



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jul 17, 2024 – 01:23 pm BST

PDB ID : 8R0S  
Title : Structure of reverse transcriptase from Cauliflower Mosaic Virus in complex with RNA/DNA hybrid  
Authors : Prabakaran, C.; Figiel, M.; Chamera, S.; Szczepanowski, R.; Nowak, E.; Nowotny, M.  
Deposited on : 2023-10-31  
Resolution : 2.35 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  
Xtriage (Phenix) : 1.13  
EDS : 2.37.1  
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) : 2.37.1

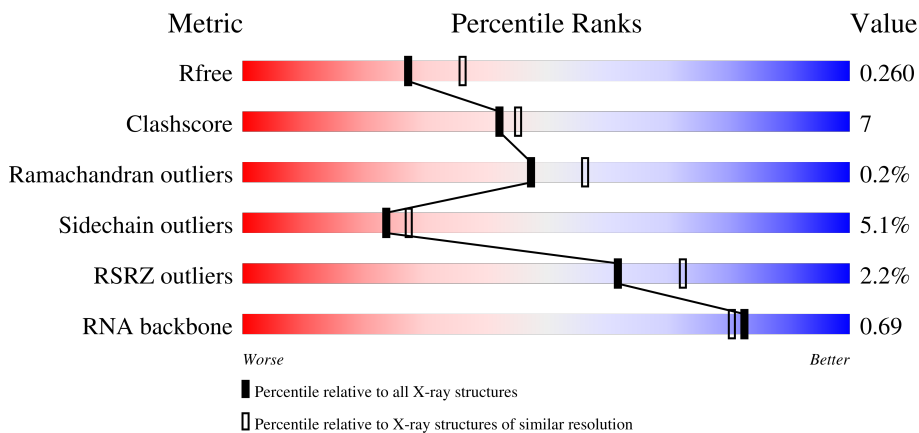
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.35 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	1164 (2.36-2.36)
Clashscore	141614	1232 (2.36-2.36)
Ramachandran outliers	138981	1211 (2.36-2.36)
Sidechain outliers	138945	1212 (2.36-2.36)
RSRZ outliers	127900	1150 (2.36-2.36)
RNA backbone	3102	1006 (2.74-1.98)

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	577	 2% 66% 15% 19%
2	C	17	 65% 35%
3	D	16	 69% 31%

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4404 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 Enzymatic polyprotein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	470	3655	2357	620	661	17	0	0	0

There are 104 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-101	MET	-	initiating methionine	UNP A0A2D2PYL0
A	-100	GLY	-	expression tag	UNP A0A2D2PYL0
A	-99	SER	-	expression tag	UNP A0A2D2PYL0
A	-98	SER	-	expression tag	UNP A0A2D2PYL0
A	-97	HIS	-	expression tag	UNP A0A2D2PYL0
A	-96	HIS	-	expression tag	UNP A0A2D2PYL0
A	-95	HIS	-	expression tag	UNP A0A2D2PYL0
A	-94	HIS	-	expression tag	UNP A0A2D2PYL0
A	-93	HIS	-	expression tag	UNP A0A2D2PYL0
A	-92	HIS	-	expression tag	UNP A0A2D2PYL0
A	-91	SER	-	expression tag	UNP A0A2D2PYL0
A	-90	SER	-	expression tag	UNP A0A2D2PYL0
A	-89	GLY	-	expression tag	UNP A0A2D2PYL0
A	-88	LEU	-	expression tag	UNP A0A2D2PYL0
A	-87	VAL	-	expression tag	UNP A0A2D2PYL0
A	-86	PRO	-	expression tag	UNP A0A2D2PYL0
A	-85	ARG	-	expression tag	UNP A0A2D2PYL0
A	-84	GLY	-	expression tag	UNP A0A2D2PYL0
A	-83	SER	-	expression tag	UNP A0A2D2PYL0
A	-82	HIS	-	expression tag	UNP A0A2D2PYL0
A	-81	MET	-	expression tag	UNP A0A2D2PYL0
A	-80	GLU	-	expression tag	UNP A0A2D2PYL0
A	-79	GLY	-	expression tag	UNP A0A2D2PYL0
A	-78	GLU	-	expression tag	UNP A0A2D2PYL0
A	-77	TYR	-	expression tag	UNP A0A2D2PYL0
A	-76	ILE	-	expression tag	UNP A0A2D2PYL0
A	-75	LYS	-	expression tag	UNP A0A2D2PYL0

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Chain	Residue	Modelled	Actual	Comment	Reference
A	-74	LEU	-	expression tag	UNP A0A2D2PYL0
A	-73	LYS	-	expression tag	UNP A0A2D2PYL0
A	-72	VAL	-	expression tag	UNP A0A2D2PYL0
A	-71	ILE	-	expression tag	UNP A0A2D2PYL0
A	-70	GLY	-	expression tag	UNP A0A2D2PYL0
A	-69	GLN	-	expression tag	UNP A0A2D2PYL0
A	-68	ASP	-	expression tag	UNP A0A2D2PYL0
A	-67	SER	-	expression tag	UNP A0A2D2PYL0
A	-66	SER	-	expression tag	UNP A0A2D2PYL0
A	-65	GLU	-	expression tag	UNP A0A2D2PYL0
A	-64	ILE	-	expression tag	UNP A0A2D2PYL0
A	-63	HIS	-	expression tag	UNP A0A2D2PYL0
A	-62	PHE	-	expression tag	UNP A0A2D2PYL0
A	-61	LYS	-	expression tag	UNP A0A2D2PYL0
A	-60	VAL	-	expression tag	UNP A0A2D2PYL0
A	-59	LYS	-	expression tag	UNP A0A2D2PYL0
A	-58	MET	-	expression tag	UNP A0A2D2PYL0
A	-57	THR	-	expression tag	UNP A0A2D2PYL0
A	-56	THR	-	expression tag	UNP A0A2D2PYL0
A	-55	HIS	-	expression tag	UNP A0A2D2PYL0
A	-54	LEU	-	expression tag	UNP A0A2D2PYL0
A	-53	LYS	-	expression tag	UNP A0A2D2PYL0
A	-52	LYS	-	expression tag	UNP A0A2D2PYL0
A	-51	LEU	-	expression tag	UNP A0A2D2PYL0
A	-50	LYS	-	expression tag	UNP A0A2D2PYL0
A	-49	GLU	-	expression tag	UNP A0A2D2PYL0
A	-48	SER	-	expression tag	UNP A0A2D2PYL0
A	-47	TYR	-	expression tag	UNP A0A2D2PYL0
A	-46	CYS	-	expression tag	UNP A0A2D2PYL0
A	-45	GLN	-	expression tag	UNP A0A2D2PYL0
A	-44	ARG	-	expression tag	UNP A0A2D2PYL0
A	-43	GLN	-	expression tag	UNP A0A2D2PYL0
A	-42	GLY	-	expression tag	UNP A0A2D2PYL0
A	-41	VAL	-	expression tag	UNP A0A2D2PYL0
A	-40	PRO	-	expression tag	UNP A0A2D2PYL0
A	-39	MET	-	expression tag	UNP A0A2D2PYL0
A	-38	ASN	-	expression tag	UNP A0A2D2PYL0
A	-37	SER	-	expression tag	UNP A0A2D2PYL0
A	-36	LEU	-	expression tag	UNP A0A2D2PYL0
A	-35	ARG	-	expression tag	UNP A0A2D2PYL0
A	-34	PHE	-	expression tag	UNP A0A2D2PYL0
A	-33	LEU	-	expression tag	UNP A0A2D2PYL0

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Chain	Residue	Modelled	Actual	Comment	Reference
A	-32	PHE	-	expression tag	UNP A0A2D2PYL0
A	-31	GLU	-	expression tag	UNP A0A2D2PYL0
A	-30	GLY	-	expression tag	UNP A0A2D2PYL0
A	-29	GLN	-	expression tag	UNP A0A2D2PYL0
A	-28	ARG	-	expression tag	UNP A0A2D2PYL0
A	-27	ILE	-	expression tag	UNP A0A2D2PYL0
A	-26	ALA	-	expression tag	UNP A0A2D2PYL0
A	-25	ASP	-	expression tag	UNP A0A2D2PYL0
A	-24	ASN	-	expression tag	UNP A0A2D2PYL0
A	-23	HIS	-	expression tag	UNP A0A2D2PYL0
A	-22	THR	-	expression tag	UNP A0A2D2PYL0
A	-21	PRO	-	expression tag	UNP A0A2D2PYL0
A	-20	LYS	-	expression tag	UNP A0A2D2PYL0
A	-19	GLU	-	expression tag	UNP A0A2D2PYL0
A	-18	LEU	-	expression tag	UNP A0A2D2PYL0
A	-17	GLY	-	expression tag	UNP A0A2D2PYL0
A	-16	MET	-	expression tag	UNP A0A2D2PYL0
A	-15	GLU	-	expression tag	UNP A0A2D2PYL0
A	-14	GLU	-	expression tag	UNP A0A2D2PYL0
A	-13	GLU	-	expression tag	UNP A0A2D2PYL0
A	-12	ASP	-	expression tag	UNP A0A2D2PYL0
A	-11	VAL	-	expression tag	UNP A0A2D2PYL0
A	-10	ILE	-	expression tag	UNP A0A2D2PYL0
A	-9	GLU	-	expression tag	UNP A0A2D2PYL0
A	-8	VAL	-	expression tag	UNP A0A2D2PYL0
A	-7	TYR	-	expression tag	UNP A0A2D2PYL0
A	-6	GLN	-	expression tag	UNP A0A2D2PYL0
A	-5	GLU	-	expression tag	UNP A0A2D2PYL0
A	-4	GLN	-	expression tag	UNP A0A2D2PYL0
A	-3	THR	-	expression tag	UNP A0A2D2PYL0
A	-2	GLY	-	expression tag	UNP A0A2D2PYL0
A	-1	GLY	-	expression tag	UNP A0A2D2PYL0
A	0	SER	-	expression tag	UNP A0A2D2PYL0
A	28	ASN	SER	conflict	UNP A0A2D2PYL0
A	421	ASN	ASP	conflict	UNP A0A2D2PYL0

- Molecule 2 is a RNA chain called RNA (5'-R(\*GP\*UP\*CP\*CP\*AP\*GP\*CP\*AP\*GP\*UP\*GP\*CP\*GP\*UP\*AP\*GP\*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	C	17	350	157	61	116	16	0	0	0

- Molecule 3 is a DNA chain called DNA (5'-D(\*GP\*CP\*TP\*AP\*CP\*GP\*CP\*AP\*CP\*TP\*GP\*CP\*TP\*GP\*GP\*A)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
3	D	16	325	155	61	94	15	0	0	0

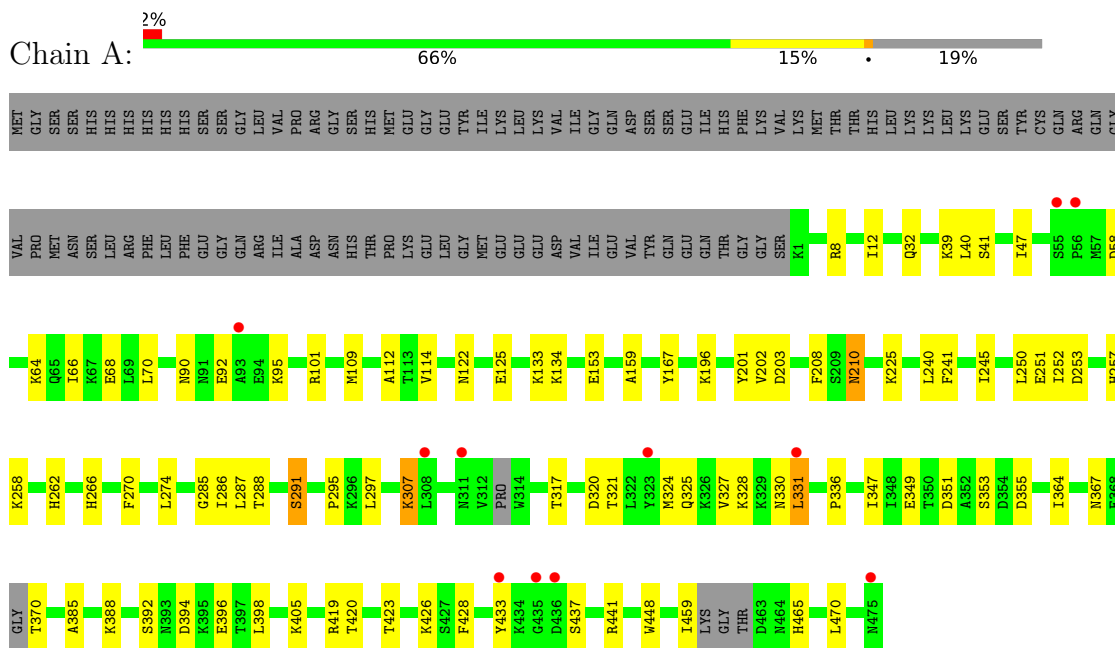
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	62	Total 62	O 62	0	0
4	C	10	Total 10	O 10	0	0
4	D	2	Total 2	O 2	0	0

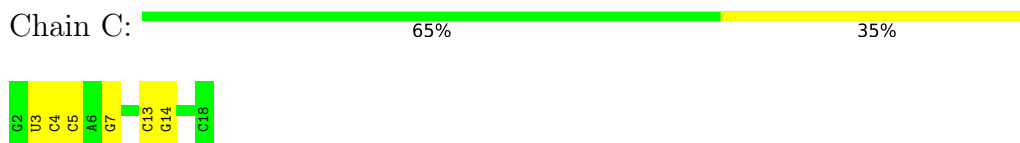
### 3 Residue-property plots [i](#)

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 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.

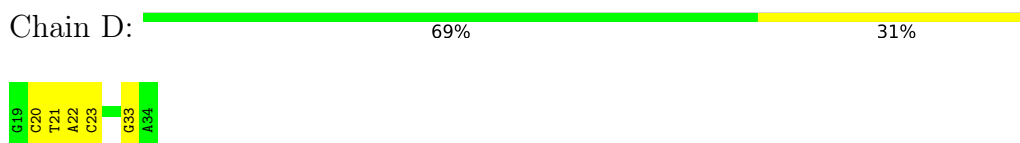
- Molecule 1: Enzymatic polyprotein



- Molecule 2: RNA (5'-R(\*GP\*UP\*CP\*CP\*AP\*GP\*CP\*AP\*GP\*UP\*GP\*CP\*GP\*UP\*AP\*GP\*C)-3')



- Molecule 3: DNA (5'-D(\*GP\*CP\*TP\*AP\*CP\*GP\*CP\*AP\*CP\*TP\*GP\*CP\*TP\*GP\*GP\*A)-3')



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	88.82Å 140.52Å 52.58Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	45.25 – 2.35 45.25 – 2.35	Depositor EDS
% Data completeness (in resolution range)	99.9 (45.25-2.35) 99.9 (45.25-2.35)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.25 (at 2.34Å)	Xtrriage
Refinement program	PHENIX 1.20.1_4487, PHENIX 1.20.1_4487	Depositor
R, $R_{free}$	0.214 , 0.263 0.211 , 0.260	Depositor DCC
$R_{free}$ test set	1408 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	59.0	Xtrriage
Anisotropy	0.198	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 46.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	4404	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	60.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.69% 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](#)

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	0.43	0/3745	0.60	0/5083
2	C	0.61	0/390	1.17	0/606
3	D	0.81	0/364	0.99	0/560
All	All	0.49	0/4499	0.72	0/6249

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 [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	3655	0	3464	49	0
2	C	350	0	181	5	0
3	D	325	0	181	3	0
4	A	62	0	0	5	0
4	C	10	0	0	2	0
4	D	2	0	0	0	0
All	All	4404	0	3826	56	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 56 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:270:PHE:O	1:A:328:LYS:NZ	2.16	0.78
1:A:428:PHE:HA	1:A:433:TYR:HB2	1.67	0.75
1:A:258:LYS:HD3	1:A:336:PRO:HB3	1.70	0.73
1:A:291:SER:HA	1:A:297:LEU:HD23	1.68	0.73
1:A:262:HIS:NE2	3:D:33:DG:OP1	2.21	0.72

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	462/577 (80%)	451 (98%)	10 (2%)	1 (0%)	47 56

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	202	VAL

### 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	372/523 (71%)	353 (95%)	19 (5%)	24 27

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	420	THR
1	A	437	SER
1	A	465	HIS
1	A	426	LYS
1	A	307	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	7	GLN
1	A	260	GLN
1	A	367	ASN

### 5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	C	16/17 (94%)	1 (6%)	0

All (1) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	C	3	U

There are no RNA pucker outliers to report.

## 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](#)

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 [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	470/577 (81%)	0.37	11 (2%) 60 70	39, 56, 85, 99	0
2	C	17/17 (100%)	0.24	0 100 100	47, 67, 95, 98	0
3	D	16/16 (100%)	-0.20	0 100 100	57, 71, 89, 90	0
All	All	503/610 (82%)	0.35	11 (2%) 62 72	39, 56, 87, 99	0

The worst 5 of 11 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	93	ALA	5.9
1	A	433	TYR	3.4
1	A	311	ASN	3.3
1	A	331	LEU	3.2
1	A	435	GLY	2.8

### 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 monosaccharides 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.