



# Full wwPDB X-ray Structure Validation Report ⓘ

Jun 23, 2024 – 07:49 AM EDT

PDB ID : 5F1N  
Title : MHC complexed to 11mer peptide  
Authors : Liu, J.; Chai, Y.; Qi, J.; Gao, G.F.  
Deposited on : 2015-11-30  
Resolution : 2.00 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](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 : 2.37.1  
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) : 2.37.1

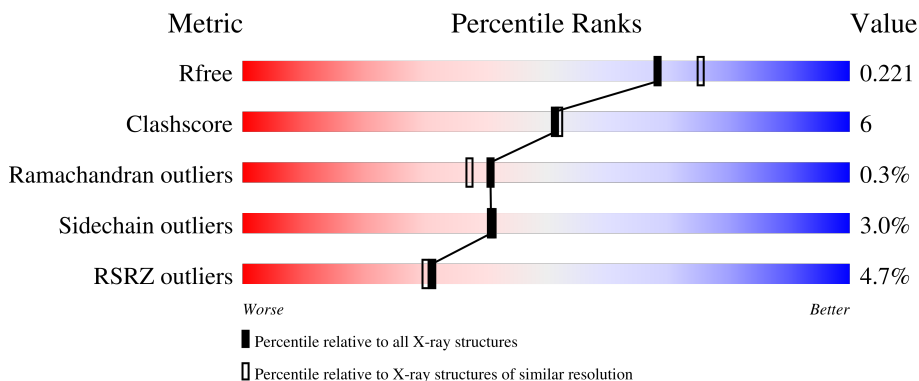
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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	275	<div style="display: flex; align-items: center;"> <div style="width: 4%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 87%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 13%; height: 10px; background-color: yellow;"></div> </div>
1	D	275	<div style="display: flex; align-items: center;"> <div style="width: 7%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 87%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 12%; height: 10px; background-color: yellow;"></div> </div>
2	B	125	<div style="display: flex; align-items: center;"> <div style="width: 2%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 70%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 8%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 21%; height: 10px; background-color: grey;"></div> </div>
2	E	125	<div style="display: flex; align-items: center;"> <div style="width: 2%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 68%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 10%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 21%; height: 10px; background-color: grey;"></div> </div>
3	C	11	<div style="display: flex; align-items: center;"> <div style="width: 64%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 36%; height: 10px; background-color: yellow;"></div> </div>

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Mol	Chain	Length	Quality of chain
3	F	11	 73% 18% 9%

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 6865 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 MHC class I antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	275	Total	C	N	O	S	0	0	0
			2228	1389	402	431	6			
1	D	275	Total	C	N	O	S	0	0	0
			2228	1389	402	431	6			

- Molecule 2 is a protein called Beta-2-microglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	99	Total	C	N	O	S	0	0	0
			817	522	138	154	3			
2	E	99	Total	C	N	O	S	0	0	0
			817	522	138	154	3			

- Molecule 3 is a protein called Peptide from Cytochrome P450 family 1 subfamily B polypeptide 1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	C	11	Total	C	N	O	0	0	0
			96	62	16	18			
3	F	11	Total	C	N	O	0	0	0
			96	62	16	18			

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	174	Total	O	0	0
			174	174		
4	B	65	Total	O	0	0
			65	65		
4	C	13	Total	O	0	0
			13	13		
4	D	218	Total	O	0	0
			218	218		

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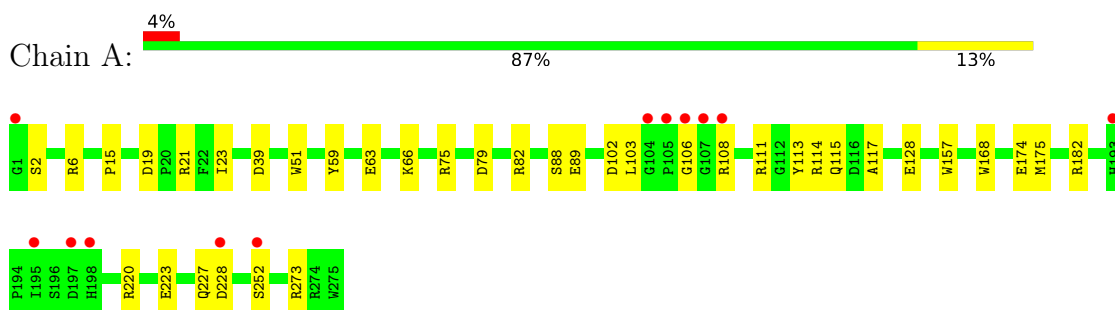
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<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>	<b>ZeroOcc</b>	<b>AltConf</b>
4	E	98	Total O 98 98	0	0
4	F	15	Total O 15 15	0	0

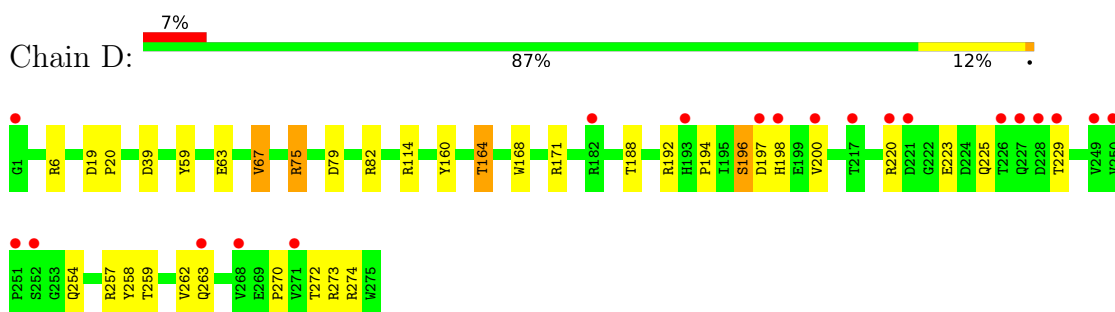
### 3 Residue-property plots [i](#)

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.

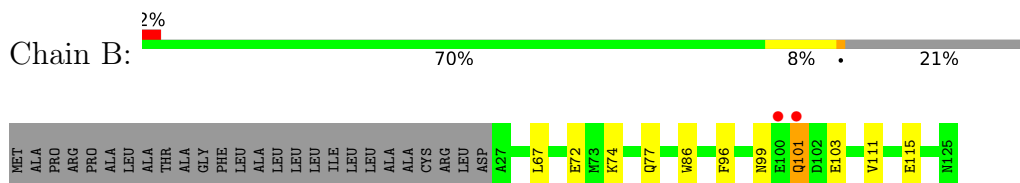
- Molecule 1: MHC class I antigen



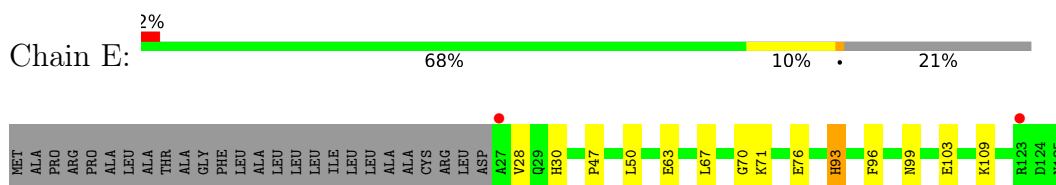
- Molecule 1: MHC class I antigen



- Molecule 2: Beta-2-microglobulin



- Molecule 2: Beta-2-microglobulin



- Molecule 3: Peptide from Cytochrome P450 family 1 subfamily B polypeptide 1

Chain C:  64% 36%



- Molecule 3: Peptide from Cytochrome P450 family 1 subfamily B polypeptide 1

Chain F:  73% 18% 9%



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	49.31Å 160.49Å 64.48Å 90.00° 104.08° 90.00°	Depositor
Resolution (Å)	31.45 – 2.00 33.77 – 2.00	Depositor EDS
% Data completeness (in resolution range)	98.8 (31.45-2.00) 98.8 (33.77-2.00)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.47 (at 2.00Å)	Xtrriage
Refinement program	PHENIX 1.8.4_1496	Depositor
R, $R_{free}$	0.184 , 0.221 0.185 , 0.221	Depositor DCC
$R_{free}$ test set	3278 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	25.7	Xtrriage
Anisotropy	0.178	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 44.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	6865	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	35.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.98% 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	0.32	0/2287	0.50	0/3114
1	D	0.37	0/2287	0.54	0/3114
2	B	0.32	0/842	0.49	0/1143
2	E	0.34	0/842	0.52	0/1143
3	C	0.72	0/97	0.66	0/125
3	F	0.82	0/97	0.96	1/125 (0.8%)
All	All	0.36	0/6452	0.53	1/8764 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	F	1	ARG	NE-CZ-NH2	-6.53	117.04	120.30

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	2228	0	2092	27	1
1	D	2228	0	2092	24	1
2	B	817	0	774	6	0
2	E	817	0	774	12	0
3	C	96	0	96	6	0
3	F	96	0	96	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	174	0	0	6	0
4	B	65	0	0	3	0
4	C	13	0	0	0	0
4	D	218	0	0	2	0
4	E	98	0	0	3	0
4	F	15	0	0	0	0
All	All	6865	0	5924	68	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 6.

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:111:ARG:NH2	4:A:304:HOH:O	2.05	0.87
1:A:182:ARG:NH2	3:F:6:ASP:OD1	2.06	0.87
1:A:63:GLU:OE1	4:A:301:HOH:O	2.01	0.77
1:A:39:ASP:OD2	4:A:303:HOH:O	2.03	0.75
1:D:63:GLU:OE2	3:F:1:ARG:HD2	1.86	0.75
1:D:259:THR:HG22	1:D:274:ARG:HE	1.52	0.74
1:A:273:ARG:NH1	1:D:19:ASP:OD2	2.21	0.73
1:D:196:SER:HG	1:D:198:HIS:HD1	0.74	0.72
1:D:220:ARG:NH1	1:D:258:TYR:OH	2.23	0.71
1:D:196:SER:OG	1:D:197:ASP:N	2.24	0.70
2:B:115:GLU:O	4:B:201:HOH:O	2.08	0.70
2:E:93:HIS:O	2:E:93:HIS:ND1	2.19	0.69
1:D:59:TYR:CE2	3:F:1:ARG:HD3	2.28	0.68
1:D:220:ARG:O	1:D:223:GLU:HG2	1.99	0.61
1:A:6:ARG:NH1	1:A:102:ASP:OD1	2.33	0.60
2:B:99:ASN:HB3	2:B:101:GLN:HG3	1.85	0.59
2:B:77:GLN:OE1	4:B:202:HOH:O	2.17	0.58
2:E:93:HIS:HD1	2:E:93:HIS:C	2.06	0.58
1:D:263:GLN:HG2	1:D:270:PRO:HG3	1.86	0.57
2:B:72:GLU:H	2:B:72:GLU:CD	2.07	0.57
2:E:76:GLU:HB2	2:E:93:HIS:CE1	2.40	0.57
1:D:39:ASP:OD1	4:D:301:HOH:O	2.18	0.57
1:A:115:GLN:NE2	4:A:309:HOH:O	2.36	0.57
1:A:19:ASP:OD1	1:A:75:ARG:NH2	2.38	0.57
2:E:103:GLU:HG2	4:E:221:HOH:O	2.05	0.57
1:A:103:LEU:HD13	1:A:106:GLY:HA2	1.88	0.55
1:D:63:GLU:O	1:D:67:VAL:HG22	2.06	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:E:70:GLY:C	2:E:71:LYS:HD2	2.27	0.54
2:B:111:VAL:HG13	4:B:211:HOH:O	2.09	0.53
1:A:63:GLU:OE2	3:C:1:ARG:HD2	2.09	0.52
1:D:225:GLN:O	1:D:229:THR:OG1	2.28	0.51
1:A:111:ARG:HD3	1:A:113:TYR:CZ	2.45	0.51
1:A:220:ARG:O	1:A:223:GLU:HG2	2.11	0.51
1:D:188:THR:HG21	1:D:262:VAL:HG21	1.94	0.50
2:E:28:VAL:HG23	4:E:240:HOH:O	2.11	0.50
1:D:259:THR:CG2	1:D:274:ARG:HE	2.20	0.49
1:A:174:GLU:OE1	4:A:305:HOH:O	2.20	0.49
1:A:21:ARG:CZ	1:A:23:ILE:HD11	2.43	0.48
1:A:168:TRP:CE2	3:C:1:ARG:HG3	2.47	0.48
1:D:164:THR:HB	4:D:492:HOH:O	2.14	0.48
2:E:71:LYS:HD2	2:E:71:LYS:N	2.29	0.48
1:A:114:ARG:HD2	1:A:157:TRP:CE2	2.48	0.48
1:D:194:PRO:HA	1:D:200:VAL:HG23	1.97	0.47
1:D:272:THR:O	1:D:273:ARG:HD2	2.14	0.47
1:D:168:TRP:CE2	3:F:1:ARG:HG3	2.50	0.46
1:A:111:ARG:HD3	1:A:113:TYR:OH	2.16	0.45
1:A:51:TRP:O	1:A:175:MET:HE2	2.16	0.45
2:E:30:HIS:HB3	4:E:257:HOH:O	2.15	0.45
1:A:15:PRO:HB2	1:A:89:GLU:O	2.16	0.45
1:A:79:ASP:OD1	1:A:82:ARG:NH1	2.50	0.45
2:E:93:HIS:ND1	2:E:93:HIS:C	2.67	0.45
1:D:254:GLN:HB3	1:D:257:ARG:HD3	1.99	0.44
1:A:59:TYR:CE2	3:C:1:ARG:HD3	2.51	0.44
1:A:117:ALA:HB2	2:B:86:TRP:CE2	2.53	0.44
3:C:3:LEU:HD12	3:C:4:ASP:H	1.83	0.44
1:A:66:LYS:HD3	3:C:4:ASP:HB3	1.99	0.43
1:D:192:ARG:HE	1:D:200:VAL:HG21	1.83	0.43
1:D:79:ASP:OD1	1:D:82:ARG:NH1	2.51	0.42
2:E:76:GLU:HB2	2:E:93:HIS:HE1	1.83	0.42
2:E:63:GLU:HB2	2:E:109:LYS:HB2	2.01	0.42
2:E:50:LEU:O	2:E:93:HIS:HA	2.19	0.42
1:A:111:ARG:CZ	1:A:128:GLU:HG3	2.50	0.42
1:D:6:ARG:HH11	1:D:6:ARG:HG3	1.85	0.41
1:A:2:SER:HA	4:A:389:HOH:O	2.20	0.41
1:A:157:TRP:CZ2	3:C:3:LEU:HD23	2.56	0.41
1:A:111:ARG:NH2	1:A:128:GLU:HG3	2.35	0.41
1:D:20:PRO:HG3	1:D:75:ARG:HG3	2.02	0.40
1:D:160:TYR:HA	1:D:164:THR:CG2	2.51	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:A:227:GLN:O	1:D:254:GLN:NE2[2_859]	2.19	0.01

### 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	273/275 (99%)	261 (96%)	11 (4%)	1 (0%)	34	30
1	D	273/275 (99%)	263 (96%)	9 (3%)	1 (0%)	34	30
2	B	97/125 (78%)	95 (98%)	2 (2%)	0	100	100
2	E	97/125 (78%)	95 (98%)	2 (2%)	0	100	100
3	C	9/11 (82%)	9 (100%)	0	0	100	100
3	F	9/11 (82%)	9 (100%)	0	0	100	100
All	All	758/822 (92%)	732 (97%)	24 (3%)	2 (0%)	41	37

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	196	SER
1	A	252	SER

#### 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	230/230 (100%)	227 (99%)	3 (1%)	69	74
1	D	230/230 (100%)	225 (98%)	5 (2%)	52	55
2	B	93/111 (84%)	88 (95%)	5 (5%)	22	18
2	E	93/111 (84%)	88 (95%)	5 (5%)	22	18
3	C	10/10 (100%)	9 (90%)	1 (10%)	7	4
3	F	10/10 (100%)	9 (90%)	1 (10%)	7	4
All	All	666/702 (95%)	646 (97%)	20 (3%)	41	41

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	88	SER
1	A	108	ARG
1	A	228	ASP
2	B	67	LEU
2	B	74	LYS
2	B	96	PHE
2	B	101	GLN
2	B	103	GLU
3	C	5	LYS
1	D	67	VAL
1	D	75	ARG
1	D	114	ARG
1	D	164	THR
1	D	171	ARG
2	E	47	PRO
2	E	67	LEU
2	E	93	HIS
2	E	96	PHE
2	E	99	ASN
3	F	5	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
2	E	99	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

### 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<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	275/275 (100%)	-0.09	12 (4%) 34 33	19, 32, 67, 102	0
1	D	275/275 (100%)	0.09	20 (7%) 15 14	15, 27, 78, 122	0
2	B	99/125 (79%)	-0.23	2 (2%) 65 63	20, 33, 56, 86	0
2	E	99/125 (79%)	-0.26	2 (2%) 65 63	16, 29, 49, 62	0
3	C	11/11 (100%)	-0.38	0 100 100	25, 27, 38, 39	0
3	F	11/11 (100%)	-0.42	0 100 100	18, 22, 30, 30	0
All	All	770/822 (93%)	-0.07	36 (4%) 31 30	15, 30, 68, 122	0

All (36) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	E	27	ALA	6.3
1	D	198	HIS	5.4
1	A	1	GLY	5.0
1	A	104	GLY	4.9
1	A	107	GLY	4.8
1	D	1	GLY	4.2
1	A	195	ILE	4.2
1	D	268	VAL	4.0
1	A	198	HIS	3.8
1	D	228	ASP	3.5
1	D	227	GLN	3.3
1	D	252	SER	3.1
1	A	105	PRO	3.1
1	A	197	ASP	3.1
1	D	229	THR	2.6
1	D	250	VAL	2.6
2	B	101	GLN	2.6
1	A	108	ARG	2.5
1	A	252	SER	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	193	HIS	2.5
1	A	106	GLY	2.4
1	D	197	ASP	2.4
1	D	200	VAL	2.4
1	D	271	VAL	2.4
1	D	220	ARG	2.3
1	D	251	PRO	2.3
1	D	193	HIS	2.2
2	B	100	GLU	2.1
1	D	182	ARG	2.1
1	D	263	GLN	2.1
1	A	228	ASP	2.1
2	E	123	ARG	2.1
1	D	249	VAL	2.1
1	D	221	ASP	2.0
1	D	217	THR	2.0
1	D	226	THR	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 monosaccharides 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.