



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 3, 2024 – 08:53 pm GMT

PDB ID : 4ZCH  
Title : Single-chain human APRIL-BAFF-BAFF Heterotrimer  
Authors : Lammens, A.; Jiang, X.; Maskos, K.; Schneider, P.  
Deposited on : 2015-04-16  
Resolution : 2.43 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  
Mogul : 1.8.4, CSD as541be (2020)  
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

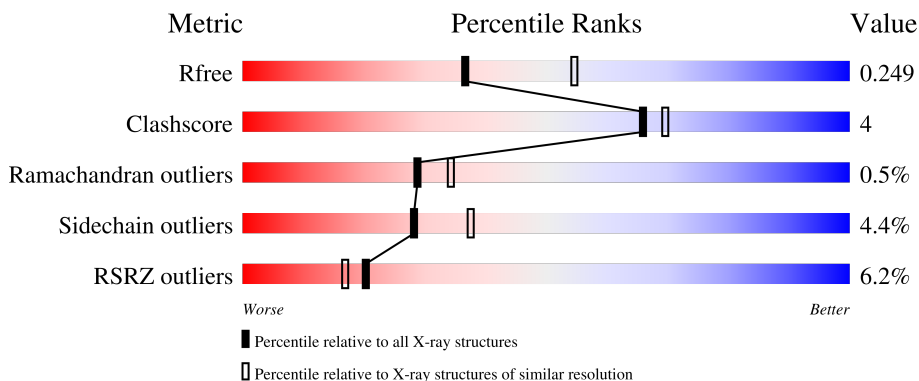
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*


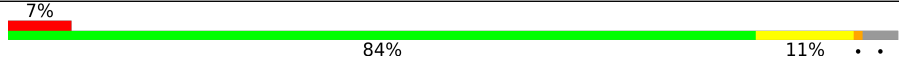
The reported resolution of this entry is 2.43 Å.

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	1564 (2.46-2.42)
Clashscore	141614	1631 (2.46-2.42)
Ramachandran outliers	138981	1617 (2.46-2.42)
Sidechain outliers	138945	1617 (2.46-2.42)
RSRZ outliers	127900	1547 (2.46-2.42)

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  $\geq 3$ , 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	438	
1	B	438	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 6997 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.

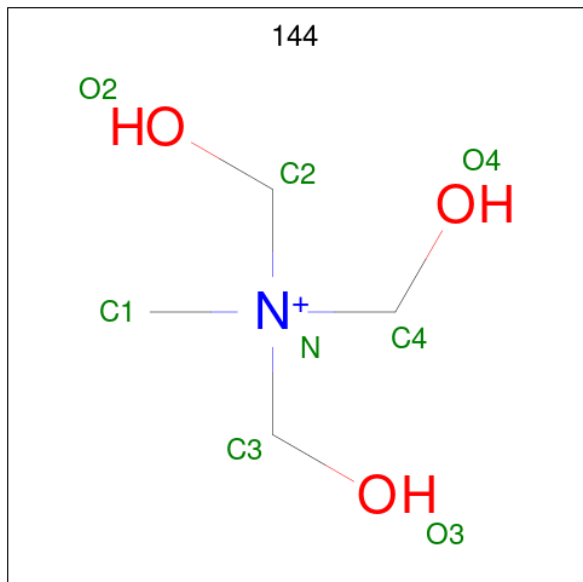
- Molecule 1 is a protein called Tumor necrosis factor ligand superfamily member 13, Tumor necrosis factor ligand superfamily member 13B, Tumor necrosis factor ligand superfamily member 13B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	422	3341	2140	565	621	15	87	1	0
1	B	419	3309	2122	558	614	15	164	0	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	18	ALA	THR	conflict	UNP O75888
A	143	GLY	-	linker	UNP O75888
A	144	GLY	-	linker	UNP O75888
A	145	GLY	-	linker	UNP O75888
A	146	GLY	-	linker	UNP O75888
A	147	SER	-	linker	UNP O75888
A	294	GLY	-	linker	UNP Q9Y275
A	295	GLY	-	linker	UNP Q9Y275
A	296	GLY	-	linker	UNP Q9Y275
A	297	GLY	-	linker	UNP Q9Y275
A	298	SER	-	linker	UNP Q9Y275
B	18	ALA	THR	conflict	UNP O75888
B	143	GLY	-	linker	UNP O75888
B	144	GLY	-	linker	UNP O75888
B	145	GLY	-	linker	UNP O75888
B	146	GLY	-	linker	UNP O75888
B	147	SER	-	linker	UNP O75888
B	294	GLY	-	linker	UNP Q9Y275
B	295	GLY	-	linker	UNP Q9Y275
B	296	GLY	-	linker	UNP Q9Y275
B	297	GLY	-	linker	UNP Q9Y275
B	298	SER	-	linker	UNP Q9Y275

- Molecule 2 is TRIS-HYDROXYMETHYL-METHYL-AMMONIUM (three-letter code: 144) (formula:  $C_4H_{12}NO_3$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	8	4	1	3	0	0

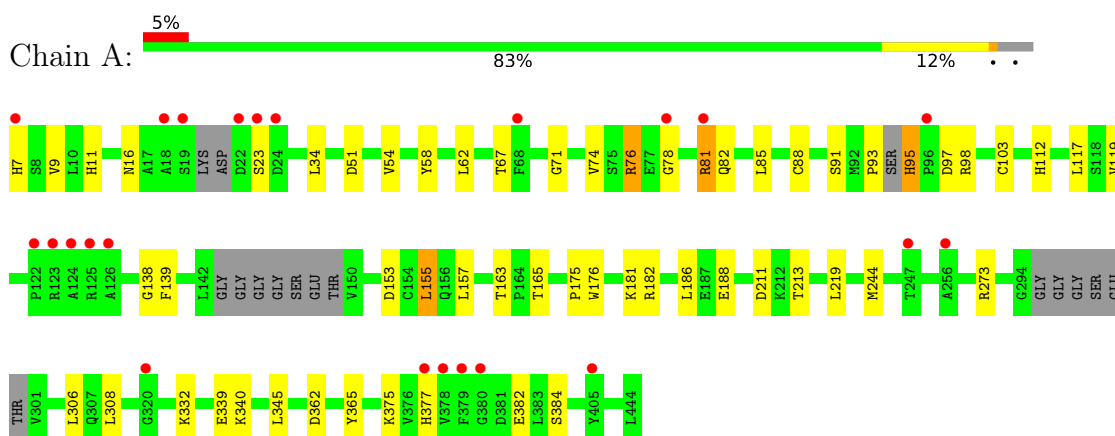
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	194	Total	O	0	0
			194	194		
3	B	145	Total	O	0	0
			145	145		

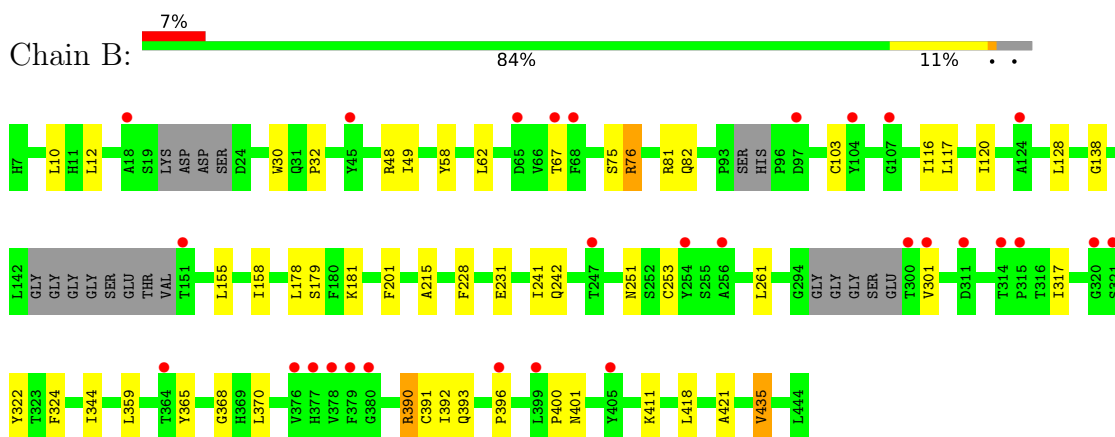
### 3 Residue-property plots

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: Tumor necrosis factor ligand superfamily member 13, Tumor necrosis factor ligand superfamily member 13B, Tumor necrosis factor ligand superfamily member 13B



- Molecule 1: Tumor necrosis factor ligand superfamily member 13, Tumor necrosis factor ligand superfamily member 13B, Tumor necrosis factor ligand superfamily member 13B



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	57.04Å 117.86Å 295.52Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.61 – 2.43 32.61 – 2.43	Depositor EDS
% Data completeness (in resolution range)	96.7 (32.61-2.43) 96.7 (32.61-2.43)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.37 (at 2.42Å)	Xtriage
Refinement program	BUSTER-TNT BUSTER 2.11.5	Depositor
R, $R_{free}$	0.177 , 0.234 0.188 , 0.249	Depositor DCC
$R_{free}$ test set	1111 reflections (3.01%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	41.4	Xtriage
Anisotropy	0.180	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.28 , 56.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	6997	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	48.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.89% 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 144

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	0.51	0/3407	0.75	0/4606
1	B	0.50	0/3374	0.72	0/4560
All	All	0.51	0/6781	0.74	0/9166

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	3341	0	3335	27	0
1	B	3309	0	3313	24	0
2	A	8	0	12	0	0
3	A	194	0	0	0	0
3	B	145	0	0	0	0
All	All	6997	0	6660	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 4.

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)
1:A:93:PRO:C	1:A:95:HIS:HB2	2.01	0.80
1:A:98:ARG:HB2	1:A:365:TYR:HD2	1.53	0.73
1:B:215:ALA:HB1	1:B:241:ILE:HD11	1.72	0.71
1:B:322:TYR:HD2	1:B:421:ALA:HB1	1.61	0.65
1:A:58:TYR:CZ	1:A:138:GLY:HA3	2.33	0.63
1:B:242:GLN:HE21	1:B:251:ASN:HB3	1.65	0.62
1:B:368:GLY:HA3	1:B:391:CYS:O	2.02	0.59
1:A:98:ARG:HD2	1:A:365:TYR:HB2	1.84	0.59
1:A:76:ARG:HG2	1:A:85:LEU:HD21	1.85	0.58
1:A:377:HIS:HB3	1:A:382:GLU:HB2	1.86	0.58
1:B:76:ARG:O	1:B:76:ARG:HG3	2.04	0.57
1:A:117:LEU:HD22	1:A:139:PHE:HE2	1.71	0.56
1:B:322:TYR:CD2	1:B:421:ALA:HB1	2.41	0.55
1:A:98:ARG:HB2	1:A:365:TYR:CD2	2.39	0.55
1:A:93:PRO:C	1:A:95:HIS:CB	2.74	0.55
1:A:76:ARG:HH12	1:A:112:HIS:HD2	1.56	0.54
1:A:11:HIS:HB3	1:A:34:LEU:HB2	1.91	0.53
1:A:74:VAL:HG22	1:A:119:VAL:HG22	1.90	0.52
1:B:75:SER:HB3	1:B:82:GLN:HE21	1.76	0.50
1:A:54:VAL:HG21	1:A:182:ARG:HD2	1.92	0.50
1:A:76:ARG:NH1	1:A:112:HIS:HD2	2.10	0.49
1:B:242:GLN:HG2	1:B:253:CYS:SG	2.52	0.49
1:B:48:ARG:HG3	1:B:116:ILE:HD13	1.95	0.49
1:A:71:GLY:HA3	1:A:88:CYS:O	2.13	0.48
1:A:308:LEU:HD21	1:A:339:GLU:HG3	1.94	0.48
1:B:228:PHE:O	1:B:231:GLU:HG2	2.14	0.48
1:A:155:LEU:HD12	1:A:181:LYS:HG3	1.96	0.47
1:B:58:TYR:CZ	1:B:138:GLY:HA3	2.50	0.47
1:B:49:ILE:HD11	1:B:117:LEU:HD13	1.96	0.47
1:A:306:LEU:HD12	1:A:332:LYS:HG3	1.98	0.46
1:B:178:LEU:HD11	1:B:181:LYS:HB2	1.98	0.45
1:A:340:LYS:HD3	1:A:345:LEU:HD22	1.99	0.45
1:B:396:PRO:HD2	1:B:400:PRO:HB3	1.99	0.45
1:B:344:ILE:HB	1:B:418:LEU:HB2	2.00	0.44
1:A:165:THR:HA	1:A:175:PRO:HD3	1.99	0.43
1:B:12:LEU:HB3	1:B:30:TRP:HB3	2.01	0.43
1:B:10:LEU:HD11	1:B:32:PRO:HB3	2.00	0.43
1:A:76:ARG:HH12	1:A:112:HIS:CD2	2.36	0.43
1:B:370:LEU:HD23	1:B:390:ARG:HD2	2.02	0.42
1:B:155:LEU:HD12	1:B:181:LYS:HG3	2.01	0.42
1:A:71:GLY:CA	1:A:88:CYS:O	2.68	0.42
1:A:157:LEU:HB3	1:A:176:TRP:HB3	2.00	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:78:GLY:HA3	1:A:81:ARG:HH21	1.84	0.42
1:A:213:THR:O	1:A:244:MET:HB2	2.20	0.42
1:B:317:ILE:HB	1:B:324:PHE:HB2	2.03	0.41
1:A:375:LYS:HB2	1:A:384:SER:HB3	2.03	0.41
1:B:201:PHE:CD1	1:B:261:LEU:HD12	2.55	0.41
1:A:93:PRO:O	1:A:95:HIS:HB2	2.19	0.41
1:B:62:LEU:HD11	1:B:392:ILE:CG2	2.50	0.41
1:B:359:LEU:HD22	1:B:435:VAL:HG21	2.02	0.41
1:B:158:ILE:HG12	1:B:179:SER:HB2	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	413/438 (94%)	395 (96%)	16 (4%)	2 (0%)	29	34
1	B	409/438 (93%)	393 (96%)	14 (3%)	2 (0%)	29	34
All	All	822/876 (94%)	788 (96%)	30 (4%)	4 (0%)	29	34

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	67	THR
1	B	67	THR
1	A	23	SER
1	B	365	TYR

### 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	365/373 (98%)	344 (94%)	21 (6%)	20	26
1	B	361/373 (97%)	350 (97%)	11 (3%)	41	53
All	All	726/746 (97%)	694 (96%)	32 (4%)	28	37

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	7	HIS
1	A	9	VAL
1	A	16	ASN
1	A	51	ASP
1	A	62	LEU
1	A	76	ARG
1	A	81	ARG
1	A	82	GLN
1	A	91	SER
1	A	95	HIS
1	A	97	ASP
1	A	103	CYS
1	A	153	ASP
1	A	155	LEU
1	A	163	THR
1	A	186	LEU
1	A	188	GLU
1	A	211	ASP
1	A	219	LEU
1	A	273	ARG
1	A	362	ASP
1	B	76	ARG
1	B	81	ARG
1	B	103	CYS
1	B	120	ILE
1	B	128	LEU
1	B	301	VAL

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Mol	Chain	Res	Type
1	B	390	ARG
1	B	393	GLN
1	B	401	ASN
1	B	411	LYS
1	B	435	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	31	GLN
1	A	101	ASN
1	A	112	HIS
1	B	82	GLN
1	B	242	GLN

### 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](#)

1 ligand is modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	144	A	501	-	1,7,7	0.48	0	3,9,9	0.29	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	144	A	501	-	-	0/0/9/9	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 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	422/438 (96%)	-0.11	23 (5%) 25 21	21, 39, 73, 109	29 (6%)
1	B	419/438 (95%)	0.11	29 (6%) 16 13	21, 48, 88, 108	53 (12%)
All	All	841/876 (96%)	-0.00	52 (6%) 20 17	21, 43, 81, 109	82 (9%)

All (52) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	379	PHE	6.1
1	B	399	LEU	5.3
1	A	379	PHE	4.6
1	B	300	THR	4.3
1	B	67	THR	4.0
1	B	301	VAL	3.7
1	B	65	ASP	3.6
1	A	18	ALA	3.6
1	B	68	PHE	3.5
1	B	124	ALA	3.5
1	A	22	ASP	3.4
1	A	78	GLY	3.4
1	A	24	ASP	3.3
1	A	378	VAL	3.3
1	A	19	SER	3.0
1	B	320	GLY	2.9
1	B	380	GLY	2.9
1	A	377	HIS	2.9
1	A	124	ALA	2.8
1	B	405	TYR	2.7
1	A	125	ARG	2.7
1	B	377	HIS	2.6
1	B	18	ALA	2.6
1	B	396	PRO	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	151	THR	2.6
1	A	81	ARG	2.5
1	B	364	THR	2.5
1	B	45	TYR	2.4
1	B	254	TYR	2.4
1	A	96	PRO	2.4
1	B	314	THR	2.4
1	A	122	PRO	2.4
1	B	378	VAL	2.3
1	A	23	SER	2.3
1	A	247	THR	2.3
1	A	7	HIS	2.3
1	B	107	GLY	2.3
1	A	405	TYR	2.3
1	A	380	GLY	2.2
1	B	376	VAL	2.2
1	B	97	ASP	2.2
1	A	126	ALA	2.2
1	A	256	ALA	2.2
1	A	123	ARG	2.1
1	B	104	TYR	2.1
1	B	247	THR	2.1
1	B	256	ALA	2.1
1	B	311	ASP	2.1
1	B	321	SER	2.1
1	A	68	PHE	2.1
1	B	315	PRO	2.0
1	A	320	GLY	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](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum,

median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	144	A	501	8/8	0.69	0.23	74,79,80,81	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.