



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 04:34 PM UTC

PDB ID : 8OVY / pdb_00008ovy
Title : Structure of analogue of superfolded GFP
Authors : Dunkelmann, D.; Fiedler, M.; Bellini, D.; Alvira, C.P.; Chin, J.W.
Deposited on : 2023-04-26
Resolution : 1.54 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 types of validation reports are described at

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

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

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

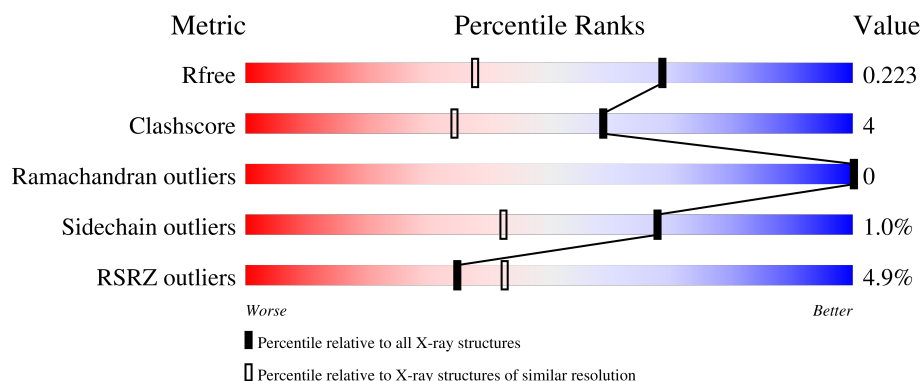
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.54 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}	180053	1003 (1.54-1.54)
Clashscore	190562	1025 (1.54-1.54)
Ramachandran outliers	187476	1007 (1.54-1.54)
Sidechain outliers	187428	1007 (1.54-1.54)
RSRZ outliers	180081	1002 (1.54-1.54)

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 ≥ 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	245	5% 83% 9% 7%
1	B	245	4% 84% 9% 7%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3785 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 Green fluorescent protein.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	227	Total	Br	C	N	O	S	0	0	0
			1813	1	1150	311	346	5			
1	B	227	Total	Br	C	N	O	S	0	0	0
			1813	1	1150	311	346	5			

There are 50 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	MET	-	initiating methionine	UNP P42212
A	1	VAL	-	expression tag	UNP P42212
A	30	ARG	SER	engineered mutation	UNP P42212
A	39	ASN	TYR	engineered mutation	UNP P42212
A	64	LEU	PHE	engineered mutation	UNP P42212
A	65	CRO	SER	chromophore	UNP P42212
A	65	CRO	TYR	chromophore	UNP P42212
A	65	CRO	GLY	chromophore	UNP P42212
A	146	ARG	GLN	engineered mutation	UNP P42212
A	165	SER	PHE	engineered mutation	UNP P42212
A	171	THR	ASN	engineered mutation	UNP P42212
A	211	PHE	TYR	engineered mutation	UNP P42212
A	215	W4T	ASN	engineered mutation	UNP P42212
A	219	THR	MET	engineered mutation	UNP P42212
A	229	ALA	VAL	engineered mutation	UNP P42212
A	237	VAL	ILE	engineered mutation	UNP P42212
A	272	VAL	ALA	engineered mutation	UNP P42212
A	305	GLY	-	expression tag	UNP P42212
A	306	SER	-	expression tag	UNP P42212
A	307	HIS	-	expression tag	UNP P42212
A	308	HIS	-	expression tag	UNP P42212
A	309	HIS	-	expression tag	UNP P42212
A	310	HIS	-	expression tag	UNP P42212
A	311	HIS	-	expression tag	UNP P42212
A	312	HIS	-	expression tag	UNP P42212

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
B	0	MET	-	initiating methionine	UNP P42212
B	1	VAL	-	expression tag	UNP P42212
B	30	ARG	SER	engineered mutation	UNP P42212
B	39	ASN	TYR	engineered mutation	UNP P42212
B	64	LEU	PHE	engineered mutation	UNP P42212
B	66	CRO	SER	chromophore	UNP P42212
B	66	CRO	TYR	chromophore	UNP P42212
B	66	CRO	GLY	chromophore	UNP P42212
B	80	ARG	GLN	engineered mutation	UNP P42212
B	99	SER	PHE	engineered mutation	UNP P42212
B	105	THR	ASN	engineered mutation	UNP P42212
B	145	PHE	TYR	engineered mutation	UNP P42212
B	149	W4T	ASN	engineered mutation	UNP P42212
B	153	THR	MET	engineered mutation	UNP P42212
B	163	ALA	VAL	engineered mutation	UNP P42212
B	171	VAL	ILE	engineered mutation	UNP P42212
B	206	VAL	ALA	engineered mutation	UNP P42212
B	239	GLY	-	expression tag	UNP P42212
B	240	SER	-	expression tag	UNP P42212
B	241	HIS	-	expression tag	UNP P42212
B	242	HIS	-	expression tag	UNP P42212
B	243	HIS	-	expression tag	UNP P42212
B	244	HIS	-	expression tag	UNP P42212
B	245	HIS	-	expression tag	UNP P42212
B	246	HIS	-	expression tag	UNP P42212

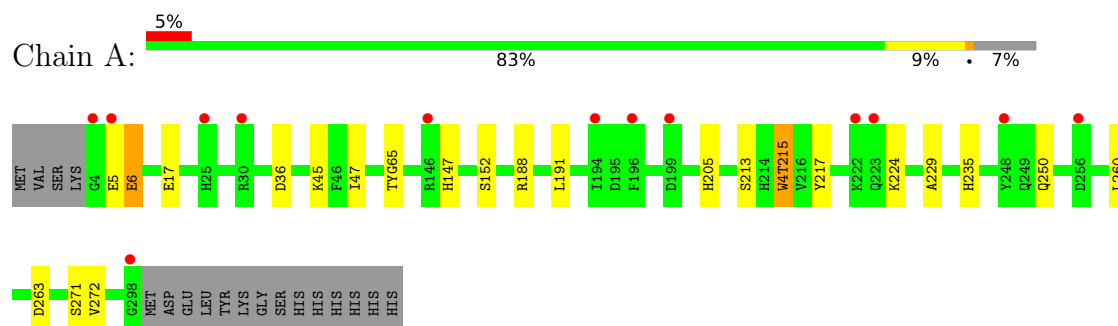
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	85	Total O 85 85	0	0
2	B	74	Total O 74 74	0	0

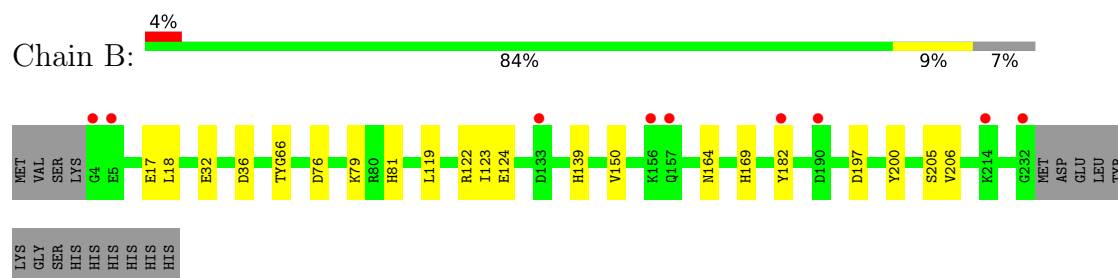
3 Residue-property plots [i](#)

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: Green fluorescent protein



- Molecule 1: Green fluorescent protein



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	130.52Å 37.72Å 91.80Å 90.00° 106.38° 90.00°	Depositor
Resolution (Å)	88.07 – 1.54 88.07 – 1.54	Depositor EDS
% Data completeness (in resolution range)	92.4 (88.07-1.54) 92.4 (88.07-1.54)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.78 (at 1.54Å)	Xtriage
Refinement program	REFMAC 5.8.0257	Depositor
R, R_{free}	0.186 , 0.214 0.197 , 0.223	Depositor DCC
R_{free} test set	2978 reflections (4.62%)	wwPDB-VP
Wilson B-factor (Å ²)	17.2	Xtriage
Anisotropy	0.008	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 23.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3785	wwPDB-VP
Average B, all atoms (Å ²)	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 82.16 % 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 2.9833e-07. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹Intensities estimated from amplitudes.

²Theoretical 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: W4T, CRO

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	1.04	1/1817 (0.1%)	1.10	1/2454 (0.0%)
1	B	1.04	0/1817	1.14	1/2454 (0.0%)
All	All	1.04	1/3634 (0.0%)	1.12	2/4908 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	213	SER	C-O	5.22	1.30	1.24

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	36	ASP	CA-CB-CG	6.58	119.18	112.60
1	A	36	ASP	CA-CB-CG	5.67	118.27	112.60

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	215	W4T	Mainchain

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	1813	0	1752	17	0
1	B	1813	0	1752	15	0
2	A	85	0	0	3	0
2	B	74	0	0	4	0
All	All	3785	0	3504	31	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 (31) 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:B:164:ASN:ND2	1:B:182:TYR:CE1	2.33	0.97
1:A:152:SER:CB	1:A:260:LEU:HD23	2.08	0.83
1:A:152:SER:HB3	1:A:260:LEU:HD23	1.71	0.73
1:B:164:ASN:ND2	1:B:182:TYR:CD1	2.60	0.69
1:B:17:GLU:OE2	1:B:122:ARG:NH1	2.26	0.69
1:B:32:GLU:OE2	2:B:301:HOH:O	2.12	0.66
1:B:205:SER:O	2:B:302:HOH:O	2.12	0.66
1:A:152:SER:HB2	1:A:260:LEU:HD23	1.76	0.65
1:A:147:HIS:HD2	1:A:263:ASP:H	1.44	0.65
1:A:147:HIS:CD2	1:A:263:ASP:H	2.20	0.59
1:A:17:GLU:OE2	1:A:188:ARG:NH1	2.36	0.59
1:A:6:GLU:H	1:A:6:GLU:CD	2.10	0.58
1:A:271:SER:O	2:A:401:HOH:O	2.17	0.56
1:B:81:HIS:HD2	1:B:197:ASP:H	1.54	0.56
1:A:205:HIS:HD2	2:A:484:HOH:O	1.89	0.55
1:B:169:HIS:HD2	2:B:348:HOH:O	1.89	0.55
1:B:139:HIS:HD2	2:B:374:HOH:O	1.90	0.55
1:B:164:ASN:ND2	1:B:182:TYR:HE1	1.96	0.53
1:A:224:LYS:NZ	1:A:250:GLN:HE22	2.08	0.52
1:B:76:ASP:HA	1:B:79:LYS:HG2	1.95	0.48
1:B:81:HIS:CD2	1:B:197:ASP:H	2.32	0.47
1:A:235:HIS:HD2	2:A:456:HOH:O	1.95	0.47
1:A:272:VAL:HG13	1:B:206:VAL:HG13	1.98	0.46

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:18:LEU:C	1:B:18:LEU:HD23	2.42	0.44
1:A:152:SER:HB2	1:A:260:LEU:CD2	2.47	0.43
1:A:191:LEU:C	1:A:191:LEU:HD23	2.43	0.43
1:B:150:VAL:O	1:B:200:TYR:HA	2.19	0.41
1:A:260:LEU:N	1:A:260:LEU:HD22	2.36	0.41
1:B:119:LEU:C	1:B:119:LEU:HD13	2.45	0.40
1:A:45:LYS:HE2	1:A:47:ILE:HD11	2.03	0.40
1:A:217:TYR:O	1:A:229:ALA:HA	2.22	0.40

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	221/245 (90%)	218 (99%)	3 (1%)	0	100	100
1	B	221/245 (90%)	218 (99%)	3 (1%)	0	100	100
All	All	442/490 (90%)	436 (99%)	6 (1%)	0	100	100

There are no Ramachandran outliers to report.

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	196/213 (92%)	194 (99%)	2 (1%)	68	42

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	196/213 (92%)	194 (99%)	2 (1%)	68	42
All	All	392/426 (92%)	388 (99%)	4 (1%)	68	42

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	5	GLU
1	A	6	GLU
1	B	123	ILE
1	B	124	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	147	HIS
1	A	201	ASN
1	A	205	HIS
1	A	230	ASN
1	A	235	HIS
1	A	243	GLN
1	A	250	GLN
1	B	81	HIS
1	B	135	ASN
1	B	139	HIS
1	B	169	HIS
1	B	177	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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	W4T	A	215	1	11,12,13	0.97	1 (9%)	12,15,17	0.81	0
1	W4T	B	149	1	11,12,13	0.79	0	12,15,17	0.97	0
1	CRO	B	66	1	22,23,24	3.23	3 (13%)	30,32,34	2.01	12 (40%)
1	CRO	A	65	1	22,23,24	2.66	4 (18%)	30,32,34	1.95	5 (16%)

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	W4T	A	215	1	-	2/7/7/8	0/1/1/1
1	W4T	B	149	1	-	2/7/7/8	0/1/1/1
1	CRO	B	66	1	-	1/12/31/32	0/2/2/2
1	CRO	A	65	1	-	0/12/31/32	0/2/2/2

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	66	CRO	CB2-CA2	12.86	1.47	1.35
1	A	65	CRO	CB2-CA2	9.97	1.44	1.35
1	A	65	CRO	C1-N2	4.94	1.39	1.32
1	B	66	CRO	C1-N2	4.93	1.39	1.32
1	B	66	CRO	CA2-C2	-4.31	1.43	1.48
1	A	65	CRO	C2-N3	-3.95	1.30	1.40
1	A	215	W4T	CE2-CZ	-2.16	1.35	1.38
1	A	65	CRO	CA2-N2	-2.01	1.34	1.38

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	65	CRO	O2-C2-CA2	-6.87	126.64	131.02
1	A	65	CRO	CA2-C2-N3	5.07	107.75	103.50
1	B	66	CRO	O2-C2-CA2	-4.67	128.04	131.02
1	B	66	CRO	CB2-CA2-N2	-3.85	123.53	128.76
1	B	66	CRO	CA2-N2-C1	-3.58	103.00	105.80
1	B	66	CRO	CB2-CA2-C2	2.89	125.86	122.36
1	B	66	CRO	C1-CA1-N1	-2.86	104.67	109.78

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	66	CRO	CA2-C2-N3	2.80	105.85	103.50
1	B	66	CRO	CD1-CE1-CZ	-2.36	117.39	119.88
1	A	65	CRO	CB2-CA2-C2	2.32	125.16	122.36
1	A	65	CRO	CG2-CB2-CA2	-2.30	127.13	129.87
1	B	66	CRO	CA1-C1-N3	-2.23	122.05	124.69
1	B	66	CRO	N3-C1-N2	2.14	113.17	111.48
1	A	65	CRO	CD2-CG2-CB2	-2.13	113.89	121.22
1	B	66	CRO	CD2-CG2-CB2	-2.13	113.92	121.22
1	B	66	CRO	CG1-CB1-CA1	-2.02	107.56	112.18
1	B	66	CRO	C2-CA2-N2	2.01	110.39	108.95

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	215	W4T	CB-CA-CG-CD2
1	A	215	W4T	CB-CA-CG-CD1
1	B	149	W4T	CB-CA-CG-CD2
1	B	149	W4T	CB-CA-CG-CD1
1	B	66	CRO	N3-C1-CA1-CB1

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides 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, 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	225/245 (91%)	0.46	13 (5%) 29 36	11, 18, 32, 64	0
1	B	225/245 (91%)	0.41	9 (4%) 42 51	10, 18, 34, 60	0
All	All	450/490 (91%)	0.43	22 (4%) 35 43	10, 18, 33, 64	0

All (22) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	182	TYR	4.1
1	B	4	GLY	3.4
1	A	222	LYS	3.2
1	A	223	GLN	3.2
1	A	4	GLY	2.9
1	A	248	TYR	2.8
1	B	232	GLY	2.8
1	B	190	ASP	2.8
1	A	30	ARG	2.6
1	B	156	LYS	2.5
1	B	157	GLN	2.5
1	B	5	GLU	2.4
1	A	256	ASP	2.4
1	A	146	ARG	2.3
1	A	199	ASP	2.3
1	B	133	ASP	2.3
1	A	298	GLY	2.3
1	B	214	LYS	2.2
1	A	196	PHE	2.2
1	A	5	GLU	2.1
1	A	194	ILE	2.1
1	A	25	HIS	2.0

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, 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($\text{\AA}^2$)	Q<0.9
1	W4T	B	149	12/13	0.93	0.09	14,16,18,22	1
1	W4T	A	215	12/13	0.94	0.08	15,17,21,22	1
1	CRO	A	65	22/23	0.97	0.05	11,12,14,15	0
1	CRO	B	66	22/23	0.97	0.05	9,11,12,14	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides 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.