



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 05:03 PM UTC

PDB ID : 5Z7R / pdb_00005z7r
Title : Crystal structure of crotonase from Clostridium acetobutylicum
Authors : Kim, E.-J.; Kim, Y.-J.; Kim, K.-J.
Deposited on : 2018-01-30
Resolution : 2.20 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

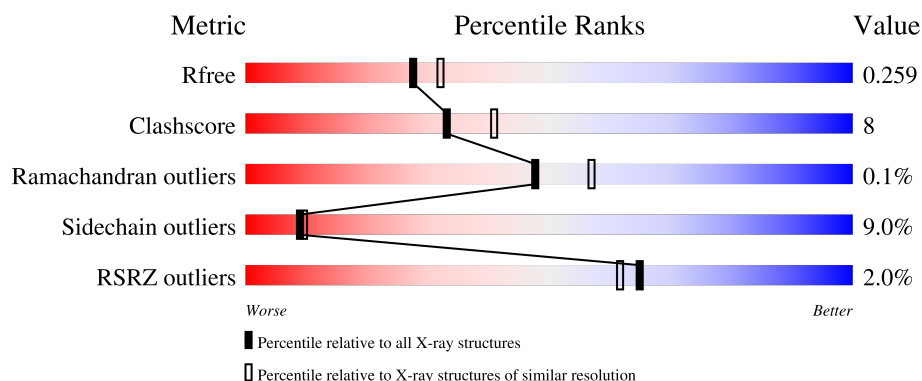
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	6164 (2.20-2.20)
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (2.20-2.20)

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	267	3% 72% 20% • 5%
1	B	267	% 75% 19% • 5%
1	C	267	% 81% 10% • 5%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5866 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 Short-chain-enoyl-CoA hydratase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	254	Total	C	N	O	S	0	0	0
			1909	1196	329	370	14			
1	B	254	Total	C	N	O	S	0	0	0
			1909	1196	329	370	14			
1	C	254	Total	C	N	O	S	0	0	0
			1909	1196	329	370	14			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	262	HIS	-	expression tag	UNP P52046
A	263	HIS	-	expression tag	UNP P52046
A	264	HIS	-	expression tag	UNP P52046
A	265	HIS	-	expression tag	UNP P52046
A	266	HIS	-	expression tag	UNP P52046
A	267	HIS	-	expression tag	UNP P52046
B	262	HIS	-	expression tag	UNP P52046
B	263	HIS	-	expression tag	UNP P52046
B	264	HIS	-	expression tag	UNP P52046
B	265	HIS	-	expression tag	UNP P52046
B	266	HIS	-	expression tag	UNP P52046
B	267	HIS	-	expression tag	UNP P52046
C	262	HIS	-	expression tag	UNP P52046
C	263	HIS	-	expression tag	UNP P52046
C	264	HIS	-	expression tag	UNP P52046
C	265	HIS	-	expression tag	UNP P52046
C	266	HIS	-	expression tag	UNP P52046
C	267	HIS	-	expression tag	UNP P52046

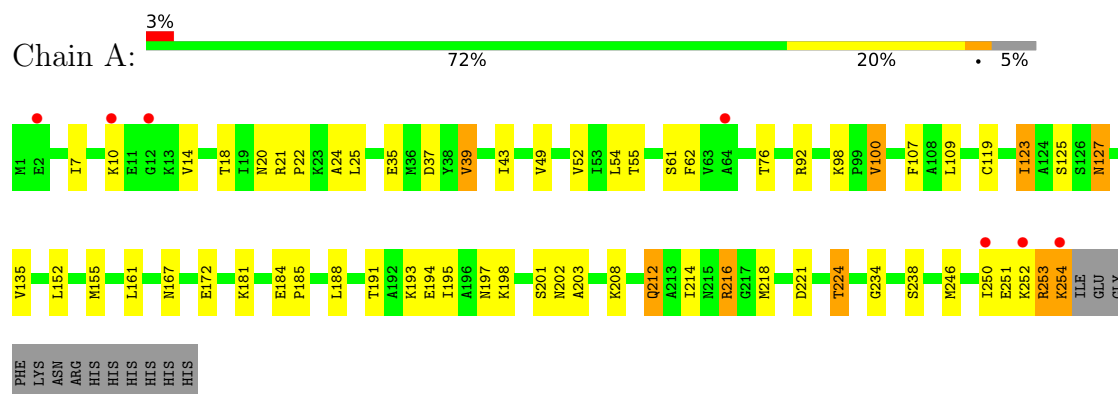
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	41	Total 41	O 41	0	0
2	B	46	Total 46	O 46	0	0
2	C	52	Total 52	O 52	0	0

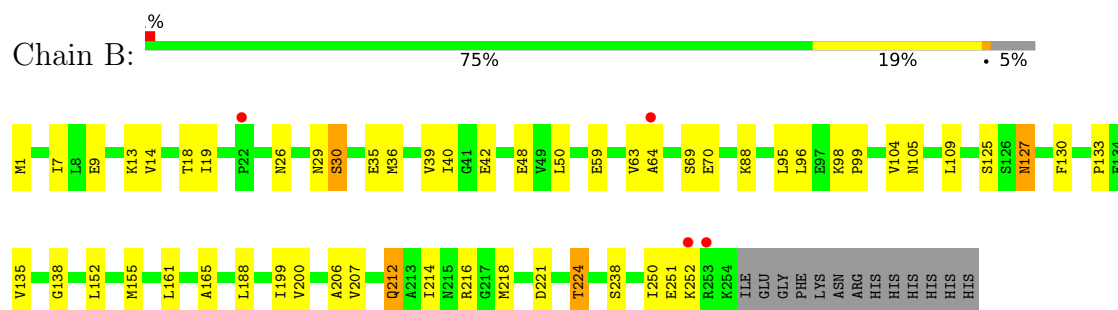
3 Residue-property plots [i](#)

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.

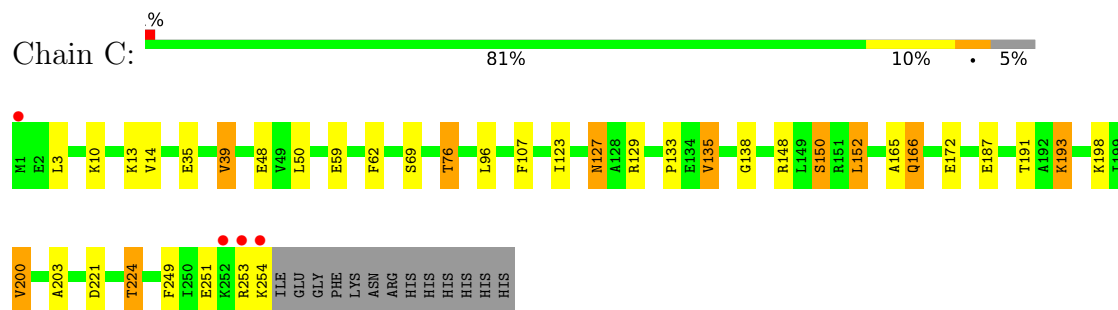
• Molecule 1: Short-chain-enoyl-CoA hydratase



• Molecule 1: Short-chain-enoyl-CoA hydratase



• Molecule 1: Short-chain-enoyl-CoA hydratase



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 1 2	Depositor
Cell constants a, b, c, α , β , γ	78.67Å 78.67Å 210.70Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.20 50.00 – 2.20	Depositor EDS
% Data completeness (in resolution range)	97.2 (50.00-2.20) 97.2 (50.00-2.20)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.62 (at 2.20Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.189 , 0.258 0.196 , 0.259	Depositor DCC
R_{free} test set	1866 reflections (4.87%)	wwPDB-VP
Wilson B-factor (Å ²)	28.4	Xtriage
Anisotropy	0.072	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 31.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.057 for -h,-k,l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5866	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.56% 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	0.90	1/1926 (0.1%)	1.06	3/2586 (0.1%)
1	B	0.86	0/1926	1.00	0/2586
1	C	0.96	0/1926	1.05	0/2586
All	All	0.91	1/5778 (0.0%)	1.04	3/7758 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	54	LEU	CA-C	-5.78	1.45	1.52

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	21	ARG	CA-C-N	5.69	125.81	119.32
1	A	21	ARG	C-N-CA	5.69	125.81	119.32
1	A	188	LEU	N-CA-C	5.47	117.70	111.02

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	1909	0	1967	49	0
1	B	1909	0	1967	36	1
1	C	1909	0	1967	24	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	41	0	0	1	0
2	B	46	0	0	1	0
2	C	52	0	0	1	0
All	All	5866	0	5901	91	1

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 8.

All (91) 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:135:VAL:HG21	1:B:207:VAL:HG23	1.63	0.78
1:A:221:ASP:OD2	1:A:224:THR:HG23	1.83	0.77
1:C:221:ASP:OD1	1:C:224:THR:HG23	1.84	0.76
1:A:135:VAL:HG21	1:B:207:VAL:CG2	2.17	0.74
1:A:253:ARG:O	1:A:254:LYS:HG3	1.88	0.72
1:B:36:MET:O	1:B:40:ILE:HG12	1.90	0.71
1:A:253:ARG:C	1:A:254:LYS:HG3	2.22	0.65
1:B:221:ASP:OD2	1:B:224:THR:HG23	1.96	0.65
1:A:125:SER:OG	1:A:127:ASN:ND2	2.31	0.64
1:A:193:LYS:O	1:A:197:ASN:ND2	2.33	0.60
1:A:198:LYS:CD	1:C:166:GLN:HE22	2.15	0.60
1:C:148:ARG:O	1:C:152:LEU:HD22	2.02	0.60
1:B:13:LYS:HB2	1:B:200:VAL:HG11	1.82	0.60
1:C:13:LYS:NZ	1:C:48:GLU:OE1	2.36	0.58
1:A:135:VAL:HG23	1:B:206:ALA:HB3	1.85	0.58
1:A:135:VAL:CG2	1:B:207:VAL:HG23	2.32	0.58
1:A:198:LYS:CE	1:C:166:GLN:HE22	2.17	0.58
1:B:250:ILE:C	1:B:252:LYS:H	2.11	0.57
1:B:125:SER:OG	1:B:188:LEU:HD22	2.05	0.56
1:A:127:ASN:HD22	1:A:127:ASN:H	1.51	0.56
1:A:212:GLN:HE21	1:A:212:GLN:HA	1.71	0.55
1:B:214:ILE:O	1:B:218:MET:HB2	2.07	0.55
1:A:76:THR:OG1	1:B:238:SER:HB3	2.06	0.55
1:C:35:GLU:O	1:C:39:VAL:HG13	2.06	0.55
1:B:35:GLU:O	1:B:39:VAL:HG13	2.07	0.54
1:A:238:SER:HB3	1:C:76:THR:CG2	2.39	0.53
1:B:221:ASP:OD2	1:B:224:THR:CG2	2.56	0.53
1:B:105:ASN:H	1:B:105:ASN:HD22	1.57	0.52
1:A:218:MET:SD	1:C:150:SER:HB3	2.50	0.52
1:A:194:GLU:O	1:A:198:LYS:HG3	2.10	0.52

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:64:ALA:O	1:B:109:LEU:HB2	2.09	0.52
1:C:50:LEU:HB2	1:C:200:VAL:HG22	1.92	0.52
1:C:187:GLU:O	1:C:191:THR:HG23	2.11	0.51
1:A:52:VAL:HB	1:A:100:VAL:HB	1.92	0.51
1:B:19:ILE:HD11	1:B:36:MET:HE3	1.92	0.51
1:B:105:ASN:H	1:B:105:ASN:ND2	2.09	0.51
1:A:62:PHE:HB3	1:A:107:PHE:O	2.11	0.50
1:B:125:SER:HB2	1:B:127:ASN:ND2	2.27	0.50
1:A:35:GLU:O	1:A:39:VAL:HG13	2.11	0.50
1:A:37:ASP:OD1	1:A:92:ARG:NH1	2.44	0.49
1:A:234:GLY:O	1:C:76:THR:HG22	2.12	0.49
1:A:221:ASP:OD2	1:A:224:THR:CG2	2.59	0.49
1:A:221:ASP:CG	1:A:224:THR:HG23	2.38	0.48
1:A:214:ILE:O	1:A:218:MET:HB2	2.14	0.48
1:C:221:ASP:CG	1:C:224:THR:HG23	2.38	0.47
1:B:50:LEU:HB2	1:B:200:VAL:HG22	1.97	0.47
1:B:104:VAL:HG11	1:B:130:PHE:CZ	2.50	0.47
1:B:138:GLY:HA2	1:C:203:ALA:CB	2.45	0.47
1:C:127:ASN:H	1:C:127:ASN:HD22	1.64	0.46
1:A:203:ALA:CB	1:C:138:GLY:HA2	2.46	0.46
1:A:198:LYS:HD2	1:C:166:GLN:HE22	1.80	0.46
1:A:246:MET:O	1:A:250:ILE:HG13	2.16	0.46
1:A:100:VAL:HG22	1:A:119:CYS:HB3	1.98	0.45
1:B:29:ASN:O	1:B:30:SER:C	2.60	0.45
1:A:202:ASN:HB3	1:C:135:VAL:HG13	1.99	0.45
1:B:155:MET:HE3	2:B:303:HOH:O	2.16	0.45
1:C:193:LYS:NZ	2:C:303:HOH:O	2.50	0.45
1:A:212:GLN:NE2	1:A:216:ARG:HD2	2.32	0.44
1:B:133:PRO:HA	1:B:165:ALA:HB1	2.00	0.44
1:A:123:ILE:HD13	1:A:195:ILE:CD1	2.48	0.44
1:A:43:ILE:HG23	1:A:49:VAL:HG11	1.99	0.44
1:A:208:LYS:HE3	2:A:312:HOH:O	2.17	0.44
1:A:135:VAL:HG21	1:B:207:VAL:HG22	1.97	0.43
1:A:253:ARG:C	1:A:254:LYS:CG	2.90	0.43
1:B:13:LYS:CB	1:B:200:VAL:HG11	2.47	0.43
1:B:127:ASN:HD22	1:B:127:ASN:H	1.66	0.43
1:C:253:ARG:O	1:C:254:LYS:HB3	2.18	0.43
1:A:135:VAL:HG23	1:B:206:ALA:CB	2.49	0.43
1:A:198:LYS:CD	1:C:166:GLN:NE2	2.82	0.43
1:C:133:PRO:HA	1:C:165:ALA:HB1	2.00	0.42
1:B:250:ILE:C	1:B:252:LYS:N	2.77	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:26:ASN:O	1:B:63:VAL:HG13	2.19	0.42
1:A:184:GLU:O	1:A:185:PRO:C	2.62	0.42
1:B:95:LEU:O	1:B:96:LEU:C	2.62	0.42
1:B:99:PRO:HG3	1:B:199:ILE:HG21	2.02	0.42
1:A:109:LEU:HD22	1:A:167:ASN:OD1	2.20	0.42
1:A:123:ILE:HG13	1:A:181:LYS:HB2	2.00	0.42
1:C:249:PHE:CD1	1:C:249:PHE:C	2.97	0.42
1:A:238:SER:HB3	1:C:76:THR:HG21	2.01	0.41
1:B:7:ILE:HB	1:B:18:THR:HB	2.02	0.41
1:A:18:THR:HA	1:A:55:THR:O	2.20	0.41
1:A:20:ASN:C	1:A:22:PRO:HD3	2.46	0.41
1:A:24:ALA:O	1:A:25:LEU:HB2	2.20	0.41
1:A:123:ILE:CG1	1:A:181:LYS:HB2	2.51	0.41
1:A:191:THR:O	1:A:194:GLU:HG2	2.21	0.41
1:B:7:ILE:HG22	1:B:9:GLU:HG3	2.03	0.41
1:B:212:GLN:NE2	1:B:216:ARG:HE	2.19	0.41
1:C:62:PHE:HB3	1:C:107:PHE:O	2.20	0.41
1:A:7:ILE:HD11	1:A:20:ASN:ND2	2.36	0.41
1:B:30:SER:N	1:B:70:GLU:OE1	2.47	0.40
1:A:7:ILE:HD11	1:A:20:ASN:HD22	1.86	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:48:GLU:OE1	1:B:48:GLU:OE1[5_554]	2.18	0.02

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	252/267 (94%)	243 (96%)	9 (4%)	0	100 100

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	252/267 (94%)	242 (96%)	9 (4%)	1 (0%)	30	34
1	C	252/267 (94%)	248 (98%)	4 (2%)	0	100	100
All	All	756/801 (94%)	733 (97%)	22 (3%)	1 (0%)	48	57

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	251	GLU

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	204/216 (94%)	184 (90%)	20 (10%)	7	8
1	B	204/216 (94%)	190 (93%)	14 (7%)	14	16
1	C	204/216 (94%)	183 (90%)	21 (10%)	7	7
All	All	612/648 (94%)	557 (91%)	55 (9%)	9	9

All (55) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	10	LYS
1	A	14	VAL
1	A	39	VAL
1	A	61	SER
1	A	98	LYS
1	A	100	VAL
1	A	123	ILE
1	A	127	ASN
1	A	152	LEU
1	A	155	MET
1	A	161	LEU
1	A	172	GLU
1	A	201	SER

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	212	GLN
1	A	216	ARG
1	A	224	THR
1	A	251	GLU
1	A	252	LYS
1	A	253	ARG
1	A	254	LYS
1	B	1	MET
1	B	14	VAL
1	B	30	SER
1	B	42	GLU
1	B	59	GLU
1	B	69	SER
1	B	88	LYS
1	B	98	LYS
1	B	127	ASN
1	B	135	VAL
1	B	152	LEU
1	B	161	LEU
1	B	212	GLN
1	B	224	THR
1	C	3	LEU
1	C	10	LYS
1	C	14	VAL
1	C	39	VAL
1	C	59	GLU
1	C	69	SER
1	C	76	THR
1	C	96	LEU
1	C	123	ILE
1	C	127	ASN
1	C	129	ARG
1	C	135	VAL
1	C	150	SER
1	C	152	LEU
1	C	166	GLN
1	C	172	GLU
1	C	193	LYS
1	C	198	LYS
1	C	200	VAL
1	C	224	THR
1	C	251	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	105	ASN
1	A	127	ASN
1	A	160	GLN
1	A	180	ASN
1	A	212	GLN
1	B	4	ASN
1	B	20	ASN
1	B	105	ASN
1	B	127	ASN
1	B	180	ASN
1	B	212	GLN
1	C	105	ASN
1	C	127	ASN
1	C	160	GLN
1	C	166	GLN
1	C	167	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	254/267 (95%)	0.00	7 (2%) 55 52	18, 34, 60, 87	0
1	B	254/267 (95%)	-0.16	4 (1%) 70 67	18, 35, 57, 102	0
1	C	254/267 (95%)	-0.33	4 (1%) 70 67	17, 27, 46, 105	0
All	All	762/801 (95%)	-0.16	15 (1%) 65 62	17, 32, 56, 105	0

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	253	ARG	3.3
1	B	64	ALA	2.9
1	A	250	ILE	2.7
1	A	254	LYS	2.6
1	A	252	LYS	2.5
1	A	64	ALA	2.5
1	C	254	LYS	2.4
1	A	10	LYS	2.2
1	C	1	MET	2.2
1	B	253	ARG	2.1
1	C	252	LYS	2.1
1	A	12	GLY	2.1
1	A	2	GLU	2.0
1	B	252	LYS	2.0
1	B	22	PRO	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.