



Full wwPDB X-ray Structure Validation Report ⓘ

May 24, 2020 – 11:04 pm BST

PDB ID : 3P22
Title : Crystal structure of the ENE, a viral RNA stability element, in complex with A9 RNA
Authors : Mitton-Fry, R.M.; DeGregorio, S.J.; Wang, J.; Steitz, T.A.; Steitz, J.A.
Deposited on : 2010-10-01
Resolution : 2.50 Å(reported)

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

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

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

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.11
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) : 2.11

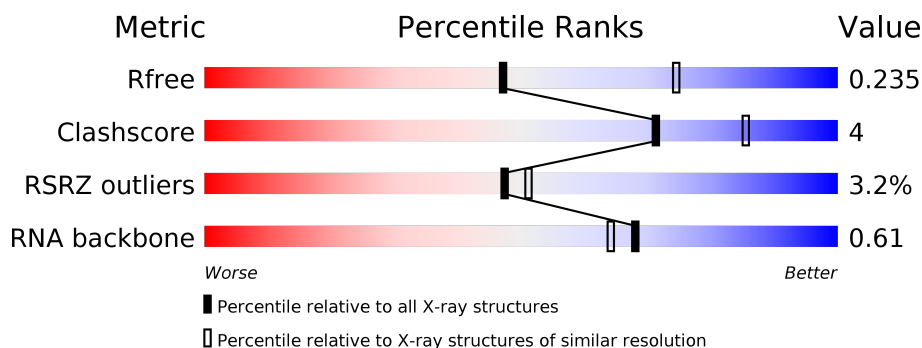
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)
RNA backbone	3102	1008 (2.84-2.16)

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 ≥ 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	40	 3% 80% 20%
1	C	40	 3% 83% 15% •
1	E	40	 3% 73% 23% 5%
1	G	40	 3% 80% 18% •
2	B	9	 67% 33%
2	D	9	 11% 56% 22% 11% 11%

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Mol	Chain	Length	Quality of chain
2	F	9	<div><div></div><div>78%</div><div>22%</div></div>
2	H	9	<div><div><div>11%</div><div>11%</div><div>44%</div><div>22%</div><div>11%</div><div>11%</div></div></div>

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 4166 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 Core ENE hairpin from KSHV PAN RNA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	40	Total	C	N	O	P	0	0	0
			853	377	139	295	42			
1	C	40	Total	C	N	O	P	0	0	0
			853	377	139	295	42			
1	E	40	Total	C	N	O	P	0	0	0
			853	377	139	295	42			
1	G	40	Total	C	N	O	P	0	0	0
			853	377	139	295	42			

- Molecule 2 is a RNA chain called oligo(A)9 RNA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	9	Total	C	N	O	P	0	0	0
			195	90	45	52	8			
2	D	8	Total	C	N	O	P	0	0	0
			173	80	40	46	7			
2	F	9	Total	C	N	O	P	0	0	0
			195	90	45	52	8			
2	H	8	Total	C	N	O	P	0	0	0
			173	80	40	46	7			

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	4	Total	O	0	0
			4	4		
3	B	1	Total	O	0	0
			1	1		
3	C	3	Total	O	0	0
			3	3		
3	D	1	Total	O	0	0
			1	1		

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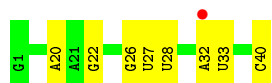
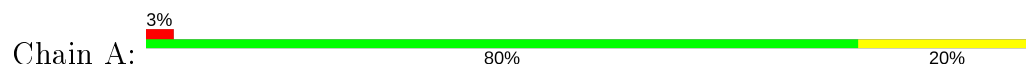
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	E	5	Total 5	O 5	0	0
3	G	3	Total 3	O 3	0	0
3	H	1	Total 1	O 1	0	0

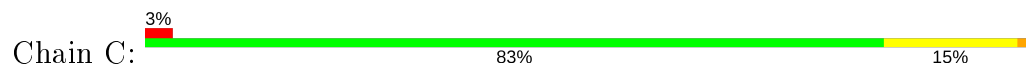
3 Residue-property plots [i](#)

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: Core ENE hairpin from KSHV PAN RNA



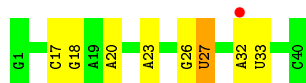
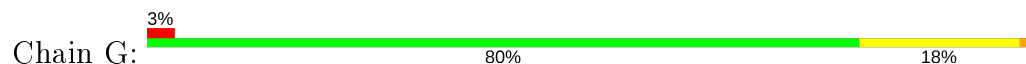
- Molecule 1: Core ENE hairpin from KSHV PAN RNA



- Molecule 1: Core ENE hairpin from KSHV PAN RNA



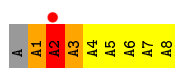
- Molecule 1: Core ENE hairpin from KSHV PAN RNA



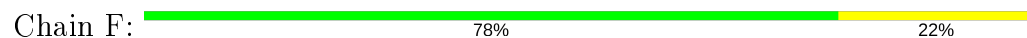
- Molecule 2: oligo(A)9 RNA



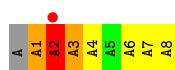
- Molecule 2: oligo(A)9 RNA



- Molecule 2: oligo(A)9 RNA



- Molecule 2: oligo(A)9 RNA



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	144.75Å 50.87Å 91.38Å 90.00° 125.06° 90.00°	Depositor
Resolution (Å)	50.00 – 2.50 44.42 – 2.50	Depositor EDS
% Data completeness (in resolution range)	97.7 (50.00-2.50) 97.7 (44.42-2.50)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.44 (at 2.51Å)	Xtrriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.218 , 0.233 0.222 , 0.235	Depositor DCC
R_{free} test set	965 reflections (5.16%)	wwPDB-VP
Wilson B-factor (Å ²)	67.8	Xtrriage
Anisotropy	0.236	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 46.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4166	wwPDB-VP
Average B, all atoms (Å ²)	59.0	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 32.87 % 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 8.7658e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹ Intensities estimated from amplitudes.

² 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	0.88	0/914	1.22	3/1420 (0.2%)
1	C	0.84	0/914	1.18	1/1420 (0.1%)
1	E	0.89	0/914	1.24	2/1420 (0.1%)
1	G	0.83	0/914	1.18	0/1420
2	B	0.81	0/221	1.13	0/343
2	D	0.85	0/196	1.29	2/304 (0.7%)
2	F	0.79	0/221	1.08	0/343
2	H	0.86	0/196	1.19	2/304 (0.7%)
All	All	0.85	0/4490	1.20	10/6974 (0.1%)

There are no bond length outliers.

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	1	A	C3'-C2'-C1'	-6.50	96.30	101.50
2	H	1	A	C3'-C2'-C1'	-6.08	96.63	101.50
1	E	9	U	O4'-C1'-N1	5.71	112.77	108.20
2	D	2	A	C3'-C2'-C1'	5.59	105.98	101.50
1	A	22	G	C4'-C3'-C2'	-5.58	97.02	102.60
1	E	22	G	C4'-C3'-C2'	-5.51	97.09	102.60
1	C	4	U	O4'-C1'-N1	5.50	112.60	108.20
1	A	40	C	O4'-C1'-N1	5.36	112.49	108.20
2	H	2	A	C3'-C2'-C1'	5.35	105.78	101.50
1	A	22	G	C8-N9-C4	-5.16	104.34	106.40

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	853	0	426	2	0
1	C	853	0	426	2	0
1	E	853	0	426	5	0
1	G	853	0	426	4	0
2	B	195	0	101	1	0
2	D	173	0	90	5	0
2	F	195	0	101	0	0
2	H	173	0	90	6	0
3	A	4	0	0	0	0
3	B	1	0	0	1	0
3	C	3	0	0	0	0
3	D	1	0	0	1	0
3	E	5	0	0	0	0
3	G	3	0	0	0	0
3	H	1	0	0	0	0
All	All	4166	0	2086	22	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 4.

All (22) 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:D:2:A:H4'	2:D:3:A:H5''	1.84	0.59
2:H:2:A:H4'	2:H:3:A:C5'	2.33	0.59
2:D:2:A:H4'	2:D:3:A:C5'	2.33	0.58
1:A:20:A:N1	1:C:18:G:H4'	2.20	0.56
2:H:2:A:H4'	2:H:3:A:H5''	1.88	0.55
2:H:2:A:H4'	2:H:3:A:O5'	2.07	0.55
1:E:18:G:H4'	1:G:20:A:N1	2.27	0.50
2:B:3:A:OP2	3:B:10:HOH:O	2.20	0.50
2:D:2:A:H4'	2:D:3:A:O5'	2.11	0.49
1:G:26:G:H2'	1:G:27:U:C6	2.47	0.49
2:H:1:A:H5''	2:H:2:A:C5	2.51	0.46
1:C:26:G:H2'	1:C:27:U:C6	2.50	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:1:A:H5''	2:D:2:A:C5	2.55	0.42
2:D:5:A:H5''	3:D:9:HOH:O	2.19	0.42
1:E:31:U:H1'	1:E:33:U:C5	2.55	0.41
1:A:26:G:H2'	1:A:27:U:C6	2.56	0.41
1:E:20:A:N1	1:G:18:G:H4'	2.36	0.41
1:E:26:G:H2'	1:E:27:U:C6	2.56	0.41
1:E:21:A:H2'	1:E:22:G:O4'	2.21	0.40
2:H:1:A:H5''	2:H:2:A:C6	2.57	0.40
2:H:1:A:O2'	2:H:3:A:C4	2.73	0.40
1:G:17:C:H2'	1:G:18:G:O4'	2.22	0.40

There are no symmetry-related clashes.

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	38/40 (95%)	3 (7%)	0
1	C	38/40 (95%)	4 (10%)	0
1	E	38/40 (95%)	3 (7%)	0
1	G	38/40 (95%)	4 (10%)	0
2	B	8/9 (88%)	2 (25%)	0
2	D	7/9 (77%)	6 (85%)	1 (14%)
2	F	8/9 (88%)	2 (25%)	0
2	H	7/9 (77%)	6 (85%)	1 (14%)
All	All	182/196 (92%)	30 (16%)	2 (1%)

All (30) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	A	28	U
1	A	32	A
1	A	33	U
2	B	5	A
2	B	7	A
1	C	23	A
1	C	27	U
1	C	32	A
1	C	33	U
2	D	2	A
2	D	3	A
2	D	4	A
2	D	6	A
2	D	7	A
2	D	8	A
1	E	28	U
1	E	32	A
1	E	33	U
2	F	5	A
2	F	7	A
1	G	23	A
1	G	27	U
1	G	32	A
1	G	33	U
2	H	2	A
2	H	3	A
2	H	4	A
2	H	6	A
2	H	7	A
2	H	8	A

All (2) RNA pucker outliers are listed below:

Mol	Chain	Res	Type
2	D	2	A
2	H	2	A

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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
1	GTP	C	1	1	26,34,34	1.07	2 (7%)	33,54,54	1.85	6 (18%)
1	GTP	E	1	1	26,34,34	1.06	2 (7%)	33,54,54	1.82	8 (24%)
1	GTP	G	1	1	26,34,34	0.90	1 (3%)	33,54,54	1.86	7 (21%)
1	GTP	A	1	1	26,34,34	0.97	1 (3%)	33,54,54	1.83	7 (21%)

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
1	GTP	C	1	1	-	3/18/38/38	0/3/3/3
1	GTP	E	1	1	-	5/18/38/38	0/3/3/3
1	GTP	G	1	1	-	3/18/38/38	0/3/3/3
1	GTP	A	1	1	-	5/18/38/38	0/3/3/3

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	1	GTP	C6-N1	3.39	1.38	1.33
1	E	1	GTP	C6-N1	3.01	1.38	1.33
1	A	1	GTP	C6-N1	2.94	1.38	1.33
1	G	1	GTP	C6-N1	2.64	1.37	1.33
1	E	1	GTP	O4'-C1'	2.41	1.44	1.41
1	C	1	GTP	O4'-C1'	2.03	1.43	1.41

All (28) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	G	1	GTP	N3-C2-N1	-5.70	119.62	127.22
1	A	1	GTP	N3-C2-N1	-5.49	119.90	127.22
1	E	1	GTP	C2-N3-C4	5.26	121.37	115.36
1	C	1	GTP	N3-C2-N1	-5.25	120.22	127.22
1	E	1	GTP	N3-C2-N1	-5.19	120.30	127.22

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1	GTP	C2-N3-C4	4.87	120.92	115.36
1	C	1	GTP	C2-N3-C4	4.63	120.65	115.36
1	G	1	GTP	C2-N3-C4	4.52	120.52	115.36
1	C	1	GTP	PA-O3A-PB	-3.69	120.17	132.83
1	C	1	GTP	C5-C6-N1	-3.34	118.86	123.43
1	G	1	GTP	PB-O3B-PG	-3.25	121.67	132.83
1	A	1	GTP	PA-O3A-PB	-3.21	121.81	132.83
1	G	1	GTP	PA-O3A-PB	-3.20	121.84	132.83
1	A	1	GTP	PB-O3B-PG	-3.15	122.01	132.83
1	G	1	GTP	C5-C6-N1	-3.15	119.13	123.43
1	G	1	GTP	C6-N1-C2	3.12	120.89	115.93
1	A	1	GTP	C5-C6-N1	-2.77	119.64	123.43
1	C	1	GTP	C6-N1-C2	2.68	120.19	115.93
1	C	1	GTP	PB-O3B-PG	-2.68	123.64	132.83
1	E	1	GTP	PA-O3A-PB	-2.65	123.72	132.83
1	E	1	GTP	C5-C6-N1	-2.64	119.82	123.43
1	E	1	GTP	PB-O3B-PG	-2.59	123.95	132.83
1	A	1	GTP	C6-N1-C2	2.57	120.01	115.93
1	E	1	GTP	O4'-C1'-C2'	-2.43	103.38	106.93
1	G	1	GTP	N2-C2-N3	2.32	121.57	117.79
1	E	1	GTP	C4-C5-N7	-2.30	107.00	109.40
1	E	1	GTP	N2-C2-N1	2.23	120.71	117.25
1	A	1	GTP	O2G-PG-O3B	2.06	111.53	104.64

There are no chirality outliers.

All (16) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	C	1	GTP	C5'-O5'-PA-O1A
1	E	1	GTP	C5'-O5'-PA-O1A
1	G	1	GTP	C5'-O5'-PA-O1A
1	A	1	GTP	C5'-O5'-PA-O1A
1	C	1	GTP	C5'-O5'-PA-O3A
1	E	1	GTP	C5'-O5'-PA-O3A
1	G	1	GTP	C5'-O5'-PA-O3A
1	A	1	GTP	C5'-O5'-PA-O3A
1	C	1	GTP	C5'-O5'-PA-O2A
1	E	1	GTP	C5'-O5'-PA-O2A
1	G	1	GTP	C5'-O5'-PA-O2A
1	A	1	GTP	C5'-O5'-PA-O2A
1	A	1	GTP	PB-O3A-PA-O2A
1	E	1	GTP	PB-O3A-PA-O1A

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Mol	Chain	Res	Type	Atoms
1	E	1	GTP	PB-O3A-PA-O2A
1	A	1	GTP	PB-O3A-PA-O1A

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q< 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	39/40 (97%)	-0.50	1 (2%) 56 59	42, 50, 77, 105	0
1	C	39/40 (97%)	-0.48	1 (2%) 56 59	45, 61, 94, 124	0
1	E	39/40 (97%)	-0.44	1 (2%) 56 59	43, 51, 81, 111	0
1	G	39/40 (97%)	-0.37	1 (2%) 56 59	41, 56, 99, 132	0
2	B	9/9 (100%)	-0.63	0 100 100	43, 48, 58, 59	0
2	D	8/9 (88%)	0.23	1 (12%) 3 3	69, 77, 80, 103	0
2	F	9/9 (100%)	-0.34	0 100 100	48, 54, 61, 62	0
2	H	8/9 (88%)	0.34	1 (12%) 3 3	65, 75, 89, 96	0
All	All	190/196 (96%)	-0.39	6 (3%) 47 51	41, 56, 94, 132	0

All (6) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	32	A	5.1
1	G	32	A	4.2
2	H	2	A	4.0
1	C	32	A	3.8
1	A	32	A	3.1
2	D	2	A	2.4

6.2 Non-standard residues in protein, DNA, RNA chains

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, 95th 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(\AA^2)	Q<0.9
1	GTP	E	1	32/32	0.81	0.23	45,52,79,82	0
1	GTP	C	1	32/32	0.82	0.20	53,56,76,77	0
1	GTP	A	1	32/32	0.90	0.16	43,48,75,77	0
1	GTP	G	1	32/32	0.91	0.17	40,44,63,65	0

6.3 Carbohydrates [i](#)

There are no carbohydrates in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.