wwPDB X-ray Structure Validation Summary Report (i)

Oct 22, 2026 – 10:08 AM JST

PDB ID	:	26TQ / pdb_000026tq
Title	:	Crystal structure of the Pseudomonas aeruginosa MlaC-MlaD complex in space group P41212
Authors	:	Ozu, S.; Matsumoto, D.; Watanabe, Y.
Deposited on	:	2026-05-14
Resolution	:	3.46 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 (i) 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 (1)) were used in the production of this report:

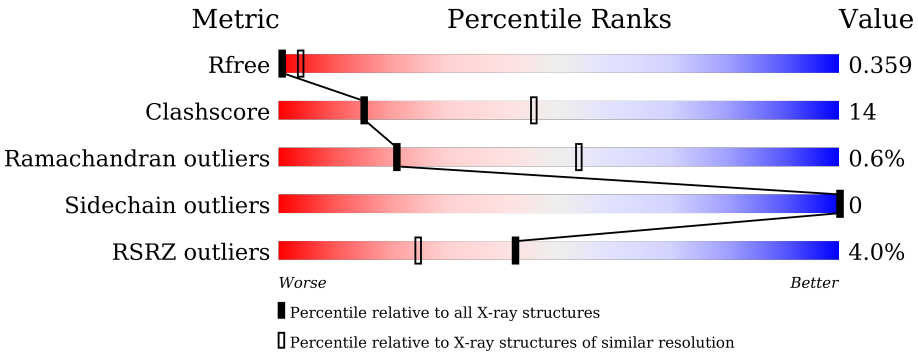
MolProbity	:	4-5-2 with Phenix2.2
Xtriage (Phenix)	:	2.2
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.51

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 3.46 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	1070 (3.50-3.42)
Clashscore	190562	1128 (3.50-3.42)
Ramachandran outliers	187476	1101 (3.50-3.42)
Sidechain outliers	187428	1102 (3.50-3.42)
RSRZ outliers	180081	1070 (3.50-3.42)

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 <=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	129	2% 60% 28% 12%
1	B	129	4% 55% 33% 12%
1	C	129	% 46% 40% 14%
1	D	129	2% 56% 30% • 12%
1	E	129	4% 64% 25% 11%
1	F	129	4% 65% 21% 14%

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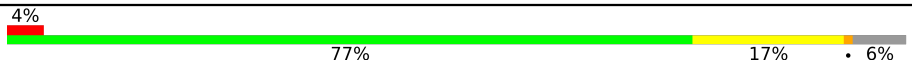
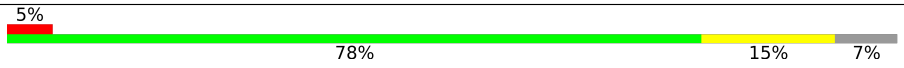
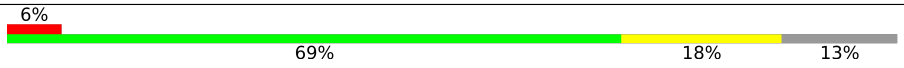
Mol	Chain	Length	Quality of chain
2	G	197	
2	H	197	
2	I	197	

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 8451 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 Mce/MlaD domain-containing protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	114	Total	C	N	O	S	0	0	0
			803	503	129	170	1			
1	B	114	Total	C	N	O	S	0	0	0
			778	491	124	162	1			
1	C	111	Total	C	N	O	S	0	0	0
			813	509	133	170	1			
1	D	113	Total	C	N	O		0	0	0
			792	497	125	170				
1	E	115	Total	C	N	O		0	0	0
			771	478	126	167				
1	F	111	Total	C	N	O	S	0	0	0
			775	489	126	159	1			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	29	GLY	-	expression tag	UNP Q9HVW3
A	30	PRO	-	expression tag	UNP Q9HVW3
B	29	GLY	-	expression tag	UNP Q9HVW3
B	30	PRO	-	expression tag	UNP Q9HVW3
C	29	GLY	-	expression tag	UNP Q9HVW3
C	30	PRO	-	expression tag	UNP Q9HVW3
D	29	GLY	-	expression tag	UNP Q9HVW3
D	30	PRO	-	expression tag	UNP Q9HVW3
E	29	GLY	-	expression tag	UNP Q9HVW3
E	30	PRO	-	expression tag	UNP Q9HVW3
F	29	GLY	-	expression tag	UNP Q9HVW3
F	30	PRO	-	expression tag	UNP Q9HVW3

- Molecule 2 is a protein called Toluene tolerance protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	G	186	Total	C	N	O	S	0	0	0
			1335	838	227	265	5			
2	H	183	Total	C	N	O	S	0	0	0
			1226	765	211	247	3			
2	I	172	Total	C	N	O	S	0	0	0
			1158	730	198	227	3			

There are 12 discrepancies between the modelled and reference sequences:

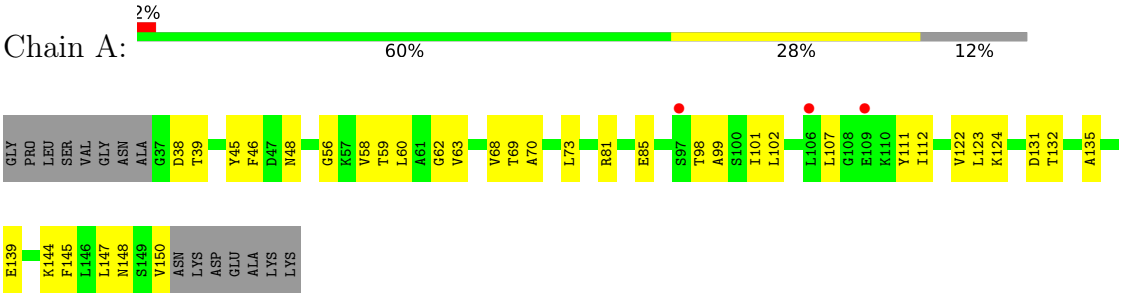
Chain	Residue	Modelled	Actual	Comment	Reference
G	19	GLY	-	expression tag	UNP Q9HVW4
G	20	PRO	-	expression tag	UNP Q9HVW4
G	21	HIS	-	expression tag	UNP Q9HVW4
G	22	MET	-	expression tag	UNP Q9HVW4
H	19	GLY	-	expression tag	UNP Q9HVW4
H	20	PRO	-	expression tag	UNP Q9HVW4
H	21	HIS	-	expression tag	UNP Q9HVW4
H	22	MET	-	expression tag	UNP Q9HVW4
I	19	GLY	-	expression tag	UNP Q9HVW4
I	20	PRO	-	expression tag	UNP Q9HVW4
I	21	HIS	-	expression tag	UNP Q9HVW4
I	22	MET	-	expression tag	UNP Q9HVW4

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.

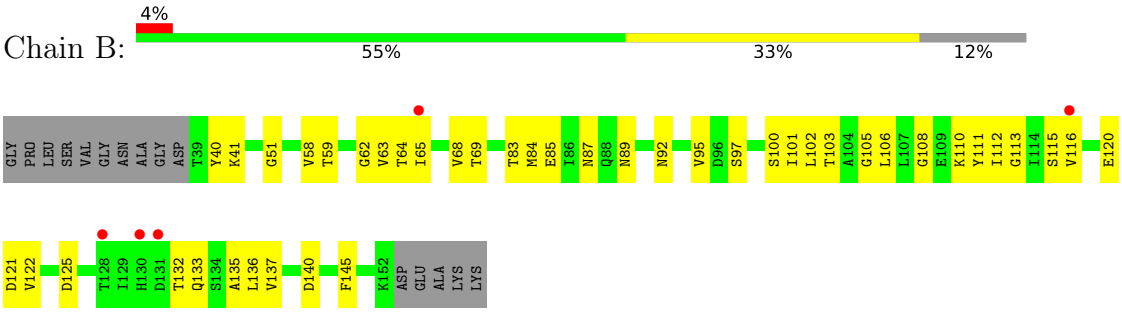
• Molecule 1: Mce/MlaD domain-containing protein

Chain A:



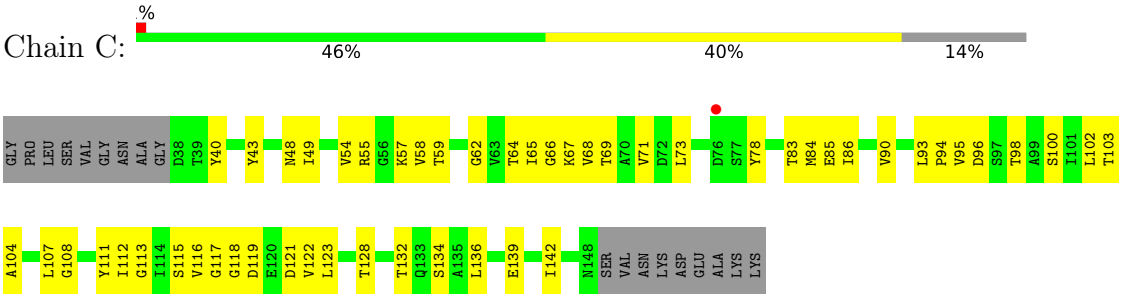
• Molecule 1: Mce/MlaD domain-containing protein

Chain B:



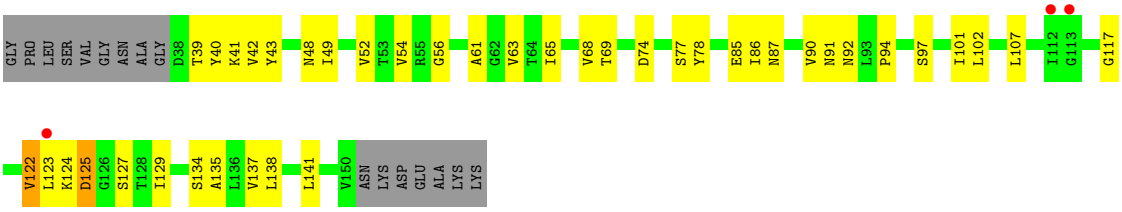
• Molecule 1: Mce/MlaD domain-containing protein

Chain C:

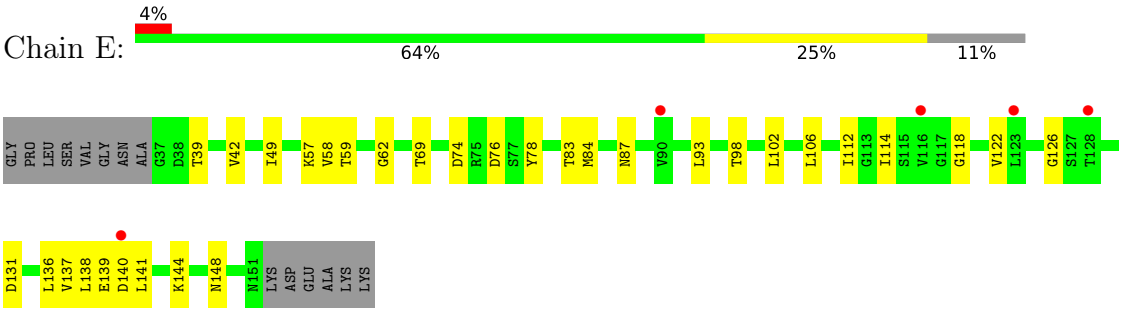


• Molecule 1: Mce/MlaD domain-containing protein

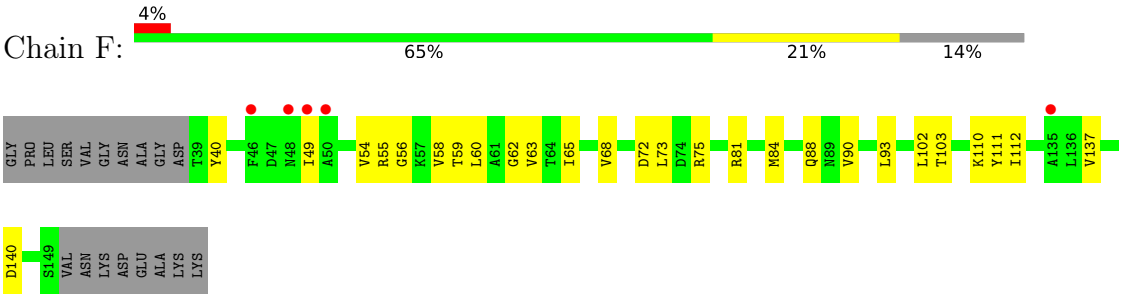
Chain D:



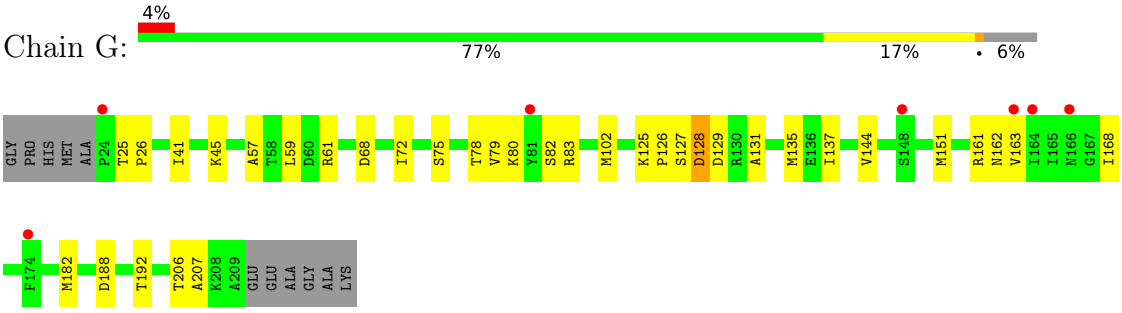
• Molecule 1: Mce/MlaD domain-containing protein



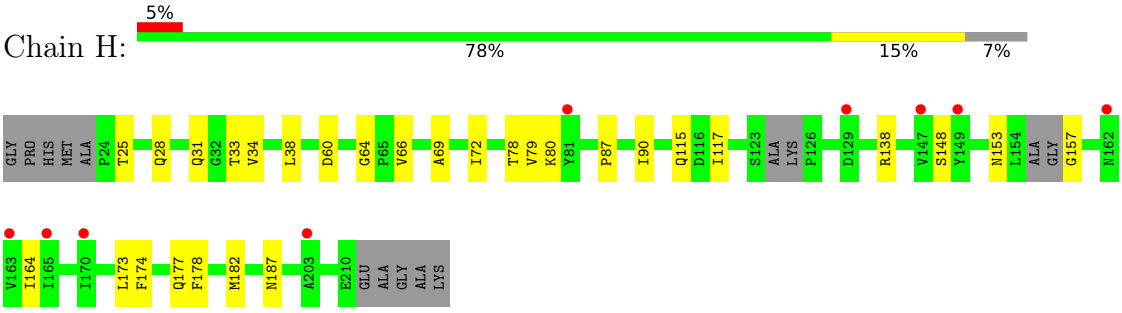
• Molecule 1: Mce/MlaD domain-containing protein



• Molecule 2: Toluene tolerance protein

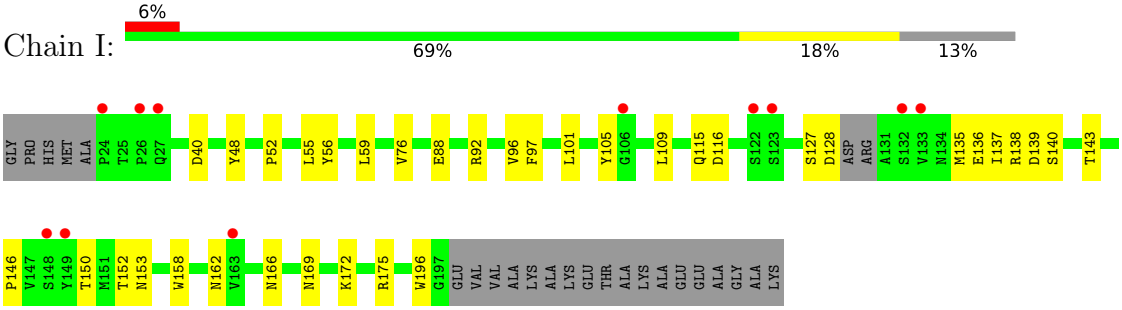


• Molecule 2: Toluene tolerance protein



• Molecule 2: Toluene tolerance protein

Chain I:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α, β, γ	125.16Å 125.16Å 178.90Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.45 – 3.46 49.45 – 3.46	Depositor EDS
% Data completeness (in resolution range)	91.9 (49.45-3.46) 94.4 (49.45-3.46)	Depositor EDS
R_{merge}	0.41	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.74 (at 3.48Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487: ???)	Depositor
R, R_{free}	0.300 , 0.357 0.306 , 0.359	Depositor DCC
R_{free} test set	856 reflections (4.48%)	wwPDB-VP
Wilson B-factor (Å^2)	102.5	Xtriage
Anisotropy	0.468	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.26 , 65.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.39	EDS
Total number of atoms	8451	wwPDB-VP
Average B, all atoms (Å^2)	102.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.57% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	0.17	0/811	0.39	0/1110
1	B	0.14	0/784	0.36	0/1077
1	C	0.20	0/821	0.43	0/1119
1	D	0.18	0/798	0.40	0/1096
1	E	0.18	0/776	0.38	0/1066
1	F	0.15	0/782	0.39	0/1072
2	G	0.16	0/1356	0.35	0/1853
2	H	0.13	0/1244	0.31	0/1709
2	I	0.13	0/1176	0.29	0/1615
All	All	0.16	0/8548	0.36	0/11717

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

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	803	0	758	28	0
1	B	778	0	735	34	0
1	C	813	0	791	45	0
1	D	792	0	748	33	0
1	E	771	0	690	25	0
1	F	775	0	743	25	0
2	G	1335	0	1238	24	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	H	1226	0	1036	16	0
2	I	1158	0	1017	25	0
All	All	8451	0	7756	221	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 14.

The worst 5 of 221 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)
2:G:78:THR:HG22	2:G:79:VAL:H	1.42	0.84
1:C:73:LEU:HB2	1:D:63:VAL:HG11	1.60	0.83
1:D:123:LEU:HD21	1:D:125:ASP:OD1	1.78	0.83
1:F:54:VAL:HG13	1:F:55:ARG:HG3	1.65	0.79
1:C:65:ILE:HD12	1:C:90:VAL:HG21	1.67	0.76

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	112/129 (87%)	91 (81%)	21 (19%)	0	100 100
1	B	112/129 (87%)	95 (85%)	16 (14%)	1 (1%)	14 46
1	C	109/129 (84%)	87 (80%)	22 (20%)	0	100 100
1	D	111/129 (86%)	93 (84%)	15 (14%)	3 (3%)	4 27
1	E	113/129 (88%)	96 (85%)	15 (13%)	2 (2%)	6 34
1	F	109/129 (84%)	93 (85%)	16 (15%)	0	100 100
2	G	184/197 (93%)	157 (85%)	26 (14%)	1 (0%)	24 57
2	H	177/197 (90%)	164 (93%)	13 (7%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
2	I	168/197 (85%)	156 (93%)	12 (7%)	0	100 100
All	All	1195/1365 (88%)	1032 (86%)	156 (13%)	7 (1%)	21 53

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	42	VAL
1	D	125	ASP
1	D	127	SER
2	G	128	ASP
1	E	126	GLY

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	83/105 (79%)	83 (100%)	0	100 100
1	B	78/105 (74%)	78 (100%)	0	100 100
1	C	87/105 (83%)	87 (100%)	0	100 100
1	D	82/105 (78%)	82 (100%)	0	100 100
1	E	73/105 (70%)	73 (100%)	0	100 100
1	F	79/105 (75%)	79 (100%)	0	100 100
2	G	129/163 (79%)	129 (100%)	0	100 100
2	H	104/163 (64%)	104 (100%)	0	100 100
2	I	101/163 (62%)	101 (100%)	0	100 100
All	All	816/1119 (73%)	816 (100%)	0	100 100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
2	I	153	ASN
2	G	187	ASN
2	G	115	GLN
1	E	151	ASN
2	G	134	ASN

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

There are no oligosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

5.7 Other polymers

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

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, 95^{th} 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	114/129 (88%)	0.43	3 (2%)	57	34	49, 82, 106, 123	0
1	B	114/129 (88%)	0.44	5 (4%)	39	23	66, 98, 123, 132	0
1	C	111/129 (86%)	0.19	1 (0%)	81	58	43, 68, 95, 104	0
1	D	113/129 (87%)	0.21	3 (2%)	56	33	57, 89, 108, 117	0
1	E	115/129 (89%)	0.51	5 (4%)	40	23	64, 105, 130, 139	0
1	F	111/129 (86%)	0.29	5 (4%)	38	22	72, 95, 113, 121	0
2	G	186/197 (94%)	0.27	7 (3%)	44	26	67, 94, 125, 138	0
2	H	183/197 (92%)	0.33	9 (4%)	35	21	83, 127, 146, 156	0
2	I	172/197 (87%)	0.54	11 (6%)	25	17	86, 140, 177, 185	0
All	All	1219/1365 (89%)	0.36	49 (4%)	42	25	43, 98, 155, 185	0

The worst 5 of 49 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	H	163	VAL	7.2
2	I	24	PRO	4.8
1	B	131	ASP	4.3
1	E	128	THR	4.2
2	H	203	ALA	4.1

6.2 Non-standard residues in protein, DNA, RNA chains

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no oligosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.