Full wwPDB X-ray Structure Validation Report (i)

Nov 19, 2026 – 06:10 pm GMT

PDB ID	:	29NZ / pdb_000029nz
Title	:	Crystal structure of the SARS-CoV-2 S RBD in complex with mab1-9 scFV
Authors	:	Hansen, G.; Krey, T.
Deposited on	:	2026-03-25
Resolution	:	2.50 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 (i) 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 (1)) were used in the production of this report:

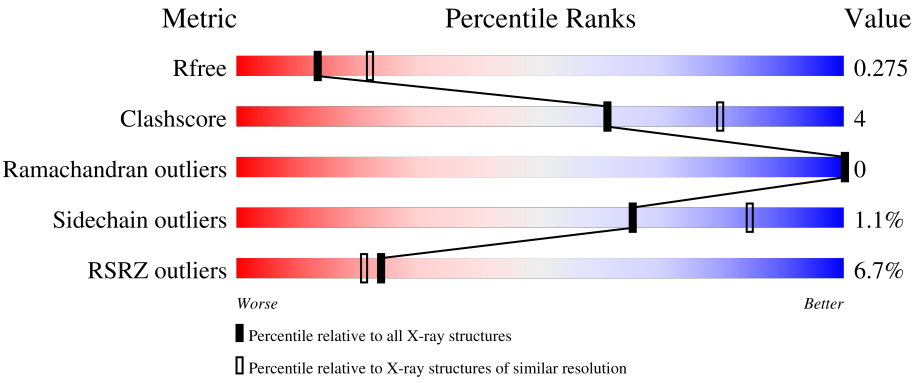
MolProbity	:	4-5-2 with Phenix2.2
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.2
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.51

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 2.50 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 >=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 <=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	298	2% 37% 6% 57%
1	L	298	4% 32% · 65%
2	A	258	4% 66% 7% 27%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 3338 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 mab1-9 single-chain Fv.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	127	Total	C	N	O	S	0	0	0
			956	598	165	186	7			
1	L	105	Total	C	N	O	S	0	0	0
			790	499	129	160	2			

- Molecule 2 is a protein called Spike protein S1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	A	189	Total	C	N	O	S	0	0	0
			1502	963	249	282	8			

There are 35 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	542	ASP	-	expression tag	UNP P0DTC2
A	543	ASP	-	expression tag	UNP P0DTC2
A	544	ASP	-	expression tag	UNP P0DTC2
A	545	ASP	-	expression tag	UNP P0DTC2
A	546	LYS	-	expression tag	UNP P0DTC2
A	547	ALA	-	expression tag	UNP P0DTC2
A	548	GLY	-	expression tag	UNP P0DTC2
A	549	TRP	-	expression tag	UNP P0DTC2
A	550	SER	-	expression tag	UNP P0DTC2
A	551	HIS	-	expression tag	UNP P0DTC2
A	552	PRO	-	expression tag	UNP P0DTC2
A	553	GLN	-	expression tag	UNP P0DTC2
A	554	PHE	-	expression tag	UNP P0DTC2
A	555	GLU	-	expression tag	UNP P0DTC2
A	556	LYS	-	expression tag	UNP P0DTC2
A	557	GLY	-	expression tag	UNP P0DTC2
A	558	GLY	-	expression tag	UNP P0DTC2
A	559	GLY	-	expression tag	UNP P0DTC2

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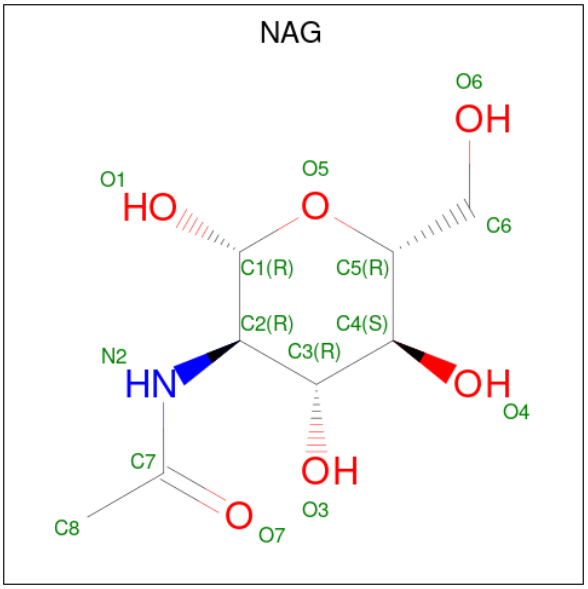
Chain	Residue	Modelled	Actual	Comment	Reference
A	560	SER	-	expression tag	UNP P0DTC2
A	561	GLY	-	expression tag	UNP P0DTC2
A	562	GLY	-	expression tag	UNP P0DTC2
A	563	GLY	-	expression tag	UNP P0DTC2
A	564	SER	-	expression tag	UNP P0DTC2
A	565	GLY	-	expression tag	UNP P0DTC2
A	566	GLY	-	expression tag	UNP P0DTC2
A	567	GLY	-	expression tag	UNP P0DTC2
A	568	SER	-	expression tag	UNP P0DTC2
A	569	TRP	-	expression tag	UNP P0DTC2
A	570	SER	-	expression tag	UNP P0DTC2
A	571	HIS	-	expression tag	UNP P0DTC2
A	572	PRO	-	expression tag	UNP P0DTC2
A	573	GLN	-	expression tag	UNP P0DTC2
A	574	PHE	-	expression tag	UNP P0DTC2
A	575	GLU	-	expression tag	UNP P0DTC2
A	576	LYS	-	expression tag	UNP P0DTC2

- Molecule 3 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	A	1	14	8	1	5	0	0

- Molecule 4 is water.

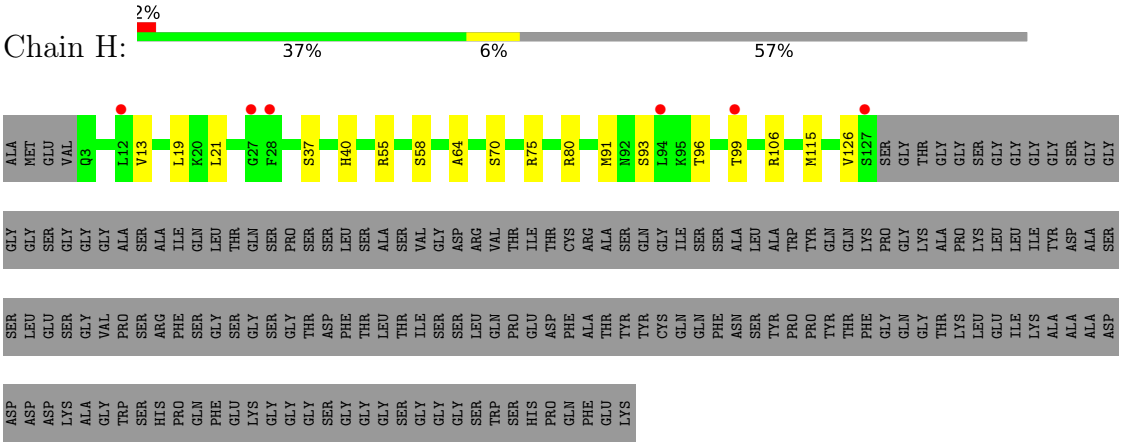
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	H	19	Total O 19 19	0	0
4	L	7	Total O 7 7	0	0
4	A	50	Total O 50 50	0	0

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.

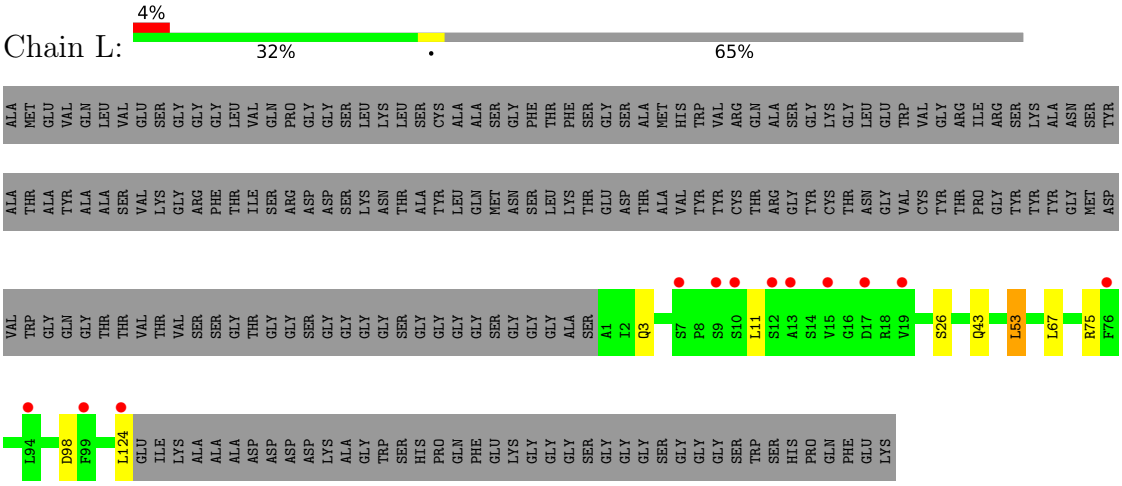
• Molecule 1: mab1-9 single-chain Fv

Chain H:



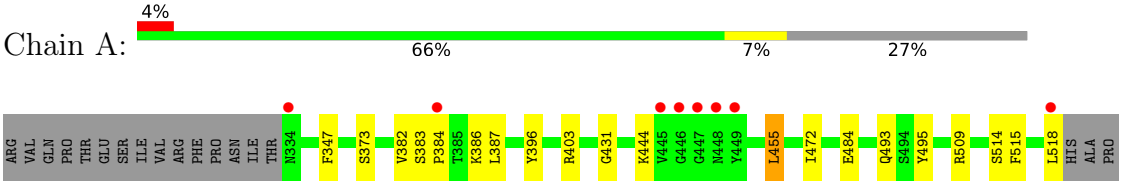
• Molecule 1: mab1-9 single-chain Fv

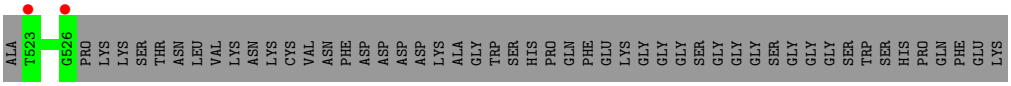
Chain L:



• Molecule 2: Spike protein S1

Chain A:




ALA
T523
G526
PRO
LYS
LYS
SER
THR
ASN
LEU
VAL
LYS
ASN
LYS
CYS
VAL
ASN
PHE
ASP
ASP
ASP
ASP
LYS
ALA
GLY
TRP
SER
HIS
PRO
GLN
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GLY
GLY
SER
TRP
SER
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PRO
GLN
PHE
GLU
LYS

4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	145.28Å 42.58Å 78.56Å 90.00° 105.00° 90.00°	Depositor
Resolution (Å)	45.93 – 2.50 45.93 – 2.50	Depositor EDS
% Data completeness (in resolution range)	97.1 (45.93-2.50) 96.1 (45.93-2.50)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.48 (at 2.51Å)	Xtriage
Refinement program	PHENIX 1.19.2_4158	Depositor
R, R_{free}	0.224 , 0.278 0.225 , 0.275	Depositor DCC
R_{free} test set	1633 reflections (9.96%)	wwPDB-VP
Wilson B-factor (Å^2)	48.5	Xtriage
Anisotropy	0.106	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.37 , 59.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	3338	wwPDB-VP
Average B, all atoms (Å^2)	59.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.51% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: NAG

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	0.10	0/977	0.27	0/1322
1	L	0.10	0/809	0.28	0/1100
2	A	0.11	0/1542	0.26	0/2095
All	All	0.10	0/3328	0.27	0/4517

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	956	0	913	12	0
1	L	790	0	766	4	0
2	A	1502	0	1420	13	0
3	A	14	0	13	0	0
4	A	50	0	0	0	0
4	H	19	0	0	0	0
4	L	7	0	0	0	0
All	All	3338	0	3112	27	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 (27) 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:L:43:GLN:HB2	1:L:53:LEU:HD11	1.80	0.63
2:A:382:VAL:HA	2:A:386:LYS:HE2	1.89	0.54
2:A:383:SER:OG	2:A:386:LYS:NZ	2.40	0.54
1:H:96:THR:HA	1:H:126:VAL:HG13	1.90	0.53
1:H:21:LEU:HD11	1:H:91:MET:HE2	1.93	0.51
1:H:70:SER:O	1:H:75:ARG:NH1	2.43	0.51
1:H:55:ARG:NH2	2:A:484:GLU:OE2	2.44	0.50
1:H:13:VAL:O	1:H:126:VAL:HA	2.11	0.50
2:A:455:LEU:HD12	2:A:493:GLN:HG3	1.94	0.49
1:H:75:ARG:HG2	1:H:93:SER:HB2	1.93	0.49
1:L:75:ARG:HH21	1:L:98:ASP:CG	2.21	0.48
2:A:431:GLY:HA2	2:A:515:PHE:CD2	2.48	0.48
1:H:58:SER:HA	1:H:80:ARG:NH1	2.30	0.47
1:H:64:ALA:HB1	2:A:472:ILE:HD11	1.99	0.45
1:H:40:HIS:ND1	1:H:115:MET:HE2	2.33	0.44
2:A:384:PRO:HA	2:A:387:LEU:HD12	1.99	0.44
2:A:403:ARG:HG3	2:A:495:TYR:CE1	2.53	0.44
2:A:396:TYR:HB2	2:A:514:SER:HB2	2.00	0.44
1:H:37:SER:OG	1:H:106:ARG:NH1	2.50	0.44
2:A:431:GLY:HA2	2:A:515:PHE:HD2	1.82	0.44
2:A:347:PHE:CD2	2:A:509:ARG:HG2	2.55	0.42
2:A:518:LEU:HD12	2:A:518:LEU:HA	1.88	0.42
2:A:444:LYS:HA	2:A:444:LYS:HD2	1.81	0.41
1:H:13:VAL:HG21	1:H:19:LEU:HD22	2.02	0.41
1:L:11:LEU:HB3	1:L:124:LEU:HD23	2.02	0.41
1:H:99:THR:HG22	1:H:126:VAL:H	1.86	0.41
1:L:3:GLN:HB2	1:L:26:SER:HB3	2.03	0.41

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	H	125/298 (42%)	121 (97%)	4 (3%)	0	100	100
1	L	103/298 (35%)	97 (94%)	6 (6%)	0	100	100
2	A	185/258 (72%)	178 (96%)	7 (4%)	0	100	100
All	All	413/854 (48%)	396 (96%)	17 (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	H	99/223 (44%)	99 (100%)	0	100	100
1	L	88/223 (40%)	86 (98%)	2 (2%)	44	72
2	A	164/220 (74%)	162 (99%)	2 (1%)	63	83
All	All	351/666 (53%)	347 (99%)	4 (1%)	65	84

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	L	53	LEU
1	L	67	LEU
2	A	373	SER
2	A	455	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	L	120	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 oligosaccharides 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	$\#\|Z\| > 2$
3	NAG	A	600	2	14,14,15	0.28	0	17,19,21	0.47	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
3	NAG	A	600	2	-	0/6/23/26	0/1/1/1

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, 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	127/298 (42%)	0.56	6 (4%) 36 32	39, 62, 83, 90	0
1	L	105/298 (35%)	0.94	12 (11%) 10 8	43, 74, 102, 109	0
2	A	189/258 (73%)	0.26	10 (5%) 32 28	32, 48, 73, 87	0
All	All	421/854 (49%)	0.52	28 (6%) 24 21	32, 60, 88, 109	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	L	124	LEU	4.9
2	A	523	THR	4.1
2	A	446	GLY	4.0
1	H	27	GLY	3.8
2	A	448	ASN	3.4
2	A	449	TYR	3.0
1	H	94	LEU	3.0
1	H	28	PHE	2.7
1	H	127	SER	2.7
2	A	384	PRO	2.6
2	A	518	LEU	2.6
1	L	99	PHE	2.5
1	L	19	VAL	2.5
1	L	13	ALA	2.5
1	H	99	THR	2.3
1	L	15	VAL	2.3
2	A	445	VAL	2.3
1	L	9	SER	2.2
1	H	12	LEU	2.2
1	L	12	SER	2.2
2	A	334	ASN	2.2
1	L	7	SER	2.2
1	L	94	LEU	2.1

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Mol	Chain	Res	Type	RSRZ
2	A	447	GLY	2.1
1	L	76	PHE	2.1
2	A	526	GLY	2.1
1	L	10	SER	2.1
1	L	17	ASP	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)

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, 95th 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^2)	Q<0.9
3	NAG	A	600	14/15	0.73	0.13	60,77,85,85	0

6.5 Other polymers (i)

There are no such residues in this entry.