



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 12:03 PM UTC

PDB ID : 7YTN / pdb_00007ytn
Title : Crystal structure of SARS-CoV-2 Alpha RBD in complex with the D27LEY neutralizing antibody Fab fragment
Authors : Jeong, B.S.; Jeon, J.Y.; Oh, B.H.
Deposited on : 2022-08-15
Resolution : 3.51 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

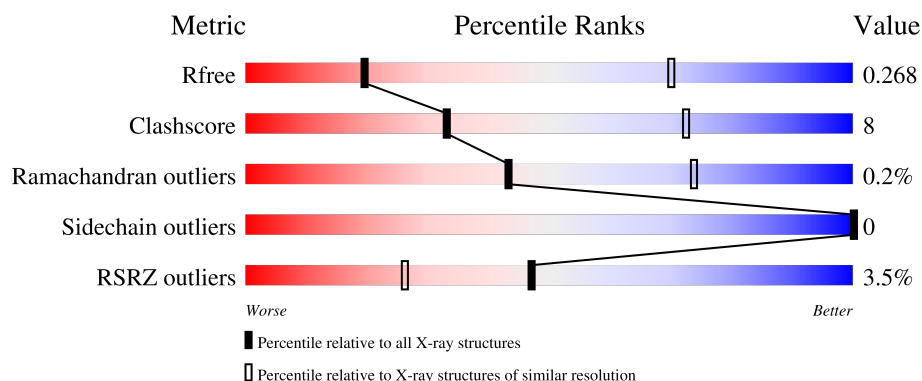
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.51 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	1025 (3.56-3.48)
Clashscore	190562	1079 (3.56-3.48)
Ramachandran outliers	187476	1052 (3.56-3.48)
Sidechain outliers	187428	1053 (3.56-3.48)
RSRZ outliers	180081	1024 (3.56-3.48)

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	H	239	6% 71% 18% 11%
2	L	239	71% 18% 12%
3	C	262	2% 58% 11% 31%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4638 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 Heavy chain of Fab.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	212	Total	C	N	O	S	0	0	0
			1568	985	263	313	7			

- Molecule 2 is a protein called Light chain of Fab.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	211	Total	C	N	O	S	0	0	0
			1620	1009	277	330	4			

- Molecule 3 is a protein called Spike protein S1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	181	Total	C	N	O	S	1	0	0
			1450	932	239	272	7			

There are 40 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	280	MET	-	initiating methionine	UNP P0DTC2
C	281	VAL	-	expression tag	UNP P0DTC2
C	282	LEU	-	expression tag	UNP P0DTC2
C	283	VAL	-	expression tag	UNP P0DTC2
C	284	ASN	-	expression tag	UNP P0DTC2
C	285	GLN	-	expression tag	UNP P0DTC2
C	286	SER	-	expression tag	UNP P0DTC2
C	287	HIS	-	expression tag	UNP P0DTC2
C	288	GLN	-	expression tag	UNP P0DTC2
C	289	GLY	-	expression tag	UNP P0DTC2
C	290	PHE	-	expression tag	UNP P0DTC2
C	291	ASN	-	expression tag	UNP P0DTC2
C	292	LYS	-	expression tag	UNP P0DTC2
C	293	GLU	-	expression tag	UNP P0DTC2

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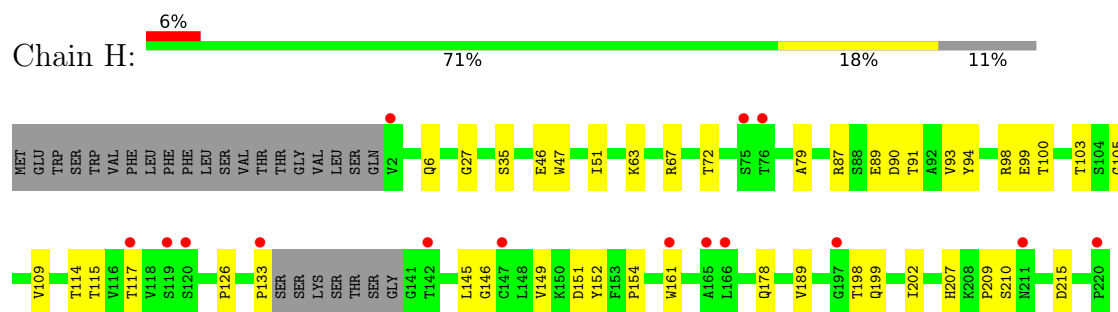
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Chain	Residue	Modelled	Actual	Comment	Reference
C	294	HIS	-	expression tag	UNP P0DTC2
C	295	THR	-	expression tag	UNP P0DTC2
C	296	SER	-	expression tag	UNP P0DTC2
C	297	LYS	-	expression tag	UNP P0DTC2
C	298	MET	-	expression tag	UNP P0DTC2
C	299	VAL	-	expression tag	UNP P0DTC2
C	300	SER	-	expression tag	UNP P0DTC2
C	301	ALA	-	expression tag	UNP P0DTC2
C	302	ILE	-	expression tag	UNP P0DTC2
C	303	VAL	-	expression tag	UNP P0DTC2
C	304	LEU	-	expression tag	UNP P0DTC2
C	305	TYR	-	expression tag	UNP P0DTC2
C	306	VAL	-	expression tag	UNP P0DTC2
C	307	LEU	-	expression tag	UNP P0DTC2
C	308	LEU	-	expression tag	UNP P0DTC2
C	309	ALA	-	expression tag	UNP P0DTC2
C	310	ALA	-	expression tag	UNP P0DTC2
C	311	ALA	-	expression tag	UNP P0DTC2
C	312	ALA	-	expression tag	UNP P0DTC2
C	313	HIS	-	expression tag	UNP P0DTC2
C	314	SER	-	expression tag	UNP P0DTC2
C	315	ALA	-	expression tag	UNP P0DTC2
C	316	PHE	-	expression tag	UNP P0DTC2
C	317	ALA	-	expression tag	UNP P0DTC2
C	318	ALA	-	expression tag	UNP P0DTC2
C	501	TYR	ASN	variant	UNP P0DTC2

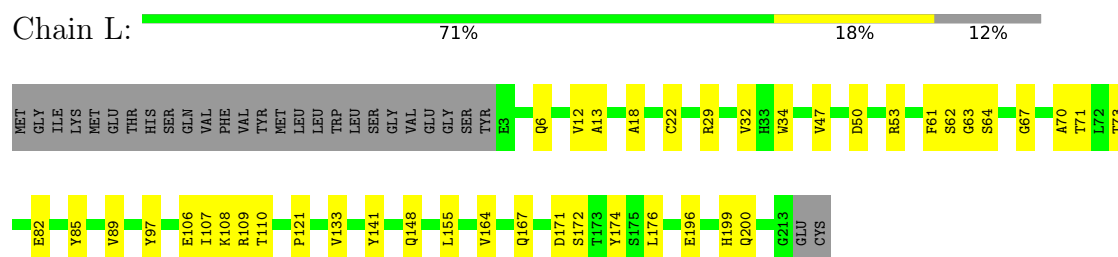
3 Residue-property plots [i](#)

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.

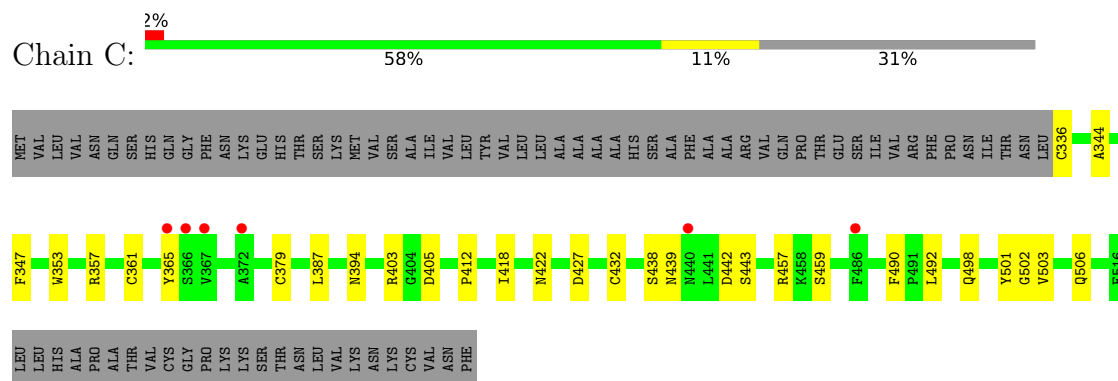
- Molecule 1: Heavy chain of Fab



- Molecule 2: Light chain of Fab



- Molecule 3: Spike protein S1



4 Data and refinement statistics

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, α , β , γ	155.96Å 155.96Å 166.68Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	38.99 – 3.51 38.99 – 3.51	Depositor EDS
% Data completeness (in resolution range)	91.1 (38.99-3.51) 88.9 (38.99-3.51)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.68 (at 3.48Å)	Xtriage
Refinement program	PHENIX 1.17.1_3660	Depositor
R, R_{free}	0.237 , 0.274 0.229 , 0.268	Depositor DCC
R_{free} test set	1540 reflections (9.89%)	wwPDB-VP
Wilson B-factor (Å ²)	35.2	Xtriage
Anisotropy	0.005	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 33.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.45$, $\langle L^2 \rangle = 0.27$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.83	EDS
Total number of atoms	4638	wwPDB-VP
Average B, all atoms (Å ²)	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.55% 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	H	0.09	0/1605	0.28	0/2188
2	L	0.09	0/1656	0.28	0/2253
3	C	0.10	0/1492	0.26	0/2028
All	All	0.09	0/4753	0.27	0/6469

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	H	1568	0	1522	30	0
2	L	1620	0	1558	24	0
3	C	1450	0	1366	20	0
All	All	4638	0	4446	71	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 8.

All (71) 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:C:336:CYS:N	3:C:361:CYS:HG	1.72	0.88

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:H:46:GLU:OE2	1:H:63:LYS:NZ	2.17	0.75
2:L:29:ARG:HH12	2:L:67:GLY:HA2	1.55	0.72
1:H:6:GLN:NE2	1:H:94:TYR:O	2.25	0.70
2:L:62:SER:HB2	2:L:73:THR:HB	1.74	0.69
1:H:6:GLN:HE21	1:H:114:THR:HG22	1.57	0.69
2:L:13:ALA:HA	2:L:108:LYS:HB2	1.76	0.67
3:C:336:CYS:HB2	3:C:361:CYS:HB2	1.75	0.67
3:C:357:ARG:NH1	3:C:394:ASN:OD1	2.28	0.66
2:L:148:GLN:HB2	2:L:155:LEU:HD11	1.79	0.63
1:H:72:THR:HG22	1:H:79:ALA:HA	1.79	0.63
3:C:457:ARG:NH1	3:C:459:SER:O	2.33	0.62
1:H:133:PRO:HD3	1:H:145:LEU:HB3	1.80	0.62
1:H:105:GLY:N	3:C:503:VAL:HG21	2.18	0.58
1:H:145:LEU:HD12	1:H:189:VAL:HG12	1.86	0.57
1:H:202:ILE:HD11	1:H:215:ASP:HB3	1.87	0.56
1:H:51:ILE:HD13	1:H:72:THR:HG23	1.87	0.55
1:H:67:ARG:NH1	1:H:90:ASP:OD2	2.38	0.55
2:L:12:VAL:HG11	2:L:18:ALA:HB2	1.89	0.55
2:L:22:CYS:N	2:L:70:ALA:O	2.37	0.54
1:H:35:SER:OG	1:H:99:GLU:OE2	2.25	0.54
1:H:91:THR:OG1	1:H:117:THR:O	2.18	0.54
2:L:148:GLN:NE2	2:L:196:GLU:OE1	2.37	0.54
2:L:34:TRP:HB2	2:L:47:VAL:HB	1.91	0.53
1:H:207:HIS:ND1	1:H:210:SER:OG	2.38	0.53
3:C:365:TYR:HD2	3:C:387:LEU:HB3	1.74	0.52
2:L:64:SER:HB3	2:L:71:THR:HG23	1.92	0.51
2:L:199:HIS:ND1	2:L:200:GLN:O	2.44	0.51
2:L:164:VAL:HG22	2:L:176:LEU:HG	1.93	0.50
1:H:105:GLY:H	3:C:503:VAL:HG21	1.75	0.50
2:L:167:GLN:HG3	2:L:174:TYR:CZ	2.47	0.49
1:H:100:THR:OG1	1:H:103:THR:OG1	2.27	0.49
3:C:379:CYS:HA	3:C:432:CYS:HA	1.93	0.49
2:L:53:ARG:HD3	2:L:61:PHE:O	2.13	0.48
3:C:438:SER:OG	3:C:442:ASP:OD2	2.30	0.48
1:H:93:VAL:HG22	1:H:115:THR:HG22	1.96	0.48
1:H:154:PRO:HD2	1:H:209:PRO:HB2	1.96	0.47
2:L:6:GLN:NE2	2:L:85:TYR:O	2.38	0.47
1:H:145:LEU:HD12	1:H:145:LEU:O	2.15	0.47
1:H:146:GLY:HA2	1:H:161:TRP:HH2	1.79	0.47
1:H:91:THR:HG23	1:H:117:THR:HA	1.97	0.47
1:H:87:ARG:NH1	1:H:89:GLU:OE1	2.48	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:H:146:GLY:HA2	1:H:161:TRP:CH2	2.49	0.47
1:H:126:PRO:HB3	1:H:152:TYR:HB3	1.95	0.47
3:C:344:ALA:HB3	3:C:347:PHE:HE1	1.80	0.47
3:C:365:TYR:CD2	3:C:387:LEU:HB3	2.50	0.47
2:L:109:ARG:HG2	2:L:110:THR:N	2.29	0.46
3:C:439:ASN:O	3:C:443:SER:OG	2.33	0.46
3:C:498:GLN:HB3	3:C:501:TYR:CD2	2.51	0.45
2:L:82:GLU:HG3	2:L:107:ILE:HG12	1.99	0.45
2:L:108:LYS:HA	2:L:141:TYR:OH	2.18	0.44
1:H:35:SER:HB3	1:H:47:TRP:HE1	1.83	0.44
2:L:121:PRO:HD3	2:L:133:VAL:HG22	1.98	0.44
3:C:336:CYS:N	3:C:361:CYS:SG	2.84	0.44
1:H:151:ASP:OD1	1:H:178:GLN:NE2	2.36	0.44
2:L:32:VAL:HA	2:L:89:VAL:HG12	1.99	0.43
1:H:47:TRP:CG	2:L:97:TYR:HB2	2.53	0.43
1:H:126:PRO:HB2	1:H:149:VAL:HG13	2.00	0.43
3:C:403:ARG:NH2	3:C:405:ASP:OD2	2.51	0.43
1:H:89:GLU:N	1:H:89:GLU:OE2	2.52	0.43
2:L:167:GLN:NE2	2:L:172:SER:HB3	2.34	0.42
1:H:198:THR:OG1	1:H:199:GLN:N	2.52	0.42
3:C:412:PRO:HB3	3:C:427:ASP:HA	2.02	0.42
1:H:98:ARG:HB2	1:H:109:VAL:HG12	2.01	0.42
2:L:50:ASP:O	2:L:63:GLY:HA3	2.20	0.41
3:C:353:TRP:CD1	3:C:353:TRP:H	2.38	0.41
3:C:418:ILE:HG23	3:C:422:ASN:HB2	2.03	0.41
3:C:502:GLY:O	3:C:506:GLN:HG3	2.20	0.41
2:L:106:GLU:OE1	2:L:174:TYR:OH	2.29	0.41
3:C:490:PHE:CE2	3:C:492:LEU:HB2	2.56	0.41
2:L:109:ARG:NH1	2:L:171:ASP:HB2	2.36	0.40

There are no symmetry-related clashes.

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	H	208/239 (87%)	194 (93%)	13 (6%)	1 (0%)	24	58
2	L	209/239 (87%)	193 (92%)	16 (8%)	0	100	100
3	C	179/262 (68%)	155 (87%)	24 (13%)	0	100	100
All	All	596/740 (80%)	542 (91%)	53 (9%)	1 (0%)	43	74

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	H	27	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	H	173/199 (87%)	173 (100%)	0	100	100
2	L	183/208 (88%)	183 (100%)	0	100	100
3	C	157/226 (70%)	157 (100%)	0	100	100
All	All	513/633 (81%)	513 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	H	6	GLN
1	H	199	GLN
2	L	36	GLN
2	L	161	GLN

5.3.3 RNA ⓘ

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	H	212/239 (88%)	0.73	15 (7%) 22 14	11, 50, 80, 93	0
2	L	211/239 (88%)	0.35	0 100 100	5, 26, 67, 81	0
3	C	181/262 (69%)	0.51	6 (3%) 49 27	11, 36, 87, 107	1 (0%)
All	All	604/740 (81%)	0.53	21 (3%) 47 26	5, 37, 80, 107	1 (0%)

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	H	76	THR	3.5
1	H	220	PRO	3.4
1	H	2	VAL	3.4
3	C	366	SER	3.1
1	H	75	SER	3.0
1	H	211	ASN	3.0
1	H	119	SER	2.9
1	H	142	THR	2.7
1	H	165	ALA	2.6
3	C	486	PHE	2.6
1	H	117	THR	2.6
3	C	367	VAL	2.6
1	H	133	PRO	2.5
1	H	161	TRP	2.4
1	H	147	CYS	2.3
1	H	166	LEU	2.2
3	C	372	ALA	2.2
3	C	440	ASN	2.1
1	H	197	GLY	2.0
1	H	120	SER	2.0
3	C	365	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 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.