



# wwPDB X-ray Structure Validation Summary Report ⓘ

Dec 16, 2023 – 11:32 AM EST

PDB ID : 4P1Y  
Title : Crystal structure of staphylococcal gamma-hemolysin prepore  
Authors : Yamashita, D.; Tanaka, Y.; Tanaka, I.; Yao, M.  
Deposited on : 2014-02-28  
Resolution : 2.99 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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36

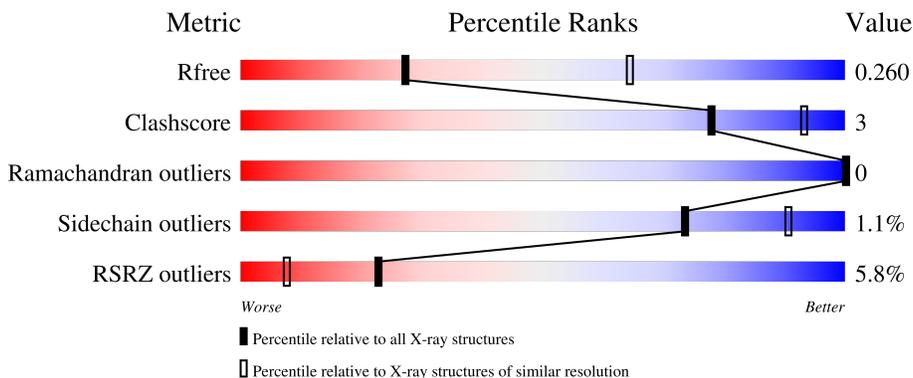
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.99 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))
$R_{free}$	130704	2092 (3.00-3.00)
Clashscore	141614	2416 (3.00-3.00)
Ramachandran outliers	138981	2333 (3.00-3.00)
Sidechain outliers	138945	2336 (3.00-3.00)
RSRZ outliers	127900	1990 (3.00-3.00)

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  $\geq 3$ , 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	309	 6% 78% 9% 14%
1	C	309	 6% 77% 9% 14%
1	E	309	 6% 77% 9% 14%
1	G	309	 6% 80% 6% 14%
2	B	290	 6% 84% 6% • 9%

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Mol	Chain	Length	Quality of chain
2	D	290	 4% 84% 7% 9%
2	F	290	 4% 83% 8% 9%
2	H	290	 3% 82% 8% 9%

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 34011 atoms, of which 16788 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 Gamma-hemolysin component B.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	267	4239	1376	2070	367	422	4	0	0	0
1	C	266	4227	1373	2065	366	419	4	0	0	0
1	E	265	4217	1370	2060	365	418	4	0	0	0
1	G	266	4228	1373	2065	366	420	4	0	0	0

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-8	MET	-	expression tag	UNP Q931F3
A	-7	GLY	-	expression tag	UNP Q931F3
A	-6	HIS	-	expression tag	UNP Q931F3
A	-5	HIS	-	expression tag	UNP Q931F3
A	-4	HIS	-	expression tag	UNP Q931F3
A	-3	HIS	-	expression tag	UNP Q931F3
A	-2	HIS	-	expression tag	UNP Q931F3
A	-1	HIS	-	expression tag	UNP Q931F3
A	0	ALA	-	expression tag	UNP Q931F3
A	1	MET	-	expression tag	UNP Q931F3
A	177	ALA	TRP	engineered mutation	UNP Q931F3
A	198	ALA	ARG	engineered mutation	UNP Q931F3
C	-8	MET	-	expression tag	UNP Q931F3
C	-7	GLY	-	expression tag	UNP Q931F3
C	-6	HIS	-	expression tag	UNP Q931F3
C	-5	HIS	-	expression tag	UNP Q931F3
C	-4	HIS	-	expression tag	UNP Q931F3
C	-3	HIS	-	expression tag	UNP Q931F3
C	-2	HIS	-	expression tag	UNP Q931F3
C	-1	HIS	-	expression tag	UNP Q931F3
C	0	ALA	-	expression tag	UNP Q931F3

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Chain	Residue	Modelled	Actual	Comment	Reference
C	1	MET	-	expression tag	UNP Q931F3
C	177	ALA	TRP	engineered mutation	UNP Q931F3
C	198	ALA	ARG	engineered mutation	UNP Q931F3
E	-8	MET	-	expression tag	UNP Q931F3
E	-7	GLY	-	expression tag	UNP Q931F3
E	-6	HIS	-	expression tag	UNP Q931F3
E	-5	HIS	-	expression tag	UNP Q931F3
E	-4	HIS	-	expression tag	UNP Q931F3
E	-3	HIS	-	expression tag	UNP Q931F3
E	-2	HIS	-	expression tag	UNP Q931F3
E	-1	HIS	-	expression tag	UNP Q931F3
E	0	ALA	-	expression tag	UNP Q931F3
E	1	MET	-	expression tag	UNP Q931F3
E	177	ALA	TRP	engineered mutation	UNP Q931F3
E	198	ALA	ARG	engineered mutation	UNP Q931F3
G	-8	MET	-	expression tag	UNP Q931F3
G	-7	GLY	-	expression tag	UNP Q931F3
G	-6	HIS	-	expression tag	UNP Q931F3
G	-5	HIS	-	expression tag	UNP Q931F3
G	-4	HIS	-	expression tag	UNP Q931F3
G	-3	HIS	-	expression tag	UNP Q931F3
G	-2	HIS	-	expression tag	UNP Q931F3
G	-1	HIS	-	expression tag	UNP Q931F3
G	0	ALA	-	expression tag	UNP Q931F3
G	1	MET	-	expression tag	UNP Q931F3
G	177	ALA	TRP	engineered mutation	UNP Q931F3
G	198	ALA	ARG	engineered mutation	UNP Q931F3

- Molecule 2 is a protein called Gamma-hemolysin component A.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	264	Total	C	H	N	O	S	0	0	0
			4275	1364	2132	370	406	3			
2	D	264	Total	C	H	N	O	S	0	0	0
			4275	1364	2132	370	406	3			
2	F	264	Total	C	H	N	O	S	0	0	0
			4275	1364	2132	370	406	3			
2	H	264	Total	C	H	N	O	S	0	0	0
			4275	1364	2132	370	406	3			

There are 88 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-9	MET	-	expression tag	UNP P0A071
B	-8	GLY	-	expression tag	UNP P0A071
B	-7	HIS	-	expression tag	UNP P0A071
B	-6	HIS	-	expression tag	UNP P0A071
B	-5	HIS	-	expression tag	UNP P0A071
B	-4	HIS	-	expression tag	UNP P0A071
B	-3	HIS	-	expression tag	UNP P0A071
B	-2	HIS	-	expression tag	UNP P0A071
B	-1	ALA	-	expression tag	UNP P0A071
B	0	MET	-	expression tag	UNP P0A071
B	1	GLU	-	expression tag	UNP P0A071
B	2	ASN	-	expression tag	UNP P0A071
B	3	LYS	-	expression tag	UNP P0A071
B	4	ILE	-	expression tag	UNP P0A071
B	5	GLU	-	expression tag	UNP P0A071
B	6	ASP	-	expression tag	UNP P0A071
B	7	ILE	-	expression tag	UNP P0A071
B	8	GLY	-	expression tag	UNP P0A071
B	9	GLN	-	expression tag	UNP P0A071
B	10	GLY	-	expression tag	UNP P0A071
B	11	ALA	-	expression tag	UNP P0A071
B	12	GLU	-	expression tag	UNP P0A071
D	-9	MET	-	expression tag	UNP P0A071
D	-8	GLY	-	expression tag	UNP P0A071
D	-7	HIS	-	expression tag	UNP P0A071
D	-6	HIS	-	expression tag	UNP P0A071
D	-5	HIS	-	expression tag	UNP P0A071
D	-4	HIS	-	expression tag	UNP P0A071
D	-3	HIS	-	expression tag	UNP P0A071
D	-2	HIS	-	expression tag	UNP P0A071
D	-1	ALA	-	expression tag	UNP P0A071
D	0	MET	-	expression tag	UNP P0A071
D	1	GLU	-	expression tag	UNP P0A071
D	2	ASN	-	expression tag	UNP P0A071
D	3	LYS	-	expression tag	UNP P0A071
D	4	ILE	-	expression tag	UNP P0A071
D	5	GLU	-	expression tag	UNP P0A071
D	6	ASP	-	expression tag	UNP P0A071
D	7	ILE	-	expression tag	UNP P0A071
D	8	GLY	-	expression tag	UNP P0A071
D	9	GLN	-	expression tag	UNP P0A071
D	10	GLY	-	expression tag	UNP P0A071
D	11	ALA	-	expression tag	UNP P0A071

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Chain	Residue	Modelled	Actual	Comment	Reference
D	12	GLU	-	expression tag	UNP P0A071
F	-9	MET	-	expression tag	UNP P0A071
F	-8	GLY	-	expression tag	UNP P0A071
F	-7	HIS	-	expression tag	UNP P0A071
F	-6	HIS	-	expression tag	UNP P0A071
F	-5	HIS	-	expression tag	UNP P0A071
F	-4	HIS	-	expression tag	UNP P0A071
F	-3	HIS	-	expression tag	UNP P0A071
F	-2	HIS	-	expression tag	UNP P0A071
F	-1	ALA	-	expression tag	UNP P0A071
F	0	MET	-	expression tag	UNP P0A071
F	1	GLU	-	expression tag	UNP P0A071
F	2	ASN	-	expression tag	UNP P0A071
F	3	LYS	-	expression tag	UNP P0A071
F	4	ILE	-	expression tag	UNP P0A071
F	5	GLU	-	expression tag	UNP P0A071
F	6	ASP	-	expression tag	UNP P0A071
F	7	ILE	-	expression tag	UNP P0A071
F	8	GLY	-	expression tag	UNP P0A071
F	9	GLN	-	expression tag	UNP P0A071
F	10	GLY	-	expression tag	UNP P0A071
F	11	ALA	-	expression tag	UNP P0A071
F	12	GLU	-	expression tag	UNP P0A071
H	-9	MET	-	expression tag	UNP P0A071
H	-8	GLY	-	expression tag	UNP P0A071
H	-7	HIS	-	expression tag	UNP P0A071
H	-6	HIS	-	expression tag	UNP P0A071
H	-5	HIS	-	expression tag	UNP P0A071
H	-4	HIS	-	expression tag	UNP P0A071
H	-3	HIS	-	expression tag	UNP P0A071
H	-2	HIS	-	expression tag	UNP P0A071
H	-1	ALA	-	expression tag	UNP P0A071
H	0	MET	-	expression tag	UNP P0A071
H	1	GLU	-	expression tag	UNP P0A071
H	2	ASN	-	expression tag	UNP P0A071
H	3	LYS	-	expression tag	UNP P0A071
H	4	ILE	-	expression tag	UNP P0A071
H	5	GLU	-	expression tag	UNP P0A071
H	6	ASP	-	expression tag	UNP P0A071
H	7	ILE	-	expression tag	UNP P0A071
H	8	GLY	-	expression tag	UNP P0A071
H	9	GLN	-	expression tag	UNP P0A071

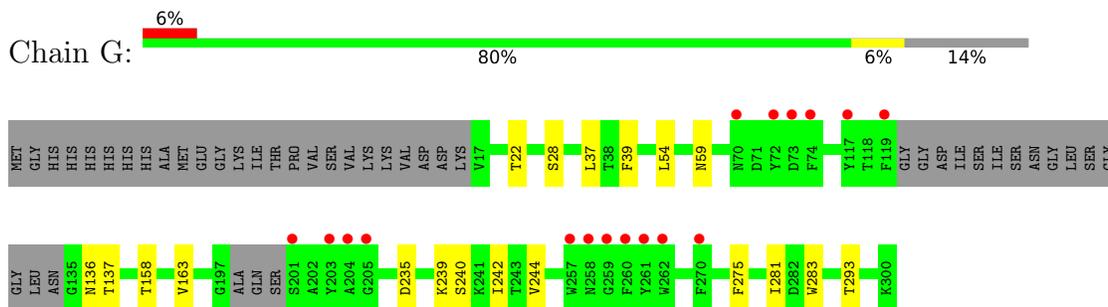
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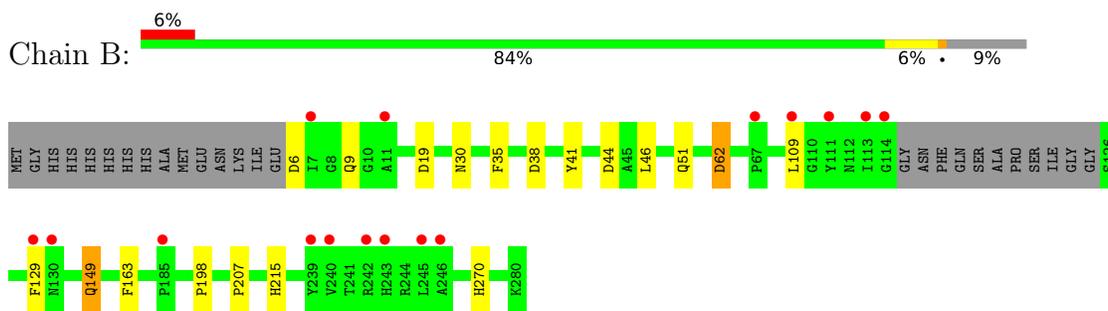
Chain	Residue	Modelled	Actual	Comment	Reference
H	10	GLY	-	expression tag	UNP P0A071
H	11	ALA	-	expression tag	UNP P0A071
H	12	GLU	-	expression tag	UNP P0A071



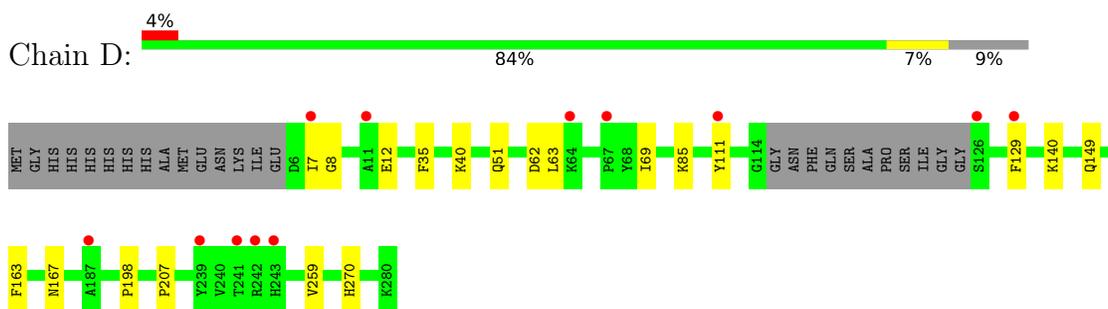
• Molecule 1: Gamma-hemolysin component B



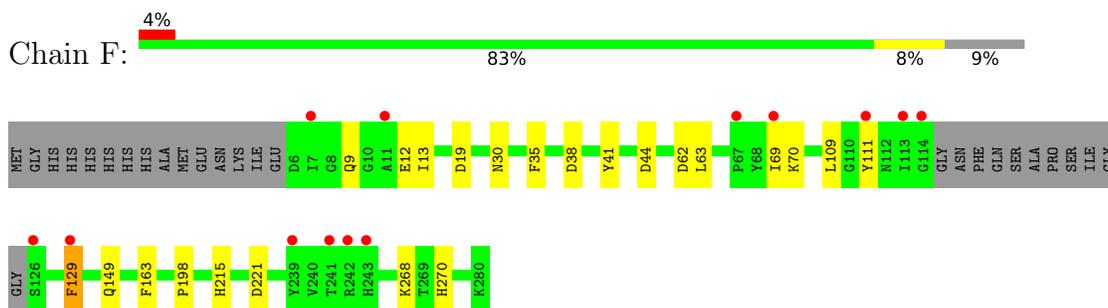
• Molecule 2: Gamma-hemolysin component A



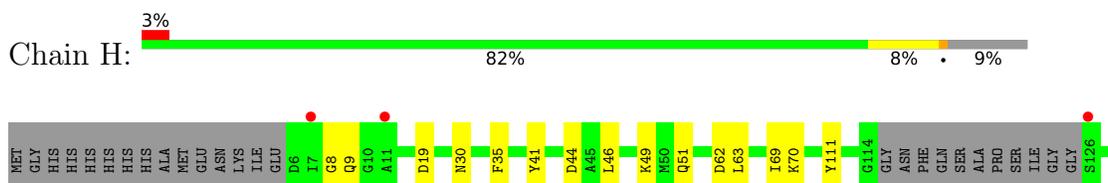
• Molecule 2: Gamma-hemolysin component A



• Molecule 2: Gamma-hemolysin component A



• Molecule 2: Gamma-hemolysin component A





## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	197.06Å 197.05Å 192.97Å 90.00° 99.04° 90.00°	Depositor
Resolution (Å)	44.40 – 2.99 44.40 – 2.99	Depositor EDS
% Data completeness (in resolution range)	95.5 (44.40-2.99) 95.5 (44.40-2.99)	Depositor EDS
$R_{merge}$	0.19	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.83 (at 3.01Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.8.2_1309)	Depositor
R, $R_{free}$	0.230 , 0.254 0.234 , 0.260	Depositor DCC
$R_{free}$ test set	6970 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	47.1	Xtrriage
Anisotropy	1.101	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 65.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.27$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.89	EDS
Total number of atoms	34011	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	56.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 12.01% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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	0.38	0/2222	0.53	0/3003
1	C	0.38	0/2215	0.53	0/2994
1	E	0.38	0/2210	0.53	0/2987
1	G	0.38	0/2216	0.53	0/2995
2	B	0.38	0/2191	0.57	0/2957
2	D	0.38	0/2191	0.56	0/2957
2	F	0.38	0/2191	0.57	0/2957
2	H	0.38	0/2191	0.56	0/2957
All	All	0.38	0/17627	0.55	0/23807

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	2169	2070	2065	16	0
1	C	2162	2065	2060	17	0
1	E	2157	2060	2055	15	0
1	G	2163	2065	2060	13	0
2	B	2143	2132	2128	11	0
2	D	2143	2132	2128	11	0
2	F	2143	2132	2128	12	0
2	H	2143	2132	2128	17	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	17223	16788	16752	99	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.

The worst 5 of 99 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:F:9:GLN:HB3	2:F:38:ASP:OD2	1.93	0.69
1:C:175:ASN:ND2	1:C:213:GLN:OE1	2.26	0.65
2:B:9:GLN:HB2	2:B:38:ASP:OD2	1.97	0.64
1:C:240:SER:HB3	1:C:283:TRP:HE1	1.68	0.58
1:C:136:ASN:OD1	1:C:137:THR:N	2.36	0.58

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	261/309 (84%)	255 (98%)	6 (2%)	0	100	100
1	C	260/309 (84%)	252 (97%)	8 (3%)	0	100	100
1	E	259/309 (84%)	252 (97%)	7 (3%)	0	100	100
1	G	260/309 (84%)	254 (98%)	6 (2%)	0	100	100
2	B	260/290 (90%)	252 (97%)	8 (3%)	0	100	100
2	D	260/290 (90%)	252 (97%)	8 (3%)	0	100	100
2	F	260/290 (90%)	251 (96%)	9 (4%)	0	100	100
2	H	260/290 (90%)	254 (98%)	6 (2%)	0	100	100
All	All	2080/2396 (87%)	2022 (97%)	58 (3%)	0	100	100

There are no Ramachandran outliers to report.

### 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	236/269 (88%)	234 (99%)	2 (1%)	81	93
1	C	234/269 (87%)	233 (100%)	1 (0%)	91	97
1	E	234/269 (87%)	232 (99%)	2 (1%)	78	92
1	G	235/269 (87%)	235 (100%)	0	100	100
2	B	237/257 (92%)	233 (98%)	4 (2%)	60	85
2	D	237/257 (92%)	232 (98%)	5 (2%)	53	82
2	F	237/257 (92%)	233 (98%)	4 (2%)	60	85
2	H	237/257 (92%)	234 (99%)	3 (1%)	69	89
All	All	1887/2104 (90%)	1866 (99%)	21 (1%)	73	90

5 of 21 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	F	12	GLU
2	F	149	GLN
2	H	259	VAL
2	H	129	PHE
2	F	129	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	C	61	ASN
2	F	138	ASN
2	H	138	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 monosaccharides 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	267/309 (86%)	0.31	20 (7%) 14 4	16, 45, 103, 138	0
1	C	266/309 (86%)	0.30	17 (6%) 19 6	18, 46, 100, 131	0
1	E	265/309 (85%)	0.27	20 (7%) 14 4	16, 45, 94, 125	0
1	G	266/309 (86%)	0.28	17 (6%) 19 6	18, 45, 100, 133	0
2	B	264/290 (91%)	0.22	16 (6%) 21 7	20, 47, 98, 151	0
2	D	264/290 (91%)	0.16	12 (4%) 33 12	20, 45, 100, 159	0
2	F	264/290 (91%)	0.22	13 (4%) 29 11	22, 46, 94, 159	0
2	H	264/290 (91%)	0.17	9 (3%) 45 19	18, 45, 95, 160	0
All	All	2120/2396 (88%)	0.24	124 (5%) 23 7	16, 46, 100, 160	0

The worst 5 of 124 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	201	SER	5.8
2	F	243	HIS	5.3
1	E	257	TRP	5.3
1	G	257	TRP	4.8
1	C	198	ALA	4.7

### 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 monosaccharides 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.