



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 14, 2026 – 10:16 AM UTC

PDB ID : 4YPJ / pdb_00004ypj
Title : X-ray Structure of The Mutant of Glycoside Hydrolase
Authors : Ishikawa, K.; Kataoka, M.; Yanamoto, T.; Nakabayashi, M.; Watanabe, M.
Deposited on : 2015-03-13
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 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
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

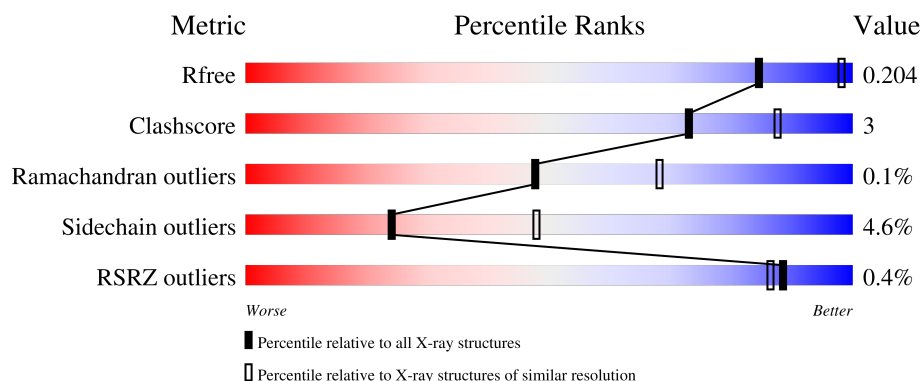
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 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}	180053	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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	810	 89% 9% .
1	B	810	 90% 8% .

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 13764 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 Beta galactosidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	810	Total	C	N	O	S	0	0	0
			6422	4065	1092	1255	10			
1	B	810	Total	C	N	O	S	0	0	0
			6422	4065	1092	1255	10			

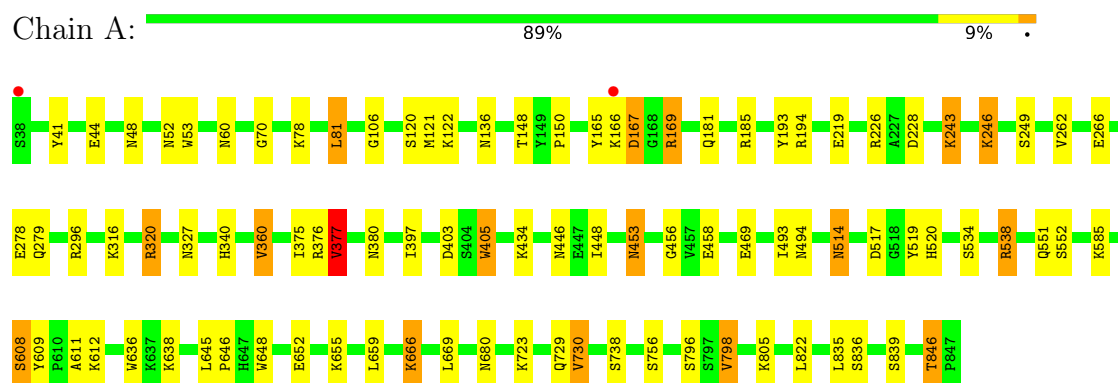
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	455	Total	O	0	0
			455	455		
2	B	465	Total	O	0	0
			465	465		

3 Residue-property plots

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: Beta galactosidase



- Molecule 1: Beta galactosidase



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	161.41Å 161.41Å 275.29Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.97 – 2.50 29.97 – 2.50	Depositor EDS
% Data completeness (in resolution range)	98.9 (29.97-2.50) 98.9 (29.97-2.50)	Depositor EDS
R_{merge}	0.16	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.12 (at 2.51Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.163 , 0.198 0.172 , 0.204	Depositor DCC
R_{free} test set	6246 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	24.7	Xtriage
Anisotropy	0.026	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 44.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	13764	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.60% of the height of the origin peak. No significant pseudotranslation is detected.*

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

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	1.14	7/6580 (0.1%)	1.11	12/8930 (0.1%)
1	B	1.11	4/6580 (0.1%)	1.09	10/8930 (0.1%)
All	All	1.13	11/13160 (0.1%)	1.10	22/17860 (0.1%)

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	278	GLU	C-O	-6.09	1.16	1.23
1	A	756	SER	CB-OG	6.07	1.54	1.42
1	B	278	GLU	C-O	-5.79	1.16	1.23
1	A	52	ASN	CA-C	-5.77	1.46	1.53
1	A	729	GLN	CA-C	-5.52	1.46	1.52
1	B	281	THR	C-O	5.31	1.28	1.24
1	B	687	SER	C-O	-5.16	1.17	1.24
1	A	249	SER	C-O	-5.12	1.18	1.24
1	B	322	PHE	CA-C	-5.06	1.46	1.52
1	A	469	GLU	C-O	-5.06	1.17	1.24
1	A	669	LEU	N-CA	-5.02	1.40	1.46

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	360	VAL	CB-CA-C	-8.73	100.17	112.22
1	A	360	VAL	CB-CA-C	-7.68	101.62	112.22
1	A	538	ARG	NE-CZ-NH2	7.50	125.95	119.20
1	A	846	THR	CB-CA-C	7.19	121.69	109.82
1	B	582	ARG	CG-CD-NE	6.88	127.13	112.00
1	B	326	GLU	CB-CA-C	-6.73	99.23	110.68
1	B	484	ARG	NE-CZ-NH2	6.66	125.19	119.20
1	A	377	VAL	CB-CA-C	6.38	120.11	111.88
1	A	798	VAL	CB-CA-C	6.24	121.52	111.29
1	A	538	ARG	NE-CZ-NH1	-6.11	115.39	121.50
1	A	246	LYS	CB-CA-C	-5.75	98.49	109.66

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	405	TRP	N-CA-C	-5.65	104.15	108.78
1	A	360	VAL	N-CA-CB	5.40	118.68	110.58
1	B	470	ILE	CB-CA-C	-5.37	106.14	111.30
1	B	434	LYS	N-CA-C	5.32	119.25	112.87
1	B	360	VAL	N-CA-CB	5.30	118.54	110.58
1	A	434	LYS	N-CA-C	5.29	119.21	112.87
1	A	798	VAL	N-CA-CB	-5.27	102.53	111.23
1	B	538	ARG	NE-CZ-NH2	-5.16	114.55	119.20
1	B	369	ASP	N-CA-CB	5.14	118.13	110.22
1	B	57	ARG	CG-CD-NE	-5.11	100.76	112.00
1	A	70	GLY	N-CA-C	5.00	120.17	114.67

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	6422	0	6186	42	0
1	B	6422	0	6186	39	0
2	A	455	0	0	1	0
2	B	465	0	0	6	0
All	All	13764	0	12372	81	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 3.

All (81) 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:167:ASP:OD2	1:B:169:ARG:HD3	1.66	0.96
1:B:582:ARG:NH1	1:B:583:ASP:OD1	2.01	0.93
1:B:407:GLN:HB3	2:B:1292:HOH:O	1.74	0.88
1:A:226:ARG:NH2	1:A:228:ASP:OD1	2.18	0.76
1:A:514:ASN:HD22	1:A:514:ASN:H	1.35	0.72

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:50:ASN:HD21	1:B:196:VAL:H	1.37	0.71
1:A:167:ASP:OD1	1:A:167:ASP:N	2.26	0.69
1:A:453:ASN:C	1:A:453:ASN:HD22	2.05	0.65
1:A:648:TRP:HB2	1:A:730:VAL:CG1	2.29	0.62
1:A:262:VAL:HG12	1:A:279:GLN:NE2	2.15	0.62
1:B:494:ASN:HD22	1:B:497:ILE:H	1.46	0.61
1:B:649:ASN:HD21	1:B:733:ALA:H	1.48	0.61
1:B:246:LYS:HE2	1:B:263:GLU:OE1	2.03	0.58
1:B:262:VAL:HG12	1:B:279:GLN:NE2	2.19	0.58
1:A:648:TRP:HB2	1:A:730:VAL:HG12	1.85	0.57
1:A:514:ASN:H	1:A:514:ASN:ND2	2.01	0.56
1:B:375:ILE:HB	1:B:397:ILE:HD13	1.88	0.56
1:A:376:ARG:HH22	1:A:446:ASN:ND2	2.05	0.54
1:B:167:ASP:N	1:B:167:ASP:OD1	2.41	0.54
1:B:582:ARG:NH2	1:B:694:GLU:OE2	2.41	0.54
1:B:585:LYS:HG2	1:B:688:TRP:CZ3	2.43	0.53
1:B:405:TRP:CD2	1:B:448:ILE:HG21	2.44	0.53
1:A:136:ASN:HA	1:A:150:PRO:HA	1.89	0.53
1:A:405:TRP:CD2	1:A:448:ILE:HG21	2.45	0.52
1:B:41:TYR:HB2	1:B:121:MET:HE2	1.92	0.52
1:B:582:ARG:HH11	1:B:582:ARG:HG2	1.73	0.52
1:A:376:ARG:HH22	1:A:446:ASN:HD22	1.56	0.52
1:B:582:ARG:NH2	2:B:901:HOH:O	2.39	0.51
1:A:375:ILE:HB	1:A:397:ILE:HD13	1.92	0.51
1:B:45:ARG:NH1	1:B:311:ASP:OD2	2.44	0.50
1:B:320:ARG:HD3	1:B:320:ARG:C	2.36	0.50
1:B:585:LYS:HG2	1:B:688:TRP:CE3	2.47	0.50
1:B:489:ASN:HB2	2:B:1250:HOH:O	2.11	0.49
1:B:608:SER:O	1:B:609:TYR:C	2.55	0.49
1:A:296:ARG:HD3	2:A:1180:HOH:O	2.13	0.49
1:A:246:LYS:HG3	1:A:266:GLU:HG2	1.95	0.49
1:B:45:ARG:NH2	2:B:913:HOH:O	2.46	0.49
1:A:608:SER:O	1:A:609:TYR:C	2.53	0.48
1:A:41:TYR:HB2	1:A:121:MET:HE2	1.95	0.48
1:A:453:ASN:ND2	1:A:456:GLY:H	2.12	0.48
1:B:340:HIS:HB3	1:B:636:TRP:CE3	2.49	0.48
1:A:167:ASP:OD2	1:A:169:ARG:HD3	2.13	0.47
1:B:136:ASN:HA	1:B:150:PRO:HA	1.95	0.47
1:A:167:ASP:OD2	1:A:169:ARG:CD	2.63	0.47
1:B:320:ARG:HD3	1:B:320:ARG:O	2.14	0.47
1:A:53:TRP:NE1	1:A:81:LEU:HD22	2.30	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:645:LEU:HB2	1:B:646:PRO:HA	1.98	0.46
1:A:738:SER:HA	1:A:835:LEU:HB3	1.97	0.45
1:A:185:ARG:HD3	1:A:403:ASP:OD2	2.16	0.45
1:A:327:ASN:HD22	1:A:520:HIS:HE1	1.64	0.45
1:A:377:VAL:HG22	1:A:380:ASN:O	2.16	0.45
1:B:612:LYS:HD2	1:B:612:LYS:C	2.42	0.45
1:B:78:LYS:HE3	1:B:78:LYS:HB2	1.57	0.45
1:A:48:ASN:OD1	1:A:48:ASN:C	2.61	0.44
1:A:493:ILE:HG22	1:A:494:ASN:O	2.17	0.44
1:A:243:LYS:HD3	1:A:243:LYS:HA	1.87	0.44
1:B:243:LYS:HD3	1:B:243:LYS:HA	1.82	0.44
1:B:378:THR:HA	1:B:379:HIS:HA	1.88	0.43
1:A:106:GLY:H	1:A:181:GLN:NE2	2.16	0.43
1:A:165:TYR:CB	1:A:169:ARG:HG3	2.48	0.43
1:A:517:ASP:O	1:A:520:HIS:HB3	2.18	0.43
1:A:666:LYS:HB3	1:A:680:ASN:HB3	1.99	0.43
1:B:50:ASN:ND2	1:B:196:VAL:H	2.09	0.43
1:B:193:TYR:CE2	1:B:194:ARG:HG3	2.53	0.43
1:B:551:GLN:O	1:B:552:SER:C	2.61	0.43
1:A:645:LEU:HB2	1:A:646:PRO:HA	2.00	0.43
1:A:193:TYR:CE2	1:A:194:ARG:HG3	2.54	0.42
1:B:45:ARG:NH1	1:B:311:ASP:OD1	2.51	0.42
1:A:185:ARG:NH1	1:A:403:ASP:OD1	2.52	0.42
1:B:48:ASN:OD1	1:B:48:ASN:C	2.62	0.42
1:A:320:ARG:O	1:A:320:ARG:HD3	2.20	0.41
1:A:551:GLN:O	1:A:552:SER:C	2.63	0.41
1:A:453:ASN:C	1:A:453:ASN:ND2	2.72	0.41
1:A:611:ALA:HA	1:A:796:SER:HA	2.01	0.41
1:A:493:ILE:HG12	1:A:519:TYR:CZ	2.56	0.41
1:B:165:TYR:HA	2:B:903:HOH:O	2.20	0.41
1:A:185:ARG:HH11	1:A:403:ASP:CG	2.29	0.41
1:A:340:HIS:HB3	1:A:636:TRP:CE3	2.55	0.41
1:B:38:SER:N	2:B:928:HOH:O	2.53	0.41
1:B:169:ARG:H	1:B:169:ARG:HG2	1.74	0.40
1:B:517:ASP:O	1:B:520:HIS:HB3	2.21	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	808/810 (100%)	777 (96%)	30 (4%)	1 (0%)	48	68
1	B	808/810 (100%)	777 (96%)	30 (4%)	1 (0%)	48	68
All	All	1616/1620 (100%)	1554 (96%)	60 (4%)	2 (0%)	48	68

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	534	SER
1	B	534	SER

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	685/685 (100%)	649 (95%)	36 (5%)	20	42
1	B	685/685 (100%)	658 (96%)	27 (4%)	28	55
All	All	1370/1370 (100%)	1307 (95%)	63 (5%)	24	48

All (63) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	44	GLU
1	A	60	ASN
1	A	78	LYS
1	A	81	LEU

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Mol	Chain	Res	Type
1	A	120	SER
1	A	122	LYS
1	A	148	THR
1	A	166	LYS
1	A	167	ASP
1	A	169	ARG
1	A	219	GLU
1	A	243	LYS
1	A	316	LYS
1	A	320	ARG
1	A	360	VAL
1	A	377	VAL
1	A	453	ASN
1	A	458	GLU
1	A	514	ASN
1	A	538	ARG
1	A	585	LYS
1	A	608	SER
1	A	612	LYS
1	A	638	LYS
1	A	652	GLU
1	A	655	LYS
1	A	659	LEU
1	A	666	LYS
1	A	723	LYS
1	A	730	VAL
1	A	798	VAL
1	A	805	LYS
1	A	822	LEU
1	A	836	SER
1	A	839	SER
1	A	846	THR
1	B	60	ASN
1	B	78	LYS
1	B	163	LYS
1	B	167	ASP
1	B	169	ARG
1	B	190	SER
1	B	230	ASN
1	B	241	GLU
1	B	243	LYS
1	B	246	LYS

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Mol	Chain	Res	Type
1	B	316	LYS
1	B	320	ARG
1	B	360	VAL
1	B	450	ASP
1	B	458	GLU
1	B	538	ARG
1	B	582	ARG
1	B	585	LYS
1	B	608	SER
1	B	612	LYS
1	B	651	LYS
1	B	655	LYS
1	B	723	LYS
1	B	766	LYS
1	B	805	LYS
1	B	806	ARG
1	B	836	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (38) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	52	ASN
1	A	92	ASN
1	A	94	ASN
1	A	179	ASN
1	A	181	GLN
1	A	230	ASN
1	A	244	GLN
1	A	257	ASN
1	A	260	GLN
1	A	298	ASN
1	A	327	ASN
1	A	363	GLN
1	A	391	ASN
1	A	446	ASN
1	A	453	ASN
1	A	462	ASN
1	A	514	ASN
1	A	550	ASN
1	A	551	GLN
1	A	559	GLN
1	A	590	GLN

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Mol	Chain	Res	Type
1	A	607	ASN
1	A	683	ASN
1	B	50	ASN
1	B	52	ASN
1	B	56	GLN
1	B	181	GLN
1	B	244	GLN
1	B	298	ASN
1	B	380	ASN
1	B	391	ASN
1	B	462	ASN
1	B	494	ASN
1	B	510	ASN
1	B	522	GLN
1	B	551	GLN
1	B	649	ASN
1	B	794	ASN

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 ⓘ

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	810/810 (100%)	-0.66	2 (0%) 91 89	15, 26, 52, 81	0
1	B	810/810 (100%)	-0.60	5 (0%) 85 83	17, 28, 55, 89	0
All	All	1620/1620 (100%)	-0.63	7 (0%) 88 86	15, 27, 54, 89	0

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	166	LYS	3.5
1	B	651	LYS	2.9
1	B	243	LYS	2.8
1	A	166	LYS	2.4
1	B	168	GLY	2.4
1	B	122	LYS	2.1
1	A	38	SER	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 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.