



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 02:25 PM EDT

PDB ID : 5JK2 / pdb_00005jk2
Title : Crystal structure of Treponema pallidum Tp0751 (Pallilysin)
Authors : Parker, M.L.; Boulanger, M.J.
Deposited on : 2016-04-25
Resolution : 2.15 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

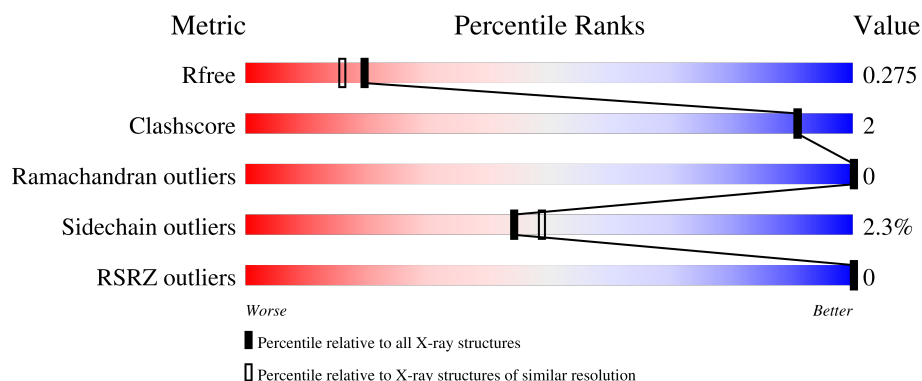
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (2.16-2.16)

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	167	
1	B	167	
1	C	167	
1	D	167	
1	E	167	

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Mol	Chain	Length	Quality of chain
1	F	167	 69% 26%
1	G	167	 68% 30%
1	H	167	 64% 7% 29%
1	I	167	 66% 31%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 9171 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 Tp0751.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	128	Total	C	N	O	S	0	0	0
			1039	656	196	185	2			
1	B	125	Total	C	N	O	S	0	0	0
			1016	642	193	179	2			
1	C	122	Total	C	N	O	S	0	0	0
			994	627	189	176	2			
1	D	128	Total	C	N	O	S	0	0	0
			1034	653	196	183	2			
1	E	128	Total	C	N	O	S	0	0	0
			1029	650	195	182	2			
1	F	123	Total	C	N	O	S	0	0	0
			1003	636	190	175	2			
1	G	117	Total	C	N	O	S	0	0	0
			950	602	179	167	2			
1	H	119	Total	C	N	O	S	0	0	0
			969	612	182	173	2			
1	I	116	Total	C	N	O	S	0	0	0
			949	602	179	166	2			

There are 72 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	74	GLY	-	expression tag	UNP O83732
A	75	SER	-	expression tag	UNP O83732
A	76	MET	-	expression tag	UNP O83732
A	77	ALA	-	expression tag	UNP O83732
A	199	ALA	GLU	engineered mutation	UNP O83732
A	238	ALA	-	expression tag	UNP O83732
A	239	ALA	-	expression tag	UNP O83732
A	240	ALA	-	expression tag	UNP O83732
B	74	GLY	-	expression tag	UNP O83732
B	75	SER	-	expression tag	UNP O83732
B	76	MET	-	expression tag	UNP O83732

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Chain	Residue	Modelled	Actual	Comment	Reference
B	77	ALA	-	expression tag	UNP 083732
B	199	ALA	GLU	engineered mutation	UNP 083732
B	238	ALA	-	expression tag	UNP 083732
B	239	ALA	-	expression tag	UNP 083732
B	240	ALA	-	expression tag	UNP 083732
C	74	GLY	-	expression tag	UNP 083732
C	75	SER	-	expression tag	UNP 083732
C	76	MET	-	expression tag	UNP 083732
C	77	ALA	-	expression tag	UNP 083732
C	199	ALA	GLU	engineered mutation	UNP 083732
C	238	ALA	-	expression tag	UNP 083732
C	239	ALA	-	expression tag	UNP 083732
C	240	ALA	-	expression tag	UNP 083732
D	74	GLY	-	expression tag	UNP 083732
D	75	SER	-	expression tag	UNP 083732
D	76	MET	-	expression tag	UNP 083732
D	77	ALA	-	expression tag	UNP 083732
D	199	ALA	GLU	engineered mutation	UNP 083732
D	238	ALA	-	expression tag	UNP 083732
D	239	ALA	-	expression tag	UNP 083732
D	240	ALA	-	expression tag	UNP 083732
E	74	GLY	-	expression tag	UNP 083732
E	75	SER	-	expression tag	UNP 083732
E	76	MET	-	expression tag	UNP 083732
E	77	ALA	-	expression tag	UNP 083732
E	199	ALA	GLU	engineered mutation	UNP 083732
E	238	ALA	-	expression tag	UNP 083732
E	239	ALA	-	expression tag	UNP 083732
E	240	ALA	-	expression tag	UNP 083732
F	74	GLY	-	expression tag	UNP 083732
F	75	SER	-	expression tag	UNP 083732
F	76	MET	-	expression tag	UNP 083732
F	77	ALA	-	expression tag	UNP 083732
F	199	ALA	GLU	engineered mutation	UNP 083732
F	238	ALA	-	expression tag	UNP 083732
F	239	ALA	-	expression tag	UNP 083732
F	240	ALA	-	expression tag	UNP 083732
G	74	GLY	-	expression tag	UNP 083732
G	75	SER	-	expression tag	UNP 083732
G	76	MET	-	expression tag	UNP 083732
G	77	ALA	-	expression tag	UNP 083732
G	199	ALA	GLU	engineered mutation	UNP 083732

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Chain	Residue	Modelled	Actual	Comment	Reference
G	238	ALA	-	expression tag	UNP O83732
G	239	ALA	-	expression tag	UNP O83732
G	240	ALA	-	expression tag	UNP O83732
H	74	GLY	-	expression tag	UNP O83732
H	75	SER	-	expression tag	UNP O83732
H	76	MET	-	expression tag	UNP O83732
H	77	ALA	-	expression tag	UNP O83732
H	199	ALA	GLU	engineered mutation	UNP O83732
H	238	ALA	-	expression tag	UNP O83732
H	239	ALA	-	expression tag	UNP O83732
H	240	ALA	-	expression tag	UNP O83732
I	74	GLY	-	expression tag	UNP O83732
I	75	SER	-	expression tag	UNP O83732
I	76	MET	-	expression tag	UNP O83732
I	77	ALA	-	expression tag	UNP O83732
I	199	ALA	GLU	engineered mutation	UNP O83732
I	238	ALA	-	expression tag	UNP O83732
I	239	ALA	-	expression tag	UNP O83732
I	240	ALA	-	expression tag	UNP O83732

- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	26	Total O 26 26	0	0
2	B	22	Total O 22 22	0	0
2	C	34	Total O 34 34	0	0
2	D	15	Total O 15 15	0	0
2	E	19	Total O 19 19	0	0
2	F	20	Total O 20 20	0	0
2	G	22	Total O 22 22	0	0
2	H	12	Total O 12 12	0	0
2	I	18	Total O 18 18	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.

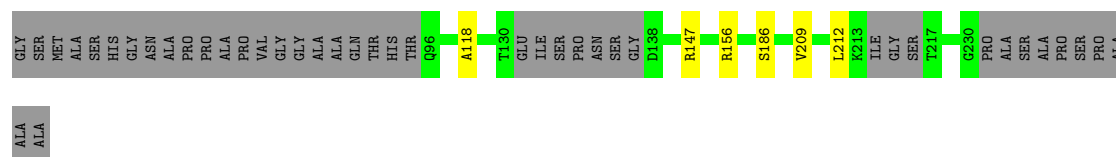
• Molecule 1: Tp0751

Chain A: 



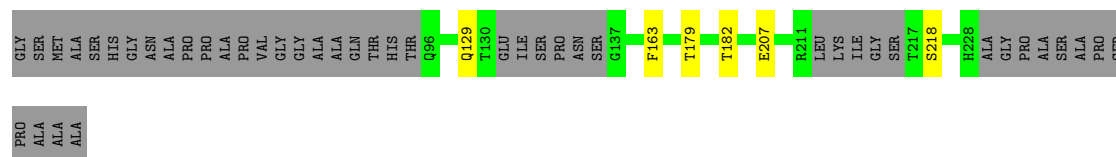
• Molecule 1: Tp0751

Chain B: 



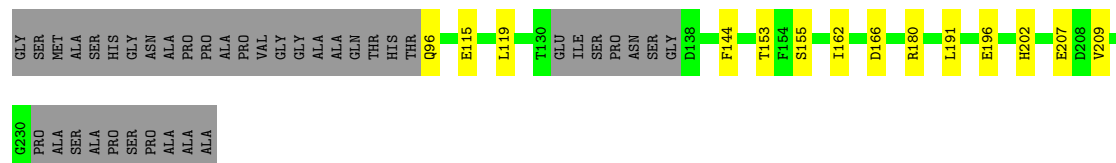
• Molecule 1: Tp0751

Chain C: 



• Molecule 1: Tp0751

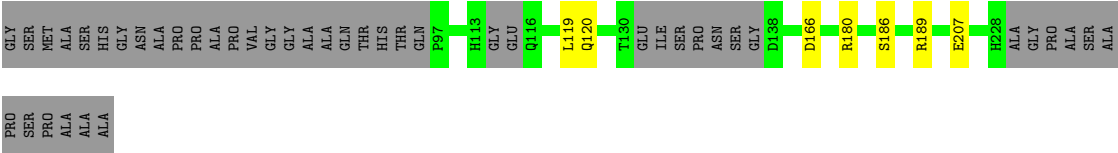
Chain D: 



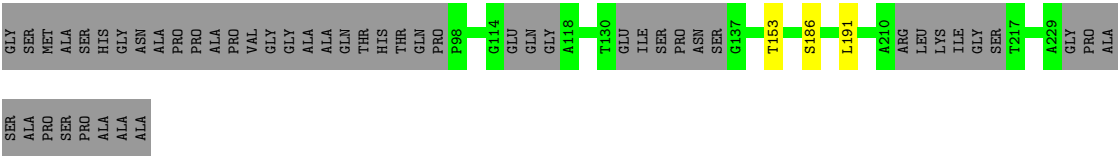
• Molecule 1: Tp0751



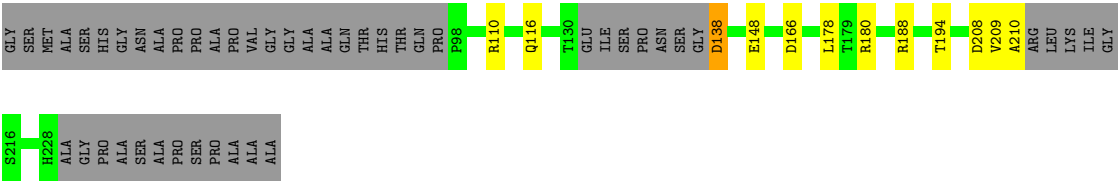
• Molecule 1: Tp0751



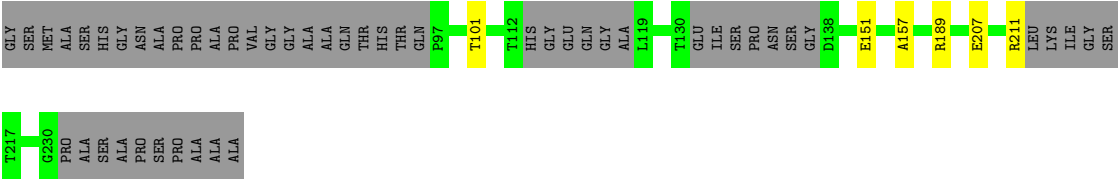
• Molecule 1: Tp0751



• Molecule 1: Tp0751



• Molecule 1: Tp0751



4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	144.72Å 144.72Å 152.61Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	65.38 – 2.15 65.38 – 2.15	Depositor EDS
% Data completeness (in resolution range)	99.9 (65.38-2.15) 99.2 (65.38-2.15)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.02 (at 2.14Å)	Xtriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.239 , 0.276 0.241 , 0.275	Depositor DCC
R_{free} test set	4990 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	36.5	Xtriage
Anisotropy	0.059	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 44.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.33$, $\langle L^2 \rangle = 0.16$	Xtriage
Estimated twinning fraction	0.417 for -h,-k,l	Xtriage
Reported twinning fraction	0.440 for -h,-k,l	Depositor
Outliers	0 of 100350 reflections	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	9171	wwPDB-VP
Average B, all atoms (Å ²)	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 28.55 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.8080e-03.*

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	0.33	0/1063	0.67	0/1441
1	B	0.29	0/1039	0.67	0/1407
1	C	0.30	0/1017	0.65	0/1378
1	D	0.31	0/1058	0.67	1/1434 (0.1%)
1	E	0.29	0/1053	0.67	1/1426 (0.1%)
1	F	0.27	0/1026	0.65	1/1389 (0.1%)
1	G	0.29	0/971	0.61	0/1314
1	H	0.29	0/991	0.63	0/1342
1	I	0.28	0/970	0.60	0/1313
All	All	0.30	0/9188	0.65	3/12444 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	F	119	LEU	N-CA-C	-5.35	106.26	112.89
1	E	119	LEU	N-CA-C	-5.30	106.32	112.89
1	D	119	LEU	N-CA-C	-5.21	106.43	112.89

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	1039	0	1023	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	1016	0	1000	5	0
1	C	994	0	971	4	0
1	D	1034	0	1020	5	1
1	E	1029	0	1016	2	0
1	F	1003	0	995	3	1
1	G	950	0	931	1	0
1	H	969	0	946	6	0
1	I	949	0	936	3	0
2	A	26	0	0	0	0
2	B	22	0	0	3	0
2	C	34	0	0	2	0
2	D	15	0	0	1	0
2	E	19	0	0	1	0
2	F	20	0	0	1	0
2	G	22	0	0	1	0
2	H	12	0	0	0	0
2	I	18	0	0	2	0
All	All	9171	0	8838	30	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 2.

All (30) 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:H:138:ASP:OD2	1:H:138:ASP:N	2.27	0.68
1:E:166:ASP:OD1	1:E:180:ARG:NH1	2.27	0.66
1:I:211:ARG:NH1	2:I:303:HOH:O	2.32	0.63
1:F:166:ASP:OD1	1:F:180:ARG:NH1	2.32	0.62
1:C:129:GLN:O	2:C:301:HOH:O	2.16	0.60
1:D:196:GLU:OE2	1:D:202:HIS:NE2	2.32	0.55
1:G:186:SER:OG	2:G:301:HOH:O	2.17	0.55
1:F:120:GLN:OE1	2:F:301:HOH:O	2.19	0.53
1:D:96:GLN:N	2:D:302:HOH:O	2.43	0.52
1:D:209:VAL:O	1:D:209:VAL:HG13	2.10	0.51
1:A:189:ARG:NE	1:A:207:GLU:OE1	2.35	0.50
1:I:189:ARG:NE	1:I:207:GLU:OE1	2.44	0.49
1:C:182:THR:O	2:C:302:HOH:O	2.20	0.48
1:D:144:PHE:HB3	1:D:153:THR:HB	1.96	0.48
1:H:166:ASP:OD1	1:H:180:ARG:NH1	2.46	0.48
1:B:147:ARG:N	2:B:305:HOH:O	2.39	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:118:ALA:O	2:B:301:HOH:O	2.20	0.47
1:D:166:ASP:OD1	1:D:180:ARG:NH1	2.47	0.46
1:H:188:ARG:O	1:H:208:ASP:N	2.45	0.46
1:B:209:VAL:O	1:B:209:VAL:HG13	2.17	0.45
1:B:156:ARG:NH2	2:B:307:HOH:O	2.51	0.44
1:C:163:PHE:HB3	1:C:179:THR:HB	2.02	0.42
1:I:157:ALA:O	2:I:301:HOH:O	2.21	0.42
1:H:209:VAL:O	1:H:210:ALA:HB3	2.19	0.41
1:H:209:VAL:O	1:H:209:VAL:HG13	2.19	0.41
1:A:130:THR:O	1:A:131:GLU:HB3	2.20	0.41
1:E:118:ALA:O	2:E:301:HOH:O	2.22	0.41
1:B:186:SER:OG	1:C:207:GLU:OE2	2.22	0.41
1:H:110:ARG:NE	1:H:116:GLN:OE1	2.48	0.41
1:F:189:ARG:NH2	1:F:207:GLU:OE1	2.49	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:D:207:GLU:OE2	1:F:186:SER:OG[4_545]	2.13	0.07

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	124/167 (74%)	114 (92%)	10 (8%)	0	100	100
1	B	119/167 (71%)	111 (93%)	8 (7%)	0	100	100
1	C	116/167 (70%)	108 (93%)	8 (7%)	0	100	100
1	D	124/167 (74%)	114 (92%)	10 (8%)	0	100	100
1	E	124/167 (74%)	115 (93%)	9 (7%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	F	117/167 (70%)	113 (97%)	4 (3%)	0	100	100
1	G	109/167 (65%)	99 (91%)	10 (9%)	0	100	100
1	H	113/167 (68%)	107 (95%)	6 (5%)	0	100	100
1	I	108/167 (65%)	103 (95%)	5 (5%)	0	100	100
All	All	1054/1503 (70%)	984 (93%)	70 (7%)	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	110/133 (83%)	106 (96%)	4 (4%)	31	31
1	B	107/133 (80%)	106 (99%)	1 (1%)	70	77
1	C	105/133 (79%)	104 (99%)	1 (1%)	68	75
1	D	109/133 (82%)	105 (96%)	4 (4%)	30	30
1	E	108/133 (81%)	104 (96%)	4 (4%)	30	30
1	F	107/133 (80%)	107 (100%)	0	100	100
1	G	100/133 (75%)	98 (98%)	2 (2%)	48	54
1	H	103/133 (77%)	99 (96%)	4 (4%)	28	28
1	I	101/133 (76%)	99 (98%)	2 (2%)	48	54
All	All	950/1197 (79%)	928 (98%)	22 (2%)	44	49

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	115	GLU
1	A	164	LEU
1	A	191	LEU
1	A	211	ARG
1	B	212	LEU

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Mol	Chain	Res	Type
1	C	218	SER
1	D	115	GLU
1	D	155	SER
1	D	162	ILE
1	D	191	LEU
1	E	115	GLU
1	E	153	THR
1	E	180	ARG
1	E	191	LEU
1	G	153	THR
1	G	191	LEU
1	H	138	ASP
1	H	148	GLU
1	H	178	LEU
1	H	194	THR
1	I	101	THR
1	I	151	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	96	GLN
1	B	129	GLN
1	B	228	HIS
1	D	96	GLN
1	D	129	GLN
1	D	198	HIS
1	G	109	ASN
1	G	169	HIS
1	G	198	HIS
1	I	120	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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, 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	128/167 (76%)	-0.68	0 100 100	21, 35, 65, 75	0
1	B	125/167 (74%)	-0.54	0 100 100	22, 40, 64, 77	0
1	C	122/167 (73%)	-0.65	0 100 100	20, 37, 61, 67	0
1	D	128/167 (76%)	-0.53	0 100 100	24, 41, 71, 77	0
1	E	128/167 (76%)	-0.63	0 100 100	21, 40, 65, 76	0
1	F	123/167 (73%)	-0.54	0 100 100	26, 44, 64, 81	0
1	G	117/167 (70%)	-0.24	0 100 100	29, 49, 74, 88	0
1	H	119/167 (71%)	-0.50	0 100 100	23, 47, 76, 87	0
1	I	116/167 (69%)	-0.27	0 100 100	30, 50, 74, 98	0
All	All	1106/1503 (73%)	-0.51	0 100 100	20, 42, 71, 98	0

There are no RSRZ outliers to report.

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.