



Full wwPDB X-ray Structure Validation Report ⓘ

Sep 7, 2026 – 01:13 pm BST

PDB ID : 31RM / pdb_000031rm
Title : Full-length structure of catalytically inactivated LysC from *Pseudomonas aeruginosa*
Authors : Harding, C.J.; Czekster, C.M.
Deposited on : 2026-06-18
Resolution : 2.17 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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

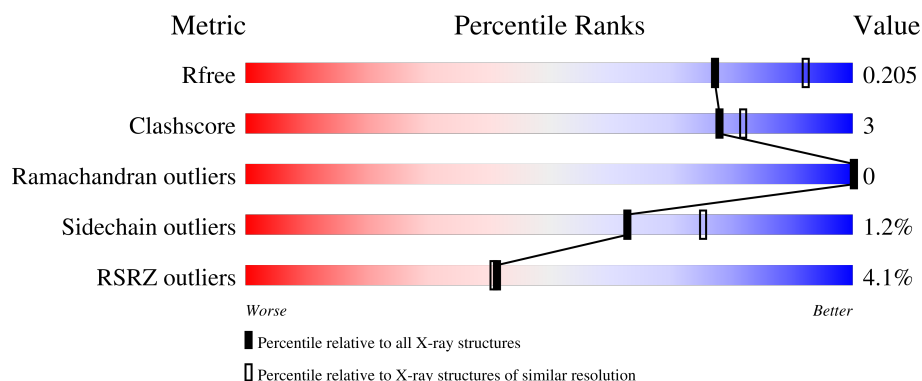
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.17 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	8975 (2.20-2.16)
Clashscore	190562	9786 (2.20-2.16)
Ramachandran outliers	187476	9664 (2.20-2.16)
Sidechain outliers	187428	9664 (2.20-2.16)
RSRZ outliers	180081	8979 (2.20-2.16)

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	448	5% 85% 9% 6%
1	B	448	4% 88% 7% 5%
1	C	448	5% 90% • 6%
1	D	448	2% 91% • 5%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 13024 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 Lysyl endopeptidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	423	Total	C	N	O	S	0	1	0
			3127	1959	545	614	9			
1	B	424	Total	C	N	O	S	0	1	0
			3138	1965	549	615	9			
1	C	422	Total	C	N	O	S	0	1	0
			3122	1956	544	613	9			
1	D	424	Total	C	N	O	S	0	1	0
			3138	1965	549	615	9			

There are 44 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	24	MET	-	initiating methionine	UNP Q9HWK6
A	409	ALA	SER	engineered mutation	UNP Q9HWK6
A	463	GLU	-	expression tag	UNP Q9HWK6
A	464	HIS	-	expression tag	UNP Q9HWK6
A	465	HIS	-	expression tag	UNP Q9HWK6
A	466	HIS	-	expression tag	UNP Q9HWK6
A	467	HIS	-	expression tag	UNP Q9HWK6
A	468	HIS	-	expression tag	UNP Q9HWK6
A	469	HIS	-	expression tag	UNP Q9HWK6
A	470	HIS	-	expression tag	UNP Q9HWK6
A	471	HIS	-	expression tag	UNP Q9HWK6
B	24	MET	-	initiating methionine	UNP Q9HWK6
B	409	ALA	SER	engineered mutation	UNP Q9HWK6
B	463	GLU	-	expression tag	UNP Q9HWK6
B	464	HIS	-	expression tag	UNP Q9HWK6
B	465	HIS	-	expression tag	UNP Q9HWK6
B	466	HIS	-	expression tag	UNP Q9HWK6
B	467	HIS	-	expression tag	UNP Q9HWK6
B	468	HIS	-	expression tag	UNP Q9HWK6
B	469	HIS	-	expression tag	UNP Q9HWK6
B	470	HIS	-	expression tag	UNP Q9HWK6

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Chain	Residue	Modelled	Actual	Comment	Reference
B	471	HIS	-	expression tag	UNP Q9HWK6
C	24	MET	-	initiating methionine	UNP Q9HWK6
C	409	ALA	SER	engineered mutation	UNP Q9HWK6
C	463	GLU	-	expression tag	UNP Q9HWK6
C	464	HIS	-	expression tag	UNP Q9HWK6
C	465	HIS	-	expression tag	UNP Q9HWK6
C	466	HIS	-	expression tag	UNP Q9HWK6
C	467	HIS	-	expression tag	UNP Q9HWK6
C	468	HIS	-	expression tag	UNP Q9HWK6
C	469	HIS	-	expression tag	UNP Q9HWK6
C	470	HIS	-	expression tag	UNP Q9HWK6
C	471	HIS	-	expression tag	UNP Q9HWK6
D	24	MET	-	initiating methionine	UNP Q9HWK6
D	409	ALA	SER	engineered mutation	UNP Q9HWK6
D	463	GLU	-	expression tag	UNP Q9HWK6
D	464	HIS	-	expression tag	UNP Q9HWK6
D	465	HIS	-	expression tag	UNP Q9HWK6
D	466	HIS	-	expression tag	UNP Q9HWK6
D	467	HIS	-	expression tag	UNP Q9HWK6
D	468	HIS	-	expression tag	UNP Q9HWK6
D	469	HIS	-	expression tag	UNP Q9HWK6
D	470	HIS	-	expression tag	UNP Q9HWK6
D	471	HIS	-	expression tag	UNP Q9HWK6

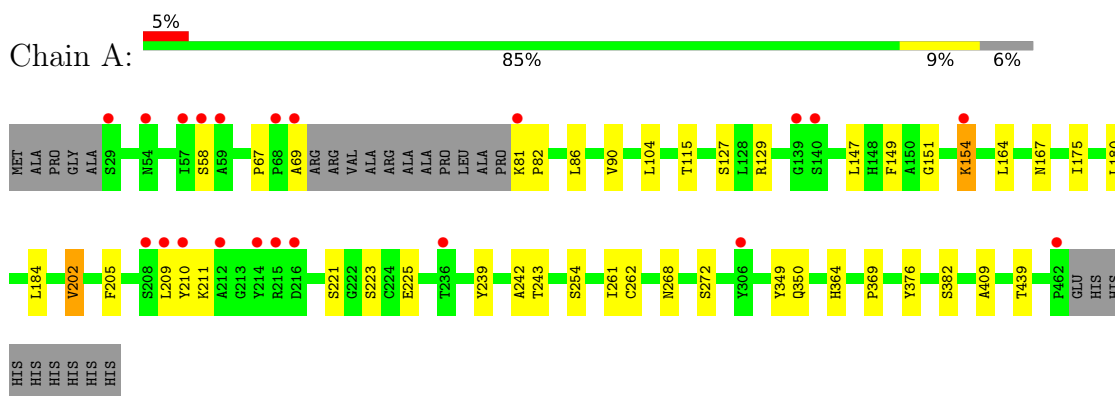
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	98	Total O 98 98	0	0
2	B	143	Total O 143 143	0	0
2	C	101	Total O 101 101	0	0
2	D	157	Total O 157 157	0	0

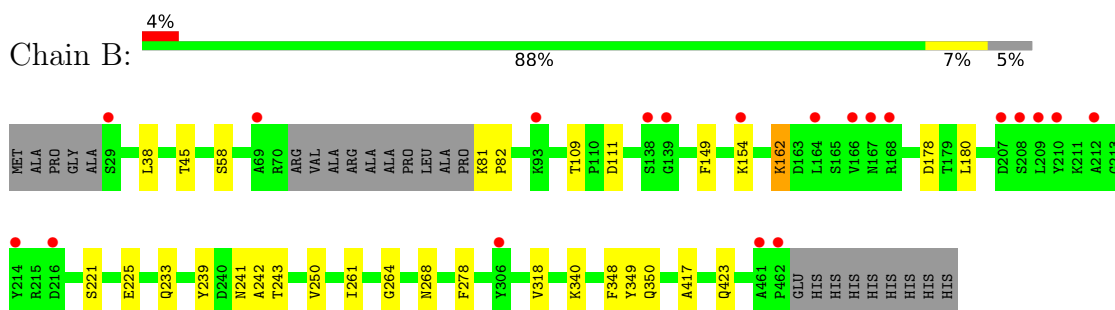
3 Residue-property plots

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.

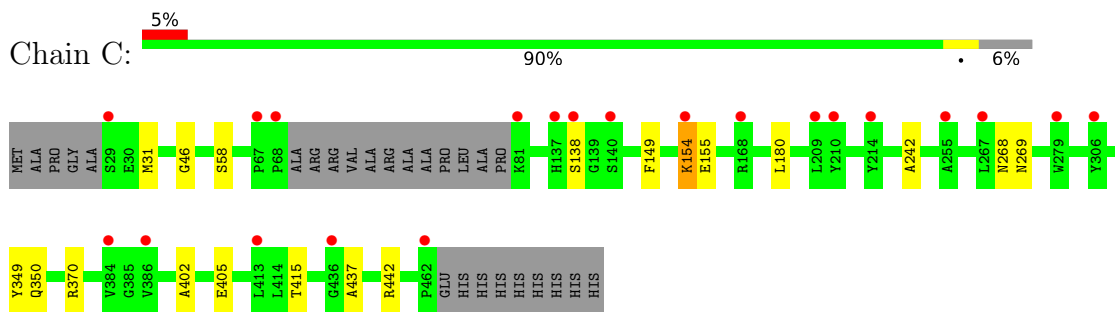
• Molecule 1: Lysyl endopeptidase



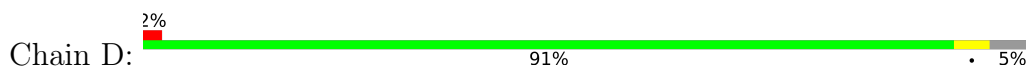
• Molecule 1: Lysyl endopeptidase

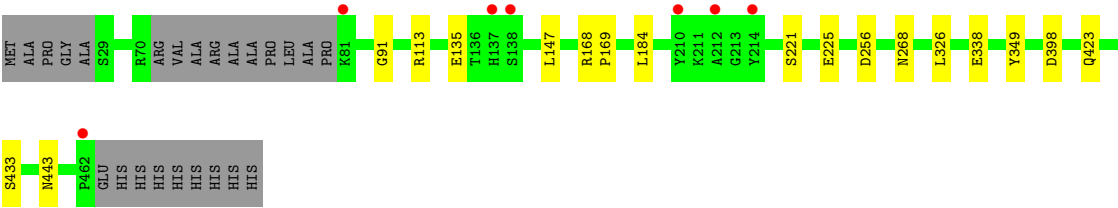


• Molecule 1: Lysyl endopeptidase



• Molecule 1: Lysyl endopeptidase





4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	127.65Å 209.33Å 154.08Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	77.04 – 2.17 77.04 – 2.17	Depositor EDS
% Data completeness (in resolution range)	99.1 (77.04-2.17) 99.1 (77.04-2.17)	Depositor EDS
R_{merge}	0.16	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.39 (at 2.16Å)	Xtriage
Refinement program	PHENIX (1.14_3260: ???)	Depositor
R, R_{free}	0.180 , 0.201 0.184 , 0.205	Depositor DCC
R_{free} test set	2059 reflections (1.90%)	wwPDB-VP
Wilson B-factor (Å ²)	44.7	Xtriage
Anisotropy	0.198	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 55.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.000 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.010 for 1/2*h+1/2*k,3/2*h-1/2*k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	13024	wwPDB-VP
Average B, all atoms (Å ²)	60.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.65% 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 [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	0.30	0/3206	0.52	0/4376
1	B	0.31	0/3217	0.54	0/4390
1	C	0.30	0/3201	0.53	0/4369
1	D	0.33	0/3217	0.55	0/4390
All	All	0.31	0/12841	0.53	0/17525

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	3127	0	3000	25	0
1	B	3138	0	3013	22	0
1	C	3122	0	2995	14	0
1	D	3138	0	3013	12	0
2	A	98	0	0	7	0
2	B	143	0	0	2	0
2	C	101	0	0	4	0
2	D	157	0	0	3	0
All	All	13024	0	12021	68	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 (68) 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:221:SER:HB3	1:A:225:GLU:HG3	1.62	0.81
1:A:225:GLU:OE1	2:A:501:HOH:O	2.05	0.74
1:B:154:LYS:HB3	1:C:154:LYS:HG2	1.69	0.73
1:D:113:ARG:NH1	2:D:501:HOH:O	1.98	0.73
1:C:415:THR:OG1	2:C:501:HOH:O	2.08	0.70
1:A:154:LYS:NZ	1:A:210:TYR:OH	2.24	0.69
1:A:223:SER:O	2:A:502:HOH:O	2.09	0.69
1:A:167:ASN:HB2	2:A:510:HOH:O	1.93	0.68
1:C:58:SER:HB3	2:C:546:HOH:O	1.92	0.68
1:B:178:ASP:OD2	2:B:501:HOH:O	2.13	0.66
1:A:350:GLN:OE1	2:A:503:HOH:O	2.14	0.65
1:A:382:SER:HA	1:B:38:LEU:HD22	1.78	0.65
1:A:439:THR:O	2:A:504:HOH:O	2.15	0.64
1:C:349:TYR:OH	2:C:502:HOH:O	2.13	0.64
1:B:81:LYS:HB3	1:B:82:PRO:HD2	1.82	0.61
1:D:423:GLN:NE2	2:D:503:HOH:O	2.31	0.58
1:B:221:SER:HB2	1:B:225:GLU:HG3	1.87	0.57
1:A:127:SER:HB2	1:A:205:PHE:HB2	1.86	0.56
1:C:268:ASN:HA	1:C:349:TYR:HB3	1.88	0.55
1:B:250:VAL:HG22	1:B:261:ILE:HG22	1.89	0.54
1:B:154:LYS:HZ2	1:C:155:GLU:HA	1.72	0.54
1:B:417:ALA:HB2	1:B:423:GLN:NE2	2.24	0.53
1:C:402:ALA:N	2:C:506:HOH:O	2.42	0.52
1:D:433:SER:O	2:D:502:HOH:O	2.19	0.52
1:D:268:ASN:HA	1:D:349:TYR:HB3	1.93	0.51
1:D:221:SER:HB2	1:D:225:GLU:HG3	1.94	0.49
1:B:154:LYS:NZ	1:C:155:GLU:HA	2.27	0.48
1:B:239:TYR:O	1:B:243:THR:HG23	2.13	0.48
1:A:67:PRO:O	1:A:69:ALA:N	2.35	0.47
1:B:268:ASN:HA	1:B:349:TYR:HB3	1.95	0.47
1:D:147:LEU:HD23	1:D:184:LEU:HA	1.98	0.46
1:A:268:ASN:HA	1:A:349:TYR:HB3	1.98	0.46
1:A:147:LEU:HD13	1:A:164:LEU:HD11	1.99	0.45
1:A:115:THR:HA	1:A:184:LEU:O	2.16	0.45
1:B:109:THR:OG1	1:B:111:ASP:OD1	2.28	0.45
1:A:149:PHE:HB3	1:A:180:LEU:HD11	1.99	0.45
1:A:129:ARG:O	1:A:202:VAL:HG22	2.17	0.44
1:A:239:TYR:O	1:A:243:THR:HG23	2.16	0.44
1:A:221:SER:OG	1:A:369:PRO:HG2	2.18	0.44
1:B:264:GLY:HA3	1:B:278:PHE:CZ	2.52	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:31:MET:HE1	1:C:269:ASN:C	2.42	0.44
1:C:437:ALA:O	1:C:442:ARG:NH1	2.46	0.44
1:B:81:LYS:HA	1:B:81:LYS:HD2	1.77	0.43
1:D:168:ARG:HA	1:D:169:PRO:HA	1.77	0.43
1:A:81:LYS:N	2:A:520:HOH:O	2.50	0.43
1:B:162:LYS:HB3	1:B:162:LYS:HE3	1.82	0.43
1:B:242:ALA:HA	1:B:350:GLN:OE1	2.18	0.43
1:A:209:LEU:HD23	1:A:209:LEU:HA	1.85	0.43
1:D:91:GLY:HA3	1:D:256:ASP:O	2.20	0.42
1:D:135:GLU:OE2	1:D:168:ARG:NH1	2.52	0.42
1:D:147:LEU:HD21	1:D:184:LEU:HD13	2.01	0.42
1:A:242:ALA:HA	1:A:350:GLN:OE1	2.20	0.42
1:D:326:LEU:HD11	1:D:338:GLU:HB2	2.02	0.42
1:D:398:ASP:OD1	1:D:443:ASN:HB3	2.20	0.42
1:A:82:PRO:HA	2:A:507:HOH:O	2.18	0.41
1:C:242:ALA:HA	1:C:350:GLN:OE1	2.19	0.41
1:A:151:GLY:HA3	1:A:175:ILE:HB	2.00	0.41
1:A:364:HIS:HB3	1:A:376:TYR:HE1	1.85	0.41
1:A:262[B]:CYS:HB2	1:A:409:ALA:O	2.21	0.41
1:B:154:LYS:NZ	1:C:46:GLY:O	2.54	0.41
1:B:340:LYS:NZ	2:B:518:HOH:O	2.54	0.41
1:C:149:PHE:HB3	1:C:180:LEU:HD11	2.03	0.41
1:B:154:LYS:O	1:B:154:LYS:HG3	2.20	0.41
1:C:268:ASN:CA	1:C:349:TYR:HB3	2.49	0.41
1:A:86:LEU:HD23	1:A:261:ILE:HD11	2.03	0.40
1:B:45:THR:HA	1:B:318:VAL:O	2.21	0.40
1:B:241:ASN:HB3	1:B:348:PHE:CG	2.57	0.40
1:B:149:PHE:HB3	1:B:180:LEU:HD11	2.02	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	420/448 (94%)	407 (97%)	13 (3%)	0	100	100
1	B	421/448 (94%)	408 (97%)	13 (3%)	0	100	100
1	C	419/448 (94%)	408 (97%)	11 (3%)	0	100	100
1	D	421/448 (94%)	408 (97%)	13 (3%)	0	100	100
All	All	1681/1792 (94%)	1631 (97%)	50 (3%)	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	323/340 (95%)	315 (98%)	8 (2%)	42	53
1	B	324/340 (95%)	321 (99%)	3 (1%)	70	81
1	C	323/340 (95%)	319 (99%)	4 (1%)	63	75
1	D	324/340 (95%)	324 (100%)	0	100	100
All	All	1294/1360 (95%)	1279 (99%)	15 (1%)	63	75

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	58	SER
1	A	90	VAL
1	A	104	LEU
1	A	154	LYS
1	A	202	VAL
1	A	211	LYS
1	A	254	SER
1	A	272	SER
1	B	58	SER
1	B	162	LYS
1	B	233	GLN
1	C	138	SER
1	C	154	LYS

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Mol	Chain	Res	Type
1	C	370	ARG
1	C	405	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	324	ASN
1	B	39	GLN
1	B	191	GLN
1	B	378	GLN
1	C	380	ASN
1	D	191	GLN
1	D	441	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

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, 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	423/448 (94%)	0.35	21 (4%) 34 33	32, 60, 96, 118	1 (0%)
1	B	424/448 (94%)	0.13	20 (4%) 36 35	29, 52, 82, 111	1 (0%)
1	C	422/448 (94%)	0.43	21 (4%) 34 33	39, 63, 98, 115	1 (0%)
1	D	424/448 (94%)	-0.02	7 (1%) 69 68	31, 51, 80, 102	1 (0%)
All	All	1693/1792 (94%)	0.22	69 (4%) 41 41	29, 57, 93, 118	4 (0%)

All (69) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	210	TYR	5.3
1	C	68	PRO	5.3
1	C	210	TYR	5.0
1	A	210	TYR	4.7
1	B	29	SER	4.5
1	D	210	TYR	4.5
1	A	209	LEU	4.5
1	A	69	ALA	4.3
1	B	154	LYS	4.0
1	B	214	TYR	3.9
1	B	167	ASN	3.9
1	C	462	PRO	3.9
1	C	279	TRP	3.8
1	B	209	LEU	3.8
1	A	212	ALA	3.8
1	C	154	LYS	3.8
1	B	166	VAL	3.7
1	A	81	LYS	3.6
1	B	69	ALA	3.4
1	A	57	ILE	3.4
1	C	209	LEU	3.4

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Mol	Chain	Res	Type	RSRZ
1	A	140	SER	3.3
1	A	462	PRO	3.2
1	B	462	PRO	3.2
1	C	413	LEU	3.1
1	A	214	TYR	3.1
1	D	462	PRO	3.1
1	A	29	SER	3.1
1	A	216	ASP	3.0
1	D	138	SER	3.0
1	A	208	SER	3.0
1	B	208	SER	2.9
1	C	137	HIS	2.9
1	B	168	ARG	2.9
1	A	68	PRO	2.9
1	C	138	SER	2.7
1	B	212	ALA	2.7
1	A	58	SER	2.7
1	C	29	SER	2.7
1	B	461	ALA	2.7
1	C	214	TYR	2.7
1	A	59	ALA	2.6
1	C	306	TYR	2.6
1	C	67	PRO	2.6
1	A	54	ASN	2.5
1	A	139	GLY	2.4
1	B	139	GLY	2.4
1	B	207	ASP	2.3
1	C	81	LYS	2.3
1	C	384	VAL	2.3
1	B	216	ASP	2.3
1	D	81	LYS	2.2
1	C	140	SER	2.2
1	A	236	THR	2.2
1	C	386	VAL	2.1
1	B	164	LEU	2.1
1	A	215	ARG	2.1
1	C	255	ALA	2.1
1	B	306	TYR	2.1
1	D	137	HIS	2.1
1	C	168	ARG	2.1
1	A	154	LYS	2.1
1	B	93	LYS	2.1

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Mol	Chain	Res	Type	RSRZ
1	D	212	ALA	2.1
1	A	306	TYR	2.1
1	B	138	SER	2.1
1	C	436	GLY	2.0
1	C	267	LEU	2.0
1	D	214	TYR	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.