



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 15, 2017 – 03:00 am GMT

PDB ID : 4DRX  
Title : GTP-Tubulin in complex with a DARPIN  
Authors : Pecqueur, L.; Gigant, B.; Knossow, M.  
Deposited on : 2012-02-17  
Resolution : 2.22 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](mailto:validation@mail.wwpdb.org)

A user guide is available at

<http://wwpdb.org/validation/2016/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 : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : 1.9-1692  
EDS : trunk28620  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : recalc28949

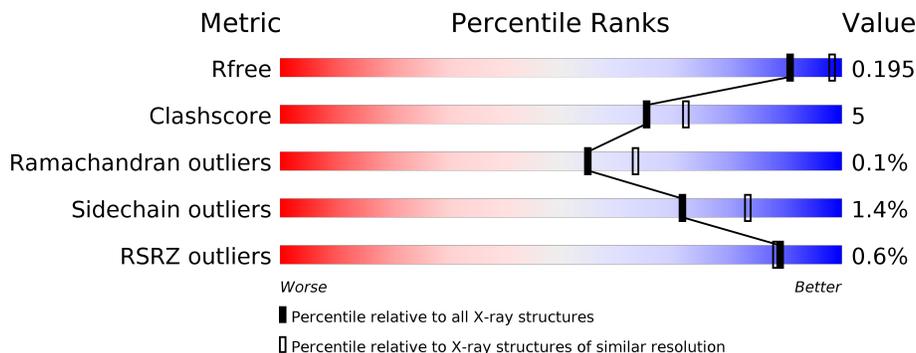
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.22 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))
$R_{free}$	100719	4744 (2.24-2.20)
Clashscore	112137	5509 (2.24-2.20)
Ramachandran outliers	110173	5427 (2.24-2.20)
Sidechain outliers	110143	5428 (2.24-2.20)
RSRZ outliers	101464	4776 (2.24-2.20)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	437	 89% 10%
1	C	437	 85% 11%
2	B	431	 84% 14%
2	D	431	 84% 16%
3	E	169	 86% 6% 8%
3	F	169	 84% 7% 8%

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 16084 atoms, of which 48 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 chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	431	3333	2108	567	637	21	0	2	0
1	C	421	3265	2072	552	621	20	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	232	SER	GLY	SEE REMARK 999	UNP D0VWZ0
A	340	SER	THR	SEE REMARK 999	UNP D0VWZ0
C	232	SER	GLY	SEE REMARK 999	UNP D0VWZ0
C	340	SER	THR	SEE REMARK 999	UNP D0VWZ0

- Molecule 2 is a protein called Tubulin beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	424	3324	2086	566	646	26	0	2	0
2	D	431	3362	2108	574	654	26	2	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	318	ILE	VAL	SEE REMARK 999	UNP D0VWY9
D	318	ILE	VAL	SEE REMARK 999	UNP D0VWY9

- Molecule 3 is a protein called Designed ankyrin repeat protein (DARPIN) D1.

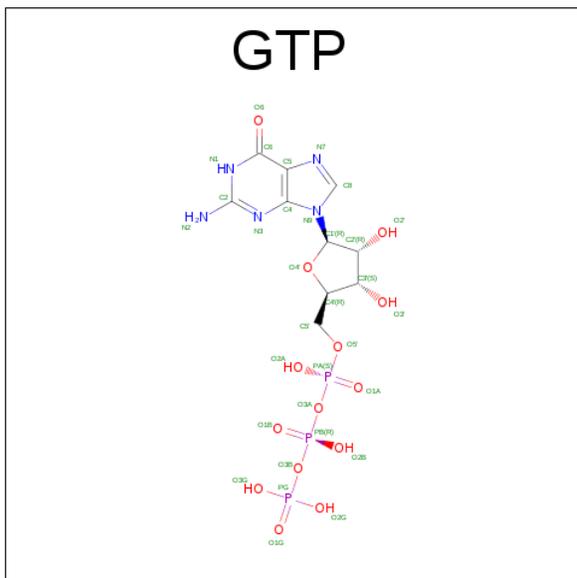
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	E	156	1140	716	196	225	3	0	0	0

*Continued on next page...*

Continued from previous page...

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	F	155	1135	713	195	224	3	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
4	B	1	44	10	12	5	14	3	0	0
4	C	1	44	10	12	5	14	3	0	0
4	D	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
5	B	1	Total Mg 1 1	0	0
5	A	1	Total Mg 1 1	0	0
5	D	1	Total Mg 1 1	0	0
5	C	1	Total Mg 1 1	0	0

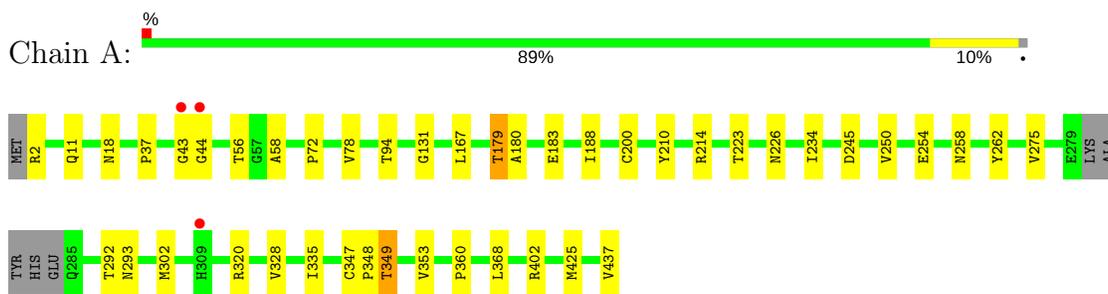
- Molecule 6 is water.

<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
6	A	80	Total 80	O 80	0	0
6	B	61	Total 61	O 61	0	0
6	C	100	Total 100	O 100	0	0
6	D	57	Total 57	O 57	0	0
6	E	25	Total 25	O 25	0	0
6	F	22	Total 22	O 22	0	0

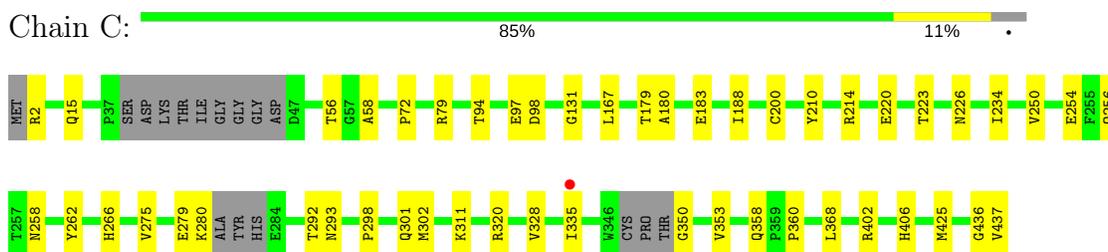
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

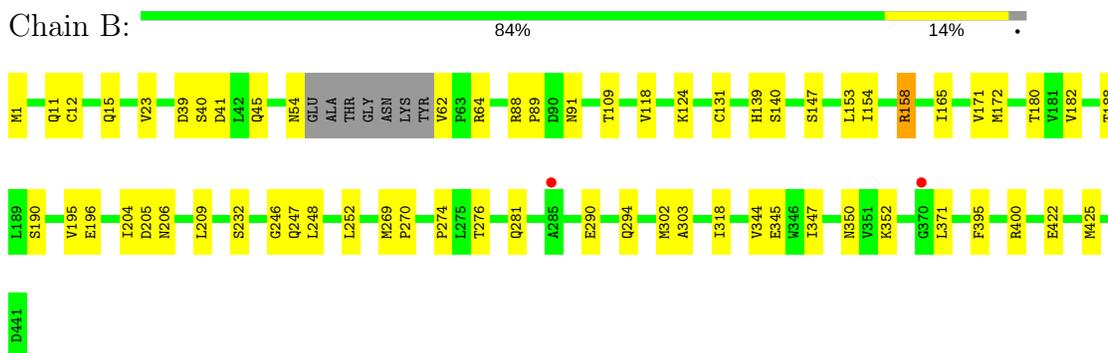
- Molecule 1: Tubulin alpha chain



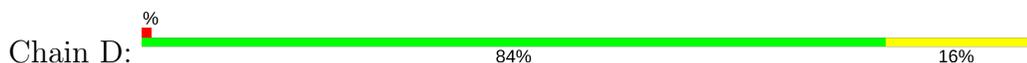
- Molecule 1: Tubulin alpha chain

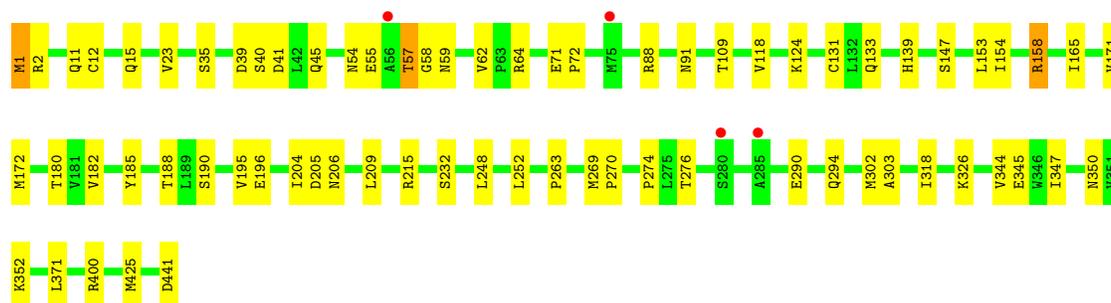


- Molecule 2: Tubulin beta chain

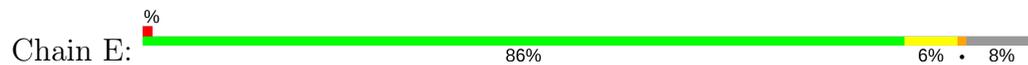


- Molecule 2: Tubulin beta chain

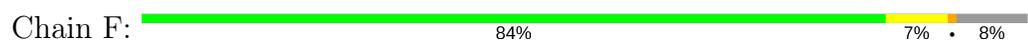




- Molecule 3: Designed ankyrin repeat protein (DARPIN) D1



- Molecule 3: Designed ankyrin repeat protein (DARPIN) D1



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	104.88Å 90.60Å 117.58Å 90.00° 90.02° 90.00°	Depositor
Resolution (Å)	39.19 – 2.22 39.19 – 2.22	Depositor EDS
% Data completeness (in resolution range)	96.1 (39.19-2.22) 96.0 (39.19-2.22)	Depositor EDS
$R_{merge}$	0.01	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.00 (at 2.22Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE: 1.7.2_869)	Depositor
R, $R_{free}$	0.159 , 0.194 0.159 , 0.195	Depositor DCC
$R_{free}$ test set	5215 reflections (4.98%)	DCC
Wilson B-factor (Å <sup>2</sup> )	35.9	Xtriage
Anisotropy	0.388	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 21.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.42$ , $\langle L^2 \rangle = 0.24$	Xtriage
Estimated twinning fraction	0.447 for h,-k,-l	Xtriage
Reported twinning fraction	0.480 for h,-k,-l	Depositor
Outliers	0 of 104776 reflections	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	16084	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	45.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.02% 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: 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	0.33	0/3411	0.43	0/4638
1	C	0.25	0/3337	0.42	0/4534
2	B	0.25	0/3399	0.45	1/4605 (0.0%)
2	D	0.24	0/3436	0.47	4/4657 (0.1%)
3	E	0.21	0/1155	0.39	0/1572
3	F	0.22	0/1150	0.40	0/1565
All	All	0.26	0/15888	0.44	5/21571 (0.0%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	109	THR	N-CA-C	7.04	130.00	111.00
2	D	2	ARG	N-CA-CB	-6.46	98.98	110.60
2	D	109	THR	N-CA-C	6.38	128.21	111.00
2	D	1	MET	N-CA-C	6.21	127.78	111.00
2	D	2	ARG	N-CA-C	5.68	126.35	111.00

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	3333	0	3197	26	0
1	C	3265	0	3144	31	0
2	B	3324	0	3189	37	0
2	D	3362	0	3218	45	0
3	E	1140	0	1127	6	0
3	F	1135	0	1125	7	0
4	A	32	12	12	1	0
4	B	32	12	12	3	0
4	C	32	12	12	2	0
4	D	32	12	12	2	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	80	0	0	1	0
6	B	61	0	0	1	0
6	C	100	0	0	4	0
6	D	57	0	0	2	0
6	E	25	0	0	0	0
6	F	22	0	0	1	0
All	All	16036	48	15048	144	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.

The worst 5 of 144 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:247:GLN:HG3	2:B:247:GLN:O	1.82	0.79
2:B:140:SER:OG	4:B:600:GTP:O1A	2.02	0.77
2:B:1:MET:N	2:B:131:CYS:SG	2.60	0.73
2:D:441:ASP:HA	6:D:743:HOH:O	1.90	0.70
1:A:179:THR:HG21	2:B:247:GLN:HG3	1.74	0.69

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	429/437 (98%)	410 (96%)	18 (4%)	1 (0%)	51	58
1	C	413/437 (94%)	398 (96%)	15 (4%)	0	100	100
2	B	422/431 (98%)	412 (98%)	10 (2%)	0	100	100
2	D	429/431 (100%)	419 (98%)	9 (2%)	1 (0%)	51	58
3	E	154/169 (91%)	151 (98%)	3 (2%)	0	100	100
3	F	153/169 (90%)	150 (98%)	3 (2%)	0	100	100
All	All	2000/2074 (96%)	1940 (97%)	58 (3%)	2 (0%)	55	63

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	D	57	THR
1	A	37	PRO

### 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	353/368 (96%)	349 (99%)	4 (1%)	78	87
1	C	347/368 (94%)	343 (99%)	4 (1%)	75	86
2	B	364/372 (98%)	358 (98%)	6 (2%)	68	80
2	D	366/372 (98%)	360 (98%)	6 (2%)	68	80
3	E	116/132 (88%)	114 (98%)	2 (2%)	66	78

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
3	F	116/132 (88%)	114 (98%)	2 (2%)	66	78
All	All	1662/1744 (95%)	1638 (99%)	24 (1%)	71	83

5 of 24 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	179	THR
1	C	437	VAL
3	F	20	GLU
1	C	262	TYR
1	C	266	HIS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	301	GLN
3	F	59	HIS
2	D	406	HIS
1	C	216	ASN
3	E	59	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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 4 are monoatomic - leaving 4 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	A	600	5	27,34,34	1.03	1 (3%)	24,54,54	1.30	2 (8%)
4	GTP	B	600	5	27,34,34	1.05	1 (3%)	24,54,54	1.22	1 (4%)
4	GTP	C	600	5	27,34,34	1.02	1 (3%)	24,54,54	1.25	1 (4%)
4	GTP	D	600	5	27,34,34	1.02	1 (3%)	24,54,54	1.23	1 (4%)

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	A	600	5	-	0/18/38/38	0/3/3/3
4	GTP	B	600	5	-	0/18/38/38	0/3/3/3
4	GTP	C	600	5	-	0/18/38/38	0/3/3/3
4	GTP	D	600	5	-	0/18/38/38	0/3/3/3

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	600	GTP	C2-N3	3.70	1.38	1.33
4	A	600	GTP	C2-N3	3.72	1.38	1.33
4	D	600	GTP	C2-N3	3.93	1.38	1.33
4	B	600	GTP	C2-N3	3.96	1.38	1.33

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	600	GTP	N2-C2-N1	2.37	120.36	117.84
4	D	600	GTP	C2-N3-C4	4.34	120.23	115.16
4	A	600	GTP	C2-N3-C4	4.36	120.25	115.16
4	C	600	GTP	C2-N3-C4	4.45	120.36	115.16
4	B	600	GTP	C2-N3-C4	4.50	120.42	115.16

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	600	GTP	1	0
4	B	600	GTP	3	0
4	C	600	GTP	2	0
4	D	600	GTP	2	0

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

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

There are no chain breaks in this entry.

## 6 Fit of model and data [i](#)

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

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 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	431/437 (98%)	-0.46	3 (0%) 87 86	24, 38, 69, 108	7 (1%)
1	C	421/437 (96%)	-0.49	1 (0%) 94 94	24, 38, 66, 99	1 (0%)
2	B	424/431 (98%)	-0.41	2 (0%) 90 90	25, 44, 80, 113	0
2	D	431/431 (100%)	-0.37	4 (0%) 84 83	25, 44, 81, 114	2 (0%)
3	E	156/169 (92%)	-0.35	2 (1%) 77 75	28, 45, 79, 92	0
3	F	155/169 (91%)	-0.38	0 100 100	29, 46, 79, 92	0
All	All	2018/2074 (97%)	-0.42	12 (0%) 89 88	24, 42, 78, 114	10 (0%)

The worst 5 of 12 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	44	GLY	4.0
2	D	56	ALA	3.3
1	A	309	HIS	3.2
1	A	43	GLY	3.1
2	B	285	ALA	3.1

### 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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
4	GTP	A	600	32/32	0.99	0.11	0.21	16,33,51,53	0
4	GTP	B	600	32/32	0.97	0.10	-0.25	32,51,69,123	0
4	GTP	C	600	32/32	0.98	0.09	-0.41	13,25,37,56	0
4	GTP	D	600	32/32	0.97	0.09	-0.92	19,43,58,79	0
5	MG	C	601	1/1	0.78	0.11	-	38,38,38,38	0
5	MG	A	601	1/1	0.99	0.06	-	29,29,29,29	0
5	MG	D	601	1/1	0.56	0.14	-	67,67,67,67	0
5	MG	B	601	1/1	0.97	0.12	-	47,47,47,47	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.