



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 18, 2026 – 08:07 AM UTC

PDB ID : 5YLJ / pdb_00005ylj
Title : Crystal structure of T2R-TTL-Millepachine complex
Authors : Yang, J.H.; Chen, L.J.
Deposited on : 2017-10-17
Resolution : 2.70 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

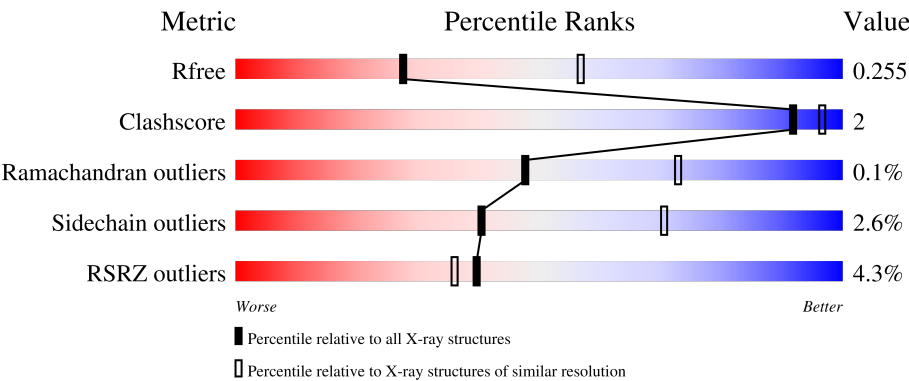
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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	3538 (2.70-2.70)
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)
RSRZ outliers	180081	3538 (2.70-2.70)

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	451	0% 90%7%
1	C	451	2% 92%5%
2	B	445	2% 89%7%
2	D	445	9% 88%7%5%
3	E	143	3% 80%15%

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Mol	Chain	Length	Quality of chain
4	F	384	8% 78% 8% • 13%

2 Entry composition [i](#)

There are 13 unique types of molecules in this entry. The entry contains 17533 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 Tubulin alpha-1B chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	437	Total	C	N	O	S	0	0	0
			3416	2163	581	650	22			
1	C	440	Total	C	N	O	S	0	0	0
			3437	2175	584	656	22			

- Molecule 2 is a protein called Tubulin beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	428	Total	C	N	O	S	0	0	0
			3369	2115	577	650	27			
2	D	421	Total	C	N	O	S	0	0	0
			3309	2080	562	640	27			

- Molecule 3 is a protein called Stathmin-4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	E	121	Total	C	N	O	S	0	0	0
			1000	617	181	197	5			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	3	MET	-	expression tag	UNP P63043
E	4	ALA	-	expression tag	UNP P63043

- Molecule 4 is a protein called Tubulin tyrosine ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	F	334	Total	C	N	O	S	0	0	0
			2744	1761	470	499	14			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
F	379	HIS	-	expression tag	UNP E1BQ43
F	380	HIS	-	expression tag	UNP E1BQ43
F	381	HIS	-	expression tag	UNP E1BQ43
F	382	HIS	-	expression tag	UNP E1BQ43
F	383	HIS	-	expression tag	UNP E1BQ43
F	384	HIS	-	expression tag	UNP E1BQ43

- Molecule 5 is GUANOSINE-5'-TRIPHOSPHATE (CCD ID: GTP) (formula: $C_{10}H_{16}N_5O_{14}P_3$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	C	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	D	1	Total	C	N	O	P	0	0
			32	10	5	14	3		

- Molecule 6 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	Mg	0	0
			1	1		
6	B	1	Total	Mg	0	0
			1	1		
6	C	1	Total	Mg	0	0
			1	1		

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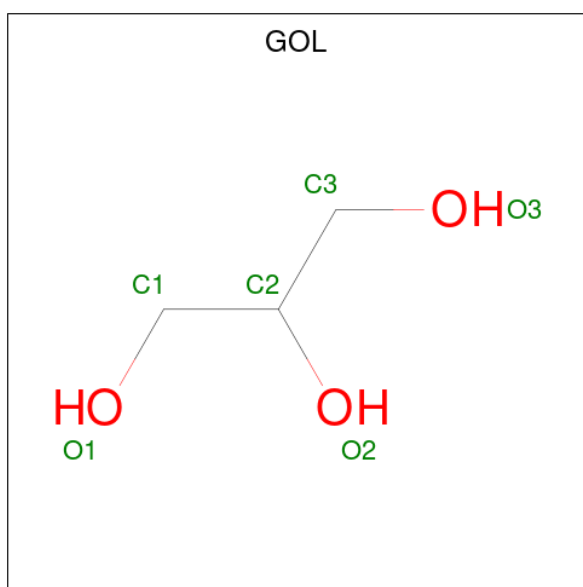
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	D	1	Total	Mg	0	0
			1	1		

- Molecule 7 is CALCIUM ION (CCD ID: CA) (formula: Ca).

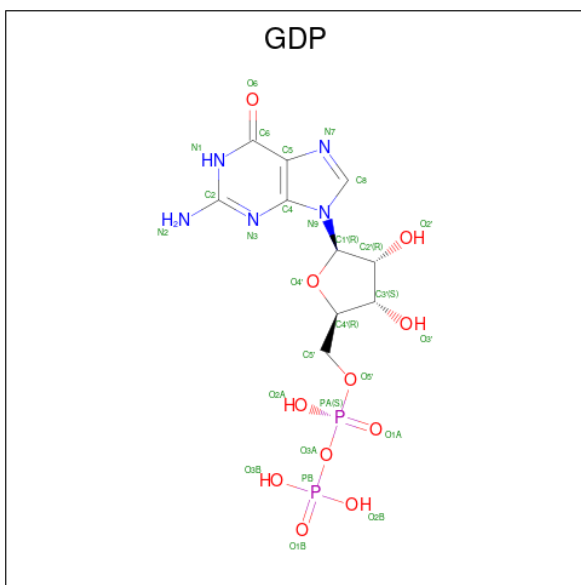
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	1	Total	Ca	0	0
			1	1		
7	C	1	Total	Ca	0	0
			1	1		

- Molecule 8 is GLYCEROL (CCD ID: GOL) (formula: C₃H₈O₃).



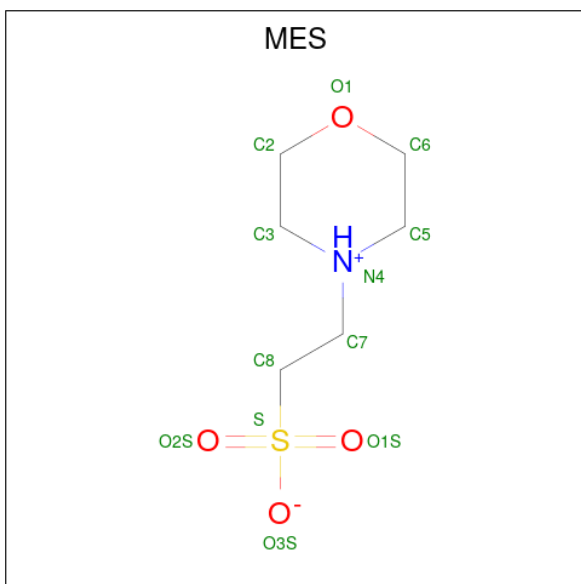
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 9 is GUANOSINE-5'-DIPHOSPHATE (CCD ID: GDP) (formula: C₁₀H₁₅N₅O₁₁P₂).



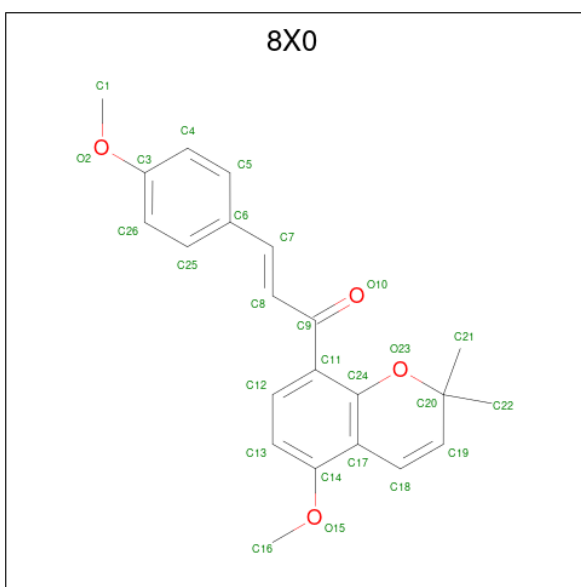
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
9	B	1	Total	C	N	O	P	0	0
			28	10	5	11	2		

- Molecule 10 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: $\text{C}_6\text{H}_{13}\text{NO}_4\text{S}$).



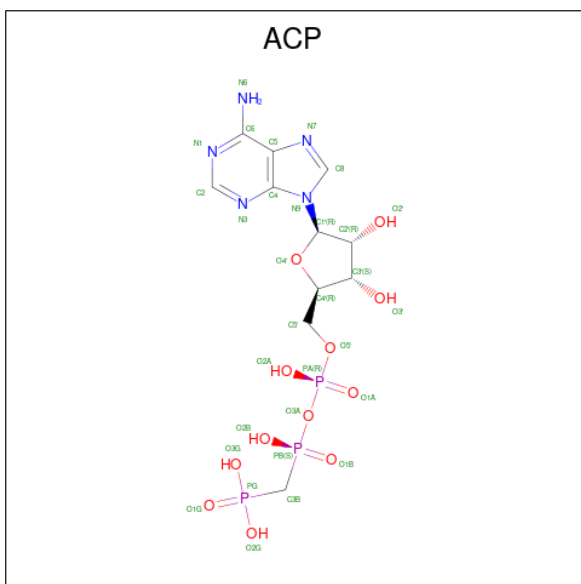
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
10	B	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 11 is (E)-1-(5-methoxy-2,2-dimethyl-chromen-8-yl)-3-(4-methoxyphenyl)prop-2-en-1-one (CCD ID: 8X0) (formula: C₂₂H₂₂O₄).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
11	B	1	Total	C	O	0	0
			26	22	4		
11	D	1	Total	C	O	0	0
			26	22	4		

- Molecule 12 is PHOSPHOMETHYLPHOSPHONIC ACID ADENYLATE ESTER (CCD ID: ACP) (formula: $\text{C}_{11}\text{H}_{18}\text{N}_5\text{O}_{12}\text{P}_3$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
12	F	1	Total 31	C 11	N 5	O 12	P 3	0	0

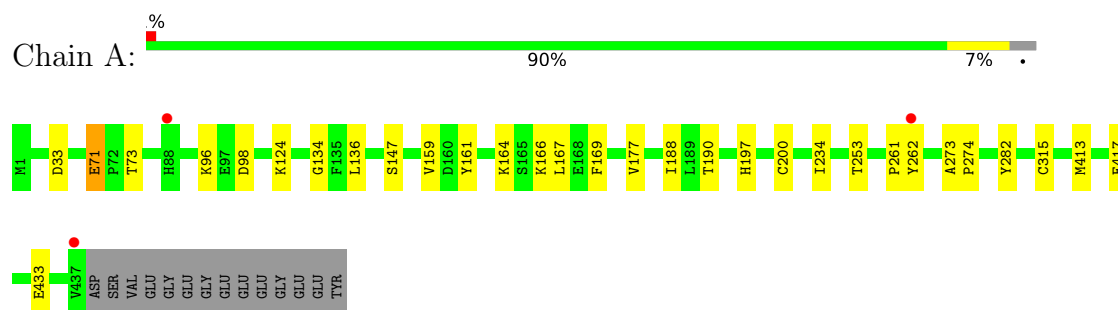
- Molecule 13 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
13	A	4	Total 4	O 4	0	0
13	B	11	Total 11	O 11	0	0
13	C	7	Total 7	O 7	0	0
13	D	5	Total 5	O 5	0	0

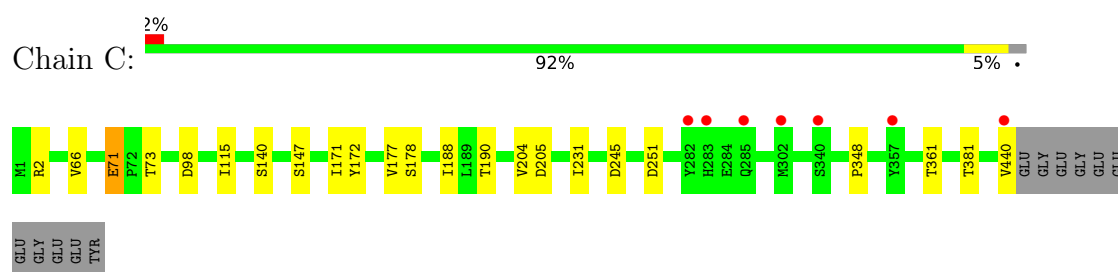
3 Residue-property plots [i](#)

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

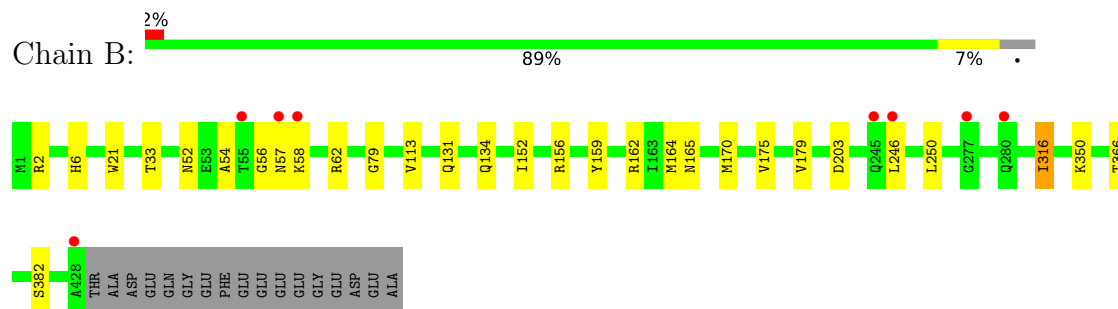
- Molecule 1: Tubulin alpha-1B chain



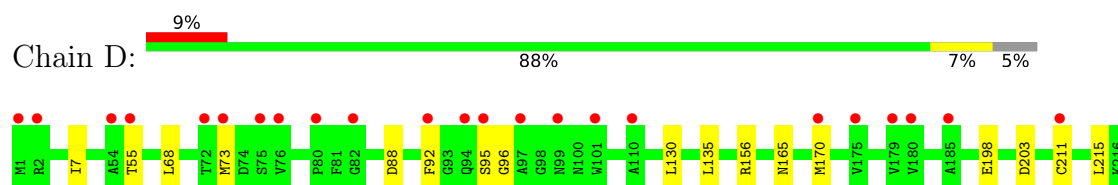
- Molecule 1: Tubulin alpha-1B chain



- Molecule 2: Tubulin beta chain

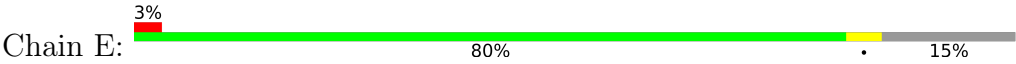


- Molecule 2: Tubulin beta chain

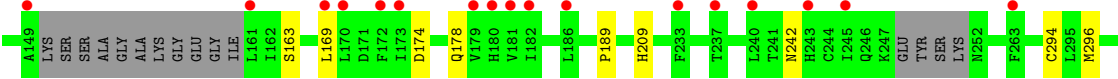
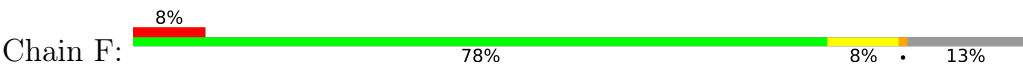




• Molecule 3: Stathmin-4



• Molecule 4: Tubulin tyrosine ligase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	105.23Å 157.37Å 182.68Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.90 – 2.70 41.90 – 2.70	Depositor EDS
% Data completeness (in resolution range)	99.6 (41.90-2.70) 99.6 (41.90-2.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.12 (at 2.69Å)	Xtriage
Refinement program	REFMAC 5.8.0107	Depositor
R, R_{free}	0.216 , 0.255 0.216 , 0.255	Depositor DCC
R_{free} test set	4187 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å ²)	59.6	Xtriage
Anisotropy	0.023	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 22.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	17533	wwPDB-VP
Average B, all atoms (Å ²)	68.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.56% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GDP, ACP, GOL, 8X0, GTP, MG, MES, CA

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	0.54	0/3494	0.95	1/4743 (0.0%)
1	C	0.59	0/3515	0.95	2/4772 (0.0%)
2	B	0.51	0/3444	0.91	3/4664 (0.1%)
2	D	0.55	0/3382	0.94	0/4581
3	E	0.50	0/1008	1.00	0/1337
4	F	0.58	0/2806	0.88	0/3791
All	All	0.55	0/17649	0.93	6/23888 (0.0%)

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	134	GLY	N-CA-C	5.71	117.60	110.29
1	C	73	THR	N-CA-C	5.38	117.15	111.28
2	B	113	VAL	N-CA-C	5.29	116.01	110.62
1	C	115	ILE	N-CA-C	5.20	115.92	110.62
2	B	79	GLY	CA-C-N	5.13	124.75	119.05
2	B	79	GLY	C-N-CA	5.13	124.75	119.05

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	3416	0	3331	9	0
1	C	3437	0	3348	6	0
2	B	3369	0	3250	12	0
2	D	3309	0	3189	12	0
3	E	1000	0	1018	3	0
4	F	2744	0	2709	16	0
5	A	32	0	12	0	0
5	C	32	0	12	0	0
5	D	32	0	12	0	0
6	A	1	0	0	0	0
6	B	1	0	0	0	0
6	C	1	0	0	0	0
6	D	1	0	0	0	0
7	A	1	0	0	0	0
7	C	1	0	0	0	0
8	A	6	0	8	0	0
9	B	28	0	12	0	0
10	B	12	0	13	1	0
11	B	26	0	0	0	0
11	D	26	0	0	1	0
12	F	31	0	14	1	0
13	A	4	0	0	0	0
13	B	11	0	0	0	0
13	C	7	0	0	0	0
13	D	5	0	0	0	0
All	All	17533	0	16928	55	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 (55) 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)
4:F:86:GLU:N	4:F:86:GLU:OE2	1.87	1.06
4:F:79:LYS:O	4:F:83:THR:OG1	1.89	0.89
2:B:131:GLN:HE21	2:B:250:LEU:H	1.39	0.69
4:F:86:GLU:H	4:F:86:GLU:CD	2.01	0.64
1:A:71:GLU:HB2	1:A:98:ASP:HB3	1.80	0.63
2:B:56:GLY:O	2:B:57:ASN:HB2	1.99	0.61
4:F:87:LEU:O	4:F:88:SER:HB3	2.01	0.59
4:F:209:HIS:HB2	4:F:310:GLN:HG2	1.83	0.59
4:F:80:LEU:O	4:F:84:SER:HB2	2.04	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:156:ARG:HG3	10:B:503:MES:H62	1.87	0.57
2:B:54:ALA:HB3	2:B:58:LYS:O	2.06	0.55
1:A:161:TYR:HB3	1:A:164:LYS:HD3	1.89	0.54
2:B:52:ASN:OD1	2:B:62:ARG:NH2	2.40	0.54
2:D:350:LYS:HG3	11:D:503:8X0:C4	2.37	0.54
4:F:102:PRO:HB3	4:F:174:ASP:HA	1.90	0.52
1:A:166:LYS:HE2	1:A:197:HIS:O	2.11	0.51
2:B:159:TYR:HB3	2:B:162:ARG:HG3	1.93	0.50
2:B:6:HIS:CD2	2:B:21:TRP:HE1	2.30	0.49
1:C:71:GLU:HB2	1:C:98:ASP:HB3	1.93	0.49
2:B:152:ILE:HG23	2:B:164:MET:HG2	1.94	0.49
4:F:85:PRO:HD2	4:F:86:GLU:OE2	2.13	0.48
4:F:304:THR:HG22	4:F:307:LEU:HD12	1.95	0.48
2:D:211:CYS:HA	2:D:215:LEU:HB2	1.95	0.48
2:D:198:GLU:OE2	2:D:253:LEU:HD23	2.13	0.47
4:F:242:ASN:HD21	12:F:401:ACP:H5'2	1.79	0.47
2:B:134:GLN:HA	2:B:165:ASN:O	2.15	0.46
2:D:319:GLY:HA2	2:D:357:PRO:HG3	1.97	0.46
4:F:91:CYS:SG	4:F:93:TRP:CE2	3.09	0.46
4:F:189:PRO:HA	4:F:322:ASP:HA	1.98	0.46
1:A:136:LEU:HD22	1:A:169:PHE:HE2	1.81	0.45
1:A:147:SER:HB2	1:A:190:THR:HB	1.99	0.45
1:A:413:MET:HE3	1:A:417:GLU:HB3	1.97	0.45
1:C:172:TYR:HB3	1:C:205:ASP:HA	1.99	0.45
4:F:71:LEU:HD11	4:F:294:CYS:HB3	1.98	0.45
2:D:170:MET:HG3	2:D:377:LEU:HD11	1.99	0.44
2:D:73:MET:HG3	2:D:92:PHE:HB3	2.00	0.44
2:D:170:MET:HB2	2:D:203:ASP:HA	1.99	0.44
3:E:11:LEU:HD11	3:E:18:GLN:HE21	1.83	0.44
2:B:179:VAL:HG12	1:C:348:PRO:HG2	2.00	0.44
2:B:170:MET:HB2	2:B:203:ASP:HA	2.01	0.43
2:D:68:LEU:HB3	2:D:96:GLY:H	1.83	0.43
2:D:156:ARG:HG2	3:E:123:LEU:HD11	2.01	0.43
4:F:26:GLN:HE22	4:F:362:ALA:H	1.66	0.42
4:F:163:SER:HB3	4:F:169:LEU:HG	2.01	0.42
1:A:273:ALA:HA	1:A:274:PRO:HA	1.84	0.42
1:A:167:LEU:HG	1:A:200:CYS:HB3	2.02	0.42
1:C:147:SER:HB2	1:C:190:THR:OG1	2.19	0.42
4:F:55:GLU:HA	4:F:56:PRO:HD2	1.96	0.42
1:C:204:VAL:HG11	1:C:231:ILE:HG12	2.02	0.41
1:C:140:SER:HA	1:C:171:ILE:HB	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:316:ILE:HG23	2:B:366:THR:HB	2.02	0.41
2:D:323:MET:HE2	2:D:353:VAL:HB	2.02	0.41
1:A:159:VAL:HG11	3:E:47:LEU:HB2	2.03	0.41
2:D:7:ILE:O	2:D:135:LEU:HA	2.21	0.41
2:D:299:MET:HE3	2:D:305:PRO:HG3	2.03	0.41

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	435/451 (96%)	425 (98%)	8 (2%)	2 (0%)	24	48
1	C	438/451 (97%)	430 (98%)	8 (2%)	0	100	100
2	B	426/445 (96%)	417 (98%)	9 (2%)	0	100	100
2	D	417/445 (94%)	405 (97%)	11 (3%)	1 (0%)	43	68
3	E	117/143 (82%)	115 (98%)	2 (2%)	0	100	100
4	F	324/384 (84%)	314 (97%)	10 (3%)	0	100	100
All	All	2157/2319 (93%)	2106 (98%)	48 (2%)	3 (0%)	48	73

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	282	TYR
2	D	95	SER
1	A	261	PRO

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	368/379 (97%)	356 (97%)	12 (3%)	33	63
1	C	371/379 (98%)	360 (97%)	11 (3%)	36	66
2	B	370/383 (97%)	363 (98%)	7 (2%)	50	77
2	D	364/383 (95%)	357 (98%)	7 (2%)	50	77
3	E	109/127 (86%)	107 (98%)	2 (2%)	51	78
4	F	301/342 (88%)	291 (97%)	10 (3%)	33	63
All	All	1883/1993 (94%)	1834 (97%)	49 (3%)	40	70

All (49) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	33	ASP
1	A	71	GLU
1	A	73	THR
1	A	96	LYS
1	A	124	LYS
1	A	177	VAL
1	A	188	ILE
1	A	234	ILE
1	A	253	THR
1	A	262	TYR
1	A	315	CYS
1	A	433	GLU
2	B	2	ARG
2	B	33	THR
2	B	175	VAL
2	B	246	LEU
2	B	316	ILE
2	B	350	LYS
2	B	382	SER
1	C	2	ARG
1	C	66	VAL
1	C	71	GLU

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Mol	Chain	Res	Type
1	C	177	VAL
1	C	178	SER
1	C	188	ILE
1	C	245	ASP
1	C	251	ASP
1	C	361	THR
1	C	381	THR
1	C	440	VAL
2	D	55	THR
2	D	88	ASP
2	D	130	LEU
2	D	165	ASN
2	D	246	LEU
2	D	247	ASN
2	D	351	THR
3	E	92	ASN
3	E	124	GLN
4	F	33	ASP
4	F	83	THR
4	F	84	SER
4	F	86	GLU
4	F	90	SER
4	F	129	GLU
4	F	178	GLN
4	F	296	MET
4	F	310	GLN
4	F	326	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (35) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	300	ASN
1	A	301	GLN
1	A	329	ASN
1	A	342	GLN
1	A	372	GLN
1	A	393	HIS
2	B	8	GLN
2	B	37	HIS
2	B	43	GLN
2	B	83	GLN
2	B	131	GLN

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Mol	Chain	Res	Type
2	B	134	GLN
2	B	332	ASN
2	B	347	ASN
2	B	423	GLN
2	B	426	GLN
1	C	11	GLN
1	C	15	GLN
1	C	50	ASN
1	C	356	ASN
1	C	393	HIS
2	D	37	HIS
2	D	99	ASN
2	D	426	GLN
3	E	12	ASN
3	E	18	GLN
3	E	90	ASN
3	E	124	GLN
4	F	26	GLN
4	F	178	GLN
4	F	183	GLN
4	F	243	HIS
4	F	260	ASN
4	F	306	HIS
4	F	333	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 15 ligands modelled in this entry, 6 are monoatomic - leaving 9 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$
12	ACP	F	401	-	31,33,33	2.04	10 (32%)	47,52,52	1.80	10 (21%)
5	GTP	D	501	6	33,34,34	1.25	5 (15%)	50,54,54	1.64	6 (12%)
8	GOL	A	504	-	5,5,5	0.22	0	5,5,5	0.34	0
5	GTP	C	501	6	33,34,34	1.29	5 (15%)	50,54,54	1.68	5 (10%)
10	MES	B	503	-	12,12,12	2.15	1 (8%)	15,16,16	5.84	6 (40%)
11	8X0	D	503	-	28,28,28	3.59	14 (50%)	40,40,40	1.78	12 (30%)
5	GTP	A	501	6	33,34,34	1.28	5 (15%)	50,54,54	1.68	6 (12%)
9	GDP	B	501	6	29,30,30	1.21	3 (10%)	45,47,47	1.73	6 (13%)
11	8X0	B	504	-	28,28,28	3.62	14 (50%)	40,40,40	1.50	8 (20%)

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
12	ACP	F	401	-	-	2/19/38/38	0/3/3/3
5	GTP	D	501	6	-	8/22/38/38	0/3/3/3
8	GOL	A	504	-	-	2/4/4/4	-
5	GTP	C	501	6	-	10/22/38/38	0/3/3/3
10	MES	B	503	-	-	3/6/14/14	0/1/1/1
11	8X0	D	503	-	-	6/13/24/24	0/3/3/3
5	GTP	A	501	6	-	7/22/38/38	0/3/3/3
9	GDP	B	501	6	-	3/16/32/32	0/3/3/3
11	8X0	B	504	-	-	8/13/24/24	0/3/3/3

All (57) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
11	B	504	8X0	C18-C19	11.31	1.47	1.33
11	D	503	8X0	C18-C19	10.99	1.47	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
11	D	503	8X0	O23-C24	10.12	1.53	1.37
11	B	504	8X0	O23-C24	9.69	1.52	1.37
10	B	503	MES	C8-S	-6.75	1.68	1.77
12	F	401	ACP	PG-O1G	5.54	1.61	1.50
12	F	401	ACP	C5-C4	5.06	1.48	1.39
11	B	504	8X0	C5-C4	5.01	1.46	1.38
11	D	503	8X0	C5-C4	4.95	1.46	1.38
11	B	504	8X0	C8-C9	4.83	1.55	1.47
11	D	503	8X0	C8-C9	4.16	1.54	1.47
11	B	504	8X0	C6-C7	3.99	1.58	1.47
11	D	503	8X0	C6-C7	3.86	1.58	1.47
11	D	503	8X0	C26-C3	3.56	1.45	1.38
11	B	504	8X0	C26-C3	3.47	1.45	1.38
5	D	501	GTP	C5-C4	3.45	1.48	1.38
12	F	401	ACP	PB-O3A	3.35	1.62	1.58
5	A	501	GTP	C5-C4	3.27	1.47	1.38
9	B	501	GDP	C5-C4	3.27	1.47	1.38
11	B	504	8X0	C8-C7	3.25	1.41	1.33
11	D	503	8X0	C17-C14	3.25	1.46	1.41
11	B	504	8X0	C17-C14	3.14	1.46	1.41
11	D	503	8X0	O15-C14	3.14	1.42	1.37
5	C	501	GTP	C5-C4	3.13	1.47	1.38
11	B	504	8X0	O15-C14	3.02	1.42	1.37
12	F	401	ACP	C5-C6	3.01	1.49	1.41
11	D	503	8X0	C8-C7	2.99	1.40	1.33
12	F	401	ACP	PG-O3G	2.93	1.61	1.55
12	F	401	ACP	PG-O2G	-2.90	1.48	1.55
5	C	501	GTP	PB-O3B	2.76	1.62	1.59
12	F	401	ACP	PA-O3A	2.74	1.62	1.59
11	B	504	8X0	C20-C19	2.74	1.55	1.50
5	C	501	GTP	PA-O3A	2.72	1.62	1.59
5	A	501	GTP	PB-O3B	2.68	1.62	1.59
11	D	503	8X0	C11-C24	2.67	1.46	1.40
5	A	501	GTP	PA-O3A	2.50	1.62	1.59
9	B	501	GDP	PA-O3A	2.46	1.62	1.59
11	D	503	8X0	C20-C19	2.33	1.54	1.50
11	D	503	8X0	C13-C12	2.29	1.42	1.38
11	B	504	8X0	C13-C12	2.28	1.42	1.38
11	B	504	8X0	C11-C24	2.28	1.45	1.40
12	F	401	ACP	C8-N7	2.27	1.36	1.31
12	F	401	ACP	C5-N7	-2.25	1.35	1.39
5	A	501	GTP	PB-O3A	2.24	1.61	1.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	C	501	GTP	PB-O3A	2.24	1.61	1.59
11	B	504	8X0	C25-C6	2.22	1.44	1.39
5	D	501	GTP	C6-N1	-2.21	1.34	1.38
5	D	501	GTP	PB-O3B	2.19	1.61	1.59
11	D	503	8X0	O2-C3	2.15	1.41	1.37
11	B	504	8X0	O2-C3	2.13	1.41	1.37
5	D	501	GTP	C5-N7	-2.07	1.34	1.39
11	D	503	8X0	O23-C20	2.07	1.51	1.47
12	F	401	ACP	PB-O2B	2.06	1.61	1.56
5	C	501	GTP	C6-N1	-2.05	1.35	1.38
5	A	501	GTP	C5-N7	-2.04	1.35	1.39
5	D	501	GTP	PA-O3A	2.02	1.61	1.59
9	B	501	GDP	C6-N1	-2.01	1.35	1.38

All (59) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
10	B	503	MES	O3S-S-C8	-11.45	83.61	106.00
10	B	503	MES	O3S-S-O2S	-11.12	83.59	111.40
10	B	503	MES	O3S-S-O1S	-10.62	84.83	111.40
10	B	503	MES	O2S-S-C8	8.17	119.07	106.73
10	B	503	MES	O1S-S-C8	8.01	118.84	106.73
12	F	401	ACP	C5-C4-N3	-5.87	118.64	126.72
5	D	501	GTP	C5-C4-N3	-5.86	119.06	128.39
5	A	501	GTP	C5-C4-N3	-5.70	119.31	128.39
9	B	501	GDP	C5-C4-N3	-5.65	119.40	128.39
5	C	501	GTP	C5-C4-N3	-5.56	119.54	128.39
5	C	501	GTP	C2-N3-C4	5.14	121.15	112.30
9	B	501	GDP	C2-N3-C4	5.06	121.01	112.30
5	A	501	GTP	C2-N3-C4	4.99	120.89	112.30
11	D	503	8X0	C22-C20-C21	-4.98	98.04	111.30
5	D	501	GTP	C2-N3-C4	4.92	120.78	112.30
12	F	401	ACP	N3-C4-N9	4.69	135.15	127.17
5	D	501	GTP	N9-C4-N3	4.50	134.95	125.95
5	A	501	GTP	N9-C4-N3	4.35	134.66	125.95
9	B	501	GDP	N9-C4-N3	4.22	134.38	125.95
11	B	504	8X0	C22-C20-C21	-4.17	100.20	111.30
5	C	501	GTP	N9-C4-N3	4.11	134.16	125.95
11	D	503	8X0	C7-C8-C9	-4.01	115.07	121.61
12	F	401	ACP	C2-N3-C4	3.88	121.30	111.83
5	C	501	GTP	C6-C5-N7	3.79	137.18	130.29
12	F	401	ACP	N3-C2-N1	-3.61	123.11	128.58

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
9	B	501	GDP	C6-C5-N7	3.56	136.78	130.29
12	F	401	ACP	C4-C5-N7	-3.44	106.65	110.58
5	A	501	GTP	C6-C5-N7	3.39	136.47	130.29
5	D	501	GTP	C6-C5-N7	3.32	136.34	130.29
11	B	504	8X0	C16-O15-C14	-3.32	112.64	117.51
11	B	504	8X0	O15-C14-C17	3.05	120.66	115.23
11	B	504	8X0	O15-C14-C13	-2.93	119.36	124.30
11	D	503	8X0	O15-C14-C17	2.88	120.35	115.23
11	D	503	8X0	O23-C20-C21	2.87	112.01	105.97
11	D	503	8X0	O15-C14-C13	-2.85	119.49	124.30
5	C	501	GTP	C4-C5-N7	-2.65	106.47	110.67
11	B	504	8X0	C7-C8-C9	-2.54	117.47	121.61
12	F	401	ACP	C5-N7-C8	2.53	107.42	103.45
9	B	501	GDP	C4-C5-N7	-2.51	106.69	110.67
5	A	501	GTP	C4-C5-N7	-2.47	106.75	110.67
5	D	501	GTP	C4-C5-N7	-2.47	106.76	110.67
11	D	503	8X0	C24-C11-C9	-2.45	120.60	124.07
5	A	501	GTP	O6-C6-C5	-2.45	120.08	126.53
12	F	401	ACP	C3'-C2'-C1'	2.44	106.07	101.46
11	D	503	8X0	C25-C6-C5	2.41	121.22	117.65
11	D	503	8X0	C16-O15-C14	-2.40	114.00	117.51
12	F	401	ACP	C4-N9-C8	2.35	108.20	105.74
11	B	504	8X0	C24-C11-C9	-2.33	120.78	124.07
11	B	504	8X0	C22-C20-C19	2.28	115.52	111.44
11	D	503	8X0	C20-C19-C18	-2.23	118.53	121.52
11	D	503	8X0	C11-C9-C8	-2.21	117.17	120.15
9	B	501	GDP	O6-C6-C5	-2.20	120.73	126.53
12	F	401	ACP	C6-C5-N7	2.19	136.32	132.09
11	B	504	8X0	C25-C6-C5	2.14	120.83	117.65
11	D	503	8X0	C24-C17-C18	2.10	120.00	117.84
12	F	401	ACP	PB-O3A-PA	-2.10	125.51	132.37
11	D	503	8X0	C4-C5-C6	-2.08	118.53	121.22
10	B	503	MES	C5-N4-C3	2.04	113.23	108.84
5	D	501	GTP	C2'-C3'-C4'	2.00	106.48	102.61

There are no chirality outliers.

All (49) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	501	GTP	PB-O3B-PG-O2G
5	A	501	GTP	C5'-O5'-PA-O3A
5	A	501	GTP	C5'-O5'-PA-O1A

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Mol	Chain	Res	Type	Atoms
5	C	501	GTP	C5'-O5'-PA-O3A
5	C	501	GTP	C5'-O5'-PA-O1A
5	D	501	GTP	PB-O3B-PG-O2G
5	D	501	GTP	C5'-O5'-PA-O1A
8	A	504	GOL	O1-C1-C2-C3
9	B	501	GDP	C5'-O5'-PA-O3A
9	B	501	GDP	C5'-O5'-PA-O1A
10	B	503	MES	N4-C7-C8-S
10	B	503	MES	C7-C8-S-O2S
10	B	503	MES	C7-C8-S-O3S
11	B	504	8X0	C26-C3-O2-C1
11	B	504	8X0	C4-C3-O2-C1
11	D	503	8X0	C7-C8-C9-O10
11	D	503	8X0	C7-C8-C9-C11
11	D	503	8X0	C13-C14-O15-C16
11	B	504	8X0	C13-C14-O15-C16
11	D	503	8X0	C17-C14-O15-C16
11	B	504	8X0	C17-C14-O15-C16
11	B	504	8X0	C7-C8-C9-C11
8	A	504	GOL	O1-C1-C2-O2
11	B	504	8X0	C7-C8-C9-O10
11	D	503	8X0	C24-C11-C9-O10
11	D	503	8X0	C24-C11-C9-C8
11	B	504	8X0	C24-C11-C9-O10
5	D	501	GTP	PB-O3A-PA-O2A
12	F	401	ACP	O4'-C4'-C5'-O5'
5	A	501	GTP	C5'-O5'-PA-O2A
5	C	501	GTP	C5'-O5'-PA-O2A
5	D	501	GTP	C5'-O5'-PA-O3A
5	D	501	GTP	C5'-O5'-PA-O2A
9	B	501	GDP	C5'-O5'-PA-O2A
5	D	501	GTP	C3'-C4'-C5'-O5'
5	C	501	GTP	C3'-C4'-C5'-O5'
5	C	501	GTP	PB-O3B-PG-O1G
5	D	501	GTP	O4'-C4'-C5'-O5'
5	A	501	GTP	PB-O3B-PG-O1G
5	A	501	GTP	PB-O3B-PG-O3G
5	C	501	GTP	PB-O3B-PG-O2G
5	C	501	GTP	PB-O3B-PG-O3G
5	C	501	GTP	O4'-C4'-C5'-O5'
5	C	501	GTP	PB-O3A-PA-O1A
5	D	501	GTP	PB-O3A-PA-O1A

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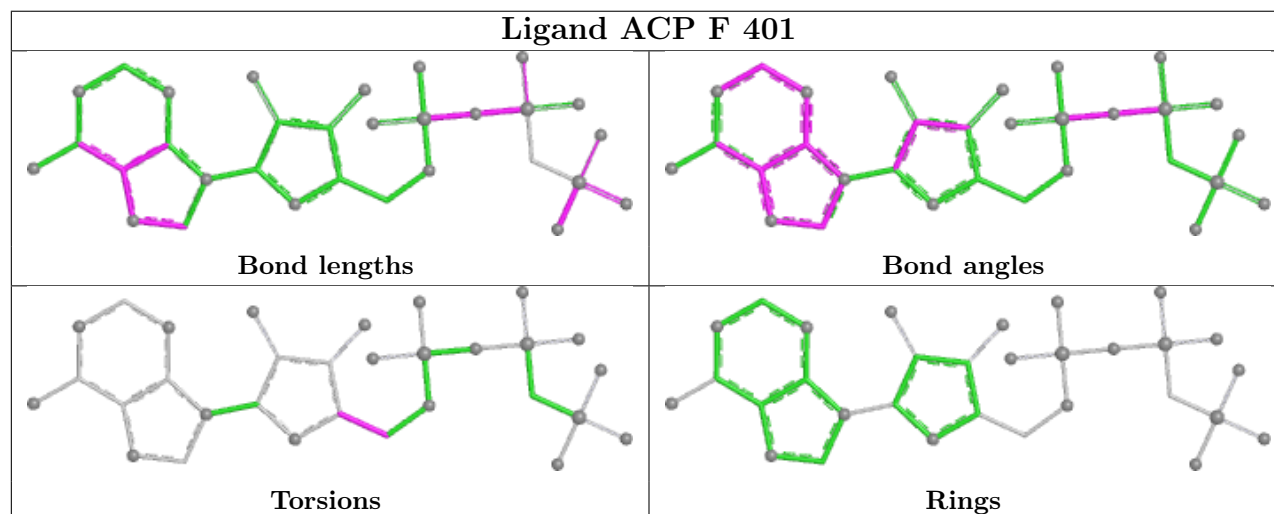
Mol	Chain	Res	Type	Atoms
11	B	504	8X0	C24-C11-C9-C8
5	A	501	GTP	PB-O3A-PA-O1A
5	C	501	GTP	PB-O3A-PA-O2A
12	F	401	ACP	C3'-C4'-C5'-O5'

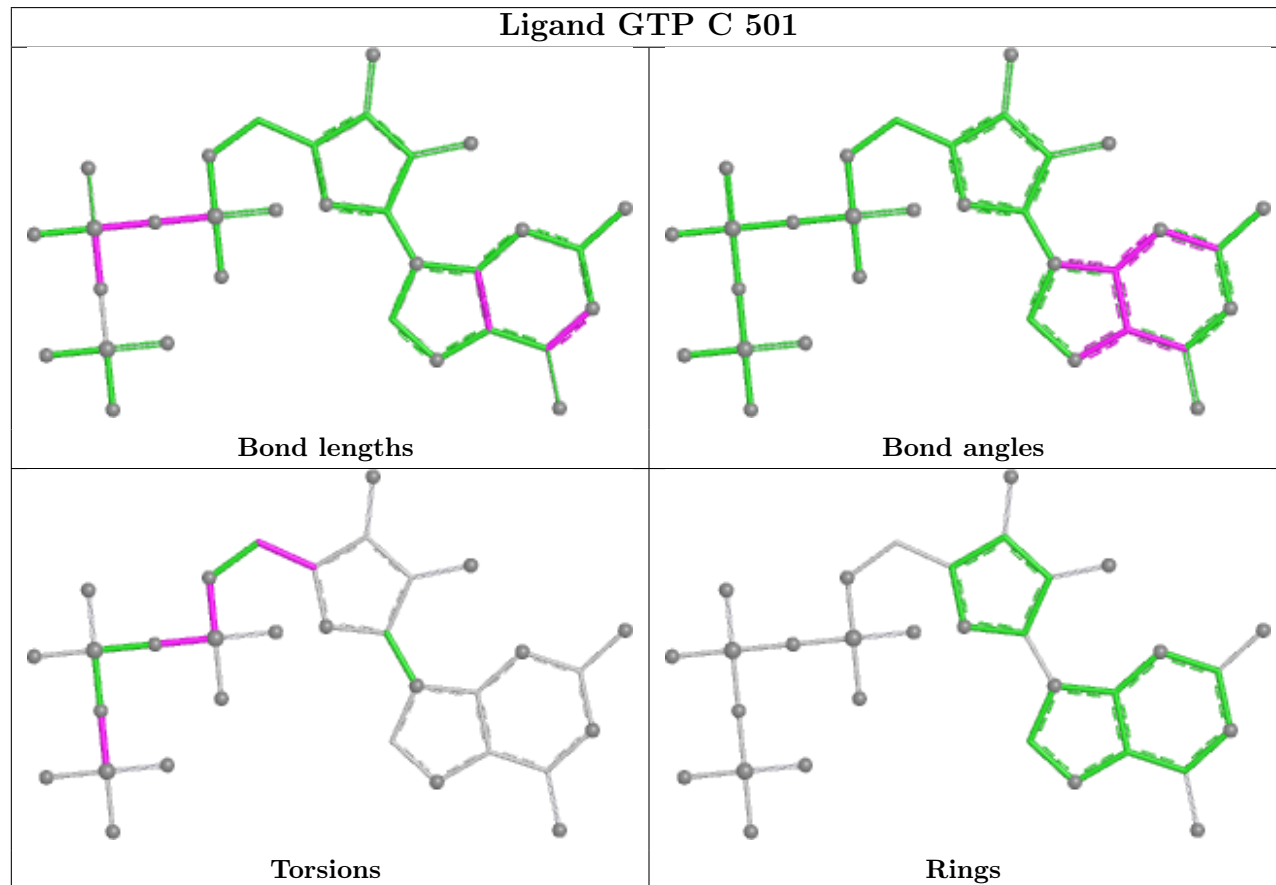
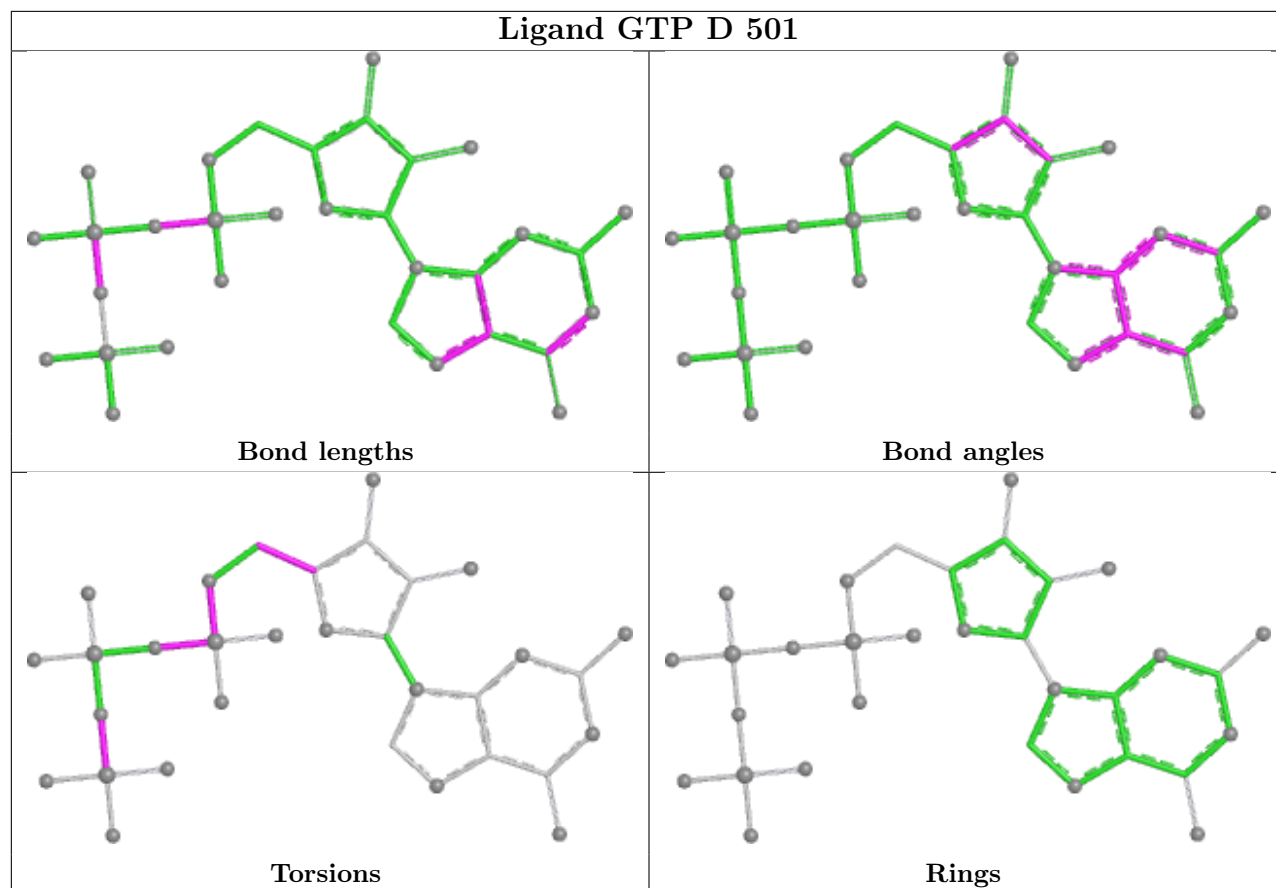
There are no ring outliers.

3 monomers are involved in 3 short contacts:

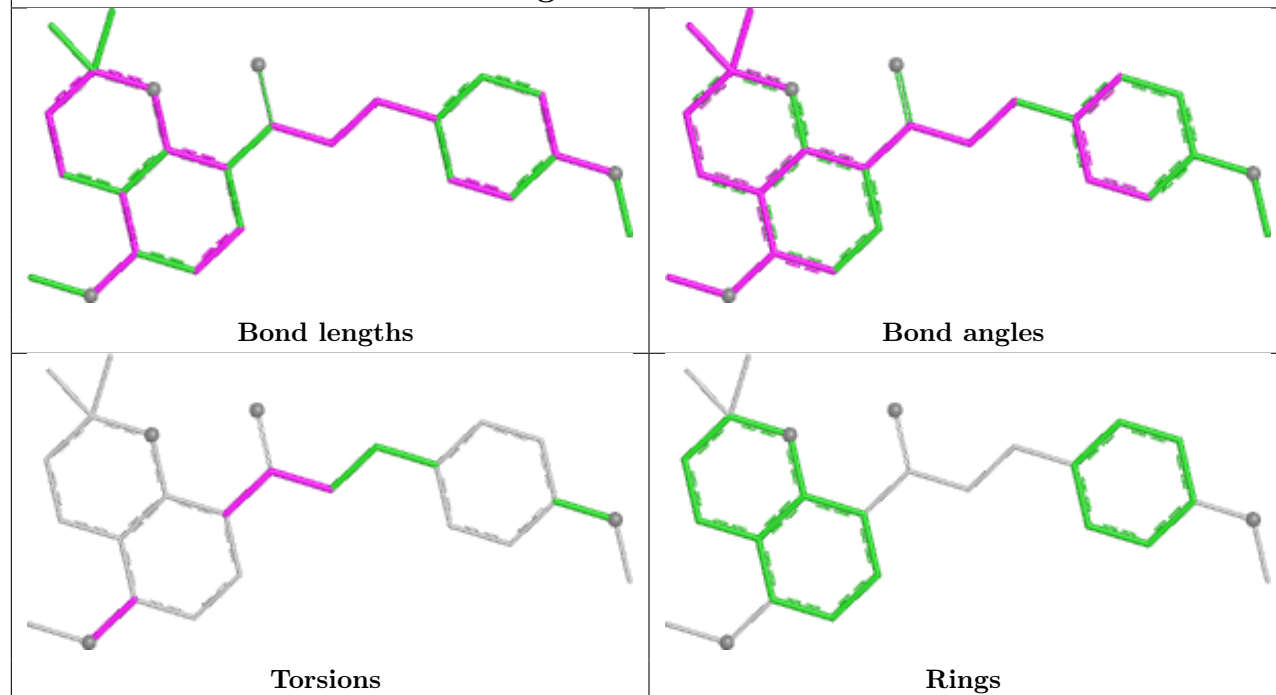
Mol	Chain	Res	Type	Clashes	Symm-Clashes
12	F	401	ACP	1	0
10	B	503	MES	1	0
11	D	503	8X0	1	0

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.

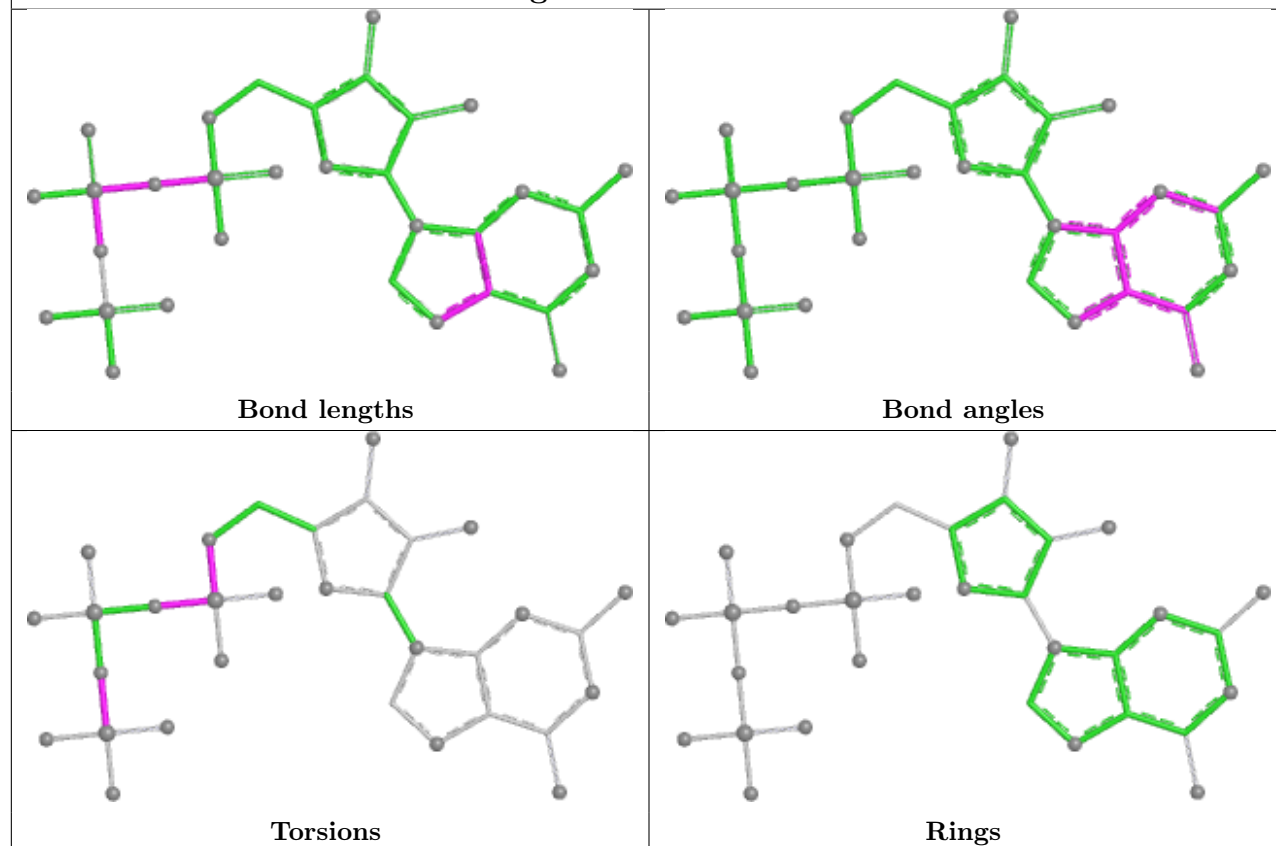


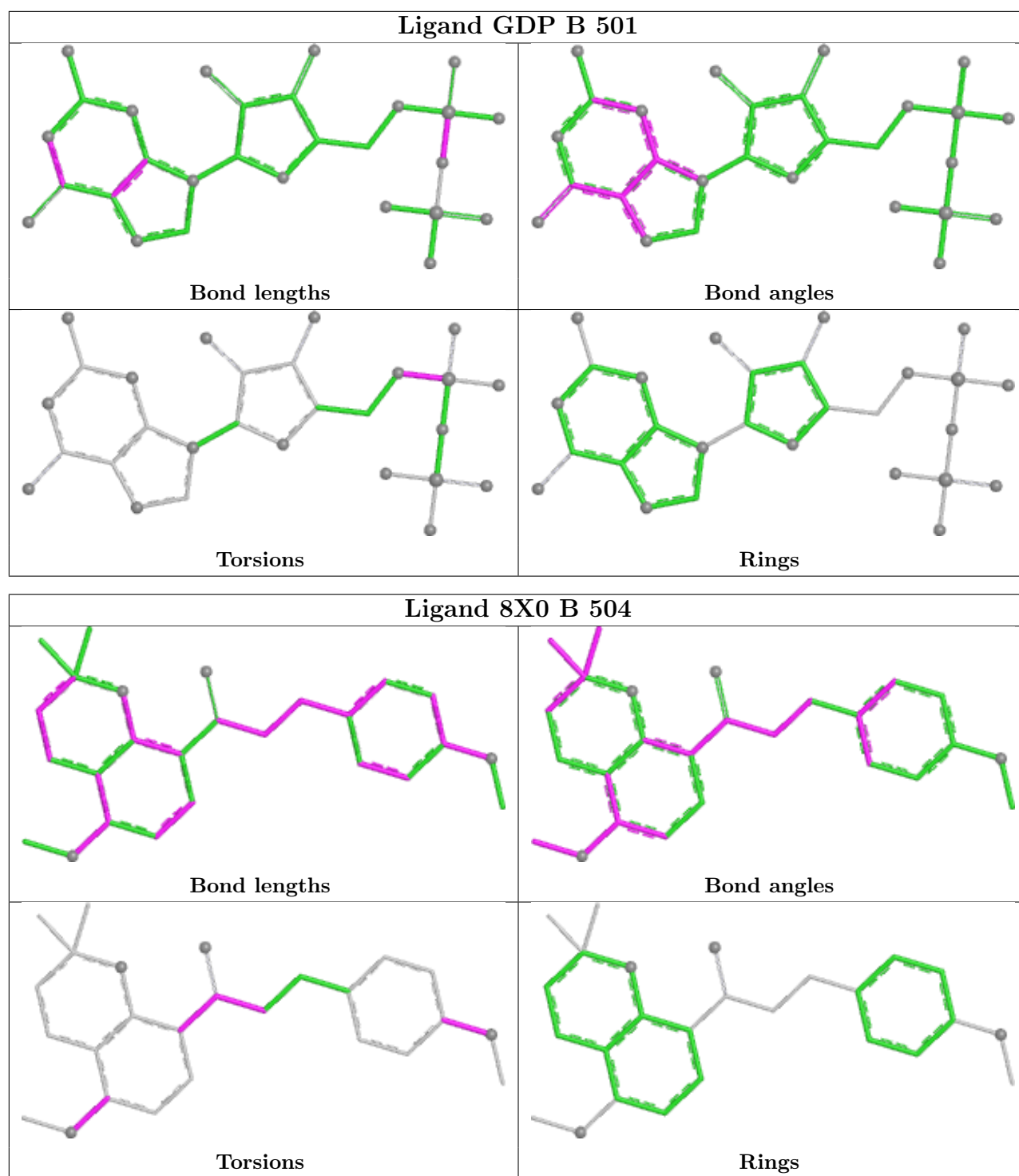


Ligand 8X0 D 503



Ligand GTP A 501





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	437/451 (96%)	0.12	3 (0%) 84 83	35, 58, 82, 105	0
1	C	440/451 (97%)	-0.14	7 (1%) 70 68	30, 48, 72, 94	0
2	B	428/445 (96%)	0.09	8 (1%) 66 63	35, 55, 85, 129	0
2	D	421/445 (94%)	0.77	40 (9%) 14 11	45, 79, 114, 136	0
3	E	121/143 (84%)	0.60	5 (4%) 41 37	47, 70, 105, 121	0
4	F	334/384 (86%)	0.73	30 (8%) 15 13	48, 83, 147, 159	0
All	All	2181/2319 (94%)	0.31	93 (4%) 40 36	30, 63, 114, 159	0

All (93) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	F	161	LEU	4.6
1	A	437	VAL	4.4
2	D	246	LEU	3.9
1	A	262	TYR	3.8
4	F	133	ALA	3.6
4	F	149	ALA	3.6
2	D	175	VAL	3.6
2	D	1	MET	3.4
4	F	130	VAL	3.4
4	F	132	LEU	3.3
4	F	134	ALA	3.2
3	E	6	MET	3.2
4	F	169	LEU	3.1
2	D	247	ASN	3.0
2	B	428	ALA	3.0
2	D	284	LEU	2.9
2	D	170	MET	2.9
2	D	397	TRP	2.9
2	D	92	PHE	2.8

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Mol	Chain	Res	Type	RSRZ
2	B	245	GLN	2.8
2	D	179	VAL	2.8
2	D	219	THR	2.7
4	F	103	THR	2.7
2	B	246	LEU	2.7
4	F	181	VAL	2.7
4	F	233	PHE	2.7
4	F	362	ALA	2.7
2	D	377	LEU	2.6
2	D	73	MET	2.6
2	D	94	GLN	2.6
2	D	221	THR	2.5
4	F	237	THR	2.5
4	F	245	ILE	2.5
4	F	243	HIS	2.5
1	C	440	VAL	2.5
2	D	54	ALA	2.5
2	D	55	THR	2.5
2	D	80	PRO	2.5
4	F	263	PHE	2.5
4	F	173	ILE	2.5
4	F	182	ILE	2.5
4	F	172	PHE	2.4
4	F	186	LEU	2.4
2	D	95	SER	2.4
3	E	27	PRO	2.4
3	E	8	VAL	2.4
4	F	131	PHE	2.4
4	F	372	THR	2.4
2	D	396	HIS	2.4
4	F	330	ILE	2.3
4	F	380	HIS	2.3
1	C	283	HIS	2.3
4	F	86	GLU	2.3
2	D	211	CYS	2.3
2	D	76	VAL	2.3
2	D	394	PHE	2.3
1	C	357	TYR	2.3
2	D	82	GLY	2.3
1	C	302	MET	2.3
2	D	72	THR	2.3
2	B	57	ASN	2.3

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Mol	Chain	Res	Type	RSRZ
1	A	88	HIS	2.2
1	C	285	GLN	2.2
2	D	393	ALA	2.2
2	B	55	THR	2.2
2	D	245	GLN	2.2
2	D	180	VAL	2.2
4	F	180	HIS	2.2
2	D	220	PRO	2.2
2	B	280	GLN	2.2
2	D	381	ILE	2.2
4	F	240	LEU	2.1
2	D	110	ALA	2.1
2	D	387	ALA	2.1
2	D	99	ASN	2.1
2	D	75	SER	2.1
3	E	141	GLU	2.1
2	D	2	ARG	2.1
2	B	58	LYS	2.1
2	D	185	ALA	2.1
2	D	306	ARG	2.1
2	D	101	TRP	2.1
2	D	217	LEU	2.1
4	F	333	ASN	2.1
1	C	282	TYR	2.1
4	F	98	TYR	2.1
3	E	28	SER	2.0
2	D	294	PHE	2.0
2	D	97	ALA	2.0
1	C	340	SER	2.0
4	F	170	LEU	2.0
2	B	277	GLY	2.0
4	F	179	VAL	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

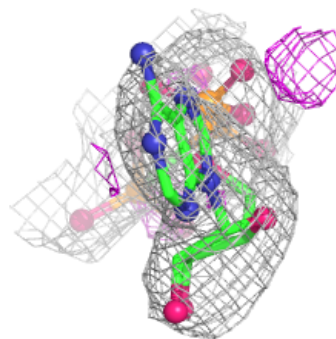
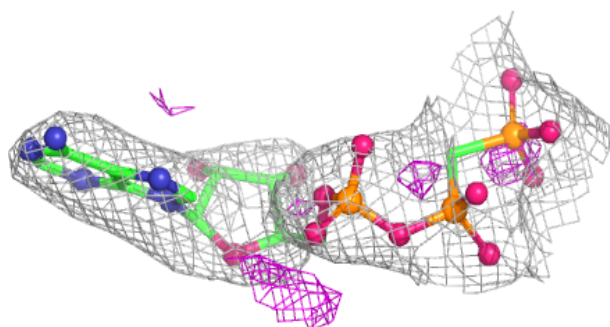
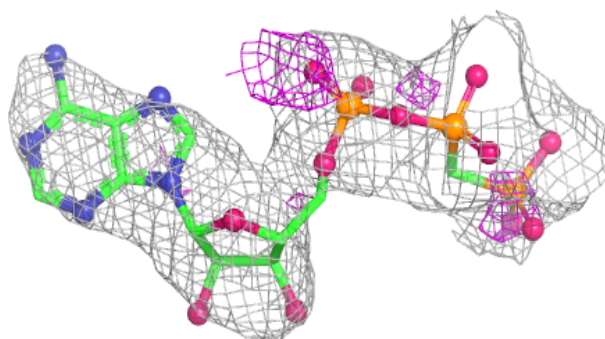
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists 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	MES	B	503	12/12	0.83	0.18	85,93,98,100	0
12	ACP	F	401	31/31	0.83	0.11	104,110,133,139	0
11	8X0	D	503	26/26	0.87	0.27	108,125,137,139	0
5	GTP	D	501	32/32	0.89	0.10	67,73,88,92	0
11	8X0	B	504	26/26	0.90	0.21	75,81,86,87	0
8	GOL	A	504	6/6	0.92	0.11	73,74,75,76	0
6	MG	D	502	1/1	0.94	0.05	83,83,83,83	0
7	CA	C	503	1/1	0.96	0.07	64,64,64,64	0
5	GTP	A	501	32/32	0.96	0.06	37,41,42,44	0
7	CA	A	503	1/1	0.96	0.07	70,70,70,70	0
5	GTP	C	501	32/32	0.98	0.05	35,39,40,40	0
9	GDP	B	501	28/28	0.98	0.05	36,41,43,44	0
6	MG	A	502	1/1	0.99	0.02	34,34,34,34	0
6	MG	C	502	1/1	1.00	0.02	40,40,40,40	0
6	MG	B	502	1/1	1.00	0.03	43,43,43,43	0

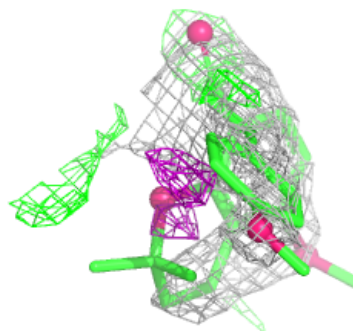
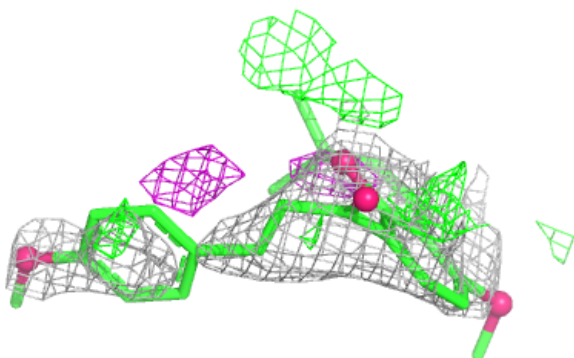
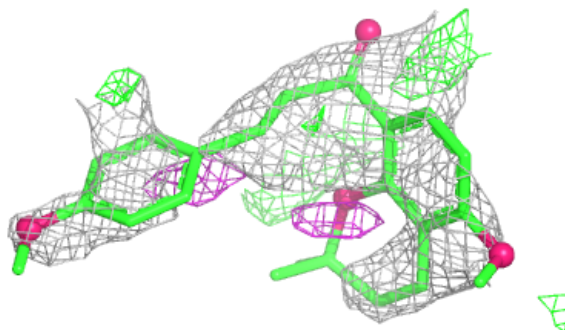
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around ACP F 401:

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

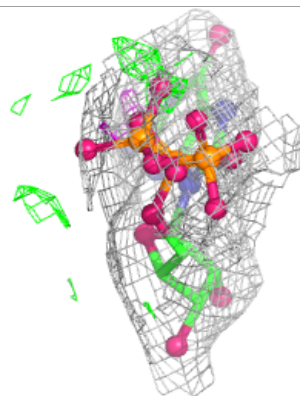
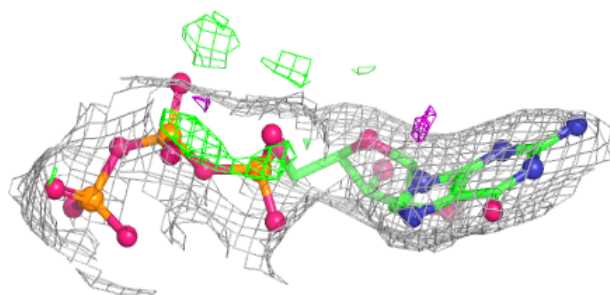
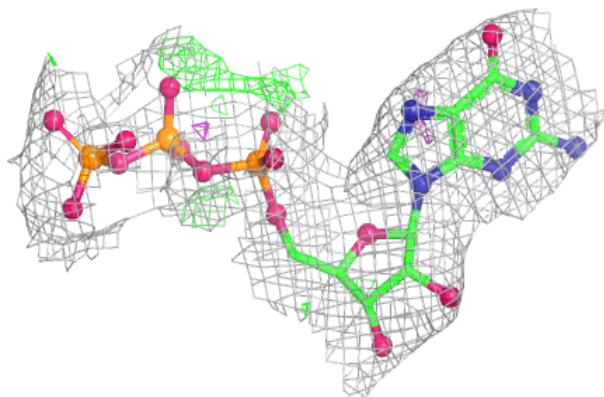
**Electron density around 8X0 D 503:**

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

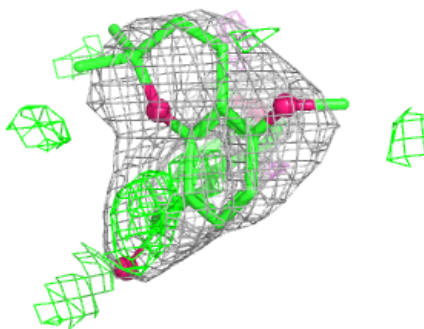
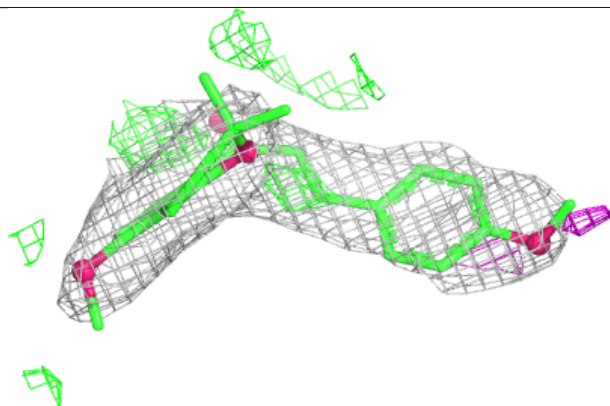
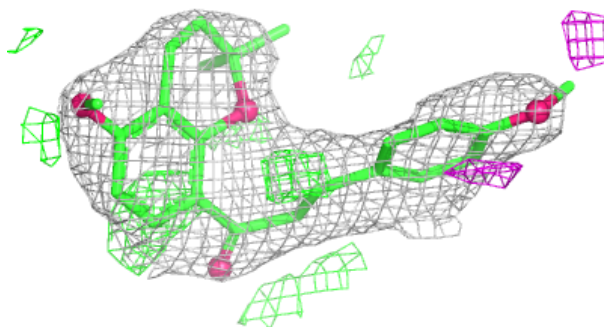


Electron density around GTP D 501:

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

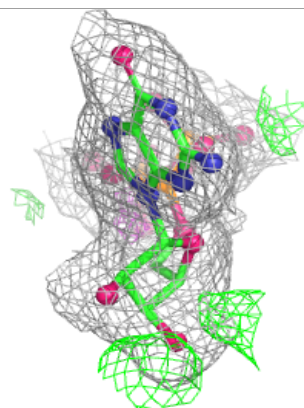
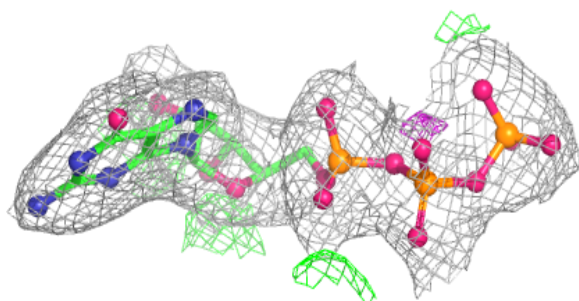
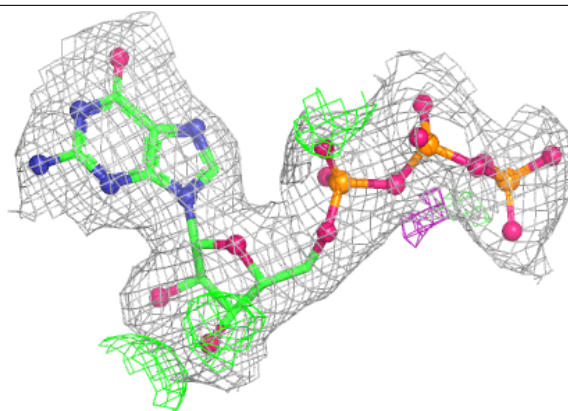
**Electron density around 8X0 B 504:**

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

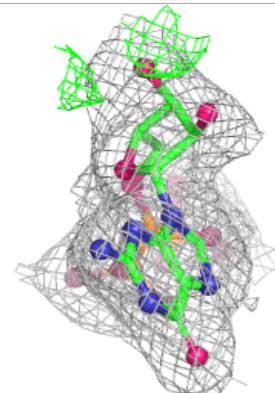
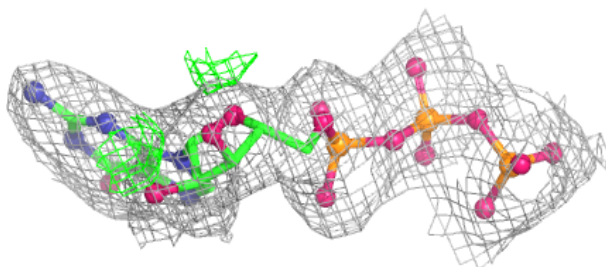
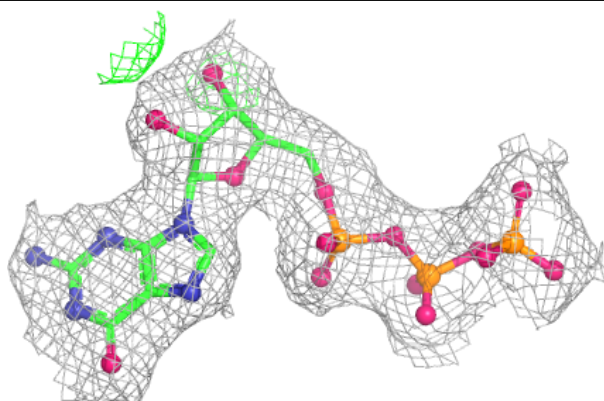


Electron density around GTP A 501:

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

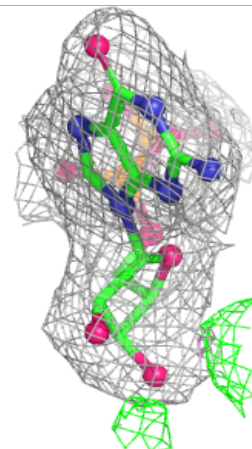
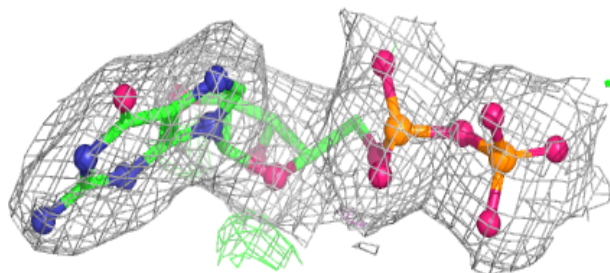
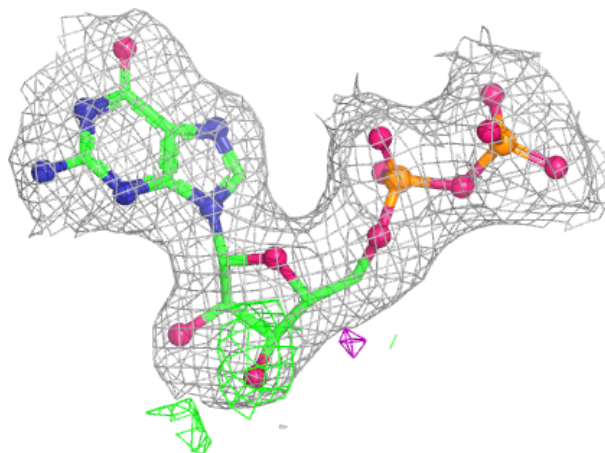
**Electron density around GTP C 501:**

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



Electron density around GDP B 501:

$2mF_o-DF_c$ (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.