



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 8, 2023 – 01:00 AM EDT

PDB ID : 4QJD  
Title : Crystal Structure of Twister with the Nucleotide 5'- to the Cleavage Site Disordered at 3.1 Å Resolution  
Authors : Eiler, D.R.; Wang, J.; Steitz, T.A.  
Deposited on : 2014-06-03  
Resolution : 3.10 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

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.35.1  
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) : 2.35.1

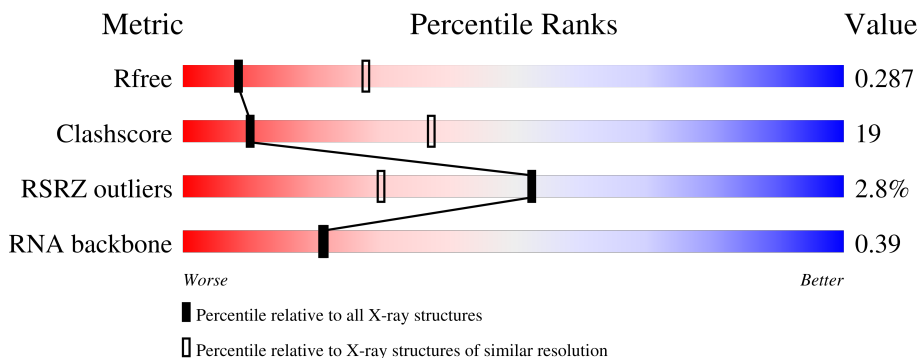
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.10 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.





Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	1094 (3.10-3.10)
Clashscore	141614	1184 (3.10-3.10)
RSRZ outliers	127900	1067 (3.10-3.10)
RNA backbone	3102	1116 (3.40-2.80)

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

Mol	Chain	Length	Quality of chain
1	A	26	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">12%</div> <div style="width: 100%; height: 15px; background: linear-gradient(to right, red 12%, orange 12% 31%, yellow 31% 42%, green 42% 58%, orange 58% 77%, red 77% 88%, grey 88% 100%);"></div> <div style="text-align: center;">31%      42%      19%      8%</div> </div>
1	C	26	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">4%</div> <div style="width: 100%; height: 15px; background: linear-gradient(to right, red 4%, orange 4% 23%, yellow 23% 54%, green 54% 73%, orange 73% 88%, red 88% 93%, grey 93% 100%);"></div> <div style="text-align: center;">23%      54%      15%      . .</div> </div>
1	E	26	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">8%</div> <div style="width: 100%; height: 15px; background: linear-gradient(to right, red 8%, orange 8% 27%, yellow 27% 58%, green 58% 73%, orange 73% 88%, red 88% 93%, grey 93% 100%);"></div> <div style="text-align: center;">27%      58%      15%</div> </div>
1	G	26	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">8%</div> <div style="width: 100%; height: 15px; background: linear-gradient(to right, red 8%, orange 8% 19%, yellow 19% 35%, green 35% 58%, orange 58% 73%, red 73% 88%, grey 88% 100%);"></div> <div style="text-align: center;">19%      35%      38%      . .</div> </div>
2	B	47	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">43%</div> <div style="width: 100%; height: 15px; background: linear-gradient(to right, green 43% 58%, yellow 58% 73%, orange 73% 88%, red 88% 93%, grey 93% 100%);"></div> <div style="text-align: center;">43%      6%      9%</div> </div>
2	D	47	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">45%</div> <div style="width: 100%; height: 15px; background: linear-gradient(to right, green 45% 58%, yellow 58% 73%, orange 73% 88%, red 88% 93%, grey 93% 100%);"></div> <div style="text-align: center;">28%      23%      .</div> </div>

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Mol	Chain	Length	Quality of chain
2	F	47	 38% 51% 11%
2	H	47	 34% 47% 15% •

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 6188 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 RNA chain called Twister RNA sequence.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	A	24	498	224	79	171	24	0	0	0
1	C	25	518	233	81	179	25	0	0	0
1	E	26	540	243	86	185	26	0	0	0
1	G	25	518	233	81	179	25	0	0	0

- Molecule 2 is a RNA chain called Twister RNA sequence.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	B	47	1019	455	198	319	47	0	0	0
2	D	47	1028	455	198	326	49	0	0	0
2	F	47	1028	455	198	326	49	0	0	0
2	H	47	1019	455	198	319	47	0	0	0

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total 1	Mg 1	0	0
3	F	2	Total 2	Mg 2	0	0
3	H	1	Total 1	Mg 1	0	0

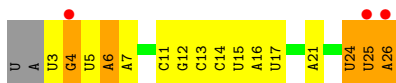
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total O 1 1	0	0
4	B	5	Total O 5 5	0	0
4	C	2	Total O 2 2	0	0
4	D	1	Total O 1 1	0	0
4	F	4	Total O 4 4	0	0
4	G	2	Total O 2 2	0	0
4	H	1	Total O 1 1	0	0

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

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

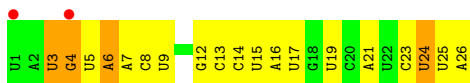
- Molecule 1: Twister RNA sequence



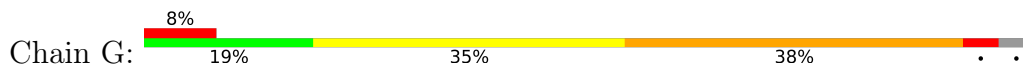
- Molecule 1: Twister RNA sequence



- Molecule 1: Twister RNA sequence



- Molecule 1: Twister RNA sequence



- Molecule 2: Twister RNA sequence



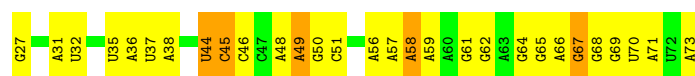
- Molecule 2: Twister RNA sequence

Chain D:  45% 28% 23% .



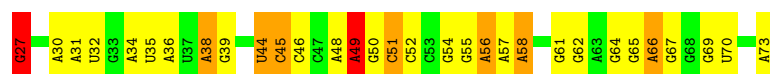
• Molecule 2: Twister RNA sequence

Chain F:  38% 51% 11%



• Molecule 2: Twister RNA sequence

Chain H:  34% 47% 15%



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	70.91Å 53.07Å 106.75Å 90.00° 106.86° 90.00°	Depositor
Resolution (Å)	102.37 – 3.10 47.09 – 3.10	Depositor EDS
% Data completeness (in resolution range)	84.9 (102.37-3.10) 85.0 (47.09-3.10)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.62 (at 3.12Å)	Xtrriage
Refinement program	REFMAC 5.8.0073	Depositor
R, $R_{free}$	0.190 , 0.287 0.190 , 0.287	Depositor DCC
$R_{free}$ test set	616 reflections (5.14%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	86.3	Xtrriage
Anisotropy	0.120	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.26 , 63.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	0.001 for h,-k,-h-l	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	6188	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	81.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 40.99 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 2.5211e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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: MG, GTP

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	0/553	0.85	0/856
1	C	0.62	1/575 (0.2%)	0.96	1/890 (0.1%)
1	E	0.57	0/600	0.95	0/929
1	G	0.57	0/575	0.97	2/890 (0.2%)
2	B	0.65	1/1118 (0.1%)	0.89	2/1743 (0.1%)
2	D	0.65	1/1118 (0.1%)	0.98	5/1743 (0.3%)
2	F	0.59	0/1118	0.92	1/1743 (0.1%)
2	H	0.58	1/1118 (0.1%)	0.86	1/1743 (0.1%)
All	All	0.60	4/6775 (0.1%)	0.92	12/10537 (0.1%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	24	U	O3'-P	5.95	1.68	1.61
2	D	68	G	O3'-P	-5.74	1.54	1.61
2	B	44	U	O3'-P	-5.09	1.55	1.61
2	H	34	A	O3'-P	-5.03	1.55	1.61

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	63	A	C2'-C3'-O3'	8.15	127.42	109.50
1	C	24	U	C2'-C3'-O3'	7.51	126.03	109.50
2	B	65	G	C2'-C3'-O3'	7.18	125.31	109.50
2	D	50	G	O5'-P-OP2	-7.01	99.39	105.70
1	G	3	U	C4'-C3'-O3'	6.52	126.04	113.00

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	498	0	256	23	1
1	C	518	0	266	21	1
1	E	540	0	277	19	1
1	G	518	0	266	32	0
2	B	1019	0	511	28	0
2	D	1028	0	511	24	1
2	F	1028	0	511	19	0
2	H	1019	0	511	22	0
3	A	1	0	0	0	0
3	F	2	0	0	0	0
3	H	1	0	0	0	0
4	A	1	0	0	1	0
4	B	5	0	0	0	0
4	C	2	0	0	0	0
4	D	1	0	0	0	0
4	F	4	0	0	0	0
4	G	2	0	0	0	0
4	H	1	0	0	0	0
All	All	6188	0	3109	172	2

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 19.

The worst 5 of 172 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:A:5:U:H5'	2:B:65:G:H1	1.07	1.13
1:A:5:U:H2''	1:A:6:A:OP1	1.60	1.02
2:H:44:U:H5''	2:H:45:C:H5''	1.42	1.00
2:B:44:U:H5''	2:B:45:C:H5''	1.44	0.99
2:D:44:U:H5''	2:D:45:C:H5''	1.44	0.98

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:11:C:OP1	1:E:19:U:O2'[1_565]	2.07	0.13
1:C:1:U:O4	2:D:56:A:O2'[2_646]	2.15	0.05

### 5.3 Torsion angles [i](#)

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

There are no protein molecules in this entry.

#### 5.3.2 Protein sidechains [i](#)

There are no protein molecules in this entry.

#### 5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	A	22/26 (84%)	6 (27%)	0
1	C	23/26 (88%)	5 (21%)	2 (8%)
1	E	24/26 (92%)	8 (33%)	3 (12%)
1	G	23/26 (88%)	11 (47%)	2 (8%)
2	B	46/47 (97%)	10 (21%)	4 (8%)
2	D	45/47 (95%)	14 (31%)	4 (8%)
2	F	45/47 (95%)	12 (26%)	1 (2%)
2	H	46/47 (97%)	15 (32%)	4 (8%)
All	All	274/292 (93%)	81 (29%)	20 (7%)

5 of 81 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	A	4	G
1	A	6	A
1	A	12	G
1	A	24	U
1	A	25	U

5 of 20 RNA pucker outliers are listed below:

Mol	Chain	Res	Type
1	G	3	U
2	H	49	A

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Mol	Chain	Res	Type
2	H	58	A
2	H	50	G
2	D	48	A

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

4 non-standard protein/DNA/RNA residues are modelled in this entry.

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$
2	GTP	F	27	2,3	26,34,34	1.09	2 (7%)	32,54,54	1.46	4 (12%)
2	GTP	H	27	2	19,25,34	0.99	2 (10%)	18,37,54	0.98	1 (5%)
2	GTP	D	27	2	26,34,34	1.17	2 (7%)	32,54,54	1.58	6 (18%)
2	GTP	B	27	2	19,25,34	0.99	2 (10%)	18,37,54	0.93	1 (5%)

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
2	GTP	F	27	2,3	-	5/18/38/38	0/3/3/3
2	GTP	H	27	2	-	2/3/25/38	0/3/3/3
2	GTP	D	27	2	-	5/18/38/38	0/3/3/3
2	GTP	B	27	2	-	3/3/25/38	0/3/3/3

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	27	GTP	C6-N1	-3.33	1.32	1.37
2	F	27	GTP	C6-N1	-2.74	1.33	1.37
2	F	27	GTP	O4'-C1'	2.57	1.44	1.41

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	27	GTP	O4'-C1'	2.47	1.44	1.41
2	H	27	GTP	C8-N7	-2.40	1.30	1.35

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	27	GTP	C5-C6-N1	3.75	120.57	113.95
2	F	27	GTP	O3'-C3'-C4'	3.45	121.01	111.05
2	F	27	GTP	PA-O3A-PB	-3.21	121.80	132.83
2	D	27	GTP	PA-O3A-PB	-2.94	122.74	132.83
2	D	27	GTP	C8-N7-C5	2.76	108.24	102.99

There are no chirality outliers.

5 of 15 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	D	27	GTP	C5'-O5'-PA-O3A
2	D	27	GTP	C5'-O5'-PA-O1A
2	D	27	GTP	O4'-C4'-C5'-O5'
2	D	27	GTP	C3'-C4'-C5'-O5'
2	F	27	GTP	C5'-O5'-PA-O3A

There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	H	27	GTP	1	0
2	B	27	GTP	3	0

## 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 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 [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	24/26 (92%)	0.54	3 (12%) 3 1	66, 89, 198, 354	0
1	C	25/26 (96%)	-0.14	1 (4%) 38 19	51, 63, 165, 180	0
1	E	26/26 (100%)	-0.14	2 (7%) 13 5	53, 66, 159, 204	0
1	G	25/26 (96%)	0.25	2 (8%) 12 5	50, 76, 214, 268	0
2	B	46/47 (97%)	-0.54	0 100 100	45, 74, 105, 219	0
2	D	46/47 (97%)	-0.54	0 100 100	53, 62, 93, 127	0
2	F	46/47 (97%)	-0.47	0 100 100	55, 64, 95, 152	0
2	H	46/47 (97%)	-0.61	0 100 100	43, 63, 99, 186	0
All	All	284/292 (97%)	-0.31	8 (2%) 53 30	43, 68, 168, 354	0

The worst 5 of 8 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	25	U	11.6
1	G	23	C	9.5
1	A	26	A	5.0
1	E	4	G	3.9
1	C	1	U	3.4

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

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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	GTP	B	27	23/32	0.55	0.24	139,176,220,244	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	GTP	H	27	23/32	0.62	0.32	147,196,223,258	0
2	GTP	D	27	32/32	0.90	0.14	69,81,153,174	0
2	GTP	F	27	32/32	0.93	0.13	66,80,135,148	0

### 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<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	MG	F	101	1/1	0.91	0.09	54,54,54,54	0
3	MG	F	102	1/1	0.94	0.12	63,63,63,63	0
3	MG	H	101	1/1	0.98	0.14	50,50,50,50	0
3	MG	A	101	1/1	0.99	0.06	55,55,55,55	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.