



wwPDB X-ray Structure Validation Summary Report ⓘ

Jul 6, 2026 – 03:35 PM JST

PDB ID : 9LF5 / pdb_00009lf5
Title : Complex structure of THC-4677 and THC-4881 Fab bound to SARS-CoV-2
WT RBD
Authors : Wang, X.; Guo, F.
Deposited on : 2025-01-08
Resolution : 2.95 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

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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

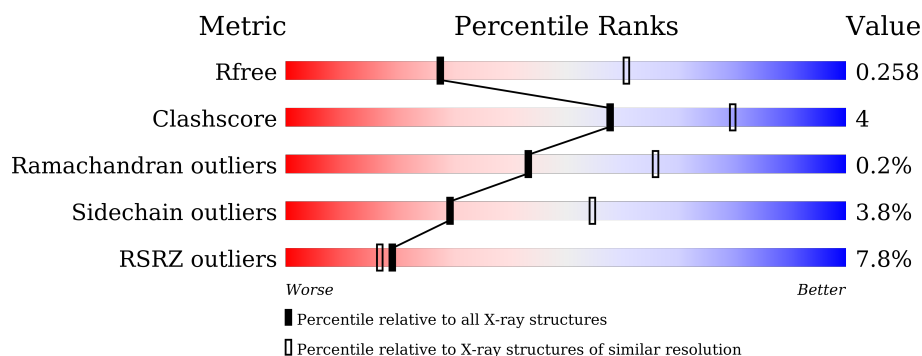
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.95 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	1130 (2.98-2.94)
Clashscore	190562	1157 (2.98-2.94)
Ramachandran outliers	187476	1101 (2.98-2.94)
Sidechain outliers	187428	1101 (2.98-2.94)
RSRZ outliers	180081	1130 (2.98-2.94)

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	194	8% 88% 12%
1	B	194	11% 90% 9% .
2	C	227	12% 81% 17% .
2	E	227	10% 84% 14% ..
3	D	221	6% 91% 8% .
3	F	221	6% 89% 11%

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Mol	Chain	Length	Quality of chain
4	G	238	7% 84% 16%
4	H	238	7% 83% 16%
5	I	214	6% 91% 7%
5	J	214	6% 86% 11%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 16853 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 Spike protein S1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	194	Total	C	N	O	S	0	0	0
			1536	984	256	288	8			
1	B	194	Total	C	N	O	S	0	0	0
			1536	984	256	288	8			

- Molecule 2 is a protein called THC-4677 Heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	225	Total	C	N	O	S	0	0	0
			1703	1082	283	331	7			
2	C	227	Total	C	N	O	S	0	0	0
			1720	1092	286	335	7			

- Molecule 3 is a protein called THC-4677 Light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	F	221	Total	C	N	O	S	0	0	0
			1699	1065	284	344	6			
3	D	221	Total	C	N	O	S	0	0	0
			1699	1065	284	344	6			

- Molecule 4 is a protein called THC-4881 Heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	G	238	Total	C	N	O	S	0	0	0
			1814	1146	305	356	7			
4	H	238	Total	C	N	O	S	0	0	0
			1814	1146	305	356	7			

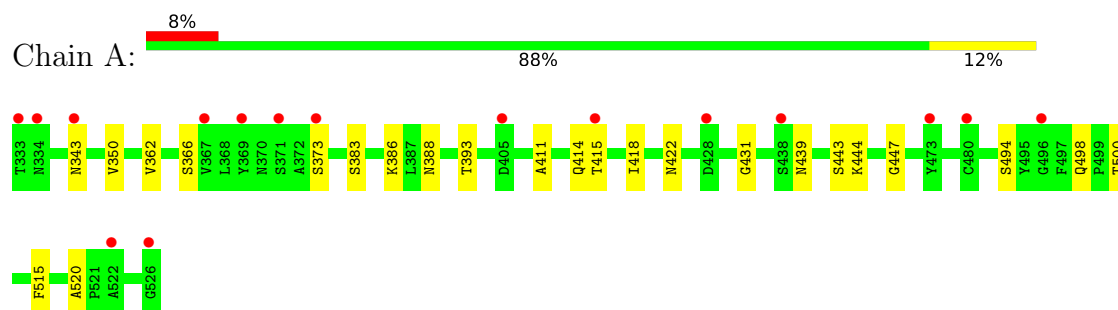
- Molecule 5 is a protein called THC-4881 Light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	J	214	Total 1666	C 1046	N 279	O 336	S 5	0	0	0
5	I	214	Total 1666	C 1046	N 279	O 336	S 5	0	0	0

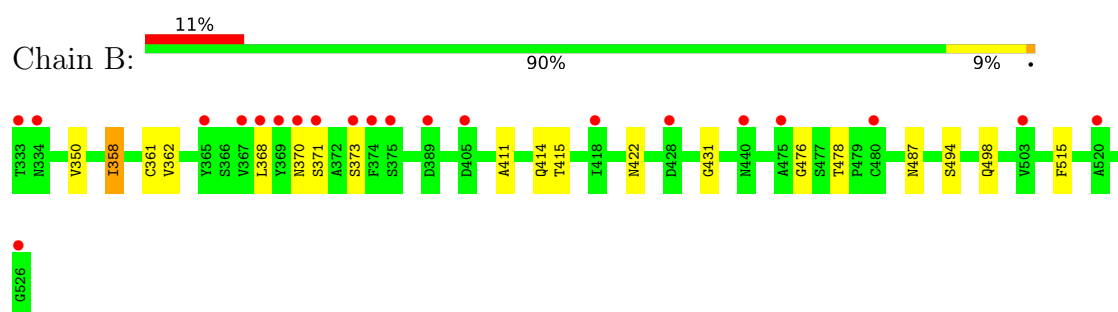
3 Residue-property plots [i](#)

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.

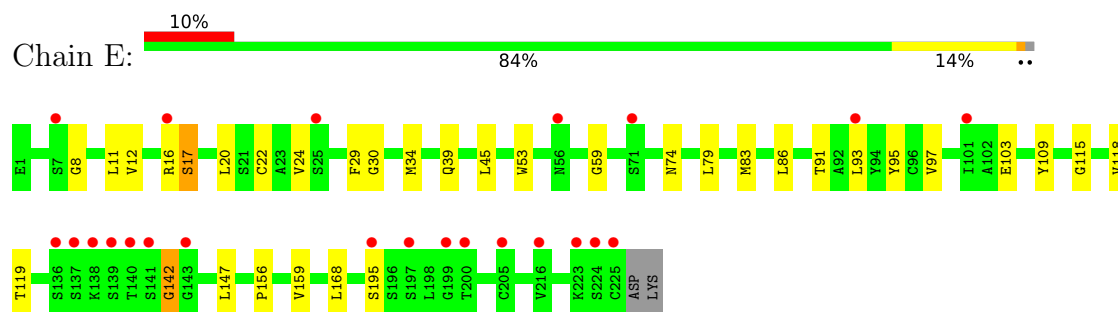
- Molecule 1: Spike protein S1



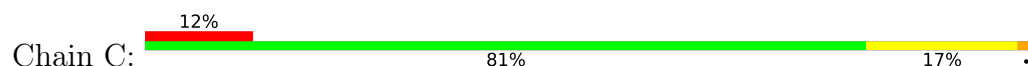
- Molecule 1: Spike protein S1

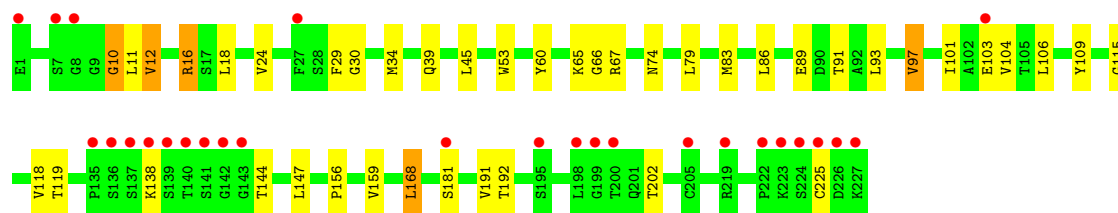


- Molecule 2: THC-4677 Heavy chain

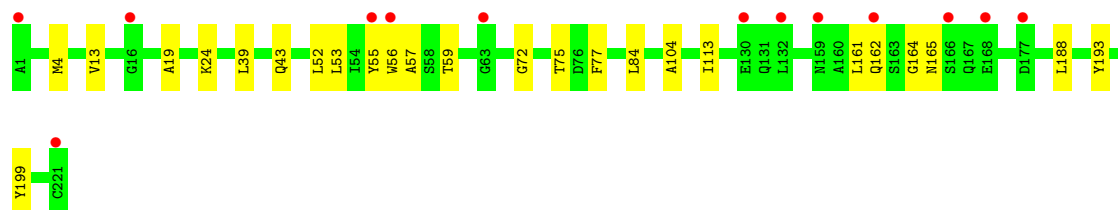
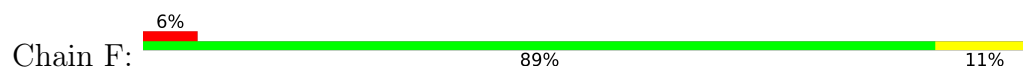


- Molecule 2: THC-4677 Heavy chain

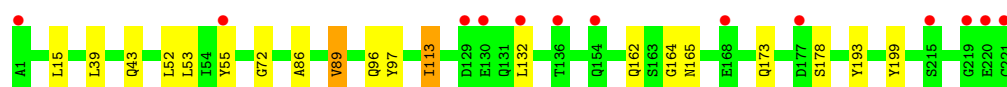




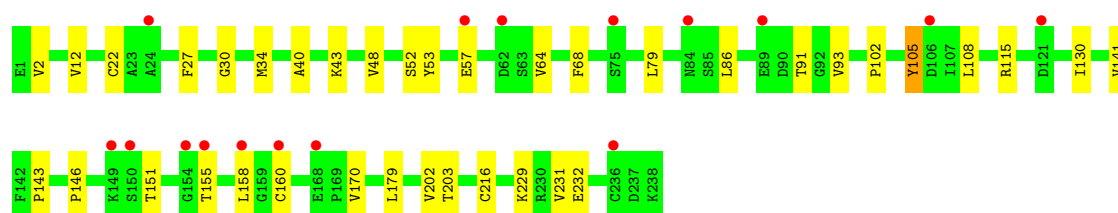
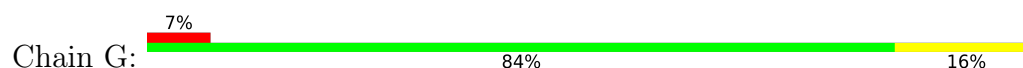
• Molecule 3: THC-4677 Light chain



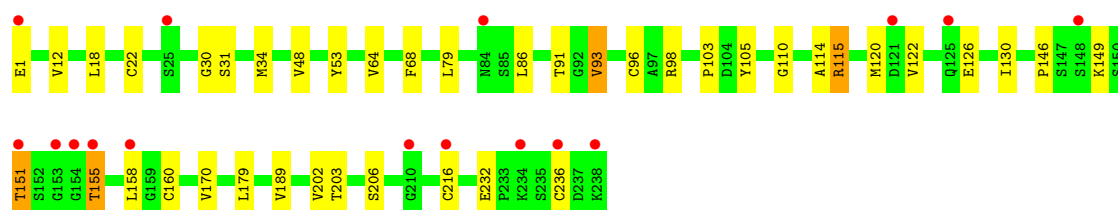
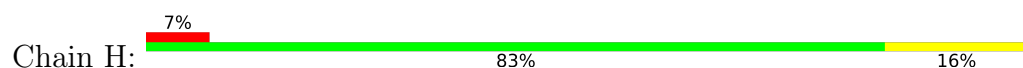
• Molecule 3: THC-4677 Light chain



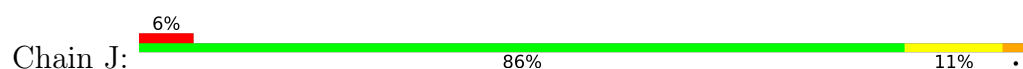
• Molecule 4: THC-4881 Heavy chain

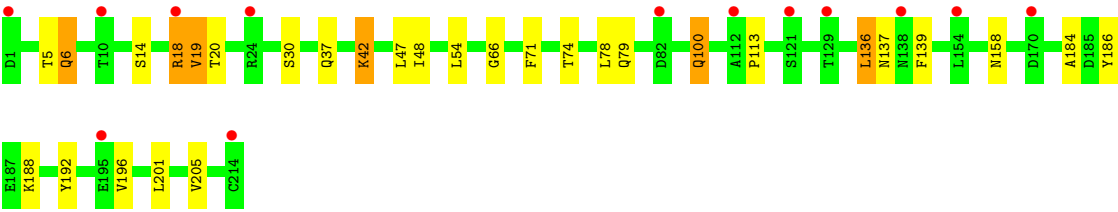


• Molecule 4: THC-4881 Heavy chain

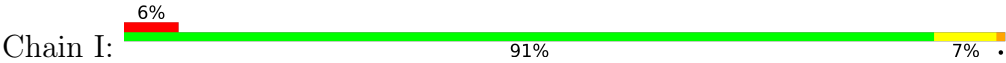


• Molecule 5: THC-4881 Light chain





● Molecule 5: THC-4881 Light chain



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	110.85Å 259.83Å 104.47Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.96 – 2.95 48.96 – 2.95	Depositor EDS
% Data completeness (in resolution range)	99.1 (48.96-2.95) 99.4 (48.96-2.95)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.46 (at 2.96Å)	Xtriage
Refinement program	PHENIX (1.18.2_3874: ???)	Depositor
R, R_{free}	0.244 , 0.258 0.243 , 0.258	Depositor DCC
R_{free} test set	1988 reflections (3.08%)	wwPDB-VP
Wilson B-factor (Å ²)	47.3	Xtriage
Anisotropy	0.411	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 27.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.88	EDS
Total number of atoms	16853	wwPDB-VP
Average B, all atoms (Å ²)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.02% 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

5.1 Standard geometry

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	0.92	0/1579	1.13	2/2149 (0.1%)
1	B	0.93	0/1579	1.13	0/2149
2	C	0.94	0/1763	1.15	1/2402 (0.0%)
2	E	0.96	0/1746	1.19	2/2380 (0.1%)
3	D	0.94	0/1736	1.16	2/2359 (0.1%)
3	F	0.94	0/1736	1.16	1/2359 (0.0%)
4	G	0.95	0/1859	1.21	1/2532 (0.0%)
4	H	0.94	0/1859	1.18	1/2532 (0.0%)
5	I	0.95	0/1703	1.17	1/2315 (0.0%)
5	J	0.94	0/1703	1.16	0/2315
All	All	0.94	0/17263	1.17	11/23492 (0.0%)

There are no bond length outliers.

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	I	7	SER	CA-C-O	-6.96	113.18	119.86
2	E	17	SER	N-CA-CB	-6.18	100.97	110.85
3	D	72	GLY	CA-C-O	-6.00	118.32	122.22
3	F	72	GLY	CA-C-O	-5.90	118.38	122.22
3	D	96	GLN	N-CA-C	-5.69	100.43	109.76

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	1536	0	1453	12	0
1	B	1536	0	1453	6	0
2	C	1720	0	1690	18	9
2	E	1703	0	1673	24	0
3	D	1699	0	1639	10	0
3	F	1699	0	1639	15	1
4	G	1814	0	1769	24	0
4	H	1814	0	1769	19	8
5	I	1666	0	1620	10	0
5	J	1666	0	1620	17	0
All	All	16853	0	16325	148	9

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.

The worst 5 of 148 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)
3:F:13:VAL:HG13	3:F:84:LEU:HD22	1.34	1.04
3:F:13:VAL:CG1	3:F:84:LEU:HD22	1.90	1.00
3:F:39:LEU:HD13	3:F:77:PHE:CD2	2.11	0.86
4:G:160:CYS:CB	4:G:216:CYS:SG	2.71	0.79
2:E:93:LEU:HD22	2:E:95:TYR:CZ	2.21	0.76

The worst 5 of 9 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)
2:C:66:GLY:O	4:H:149:LYS:CE[2_455]	0.78	1.42
2:C:67:ARG:N	4:H:149:LYS:NZ[2_455]	0.80	1.40
2:C:67:ARG:CA	4:H:149:LYS:NZ[2_455]	1.01	1.19
2:C:66:GLY:C	4:H:149:LYS:NZ[2_455]	1.45	0.75
2:C:66:GLY:C	4:H:149:LYS:CE[2_455]	1.50	0.70

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	192/194 (99%)	188 (98%)	4 (2%)	0	100	100
1	B	192/194 (99%)	186 (97%)	6 (3%)	0	100	100
2	C	225/227 (99%)	218 (97%)	6 (3%)	1 (0%)	30	53
2	E	223/227 (98%)	214 (96%)	9 (4%)	0	100	100
3	D	219/221 (99%)	215 (98%)	4 (2%)	0	100	100
3	F	219/221 (99%)	216 (99%)	3 (1%)	0	100	100
4	G	236/238 (99%)	233 (99%)	3 (1%)	0	100	100
4	H	236/238 (99%)	231 (98%)	5 (2%)	0	100	100
5	I	212/214 (99%)	206 (97%)	5 (2%)	1 (0%)	24	49
5	J	212/214 (99%)	204 (96%)	5 (2%)	3 (1%)	9	24
All	All	2166/2188 (99%)	2111 (98%)	50 (2%)	5 (0%)	43	66

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
5	J	19	VAL
5	J	18	ARG
5	J	14	SER
5	I	14	SER
2	C	10	GLY

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	167/167 (100%)	165 (99%)	2 (1%)	63	79
1	B	167/167 (100%)	159 (95%)	8 (5%)	23	48
2	C	194/194 (100%)	179 (92%)	15 (8%)	12	30

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	E	192/194 (99%)	187 (97%)	5 (3%)	40	65
3	D	190/190 (100%)	185 (97%)	5 (3%)	40	65
3	F	190/190 (100%)	188 (99%)	2 (1%)	65	80
4	G	202/202 (100%)	195 (96%)	7 (4%)	32	57
4	H	202/202 (100%)	189 (94%)	13 (6%)	16	38
5	I	189/189 (100%)	184 (97%)	5 (3%)	40	65
5	J	189/189 (100%)	180 (95%)	9 (5%)	23	48
All	All	1882/1884 (100%)	1811 (96%)	71 (4%)	29	55

5 of 71 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	H	105	TYR
4	H	151	THR
4	H	236	CYS
5	J	158	ASN
5	J	136	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 44 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	439	ASN
3	D	36	GLN
1	B	481	ASN
2	C	173	HIS
3	D	144	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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 [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, 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	194/194 (100%)	0.76	16 (8%) 17 15	24, 38, 60, 69	0
1	B	194/194 (100%)	0.91	21 (10%) 11 10	25, 39, 72, 103	0
2	C	227/227 (100%)	0.99	27 (11%) 9 8	28, 44, 92, 222	0
2	E	225/227 (99%)	0.86	23 (10%) 12 11	29, 45, 81, 128	0
3	D	221/221 (100%)	0.70	13 (5%) 28 23	25, 39, 68, 108	0
3	F	221/221 (100%)	0.66	13 (5%) 28 23	26, 40, 58, 98	0
4	G	238/238 (100%)	0.64	16 (6%) 24 20	28, 38, 58, 81	0
4	H	238/238 (100%)	0.70	16 (6%) 24 20	25, 38, 61, 81	0
5	I	214/214 (100%)	0.79	13 (6%) 27 22	28, 44, 61, 80	0
5	J	214/214 (100%)	0.80	13 (6%) 27 22	28, 47, 63, 81	0
All	All	2186/2188 (99%)	0.78	171 (7%) 19 17	24, 41, 66, 222	0

The worst 5 of 171 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	C	140	THR	7.2
2	C	142	GLY	6.9
5	I	214	CYS	6.3
2	C	141	SER	5.8
2	E	140	THR	5.6

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.