Full wwPDB X-ray Structure Validation Report ⓘ

Jan 23, 2021 – 12:51 PM GMT

PDB ID	:	6TIU
Title	:	DROSOPHILA GTP-TUBULIN Y222F MUTANT
Authors	:	Gigant, B.
Deposited on	:	2019-11-22
Resolution	:	3.57 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 following versions of software and data (see references ⓘ) were used in the production of this report:

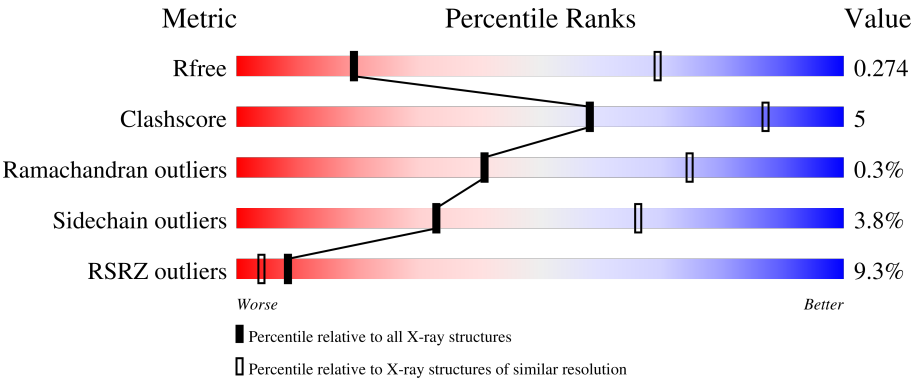
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.16
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.16

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 3.57 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}	130704	1094 (3.66-3.50)
Clashscore	141614	1181 (3.66-3.50)
Ramachandran outliers	138981	1143 (3.66-3.50)
Sidechain outliers	138945	1143 (3.66-3.50)
RSRZ outliers	127900	1012 (3.66-3.50)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5% The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	450	8% 82% 14% ·
1	C	450	7% 84% 11% · ·
2	B	447	11% 82% 13% · ·
2	D	447	7% 83% 13% ·
3	E	143	15% 76% 10% · 11%

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
5	MG	B	502[A]	-	-	-	X

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 14668 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-1 chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	432	Total	C	N	O	S	0	0	0
			3384	2144	575	642	23			
1	C	432	Total	C	N	O	S	0	0	0
			3368	2133	573	639	23			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	40	ARG	LYS	engineered mutation	UNP P06603
C	40	ARG	LYS	engineered mutation	UNP P06603

- Molecule 2 is a protein called Tubulin beta-1 chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	428	Total	C	N	O	S	0	0	0
			3348	2105	571	646	26			
2	D	427	Total	C	N	O	S	0	0	0
			3342	2101	570	645	26			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	222	PHE	TYR	engineered mutation	UNP Q24560
D	222	PHE	TYR	engineered mutation	UNP Q24560

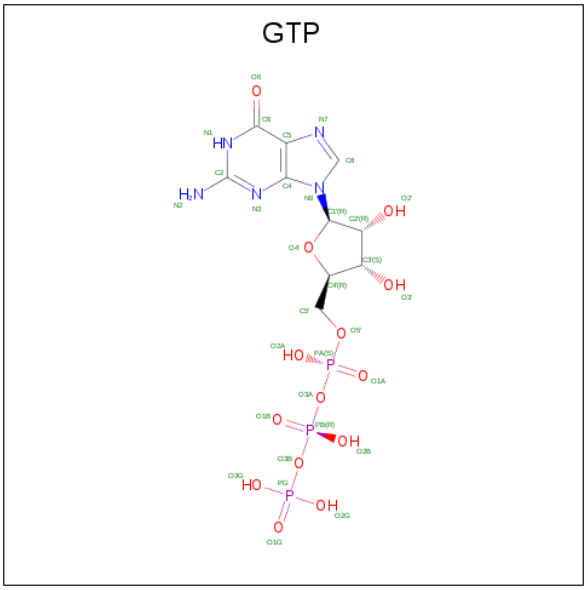
- Molecule 3 is a protein called Stathmin-4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	E	127	Total	C	N	O	S	0	0	0
			1041	644	188	205	4			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	3	MET	-	initiating methionine	UNP P63043
E	4	ALA	SER	engineered mutation	UNP P63043
E	14	ALA	CYS	conflict	UNP P63043
E	20	TRP	PHE	engineered mutation	UNP P63043

- Molecule 4 is GUANOSINE-5'-TRIPHOSPHATE (three-letter code: GTP) (formula: $C_{10}H_{16}N_5O_{14}P_3$).



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

- Molecule 5 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	B	1	Total	Mg	0	1
			1	1		
5	A	1	Total	Mg	0	0
			1	1		
5	D	1	Total	Mg	0	0
			1	1		

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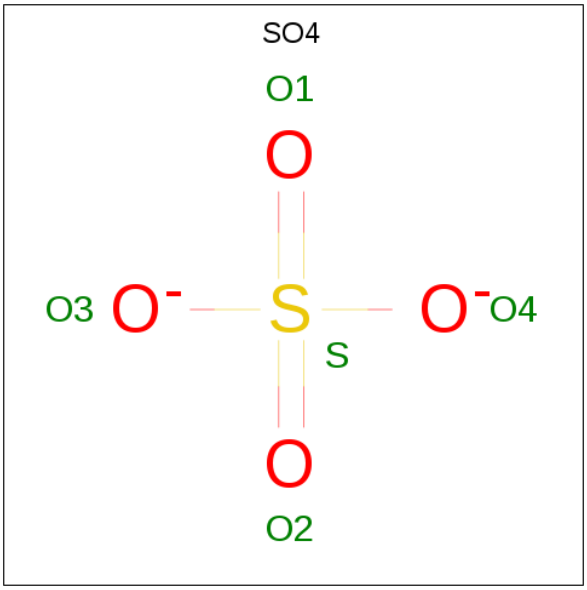
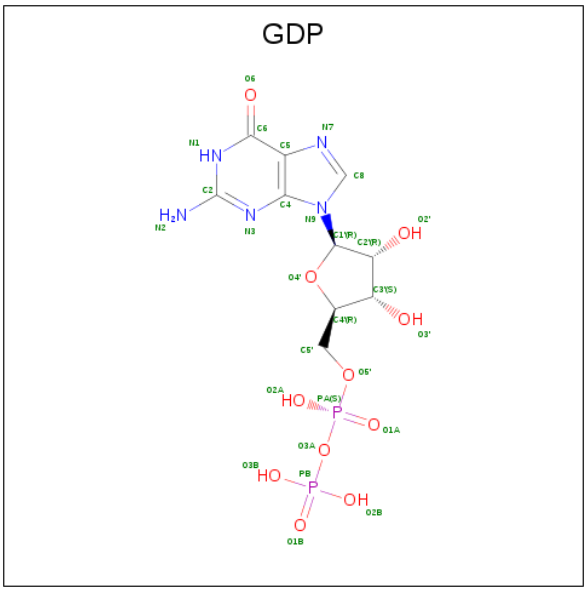
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	C	1	Total Mg 1 1	0	0

- Molecule 6 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



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

- Molecule 7 is GUANOSINE-5'-DIPHOSPHATE (three-letter code: GDP) (formula: $C_{10}H_{15}N_5O_{11}P_2$).

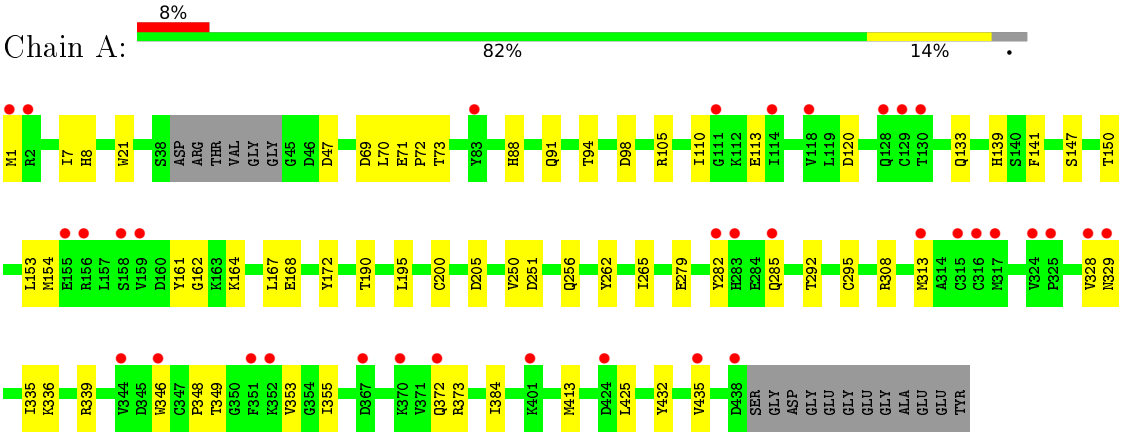


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
7	B	1	28	10	5	11	2	0	1

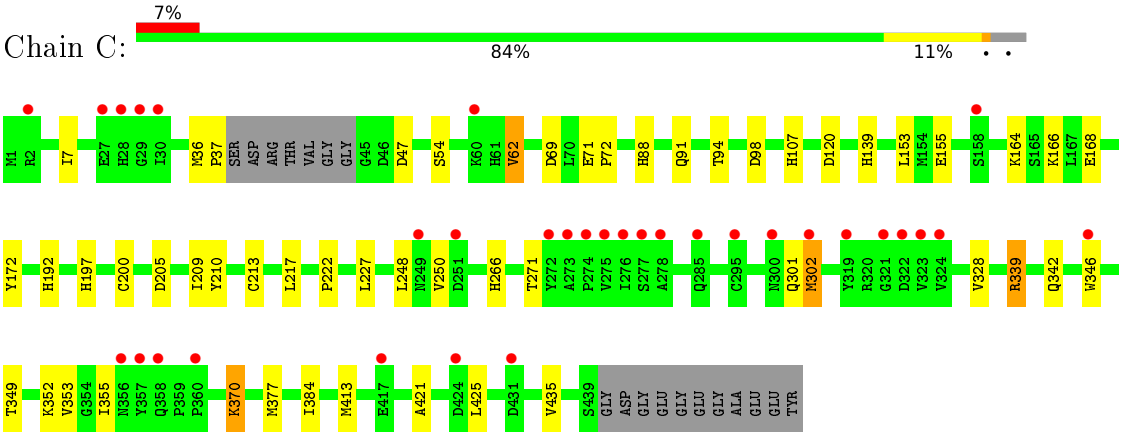
3 Residue-property plots (i)

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.

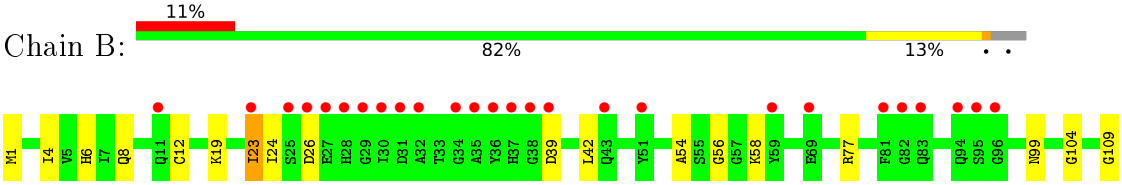
- Molecule 1: Tubulin alpha-1 chain

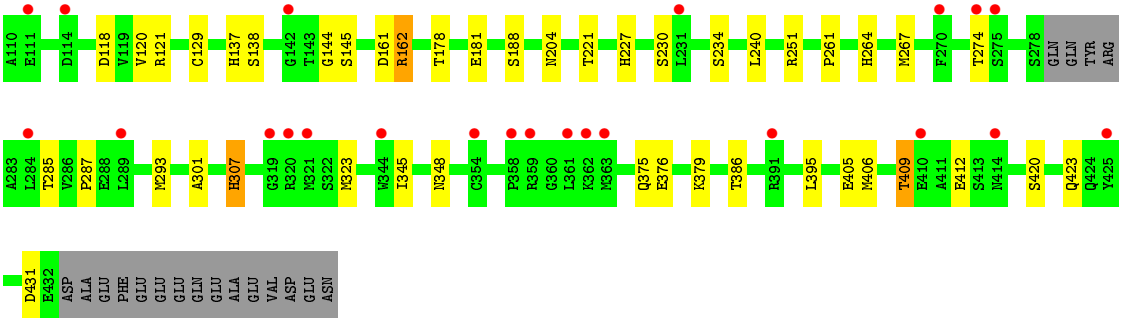


- Molecule 1: Tubulin alpha-1 chain

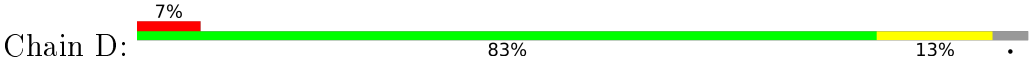


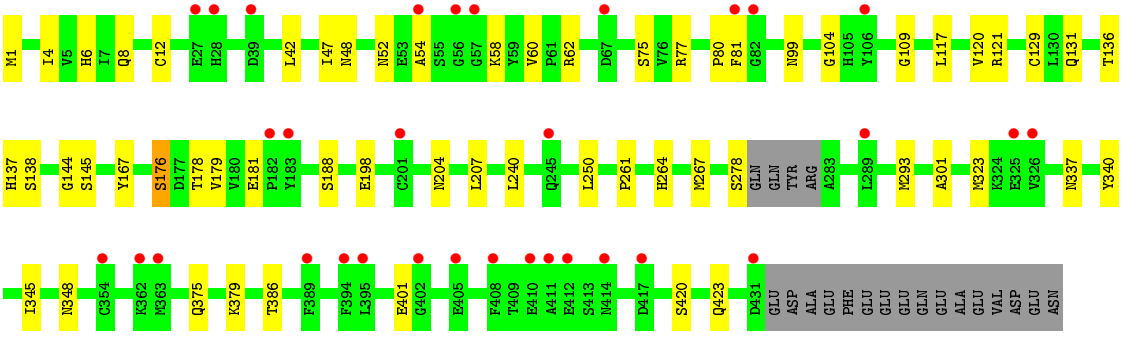
- Molecule 2: Tubulin beta-1 chain



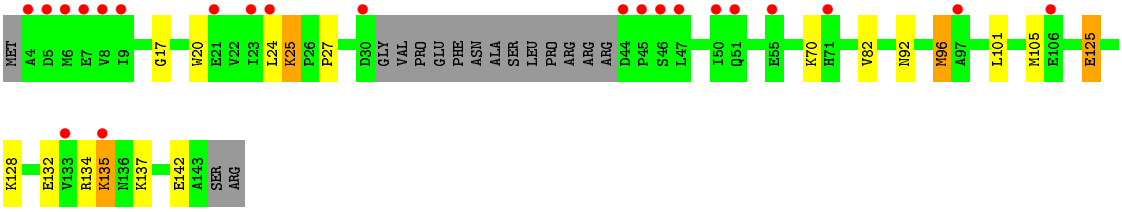


- Molecule 2: Tubulin beta-1 chain





- Molecule 3: Stathmin-4



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	65.97Å 126.35Å 249.79Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.00 – 3.57 47.86 – 3.57	Depositor EDS
% Data completeness (in resolution range)	98.7 (48.00-3.57) 98.7 (47.86-3.57)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.33 (at 3.57Å)	Xtriage
Refinement program	BUSTER 2.10.3 (3-OCT-2019)	Depositor
R, R_{free}	0.221 , 0.244 0.240 , 0.274	Depositor DCC
R_{free} test set	1266 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å^2)	110.9	Xtriage
Anisotropy	0.593	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 75.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.38$, $< L^2 > = 0.21$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.90	EDS
Total number of atoms	14668	wwPDB-VP
Average B, all atoms (Å^2)	110.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.95% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GDP, GTP, MG, SO4

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	0.42	0/3461	0.60	0/4698
1	C	0.41	0/3443	0.60	0/4674
2	B	0.40	0/3420	0.59	0/4631
2	D	0.42	0/3414	0.61	0/4623
3	E	0.42	0/1051	0.58	0/1398
All	All	0.41	0/14789	0.60	0/20024

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

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	3384	0	3295	43	0
1	C	3368	0	3279	29	0
2	B	3348	0	3234	35	0
2	D	3342	0	3230	29	0
3	E	1041	0	1046	12	0
4	A	32	0	12	1	0
4	B	32	0	12	1	0
4	C	32	0	12	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	D	32	0	12	3	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
5	C	1	0	0	0	0
5	D	1	0	0	0	0
6	A	5	0	0	0	0
6	B	10	0	0	1	0
6	D	10	0	0	0	0
7	B	28	0	12	1	0
All	All	14668	0	14144	139	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 5.

All (139) 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)
2:B:6:HIS:HE1	2:B:8:GLN:HE21	1.07	1.02
2:D:6:HIS:HE1	2:D:8:GLN:HE21	1.04	0.99
1:A:133:GLN:HE22	1:A:251:ASP:HB2	1.30	0.96
2:D:204:ASN:HD21	4:D:501:GTP:HN22	1.16	0.93
2:D:6:HIS:CE1	2:D:8:GLN:HE21	1.90	0.90
2:B:204:ASN:HD21	4:B:501[A]:GTP:HN22	1.24	0.85
2:B:6:HIS:CE1	2:B:8:GLN:HE21	1.95	0.83
1:A:329:ASN:HD21	3:E:20:TRP:HE1	1.27	0.82
1:A:308:ARG:NH1	1:A:339:ARG:HH12	1.79	0.79
1:C:339:ARG:H	1:C:339:ARG:HD3	1.51	0.75
1:A:71:GLU:OE2	1:A:73:THR:HB	1.90	0.71
1:A:71:GLU:HB2	1:A:98:ASP:HB3	1.72	0.71
1:A:133:GLN:NE2	1:A:251:ASP:HB2	2.08	0.66
2:B:307:HIS:HD2	2:B:376:GLU:OE1	1.78	0.66
2:B:261:PRO:O	2:B:264:HIS:HD2	1.78	0.66
1:A:292:THR:O	1:A:295:CYS:HB2	1.97	0.65
1:C:328:VAL:HG11	1:C:353:VAL:HG11	1.78	0.64
1:A:328:VAL:HG11	1:A:353:VAL:HG11	1.80	0.63
1:C:107:HIS:HE1	1:C:155:GLU:OE2	1.80	0.63
2:D:261:PRO:O	2:D:264:HIS:HD2	1.82	0.61
2:B:162:ARG:HE	2:B:162:ARG:HA	1.65	0.61
1:A:8:HIS:HE1	1:A:21:TRP:HE1	1.49	0.60
2:B:99:ASN:HD21	1:C:352:LYS:NZ	2.00	0.60
1:C:248:LEU:HD13	1:C:355:ILE:HD12	1.84	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:406:MET:HA	2:B:409:THR:HG23	1.86	0.58
2:D:6:HIS:HE1	2:D:8:GLN:NE2	1.88	0.58
1:A:110:ILE:O	1:A:113:GLU:HG2	2.04	0.57
1:A:139:HIS:HE1	1:A:168:GLU:OE1	1.88	0.57
2:B:267:MET:HG3	2:B:301:ALA:HB3	1.87	0.57
1:A:348:PRO:HB3	3:E:27:PRO:HD3	1.86	0.57
1:A:8:HIS:CE1	1:A:21:TRP:HE1	2.23	0.56
2:D:267:MET:HG3	2:D:301:ALA:HB3	1.87	0.56
2:B:104:GLY:O	2:B:109:GLY:HA3	2.07	0.55
2:D:137:HIS:HD2	2:D:144:GLY:O	1.90	0.55
1:A:308:ARG:HH11	1:A:339:ARG:HH12	1.56	0.54
2:D:54:ALA:HB3	2:D:58:LYS:HG3	1.90	0.54
1:C:166:LYS:HE2	1:C:197:HIS:O	2.08	0.54
1:C:209:ILE:HG22	1:C:227:LEU:HD22	1.90	0.54
1:A:308:ARG:HH11	1:A:339:ARG:NH1	2.06	0.53
2:B:54:ALA:HB3	2:B:58:LYS:HG3	1.89	0.53
2:D:131:GLN:NE2	2:D:250:LEU:H	2.07	0.53
2:B:12:CYS:HB3	2:B:138:SER:HB3	1.90	0.53
2:D:1:MET:N	2:D:129:CYS:SG	2.73	0.53
2:D:104:GLY:O	2:D:109:GLY:HA3	2.08	0.52
2:B:285:THR:HG23	2:B:287:PRO:HD2	1.91	0.52
3:E:132:GLU:HG3	3:E:135:LYS:HZ1	1.75	0.52
1:A:262:TYR:HE2	1:A:346:TRP:CH2	2.28	0.52
1:A:308:ARG:NH1	1:A:339:ARG:NH1	2.53	0.52
1:C:107:HIS:CE1	1:C:155:GLU:OE2	2.61	0.52
2:D:12:CYS:HB3	2:D:138:SER:HB3	1.91	0.52
2:B:345:ILE:HG22	2:B:348:ASN:HB3	1.91	0.52
1:C:88:HIS:O	1:C:91:GLN:HG2	2.10	0.52
2:B:386:THR:HG22	2:B:412:GLU:OE2	2.10	0.51
2:B:23:ILE:HG12	2:B:230:SER:HB2	1.92	0.51
2:D:345:ILE:HG22	2:D:348:ASN:HB3	1.93	0.50
1:A:285:GLN:NE2	1:A:372:GLN:H	2.10	0.50
1:A:88:HIS:O	1:A:91:GLN:HG2	2.11	0.50
2:D:48:ASN:O	2:D:62:ARG:NH2	2.44	0.50
2:B:227:HIS:HE1	2:B:274:THR:HG23	1.78	0.49
2:D:145:SER:HB2	2:D:188:SER:OG	2.12	0.49
1:A:88:HIS:H	1:A:91:GLN:NE2	2.11	0.49
1:A:147:SER:HB2	1:A:190:THR:HB	1.94	0.48
2:D:4:ILE:HD11	2:D:240:LEU:HD22	1.95	0.48
2:B:144:GLY:H	7:B:503[B]:GDP:PB	2.36	0.48
2:B:99:ASN:HD21	1:C:352:LYS:HZ1	1.61	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:346:TRP:HZ2	1:A:435:VAL:HG13	1.79	0.48
1:A:167:LEU:HG	1:A:200:CYS:HB3	1.95	0.48
2:D:204:ASN:HD21	4:D:501:GTP:N2	1.98	0.48
3:E:92:ASN:O	3:E:96:MET:SD	2.72	0.48
1:A:71:GLU:OE2	1:A:73:THR:CB	2.61	0.47
2:B:1:MET:N	2:B:129:CYS:SG	2.75	0.47
2:B:23:ILE:HD13	2:B:234:SER:HB2	1.96	0.47
1:C:139:HIS:HE1	1:C:168:GLU:OE1	1.96	0.47
2:D:375:GLN:HE21	2:D:379:LYS:HE3	1.79	0.47
2:B:395:LEU:HD21	2:B:405:GLU:HG3	1.95	0.47
2:B:4:ILE:HD11	2:B:240:LEU:HD22	1.95	0.47
1:C:213:CYS:HA	1:C:217:LEU:HD12	1.96	0.47
1:A:292:THR:HG22	1:A:335:ILE:CD1	2.44	0.47
2:B:137:HIS:HD2	2:B:144:GLY:O	1.98	0.47
1:C:271:THR:OG1	1:C:377:MET:HB3	2.14	0.47
1:C:200:CYS:HA	1:C:266:HIS:HB2	1.97	0.47
1:A:265:ILE:HG23	1:A:432:TYR:CE1	2.50	0.46
1:A:139:HIS:CE1	1:A:168:GLU:OE1	2.69	0.46
3:E:125:GLU:HA	3:E:128:LYS:HD2	1.97	0.46
1:A:70:LEU:HD13	1:A:110:ILE:HG22	1.97	0.46
2:D:375:GLN:HE22	2:D:423:GLN:HE21	1.64	0.46
1:A:141:PHE:O	1:A:147:SER:HB3	2.16	0.46
2:B:375:GLN:HE21	2:B:379:LYS:HE3	1.81	0.46
1:C:271:THR:HG22	1:C:301:GLN:HA	1.97	0.45
1:C:54:SER:OG	1:C:62:VAL:HG13	2.16	0.45
1:A:172:TYR:HB3	1:A:205:ASP:HA	1.98	0.45
2:B:145:SER:HB2	2:B:188:SER:OG	2.16	0.45
2:D:176:SER:HB3	2:D:181:GLU:OE2	2.16	0.45
2:B:118:ASP:OD1	2:B:121:ARG:NH1	2.49	0.45
2:B:375:GLN:HE22	2:B:423:GLN:HE21	1.64	0.45
1:C:210:TYR:CE1	1:C:222:PRO:HD2	2.51	0.45
2:B:307:HIS:CD2	2:B:376:GLU:OE1	2.66	0.45
1:C:88:HIS:H	1:C:91:GLN:NE2	2.15	0.44
1:A:355:ILE:O	3:E:17:GLY:HA2	2.17	0.44
1:C:172:TYR:HB3	1:C:205:ASP:HA	2.00	0.44
1:C:209:ILE:HD11	1:C:302:MET:HG3	1.99	0.44
2:D:80:PRO:O	2:D:81:PHE:HB2	2.17	0.44
1:A:69:ASP:O	1:A:94:THR:HA	2.18	0.44
1:A:150:THR:O	1:A:154:MET:HG2	2.17	0.44
1:C:7:ILE:HG21	1:C:153:LEU:HD21	1.98	0.44
2:B:23:ILE:HD12	2:B:24:ILE:HG23	2.00	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:221:THR:OG1	6:B:504:SO4:O4	2.23	0.43
1:A:88:HIS:HB2	1:A:91:GLN:HE21	1.84	0.43
2:B:178:THR:HG23	2:B:181:GLU:HG3	2.00	0.43
3:E:132:GLU:HG3	3:E:135:LYS:NZ	2.34	0.43
2:D:204:ASN:ND2	4:D:501:GTP:HN22	1.99	0.43
1:A:71:GLU:HG2	1:A:72:PRO:HD2	1.99	0.43
1:A:346:TRP:CZ2	1:A:435:VAL:HG13	2.55	0.42
1:A:7:ILE:HG21	1:A:153:LEU:HD21	2.01	0.42
2:B:161:ASP:O	2:B:251:ARG:NH2	2.52	0.42
1:C:370:LYS:H	1:C:370:LYS:HD3	1.85	0.42
1:A:329:ASN:ND2	3:E:20:TRP:HE1	2.07	0.42
2:D:117:LEU:O	2:D:121:ARG:HG3	2.20	0.42
2:B:19:LYS:O	2:B:23:ILE:HG13	2.20	0.42
1:C:192:HIS:CG	1:C:421:ALA:HA	2.55	0.42
1:A:349:THR:HB	3:E:25:LYS:HB2	2.00	0.42
1:A:336:LYS:HD3	3:E:24:LEU:HD13	2.02	0.41
1:A:161:TYR:HB3	1:A:164:LYS:HG3	2.02	0.41
2:D:204:ASN:HD22	2:D:207:LEU:HD12	1.85	0.41
1:C:36:MET:HA	1:C:37:PRO:HD3	1.93	0.41
2:D:52:ASN:HB2	2:D:60:VAL:HG13	2.02	0.41
2:D:337:ASN:HB3	2:D:340:TYR:HD2	1.85	0.41
1:C:88:HIS:HB2	1:C:91:GLN:HE21	1.84	0.41
2:D:401:GLU:O	3:E:137:LYS:HB2	2.21	0.41
2:D:47:ILE:HD12	2:D:47:ILE:HA	1.96	0.41
2:B:12:CYS:CB	2:B:138:SER:HB3	2.51	0.40
1:C:98:ASP:HB2	4:C:600:GTP:O2G	2.21	0.40
1:A:105:ARG:HG2	1:A:110:ILE:HD13	2.02	0.40
1:C:72:PRO:HA	1:C:94:THR:HG21	2.04	0.40
2:D:136:THR:HG22	2:D:167:TYR:HB2	2.03	0.40
1:A:98:ASP:HB2	4:A:501:GTP:O2G	2.21	0.40
1:C:346:TRP:HZ2	1:C:435:VAL:HG13	1.86	0.40
1:C:69:ASP:O	1:C:94:THR:HA	2.21	0.40
3:E:101:LEU:O	3:E:105:MET:HG2	2.22	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	428/450 (95%)	412 (96%)	14 (3%)	2 (0%)	29	67
1	C	428/450 (95%)	410 (96%)	18 (4%)	0	100	100
2	B	424/447 (95%)	412 (97%)	11 (3%)	1 (0%)	47	80
2	D	423/447 (95%)	413 (98%)	9 (2%)	1 (0%)	47	80
3	E	123/143 (86%)	120 (98%)	2 (2%)	1 (1%)	19	59
All	All	1826/1937 (94%)	1767 (97%)	54 (3%)	5 (0%)	41	74

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	282	TYR
2	D	179	VAL
1	A	162	GLY
3	E	142	GLU
2	B	56	GLY

5.3.2 Protein sidechains (i)

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	364/375 (97%)	352 (97%)	12 (3%)	38	69
1	C	361/375 (96%)	347 (96%)	14 (4%)	32	65
2	B	364/382 (95%)	351 (96%)	13 (4%)	35	67
2	D	364/382 (95%)	351 (96%)	13 (4%)	35	67

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
3	E	110/126 (87%)	103 (94%)	7 (6%)	17 51
All	All	1563/1640 (95%)	1504 (96%)	59 (4%)	33 66

All (59) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	47	ASP
1	A	120	ASP
1	A	195	LEU
1	A	250	VAL
1	A	256	GLN
1	A	279	GLU
1	A	313	MET
1	A	373	ARG
1	A	384	ILE
1	A	413	MET
1	A	425	LEU
2	B	23	ILE
2	B	26	ASP
2	B	39	ASP
2	B	42	LEU
2	B	77	ARG
2	B	120	VAL
2	B	162	ARG
2	B	293	MET
2	B	307	HIS
2	B	323	MET
2	B	409	THR
2	B	420	SER
2	B	431	ASP
1	C	47	ASP
1	C	62	VAL
1	C	71	GLU
1	C	120	ASP
1	C	164	LYS
1	C	250	VAL
1	C	302	MET
1	C	339	ARG
1	C	342	GLN
1	C	349	THR
1	C	370	LYS

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Mol	Chain	Res	Type
1	C	384	ILE
1	C	413	MET
1	C	425	LEU
2	D	42	LEU
2	D	75	SER
2	D	77	ARG
2	D	99	ASN
2	D	120	VAL
2	D	176	SER
2	D	178	THR
2	D	198	GLU
2	D	278	SER
2	D	293	MET
2	D	323	MET
2	D	386	THR
2	D	420	SER
3	E	25	LYS
3	E	70	LYS
3	E	82	VAL
3	E	96	MET
3	E	125	GLU
3	E	134	ARG
3	E	135	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (49) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	8	HIS
1	A	91	GLN
1	A	133	GLN
1	A	139	HIS
1	A	197	HIS
1	A	249	ASN
1	A	285	GLN
1	A	301	GLN
1	A	329	ASN
2	B	6	HIS
2	B	8	GLN
2	B	14	ASN
2	B	99	ASN
2	B	134	GLN
2	B	137	HIS

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Mol	Chain	Res	Type
2	B	204	ASN
2	B	227	HIS
2	B	264	HIS
2	B	292	GLN
2	B	298	ASN
2	B	307	HIS
2	B	375	GLN
2	B	423	GLN
2	B	424	GLN
1	C	8	HIS
1	C	91	GLN
1	C	107	HIS
1	C	139	HIS
1	C	197	HIS
1	C	249	ASN
1	C	256	GLN
1	C	301	GLN
1	C	329	ASN
2	D	6	HIS
2	D	8	GLN
2	D	14	ASN
2	D	99	ASN
2	D	131	GLN
2	D	134	GLN
2	D	137	HIS
2	D	204	ASN
2	D	264	HIS
2	D	292	GLN
2	D	298	ASN
2	D	375	GLN
2	D	423	GLN
2	D	424	GLN
3	E	18	GLN
3	E	111	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 (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 14 ligands modelled in this entry, 4 are monoatomic - leaving 10 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
4	GTP	C	600	5	26,34,34	0.94	1 (3%)	33,54,54	2.00	5 (15%)
6	SO4	D	504	-	4,4,4	0.30	0	6,6,6	0.27	0
4	GTP	D	501	5	26,34,34	1.05	1 (3%)	33,54,54	2.05	6 (18%)
4	GTP	B	501[A]	5	26,34,34	0.96	2 (7%)	33,54,54	2.03	5 (15%)
7	GDP	B	503[B]	-	24,30,30	1.07	2 (8%)	31,47,47	2.18	6 (19%)
6	SO4	B	505	-	4,4,4	0.12	0	6,6,6	0.28	0
6	SO4	B	504	-	4,4,4	0.47	0	6,6,6	0.33	0
4	GTP	A	501	5	26,34,34	0.96	1 (3%)	33,54,54	2.01	5 (15%)
6	SO4	A	503	-	4,4,4	0.71	0	6,6,6	0.18	0
6	SO4	D	503	-	4,4,4	0.28	0	6,6,6	0.11	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
4	GTP	B	501[A]	5	-	3/18/38/38	0/3/3/3
4	GTP	D	501	5	-	5/18/38/38	0/3/3/3
4	GTP	A	501	5	-	8/18/38/38	0/3/3/3
4	GTP	C	600	5	-	8/18/38/38	0/3/3/3
7	GDP	B	503[B]	-	-	3/12/32/32	0/3/3/3

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	501[A]	GTP	C6-N1	3.32	1.38	1.33
7	B	503[B]	GDP	C6-N1	3.31	1.38	1.33
4	D	501	GTP	C6-N1	3.10	1.38	1.33
4	A	501	GTP	C6-N1	2.94	1.38	1.33
4	C	600	GTP	C6-N1	2.86	1.38	1.33
7	B	503[B]	GDP	C6-C5	2.29	1.45	1.41
4	B	501[A]	GTP	C6-C5	2.05	1.44	1.41

All (27) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
7	B	503[B]	GDP	C5-C6-N1	-8.34	112.03	123.43
4	B	501[A]	GTP	C5-C6-N1	-8.31	112.06	123.43
4	C	600	GTP	C5-C6-N1	-8.25	112.15	123.43
4	A	501	GTP	C5-C6-N1	-8.17	112.26	123.43
4	D	501	GTP	C5-C6-N1	-8.07	112.40	123.43
4	B	501[A]	GTP	C6-N1-C2	5.92	125.34	115.93
7	B	503[B]	GDP	C6-N1-C2	5.91	125.31	115.93
4	A	501	GTP	C6-N1-C2	5.88	125.27	115.93
4	C	600	GTP	C6-N1-C2	5.78	125.12	115.93
4	D	501	GTP	C6-N1-C2	5.65	124.91	115.93
4	A	501	GTP	N3-C2-N1	-2.93	123.31	127.22
7	B	503[B]	GDP	C6-C5-C4	-2.92	118.01	120.80
4	B	501[A]	GTP	C6-C5-C4	-2.88	118.05	120.80
7	B	503[B]	GDP	N3-C2-N1	-2.88	123.39	127.22
4	D	501	GTP	N3-C2-N1	-2.83	123.45	127.22
4	B	501[A]	GTP	N3-C2-N1	-2.82	123.46	127.22
4	C	600	GTP	N3-C2-N1	-2.81	123.47	127.22
4	A	501	GTP	C6-C5-C4	-2.70	118.22	120.80
4	D	501	GTP	C6-C5-C4	-2.66	118.25	120.80
4	D	501	GTP	O5'-PA-O1A	2.62	119.30	109.07
4	C	600	GTP	C6-C5-C4	-2.57	118.35	120.80
4	B	501[A]	GTP	C2-N3-C4	-2.22	112.82	115.36
4	A	501	GTP	C2-N3-C4	-2.19	112.85	115.36
4	C	600	GTP	C2-N3-C4	-2.14	112.91	115.36
4	D	501	GTP	C2-N3-C4	-2.13	112.92	115.36
7	B	503[B]	GDP	O2B-PB-O3A	2.12	111.73	104.64
7	B	503[B]	GDP	C2-N3-C4	-2.04	113.02	115.36

There are no chirality outliers.

All (27) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	C	600	GTP	C5'-O5'-PA-O1A
4	C	600	GTP	C5'-O5'-PA-O2A
4	D	501	GTP	C5'-O5'-PA-O1A
7	B	503[B]	GDP	PA-O3A-PB-O2B
4	A	501	GTP	C5'-O5'-PA-O1A
4	A	501	GTP	C5'-O5'-PA-O2A
4	A	501	GTP	PB-O3B-PG-O3G
4	B	501[A]	GTP	C5'-O5'-PA-O3A
4	D	501	GTP	C5'-O5'-PA-O2A
4	B	501[A]	GTP	C5'-O5'-PA-O2A
4	D	501	GTP	PB-O3A-PA-O2A
4	A	501	GTP	PB-O3A-PA-O2A
4	C	600	GTP	PB-O3B-PG-O1G
4	A	501	GTP	PB-O3B-PG-O1G
4	B	501[A]	GTP	PG-O3B-PB-O1B
4	C	600	GTP	PB-O3B-PG-O2G
4	C	600	GTP	PB-O3B-PG-O3G
7	B	503[B]	GDP	PA-O3A-PB-O3B
4	A	501	GTP	PB-O3B-PG-O2G
4	C	600	GTP	C5'-O5'-PA-O3A
4	D	501	GTP	C5'-O5'-PA-O3A
4	A	501	GTP	C5'-O5'-PA-O3A
4	C	600	GTP	PB-O3A-PA-O1A
4	C	600	GTP	PB-O3A-PA-O2A
4	D	501	GTP	PB-O3A-PA-O1A
4	A	501	GTP	PB-O3A-PA-O1A
7	B	503[B]	GDP	C5'-O5'-PA-O1A

There are no ring outliers.

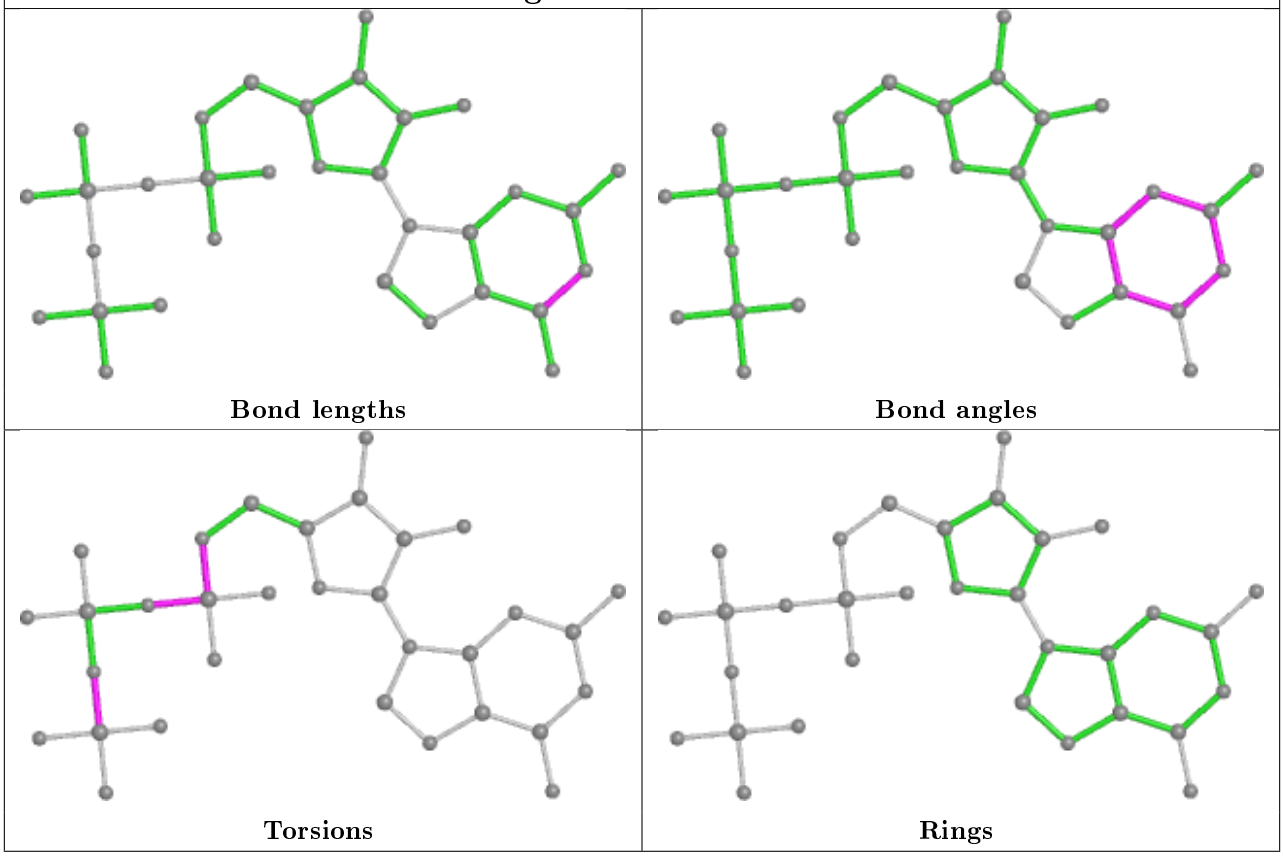
6 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	C	600	GTP	1	0
4	D	501	GTP	3	0
4	B	501[A]	GTP	1	0
7	B	503[B]	GDP	1	0
6	B	504	SO4	1	0
4	A	501	GTP	1	0

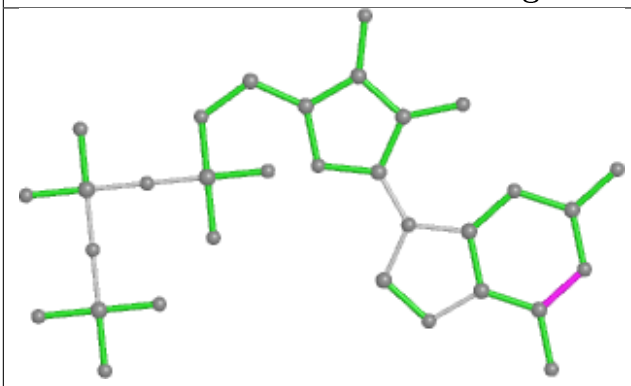
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is

within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

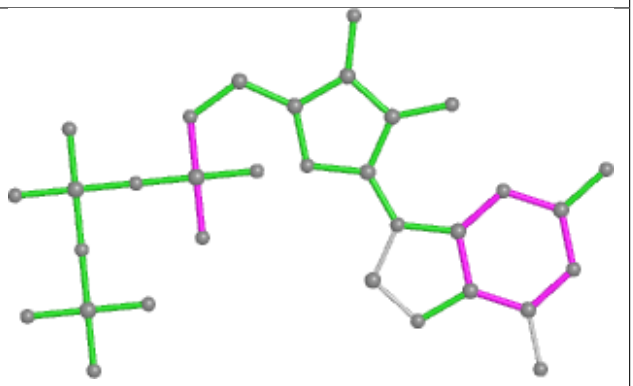
Ligand GTP C 600



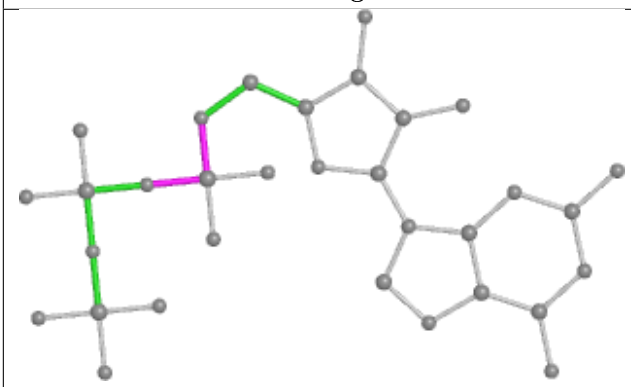
Ligand GTP D 501



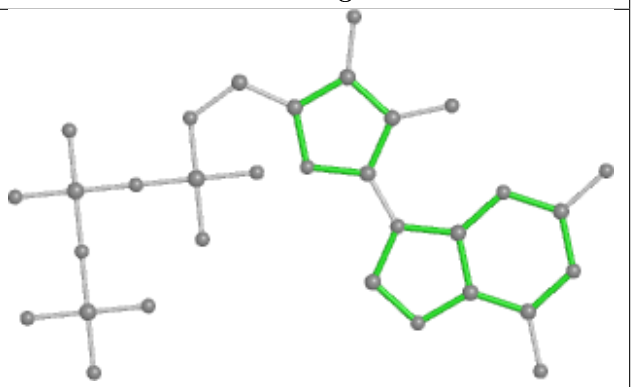
Bond lengths



Bond angles

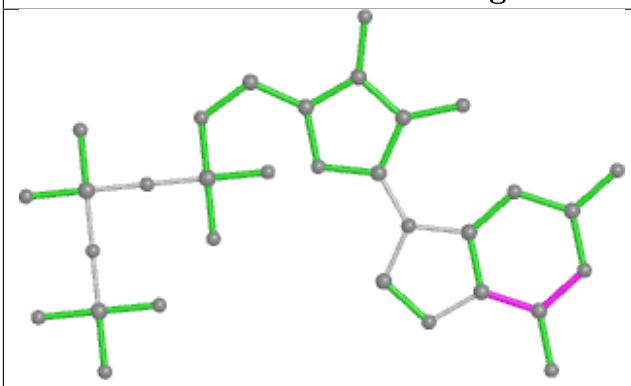


Torsions

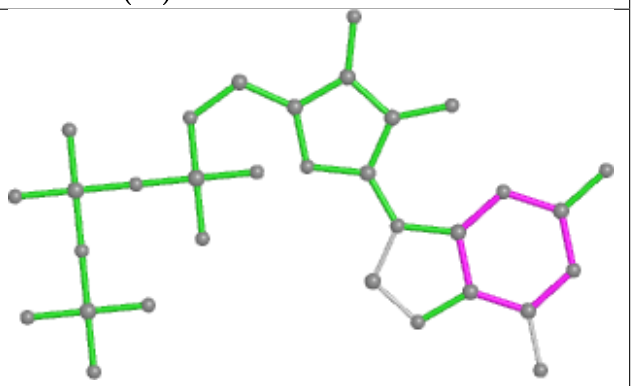


Rings

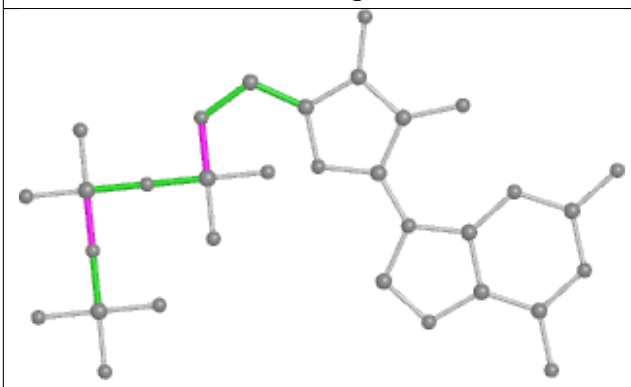
Ligand GTP B 501 (A)



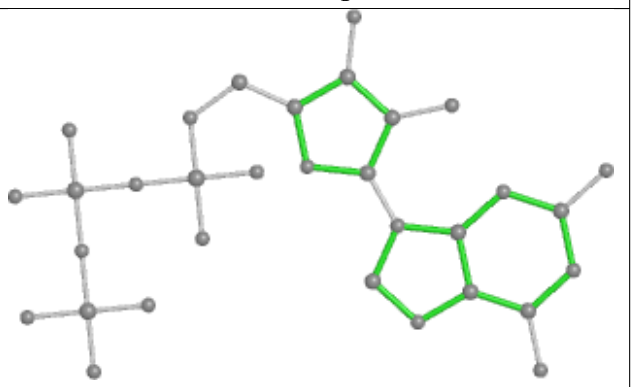
Bond lengths



Bond angles

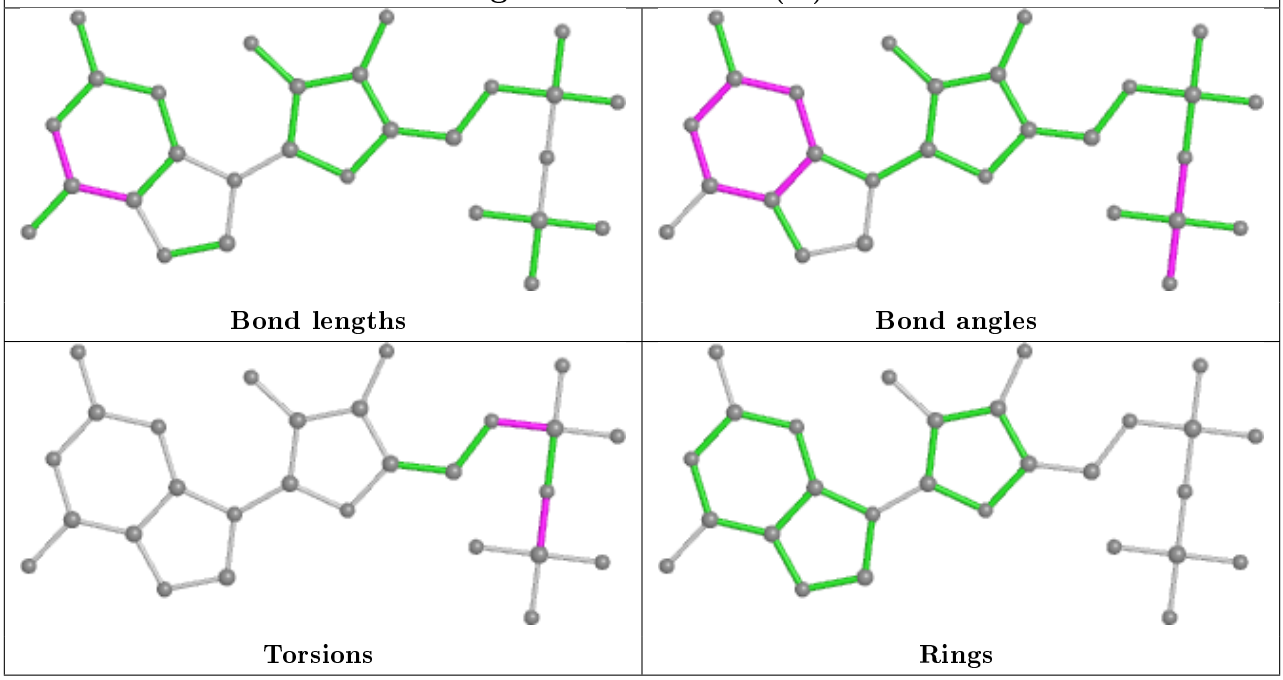


Torsions

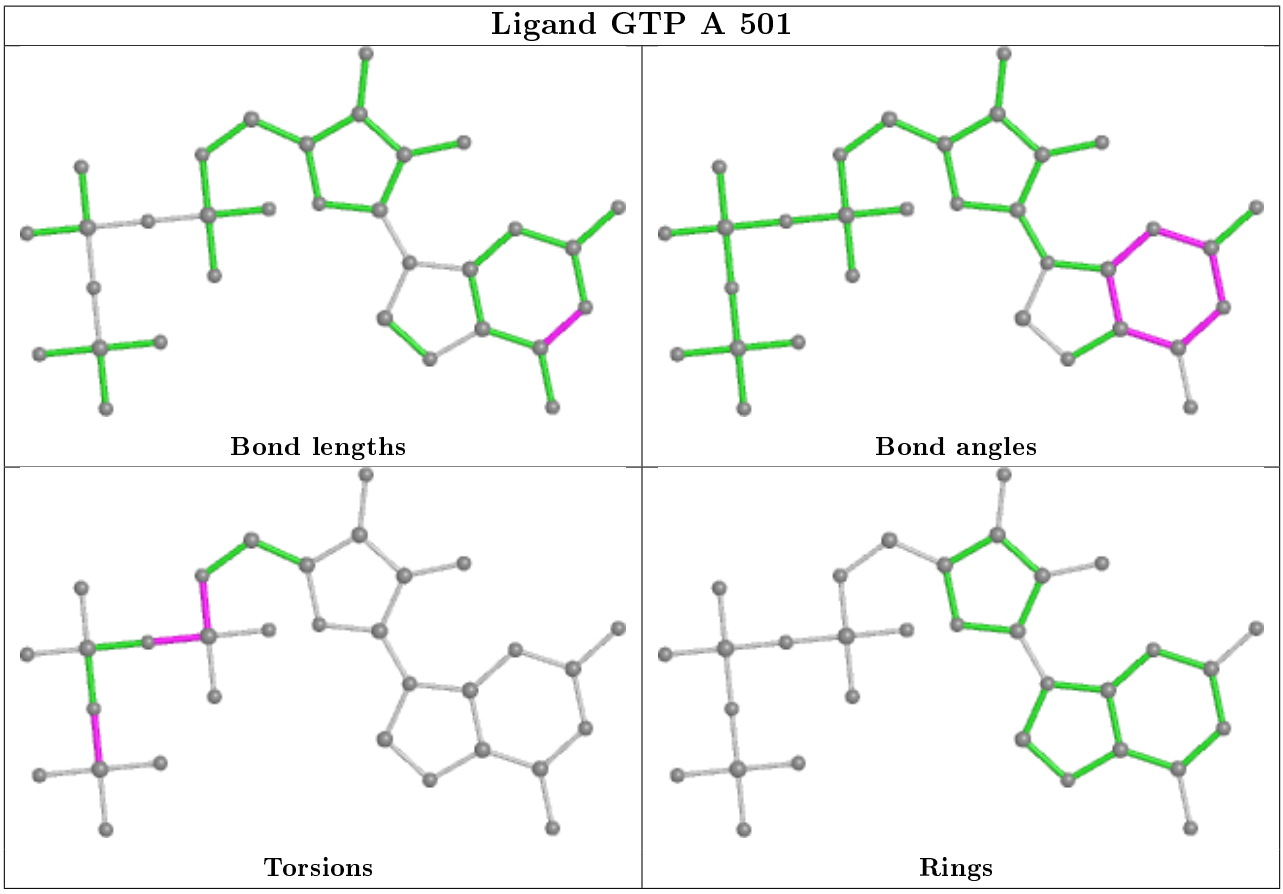


Rings

Ligand GDP B 503 (B)



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, 95^{th} 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	432/450 (96%)	0.39	35 (8%)	12	6	81, 103, 145, 246	0
1	C	432/450 (96%)	0.45	33 (7%)	13	7	80, 108, 156, 229	0
2	B	428/447 (95%)	0.50	49 (11%)	5	3	71, 104, 162, 256	0
2	D	427/447 (95%)	0.37	32 (7%)	14	7	55, 100, 148, 234	0
3	E	127/143 (88%)	0.75	22 (17%)	1	0	80, 122, 171, 230	0
All	All	1846/1937 (95%)	0.45	171 (9%)	8	4	55, 105, 156, 256	0

All (171) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	E	5	ASP	7.6
2	B	95	SER	6.3
2	B	30	ILE	5.6
3	E	45	PRO	5.3
2	D	431	ASP	5.2
2	B	81	PHE	5.2
2	D	402	GLY	5.1
2	B	361	LEU	4.6
2	B	27	GLU	4.5
2	B	96	GLY	4.4
1	A	282	TYR	4.3
2	D	408	PHE	4.3
1	C	28	HIS	4.3
2	D	57	GLY	4.2
1	A	424	ASP	4.2
2	B	363	MET	4.2
1	C	274	PRO	4.1
1	A	370	LYS	4.0
3	E	9	ILE	4.0
1	A	346	TRP	4.0

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Mol	Chain	Res	Type	RSRZ
3	E	51	GLN	3.9
2	B	414	ASN	3.8
2	B	38	GLY	3.8
2	D	354	CYS	3.7
2	B	362	LYS	3.7
3	E	30	ASP	3.7
2	B	28	HIS	3.7
3	E	21	GLU	3.6
1	C	285	GLN	3.6
2	D	395	LEU	3.6
2	B	274	THR	3.6
1	A	435	VAL	3.5
1	A	401	LYS	3.4
1	C	27	GLU	3.3
2	B	39	ASP	3.3
3	E	106	GLU	3.3
2	D	39	ASP	3.3
1	A	1	MET	3.3
2	B	29	GLY	3.3
2	D	325	GLU	3.3
1	C	29	GLY	3.3
1	C	346	TRP	3.3
1	C	30	ILE	3.3
2	B	391	ARG	3.3
1	A	367	ASP	3.3
1	C	272	TYR	3.3
1	C	424	ASP	3.3
2	D	67	ASP	3.3
2	D	363	MET	3.2
2	B	359	ARG	3.2
2	B	26	ASP	3.2
1	A	156	ARG	3.2
2	B	82	GLY	3.2
1	A	372	GLN	3.1
2	B	37	HIS	3.1
2	B	25	SER	3.1
2	D	414	ASN	3.0
2	B	289	LEU	3.0
2	D	54	ALA	3.0
2	B	111	GLU	3.0
1	C	300	ASN	3.0
3	E	7	GLU	3.0

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Mol	Chain	Res	Type	RSRZ
3	E	6	MET	2.9
2	D	81	PHE	2.9
1	A	283	HIS	2.9
1	C	358	GLN	2.9
3	E	47	LEU	2.9
3	E	50	ILE	2.9
1	C	275	VAL	2.9
1	C	431	ASP	2.9
3	E	46	SER	2.9
2	B	114	ASP	2.9
1	C	356	ASN	2.8
3	E	4	ALA	2.8
1	C	251	ASP	2.8
2	B	142	GLY	2.8
2	B	69	GLU	2.8
2	B	321	MET	2.8
2	D	412	GLU	2.8
2	D	389	PHE	2.8
2	B	31	ASP	2.8
2	B	36	TYR	2.8
1	C	277	SER	2.7
2	D	405	GLU	2.7
2	D	411	ALA	2.7
2	D	245	GLN	2.7
1	C	276	ILE	2.7
2	D	106	TYR	2.7
2	B	32	ALA	2.7
1	A	114	ILE	2.6
2	B	319	GLY	2.6
1	A	130	THR	2.6
1	C	323	VAL	2.6
1	C	319	TYR	2.6
2	D	410	GLU	2.6
3	E	8	VAL	2.6
3	E	23	ILE	2.6
1	A	158	SER	2.6
2	D	56	GLY	2.6
2	B	358	PRO	2.5
2	D	82	GLY	2.5
3	E	44	ASP	2.5
1	A	325	PRO	2.5
2	D	201	CYS	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	438	ASP	2.5
1	A	2	ARG	2.5
1	A	129	CYS	2.5
1	A	118	VAL	2.5
2	B	320	ARG	2.5
2	B	344	TRP	2.4
1	A	83	TYR	2.4
2	B	410	GLU	2.4
1	C	249	ASN	2.4
2	D	28	HIS	2.4
2	B	43	GLN	2.4
3	E	24	LEU	2.4
1	A	313	MET	2.4
1	A	351	PHE	2.4
1	A	285	GLN	2.4
1	A	344	VAL	2.4
2	D	289	LEU	2.4
1	A	315	CYS	2.4
1	A	155	GLU	2.4
3	E	133	VAL	2.4
2	B	11	GLN	2.4
2	B	51	TYR	2.4
2	B	425	TYR	2.4
2	B	284	LEU	2.4
1	C	158	SER	2.3
1	A	159	VAL	2.3
2	B	270	PHE	2.3
2	B	34	GLY	2.3
2	B	354	CYS	2.3
1	C	360	PRO	2.3
1	C	278	ALA	2.3
1	A	329	ASN	2.2
2	B	23	ILE	2.2
2	B	83	GLN	2.2
1	C	357	TYR	2.2
3	E	135	LYS	2.2
2	B	94	GLN	2.2
1	C	322	ASP	2.2
2	B	35	ALA	2.2
2	D	362	LYS	2.2
2	D	183	TYR	2.2
2	B	59	TYR	2.2

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Mol	Chain	Res	Type	RSRZ
1	C	321	GLY	2.2
1	C	302	MET	2.2
1	C	2	ARG	2.1
1	A	128	GLN	2.1
1	C	295	CYS	2.1
1	C	324	VAL	2.1
1	A	111	GLY	2.1
2	B	275	SER	2.1
1	C	273	ALA	2.1
3	E	71	HIS	2.1
1	A	316	CYS	2.1
2	D	182	PRO	2.1
3	E	97	ALA	2.1
2	D	417	ASP	2.1
1	C	417	GLU	2.1
3	E	55	GLU	2.1
1	A	352	LYS	2.0
2	D	27	GLU	2.0
1	A	324	VAL	2.0
2	D	326	VAL	2.0
1	C	60	LYS	2.0
2	D	394	PHE	2.0
2	B	231	LEU	2.0
1	A	317	MET	2.0
1	A	328	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 monosaccharides in this entry.

6.4 Ligands (i)

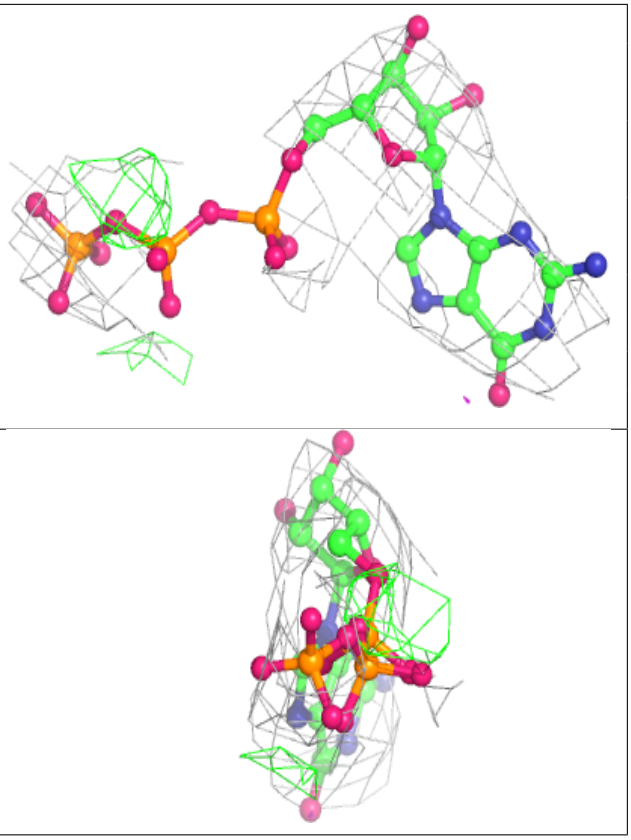
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' 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
5	MG	B	502[A]	1/1	0.35	1.88	80,80,80,80	1
6	SO4	B	504	5/5	0.79	0.26	113,114,115,117	0
4	GTP	B	501[A]	32/32	0.83	0.35	79,83,88,89	32
7	GDP	B	503[B]	28/28	0.84	0.32	65,69,73,75	28
6	SO4	D	504	5/5	0.84	0.20	127,129,129,130	0
4	GTP	C	600	32/32	0.88	0.32	85,94,101,104	0
6	SO4	A	503	5/5	0.88	0.30	82,83,84,85	0
6	SO4	B	505	5/5	0.91	0.13	156,157,157,158	0
4	GTP	A	501	32/32	0.92	0.32	79,84,89,90	0
4	GTP	D	501	32/32	0.92	0.22	82,87,92,93	0
5	MG	C	601	1/1	0.93	0.52	94,94,94,94	0
6	SO4	D	503	5/5	0.93	0.12	83,88,89,90	0
5	MG	A	502	1/1	0.95	0.71	95,95,95,95	0
5	MG	D	502	1/1	0.96	0.33	80,80,80,80	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.

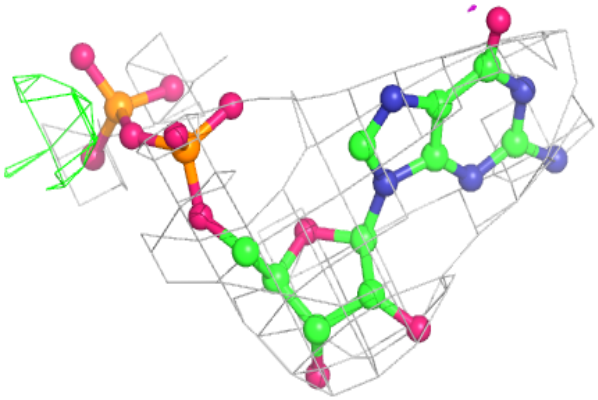
Electron density around GTP B 501 (A):

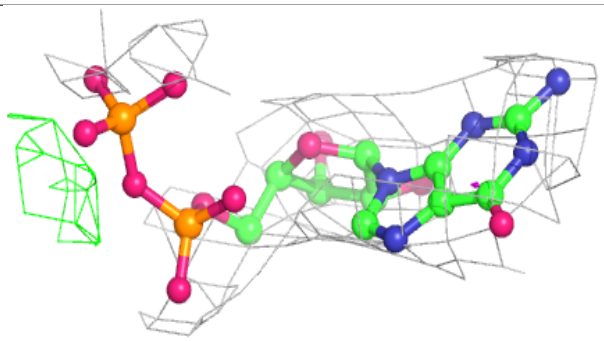
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

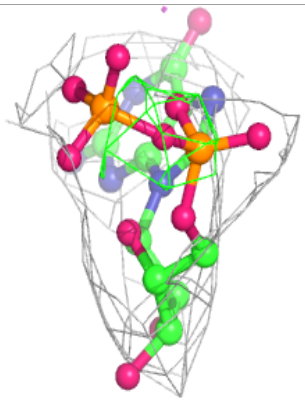


Electron density around GDP B 503 (B):

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

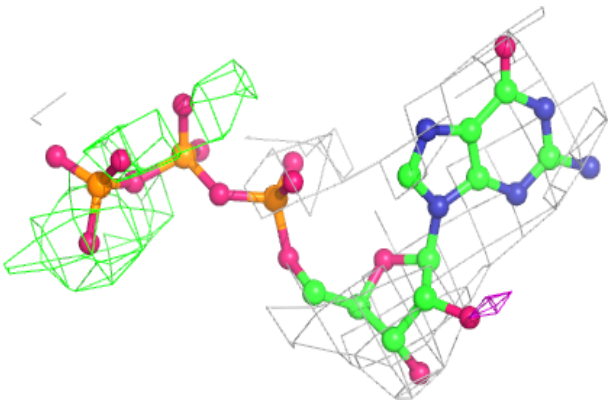


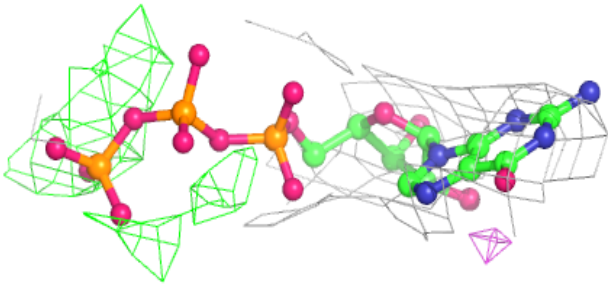


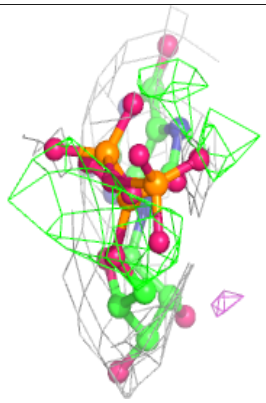


Electron density around GTP C 600:

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

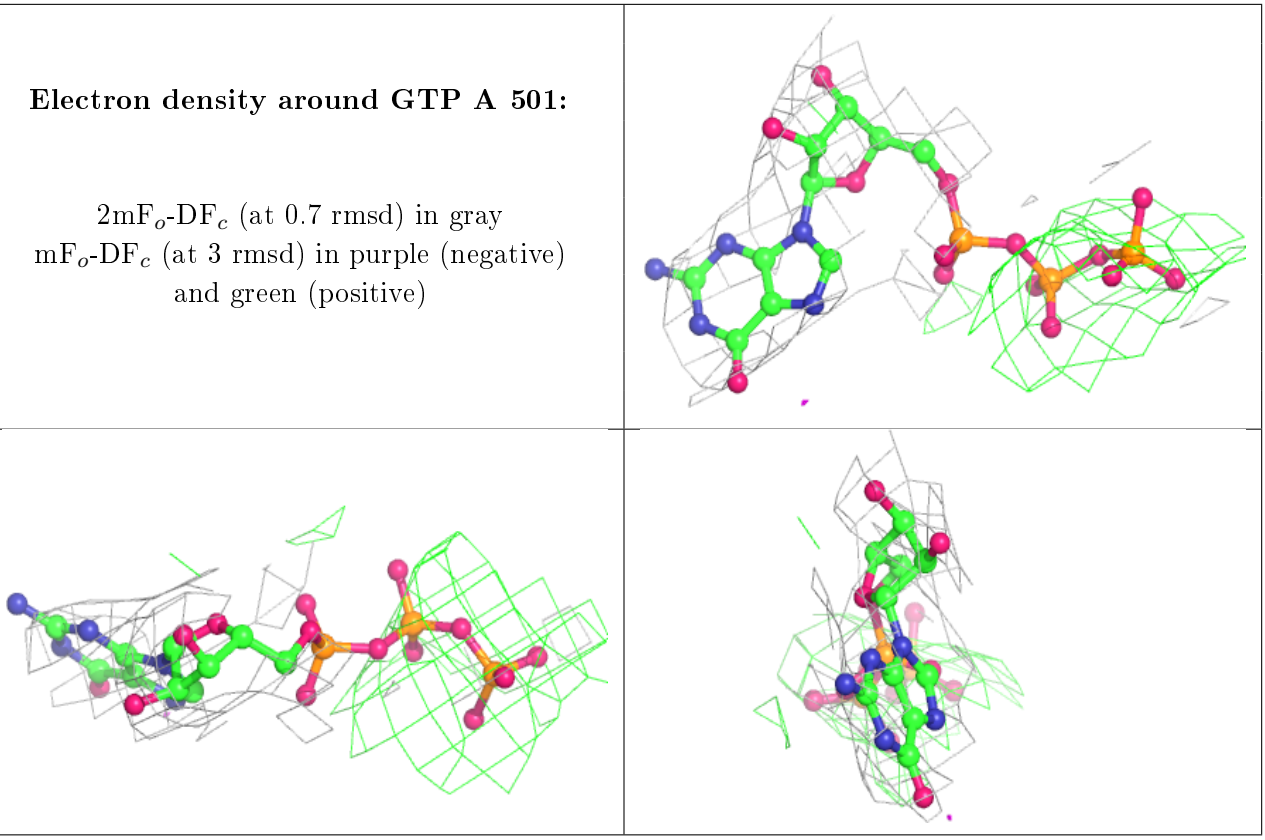






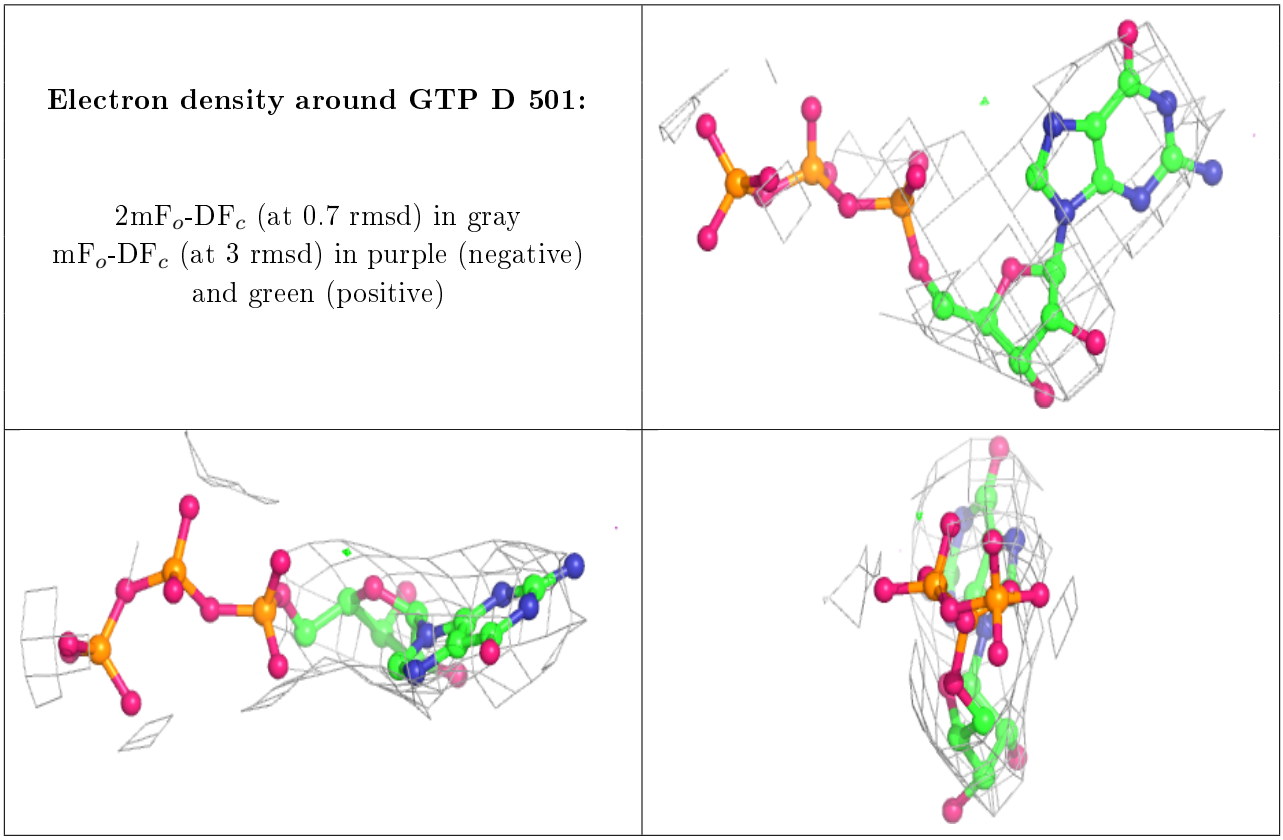
Electron density around GTP A 501:

$2mF_o$-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 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)



6.5 Other polymers (i)

There are no such residues in this entry.