



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 02:11 PM UTC

PDB ID : 4TUY / pdb\_00004tuy  
Title : Tubulin-Rhizoxin complex  
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Deposited on : 2014-06-25  
Resolution : 2.10 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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

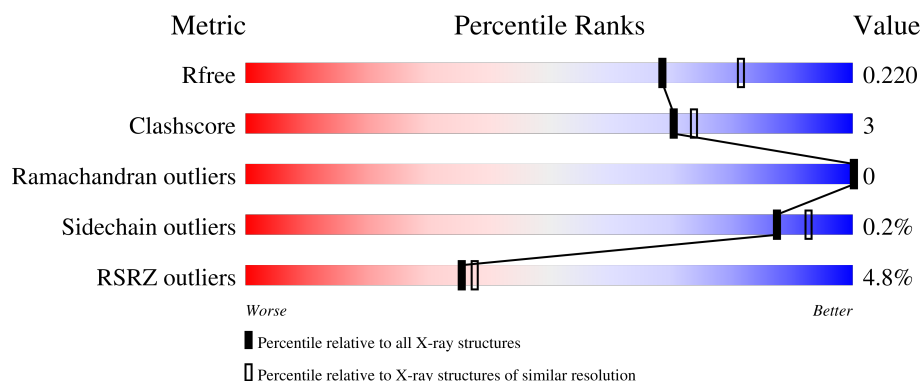
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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	6658 (2.10-2.10)
Clashscore	190562	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)
RSRZ outliers	180081	6662 (2.10-2.10)

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  $\geq 3$ , 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	<div> <div>2%</div> <div>87% 10% .</div> </div>
1	C	451	<div> <div>3%</div> <div>91% 7% .</div> </div>
2	B	445	<div> <div>3%</div> <div>88% 7% 5%</div> </div>
2	D	445	<div> <div>3%</div> <div>87% 8% 5%</div> </div>
3	E	143	<div> <div>4%</div> <div>80% . 16%</div> </div>

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Mol	Chain	Length	Quality of chain
4	F	384	<div><div></div><div>12%</div><div>78%</div><div>9%</div><div>13%</div></div>

## 2 Entry composition

There are 12 unique types of molecules in this entry. The entry contains 18801 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	438	Total	C	N	O	S	0	12	0
			3475	2210	583	657	25			
1	C	440	Total	C	N	O	S	0	10	0
			3475	2203	585	663	24			

- Molecule 2 is a protein called Tubulin beta-2B chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	424	Total	C	N	O	S	0	8	0
			3372	2121	571	652	28			
2	D	422	Total	C	N	O	S	0	3	0
			3325	2090	563	644	28			

- Molecule 3 is a protein called Stathmin-4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	E	120	Total	C	N	O	S	0	2	0
			1002	619	182	196	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

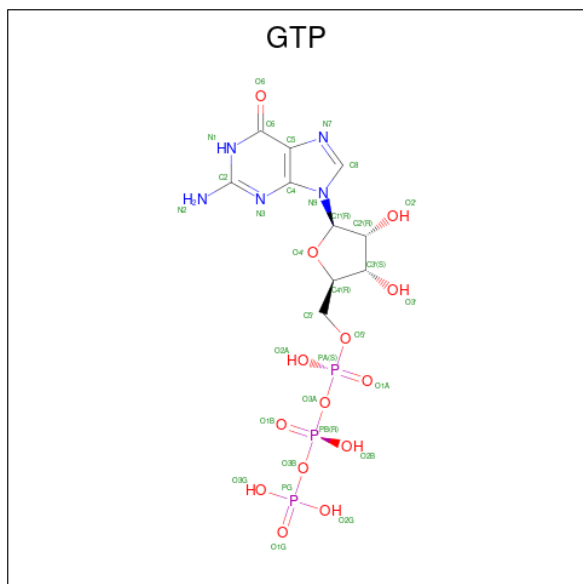
- Molecule 4 is a protein called Tubulin-Tyrosine Ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	F	335	Total	C	N	O	S	0	0	0
			2749	1768	467	500	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		

- 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		
6	D	1	Total	Mg	0	0
			1	1		

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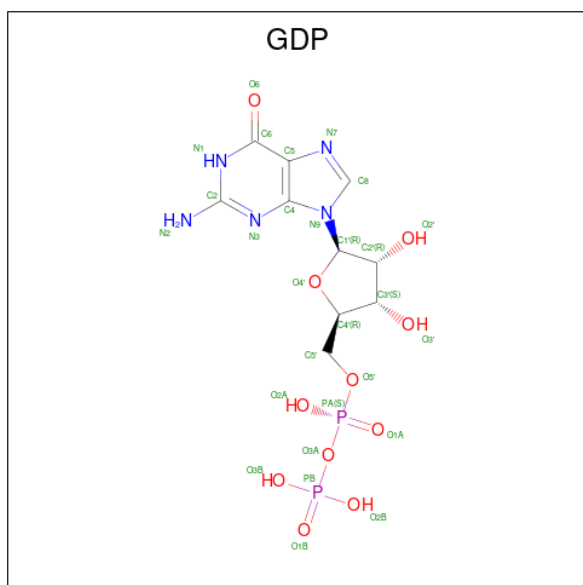
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	F	1	Total	Mg	0	0
			1	1		

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

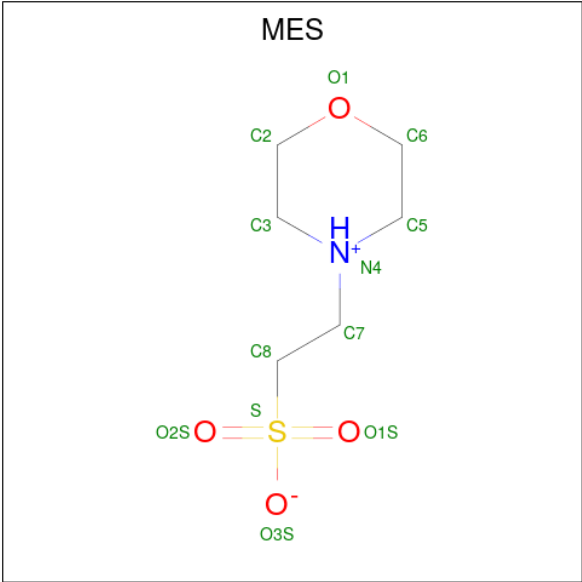
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	1	Total	Ca	0	0
			1	1		
7	C	1	Total	Ca	0	0
			1	1		

- Molecule 8 is GUANOSINE-5'-DIPHOSPHATE (CCD ID: GDP) (formula: C<sub>10</sub>H<sub>15</sub>N<sub>5</sub>O<sub>11</sub>P<sub>2</sub>).



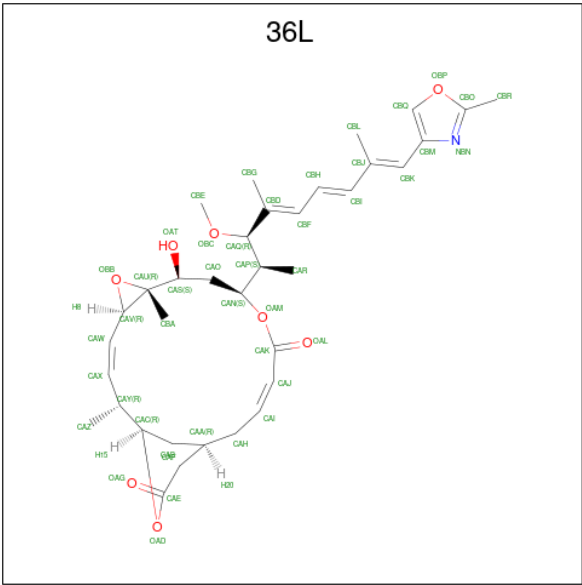
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
8	B	1	Total 28	C 10	N 5	O 11	P 2	0	0
8	D	1	Total 28	C 10	N 5	O 11	P 2	0	0

- Molecule 9 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: C<sub>6</sub>H<sub>13</sub>NO<sub>4</sub>S).



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

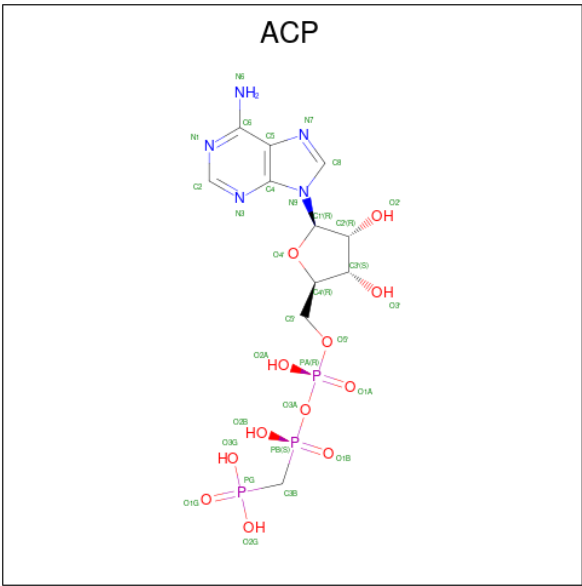
- Molecule 10 is (1R,2R,3E,5R,7R,8S,10S,13E,16R)-8-hydroxy-10-[(2S,3R,4E,6E,8E)-3-methoxy-4,8-dimethyl-9-(2-methyl-1,3-oxazol-4-yl)nona-4,6,8-trien-2-yl]-2,7-dimethyl-6,11,19-trioxatricyclo[14.3.1.0 5,7 ]icosa-3,13-diene-12,18-dione (CCD ID: 36L) (formula: C<sub>35</sub>H<sub>47</sub>NO<sub>8</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
10	D	1	44	35	1	8	0	0

- Molecule 11 is PHOSPHOMETHYLPHOSPHONIC ACID ADENYLATE ESTER (CCD

ID: ACP) (formula: C<sub>11</sub>H<sub>18</sub>N<sub>5</sub>O<sub>12</sub>P<sub>3</sub>).



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

- Molecule 12 is water.

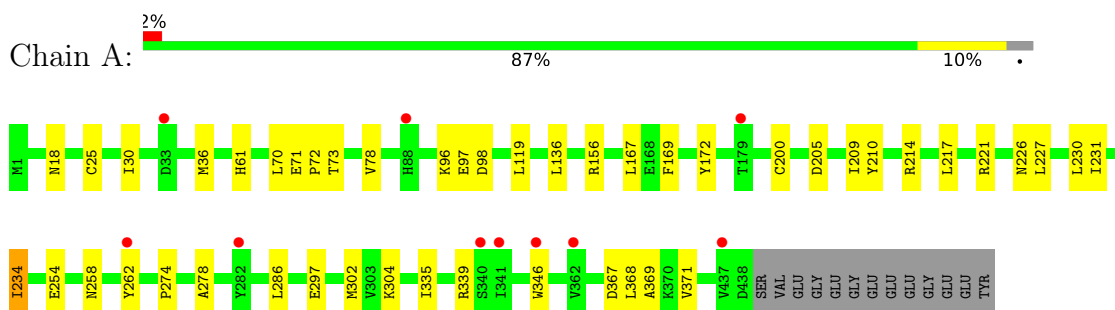
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
12	A	244	Total	O	0	0
			244	244		
12	B	226	Total	O	0	0
			226	226		
12	C	378	Total	O	0	0
			378	378		
12	D	172	Total	O	0	0
			172	172		
12	E	74	Total	O	0	0
			74	74		
12	F	95	Total	O	0	0
			95	95		



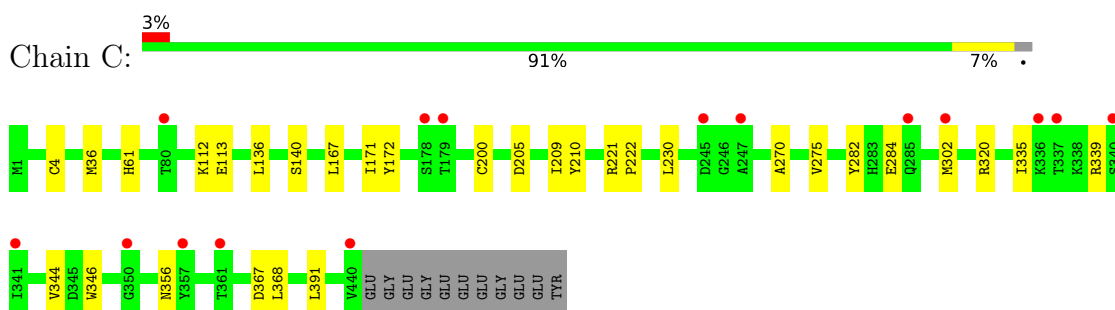
### 3 Residue-property plots [i](#)

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.

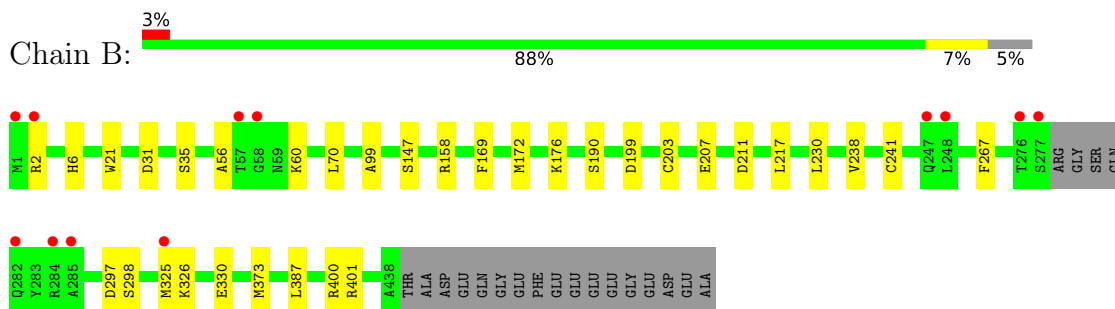
- Molecule 1: Tubulin alpha-1B chain



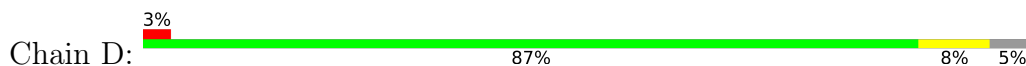
- Molecule 1: Tubulin alpha-1B chain

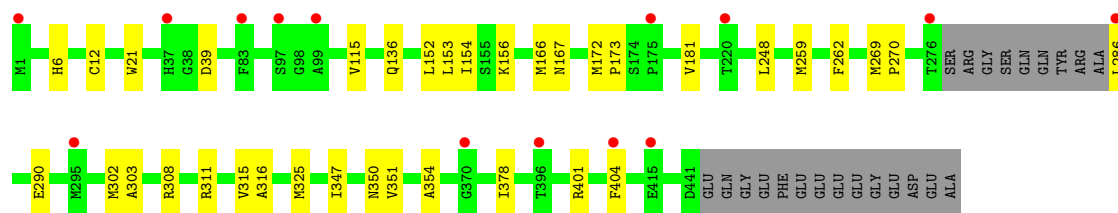


- Molecule 2: Tubulin beta-2B chain

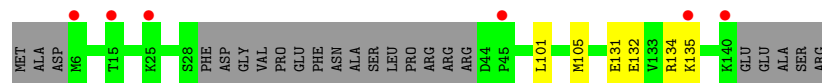
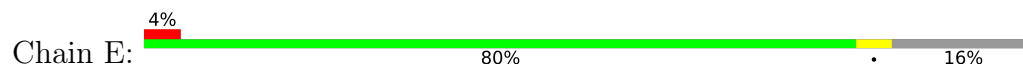


- Molecule 2: Tubulin beta-2B chain

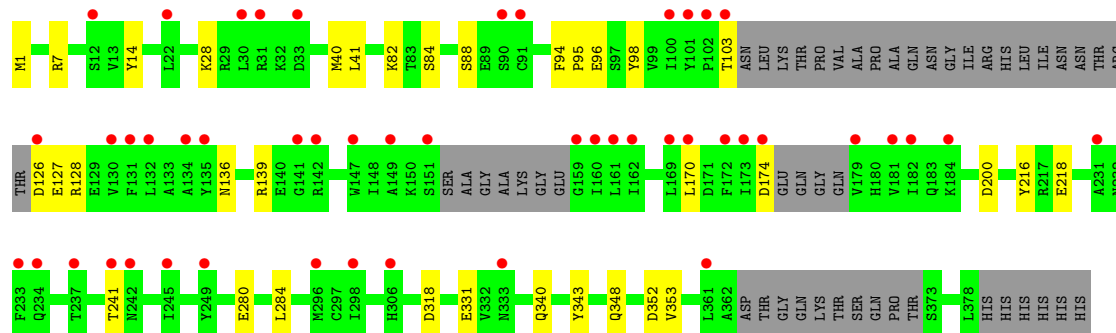
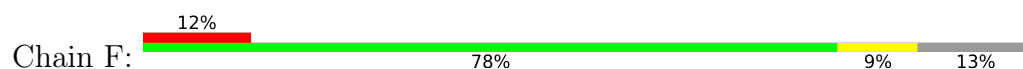




● Molecule 3: Stathmin-4



● 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, $\alpha$ , $\beta$ , $\gamma$	104.31Å 156.92Å 181.12Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	62.70 – 2.10 62.70 – 2.10	Depositor EDS
% Data completeness (in resolution range)	100.0 (62.70-2.10) 99.9 (62.70-2.10)	Depositor EDS
$R_{merge}$	0.17	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.45 (at 2.10Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE: 1.9_1692)	Depositor
R, $R_{free}$	0.184 , 0.217 0.189 , 0.220	Depositor DCC
$R_{free}$ test set	8663 reflections (4.33%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	36.8	Xtriage
Anisotropy	0.282	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 59.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	18801	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.48% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: ACP, GTP, MG, GDP, 36L, CA, MES

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	0.28	0/3590	0.71	2/4875 (0.0%)
1	C	0.29	0/3583	0.68	0/4867
2	B	0.29	0/3467	0.67	0/4695
2	D	0.28	0/3407	0.68	2/4615 (0.0%)
3	E	0.27	0/1016	0.62	0/1348
4	F	0.25	0/2810	0.66	0/3794
All	All	0.28	0/17873	0.68	4/24194 (0.0%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	262	PHE	CA-C-N	5.92	125.40	119.24
2	D	262	PHE	C-N-CA	5.92	125.40	119.24
1	A	262	TYR	CA-C-N	5.52	124.98	119.24
1	A	262	TYR	C-N-CA	5.52	124.98	119.24

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	3475	0	3429	31	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	3475	0	3410	18	0
2	B	3372	0	3265	21	0
2	D	3325	0	3211	25	0
3	E	1002	0	1026	3	0
4	F	2749	0	2728	20	0
5	A	32	0	12	0	0
5	C	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
6	F	1	0	0	0	0
7	A	1	0	0	0	0
7	C	1	0	0	0	0
8	B	28	0	12	0	0
8	D	28	0	12	1	0
9	B	12	0	13	3	0
10	D	44	0	47	9	0
11	F	31	0	14	2	0
12	A	244	0	0	2	0
12	B	226	0	0	2	0
12	C	378	0	0	1	0
12	D	172	0	0	3	0
12	E	74	0	0	0	0
12	F	95	0	0	1	0
All	All	18801	0	17191	118	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 3.

All (118) 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)
10:D:503:36L:H47	10:D:503:36L:H40	1.20	1.13
10:D:503:36L:H40	10:D:503:36L:CBQ	1.91	0.96
2:D:404:PHE:HE1	10:D:503:36L:H41	1.36	0.90
2:D:404:PHE:CE1	10:D:503:36L:H41	2.14	0.82
1:A:71:GLU:OE2	1:A:73:THR:OG1	1.97	0.82
2:B:147[A]:SER:HG	2:B:190:SER:HG	1.33	0.76
2:B:211:ASP:OD2	12:B:753:HOH:O	2.06	0.73
2:D:270:PRO:HG2	2:D:302:MET:HB2	1.69	0.73

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:367:ASP:OD2	12:C:902:HOH:O	2.09	0.70
3:E:131:GLU:OE2	3:E:134:ARG:NH2	2.24	0.68
2:D:269:MET:HG3	2:D:303:ALA:HB3	1.76	0.68
2:B:199:ASP:OD2	9:B:503:MES:H52	1.95	0.66
4:F:318:ASP:OD2	11:F:401:ACP:O3G	2.12	0.66
1:C:270:ALA:HB3	1:C:302:MET:HE2	1.78	0.65
2:B:326:LYS:NZ	2:B:330:GLU:OE2	2.27	0.65
4:F:82:LYS:NZ	4:F:127:GLU:OE1	2.29	0.64
4:F:348:GLN:NE2	4:F:352:ASP:OD1	2.31	0.64
4:F:280:GLU:HA	4:F:284:LEU:HB2	1.81	0.62
4:F:1:MET:HE3	4:F:28:LYS:HB2	1.81	0.62
10:D:503:36L:OAL	10:D:503:36L:H35	2.00	0.61
1:A:209[A]:ILE:HG23	1:A:230:LEU:HD23	1.82	0.61
2:D:181:VAL:HG21	10:D:503:36L:CBK	2.34	0.57
1:C:209:ILE:HG23	1:C:230:LEU:HD23	1.89	0.55
2:D:6:HIS:CD2	2:D:21:TRP:HE1	2.25	0.54
2:B:56:ALA:HB3	2:B:60:LYS:HB2	1.90	0.54
2:B:158:ARG:CZ	9:B:503:MES:H21	2.38	0.53
2:B:400:ARG:HG3	2:B:401:ARG:HG2	1.90	0.53
2:B:6:HIS:CD2	2:B:21:TRP:HE1	2.27	0.52
1:C:112:LYS:NZ	1:C:113:GLU:OE2	2.41	0.52
2:D:286:LEU:N	2:D:290:GLU:OE1	2.42	0.52
2:B:176:LYS:HD2	2:B:207:GLU:HG3	1.91	0.52
2:D:308:ARG:NH1	12:D:601:HOH:O	2.39	0.52
4:F:128:ARG:NH1	4:F:170:LEU:HD13	2.25	0.51
1:A:209[B]:ILE:HD13	1:A:231:ILE:HD11	1.92	0.51
1:A:221:ARG:NH2	2:B:325:MET:SD	2.84	0.51
1:A:209[B]:ILE:HD12	1:A:227:LEU:HB3	1.92	0.51
1:A:221:ARG:HG2	2:B:325:MET:HB3	1.93	0.51
1:A:71:GLU:O	12:A:665:HOH:O	2.19	0.51
1:C:4[A]:CYS:SG	1:C:136:LEU:HG	2.51	0.50
1:A:210:TYR:CE2	1:A:214:ARG:HD2	2.46	0.50
1:A:172:TYR:HB3	1:A:205:ASP:HA	1.94	0.50
1:C:167:LEU:HG	1:C:200:CYS:HB3	1.94	0.50
2:B:31:ASP:OD2	2:B:35:SER:HB2	2.12	0.49
1:A:274:PRO:HB3	1:A:286:LEU:HD12	1.95	0.49
1:C:172:TYR:HB3	1:C:205:ASP:HA	1.95	0.49
1:A:71:GLU:HG2	1:A:72:PRO:HD2	1.95	0.49
2:D:115:VAL:HG23	2:D:153:LEU:HD23	1.95	0.48
4:F:340:GLN:HA	4:F:343:TYR:HD2	1.79	0.48
1:A:226:ASN:ND2	1:A:367:ASP:OD2	2.44	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:316:ALA:HB3	2:D:378:ILE:HB	1.96	0.47
2:D:12:CYS:HB2	8:D:501:GDP:C8	2.49	0.47
3:E:132:GLU:HA	3:E:135:LYS:HG2	1.96	0.47
1:A:304:LYS:NZ	12:A:768:HOH:O	2.47	0.47
2:D:401:ARG:HD2	10:D:503:36L:H44	1.97	0.46
1:C:140:SER:HA	1:C:171:ILE:HB	1.98	0.46
4:F:84:SER:O	4:F:88:SER:N	2.42	0.46
4:F:128:ARG:HH12	4:F:170:LEU:HD13	1.81	0.46
1:C:335:ILE:HG23	1:C:339:ARG:HG3	1.96	0.46
1:A:254:GLU:HG2	1:A:258:ASN:ND2	2.31	0.46
2:B:241[B]:CYS:SG	12:B:665:HOH:O	2.61	0.46
2:D:347:ILE:HG22	2:D:350:ASN:HB3	1.98	0.45
4:F:136:ASN:HA	4:F:139:ARG:HB3	1.99	0.45
4:F:14:TYR:HB3	4:F:41:LEU:HD13	1.97	0.45
1:C:36:MET:HB3	1:C:61:HIS:CE1	2.50	0.45
2:D:311:ARG:NH1	12:D:632:HOH:O	2.49	0.45
1:A:335:ILE:HG23	1:A:339:ARG:HD2	1.99	0.45
2:D:39:ASP:N	2:D:39:ASP:OD1	2.49	0.44
1:A:136[B]:LEU:HD23	1:A:169:PHE:HE1	1.83	0.44
1:C:172:TYR:CE2	1:C:391:LEU:HD22	2.52	0.44
4:F:126:ASP:OD1	4:F:128:ARG:HG3	2.17	0.44
2:B:172:MET:HG3	2:B:387:LEU:HD11	2.00	0.44
1:A:278:ALA:HA	1:A:369:ALA:HB2	1.99	0.44
2:D:259:MET:HE2	2:D:378:ILE:HG22	2.00	0.44
2:D:248:LEU:HD23	2:D:354:ALA:HB2	1.99	0.44
4:F:331:GLU:OE2	11:F:401:ACP:O2B	2.35	0.44
1:A:209[A]:ILE:HD11	1:A:302[A]:MET:SD	2.57	0.44
2:B:203:CYS:SG	2:B:267:PHE:HB3	2.58	0.44
1:C:221:ARG:HD2	2:D:325:MET:HE3	2.00	0.43
4:F:103:THR:OG1	4:F:174:ASP:OD2	2.27	0.43
2:D:152:LEU:O	2:D:156:LYS:HG2	2.18	0.43
2:B:217:LEU:HD11	2:B:230:LEU:HD21	2.00	0.43
1:A:167:LEU:HG	1:A:200:CYS:HB3	2.01	0.43
1:C:221:ARG:HG3	2:D:325:MET:HG2	2.00	0.43
2:B:70:LEU:HD12	2:B:99:ALA:HB2	2.01	0.42
4:F:96:GLU:OE2	4:F:98:TYR:OH	2.24	0.42
4:F:200:ASP:OD2	4:F:241:THR:OG1	2.28	0.42
2:B:199:ASP:OD1	9:B:503:MES:H32	2.19	0.42
10:D:503:36L:H7	10:D:503:36L:H1	1.86	0.42
1:A:25:CYS:HB3	1:A:30:ILE:O	2.20	0.42
1:A:217:LEU:HD21	1:A:368:LEU:HD23	2.01	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:346:TRP:CD1	1:A:346:TRP:H	2.37	0.42
2:D:167:ASN:ND2	12:D:648:HOH:O	2.51	0.42
3:E:101:LEU:O	3:E:105:MET:HG2	2.20	0.42
4:F:94:PHE:HA	4:F:95:PRO:HD3	1.90	0.42
1:A:119:LEU:HD11	1:A:156:ARG:HB3	2.01	0.42
1:A:274:PRO:HG2	1:A:371:VAL:HG11	2.02	0.41
1:C:210:TYR:CZ	1:C:222:PRO:HD2	2.55	0.41
2:D:136:GLN:HA	2:D:167:ASN:O	2.20	0.41
2:D:315:VAL:HB	2:D:351:VAL:HG22	2.01	0.41
1:C:320:ARG:HA	1:C:356:ASN:O	2.20	0.41
2:D:172:MET:HA	2:D:173:PRO:HD3	1.82	0.41
1:A:297:GLU:OE2	1:A:339:ARG:NH2	2.34	0.41
4:F:7:ARG:HD3	4:F:40:MET:HE3	2.02	0.41
1:A:18:ASN:HD21	1:A:78:VAL:HG22	1.85	0.41
4:F:14:TYR:OH	12:F:514:HOH:O	2.22	0.41
1:A:36:MET:HB3	1:A:61:HIS:CE1	2.55	0.41
1:A:70:LEU:HB2	1:A:98:ASP:HA	2.02	0.41
2:D:154:ILE:HG23	2:D:166:MET:HG2	2.03	0.41
1:A:230:LEU:O	1:A:234:ILE:HD12	2.21	0.41
1:C:275:VAL:HG13	1:C:368:LEU:HD21	2.03	0.41
1:C:282:TYR:O	1:C:284:GLU:HG2	2.21	0.41
4:F:216:TYR:CZ	4:F:218:GLU:HB2	2.56	0.41
1:A:71:GLU:HB2	1:A:98:ASP:HB3	2.03	0.41
1:A:97:GLU:OE2	2:B:2:ARG:NH2	2.54	0.41
10:D:503:36L:CBQ	10:D:503:36L:CBL	2.76	0.41
1:C:344:VAL:HG21	1:C:346:TRP:CE2	2.57	0.40
2:B:169:PHE:HE2	2:B:238[A]:VAL:HG21	1.87	0.40
2:B:297:ASP:OD1	2:B:298:SER:N	2.54	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.



Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	448/451 (99%)	437 (98%)	11 (2%)	0	100	100
1	C	448/451 (99%)	441 (98%)	7 (2%)	0	100	100
2	B	428/445 (96%)	420 (98%)	8 (2%)	0	100	100
2	D	421/445 (95%)	414 (98%)	7 (2%)	0	100	100
3	E	118/143 (82%)	117 (99%)	1 (1%)	0	100	100
4	F	325/384 (85%)	315 (97%)	10 (3%)	0	100	100
All	All	2188/2319 (94%)	2144 (98%)	44 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	381/379 (100%)	379 (100%)	2 (0%)	81	88
1	C	381/379 (100%)	381 (100%)	0	100	100
2	B	375/383 (98%)	374 (100%)	1 (0%)	86	91
2	D	368/383 (96%)	368 (100%)	0	100	100
3	E	110/127 (87%)	110 (100%)	0	100	100
4	F	302/342 (88%)	301 (100%)	1 (0%)	86	91
All	All	1917/1993 (96%)	1913 (100%)	4 (0%)	87	93

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	96	LYS
1	A	234	ILE
2	B	373	MET
4	F	353	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	393	HIS
2	B	300	ASN
2	B	331	GLN
2	B	349	ASN
1	C	393	HIS
2	D	37	HIS
2	D	101	ASN
2	D	331	GLN
3	E	12	ASN
4	F	269	GLN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

## 5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 14 ligands modelled in this entry, 7 are monoatomic - leaving 7 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	$\# Z  > 2$
9	MES	B	503	-	12,12,12	2.29	1 (8%)	15,16,16	1.03	1 (6%)
8	GDP	B	501	6	29,30,30	1.18	3 (10%)	45,47,47	1.73	6 (13%)
5	GTP	A	501	6	33,34,34	1.25	4 (12%)	50,54,54	1.65	6 (12%)
5	GTP	C	501	6	33,34,34	1.22	4 (12%)	50,54,54	1.65	6 (12%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
10	36L	D	503	-	46,47,47	1.13	3 (6%)	47,67,67	2.40	9 (19%)
8	GDP	D	501	6	29,30,30	1.15	2 (6%)	45,47,47	1.74	6 (13%)
11	ACP	F	401	6	31,33,33	1.67	7 (22%)	47,52,52	1.84	9 (19%)

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
9	MES	B	503	-	-	1/6/14/14	0/1/1/1
8	GDP	B	501	6	-	3/16/32/32	0/3/3/3
5	GTP	A	501	6	-	5/22/38/38	0/3/3/3
5	GTP	C	501	6	-	6/22/38/38	0/3/3/3
10	36L	D	503	-	-	10/52/73/73	0/3/4/4
8	GDP	D	501	6	-	3/16/32/32	0/3/3/3
11	ACP	F	401	6	-	6/19/38/38	0/3/3/3

All (24) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
9	B	503	MES	C8-S	-7.67	1.66	1.77
11	F	401	ACP	C5-C4	4.76	1.47	1.39
10	D	503	36L	OBB-CAU	-4.53	1.40	1.46
10	D	503	36L	OBB-CAV	-3.12	1.40	1.46
8	D	501	GDP	C5-C4	3.12	1.47	1.38
5	C	501	GTP	C5-C4	3.10	1.47	1.38
5	A	501	GTP	C5-C4	3.10	1.47	1.38
8	B	501	GDP	C5-C4	3.06	1.47	1.38
11	F	401	ACP	PG-O2G	2.92	1.61	1.55
11	F	401	ACP	PG-O3G	2.87	1.61	1.55
11	F	401	ACP	PB-O3A	2.78	1.61	1.58
5	A	501	GTP	PB-O3B	2.77	1.62	1.59
11	F	401	ACP	C5-C6	2.74	1.48	1.41
5	C	501	GTP	PB-O3B	2.55	1.62	1.59
5	A	501	GTP	C6-N1	-2.39	1.34	1.38
10	D	503	36L	OAD-CAC	-2.39	1.43	1.46
11	F	401	ACP	C8-N7	2.35	1.36	1.31
8	D	501	GDP	C6-N1	-2.34	1.34	1.38
8	B	501	GDP	C6-N1	-2.32	1.34	1.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
11	F	401	ACP	C5-N7	-2.30	1.34	1.39
8	B	501	GDP	PA-O3A	2.29	1.62	1.59
5	C	501	GTP	C6-N1	-2.26	1.34	1.38
5	A	501	GTP	PA-O3A	2.23	1.61	1.59
5	C	501	GTP	PA-O3A	2.04	1.61	1.59

All (43) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
10	D	503	36L	CBM-NBN-CBO	9.42	108.65	105.44
10	D	503	36L	CBQ-OBP-CBO	7.59	108.56	104.29
5	C	501	GTP	C5-C4-N3	-5.94	118.94	128.39
8	D	501	GDP	C5-C4-N3	-5.91	118.98	128.39
8	B	501	GDP	C5-C4-N3	-5.91	118.99	128.39
11	F	401	ACP	C5-C4-N3	-5.88	118.62	126.72
5	A	501	GTP	C5-C4-N3	-5.87	119.05	128.39
8	B	501	GDP	C2-N3-C4	5.08	121.06	112.30
5	A	501	GTP	C2-N3-C4	5.00	120.91	112.30
8	D	501	GDP	C2-N3-C4	5.00	120.91	112.30
10	D	503	36L	OBP-CBO-NBN	-4.95	108.88	114.75
5	C	501	GTP	C2-N3-C4	4.94	120.82	112.30
11	F	401	ACP	N3-C4-N9	4.74	135.23	127.17
5	C	501	GTP	N9-C4-N3	4.55	135.05	125.95
8	B	501	GDP	N9-C4-N3	4.44	134.84	125.95
8	D	501	GDP	N9-C4-N3	4.39	134.74	125.95
5	A	501	GTP	N9-C4-N3	4.39	134.72	125.95
10	D	503	36L	OBP-CBO-CBR	4.21	125.69	117.46
11	F	401	ACP	C2-N3-C4	3.70	120.86	111.83
11	F	401	ACP	PB-O3A-PA	-3.48	121.02	132.37
11	F	401	ACP	C4-C5-N7	-3.39	106.70	110.58
8	D	501	GDP	C6-C5-N7	3.37	136.42	130.29
5	A	501	GTP	C6-C5-N7	3.35	136.38	130.29
8	B	501	GDP	C6-C5-N7	3.34	136.37	130.29
5	C	501	GTP	C6-C5-N7	3.21	136.12	130.29
11	F	401	ACP	N3-C2-N1	-3.20	123.74	128.58
10	D	503	36L	CAB-CAC-CAY	-3.18	110.19	114.41
10	D	503	36L	OAM-CAK-OAL	-2.79	118.88	123.34
11	F	401	ACP	C4-N9-C8	2.70	108.57	105.74
10	D	503	36L	OB-CAU-CBA	2.61	117.80	114.12
8	D	501	GDP	C4-C5-N7	-2.55	106.62	110.67
11	F	401	ACP	C5-N7-C8	2.55	107.46	103.45
5	C	501	GTP	C4-C5-N7	-2.47	106.76	110.67

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	501	GTP	C4-C5-N7	-2.46	106.76	110.67
10	D	503	36L	OAD-CAC-CAY	2.44	110.32	105.64
10	D	503	36L	OAM-CAK-CAJ	2.42	116.66	111.39
8	B	501	GDP	C4-C5-N7	-2.41	106.84	110.67
11	F	401	ACP	C3'-C2'-C1'	2.41	106.03	101.46
5	C	501	GTP	O6-C6-C5	-2.24	120.63	126.53
8	B	501	GDP	O6-C6-C5	-2.24	120.63	126.53
8	D	501	GDP	O6-C6-C5	-2.11	120.97	126.53
5	A	501	GTP	O6-C6-C5	-2.10	121.00	126.53
9	B	503	MES	O3S-S-C8	2.09	110.10	106.00

There are no chirality outliers.

All (34) 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
5	A	501	GTP	C5'-O5'-PA-O2A
5	C	501	GTP	C5'-O5'-PA-O3A
5	C	501	GTP	C5'-O5'-PA-O1A
5	C	501	GTP	C5'-O5'-PA-O2A
8	B	501	GDP	C5'-O5'-PA-O3A
8	B	501	GDP	C5'-O5'-PA-O1A
8	B	501	GDP	C5'-O5'-PA-O2A
8	D	501	GDP	C5'-O5'-PA-O3A
8	D	501	GDP	C5'-O5'-PA-O1A
9	B	503	MES	C8-C7-N4-C5
10	D	503	36L	CAO-CAS-CAU-CBA
10	D	503	36L	OAT-CAS-CAU-CBA
10	D	503	36L	OAT-CAS-CAU-CAV
11	F	401	ACP	PB-C3B-PG-O1G
11	F	401	ACP	PB-C3B-PG-O2G
11	F	401	ACP	PB-C3B-PG-O3G
10	D	503	36L	CAA-CAH-CAI-CAJ
10	D	503	36L	CAF-CAA-CAH-CAI
10	D	503	36L	CAP-CAN-CAO-CAS
10	D	503	36L	CAO-CAS-CAU-CAV
10	D	503	36L	CAB-CAA-CAH-CAI
8	D	501	GDP	C5'-O5'-PA-O2A
11	F	401	ACP	C5'-O5'-PA-O1A
11	F	401	ACP	C5'-O5'-PA-O2A

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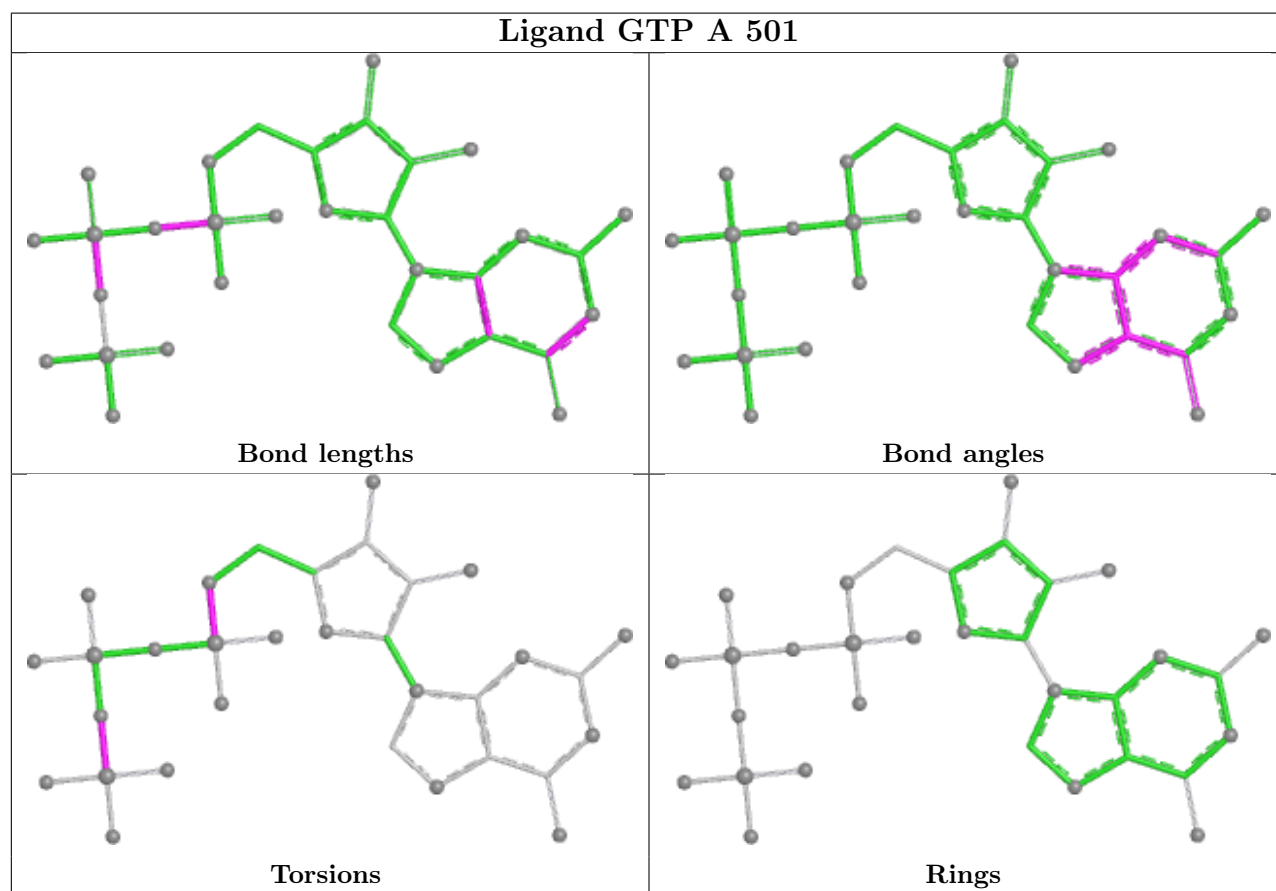
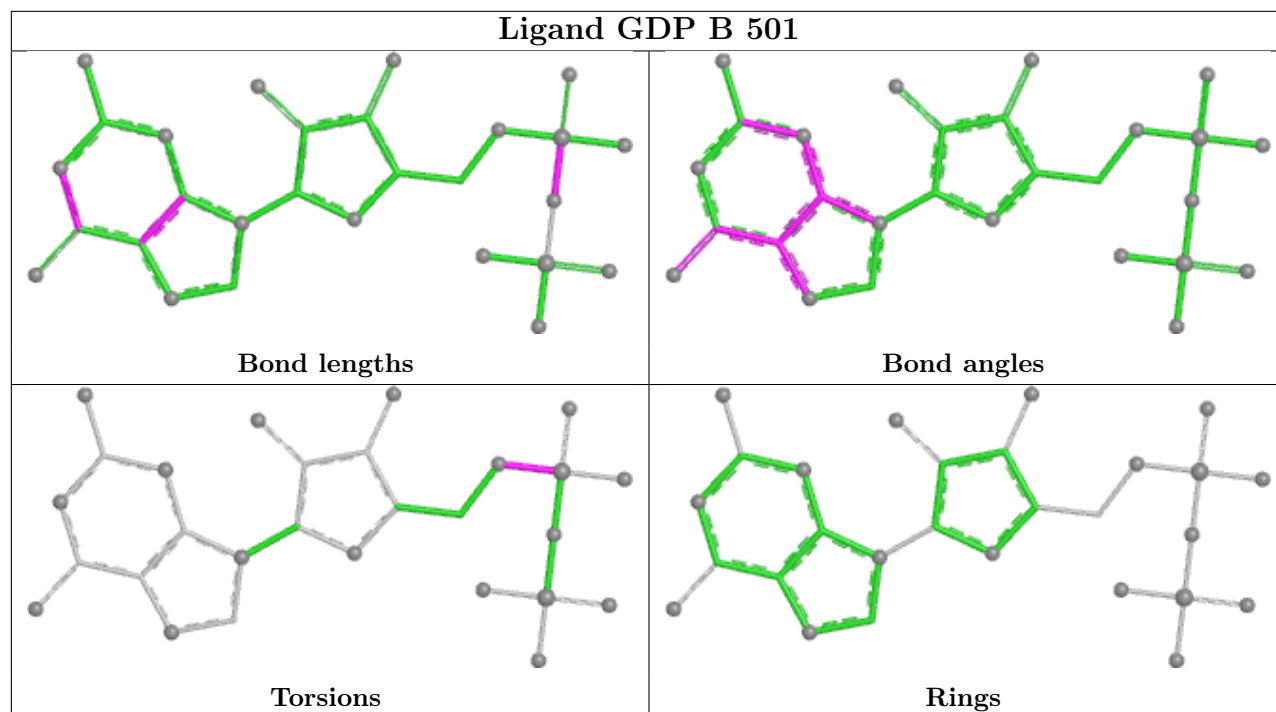
Mol	Chain	Res	Type	Atoms
11	F	401	ACP	C5'-O5'-PA-O3A
10	D	503	36L	OAM-CAN-CAO-CAS
5	C	501	GTP	PB-O3B-PG-O1G
5	A	501	GTP	PB-O3B-PG-O3G
5	C	501	GTP	PB-O3B-PG-O2G
5	C	501	GTP	PB-O3B-PG-O3G
10	D	503	36L	CAN-CAO-CAS-OAT

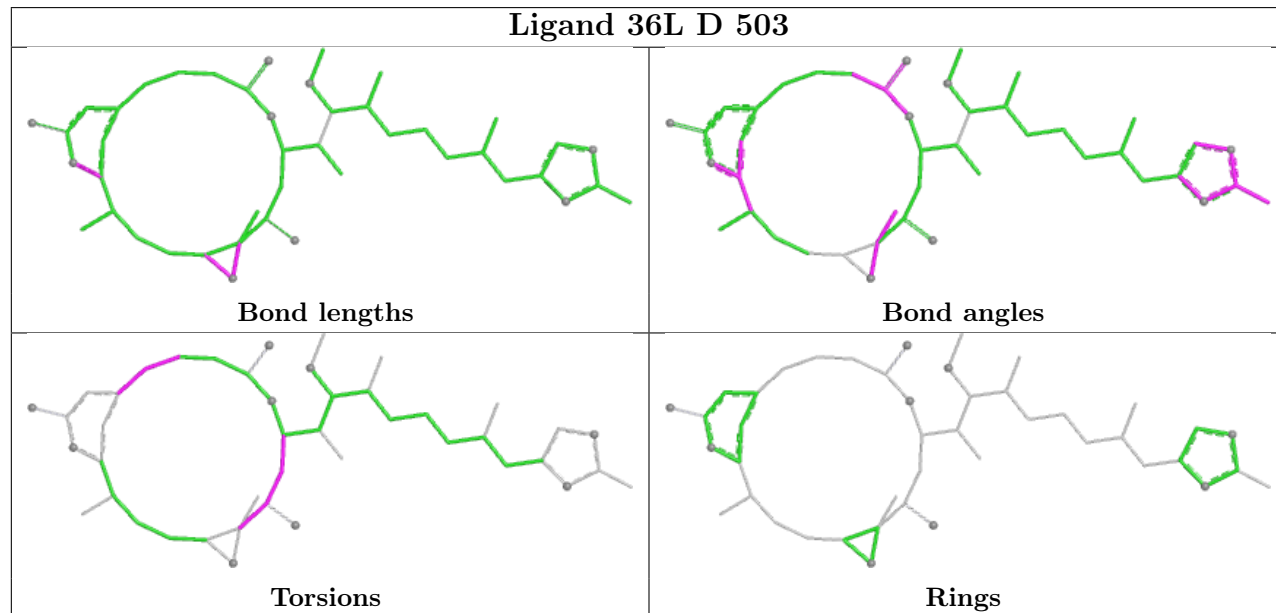
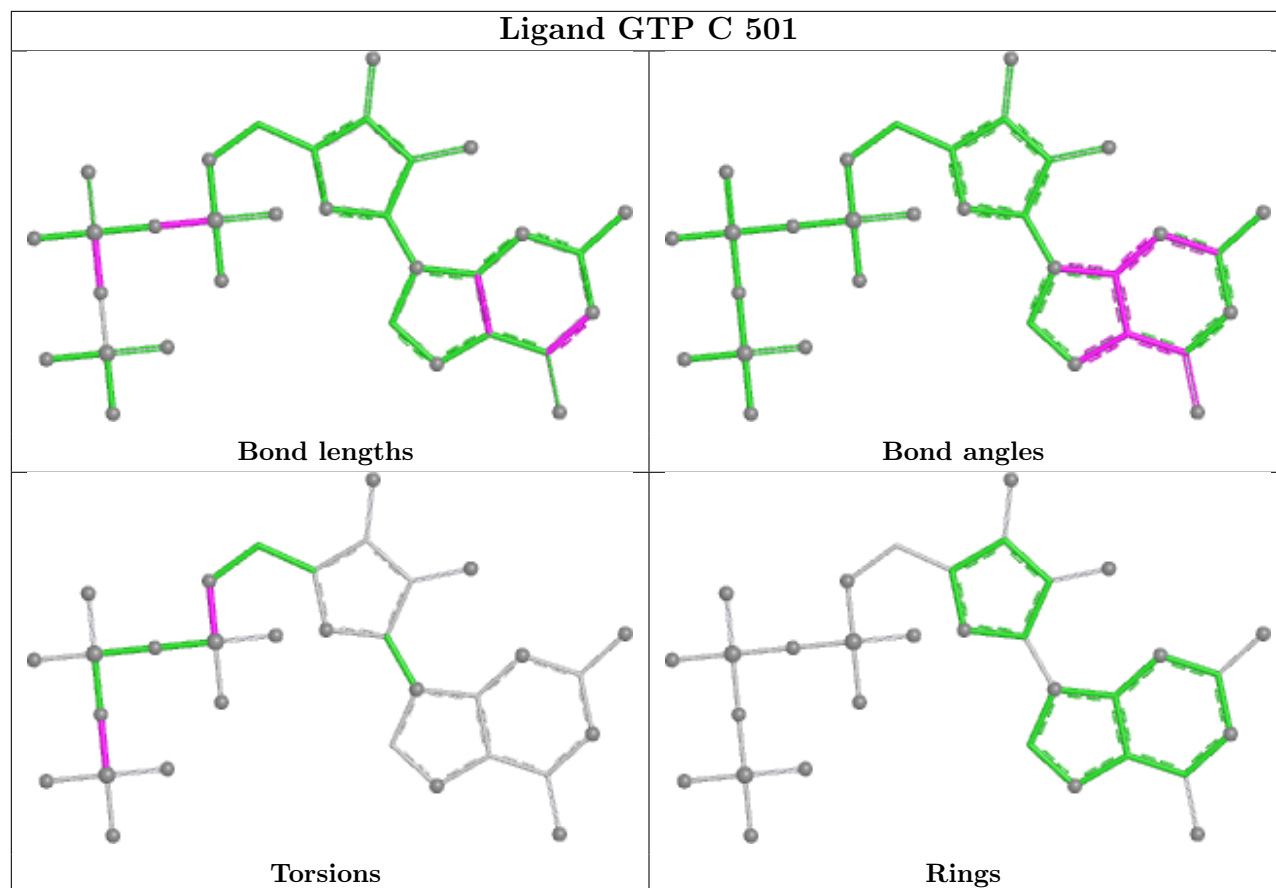
There are no ring outliers.

4 monomers are involved in 15 short contacts:

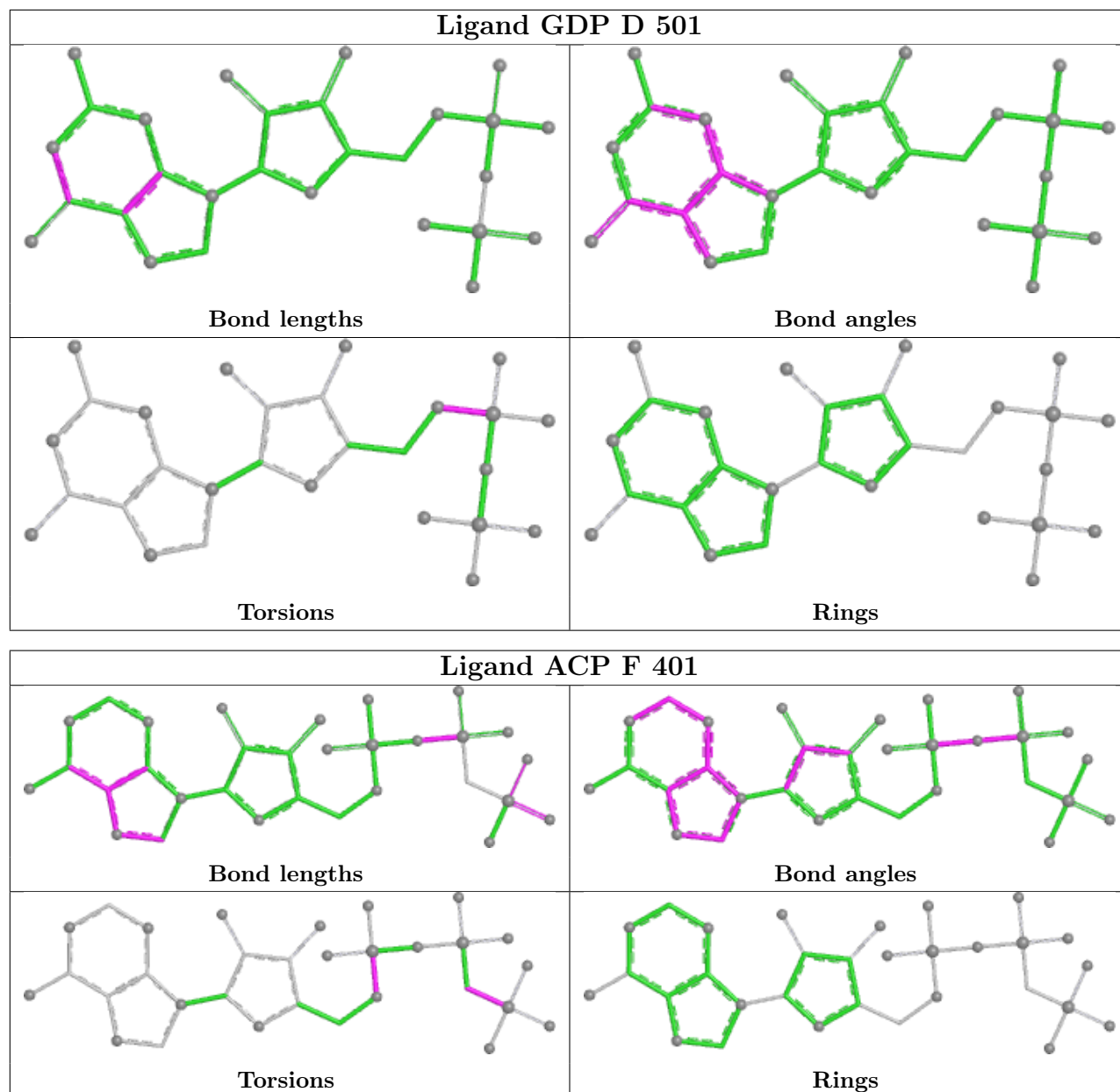
Mol	Chain	Res	Type	Clashes	Symm-Clashes
9	B	503	MES	3	0
10	D	503	36L	9	0
8	D	501	GDP	1	0
11	F	401	ACP	2	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.









## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

## 6 Fit of model and data ⓘ

### 6.1 Protein, DNA and RNA chains ⓘ

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	438/451 (97%)	0.11	10 (2%) 61 64	20, 43, 76, 92	12 (2%)
1	C	440/451 (97%)	-0.12	15 (3%) 48 50	17, 34, 57, 106	10 (2%)
2	B	424/445 (95%)	0.13	12 (2%) 55 57	17, 41, 73, 113	9 (2%)
2	D	422/445 (94%)	0.41	14 (3%) 49 51	25, 52, 83, 108	7 (1%)
3	E	120/143 (83%)	0.69	6 (5%) 34 36	25, 57, 90, 101	2 (1%)
4	F	335/384 (87%)	0.89	48 (14%) 6 6	35, 68, 128, 158	0
All	All	2179/2319 (93%)	0.28	105 (4%) 35 38	17, 46, 89, 158	40 (1%)

All (105) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	D	286	LEU	5.2
4	F	179	VAL	4.6
1	C	357	TYR	4.1
2	D	1	MET	3.9
4	F	130	VAL	3.8
4	F	161	LEU	3.7
2	B	57	THR	3.7
2	D	276	THR	3.7
4	F	181	VAL	3.5
4	F	245	ILE	3.5
2	B	1	MET	3.5
1	A	262	TYR	3.4
2	B	276	THR	3.4
4	F	249	TYR	3.2
4	F	160	ILE	3.2
4	F	242	ASN	3.2
2	D	97	SER	3.2
3	E	140	LYS	3.2
4	F	169	LEU	3.2

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Mol	Chain	Res	Type	RSRZ
4	F	90	SER	3.2
4	F	33	ASP	3.1
4	F	162	ILE	3.0
4	F	103	THR	3.0
1	A	340	SER	2.9
4	F	151	SER	2.9
1	C	341	ILE	2.9
1	C	340	SER	2.9
4	F	231	ALA	2.9
1	C	285	GLN	2.8
4	F	184	LYS	2.8
4	F	173	ILE	2.8
2	B	277	SER	2.8
2	B	284	ARG	2.8
1	A	282	TYR	2.8
2	B	285	ALA	2.8
4	F	149	ALA	2.8
3	E	135	LYS	2.7
4	F	102	PRO	2.7
4	F	126	ASP	2.7
2	B	248	LEU	2.7
2	D	220	THR	2.6
3	E	15	THR	2.6
4	F	131	PHE	2.6
1	A	179	THR	2.6
4	F	233	PHE	2.6
1	A	33	ASP	2.6
4	F	142	ARG	2.6
2	B	325	MET	2.6
1	C	179	THR	2.6
4	F	132	LEU	2.6
4	F	141	GLY	2.5
1	C	80[A]	THR	2.5
4	F	333	ASN	2.5
2	D	83	PHE	2.5
2	D	295	MET	2.5
4	F	31	ARG	2.5
2	B	282	GLN	2.5
4	F	12	SER	2.5
4	F	147	TRP	2.5
4	F	101	TYR	2.4
3	E	6	MET	2.4

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Mol	Chain	Res	Type	RSRZ
2	B	2	ARG	2.4
2	B	58	GLY	2.4
1	C	440	VAL	2.4
4	F	91	CYS	2.4
4	F	134	ALA	2.3
4	F	172	PHE	2.3
2	D	37	HIS	2.3
4	F	298	ILE	2.3
1	A	362	VAL	2.3
1	A	346	TRP	2.3
4	F	296	MET	2.3
1	A	341	ILE	2.3
1	C	337	THR	2.3
2	D	396	THR	2.3
3	E	45	PRO	2.3
4	F	170	LEU	2.3
1	C	336	LYS	2.2
4	F	100	ILE	2.2
1	C	245	ASP	2.2
1	C	178	SER	2.2
4	F	241	THR	2.2
2	D	404	PHE	2.1
2	B	247	GLN	2.1
4	F	159	GLY	2.1
2	D	99	ALA	2.1
4	F	30	LEU	2.1
4	F	361	LEU	2.1
4	F	135	TYR	2.1
4	F	182	ILE	2.1
4	F	234	GLN	2.1
4	F	306	HIS	2.1
1	C	302	MET	2.1
4	F	174	ASP	2.1
4	F	237	THR	2.1
1	A	88	HIS	2.1
2	D	175	PRO	2.1
2	D	370	GLY	2.1
1	A	437	VAL	2.1
1	C	247	ALA	2.1
2	D	415	GLU	2.0
4	F	22	LEU	2.0
3	E	25	LYS	2.0

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Mol	Chain	Res	Type	RSRZ
1	C	361	THR	2.0
1	C	350	GLY	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

## 6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 6.4 Ligands [i](#)

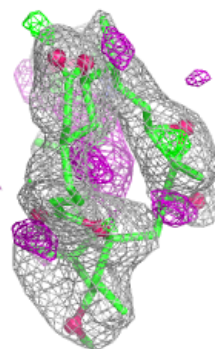
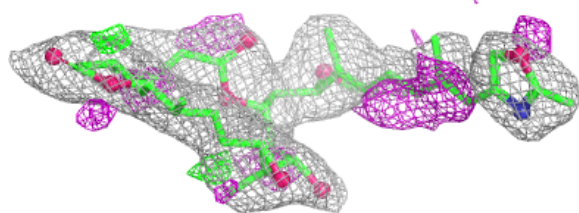
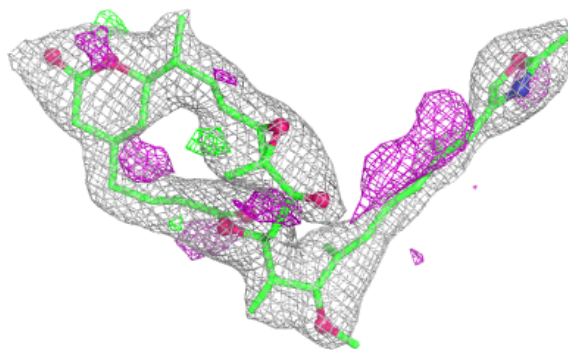
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
10	36L	D	503	44/44	0.83	0.16	51,64,73,74	0
11	ACP	F	401	31/31	0.88	0.12	61,71,119,144	0
9	MES	B	503	12/12	0.90	0.12	43,52,62,64	0
8	GDP	D	501	28/28	0.93	0.09	37,46,60,60	0
6	MG	D	502	1/1	0.93	0.07	45,45,45,45	0
7	CA	A	503	1/1	0.95	0.06	59,59,59,59	0
6	MG	F	402	1/1	0.96	0.05	61,61,61,61	0
5	GTP	A	501	32/32	0.98	0.06	22,29,34,37	0
8	GDP	B	501	28/28	0.98	0.06	23,29,34,34	0
5	GTP	C	501	32/32	0.98	0.05	18,26,29,34	0
7	CA	C	503	1/1	0.99	0.04	43,43,43,43	0
6	MG	C	502	1/1	0.99	0.05	25,25,25,25	0
6	MG	A	502	1/1	0.99	0.03	29,29,29,29	0
6	MG	B	502	1/1	1.00	0.03	20,20,20,20	0

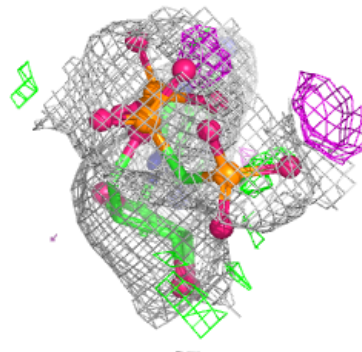
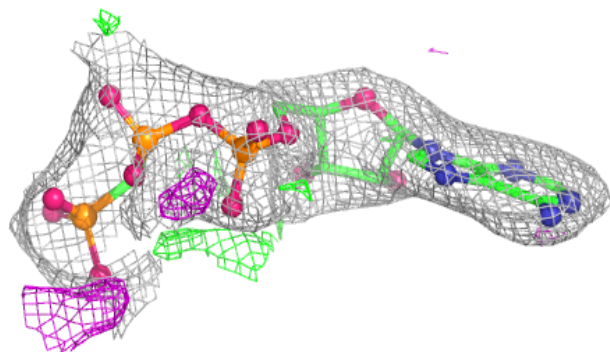
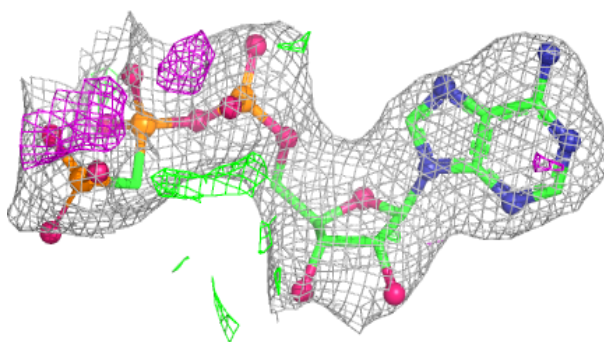
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

**Electron density around 36L 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)

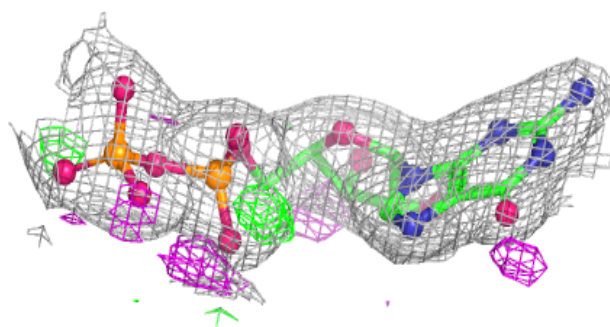
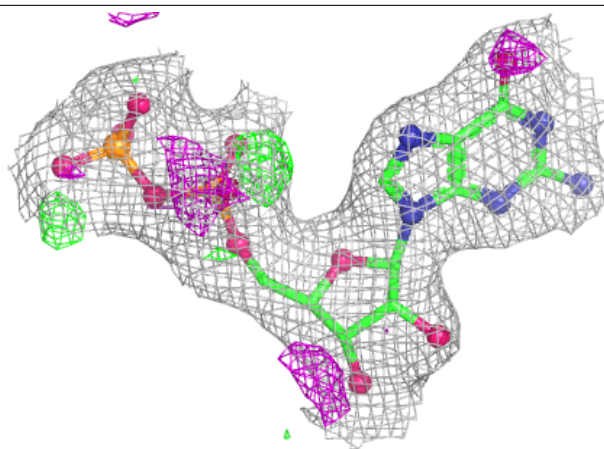
**Electron density around ACP F 401:**

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



**Electron density around GDP D 501:**

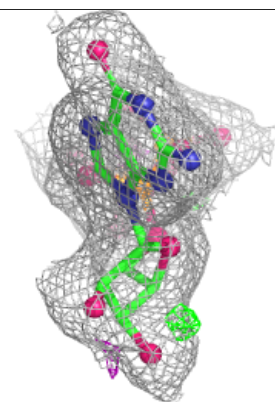
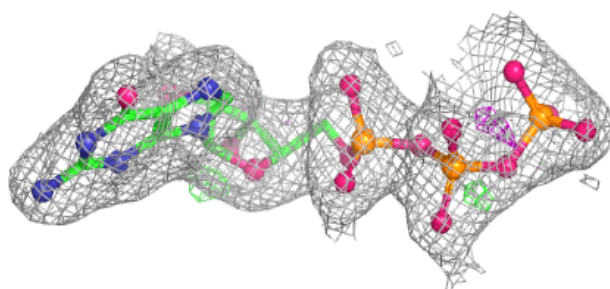
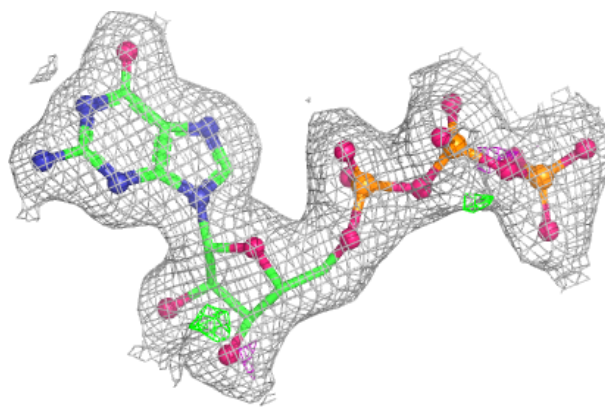
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





**Electron density around GTP A 501:**

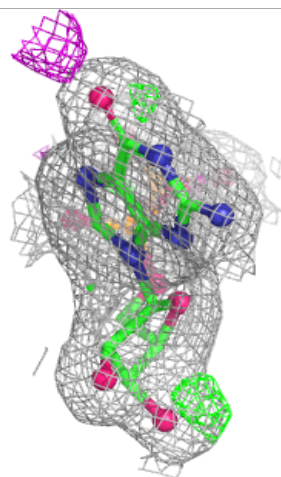
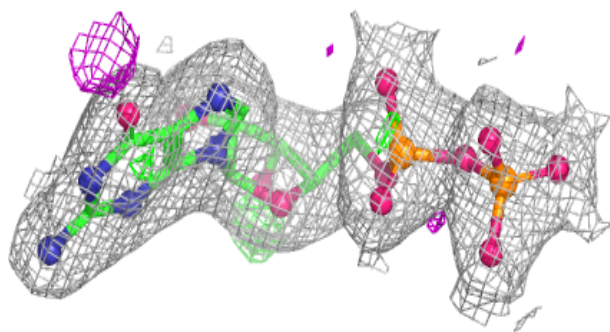
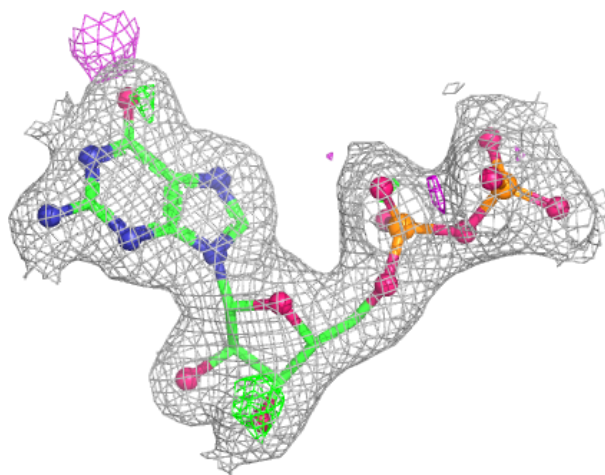
$2mF_o - DF_c$  (at 0.7 rmsd) in gray  
 $mF_o - DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

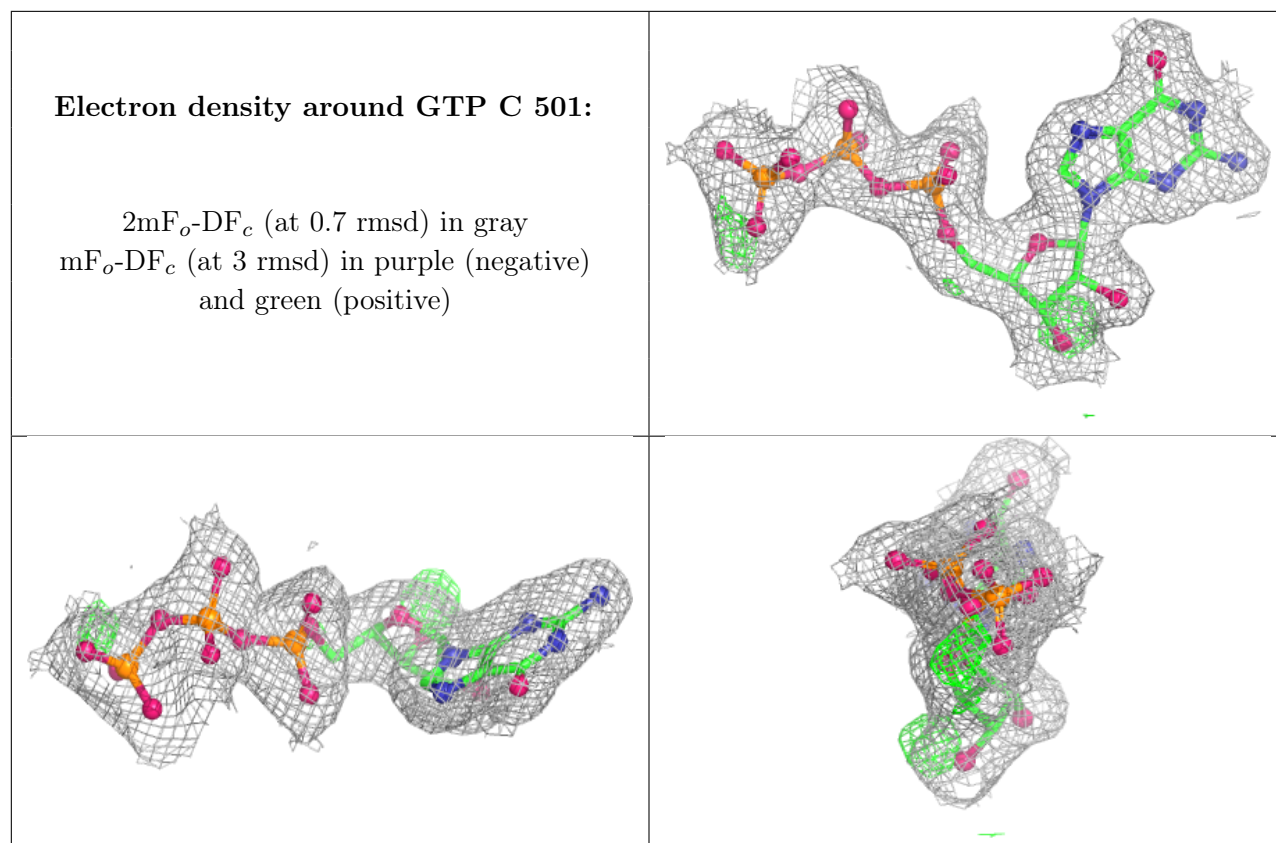




**Electron density around GDP B 501:**

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





## 6.5 Other polymers ⓘ

There are no such residues in this entry.