



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 7, 2016 – 10:38 PM EST

PDB ID : 5EY1  
Title : Crystal structure of CodY from Staphylococcus aureus with GTP and Ile  
Authors : Han, A.; Hwang, K.Y.  
Deposited on : 2015-11-24  
Resolution : 2.00 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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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 : 1.7.1 (RC1), CSD as537be (2016)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20028320  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
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) : rb-20028320

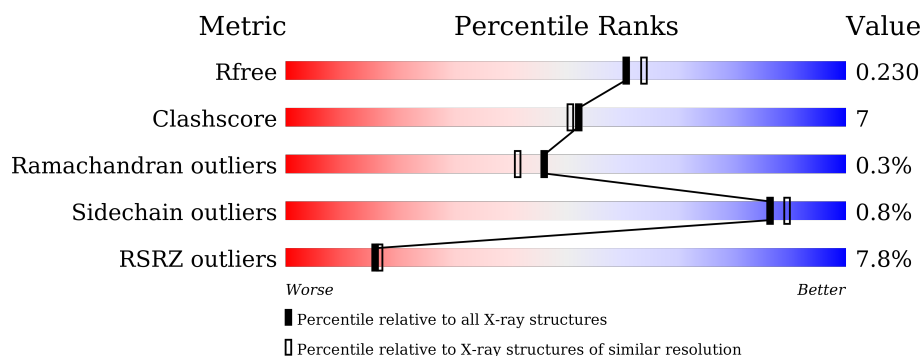
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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))
$R_{free}$	91344	6249 (2.00-2.00)
Clashscore	102246	7340 (2.00-2.00)
Ramachandran outliers	100387	7248 (2.00-2.00)
Sidechain outliers	100360	7247 (2.00-2.00)
RSRZ outliers	91569	6262 (2.00-2.00)

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	274	<div> <div>10%</div> <div>72%</div> <div>15%</div> <div>12%</div> </div>
1	B	274	<div> <div>2%</div> <div>55%</div> <div>7%</div> <div>39%</div> </div>

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
2	ILE	B	301	-	-	-	X

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 3660 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 GTP-sensing transcriptional pleiotropic repressor CodY.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	240	Total	C	N	O	S	0	0	0
			1906	1203	328	370	5			
1	B	168	Total	C	N	O	S	0	0	0
			1337	838	234	261	4			

There are 34 discrepancies between the modelled and reference sequences:

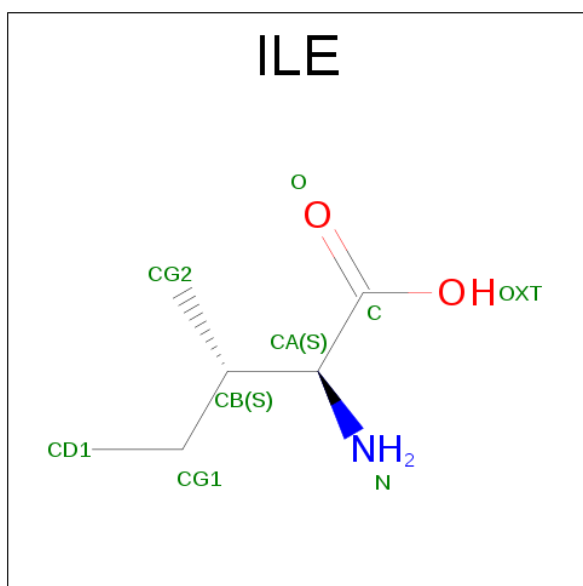
Chain	Residue	Modelled	Actual	Comment	Reference
A	-16	HIS	-	expression tag	UNP A7X1N2
A	-15	HIS	-	expression tag	UNP A7X1N2
A	-14	HIS	-	expression tag	UNP A7X1N2
A	-13	HIS	-	expression tag	UNP A7X1N2
A	-12	HIS	-	expression tag	UNP A7X1N2
A	-11	HIS	-	expression tag	UNP A7X1N2
A	-10	SER	-	expression tag	UNP A7X1N2
A	-9	SER	-	expression tag	UNP A7X1N2
A	-8	GLY	-	expression tag	UNP A7X1N2
A	-7	LEU	-	expression tag	UNP A7X1N2
A	-6	VAL	-	expression tag	UNP A7X1N2
A	-5	PRO	-	expression tag	UNP A7X1N2
A	-4	ARG	-	expression tag	UNP A7X1N2
A	-3	GLY	-	expression tag	UNP A7X1N2
A	-2	SER	-	expression tag	UNP A7X1N2
A	-1	HIS	-	expression tag	UNP A7X1N2
A	0	MET	-	expression tag	UNP A7X1N2
B	-16	HIS	-	expression tag	UNP A7X1N2
B	-15	HIS	-	expression tag	UNP A7X1N2
B	-14	HIS	-	expression tag	UNP A7X1N2
B	-13	HIS	-	expression tag	UNP A7X1N2
B	-12	HIS	-	expression tag	UNP A7X1N2
B	-11	HIS	-	expression tag	UNP A7X1N2
B	-10	SER	-	expression tag	UNP A7X1N2
B	-9	SER	-	expression tag	UNP A7X1N2

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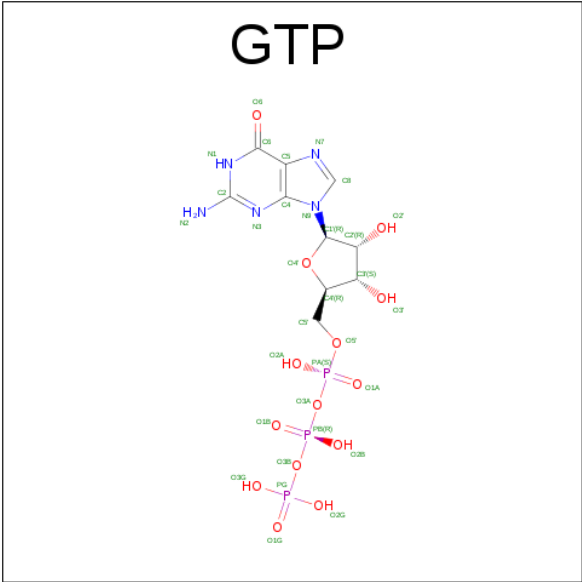
Chain	Residue	Modelled	Actual	Comment	Reference
B	-8	GLY	-	expression tag	UNP A7X1N2
B	-7	LEU	-	expression tag	UNP A7X1N2
B	-6	VAL	-	expression tag	UNP A7X1N2
B	-5	PRO	-	expression tag	UNP A7X1N2
B	-4	ARG	-	expression tag	UNP A7X1N2
B	-3	GLY	-	expression tag	UNP A7X1N2
B	-2	SER	-	expression tag	UNP A7X1N2
B	-1	HIS	-	expression tag	UNP A7X1N2
B	0	MET	-	expression tag	UNP A7X1N2

- Molecule 2 is ISOLEUCINE (three-letter code: ILE) (formula:  $C_6H_{13}NO_2$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			9	6	1	2		
2	B	1	Total	C	N	O	0	0
			9	6	1	2		

- Molecule 3 is GUANOSINE-5'-TRIPHOSPHATE (three-letter code: GTP) (formula:  $C_{10}H_{16}N_5O_{14}P_3$ ).



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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	169	Total	O	0	0
			169	169		
4	B	166	Total	O	0	0
			166	166		



- Molecule 1: GTP-sensing transcriptional pleiotropic repressor CodY



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	45.82Å 75.99Å 166.30Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.25 – 2.00 29.25 – 1.97	Depositor EDS
% Data completeness (in resolution range)	98.2 (29.25-2.00) 98.2 (29.25-1.97)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.83 (at 1.96Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.9_1692)	Depositor
R, $R_{free}$	0.188 , 0.230 0.186 , 0.230	Depositor DCC
$R_{free}$ test set	1927 reflections (4.86%)	DCC
Wilson B-factor (Å <sup>2</sup> )	20.2	Xtriage
Anisotropy	0.620	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 55.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	3660	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.51% 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 ⓘ

### 5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.37	0/1923	0.57	0/2580
1	B	0.41	0/1352	0.56	0/1822
All	All	0.39	0/3275	0.57	0/4402

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	1906	0	1975	33	1
1	B	1337	0	1370	11	1
2	A	9	0	10	1	0
2	B	9	0	10	1	0
3	A	32	0	12	1	0
3	B	32	0	12	0	0
4	A	169	0	0	4	1
4	B	166	0	0	3	0
All	All	3660	0	3389	45	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 7.

All (45) 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:198:GLU:HA	1:A:243:LYS:HE3	1.53	0.91
1:A:167:ARG:NH1	1:A:168:ASP:OD1	2.12	0.82
1:B:77:GLU:OE2	4:B:401:HOH:O	2.06	0.73
1:A:61:ARG:NH2	2:A:301:ILE:OXT	2.22	0.71
1:A:1:MET:N	4:A:404:HOH:O	2.28	0.66
1:B:9:GLU:OE1	4:B:402:HOH:O	2.14	0.63
1:A:191:PHE:CD2	1:A:250:LEU:HD21	2.34	0.63
1:A:190:ILE:HD11	1:A:217:ILE:HG23	1.80	0.62
3:A:302:GTP:O2A	4:A:401:HOH:O	2.16	0.60
1:A:202:ILE:O	4:A:402:HOH:O	2.17	0.58
1:A:191:PHE:HD2	1:A:250:LEU:HD21	1.70	0.56
1:A:244:VAL:HG22	1:A:246:LYS:H	1.73	0.53
1:B:168:ASP:O	4:B:403:HOH:O	2.18	0.53
1:A:241:PHE:CZ	1:A:243:LYS:HE2	2.44	0.53
1:A:198:GLU:HA	1:A:243:LYS:CE	2.33	0.52
1:A:214:ARG:HD3	1:A:214:ARG:N	2.26	0.51
1:B:22:VAL:HG23	1:B:153:GLU:OE1	2.10	0.51
1:A:201:LEU:HD13	1:A:240:THR:HG22	1.93	0.50
1:B:61:ARG:NH2	2:B:301:ILE:OXT	2.42	0.49
1:A:61:ARG:HD3	1:A:101:GLU:OE2	2.14	0.48
1:A:55:GLU:HG2	1:A:131:VAL:HG21	1.96	0.47
1:B:80:MET:HE2	1:B:80:MET:HA	1.95	0.47
1:A:199:GLY:O	1:A:241:PHE:HE1	1.97	0.47
1:A:187:ILE:HA	1:A:190:ILE:HD12	1.99	0.45
1:A:25:LYS:O	1:A:29:GLN:HG2	2.17	0.45
1:A:99:PRO:HA	1:A:100:PRO:HD3	1.90	0.44
1:A:172:ILE:HD11	1:A:246:LYS:HB3	1.98	0.44
1:A:77:GLU:HG2	1:A:78:ARG:NH1	2.34	0.43
1:A:230:ILE:HA	1:A:243:LYS:O	2.19	0.43
1:A:250:LEU:HD23	1:A:250:LEU:HA	1.58	0.43
1:B:164:LYS:O	1:B:167:ARG:HG2	2.19	0.43
1:A:222:ARG:HA	1:A:225:GLU:HG2	2.01	0.42
1:A:10:LEU:HA	1:A:30:THR:HG21	2.01	0.42
1:B:99:PRO:HA	1:B:100:PRO:HD3	1.88	0.42
1:A:233:ARG:HH11	1:A:233:ARG:HG3	1.84	0.42
1:B:17:HIS:NE2	1:B:22:VAL:HG22	2.34	0.42
1:A:168:ASP:OD1	1:A:246:LYS:HE3	2.19	0.41
1:B:31:ILE:HD11	1:B:146:ALA:HB1	2.03	0.41
1:A:186:ALA:O	1:A:190:ILE:HG13	2.20	0.41
1:A:191:PHE:CE2	1:A:250:LEU:HD21	2.56	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:84:GLN:HG2	4:A:508:HOH:O	2.21	0.41
1:B:78:ARG:CZ	1:B:94:VAL:HG21	2.51	0.41
1:A:27:VAL:O	1:A:31:ILE:HG12	2.21	0.41
1:A:241:PHE:CD1	1:A:242:ILE:N	2.90	0.40
1:A:243:LYS:HD3	1:A:243:LYS:HA	1.26	0.40

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:255:LYS:O	1:B:69:ARG:NH1[3_644]	2.16	0.04
4:A:451:HOH:O	4:A:484:HOH:O[4_545]	2.18	0.02

## 5.3 Torsion angles ⓘ

### 5.3.1 Protein backbone ⓘ

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	232/274 (85%)	227 (98%)	4 (2%)	1 (0%)	39	33
1	B	166/274 (61%)	162 (98%)	4 (2%)	0	100	100
All	All	398/548 (73%)	389 (98%)	8 (2%)	1 (0%)	46	41

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	201	LEU

### 5.3.2 Protein sidechains ⓘ

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	216/242 (89%)	214 (99%)	2 (1%)	84	88
1	B	153/242 (63%)	152 (99%)	1 (1%)	88	91
All	All	369/484 (76%)	366 (99%)	3 (1%)	86	89

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	160	SER
1	A	240	THR
1	B	105	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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](#)

4 ligands 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	ILE	A	301	-	5,8,8	0.37	0	5,10,10	0.10	0
3	GTP	A	302	-	26,34,34	0.96	1 (3%)	29,54,54	1.61	4 (13%)
2	ILE	B	301	-	5,8,8	0.44	0	5,10,10	0.26	0
3	GTP	B	302	-	26,34,34	1.05	1 (3%)	29,54,54	1.83	4 (13%)

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	ILE	A	301	-	-	0/6/10/10	0/0/0/0
3	GTP	A	302	-	-	0/18/38/38	0/3/3/3
2	ILE	B	301	-	-	0/6/10/10	0/0/0/0
3	GTP	B	302	-	-	0/18/38/38	0/3/3/3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	302	GTP	C6-N1	2.87	1.38	1.33
3	B	302	GTP	C6-N1	3.23	1.38	1.33

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	302	GTP	N3-C2-N1	-5.99	119.41	127.56
3	A	302	GTP	N3-C2-N1	-5.60	119.93	127.56
3	A	302	GTP	C5-C6-N1	-3.04	119.55	123.52
3	B	302	GTP	C5-C6-N1	-2.99	119.61	123.52
3	B	302	GTP	C1'-N9-C4	-2.68	123.81	126.81
3	A	302	GTP	C1'-N9-C4	-2.36	124.17	126.81
3	A	302	GTP	C6-N1-C2	3.59	120.09	115.88
3	B	302	GTP	C6-N1-C2	4.34	120.97	115.88

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	301	ILE	1	0
3	A	302	GTP	1	0
2	B	301	ILE	1	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 ⓘ

### 6.1 Protein, DNA and RNA chains ⓘ

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q< 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	240/274 (87%)	0.34	27 (11%) 7 7	15, 33, 105, 140	0
1	B	168/274 (61%)	-0.35	5 (2%) 54 55	14, 24, 58, 103	0
All	All	408/548 (74%)	0.05	32 (7%) 16 17	14, 27, 95, 140	0

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	240	THR	12.7
1	B	166	ALA	5.9
1	A	233	ARG	5.5
1	A	198	GLU	5.1
1	A	214	ARG	5.1
1	A	202	ILE	4.9
1	B	163	GLU	4.4
1	A	167	ARG	4.1
1	A	193	GLU	3.7
1	A	232	SER	3.5
1	B	168	ASP	3.5
1	A	191	PHE	3.5
1	A	200	LEU	3.4
1	A	195	GLY	3.4
1	A	242	ILE	3.3
1	B	165	GLU	3.2
1	A	241	PHE	3.1
1	A	231	GLU	3.0
1	A	227	ALA	2.9
1	A	225	GLU	2.8
1	A	228	GLY	2.7
1	A	190	ILE	2.6
1	A	245	LYS	2.5
1	A	255	LYS	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	226	SER	2.4
1	A	192	GLU	2.4
1	A	165	GLU	2.4
1	B	162	VAL	2.2
1	A	194	LEU	2.2
1	A	213	THR	2.2
1	A	199	GLY	2.1
1	A	170	ALA	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 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
2	ILE	B	301	9/9	0.93	0.12	3.38	18,21,26,36	0
2	ILE	A	301	9/9	0.95	0.10	-0.02	16,22,26,27	0
3	GTP	A	302	32/32	0.98	0.07	-0.99	18,34,60,66	0
3	GTP	B	302	32/32	0.98	0.09	-1.11	21,28,43,44	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.