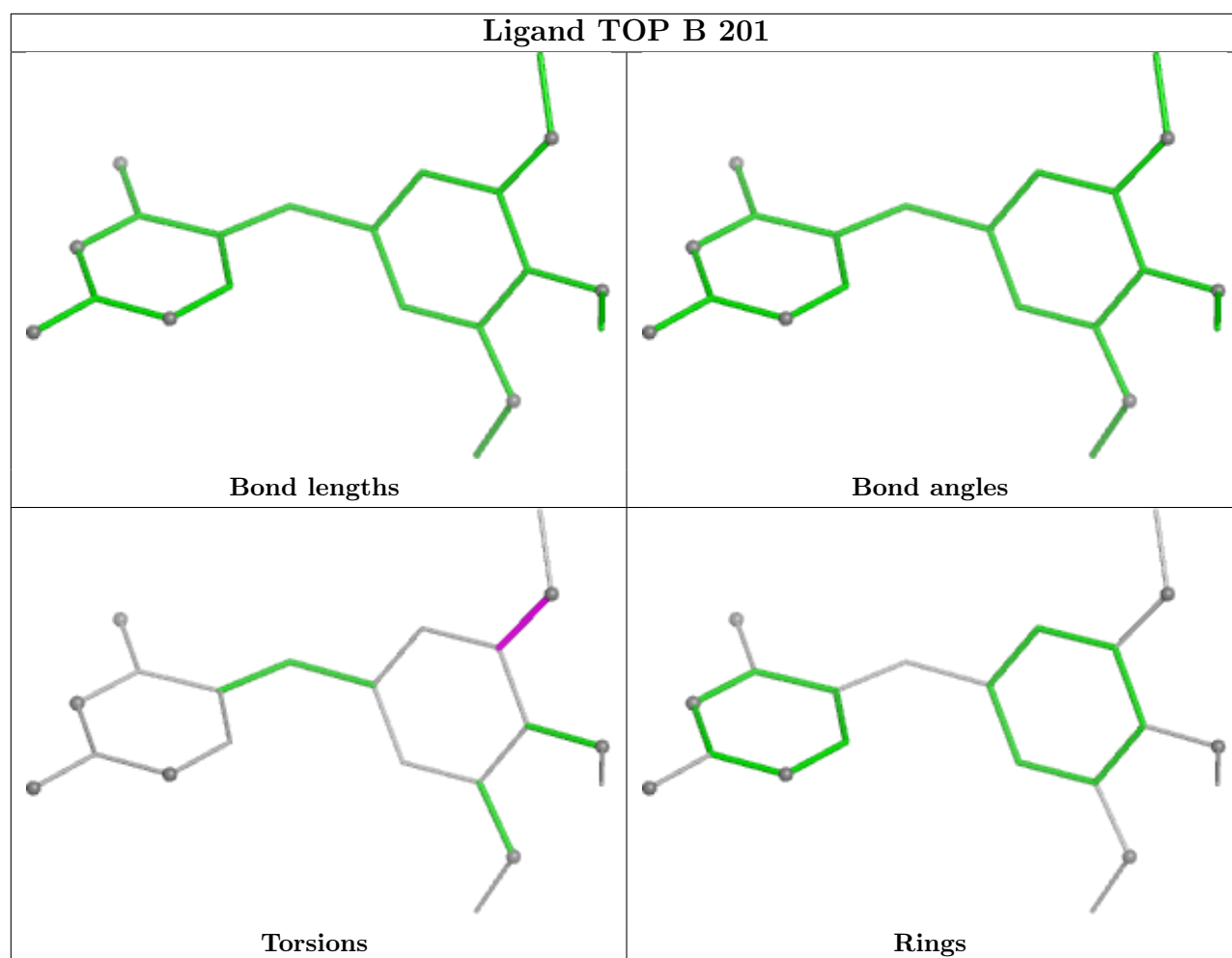












5.7 Other polymers [i](#)

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	167/169 (98%)	-1.38	0 100 100	32, 40, 56, 84	0
1	B	167/169 (98%)	-1.25	0 100 100	35, 47, 66, 80	0
1	C	167/169 (98%)	-1.35	0 100 100	34, 42, 58, 84	0
1	D	164/169 (97%)	-1.18	0 100 100	38, 55, 83, 105	0
1	E	164/169 (97%)	-1.26	0 100 100	34, 46, 69, 90	0
All	All	829/845 (98%)	-1.28	0 100 100	32, 46, 73, 105	0

There are no RSRZ outliers to report.

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(Å ²)	Q<0.9
4	SO4	C	204	5/5	0.98	0.04	65,76,87,95	0
4	SO4	E	203	5/5	0.98	0.04	80,90,106,123	0
4	SO4	E	205	5/5	0.98	0.03	65,74,77,82	0

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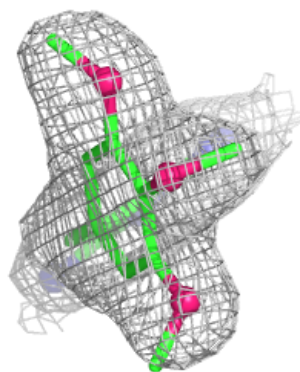
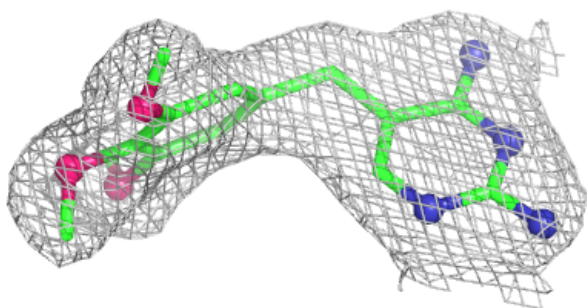
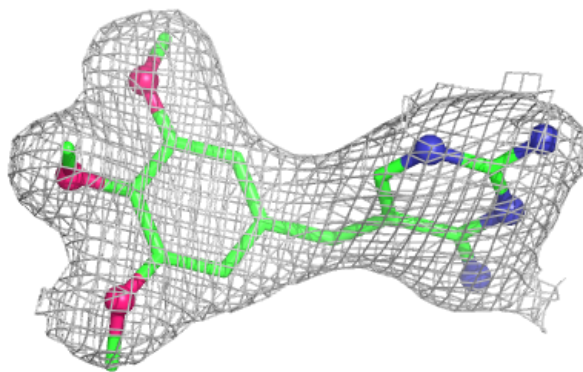
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	TOP	E	201	21/21	0.99	0.03	35,43,48,50	0
3	NDP	B	202	48/48	0.99	0.03	37,53,70,75	0
3	NDP	D	202	48/48	0.99	0.03	41,62,77,80	0
3	NDP	E	202	48/48	0.99	0.04	41,55,65,74	0
4	SO4	A	203	5/5	0.99	0.04	50,52,61,61	0
4	SO4	B	203	5/5	0.99	0.03	54,59,62,62	0
2	TOP	A	201	21/21	0.99	0.03	31,34,36,37	0
4	SO4	C	205	5/5	0.99	0.04	62,65,73,74	0
4	SO4	C	206	5/5	0.99	0.05	50,52,56,61	0
2	TOP	B	201	21/21	0.99	0.03	33,42,45,47	0
2	TOP	D	201	21/21	0.99	0.03	34,43,47,50	0
2	TOP	C	201	21/21	1.00	0.03	32,34,40,41	0
3	NDP	C	202	48/48	1.00	0.03	33,41,51,59	0
4	SO4	A	204	5/5	1.00	0.03	41,41,41,43	0
4	SO4	D	203	5/5	1.00	0.02	48,50,57,57	0
3	NDP	A	202	48/48	1.00	0.03	34,42,54,61	0
4	SO4	E	204	5/5	1.00	0.02	49,50,61,68	0
4	SO4	C	203	5/5	1.00	0.02	40,41,42,44	0

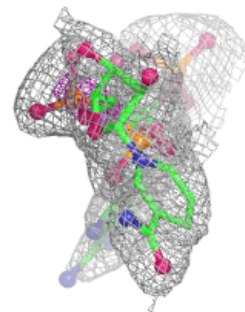
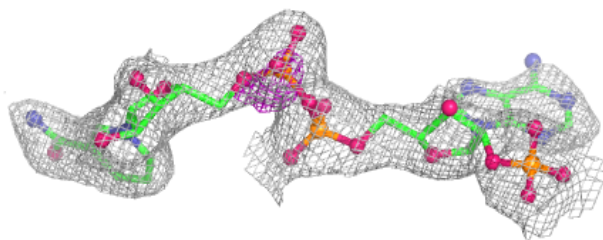
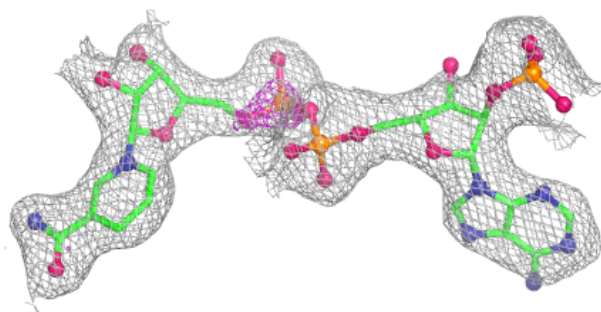
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around TOP E 201:

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

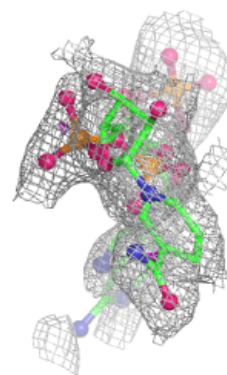
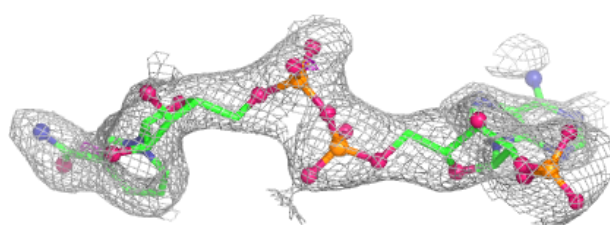
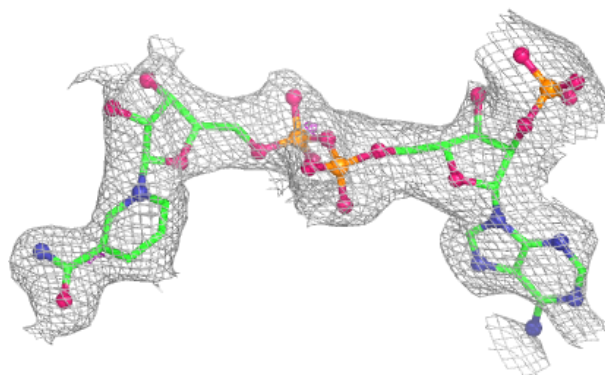
**Electron density around NDP B 202:**

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

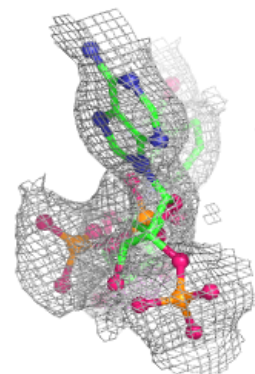
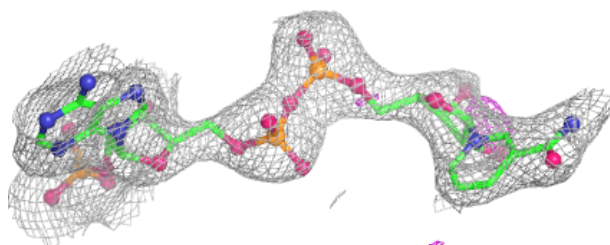
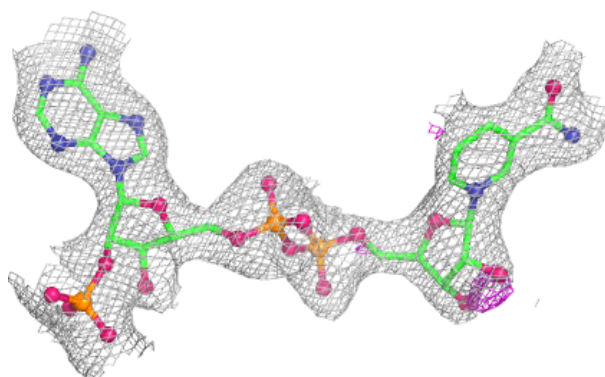


Electron density around NDP D 202:

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

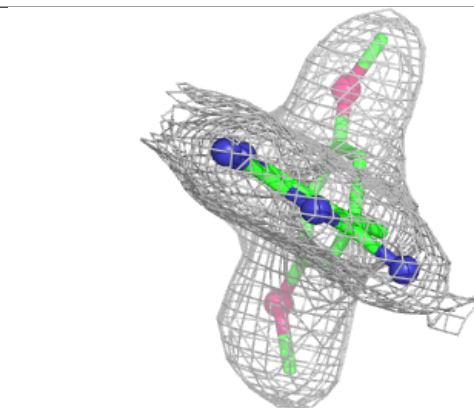
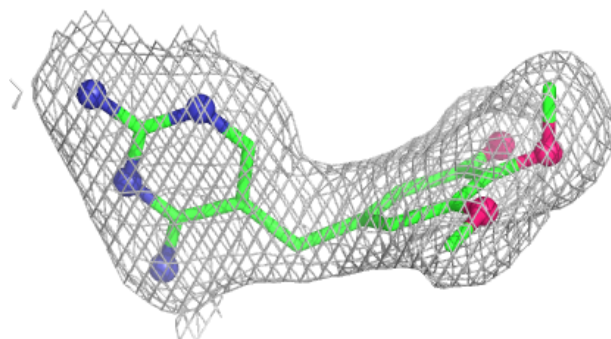
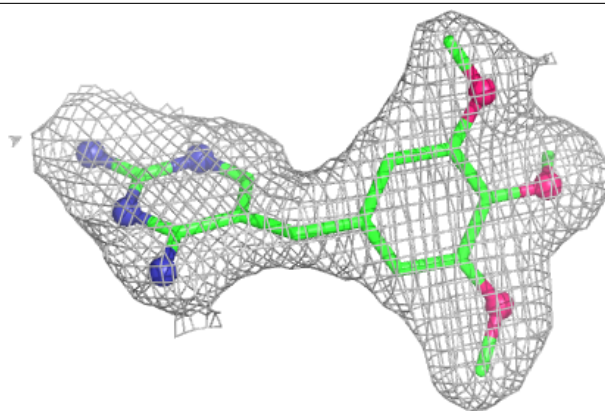
**Electron density around NDP E 202:**

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

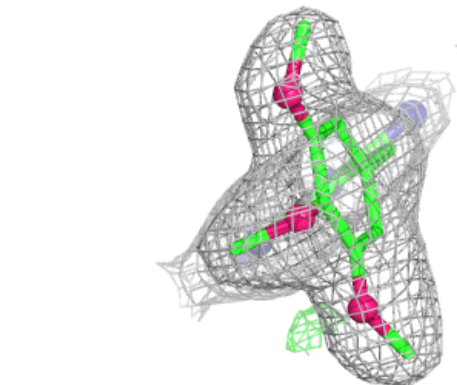
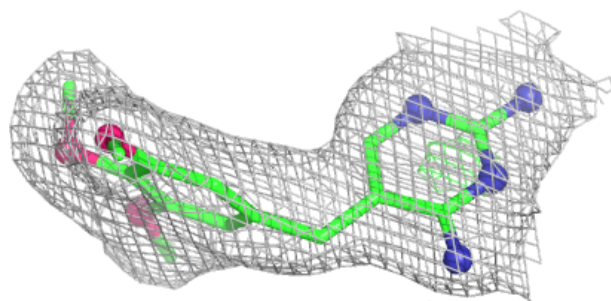
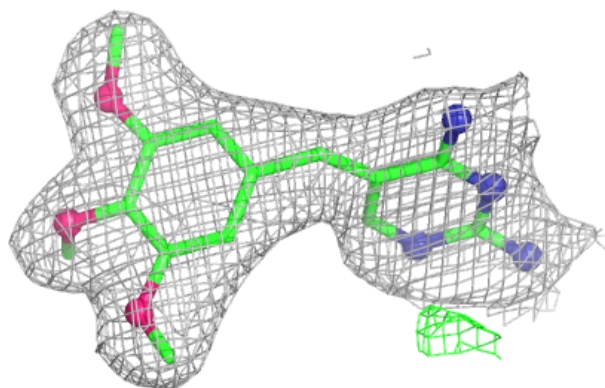


Electron density around TOP A 201:

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

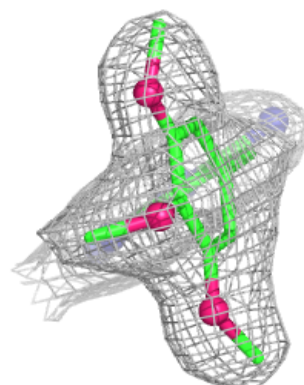
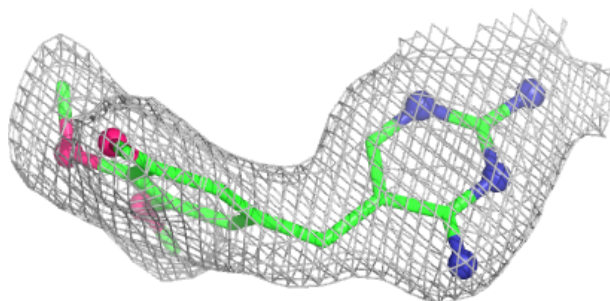
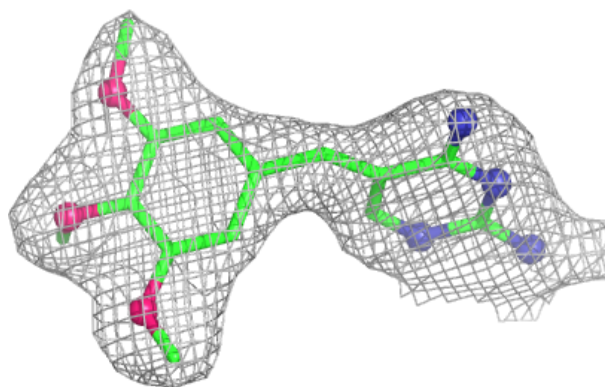
**Electron density around TOP B 201:**

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

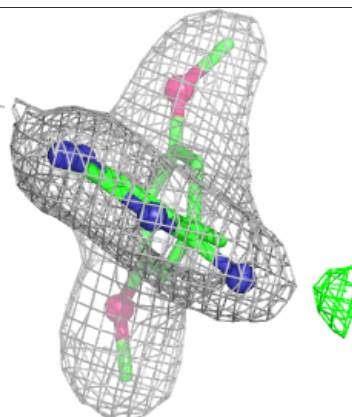
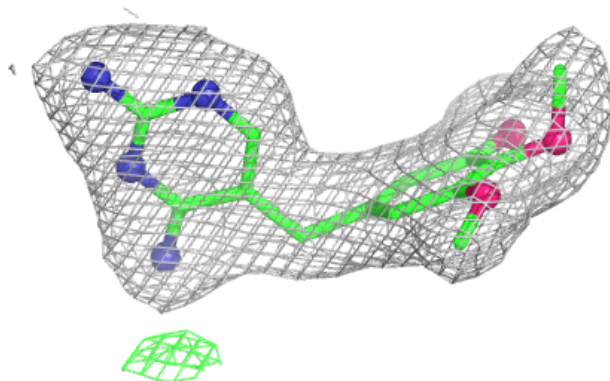
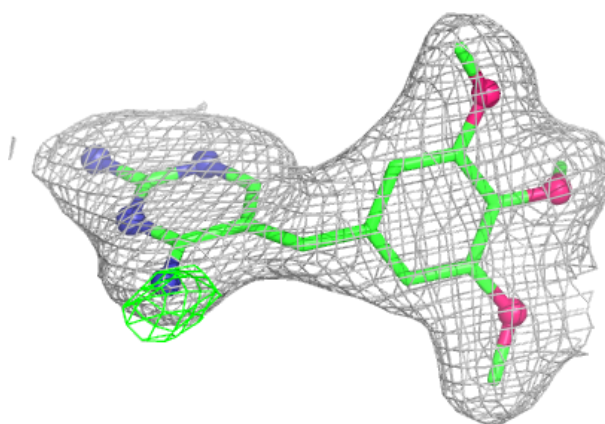


Electron density around TOP D 201:

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

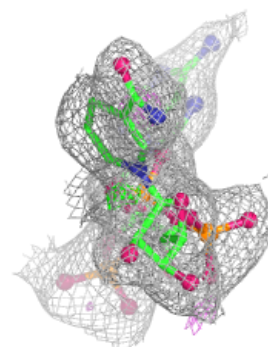
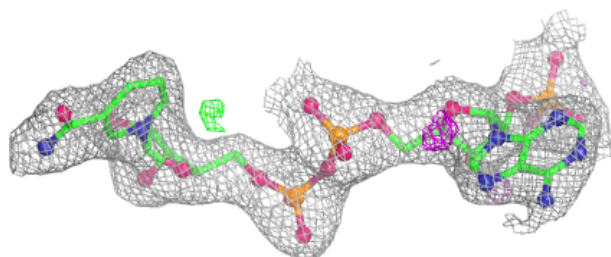
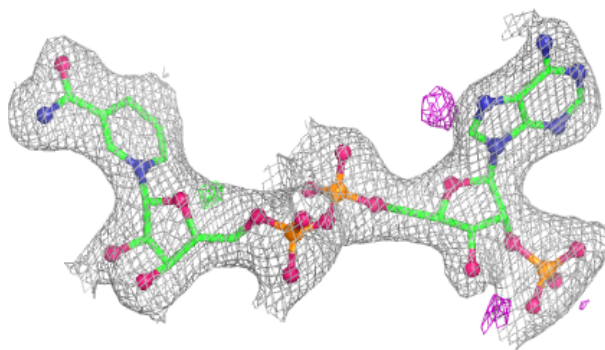
**Electron density around TOP C 201:**

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

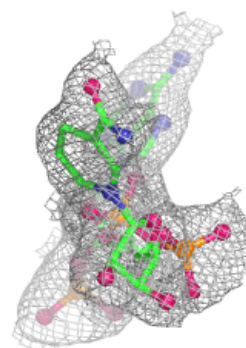
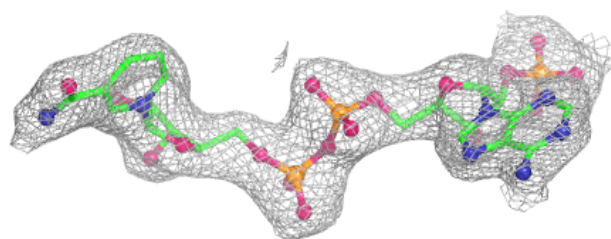
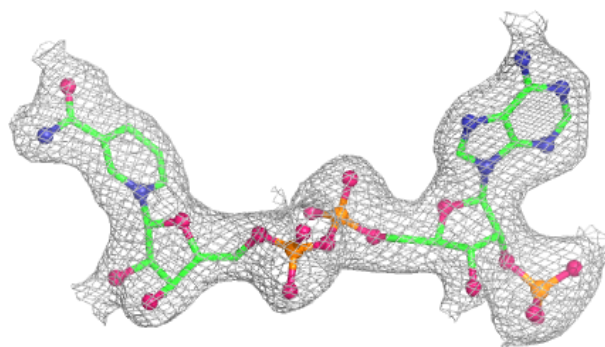


Electron density around NDP C 202:

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

**Electron density around NDP A 202:**

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



6.5 Other polymers [i](#)

There are no such residues in this entry.