



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 24, 2025 – 12:18 PM JST

PDB ID : 9K9M  
Title : X-ray structure of FBB18 from Chlamydomonas reinhardtii.  
Authors : Sahashi, Y.; Tanaka, H.; Shimo-Kon, R.; Yamamoto, R.; Kurisu, G.; Kon, T.  
Deposited on : 2024-10-27  
Resolution : 2.30 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

<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)	:	1.21
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.004 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.4

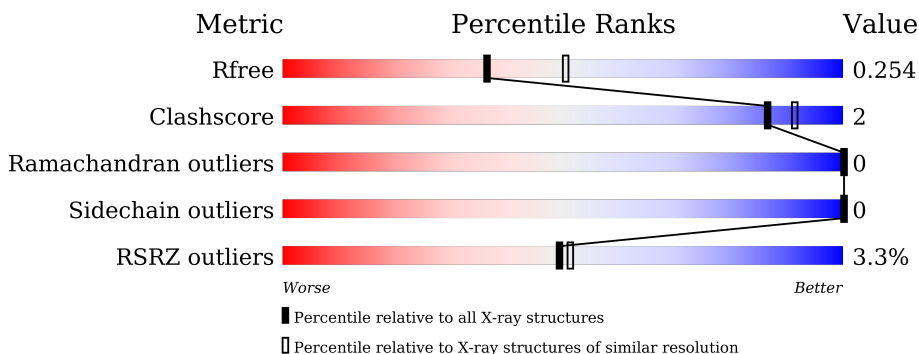
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 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))
$R_{free}$	164625	5963 (2.30-2.30)
Clashscore	180529	6698 (2.30-2.30)
Ramachandran outliers	177936	6640 (2.30-2.30)
Sidechain outliers	177891	6640 (2.30-2.30)
RSRZ outliers	164620	5963 (2.30-2.30)

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	239	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, orange, yellow, green, grey);"></div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span>%</span> <span>85%</span> <span>6%</span> <span>10%</span> </div> </div>
1	B	239	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, orange, yellow, green, grey);"></div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span>3%</span> <span>82%</span> <span>5%</span> <span>12%</span> </div> </div>
1	C	239	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, orange, yellow, green, grey);"></div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span>4%</span> <span>85%</span> <span>.</span> <span>12%</span> </div> </div>
1	D	239	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, orange, yellow, green, grey);"></div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span>4%</span> <span>82%</span> <span>5%</span> <span>13%</span> </div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 6587 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 Flagellar associated protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	216	Total	C	N	O	S	0	0	0
			1651	1035	294	314	8			
1	C	210	Total	C	N	O	S	0	0	0
			1613	1013	287	304	9			
1	B	210	Total	C	N	O	S	0	0	0
			1602	1007	284	303	8			
1	D	209	Total	C	N	O	S	0	0	0
			1603	1003	287	304	9			

There are 84 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-20	MET	-	initiating methionine	UNP A0A2K3CU42
A	-19	GLY	-	expression tag	UNP A0A2K3CU42
A	-18	GLY	-	expression tag	UNP A0A2K3CU42
A	-17	SER	-	expression tag	UNP A0A2K3CU42
A	-16	HIS	-	expression tag	UNP A0A2K3CU42
A	-15	HIS	-	expression tag	UNP A0A2K3CU42
A	-14	HIS	-	expression tag	UNP A0A2K3CU42
A	-13	HIS	-	expression tag	UNP A0A2K3CU42
A	-12	HIS	-	expression tag	UNP A0A2K3CU42
A	-11	HIS	-	expression tag	UNP A0A2K3CU42
A	-10	SER	-	expression tag	UNP A0A2K3CU42
A	-9	SER	-	expression tag	UNP A0A2K3CU42
A	-8	GLY	-	expression tag	UNP A0A2K3CU42
A	-7	GLU	-	expression tag	UNP A0A2K3CU42
A	-6	ASN	-	expression tag	UNP A0A2K3CU42
A	-5	LEU	-	expression tag	UNP A0A2K3CU42
A	-4	TYR	-	expression tag	UNP A0A2K3CU42
A	-3	PHE	-	expression tag	UNP A0A2K3CU42
A	-2	GLN	-	expression tag	UNP A0A2K3CU42
A	-1	GLY	-	expression tag	UNP A0A2K3CU42
A	0	HIS	-	expression tag	UNP A0A2K3CU42

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Chain	Residue	Modelled	Actual	Comment	Reference
C	-20	MET	-	initiating methionine	UNP A0A2K3CU42
C	-19	GLY	-	expression tag	UNP A0A2K3CU42
C	-18	GLY	-	expression tag	UNP A0A2K3CU42
C	-17	SER	-	expression tag	UNP A0A2K3CU42
C	-16	HIS	-	expression tag	UNP A0A2K3CU42
C	-15	HIS	-	expression tag	UNP A0A2K3CU42
C	-14	HIS	-	expression tag	UNP A0A2K3CU42
C	-13	HIS	-	expression tag	UNP A0A2K3CU42
C	-12	HIS	-	expression tag	UNP A0A2K3CU42
C	-11	HIS	-	expression tag	UNP A0A2K3CU42
C	-10	SER	-	expression tag	UNP A0A2K3CU42
C	-9	SER	-	expression tag	UNP A0A2K3CU42
C	-8	GLY	-	expression tag	UNP A0A2K3CU42
C	-7	GLU	-	expression tag	UNP A0A2K3CU42
C	-6	ASN	-	expression tag	UNP A0A2K3CU42
C	-5	LEU	-	expression tag	UNP A0A2K3CU42
C	-4	TYR	-	expression tag	UNP A0A2K3CU42
C	-3	PHE	-	expression tag	UNP A0A2K3CU42
C	-2	GLN	-	expression tag	UNP A0A2K3CU42
C	-1	GLY	-	expression tag	UNP A0A2K3CU42
C	0	HIS	-	expression tag	UNP A0A2K3CU42
B	-20	MET	-	initiating methionine	UNP A0A2K3CU42
B	-19	GLY	-	expression tag	UNP A0A2K3CU42
B	-18	GLY	-	expression tag	UNP A0A2K3CU42
B	-17	SER	-	expression tag	UNP A0A2K3CU42
B	-16	HIS	-	expression tag	UNP A0A2K3CU42
B	-15	HIS	-	expression tag	UNP A0A2K3CU42
B	-14	HIS	-	expression tag	UNP A0A2K3CU42
B	-13	HIS	-	expression tag	UNP A0A2K3CU42
B	-12	HIS	-	expression tag	UNP A0A2K3CU42
B	-11	HIS	-	expression tag	UNP A0A2K3CU42
B	-10	SER	-	expression tag	UNP A0A2K3CU42
B	-9	SER	-	expression tag	UNP A0A2K3CU42
B	-8	GLY	-	expression tag	UNP A0A2K3CU42
B	-7	GLU	-	expression tag	UNP A0A2K3CU42
B	-6	ASN	-	expression tag	UNP A0A2K3CU42
B	-5	LEU	-	expression tag	UNP A0A2K3CU42
B	-4	TYR	-	expression tag	UNP A0A2K3CU42
B	-3	PHE	-	expression tag	UNP A0A2K3CU42
B	-2	GLN	-	expression tag	UNP A0A2K3CU42
B	-1	GLY	-	expression tag	UNP A0A2K3CU42
B	0	HIS	-	expression tag	UNP A0A2K3CU42

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Chain	Residue	Modelled	Actual	Comment	Reference
D	-20	MET	-	initiating methionine	UNP A0A2K3CU42
D	-19	GLY	-	expression tag	UNP A0A2K3CU42
D	-18	GLY	-	expression tag	UNP A0A2K3CU42
D	-17	SER	-	expression tag	UNP A0A2K3CU42
D	-16	HIS	-	expression tag	UNP A0A2K3CU42
D	-15	HIS	-	expression tag	UNP A0A2K3CU42
D	-14	HIS	-	expression tag	UNP A0A2K3CU42
D	-13	HIS	-	expression tag	UNP A0A2K3CU42
D	-12	HIS	-	expression tag	UNP A0A2K3CU42
D	-11	HIS	-	expression tag	UNP A0A2K3CU42
D	-10	SER	-	expression tag	UNP A0A2K3CU42
D	-9	SER	-	expression tag	UNP A0A2K3CU42
D	-8	GLY	-	expression tag	UNP A0A2K3CU42
D	-7	GLU	-	expression tag	UNP A0A2K3CU42
D	-6	ASN	-	expression tag	UNP A0A2K3CU42
D	-5	LEU	-	expression tag	UNP A0A2K3CU42
D	-4	TYR	-	expression tag	UNP A0A2K3CU42
D	-3	PHE	-	expression tag	UNP A0A2K3CU42
D	-2	GLN	-	expression tag	UNP A0A2K3CU42
D	-1	GLY	-	expression tag	UNP A0A2K3CU42
D	0	HIS	-	expression tag	UNP A0A2K3CU42

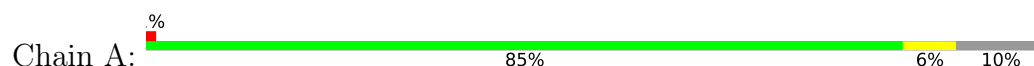
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	51	Total	O	0	0
			51	51		
2	C	26	Total	O	0	0
			26	26		
2	B	30	Total	O	0	0
			30	30		
2	D	11	Total	O	0	0
			11	11		

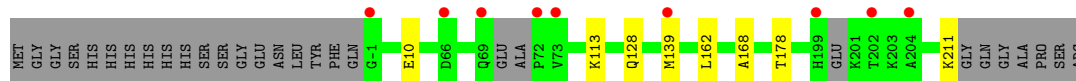
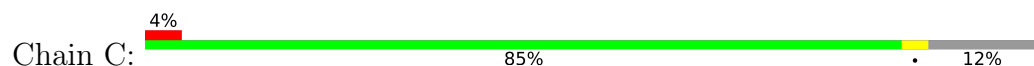
### 3 Residue-property plots [i](#)

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.

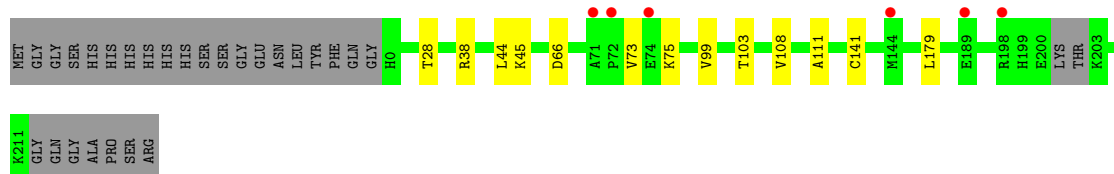
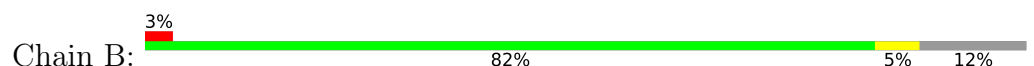
- Molecule 1: Flagellar associated protein



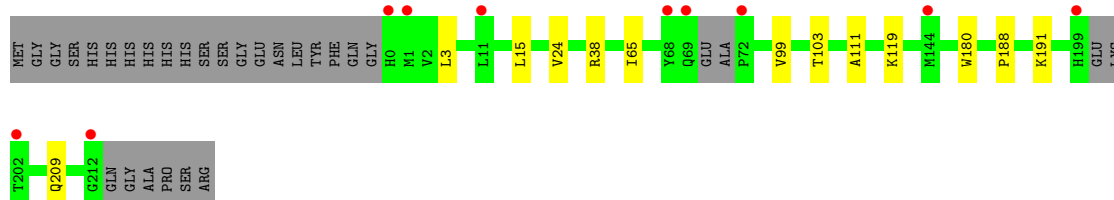
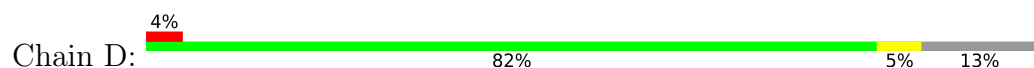
- Molecule 1: Flagellar associated protein



- Molecule 1: Flagellar associated protein



- Molecule 1: Flagellar associated protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	122.95Å 152.09Å 116.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.61 – 2.30 34.61 – 2.30	Depositor EDS
% Data completeness (in resolution range)	98.0 (34.61-2.30) 98.8 (34.61-2.30)	Depositor EDS
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.60 (at 2.31Å)	Xtriage
Refinement program	PHENIX 1.14_3260	Depositor
R, $R_{free}$	0.198 , 0.251 0.202 , 0.254	Depositor DCC
$R_{free}$ test set	46674 reflections (4.12%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	52.2	Xtriage
Anisotropy	0.542	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 40.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	6587	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	64.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.44% 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

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	0/1681	0.61	1/2274 (0.0%)
1	B	0.42	1/1630 (0.1%)	0.57	0/2206
1	C	0.41	0/1640	0.58	1/2213 (0.0%)
1	D	0.37	0/1630	0.59	0/2203
All	All	0.41	1/6581 (0.0%)	0.59	2/8896 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	141	CYS	CB-SG	-5.25	1.73	1.81

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	184	LYS	CD-CE-NZ	-5.87	98.19	111.70
1	C	139	MET	CA-CB-CG	-5.16	104.54	113.30

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	1651	0	1642	7	0
1	B	1602	0	1588	7	0
1	C	1613	0	1621	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	D	1603	0	1597	8	0
2	A	51	0	0	0	0
2	B	30	0	0	0	0
2	C	26	0	0	1	0
2	D	11	0	0	0	0
All	All	6587	0	6448	26	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 2.

All (26) 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:176:VAL:HA	1:A:211:LYS:HE2	1.77	0.65
1:C:128:GLN:HG3	2:C:325:HOH:O	2.09	0.51
1:D:24:VAL:HB	1:D:188:PRO:HA	1.91	0.51
1:C:10:GLU:O	1:C:113:LYS:HD2	2.12	0.50
1:B:45:LYS:HD3	1:B:108:VAL:HG21	1.94	0.49
1:B:99:VAL:O	1:B:103:THR:HG23	2.12	0.49
1:A:67:ARG:HG3	1:A:81:GLU:OE2	2.15	0.47
1:A:69:GLN:NE2	1:A:73:VAL:HG12	2.32	0.45
1:A:10:GLU:O	1:A:113:LYS:HD2	2.16	0.45
1:D:180:TRP:CD1	1:D:209:GLN:HG3	2.53	0.44
1:D:65:ILE:HD12	1:D:65:ILE:H	1.82	0.44
1:D:191:LYS:HB3	1:D:191:LYS:HE3	1.91	0.44
1:B:44:LEU:HD12	1:B:44:LEU:HA	1.80	0.44
1:C:178:THR:CG2	1:C:211:LYS:HE2	2.48	0.44
1:D:99:VAL:O	1:D:103:THR:HG23	2.18	0.44
1:A:29:ARG:HG2	1:A:174:ALA:HB1	1.99	0.43
1:C:162:LEU:O	1:C:168:ALA:HB2	2.18	0.42
1:D:119:LYS:HB2	1:D:119:LYS:HE3	1.88	0.42
1:B:73:VAL:HG23	1:B:75:LYS:HG2	2.02	0.42
1:A:102:LYS:HE2	1:A:102:LYS:HB3	1.87	0.42
1:D:38:ARG:HG2	1:D:111:ALA:HB1	2.02	0.42
1:D:3:LEU:HD11	1:D:15:LEU:HB3	2.02	0.41
1:B:28:THR:OG1	1:B:179:LEU:HB2	2.20	0.41
1:B:38:ARG:HG2	1:B:111:ALA:HB1	2.03	0.41
1:B:66:ASP:HB3	1:B:73:VAL:HG11	2.02	0.41
1:A:44:LEU:HD21	1:A:156:LEU:HD23	2.04	0.40

There are no symmetry-related clashes.

## 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	214/239 (90%)	210 (98%)	4 (2%)	0	100	100
1	B	206/239 (86%)	201 (98%)	5 (2%)	0	100	100
1	C	204/239 (85%)	202 (99%)	2 (1%)	0	100	100
1	D	203/239 (85%)	199 (98%)	4 (2%)	0	100	100
All	All	827/956 (86%)	812 (98%)	15 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	168/195 (86%)	168 (100%)	0	100	100
1	B	162/195 (83%)	162 (100%)	0	100	100
1	C	167/195 (86%)	167 (100%)	0	100	100
1	D	166/195 (85%)	166 (100%)	0	100	100
All	All	663/780 (85%)	663 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes 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 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

### 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	216/239 (90%)	-0.02	3 (1%) 73 74	39, 56, 91, 100	0
1	B	210/239 (87%)	0.01	6 (2%) 54 55	41, 59, 86, 122	0
1	C	210/239 (87%)	0.12	9 (4%) 40 41	43, 61, 91, 105	0
1	D	209/239 (87%)	0.30	10 (4%) 36 37	49, 68, 98, 119	0
All	All	845/956 (88%)	0.10	28 (3%) 49 51	39, 61, 93, 122	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	69	GLN	5.7
1	A	215	ALA	4.7
1	C	72	PRO	4.6
1	D	199	HIS	4.4
1	C	199	HIS	3.3
1	C	139	MET	3.1
1	A	0	HIS	3.0
1	D	72	PRO	3.0
1	C	204	ALA	3.0
1	D	1	MET	2.9
1	B	198	ARG	2.7
1	D	68	TYR	2.7
1	D	202	THR	2.6
1	A	214	GLY	2.4
1	B	72	PRO	2.4
1	D	0	HIS	2.4
1	B	71	ALA	2.4
1	B	144	MET	2.3
1	B	74	GLU	2.3
1	C	73	VAL	2.3
1	D	69	GLN	2.3

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Mol	Chain	Res	Type	RSRZ
1	D	144	MET	2.2
1	C	202	THR	2.2
1	B	189	GLU	2.2
1	D	11	LEU	2.2
1	C	-1	GLY	2.1
1	D	212	GLY	2.0
1	C	66	ASP	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 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.