



# wwPDB X-ray Structure Validation Summary Report ⓘ

Sep 5, 2023 – 11:42 PM EDT

PDB ID : 4EUP  
Title : The complex between TCR JKF6 and human Class I MHC HLA-A2 presenting the MART-1(27-35)(A27L) peptide  
Authors : Hossain, M.; Baker, B.M.  
Deposited on : 2012-04-25  
Resolution : 2.88 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 : 2.35  
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) : 2.35

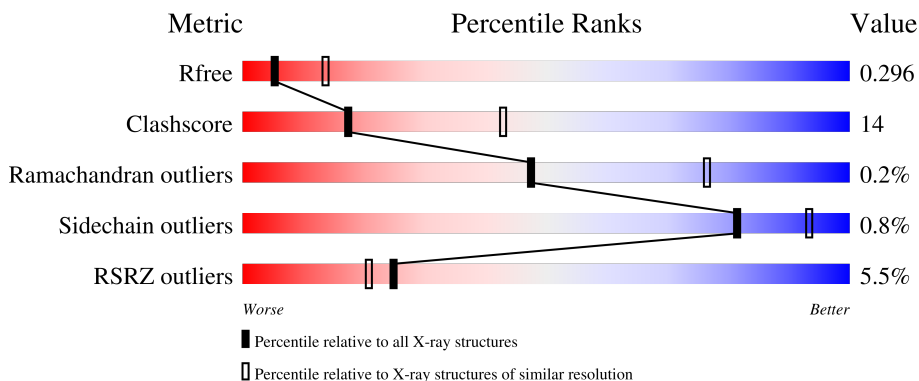
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.88 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	2691 (2.90-2.86)
Clashscore	141614	2947 (2.90-2.86)
Ramachandran outliers	138981	2868 (2.90-2.86)
Sidechain outliers	138945	2871 (2.90-2.86)
RSRZ outliers	127900	2629 (2.90-2.86)

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	 2% 73% 23% ..
1	D	275	 4% 72% 23% ..
2	B	100	 2% 68% 32%
2	E	100	 % 83% 17%
3	C	9	 56% 44%

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Mol	Chain	Length	Quality of chain
3	F	9	 78% 22%
4	G	206	 10% 77% 20% ..
4	I	206	 16% 76% 21% .
5	H	243	 4% 76% 23% .
5	J	243	 3% 71% 28% .

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 13167 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 HLA class I histocompatibility antigen, A-2 alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	D	265	Total 2164	C 1359	N 394	O 402	S 9	0	0	0
1	A	267	Total 2183	C 1369	N 399	O 406	S 9	0	0	0

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	E	100	Total 836	C 533	N 141	O 158	S 4	0	0	0
2	B	100	Total 836	C 533	N 141	O 158	S 4	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	0	MET	-	initiating methionine	UNP P61769
B	0	MET	-	initiating methionine	UNP P61769

- Molecule 3 is a protein called Melanoma antigen recognized by T-cells 1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	F	9	Total 60	C 40	N 9	O 11	0	0	0
3	C	9	Total 60	C 40	N 9	O 11	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
F	2	LEU	ALA	engineered mutation	UNP Q16655
C	2	LEU	ALA	engineered mutation	UNP Q16655

- Molecule 4 is a protein called JKF6 alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	G	201	Total	C	N	O	S	0	0	0
			1537	955	255	319	8			
4	I	201	Total	C	N	O	S	0	0	0
			1537	955	255	319	8			

- Molecule 5 is a protein called JKF6 beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	H	241	Total	C	N	O	S	0	0	0
			1938	1229	330	370	9			
5	J	240	Total	C	N	O	S	0	0	0
			1930	1225	329	367	9			

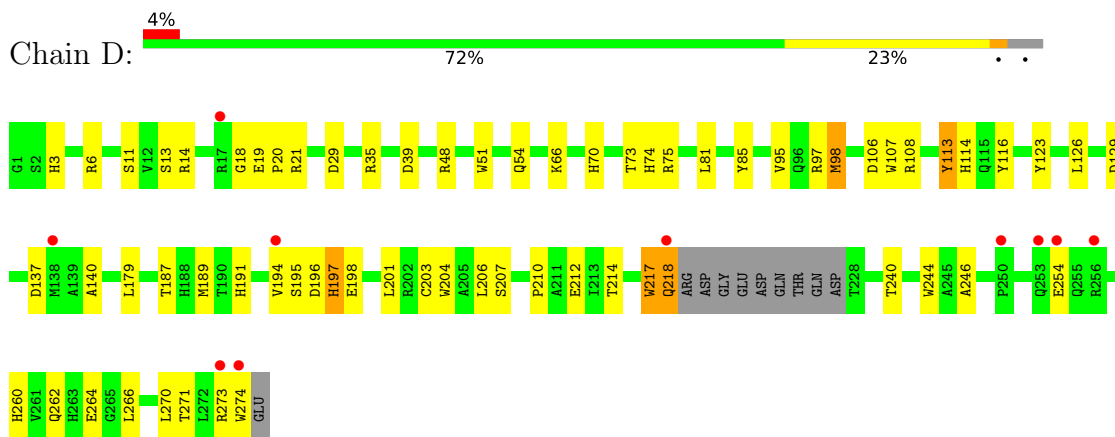
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	D	13	Total	O	0	0
			13	13		
6	E	9	Total	O	0	0
			9	9		
6	A	10	Total	O	0	0
			10	10		
6	B	12	Total	O	0	0
			12	12		
6	G	10	Total	O	0	0
			10	10		
6	I	5	Total	O	0	0
			5	5		
6	H	13	Total	O	0	0
			13	13		
6	J	14	Total	O	0	0
			14	14		

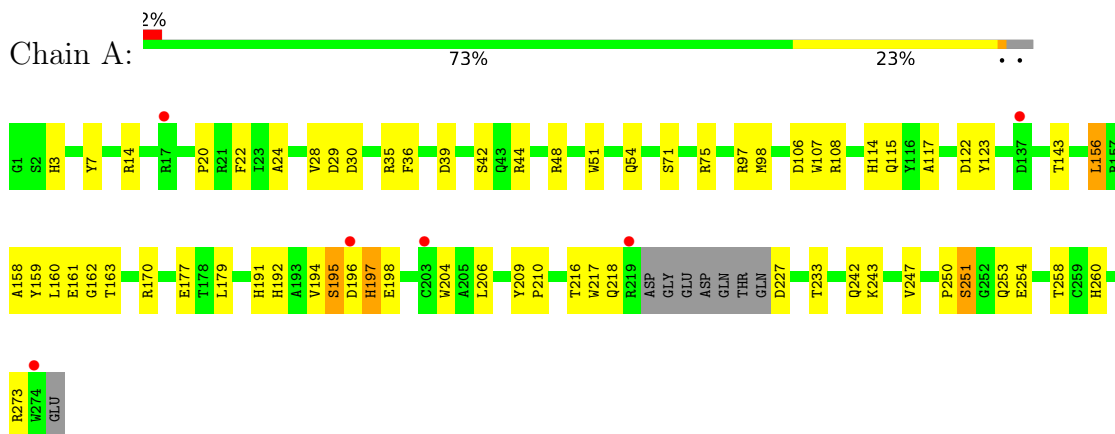
### 3 Residue-property plots [i](#)

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.

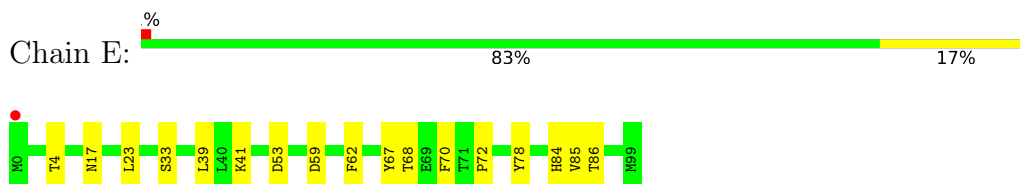
- Molecule 1: HLA class I histocompatibility antigen, A-2 alpha chain



- Molecule 1: HLA class I histocompatibility antigen, A-2 alpha chain



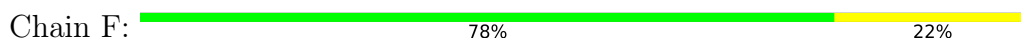
- Molecule 2: Beta-2-microglobulin



- Molecule 2: Beta-2-microglobulin



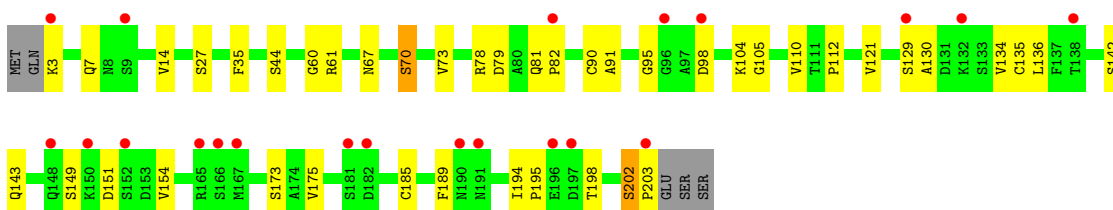
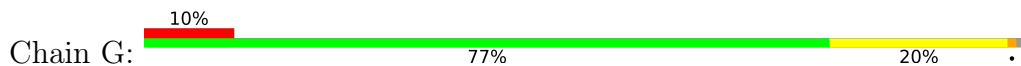
- Molecule 3: Melanoma antigen recognized by T-cells 1



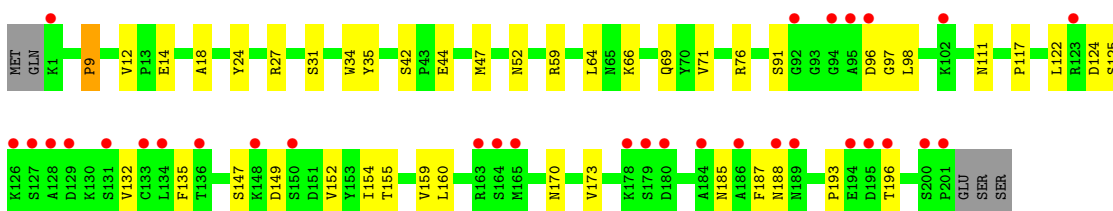
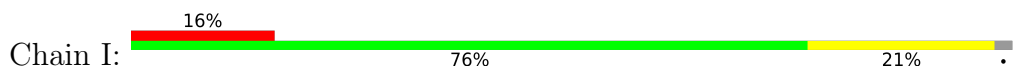
- Molecule 3: Melanoma antigen recognized by T-cells 1



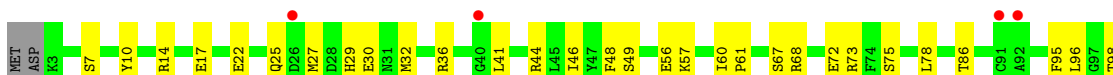
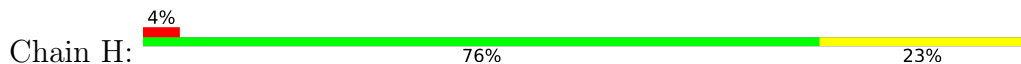
- Molecule 4: JFK6 alpha chain



- Molecule 4: JFK6 alpha chain

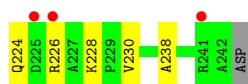
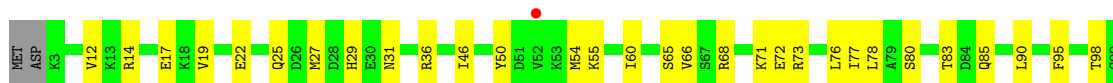


- Molecule 5: JFK6 beta chain





● Molecule 5: JKF6 beta chain





## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	127.66Å 53.70Å 150.51Å 90.00° 112.46° 90.00°	Depositor
Resolution (Å)	20.00 – 2.88 19.94 – 2.88	Depositor EDS
% Data completeness (in resolution range)	92.6 (20.00-2.88) 92.6 (19.94-2.88)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.59 (at 2.88Å)	Xtrriage
Refinement program	REFMAC 5.5.0110	Depositor
R, $R_{free}$	0.235 , 0.295 0.242 , 0.296	Depositor DCC
$R_{free}$ test set	2007 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	45.9	Xtrriage
Anisotropy	0.089	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 59.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.000 for h,-k,-h-l	Xtrriage
$F_o, F_c$ correlation	0.91	EDS
Total number of atoms	13167	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	52.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 36.21 % 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 5.1727e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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	0.79	0/2247	0.80	2/3049 (0.1%)
1	D	0.78	2/2228 (0.1%)	0.90	7/3024 (0.2%)
2	B	0.84	1/859 (0.1%)	0.78	0/1162
2	E	0.81	0/859	0.76	0/1162
3	C	0.78	0/59	0.93	0/78
3	F	0.81	0/59	1.05	0/78
4	G	0.69	2/1569 (0.1%)	0.78	3/2128 (0.1%)
4	I	0.65	0/1569	0.77	3/2128 (0.1%)
5	H	0.61	0/1988	0.68	1/2696 (0.0%)
5	J	0.66	0/1980	0.72	1/2685 (0.0%)
All	All	0.72	5/13417 (0.0%)	0.78	17/18190 (0.1%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	G	90	CYS	CB-SG	-7.34	1.69	1.82
4	G	202	SER	CB-OG	6.79	1.51	1.42
1	D	212	GLU	CG-CD	5.47	1.60	1.51
1	D	217	TRP	C-N	-5.29	1.21	1.34
2	B	77	GLU	CB-CG	5.24	1.62	1.52

The worst 5 of 17 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	217	TRP	O-C-N	-13.31	101.41	122.70
1	D	217	TRP	C-N-CA	9.67	145.89	121.70
1	D	217	TRP	CA-C-N	9.51	138.13	117.20
4	I	9	PRO	CA-N-CD	-8.48	99.63	111.50
4	I	97	GLY	N-CA-C	-8.04	93.00	113.10

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	2183	0	2049	61	0
1	D	2164	0	2031	72	0
2	B	836	0	803	32	0
2	E	836	0	803	19	0
3	C	60	0	73	6	0
3	F	60	0	73	4	0
4	G	1537	0	1448	41	0
4	I	1537	0	1451	37	0
5	H	1938	0	1862	59	0
5	J	1930	0	1858	59	0
6	A	10	0	0	0	0
6	B	12	0	0	0	0
6	D	13	0	0	1	0
6	E	9	0	0	0	0
6	G	10	0	0	0	0
6	H	13	0	0	0	0
6	I	5	0	0	0	0
6	J	14	0	0	1	0
All	All	13167	0	12451	352	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 352 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:D:196:ASP:HB3	1:D:197:HIS:CD2	1.39	1.55
1:D:196:ASP:CB	1:D:197:HIS:HD2	1.47	1.26
4:G:7:GLN:NE2	4:G:105:GLY:H	1.36	1.24
1:D:196:ASP:CB	1:D:197:HIS:CD2	2.21	1.21
1:D:35:ARG:HD3	2:E:53:ASP:OD1	1.42	1.17

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	263/275 (96%)	242 (92%)	19 (7%)	2 (1%)	19	48
1	D	261/275 (95%)	245 (94%)	16 (6%)	0	100	100
2	B	98/100 (98%)	94 (96%)	4 (4%)	0	100	100
2	E	98/100 (98%)	94 (96%)	4 (4%)	0	100	100
3	C	7/9 (78%)	5 (71%)	2 (29%)	0	100	100
3	F	7/9 (78%)	6 (86%)	1 (14%)	0	100	100
4	G	199/206 (97%)	179 (90%)	19 (10%)	1 (0%)	29	59
4	I	199/206 (97%)	187 (94%)	12 (6%)	0	100	100
5	H	239/243 (98%)	228 (95%)	10 (4%)	1 (0%)	34	64
5	J	238/243 (98%)	221 (93%)	17 (7%)	0	100	100
All	All	1609/1666 (97%)	1501 (93%)	104 (6%)	4 (0%)	47	76

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	195	SER
5	H	219	ALA
1	A	251	SER
4	G	95	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	224/231 (97%)	221 (99%)	3 (1%)	69	88
1	D	222/231 (96%)	220 (99%)	2 (1%)	78	92
2	B	95/95 (100%)	94 (99%)	1 (1%)	73	90
2	E	95/95 (100%)	95 (100%)	0	100	100
3	C	6/6 (100%)	6 (100%)	0	100	100
3	F	6/6 (100%)	6 (100%)	0	100	100
4	G	174/179 (97%)	171 (98%)	3 (2%)	60	84
4	I	174/179 (97%)	173 (99%)	1 (1%)	86	95
5	H	212/214 (99%)	212 (100%)	0	100	100
5	J	211/214 (99%)	210 (100%)	1 (0%)	88	96
All	All	1419/1450 (98%)	1408 (99%)	11 (1%)	81	93

5 of 11 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	G	73	VAL
4	G	143	GLN
5	J	72	GLU
4	I	132	VAL
1	A	197	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 27 such sidechains are listed below:

Mol	Chain	Res	Type
4	G	172	ASN
4	I	69	GLN
5	J	25	GLN
4	I	52	ASN
4	I	111	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	267/275 (97%)	-0.15	6 (2%) 62 60	20, 37, 67, 84	5 (1%)
1	D	265/275 (96%)	-0.10	10 (3%) 40 36	19, 35, 74, 91	5 (1%)
2	B	100/100 (100%)	-0.22	2 (2%) 65 63	21, 34, 54, 75	1 (1%)
2	E	100/100 (100%)	-0.25	1 (1%) 82 82	21, 33, 53, 72	1 (1%)
3	C	9/9 (100%)	-0.48	0 100 100	36, 38, 38, 39	0
3	F	9/9 (100%)	-0.50	0 100 100	29, 31, 33, 34	0
4	G	201/206 (97%)	0.62	21 (10%) 6 4	39, 63, 98, 107	2 (0%)
4	I	201/206 (97%)	0.82	32 (15%) 1 1	34, 65, 119, 144	3 (1%)
5	H	241/243 (99%)	0.30	10 (4%) 37 32	39, 56, 77, 91	0
5	J	240/243 (98%)	0.42	8 (3%) 46 41	40, 61, 93, 115	0
All	All	1633/1666 (98%)	0.21	90 (5%) 25 21	19, 50, 93, 144	17 (1%)

The worst 5 of 90 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	I	201	PRO	9.7
4	I	127	SER	9.2
5	J	225	ASP	5.3
4	I	200	SER	4.8
4	G	203	PRO	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 [i](#)

There are no ligands in this entry.

### 6.5 Other polymers [i](#)

There are no such residues in this entry.