



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 10:20 AM UTC

PDB ID : 5VKK / pdb_00005vkk
Title : Crystal structure of Fab fragment of anti-CD22 Epratuzumab
Authors : Sicard, T.; Ereno-Orbea, J.; Julien, J.P.
Deposited on : 2017-04-21
Resolution : 2.01 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

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>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
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

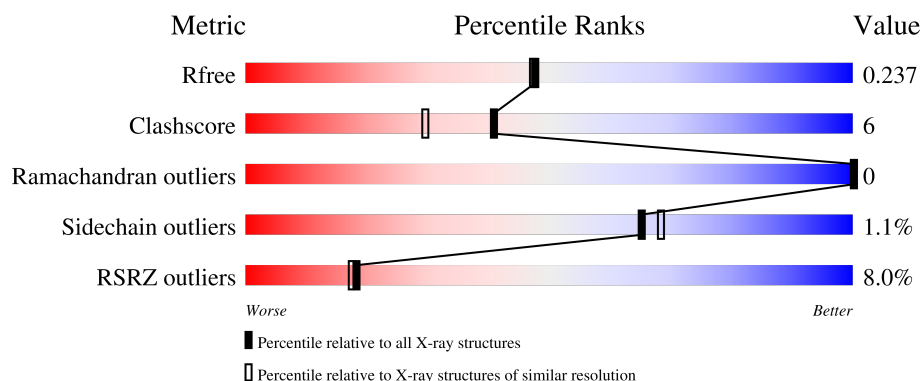
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.01 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	13299 (2.04-2.00)
Clashscore	190562	1022 (2.02-2.02)
Ramachandran outliers	187476	1014 (2.02-2.02)
Sidechain outliers	187428	1014 (2.02-2.02)
RSRZ outliers	180081	13314 (2.04-2.00)

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 ≥ 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	219	12% 85% 12% ..
1	H	219	6% 89% 11%
2	B	219	11% 79% 21%
2	L	219	3% 85% 15%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 7184 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 Epratuzumab Fab Heavy Chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	218	Total	C	N	O	S	0	0	0
			1662	1049	277	330	6			
1	A	215	Total	C	N	O	S	0	0	0
			1637	1032	274	325	6			

- Molecule 2 is a protein called Epratuzumab Fab Light Chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	219	Total	C	N	O	S	0	0	0
			1691	1060	284	341	6			
2	B	219	Total	C	N	O	S	0	0	0
			1691	1060	284	341	6			

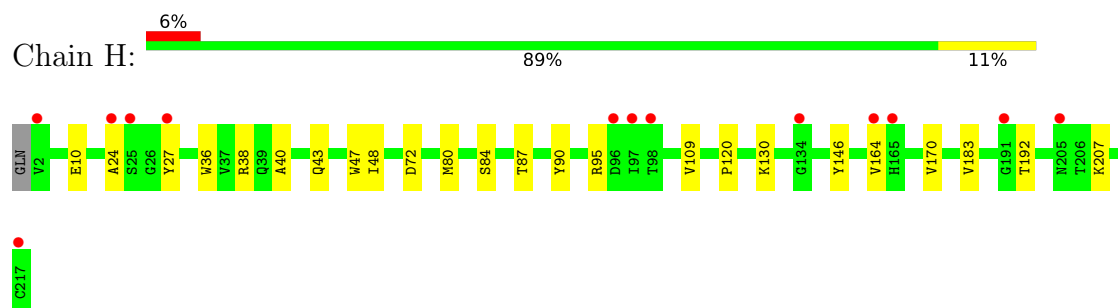
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	H	161	Total	O	0	0
			161	161		
3	L	152	Total	O	0	0
			152	152		
3	A	100	Total	O	0	0
			100	100		
3	B	90	Total	O	0	0
			90	90		

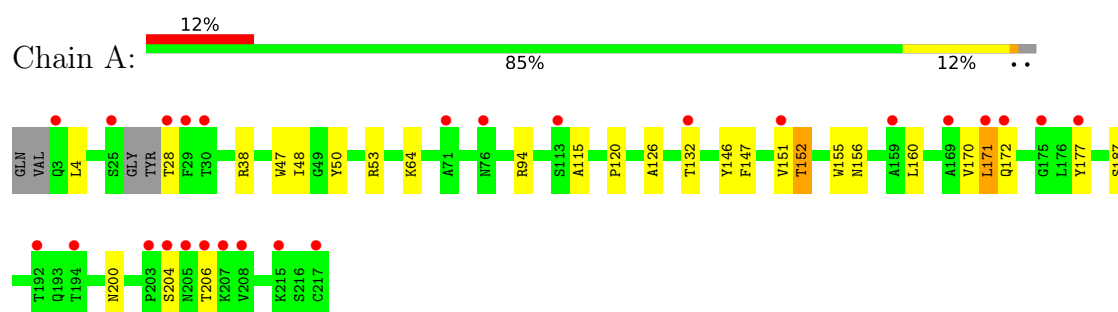
3 Residue-property plots [i](#)

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.

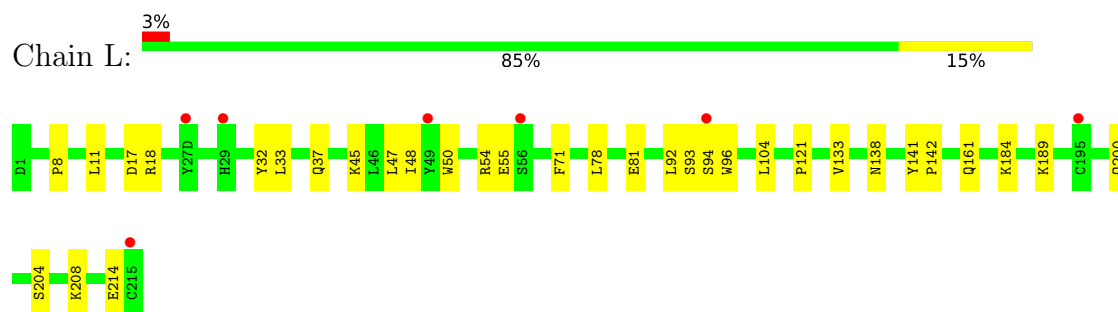
- Molecule 1: Epratuzumab Fab Heavy Chain



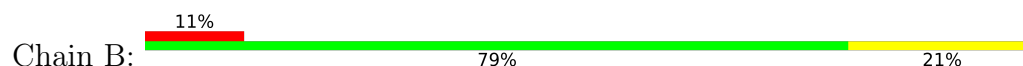
- Molecule 1: Epratuzumab Fab Heavy Chain

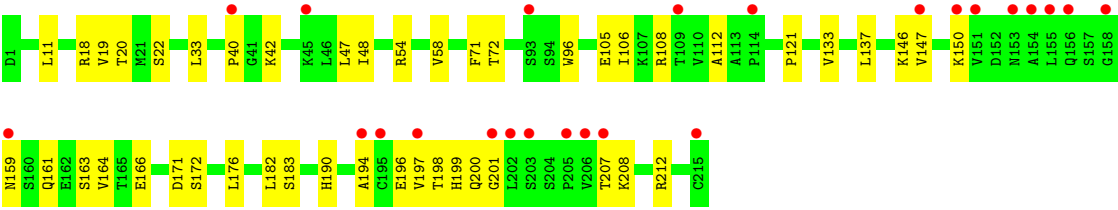


- Molecule 2: Epratuzumab Fab Light Chain



- Molecule 2: Epratuzumab Fab Light Chain





4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	56.71Å 61.56Å 65.28Å 71.81° 81.07° 75.95°	Depositor
Resolution (Å)	49.67 – 2.01 49.67 – 2.01	Depositor EDS
% Data completeness (in resolution range)	97.0 (49.67-2.01) 96.9 (49.67-2.01)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.41 (at 2.01Å)	Xtriage
Refinement program	PHENIX (1.12_2829)	Depositor
R, R_{free}	0.212 , 0.237 0.213 , 0.237	Depositor DCC
R_{free} test set	2000 reflections (3.73%)	wwPDB-VP
Wilson B-factor (Å ²)	27.7	Xtriage
Anisotropy	0.272	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 50.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	7184	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage'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.*

¹Intensities estimated from amplitudes.

²Theoretical 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	0.24	0/1678	0.52	0/2287
1	H	0.20	0/1705	0.49	0/2326
2	B	0.22	0/1730	0.52	0/2348
2	L	0.21	0/1730	0.47	0/2348
All	All	0.22	0/6843	0.50	0/9309

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	1637	0	1580	21	1
1	H	1662	0	1607	17	1
2	B	1691	0	1639	33	0
2	L	1691	0	1639	22	0
3	A	100	0	0	6	1
3	B	90	0	0	5	2
3	H	161	0	0	5	2
3	L	152	0	0	9	3
All	All	7184	0	6465	85	5

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 (85) 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:H:84:SER:OG	3:H:301:HOH:O	1.80	0.99
1:H:72:ASP:OD2	3:H:302:HOH:O	1.82	0.96
1:A:172:GLN:HA	2:B:161:GLN:HE22	1.32	0.94
2:L:18:ARG:NH1	3:L:303:HOH:O	2.08	0.87
2:B:159:ASN:HD21	2:B:182:LEU:HD21	1.42	0.83
1:A:160:LEU:O	3:A:301:HOH:O	1.98	0.81
2:L:45:LYS:NZ	3:L:306:HOH:O	2.18	0.74
1:H:120:PRO:HB3	1:H:146:TYR:HB3	1.68	0.73
1:H:170:VAL:HG11	2:L:161:GLN:HB3	1.70	0.73
2:L:214:GLU:O	3:L:301:HOH:O	2.06	0.73
2:L:81:GLU:OE2	3:L:302:HOH:O	2.07	0.73
2:B:137:LEU:HD22	2:B:176:LEU:HD23	1.71	0.72
1:A:64:LYS:O	3:A:302:HOH:O	2.07	0.72
2:B:108:ARG:HD2	2:B:172:SER:HB2	1.71	0.72
2:B:108:ARG:HH22	2:B:112:ALA:HB2	1.57	0.68
2:B:199:HIS:ND1	2:B:200:GLN:O	2.29	0.66
1:H:24:ALA:HB1	1:H:27:TYR:CE1	2.32	0.66
2:B:183:SER:HB2	3:B:330:HOH:O	1.96	0.65
2:B:146:LYS:HB3	2:B:198:THR:HB	1.77	0.65
2:B:208:LYS:NZ	3:B:302:HOH:O	2.30	0.64
1:A:120:PRO:HD2	1:A:206:THR:HG21	1.79	0.64
2:B:22:SER:HB2	3:B:323:HOH:O	1.98	0.64
2:L:200:GLN:OE1	3:L:304:HOH:O	2.16	0.60
1:A:170:VAL:HG11	2:B:161:GLN:HB3	1.84	0.60
1:A:172:GLN:HA	2:B:161:GLN:NE2	2.11	0.60
1:A:172:GLN:HG2	2:B:161:GLN:OE1	2.02	0.59
1:H:164:VAL:HG22	1:H:183:VAL:HG22	1.84	0.59
2:B:11:LEU:HD11	2:B:19:VAL:HG13	1.83	0.59
1:H:40:ALA:HB3	1:H:43:GLN:HG3	1.85	0.59
2:L:184:LYS:NZ	3:L:311:HOH:O	2.35	0.58
1:H:207:LYS:HE3	3:H:370:HOH:O	2.05	0.57
2:L:17:ASP:OD2	3:L:305:HOH:O	2.17	0.57
1:A:152:THR:HG23	1:A:200:ASN:HB2	1.87	0.56
2:B:164:VAL:HG22	2:B:176:LEU:HD13	1.86	0.56
1:A:171:LEU:HG	1:A:177:TYR:CE1	2.42	0.55
1:A:126:ALA:HB2	3:A:374:HOH:O	2.07	0.54
2:L:93:SER:OG	2:L:94:SER:N	2.41	0.53
1:H:36:TRP:CE2	1:H:80:MET:HB2	2.43	0.53
2:B:190:HIS:O	2:B:212:ARG:NE	2.22	0.52
1:A:187:SER:HB3	3:A:369:HOH:O	2.10	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:L:204:SER:O	3:L:307:HOH:O	2.19	0.51
2:B:150:LYS:HB2	2:B:194:ALA:HB3	1.92	0.51
1:A:120:PRO:HB3	1:A:146:TYR:HB3	1.93	0.51
1:A:38:ARG:HB2	1:A:48:ILE:HD11	1.93	0.51
1:H:47:TRP:CD1	2:L:96:TRP:HB2	2.46	0.50
1:A:28:THR:O	1:A:53:ARG:NH2	2.44	0.50
2:L:37:GLN:HB2	2:L:47:LEU:HD11	1.93	0.49
2:B:171:ASP:CG	3:B:304:HOH:O	2.55	0.49
1:H:95:ARG:NH2	3:H:303:HOH:O	2.15	0.49
2:L:121:PRO:HD3	2:L:133:VAL:HG22	1.96	0.48
2:L:8:PRO:HG2	2:L:11:LEU:HG	1.97	0.47
2:B:147:VAL:HG22	2:B:197:VAL:HG22	1.95	0.47
2:B:163:SER:O	2:B:176:LEU:HD12	2.14	0.46
2:B:121:PRO:HD3	2:B:133:VAL:HG22	1.95	0.46
1:A:156:ASN:C	3:A:308:HOH:O	2.59	0.46
2:L:32:TYR:HB2	2:L:92:LEU:HB2	1.97	0.45
2:B:18:ARG:HH11	2:B:20:THR:HG23	1.82	0.45
2:L:33:LEU:HD22	2:L:71:PHE:CG	2.50	0.45
2:B:54:ARG:HG2	2:B:58:VAL:HB	1.98	0.45
1:A:47:TRP:CG	2:B:96:TRP:HB2	2.52	0.45
1:A:171:LEU:O	2:B:161:GLN:NE2	2.49	0.45
2:L:48:ILE:HD13	2:L:54:ARG:HA	1.98	0.45
2:B:72:THR:HG23	3:B:313:HOH:O	2.16	0.44
2:B:105:GLU:HG2	2:B:106:ILE:N	2.33	0.44
2:L:189:LYS:HD2	3:L:380:HOH:O	2.18	0.44
1:A:132:THR:OG1	3:A:303:HOH:O	2.18	0.44
2:L:78:LEU:HD21	2:L:104:LEU:HD21	1.99	0.44
1:H:24:ALA:HB1	1:H:27:TYR:HE1	1.81	0.44
2:B:33:LEU:HD22	2:B:71:PHE:CG	2.53	0.43
1:A:47:TRP:HZ2	1:A:50:TYR:HD1	1.66	0.43
1:H:38:ARG:HB2	1:H:48:ILE:HD11	2.01	0.43
1:H:130:LYS:NZ	3:H:307:HOH:O	2.36	0.43
2:L:208:LYS:HD3	2:L:208:LYS:HA	1.92	0.42
2:B:200:GLN:HG2	2:B:201:GLY:N	2.35	0.42
1:A:155:TRP:HB3	1:A:160:LEU:HD23	2.02	0.42
2:L:32:TYR:CG	2:L:50:TRP:HZ3	2.38	0.42
2:B:47:LEU:C	2:B:48:ILE:HG13	2.45	0.42
2:B:40:PRO:HG2	2:B:166:GLU:HG3	2.01	0.41
1:A:115:ALA:HB3	1:A:147:PHE:CE2	2.54	0.41
2:B:196:GLU:HG3	2:B:207:THR:OG1	2.20	0.41
1:H:87:THR:HA	1:H:109:VAL:O	2.21	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:L:141:TYR:CG	2:L:142:PRO:HA	2.56	0.41
1:H:120:PRO:CB	1:H:146:TYR:HB3	2.45	0.40
2:B:42:LYS:HB3	2:B:42:LYS:HE2	1.84	0.40
1:H:80:MET:HE1	1:H:90:TYR:CD2	2.56	0.40

All (5) 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)
3:H:329:HOH:O	3:L:332:HOH:O[1_655]	1.88	0.32
3:L:440:HOH:O	3:B:381:HOH:O[1_554]	1.97	0.23
3:H:426:HOH:O	3:L:342:HOH:O[1_655]	1.99	0.21
1:H:192:THR:O	1:A:94:ARG:NH2[1_654]	2.12	0.08
3:A:400:HOH:O	3:B:384:HOH:O[1_465]	2.15	0.05

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	211/219 (96%)	205 (97%)	6 (3%)	0	100	100
1	H	216/219 (99%)	213 (99%)	3 (1%)	0	100	100
2	B	217/219 (99%)	211 (97%)	6 (3%)	0	100	100
2	L	217/219 (99%)	213 (98%)	4 (2%)	0	100	100
All	All	861/876 (98%)	842 (98%)	19 (2%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains ⓘ

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	185/189 (98%)	180 (97%)	5 (3%)	39	37
1	H	188/189 (100%)	187 (100%)	1 (0%)	81	81
2	B	193/193 (100%)	193 (100%)	0	100	100
2	L	193/193 (100%)	191 (99%)	2 (1%)	68	71
All	All	759/764 (99%)	751 (99%)	8 (1%)	65	68

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	10	GLU
2	L	55	GLU
2	L	138	ASN
1	A	4	LEU
1	A	151	VAL
1	A	152	THR
1	A	171	LEU
1	A	204	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	H	39	GLN
1	H	76	ASN
2	L	27	GLN
2	L	138	ASN
1	A	39	GLN
1	A	172	GLN
2	B	27	GLN
2	B	38	GLN
2	B	159	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 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, 95th 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 ²)	Q<0.9
1	A	215/219 (98%)	0.85	26 (12%) 8 8	19, 38, 65, 87	0
1	H	218/219 (99%)	0.32	13 (5%) 27 27	16, 28, 51, 59	0
2	B	219/219 (100%)	0.71	24 (10%) 10 9	19, 36, 72, 89	0
2	L	219/219 (100%)	0.27	7 (3%) 50 49	18, 30, 50, 62	0
All	All	871/876 (99%)	0.54	70 (8%) 18 17	16, 33, 62, 89	0

All (70) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	155	LEU	4.7
2	B	206	VAL	4.3
1	A	203	PRO	3.7
2	L	56	SER	3.6
1	A	71	ALA	3.6
1	A	113	SER	3.4
1	H	98	THR	3.4
1	H	165	HIS	3.4
1	A	171	LEU	3.4
1	A	29	PHE	3.4
1	H	96	ASP	3.3
2	B	154	ALA	3.3
2	B	195	CYS	3.3
1	A	25	SER	3.3
1	H	97	ILE	3.3
2	B	159	ASN	3.3
2	L	49	TYR	3.2
1	A	151	VAL	3.2
1	A	194	THR	3.2
1	A	177	TYR	3.1
1	A	3	GLN	2.9

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Mol	Chain	Res	Type	RSRZ
2	B	205	PRO	2.8
1	A	207	LYS	2.8
2	L	94	SER	2.8
2	B	93	SER	2.8
1	A	192	THR	2.8
1	A	215	LYS	2.7
2	B	151	VAL	2.7
2	L	215	CYS	2.7
1	H	217	CYS	2.7
1	H	191	GLY	2.7
1	H	2	VAL	2.6
1	A	159	ALA	2.6
2	B	203	SER	2.6
2	B	202	LEU	2.6
2	L	27(D)	TYR	2.6
2	B	147	VAL	2.6
1	A	205	ASN	2.6
1	A	206	THR	2.6
1	A	204	SER	2.6
1	A	30	THR	2.5
2	B	45	LYS	2.5
1	A	76	ASN	2.5
1	H	24	ALA	2.5
2	B	194	ALA	2.5
2	B	40	PRO	2.4
1	A	169	ALA	2.4
2	B	150	LYS	2.4
2	B	153	ASN	2.4
1	A	28	THR	2.4
2	B	201	GLY	2.4
1	A	172	GLN	2.4
1	H	164	VAL	2.3
2	B	207	THR	2.3
2	B	158	GLY	2.3
2	L	195	CYS	2.2
1	A	132	THR	2.2
1	A	175	GLY	2.2
2	L	29	HIS	2.2
2	B	156	GLN	2.2
1	H	205	ASN	2.2
1	H	27	TYR	2.1
1	A	208	VAL	2.1

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Mol	Chain	Res	Type	RSRZ
1	H	25	SER	2.1
2	B	215	CYS	2.1
1	H	134	GLY	2.1
2	B	197	VAL	2.1
1	A	217	CYS	2.1
2	B	109	THR	2.0
2	B	114	PRO	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 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.