



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 01:29 PM UTC

PDB ID : 8A44 / pdb\_00008a44  
Title : Plasmodium vivax Duffy binding protein region II bound the DARC ectodomain and monoclonal antibody DB1  
Authors : Moskovitz, R.; Higgins, M.K.  
Deposited on : 2022-06-10  
Resolution : 2.49 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 : 4-5-2 with Phenix2.0  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
CCP4 : 9.0.010 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

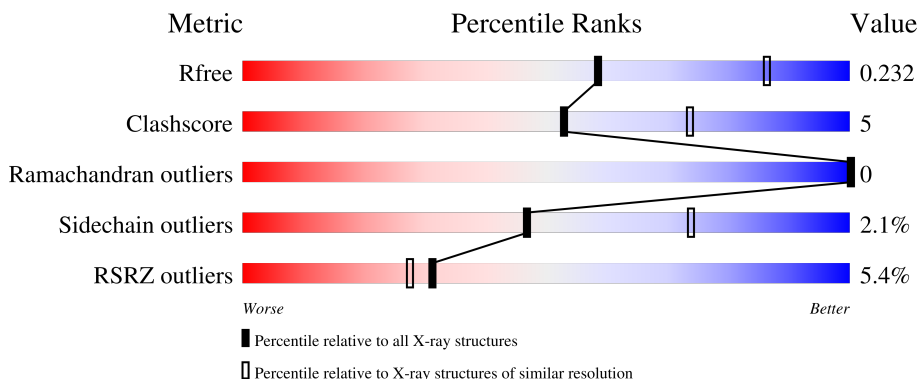
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.49 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))
$R_{free}$	180053	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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	294	 10% 81% 17%
2	B	60	 10% 37% 12% 52%
3	C	225	 3% 92% 8%
4	D	213	 92% 8%

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 6258 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 Duffy binding protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	293	2452	1552	435	448	17	0	0	0

- Molecule 2 is a protein called Atypical chemokine receptor 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	29	236	144	34	57	1	0	0	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	4	ALA	CYS	engineered mutation	UNP A0A1P8P1S7
B	51	ALA	CYS	engineered mutation	UNP A0A1P8P1S7
B	54	ALA	CYS	engineered mutation	UNP A0A1P8P1S7

- Molecule 3 is a protein called Heavy chain of monoclonal antibody DB1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	C	225	1688	1072	272	336	8	0	0	0

- Molecule 4 is a protein called Light chain of monoclonal antibody DB1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	D	213	1632	1022	273	332	5	0	0	0

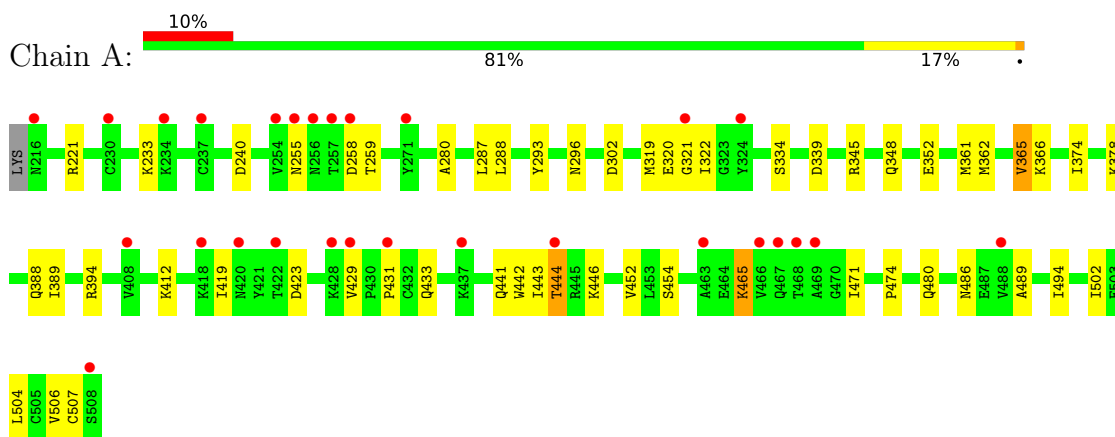
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	46	Total O 46 46	0	0
5	B	1	Total O 1 1	0	0
5	C	106	Total O 106 106	0	0
5	D	97	Total O 97 97	0	0

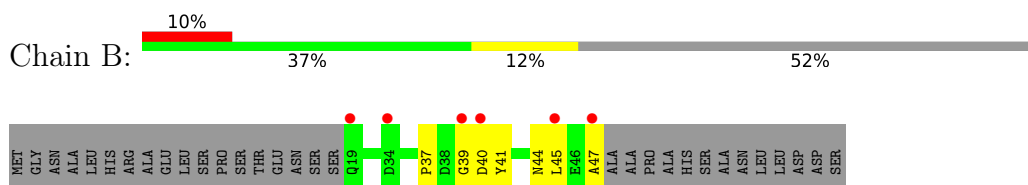
### 3 Residue-property plots [i](#)

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.

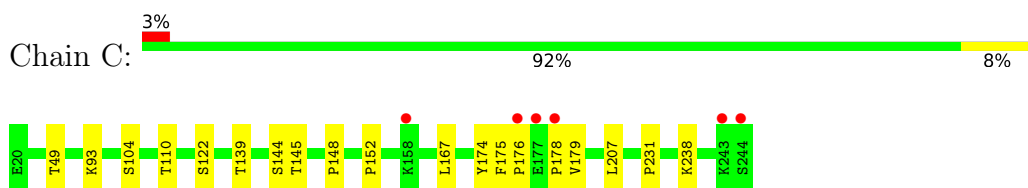
- Molecule 1: Duffy binding protein



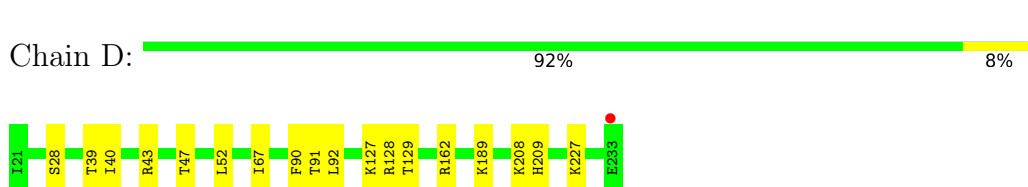
- Molecule 2: Atypical chemokine receptor 1



- Molecule 3: Heavy chain of monoclonal antibody DB1



- Molecule 4: Light chain of monoclonal antibody DB1



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	52.20Å 97.95Å 287.99Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	72.00 – 2.49 72.00 – 2.49	Depositor EDS
% Data completeness (in resolution range)	99.8 (72.00-2.49) 99.8 (72.00-2.49)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.13 (at 2.48Å)	Xtrriage
Refinement program	BUSTER	Depositor
R, $R_{free}$	0.196 , 0.225 0.206 , 0.232	Depositor DCC
$R_{free}$ test set	2633 reflections (4.82%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	56.4	Xtrriage
Anisotropy	0.302	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 42.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	6258	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	67.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.76% 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](#)

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

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	0.34	0/2501	0.51	0/3366
2	B	0.49	0/224	0.72	0/304
3	C	0.42	0/1732	0.61	0/2357
4	D	0.40	0/1666	0.60	0/2263
All	All	0.39	0/6123	0.58	0/8290

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	2452	0	2437	36	0
2	B	236	0	184	5	0
3	C	1688	0	1642	12	0
4	D	1632	0	1596	12	0
5	A	46	0	0	1	0
5	B	1	0	0	0	0
5	C	106	0	0	1	0
5	D	97	0	0	1	0
All	All	6258	0	5859	59	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 5.

All (59) 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:319:MET:HE1	1:A:389:ILE:HB	1.73	0.71
4:D:162:ARG:HH11	4:D:162:ARG:HG2	1.56	0.71
1:A:394:ARG:HH22	1:A:480:GLN:HE22	1.45	0.64
1:A:348:GLN:O	1:A:352:GLU:HG2	1.96	0.64
4:D:39:THR:HG23	4:D:91:THR:HG23	1.80	0.64
1:A:221:ARG:NH1	1:A:240:ASP:OD2	2.32	0.63
1:A:280:ALA:HB1	1:A:361:MET:HG3	1.80	0.63
3:C:176:PRO:HD2	3:C:231:PRO:HB2	1.81	0.61
3:C:178:PRO:HG3	5:C:403:HOH:O	2.00	0.60
4:D:208:LYS:HE3	4:D:209:HIS:NE2	2.17	0.60
4:D:128:ARG:HG2	4:D:129:THR:N	2.20	0.56
1:A:394:ARG:HH12	1:A:480:GLN:HE21	1.53	0.56
1:A:319:MET:HE3	1:A:388:GLN:HB3	1.88	0.55
1:A:293:TYR:HB3	2:B:47:ALA:HB2	1.89	0.55
3:C:207:LEU:C	3:C:207:LEU:HD12	2.31	0.55
1:A:320:GLU:HG2	1:A:322:ILE:HD12	1.88	0.54
1:A:441:GLN:O	1:A:444:THR:HG22	2.08	0.53
1:A:233:LYS:NZ	1:A:321:GLY:H	2.07	0.53
3:C:176:PRO:HG2	3:C:231:PRO:HG2	1.92	0.51
1:A:288:LEU:HD22	1:A:365:VAL:HG13	1.93	0.50
4:D:127:LYS:HG3	4:D:128:ARG:N	2.26	0.50
1:A:412:LYS:HE2	1:A:504:LEU:HD11	1.92	0.50
1:A:454:SER:HB3	1:A:474:PRO:HG2	1.94	0.49
1:A:443:ILE:HD11	1:A:494:ILE:HA	1.94	0.49
4:D:40:ILE:HD12	4:D:92:LEU:HD23	1.94	0.49
3:C:176:PRO:HD2	3:C:231:PRO:CB	2.43	0.48
1:A:258:ASP:O	1:A:259:THR:HB	2.14	0.48
4:D:208:LYS:HG2	4:D:208:LYS:O	2.14	0.48
3:C:152:PRO:HD3	3:C:238:LYS:HE2	1.95	0.48
1:A:465:LYS:HD3	1:A:465:LYS:O	2.13	0.48
1:A:296:ASN:HD22	2:B:44:ASN:HD21	1.61	0.47
1:A:429:VAL:O	1:A:433:GLN:HG3	2.15	0.47
4:D:227:LYS:HA	4:D:227:LYS:HD3	1.77	0.46
4:D:189:LYS:NZ	5:D:303:HOH:O	2.48	0.46
3:C:148:PRO:HB3	3:C:174:TYR:HB3	1.98	0.46
1:A:442:TRP:NE1	1:A:446:LYS:HE2	2.31	0.45
4:D:52:LEU:HD22	4:D:90:PHE:CG	2.51	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:287:LEU:HD13	1:A:302:ASP:HB3	1.98	0.44
1:A:465:LYS:HB2	1:A:465:LYS:HE2	1.72	0.44
1:A:221:ARG:HH12	1:A:240:ASP:CG	2.24	0.44
1:A:374:ILE:HG22	2:B:37:PRO:HD2	2.00	0.44
1:A:255:ASN:ND2	5:A:601:HOH:O	2.50	0.44
1:A:334:SER:HB2	3:C:122:SER:O	2.18	0.44
1:A:296:ASN:HD22	2:B:44:ASN:ND2	2.16	0.44
1:A:374:ILE:HD12	2:B:39:GLY:HA3	1.99	0.44
1:A:419:ILE:HG23	1:A:423:ASP:HB2	1.99	0.44
3:C:179:VAL:HG13	3:C:207:LEU:HD21	1.99	0.43
1:A:486:ASN:HB3	1:A:489:ALA:HB3	2.01	0.43
1:A:394:ARG:HH12	1:A:480:GLN:NE2	2.17	0.42
3:C:110:THR:HG23	3:C:139:THR:HA	2.01	0.42
4:D:43:ARG:HE	4:D:43:ARG:HB2	1.51	0.42
1:A:429:VAL:HG12	1:A:431:PRO:HD2	2.01	0.42
3:C:145:THR:HA	3:C:175:PHE:O	2.20	0.41
1:A:362:MET:O	1:A:366:LYS:HB2	2.20	0.41
3:C:49:THR:HG22	3:C:93:LYS:HD2	2.01	0.41
4:D:67:ILE:HD12	4:D:92:LEU:HD12	2.01	0.41
1:A:339:ASP:CG	1:A:345:ARG:HH22	2.29	0.40
1:A:446:LYS:HA	1:A:446:LYS:HD3	1.89	0.40
1:A:502:ILE:HA	1:A:506:VAL:HG23	2.04	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	291/294 (99%)	281 (97%)	10 (3%)	0	100	100
2	B	26/60 (43%)	23 (88%)	3 (12%)	0	100	100
3	C	223/225 (99%)	215 (96%)	8 (4%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
4	D	211/213 (99%)	203 (96%)	8 (4%)	0	100	100
All	All	751/792 (95%)	722 (96%)	29 (4%)	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	270/271 (100%)	263 (97%)	7 (3%)	40	68
2	B	24/48 (50%)	22 (92%)	2 (8%)	10	22
3	C	189/189 (100%)	186 (98%)	3 (2%)	55	79
4	D	188/188 (100%)	186 (99%)	2 (1%)	65	84
All	All	671/696 (96%)	657 (98%)	14 (2%)	47	74

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

Mol	Chain	Res	Type
1	A	365	VAL
1	A	378	LYS
1	A	444	THR
1	A	452	VAL
1	A	465	LYS
1	A	471	ILE
1	A	507	CYS
2	B	40	ASP
2	B	45	LEU
3	C	104	SER
3	C	144	SER
3	C	167	LEU
4	D	28	SER
4	D	47	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11)

such sidechains are listed below:

Mol	Chain	Res	Type
1	A	291	ASN
1	A	296	ASN
1	A	343	GLN
1	A	344	GLN
1	A	380	ASN
1	A	480	GLN
1	A	495	ASN
2	B	19	GLN
3	C	228	ASN
4	D	157	ASN
4	D	219	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](#)

1 non-standard protein/DNA/RNA residue 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	TYS	B	41	2	15,16,17	2.76	3 (20%)	15,22,24	1.35	2 (13%)

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	TYS	B	41	2	-	4/10/11/13	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	41	TYS	OH-S	7.97	1.73	1.58
2	B	41	TYS	OH-CZ	-5.68	1.33	1.42
2	B	41	TYS	O3-S	-2.01	1.38	1.50

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	41	TYS	OH-S-O2	-3.17	97.91	107.56
2	B	41	TYS	O3-S-O1	2.16	116.12	108.56

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	41	TYS	N-CA-CB-CG
2	B	41	TYS	C-CA-CB-CG
2	B	41	TYS	CA-CB-CG-CD2
2	B	41	TYS	CA-CB-CG-CD1

There are no ring outliers.

No monomer is involved in short contacts.

## 5.5 Carbohydrates [i](#)

There are no oligosaccharides 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	293/294 (99%)	0.52	28 (9%) <b>13</b> <b>11</b>	46, 80, 127, 158	0
2	B	28/60 (46%)	0.82	6 (21%) <b>2</b> <b>2</b>	58, 85, 110, 126	0
3	C	225/225 (100%)	-0.20	6 (2%) 56 51	40, 52, 70, 101	0
4	D	213/213 (100%)	-0.05	1 (0%) 87 85	43, 58, 74, 108	0
All	All	759/792 (95%)	0.16	41 (5%) 31 27	40, 60, 120, 158	0

All (41) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	466	VAL	5.1
2	B	47	ALA	4.4
1	A	257	THR	4.0
1	A	321	GLY	3.7
1	A	508	SER	3.7
3	C	177	GLU	3.6
1	A	256	ASN	3.4
3	C	244	SER	3.4
4	D	233	GLU	3.3
1	A	254	VAL	3.2
3	C	158	LYS	3.2
1	A	258	ASP	3.0
3	C	178	PRO	2.9
1	A	255	ASN	2.9
1	A	324	TYR	2.9
1	A	469	ALA	2.8
2	B	40	ASP	2.8
1	A	428	LYS	2.8
3	C	243	LYS	2.7
1	A	429	VAL	2.7
1	A	216	ASN	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	237	CYS	2.5
1	A	408	VAL	2.4
2	B	39	GLY	2.3
1	A	467	GLN	2.3
2	B	19	GLN	2.3
2	B	34	ASP	2.3
1	A	422	THR	2.3
1	A	468	THR	2.3
1	A	234	LYS	2.3
1	A	420	ASN	2.2
2	B	45	LEU	2.2
1	A	444	THR	2.2
1	A	418	LYS	2.1
3	C	176	PRO	2.1
1	A	431	PRO	2.1
1	A	488	VAL	2.0
1	A	463	ALA	2.0
1	A	437	LYS	2.0
1	A	230	CYS	2.0
1	A	271	TYR	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains [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	TYS	B	41	16/17	0.94	0.12	78,84,88,90	0

## 6.3 Carbohydrates [i](#)

There are no oligosaccharides 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.