wwPDB X-ray Structure Validation Summary Report (i)

Jan 7, 2024 – 04:39 pm GMT

PDB ID	:	6GWD
Title	:	Tubulin:iiH5 alphaRep complex
Authors	:	Gigant, B.; Campanacci, V.
Deposited on	:	2018-06-22
Resolution	:	3.20 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 (i) 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 (i)) were used in the production of this report:

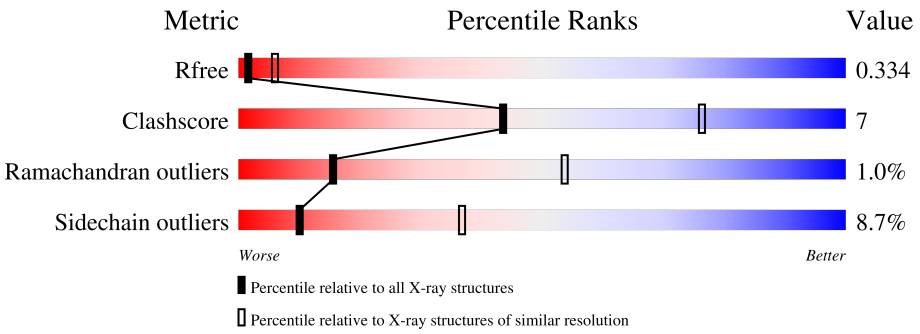
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 3.20 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	1133 (3.20-3.20)
Clashscore	141614	1253 (3.20-3.20)
Ramachandran outliers	138981	1234 (3.20-3.20)
Sidechain outliers	138945	1233 (3.20-3.20)

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

Mol	Chain	Length	Quality of chain
1	A	451	76% 19% • •
1	C	451	74% 21% • •
1	E	451	75% 20% • •
2	B	445	80% 17% •
2	D	445	77% 17% • •
2	F	445	80% 16% • •
3	G	170	47% 35% 8% 10%

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Mol	Chain	Length	Quality of chain
3	H	170	69% 20% • 8%
3	I	170	66% 23% • 9%

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 23868 atoms, of which 72 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 ALPHA-TUBULIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	434	3330	2106	564	638	22	0	0	0
1	C	436	3342	2114	569	638	21	0	0	0
1	E	432	3338	2114	564	639	21	0	0	0

- Molecule 2 is a protein called Tubulin beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	430	3342	2100	569	647	26	0	0	0
2	D	430	3346	2100	572	647	27	0	0	0
2	F	431	3360	2110	573	650	27	0	0	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	203	CYS	SER	conflict	UNP D0VWY9
B	318	ILE	VAL	conflict	UNP D0VWY9
D	203	CYS	SER	conflict	UNP D0VWY9
D	318	ILE	VAL	conflict	UNP D0VWY9
F	203	CYS	SER	conflict	UNP D0VWY9
F	318	ILE	VAL	conflict	UNP D0VWY9

- Molecule 3 is a protein called iiH5 ALPHAREP.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	G	153	1186	746	213	225	2	0	0	0

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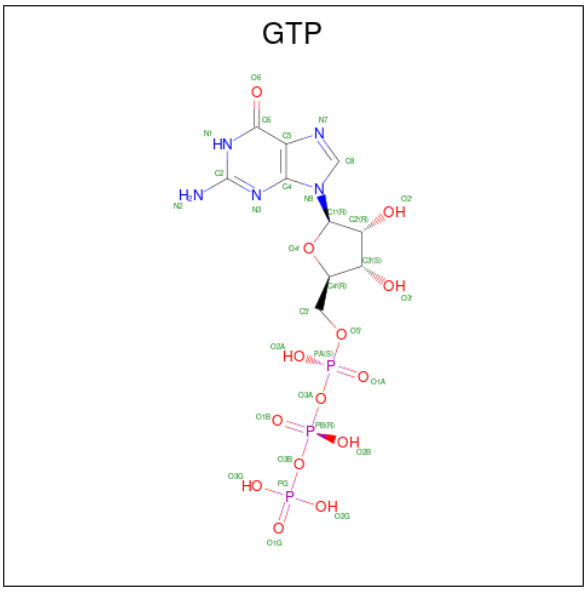
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	H	156	1189	746	212	229	2	0	0	0
			Total	C	N	O	S			
3	I	154	1180	742	211	225	2	0	0	0

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

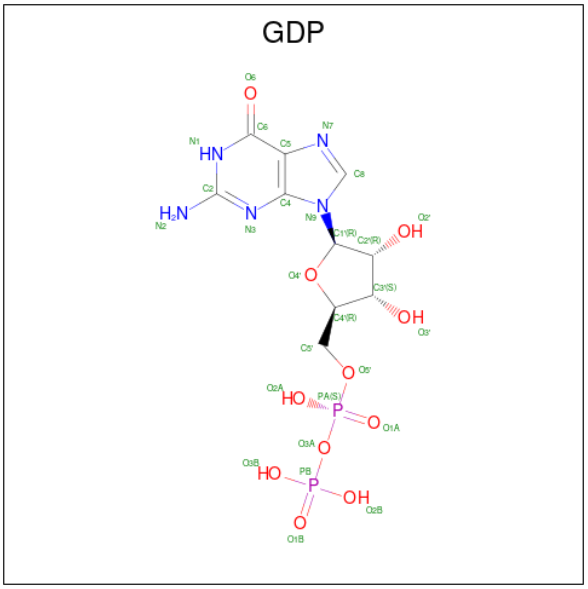


Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
			Total	C	H	N	O	P		
4	A	1	44	10	12	5	14	3	0	0
			Total	C	H	N	O	P		
4	C	1	44	10	12	5	14	3	0	0
			Total	C	H	N	O	P		
4	E	1	44	10	12	5	14	3	0	0

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

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

- Molecule 6 is GUANOSINE-5'-DIPHOSPHATE (three-letter code: GDP) (formula: $C_{10}H_{15}N_5O_{11}P_2$).



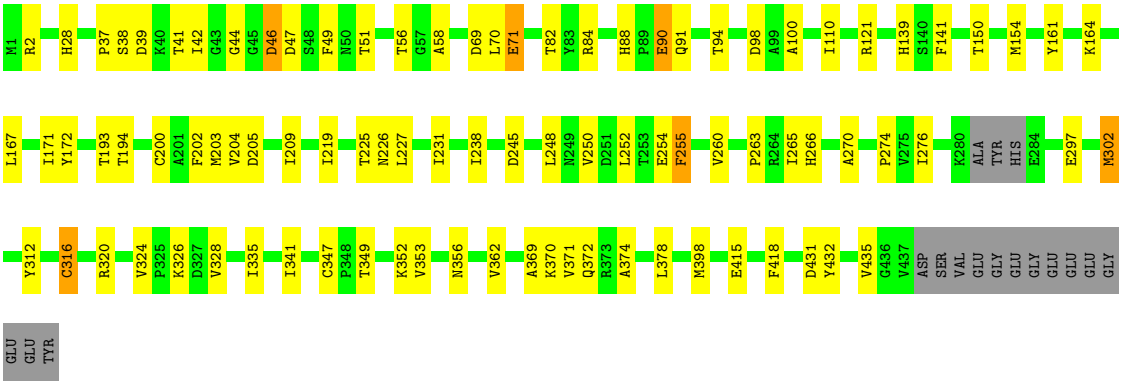
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
			Total	C	H	N	O	P		
6	B	1	40	10	12	5	11	2	0	0
			Total	C	H	N	O	P		
6	D	1	40	10	12	5	11	2	0	0
			Total	C	H	N	O	P		
6	F	1	40	10	12	5	11	2	0	0

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. 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. 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.

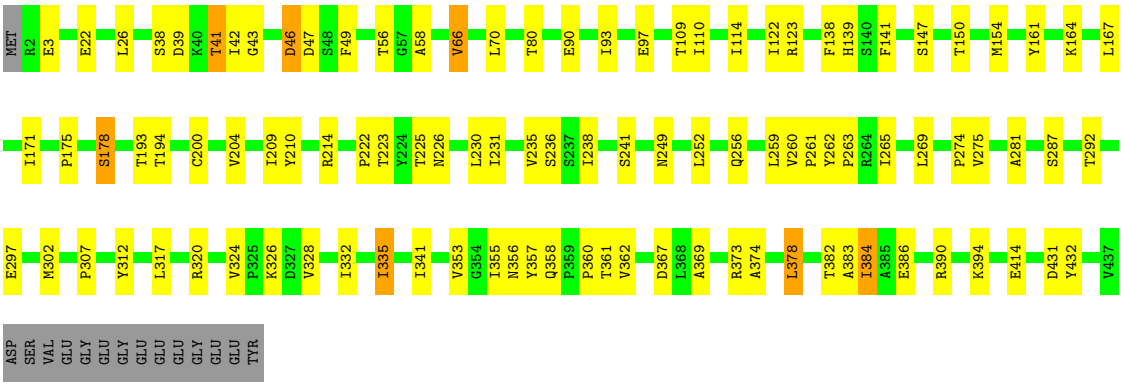
• Molecule 1: ALPHA-TUBULIN

Chain A:



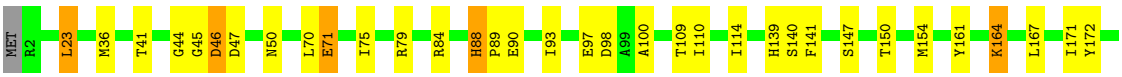
• Molecule 1: ALPHA-TUBULIN

Chain C:



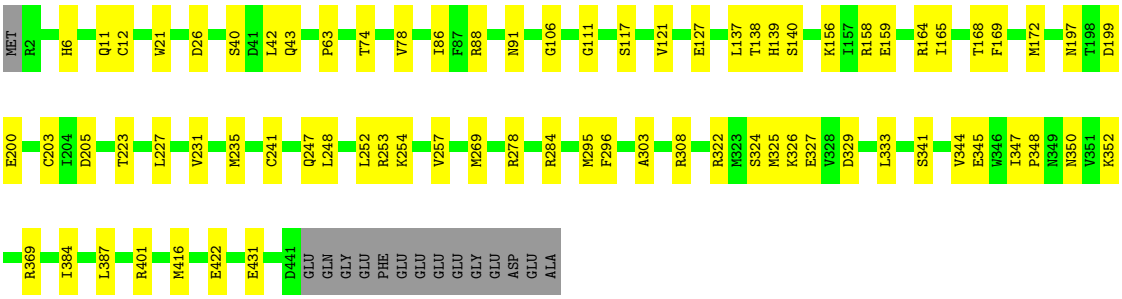
• Molecule 1: ALPHA-TUBULIN

Chain E:



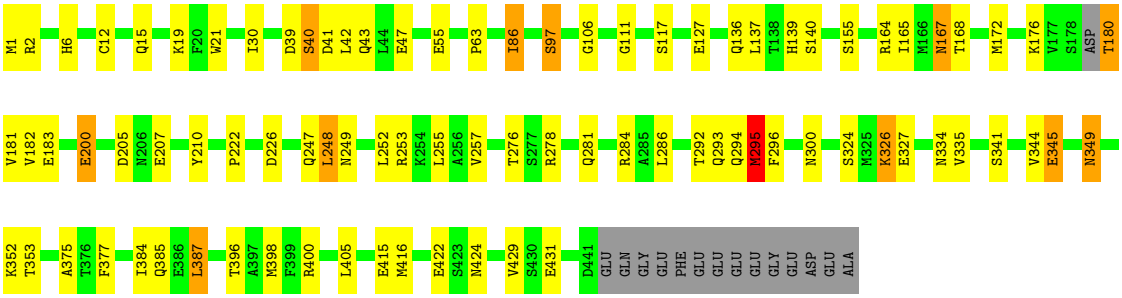
- Molecule 2: Tubulin beta chain

Chain B: 80% 17%



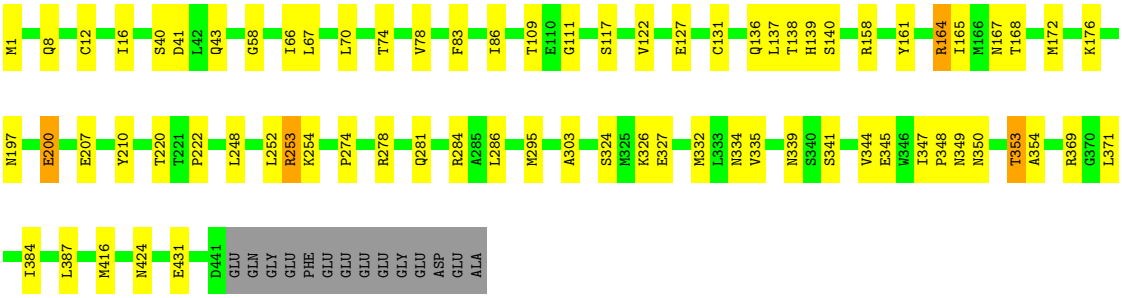
- Molecule 2: Tubulin beta chain

Chain D: 77% 17%



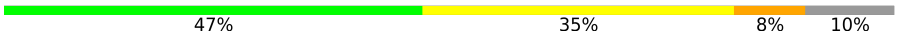
- Molecule 2: Tubulin beta chain

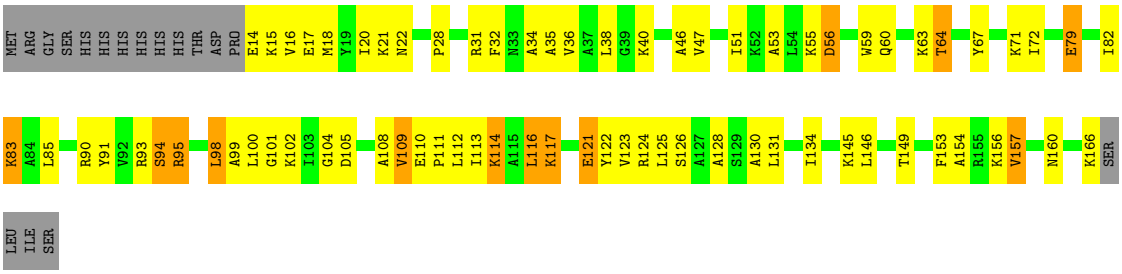
Chain F: 80% 16%



- Molecule 3: iiH5 ALPHAREP

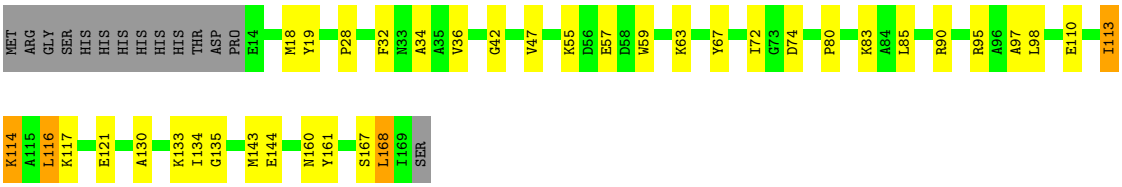
Chain G:





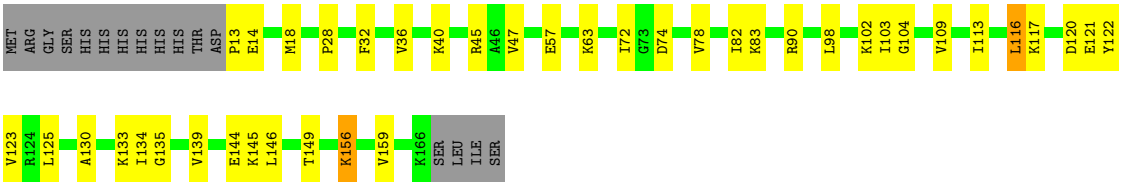
• Molecule 3: iiH5 ALPHAREP

Chain H:



• Molecule 3: iiH5 ALPHAREP

Chain I:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	450.80Å 53.84Å 229.62Å 90.00° 118.76° 90.00°	Depositor
Resolution (Å)	36.85 – 3.20 49.40 – 3.20	Depositor EDS
% Data completeness (in resolution range)	98.7 (36.85-3.20) 98.7 (49.40-3.20)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.34 (at 3.19Å)	Xtriage
Refinement program	BUSTER 2.10.3	Depositor
R, R_{free}	0.230 , 0.270 0.279 , 0.334	Depositor DCC
R_{free} test set	4037 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å^2)	71.8	Xtriage
Anisotropy	0.723	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 85.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.36$, $< L^2 > = 0.19$	Xtriage
Estimated twinning fraction	0.038 for -h-2*l,-k,l	Xtriage
F_o,F_c correlation	0.87	EDS
Total number of atoms	23868	wwPDB-VP
Average B, all atoms (Å^2)	90.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.39% 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 (i)

5.1 Standard geometry (i)

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

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	0.51	0/3404	0.74	1/4628 (0.0%)
1	C	0.51	0/3419	0.73	0/4652
1	E	0.52	0/3413	0.74	0/4640
2	B	0.49	0/3416	0.70	0/4631
2	D	0.50	0/3418	0.71	0/4630
2	F	0.49	0/3434	0.70	0/4653
3	G	0.76	0/1200	0.93	1/1612 (0.1%)
3	H	0.51	0/1203	0.74	0/1622
3	I	0.53	0/1194	0.72	0/1605
All	All	0.52	0/24101	0.73	2/32673 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	46	ASP	C-N-CA	5.29	134.93	121.70
3	G	15	LYS	C-N-CA	5.01	134.22	121.70

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	3330	0	3193	44	0
1	C	3342	0	3192	63	0
1	E	3338	0	3216	47	0
2	B	3342	0	3196	26	0
2	D	3346	0	3211	47	0
2	F	3360	0	3223	31	0
3	G	1186	0	1227	51	0
3	H	1189	0	1201	19	0
3	I	1180	0	1217	15	0
4	A	32	12	12	0	0
4	C	32	12	12	0	0
4	E	32	12	12	0	0
5	A	1	0	0	0	0
5	C	1	0	0	0	0
5	E	1	0	0	0	0
6	B	28	12	12	0	0
6	D	28	12	12	0	0
6	F	28	12	12	0	0
All	All	23796	72	22948	312	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 7.

The worst 5 of 312 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:161:TYR:HB3	1:E:164:LYS:HG3	1.52	0.91
1:E:267:PHE:O	1:E:384:ILE:HD13	1.74	0.87
2:D:292:THR:O	2:D:295:MET:HB3	1.84	0.77
1:C:328:VAL:HG11	1:C:353:VAL:HG11	1.67	0.77
3:G:121:GLU:HG2	3:G:124:ARG:NH2	2.00	0.76

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	430/451 (95%)	401 (93%)	23 (5%)	6 (1%)	11	46
1	C	434/451 (96%)	412 (95%)	17 (4%)	5 (1%)	13	49
1	E	428/451 (95%)	402 (94%)	23 (5%)	3 (1%)	22	61
2	B	428/445 (96%)	402 (94%)	25 (6%)	1 (0%)	47	79
2	D	426/445 (96%)	399 (94%)	22 (5%)	5 (1%)	13	49
2	F	429/445 (96%)	409 (95%)	16 (4%)	4 (1%)	17	56
3	G	151/170 (89%)	139 (92%)	10 (7%)	2 (1%)	12	47
3	H	154/170 (91%)	144 (94%)	7 (4%)	3 (2%)	8	39
3	I	152/170 (89%)	146 (96%)	5 (3%)	1 (1%)	22	61
All	All	3032/3198 (95%)	2854 (94%)	148 (5%)	30 (1%)	15	54

5 of 30 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	42	ILE
1	A	44	GLY
1	A	349	THR
1	C	281	ALA
2	D	97	SER

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	352/379 (93%)	332 (94%)	20 (6%)	20	56
1	C	351/379 (93%)	327 (93%)	24 (7%)	16	49
1	E	356/379 (94%)	327 (92%)	29 (8%)	11	42
2	B	362/383 (94%)	337 (93%)	25 (7%)	15	49
2	D	363/383 (95%)	324 (89%)	39 (11%)	6	27

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
2	F	365/383 (95%)	340 (93%)	25 (7%)	16 49
3	G	119/135 (88%)	96 (81%)	23 (19%)	1 8
3	H	117/135 (87%)	103 (88%)	14 (12%)	5 22
3	I	118/135 (87%)	98 (83%)	20 (17%)	2 10
All	All	2503/2691 (93%)	2284 (91%)	219 (9%)	10 37

5 of 219 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	90	GLU
2	F	164	ARG
3	I	14	GLU
1	E	193	THR
1	E	335	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 28 such sidechains are listed below:

Mol	Chain	Res	Type
2	D	349	ASN
3	G	60	GLN
1	E	101	ASN
2	F	43	GLN
1	E	88	HIS

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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 9 ligands modelled in this entry, 3 are monoatomic - leaving 6 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	0.85	3 (11%)	32,54,54	0.61	0
6	GDP	F	600	-	24,30,30	0.80	0	30,47,47	0.69	1 (3%)
6	GDP	D	600	-	24,30,30	0.95	0	30,47,47	0.81	1 (3%)
6	GDP	B	600	-	24,30,30	0.87	1 (4%)	30,47,47	0.66	1 (3%)
4	GTP	E	600	5	26,34,34	0.74	0	32,54,54	0.69	0
4	GTP	A	600	5	26,34,34	0.90	2 (7%)	32,54,54	0.77	1 (3%)

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	C	600	5	-	3/18/38/38	0/3/3/3
6	GDP	F	600	-	-	5/12/32/32	0/3/3/3
6	GDP	D	600	-	-	4/12/32/32	0/3/3/3
6	GDP	B	600	-	-	4/12/32/32	0/3/3/3
4	GTP	E	600	5	-	4/18/38/38	0/3/3/3
4	GTP	A	600	5	-	3/18/38/38	0/3/3/3

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	B	600	GDP	PB-O2B	-2.31	1.45	1.54
4	A	600	GTP	PG-O3G	-2.28	1.46	1.54
4	A	600	GTP	C5-C6	-2.13	1.43	1.47
4	C	600	GTP	PG-O1G	-2.12	1.43	1.50
4	C	600	GTP	C5-C4	-2.04	1.37	1.43

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
6	D	600	GDP	O2B-PB-O3A	2.71	113.71	104.64
6	F	600	GDP	O3B-PB-O3A	2.33	112.44	104.64
4	A	600	GTP	O3G-PG-O3B	2.20	112.01	104.64
6	B	600	GDP	O2B-PB-O3A	2.16	111.87	104.64

There are no chirality outliers.

5 of 23 torsion outliers are listed below:

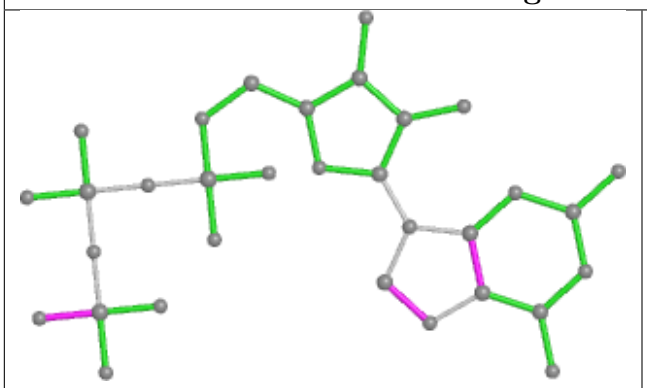
Mol	Chain	Res	Type	Atoms
4	A	600	GTP	C5'-O5'-PA-O1A
4	A	600	GTP	C5'-O5'-PA-O2A
4	C	600	GTP	C5'-O5'-PA-O1A
4	C	600	GTP	C5'-O5'-PA-O2A
4	E	600	GTP	C5'-O5'-PA-O1A

There are no ring outliers.

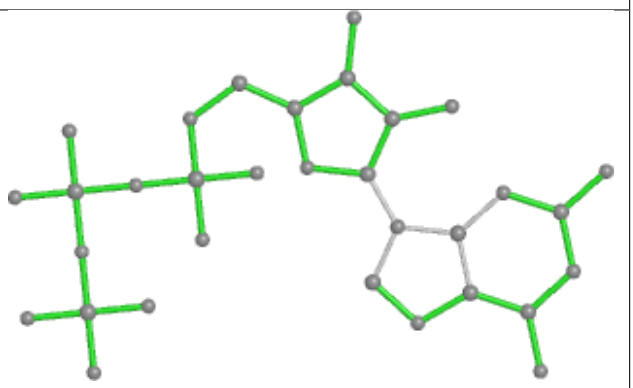
No monomer is involved in short contacts.

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.

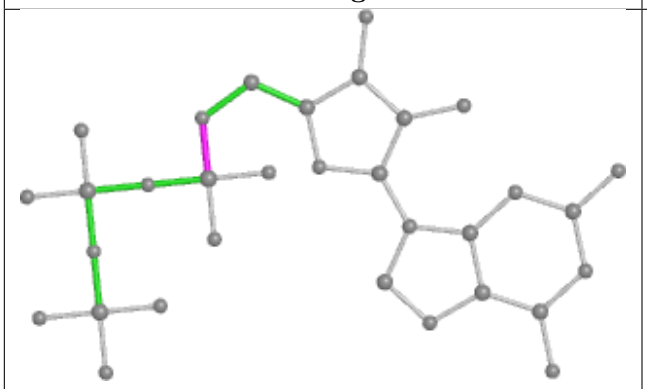
Ligand GTP C 600



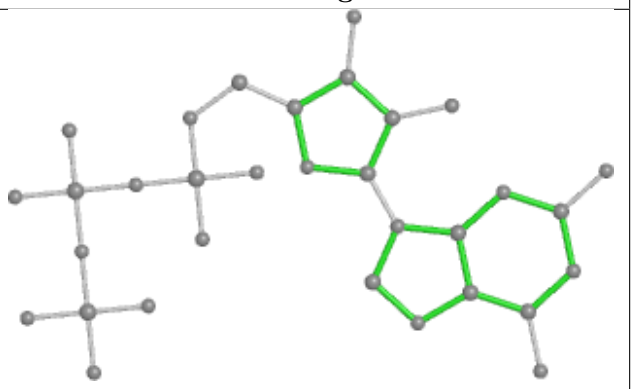
Bond lengths



Bond angles

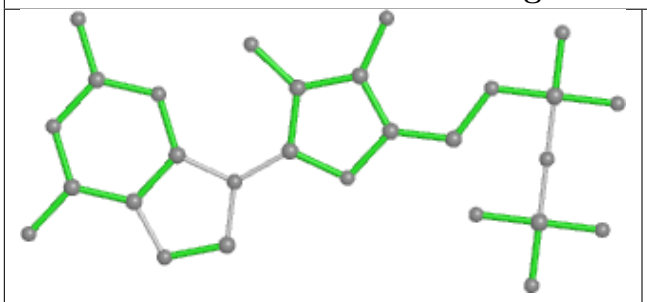


Torsions

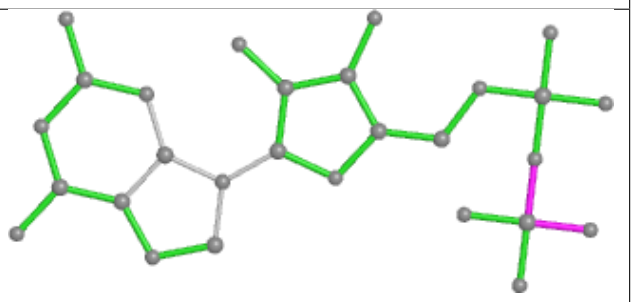


Rings

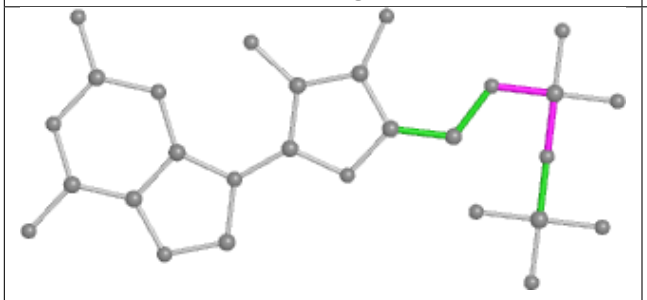
Ligand GDP F 600



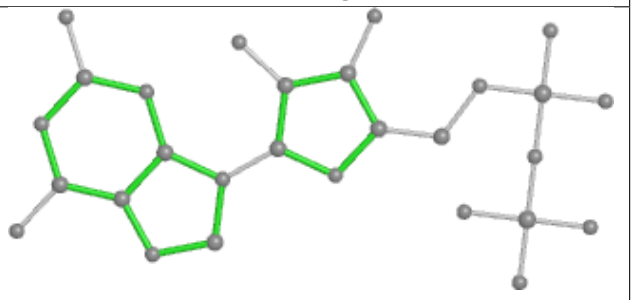
Bond lengths



Bond angles

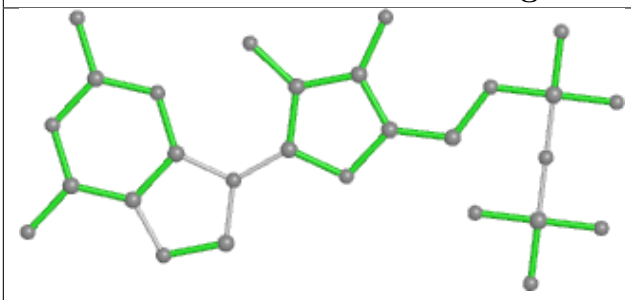


Torsions

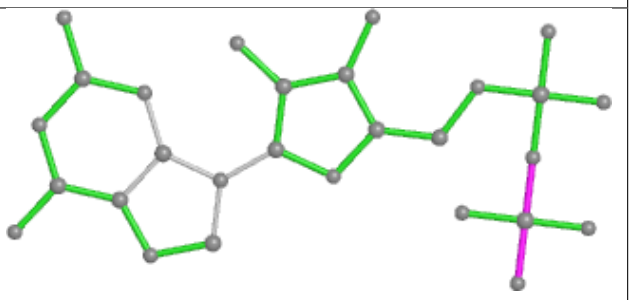


Rings

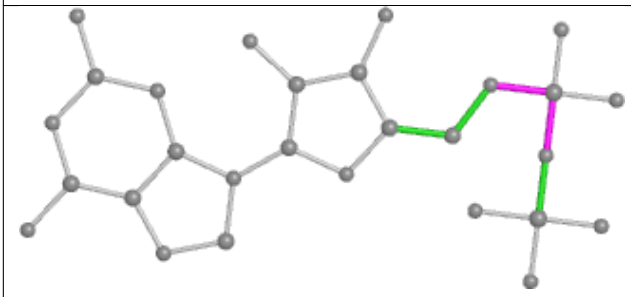
Ligand GDP D 600



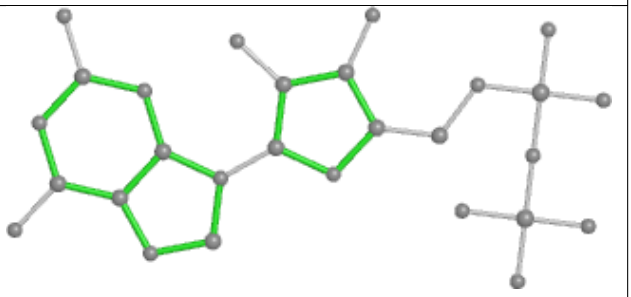
Bond lengths



Bond angles

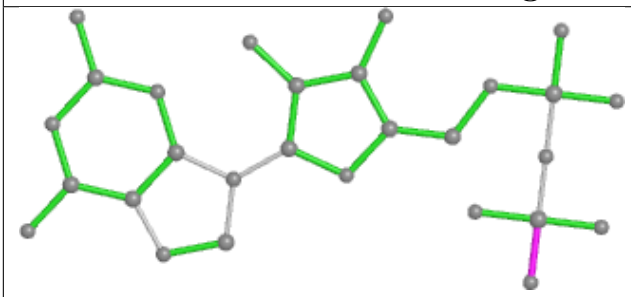


Torsions

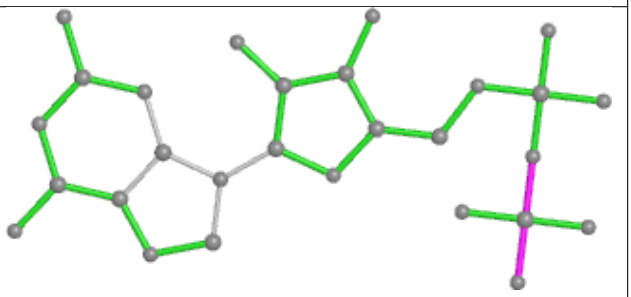


Rings

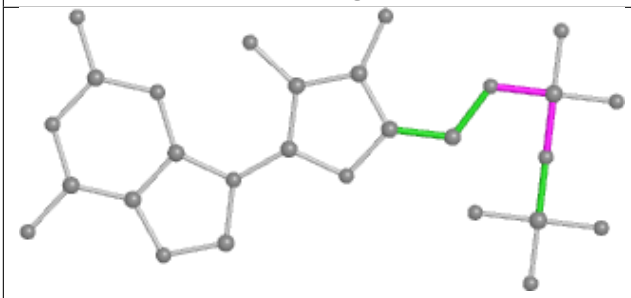
Ligand GDP B 600



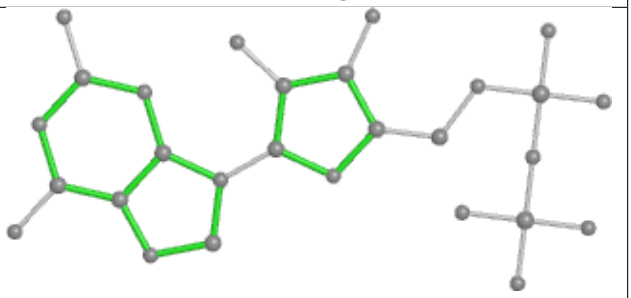
Bond lengths



Bond angles

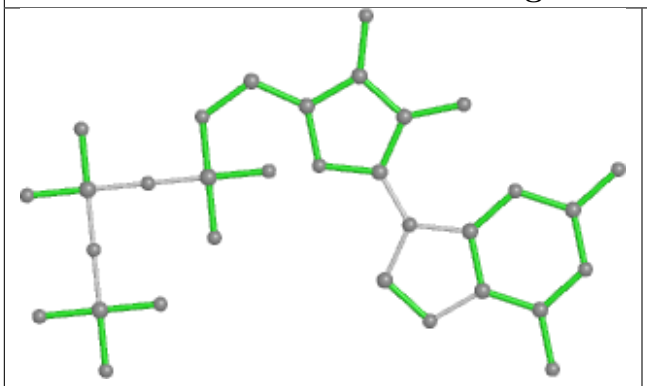


Torsions



Rings

Ligand GTP E 600



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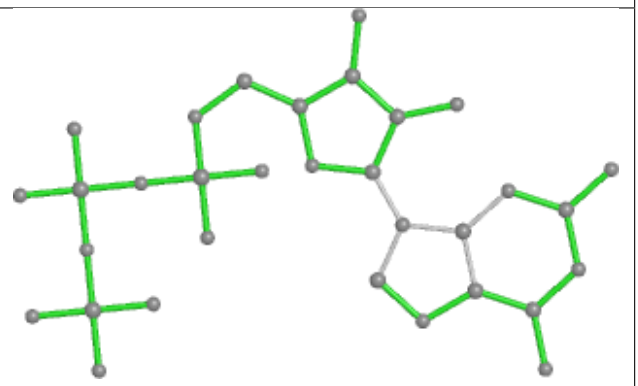
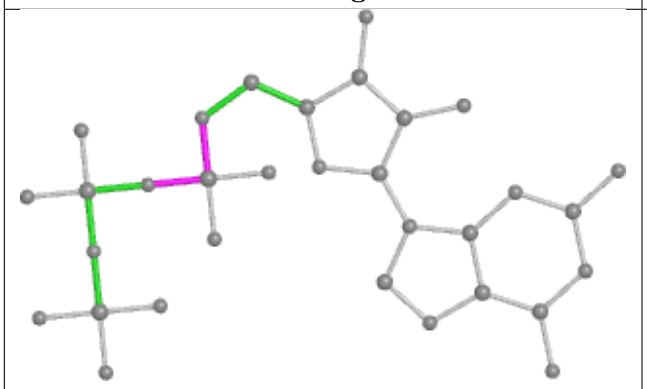


Bond angles



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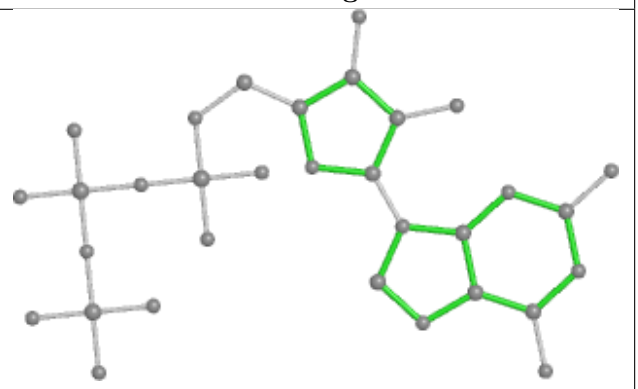
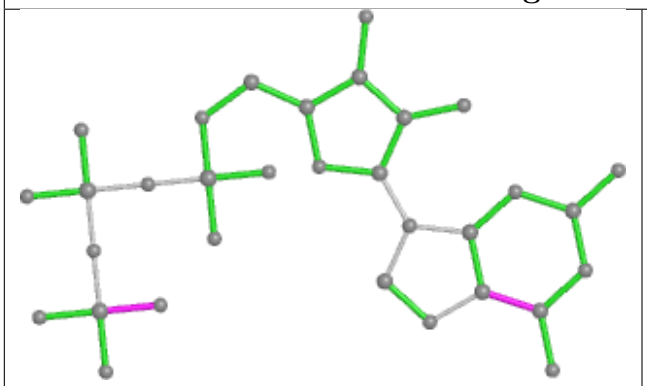
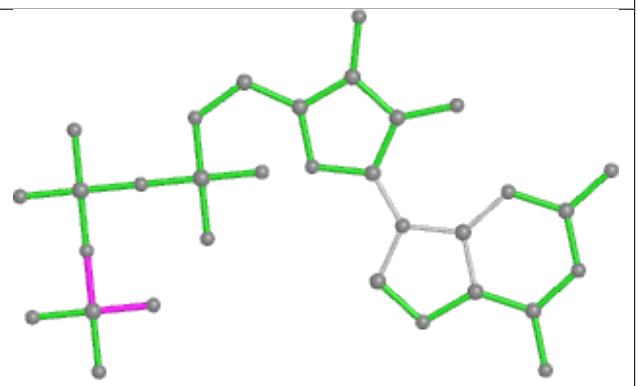


Rings

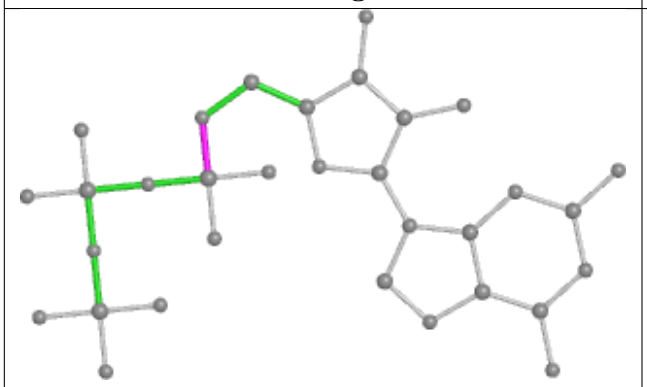
Ligand GTP A 600



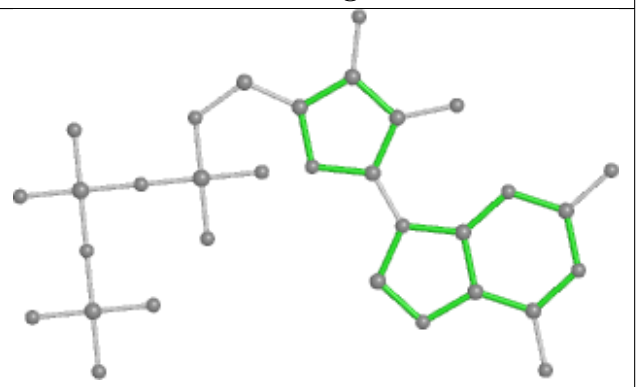
Bond lengths



Bond angles



Torsions



Rings

5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data (i)

6.1 Protein, DNA and RNA chains (i)

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

6.3 Carbohydrates (i)

Unable to reproduce the depositors R factor - this section is therefore empty.

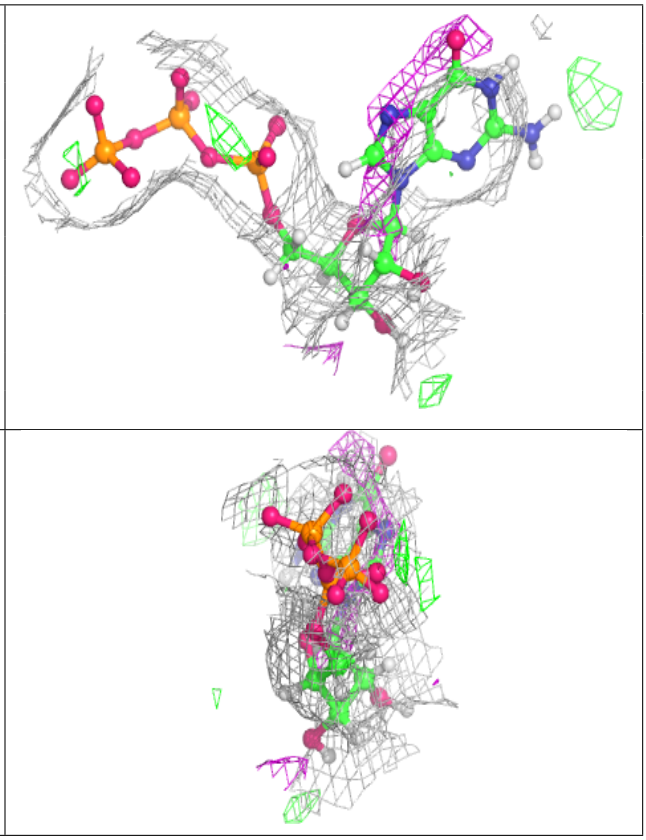
6.4 Ligands (i)

Unable to reproduce the depositors R factor - this section is therefore empty.

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.

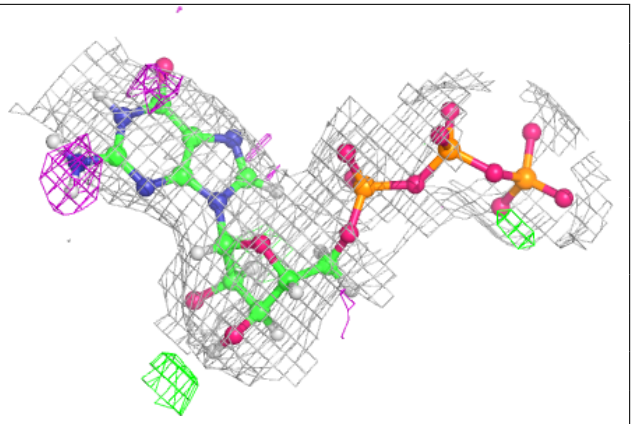
Electron density around GTP A 600:

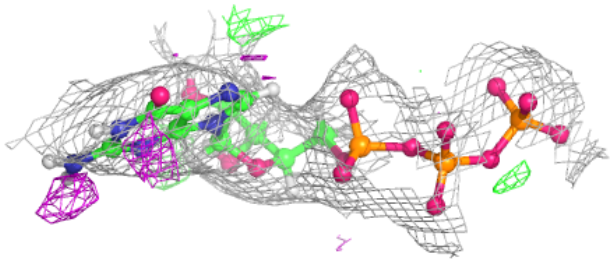
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

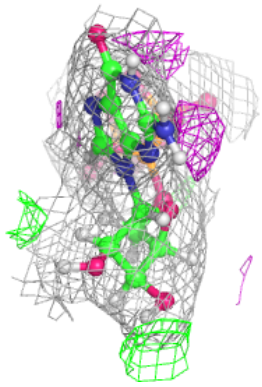


Electron density around GTP C 600:

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

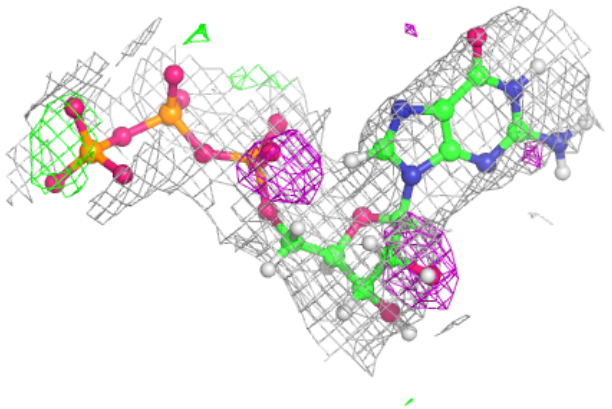


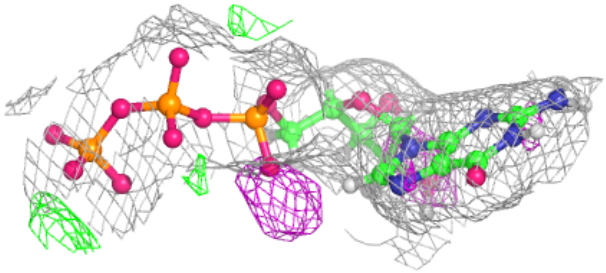




Electron density around GTP E 600:

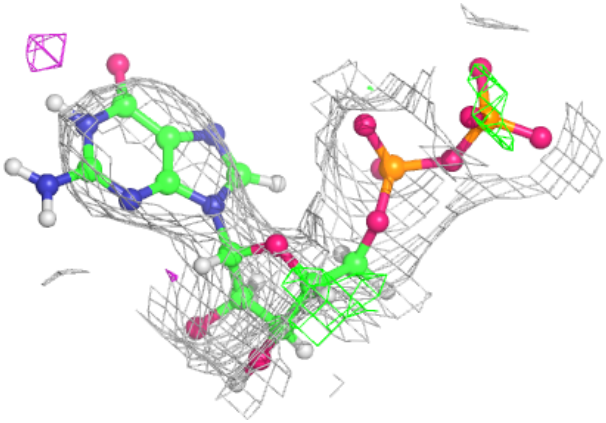
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

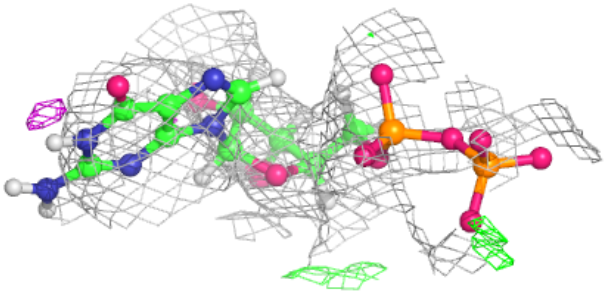


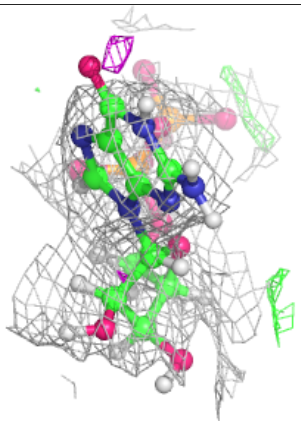


Electron density around GDP B 600:

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







Electron density around GDP D 600:

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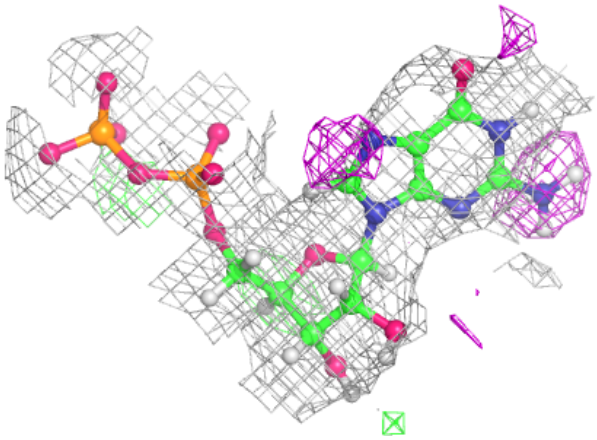
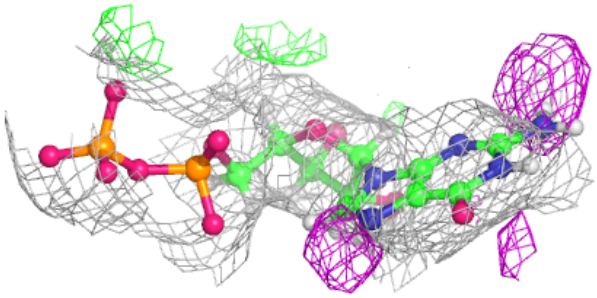
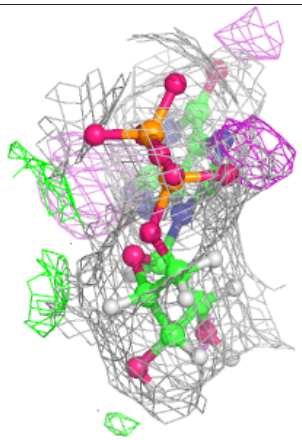
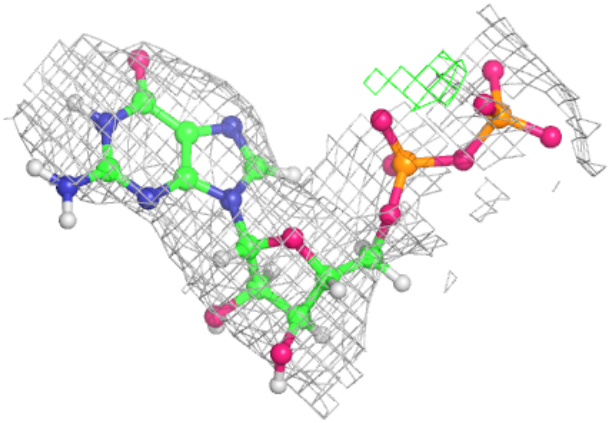
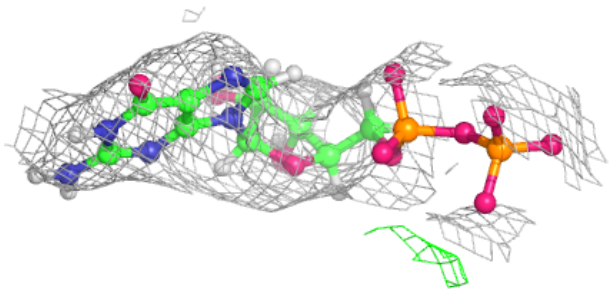
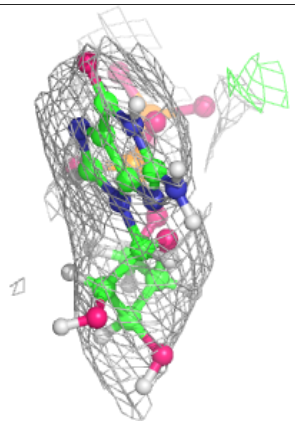
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)







Electron density around GDP F 600: $2mF_o$-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)

Unable to reproduce the depositors R factor - this section is therefore empty.