



# Full wwPDB X-ray Structure Validation Report ⓘ

May 6, 2024 – 10:13 AM JST

PDB ID : 8WTE  
Title : Crystal structure of TCR in complex with HLA-A\*11:01 bound to KRAS-G12V peptide (VVGAVGVGK)  
Authors : Zhang, M.Y.; Luo, L.J.; Xu, W.; Guan, F.H.; Wang, X.Y.; Zhu, P.; Zhang, J.H.; Zhou, X.Y.; Wang, F.; Ye, S.  
Deposited on : 2023-10-18  
Resolution : 2.17 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 : 2.36.2  
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) : 2.36.2

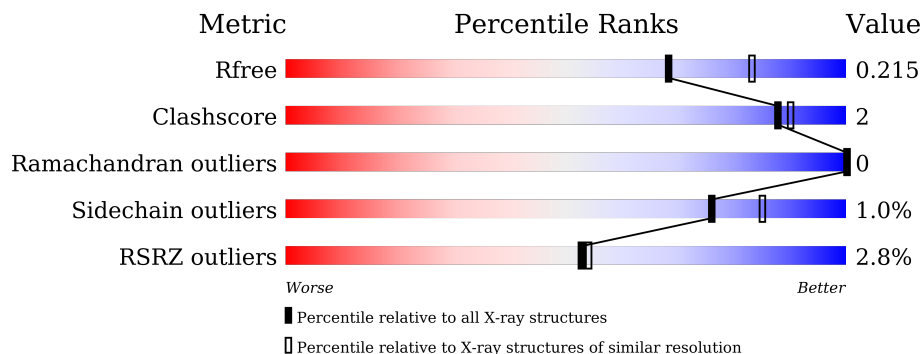
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.17 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.



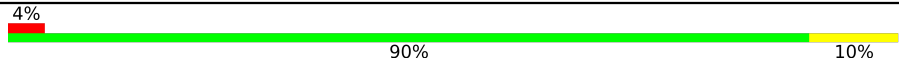
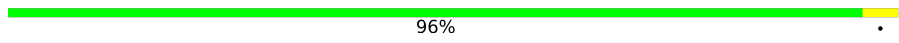
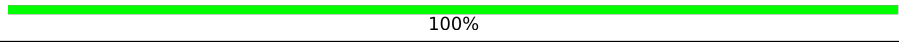
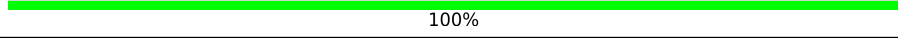
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	6864 (2.20-2.16)
Clashscore	141614	7689 (2.20-2.16)
Ramachandran outliers	138981	7564 (2.20-2.16)
Sidechain outliers	138945	7564 (2.20-2.16)
RSRZ outliers	127900	6738 (2.20-2.16)

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  $\geq 3$ , 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	198	 6% 81% 12% 8%
1	C	198	 6% 83% 9% 8%
2	B	239	 3% 94% 5% 8%
2	D	239	 2% 92% 8% 8%
3	E	275	 % 96% 8% 8%
3	H	275	 % 95% 8% 8%

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Mol	Chain	Length	Quality of chain
4	F	99	 4% 90% 10%
4	I	99	 96%
5	G	9	 100%
5	J	9	 100%

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 13431 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 T-cell receptor alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	183	1433	895	242	285	11	0	0	0
1	C	182	1423	887	242	283	11	0	0	0

- Molecule 2 is a protein called T-cell receptor beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	236	1904	1209	331	355	9	0	0	0
2	D	239	1923	1219	334	361	9	0	0	0

- Molecule 3 is a protein called MHC class I antigen (Fragment).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	H	274	2235	1389	407	430	9	0	0	0
3	E	275	2244	1394	408	433	9	0	0	0

- Molecule 4 is a protein called Beta-2-microglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	I	99	828	528	140	157	3	0	0	0
4	F	99	828	528	140	157	3	0	0	0

- Molecule 5 is a protein called KRAS-G12V nonamer peptide.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
5	J	9	Total	C	N	O	0	0	0
			54	35	10	9			
5	G	9	Total	C	N	O	0	0	0
			54	35	10	9			

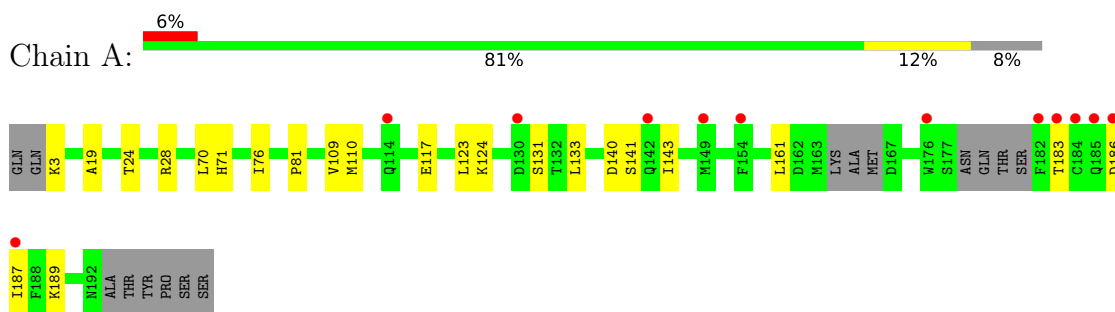
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	57	Total	O	0	0
			57	57		
6	B	61	Total	O	0	0
			61	61		
6	H	123	Total	O	0	0
			123	123		
6	I	42	Total	O	0	0
			42	42		
6	J	2	Total	O	0	0
			2	2		
6	C	60	Total	O	0	0
			60	60		
6	D	68	Total	O	0	0
			68	68		
6	E	68	Total	O	0	0
			68	68		
6	F	18	Total	O	0	0
			18	18		
6	G	6	Total	O	0	0
			6	6		

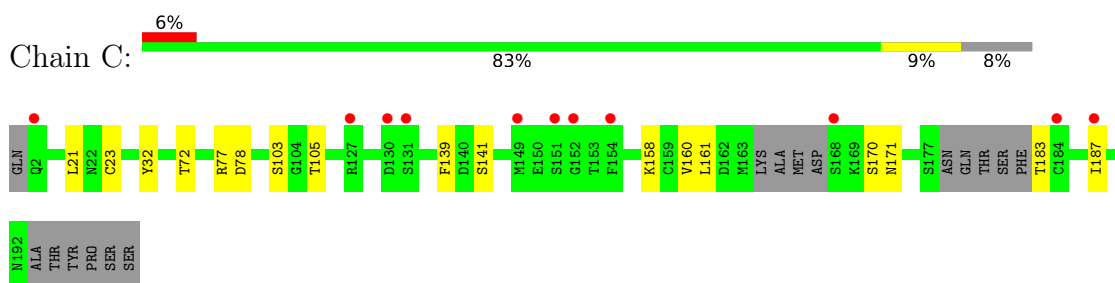
### 3 Residue-property plots [i](#)

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.

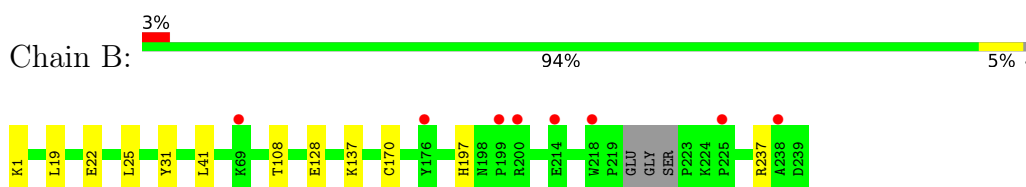
- Molecule 1: T-cell receptor alpha chain



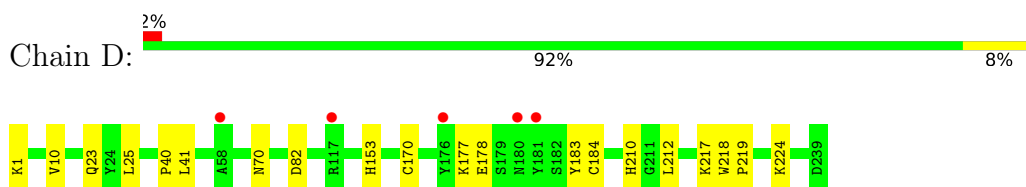
- Molecule 1: T-cell receptor alpha chain



- Molecule 2: T-cell receptor beta chain



- Molecule 2: T-cell receptor beta chain



- Molecule 3: MHC class I antigen (Fragment)



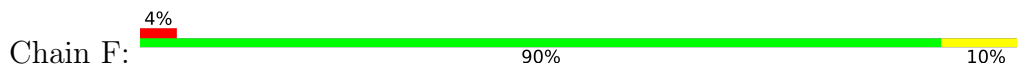
- Molecule 3: MHC class I antigen (Fragment)



- Molecule 4: Beta-2-microglobulin



- Molecule 4: Beta-2-microglobulin



- Molecule 5: KRAS-G12V nonamer peptide



There are no outlier residues recorded for this chain.

- Molecule 5: KRAS-G12V nonamer peptide



There are no outlier residues recorded for this chain.

## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	45.60Å 96.14Å 117.79Å 80.83° 82.14° 78.59°	Depositor
Resolution (Å)	39.01 – 2.17 115.59 – 2.17	Depositor EDS
% Data completeness (in resolution range)	96.0 (39.01-2.17) 96.0 (115.59-2.17)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.65 (at 2.16Å)	Xtrriage
Refinement program	PHENIX 1.17.1_3660	Depositor
R, $R_{free}$	0.171 , 0.216 0.171 , 0.215	Depositor DCC
$R_{free}$ test set	4771 reflections (4.87%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	38.3	Xtrriage
Anisotropy	0.500	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 54.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	13431	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	52.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.72% 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	0.35	0/1464	0.53	0/1979
1	C	0.37	0/1453	0.54	0/1964
2	B	0.34	0/1956	0.50	0/2648
2	D	0.34	0/1976	0.52	0/2677
3	E	0.32	0/2305	0.50	0/3129
3	H	0.35	0/2296	0.52	0/3117
4	F	0.31	0/851	0.53	0/1152
4	I	0.34	0/851	0.52	0/1152
5	G	0.39	0/53	0.54	0/70
5	J	0.42	0/53	0.52	0/70
All	All	0.34	0/13258	0.52	0/17958

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	1433	0	1367	13	0
1	C	1423	0	1362	9	0
2	B	1904	0	1845	6	0
2	D	1923	0	1859	11	0
3	E	2244	0	2091	5	0
3	H	2235	0	2085	6	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	F	828	0	794	5	0
4	I	828	0	794	2	0
5	G	54	0	65	0	0
5	J	54	0	65	0	0
6	A	57	0	0	1	0
6	B	61	0	0	0	0
6	C	60	0	0	0	0
6	D	68	0	0	1	0
6	E	68	0	0	0	0
6	F	18	0	0	1	0
6	G	6	0	0	0	0
6	H	123	0	0	0	0
6	I	42	0	0	0	0
6	J	2	0	0	0	0
All	All	13431	0	12327	51	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 2.

All (51) 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)
4:I:45:ARG:NH1	4:I:47:GLU:OE1	2.29	0.66
2:D:217:LYS:NZ	6:D:302:HOH:O	2.31	0.64
1:A:28:ARG:HA	1:A:70:LEU:HD11	1.80	0.62
1:C:141:SER:O	1:C:158:LYS:NZ	2.35	0.58
4:F:58:LYS:NZ	6:F:101:HOH:O	2.37	0.56
2:B:128:GLU:OE2	2:B:237:ARG:NH2	2.39	0.56
1:C:21:LEU:HD22	1:C:105:THR:HG21	1.88	0.54
1:C:77:ARG:NH1	1:C:78:ASP:OD2	2.40	0.53
1:A:140:ASP:H	1:A:143:ILE:HD12	1.73	0.52
2:B:1:LYS:HB2	2:B:25:LEU:HD21	1.90	0.52
4:F:39:LEU:HD23	4:F:68:THR:HG22	1.92	0.51
1:C:161:LEU:HB3	2:D:170:CYS:HB2	1.93	0.50
1:A:124:LYS:HD2	1:A:131:SER:O	2.12	0.50
3:H:219:ARG:HD3	3:H:257:TYR:CZ	2.46	0.50
3:H:117:ALA:HB2	4:I:60:TRP:CE2	2.48	0.48
2:D:178:GLU:OE1	2:D:184:CYS:HB3	2.14	0.48
1:A:3:LYS:NZ	6:A:206:HOH:O	2.45	0.48
3:H:9:TYR:CE2	3:H:70:GLN:HG2	2.49	0.48
2:D:1:LYS:HB3	2:D:25:LEU:HD21	1.96	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:110:MET:HB3	1:A:141:SER:HB3	1.95	0.47
4:F:78:TYR:H	4:F:94:LYS:HE2	1.79	0.47
1:C:139:PHE:HE1	1:C:158:LYS:HD2	1.80	0.46
2:D:10:VAL:HG21	2:D:212:LEU:HD23	1.98	0.46
3:H:191:HIS:CD2	3:H:254:GLU:HG2	2.51	0.45
3:H:214:THR:HB	3:H:262:GLN:HB2	1.98	0.45
1:A:117:GLU:HB2	2:B:137:LYS:HE2	1.99	0.45
3:E:181:ARG:HD2	3:E:181:ARG:HA	1.77	0.45
1:A:186:ASP:HA	1:A:189:LYS:HG3	1.99	0.45
1:A:19:ALA:HB3	1:A:76:ILE:HB	1.99	0.44
1:C:183:THR:O	1:C:187:ILE:HG13	2.17	0.44
2:D:177:LYS:HG2	2:D:183:TYR:CE2	2.53	0.43
1:C:160:VAL:HG22	1:C:171:ASN:OD1	2.18	0.43
1:C:103:SER:O	2:D:40:PRO:HG3	2.17	0.43
3:E:117:ALA:HB2	4:F:60:TRP:CE2	2.54	0.43
1:A:161:LEU:HB3	2:B:170:CYS:HB2	2.01	0.42
1:A:183:THR:O	1:A:187:ILE:HG13	2.19	0.42
3:H:182:THR:HG23	3:H:210:PRO:HD2	2.01	0.42
1:A:123:LEU:HB2	1:A:133:LEU:HD12	2.02	0.42
3:E:129:ASP:O	3:E:131:ARG:HG2	2.20	0.42
3:E:191:HIS:CD2	3:E:254:GLU:HG2	2.55	0.42
3:E:9:TYR:CE2	3:E:70:GLN:HG2	2.55	0.41
2:D:212:LEU:HD12	2:D:224:LYS:HG3	2.02	0.41
2:D:218:TRP:CD2	2:D:219:PRO:HD2	2.56	0.41
1:A:24:THR:HG22	1:A:71:HIS:HD2	1.85	0.41
1:C:23:CYS:HB3	1:C:72:THR:CG2	2.51	0.41
2:D:153:HIS:HB3	2:D:210:HIS:HB2	2.02	0.41
2:B:197:HIS:HA	2:B:237:ARG:O	2.20	0.41
2:D:23:GLN:O	2:D:70:ASN:HB3	2.21	0.41
4:F:94:LYS:HD3	4:F:95:TRP:N	2.36	0.41
1:A:81:PRO:HA	1:A:109:VAL:HB	2.04	0.40
2:B:19:LEU:HD22	2:B:108:THR:HG21	2.03	0.40

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	177/198 (89%)	175 (99%)	2 (1%)	0	100	100
1	C	176/198 (89%)	175 (99%)	1 (1%)	0	100	100
2	B	232/239 (97%)	222 (96%)	10 (4%)	0	100	100
2	D	237/239 (99%)	228 (96%)	9 (4%)	0	100	100
3	E	273/275 (99%)	269 (98%)	4 (2%)	0	100	100
3	H	272/275 (99%)	270 (99%)	2 (1%)	0	100	100
4	F	97/99 (98%)	97 (100%)	0	0	100	100
4	I	97/99 (98%)	96 (99%)	1 (1%)	0	100	100
5	G	7/9 (78%)	6 (86%)	1 (14%)	0	100	100
5	J	7/9 (78%)	5 (71%)	2 (29%)	0	100	100
All	All	1575/1640 (96%)	1543 (98%)	32 (2%)	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	165/178 (93%)	165 (100%)	0	100	100
1	C	164/178 (92%)	162 (99%)	2 (1%)	71	81
2	B	209/211 (99%)	206 (99%)	3 (1%)	67	78
2	D	211/211 (100%)	209 (99%)	2 (1%)	78	87
3	E	232/232 (100%)	230 (99%)	2 (1%)	78	87
3	H	231/232 (100%)	230 (100%)	1 (0%)	91	95
4	F	94/94 (100%)	91 (97%)	3 (3%)	39	47
4	I	94/94 (100%)	93 (99%)	1 (1%)	73	83

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
5	G	5/5 (100%)	5 (100%)	0	100	100
5	J	5/5 (100%)	5 (100%)	0	100	100
All	All	1410/1440 (98%)	1396 (99%)	14 (1%)	76	85

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	22	GLU
2	B	31	TYR
2	B	41	LEU
3	H	35	ARG
4	I	70	PHE
1	C	32	TYR
1	C	170	SER
2	D	41	LEU
2	D	82	ASP
3	E	35	ARG
3	E	116	ASP
4	F	34	ASP
4	F	47	GLU
4	F	70	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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	183/198 (92%)	0.58	12 (6%) 18 19	26, 49, 109, 145	0
1	C	182/198 (91%)	0.55	11 (6%) 21 23	28, 46, 95, 126	0
2	B	236/239 (98%)	0.54	8 (3%) 45 46	27, 53, 88, 118	0
2	D	239/239 (100%)	0.44	5 (2%) 63 64	28, 49, 86, 115	0
3	E	275/275 (100%)	0.33	2 (0%) 87 88	29, 51, 80, 103	0
3	H	274/275 (99%)	0.36	3 (1%) 80 80	25, 40, 87, 108	0
4	F	99/99 (100%)	0.74	4 (4%) 38 39	39, 62, 86, 113	0
4	I	99/99 (100%)	0.36	0 100 100	30, 46, 72, 78	0
5	G	9/9 (100%)	0.53	0 100 100	33, 37, 39, 40	0
5	J	9/9 (100%)	0.21	0 100 100	30, 31, 35, 37	0
All	All	1605/1640 (97%)	0.46	45 (2%) 53 54	25, 49, 88, 145	0

All (45) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	182	PHE	4.4
1	C	149	MET	4.2
1	C	184	CYS	4.1
1	C	152	GLY	4.0
1	A	149	MET	3.9
1	A	176	TRP	3.8
1	C	130	ASP	3.6
1	A	183	THR	3.5
2	D	58	ALA	3.5
3	H	222	GLU	3.5
1	A	187	ILE	3.4
3	E	194	ILE	3.3
2	B	199	PRO	3.2

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Mol	Chain	Res	Type	RSRZ
1	A	185	GLN	3.2
1	A	130	ASP	3.1
2	B	238	ALA	3.1
3	E	1	GLY	3.0
4	F	67	TYR	3.0
4	F	22	PHE	3.0
1	C	2	GLN	2.9
1	C	168	SER	2.8
1	A	154	PHE	2.8
4	F	50	GLU	2.8
1	A	186	ASP	2.8
3	H	226	GLN	2.8
2	B	176	TYR	2.7
3	H	224	GLN	2.6
1	A	114	GLN	2.6
2	D	180	ASN	2.5
2	B	225	PRO	2.5
1	C	154	PHE	2.5
2	B	218	TRP	2.4
1	C	151	SER	2.4
2	D	176	TYR	2.4
1	A	184	CYS	2.3
1	A	142	GLN	2.3
1	C	127	ARG	2.3
2	B	69	LYS	2.3
1	C	187	ILE	2.3
1	C	131	SER	2.2
2	D	117	ARG	2.2
2	B	214	GLU	2.2
2	B	200	ARG	2.1
2	D	181	TYR	2.0
4	F	66	TYR	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

There are no ligands in this entry.

## 6.5 Other polymers

There are no such residues in this entry.