



# Full wwPDB X-ray Structure Validation Report ⓘ

May 7, 2026 – 10:37 AM EDT

PDB ID : 4QCC / pdb\_00004qcc  
Title : Structure of a cube-shaped, highly porous protein cage designed by fusing symmetric oligomeric domains  
Authors : Lai, Y.-T.; Yeates, T.O.  
Deposited on : 2014-05-10  
Resolution : 7.08 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 : 4-5-2 with Phenix2.0  
Xtrriage (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

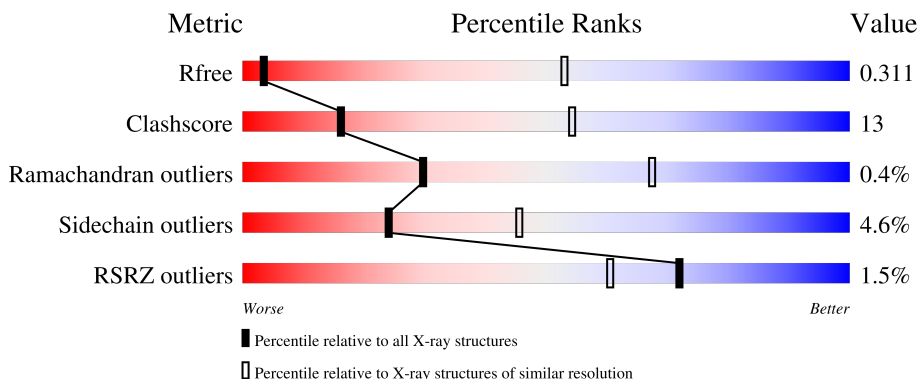
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 7.08 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	1167 (10.00-4.00)
Clashscore	190562	1000 (10.00-4.06)
Ramachandran outliers	187476	1054 (10.00-4.00)
Sidechain outliers	187428	1017 (10.00-4.00)
RSRZ outliers	180081	1161 (10.00-4.00)

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 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	291	 2% 74% 16% • 7%
1	B	291	 % 75% 16% • 7%

## 2 Entry composition i

There is only 1 type of molecule in this entry. The entry contains 3954 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 2-dehydro-3-deoxy-6-phosphogalactonate aldolase, peptidyl-prolyl cis-trans isomerase chimera.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	270	1977	1251	335	384	7	0	1	0
1	B	270	1977	1251	335	384	7	0	1	0

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	204	GLN	-	linker	UNP U6NBA4
A	205	LYS	-	linker	UNP U6NBA4
A	206	GLN	-	linker	UNP U6NBA4
A	207	LYS	-	linker	UNP U6NBA4
A	208	GLU	-	linker	UNP U6NBA4
A	209	GLN	-	linker	UNP U6NBA4
A	210	ARG	-	linker	UNP U6NBA4
A	211	GLN	-	linker	UNP U6NBA4
A	284	LEU	-	expression tag	UNP U6NBA4
A	285	GLU	-	expression tag	UNP U6NBA4
A	286	HIS	-	expression tag	UNP U6NBA4
A	287	HIS	-	expression tag	UNP U6NBA4
A	288	HIS	-	expression tag	UNP U6NBA4
A	289	HIS	-	expression tag	UNP U6NBA4
A	290	HIS	-	expression tag	UNP U6NBA4
A	291	HIS	-	expression tag	UNP U6NBA4
B	204	GLN	-	linker	UNP U6NBA4
B	205	LYS	-	linker	UNP U6NBA4
B	206	GLN	-	linker	UNP U6NBA4
B	207	LYS	-	linker	UNP U6NBA4
B	208	GLU	-	linker	UNP U6NBA4
B	209	GLN	-	linker	UNP U6NBA4
B	210	ARG	-	linker	UNP U6NBA4
B	211	GLN	-	linker	UNP U6NBA4

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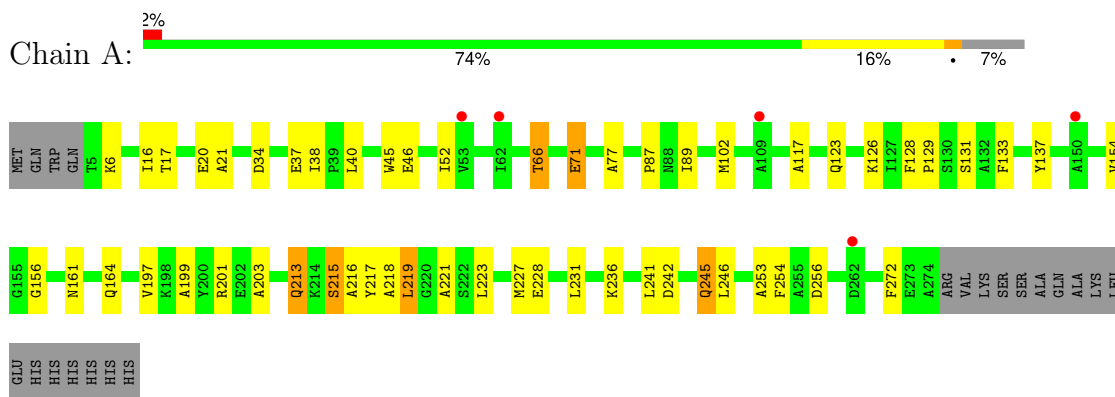
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Chain	Residue	Modelled	Actual	Comment	Reference
B	284	LEU	-	expression tag	UNP U6NBA4
B	285	GLU	-	expression tag	UNP U6NBA4
B	286	HIS	-	expression tag	UNP U6NBA4
B	287	HIS	-	expression tag	UNP U6NBA4
B	288	HIS	-	expression tag	UNP U6NBA4
B	289	HIS	-	expression tag	UNP U6NBA4
B	290	HIS	-	expression tag	UNP U6NBA4
B	291	HIS	-	expression tag	UNP U6NBA4

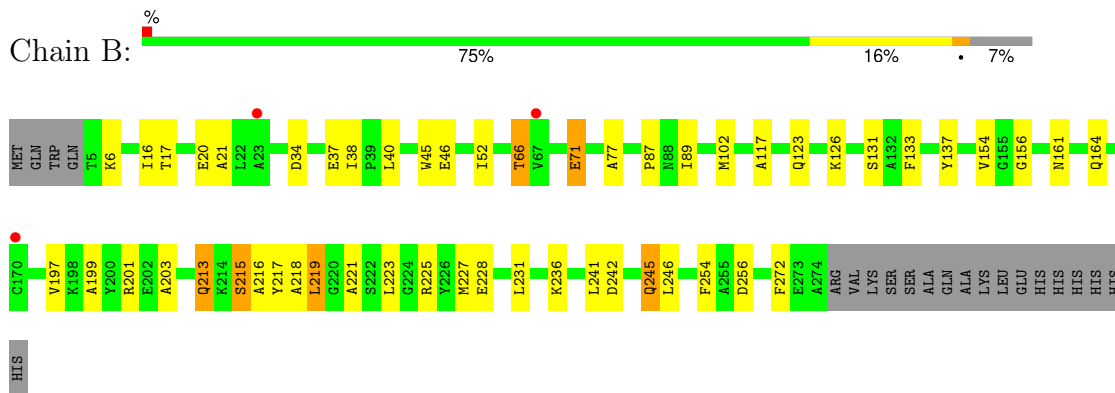
### 3 Residue-property plots [i](#)

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: 2-dehydro-3-deoxy-6-phosphogalactonate aldolase, peptidyl-prolyl cis-trans isomerase chimera



- Molecule 1: 2-dehydro-3-deoxy-6-phosphogalactonate aldolase, peptidyl-prolyl cis-trans isomerase chimera



## 4 Data and refinement statistics

Property	Value	Source
Space group	F 2 3	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	272.68Å 272.68Å 272.68Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	96.41 – 7.08 96.41 – 7.08	Depositor EDS
% Data completeness (in resolution range)	94.7 (96.41-7.08) 94.7 (96.41-7.08)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.55 (at 7.43Å)	Xtrriage
Refinement program	REFMAC 5.8.0069	Depositor
R, $R_{free}$	0.283 , 0.317 0.274 , 0.311	Depositor DCC
$R_{free}$ test set	127 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	410.5	Xtrriage
Anisotropy	0.000	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.50 , 999.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.35$	Xtrriage
Estimated twinning fraction	0.437 for k,h,-l	Xtrriage
$F_o, F_c$ correlation	0.74	EDS
Total number of atoms	3954	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	292.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.33% 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	0.57	0/2009	0.83	0/2729
1	B	0.57	0/2009	0.83	0/2729
All	All	0.57	0/4018	0.83	0/5458

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	1977	0	1963	71	0
1	B	1977	0	1963	69	0
All	All	3954	0	3926	103	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 13.

All (103) 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:216:ALA:HB2	1:B:241:LEU:HD22	1.17	1.10
1:A:241:LEU:HD22	1:B:216:ALA:HB2	1.35	1.08

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:216:ALA:HB2	1:B:241:LEU:CD2	1.90	1.01
1:A:216:ALA:CB	1:B:241:LEU:HD22	2.02	0.88
1:B:21:ALA:HB1	1:B:52:ILE:HD11	1.56	0.87
1:A:77:ALA:HA	1:A:102:MET:CE	2.05	0.87
1:B:77:ALA:HA	1:B:102:MET:CE	2.06	0.86
1:A:21:ALA:HB1	1:A:52:ILE:HD11	1.56	0.86
1:A:241:LEU:CD2	1:B:216:ALA:HB2	2.07	0.84
1:B:77:ALA:HA	1:B:102:MET:HE1	1.60	0.84
1:A:77:ALA:HA	1:A:102:MET:HE1	1.59	0.83
1:A:245:GLN:HB3	1:B:217:TYR:HD2	1.47	0.80
1:A:217:TYR:HD2	1:B:245:GLN:HB3	1.46	0.80
1:A:215:SER:HB3	1:B:272:PHE:CD1	2.22	0.75
1:A:241:LEU:HD13	1:B:216:ALA:HA	1.68	0.75
1:A:77:ALA:CA	1:A:102:MET:HE1	2.18	0.74
1:A:241:LEU:HD22	1:B:216:ALA:CB	2.15	0.74
1:B:77:ALA:CA	1:B:102:MET:HE1	2.18	0.73
1:A:216:ALA:HA	1:B:241:LEU:HD13	1.74	0.70
1:A:216:ALA:HB2	1:B:241:LEU:CG	2.23	0.68
1:B:197:VAL:HG12	1:B:201:ARG:HD2	1.77	0.67
1:A:131:SER:OG	1:A:156:GLY:HA3	1.95	0.67
1:A:197:VAL:HG12	1:A:201:ARG:HD2	1.77	0.67
1:B:131:SER:OG	1:B:156:GLY:HA3	1.95	0.66
1:A:245:GLN:HB3	1:B:217:TYR:CD2	2.30	0.65
1:A:242:ASP:HB2	1:B:213:GLN:HG3	1.77	0.65
1:A:241:LEU:HB3	1:B:216:ALA:CB	2.30	0.62
1:A:217:TYR:CD2	1:B:245:GLN:HB3	2.34	0.61
1:A:227:MET:CE	1:A:246:LEU:HD11	2.32	0.60
1:B:161:ASN:O	1:B:164:GLN:HG2	2.02	0.60
1:B:227:MET:CE	1:B:246:LEU:HD11	2.32	0.59
1:A:161:ASN:O	1:A:164:GLN:HG2	2.02	0.59
1:A:272:PHE:CD1	1:B:215:SER:HB3	2.38	0.58
1:B:16:ILE:HG13	1:B:20:GLU:HG3	1.85	0.58
1:A:16:ILE:HG13	1:A:20:GLU:HG3	1.85	0.58
1:A:218:ALA:O	1:A:221:ALA:N	2.37	0.57
1:B:218:ALA:O	1:B:221:ALA:N	2.37	0.57
1:A:256:ASP:OD1	1:B:228:GLU:OE2	2.21	0.57
1:A:216:ALA:CB	1:B:241:LEU:HD13	2.34	0.57
1:A:241:LEU:CG	1:B:216:ALA:HB2	2.35	0.57
1:B:227:MET:HE2	1:B:246:LEU:HD21	1.87	0.56
1:A:216:ALA:CA	1:B:241:LEU:HD13	2.36	0.56
1:A:227:MET:HE2	1:A:246:LEU:HD21	1.88	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:197:VAL:CG1	1:B:201:ARG:HD2	2.36	0.56
1:A:242:ASP:HB2	1:B:213:GLN:CG	2.36	0.55
1:A:227:MET:HE3	1:A:246:LEU:HD11	1.88	0.55
1:A:241:LEU:CB	1:B:216:ALA:HB2	2.37	0.55
1:A:197:VAL:CG1	1:A:201:ARG:HD2	2.36	0.55
1:B:133:PHE:HB3	1:B:137:TYR:CG	2.42	0.55
1:B:227:MET:HE3	1:B:246:LEU:HD11	1.88	0.55
1:A:213:GLN:HG3	1:B:242:ASP:HB2	1.88	0.54
1:A:216:ALA:CB	1:B:241:LEU:HB3	2.37	0.54
1:B:89:ILE:HD12	1:B:117:ALA:HB2	1.90	0.54
1:B:38:ILE:HD11	1:B:52:ILE:CD1	2.38	0.54
1:A:89:ILE:HD12	1:A:117:ALA:HB2	1.89	0.54
1:A:38:ILE:HD11	1:A:52:ILE:CD1	2.38	0.54
1:A:133:PHE:HB3	1:A:137:TYR:CG	2.42	0.53
1:A:241:LEU:HB3	1:B:216:ALA:HB1	1.89	0.53
1:B:66:THR:HA	1:B:87:PRO:HD3	1.91	0.53
1:A:66:THR:HA	1:A:87:PRO:HD3	1.91	0.52
1:A:213:GLN:CG	1:B:242:ASP:HB2	2.40	0.52
1:B:71:GLU:H	1:B:71:GLU:CD	2.19	0.51
1:A:254:PHE:HZ	1:B:231:LEU:HD22	1.74	0.51
1:A:253:ALA:O	1:B:225:ARG:NH1	2.44	0.51
1:A:216:ALA:HB1	1:B:241:LEU:HB3	1.93	0.51
1:A:227:MET:HE1	1:A:246:LEU:HG	1.93	0.51
1:A:71:GLU:H	1:A:71:GLU:CD	2.18	0.51
1:A:77:ALA:CA	1:A:102:MET:CE	2.82	0.50
1:A:199:ALA:O	1:A:203:ALA:CB	2.59	0.50
1:B:199:ALA:O	1:B:203:ALA:CB	2.59	0.50
1:B:227:MET:HE1	1:B:246:LEU:HG	1.93	0.49
1:A:227:MET:CE	1:A:246:LEU:HG	2.42	0.49
1:B:227:MET:CE	1:B:246:LEU:HG	2.43	0.48
1:A:254:PHE:CZ	1:B:231:LEU:HD22	2.49	0.48
1:A:216:ALA:HB2	1:B:241:LEU:CB	2.43	0.47
1:A:241:LEU:HD13	1:B:216:ALA:CA	2.39	0.47
1:B:77:ALA:CA	1:B:102:MET:CE	2.82	0.47
1:A:231:LEU:HD22	1:B:254:PHE:HZ	1.79	0.47
1:A:126:LYS:HE3	1:A:154:VAL:HG11	1.99	0.45
1:B:46:GLU:H	1:B:46:GLU:CD	2.25	0.45
1:A:46:GLU:H	1:A:46:GLU:CD	2.25	0.44
1:B:126:LYS:HE3	1:B:154:VAL:HG11	1.99	0.44
1:A:228:GLU:OE2	1:B:256:ASP:OD1	2.36	0.44
1:A:227:MET:CE	1:A:246:LEU:CD1	2.96	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:17:THR:OG1	1:B:20:GLU:HG2	2.18	0.44
1:B:227:MET:CE	1:B:246:LEU:CG	2.96	0.44
1:A:227:MET:CE	1:A:246:LEU:CG	2.95	0.43
1:A:241:LEU:HB3	1:B:216:ALA:HB2	1.94	0.43
1:A:17:THR:OG1	1:A:20:GLU:HG2	2.18	0.43
1:B:216:ALA:O	1:B:219:LEU:HB2	2.19	0.43
1:A:216:ALA:O	1:A:219:LEU:HB2	2.19	0.42
1:A:227:MET:HE2	1:A:246:LEU:CD2	2.50	0.42
1:B:227:MET:CE	1:B:246:LEU:CD1	2.96	0.41
1:A:40:LEU:HD22	1:A:45:TRP:CD2	2.56	0.41
1:B:40:LEU:HD22	1:B:45:TRP:CD2	2.56	0.41
1:A:128:PHE:HA	1:A:129:PRO:HA	1.94	0.41
1:A:6:LYS:HB2	1:A:34:ASP:OD2	2.21	0.41
1:A:241:LEU:HD22	1:B:216:ALA:CA	2.50	0.41
1:B:6:LYS:HB2	1:B:34:ASP:OD2	2.21	0.41
1:B:218:ALA:O	1:B:219:LEU:C	2.64	0.41
1:A:218:ALA:O	1:A:219:LEU:C	2.64	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	268/291 (92%)	263 (98%)	4 (2%)	1 (0%)	30	67
1	B	268/291 (92%)	263 (98%)	4 (2%)	1 (0%)	30	67
All	All	536/582 (92%)	526 (98%)	8 (2%)	2 (0%)	30	67

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	219	LEU

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Mol	Chain	Res	Type
1	B	219	LEU

### 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	195/222 (88%)	186 (95%)	9 (5%)	24	45
1	B	195/222 (88%)	186 (95%)	9 (5%)	24	45
All	All	390/444 (88%)	372 (95%)	18 (5%)	24	45

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	37	GLU
1	A	66	THR
1	A	71	GLU
1	A	123	GLN
1	A	213	GLN
1	A	215	SER
1	A	223	LEU
1	A	236	LYS
1	A	245	GLN
1	B	37	GLU
1	B	66	THR
1	B	71	GLU
1	B	123	GLN
1	B	213	GLN
1	B	215	SER
1	B	223	LEU
1	B	236	LYS
1	B	245	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	245	GLN
1	A	251	GLN
1	A	270	GLN
1	B	245	GLN
1	B	251	GLN
1	B	270	GLN

### 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 [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	270/291 (92%)	0.25	5 (1%) 66 56	120, 289, 414, 440	1 (0%)
1	B	270/291 (92%)	0.22	3 (1%) 78 66	118, 285, 406, 443	1 (0%)
All	All	540/582 (92%)	0.24	8 (1%) 72 60	118, 286, 414, 443	2 (0%)

All (8) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	23	ALA	2.9
1	B	170	CYS	2.7
1	A	109	ALA	2.5
1	B	67	VAL	2.4
1	A	150	ALA	2.3
1	A	62	ILE	2.2
1	A	262	ASP	2.2
1	A	53	VAL	2.1

### 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 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.