



Full wwPDB EM Validation Report ⓘ

Jul 15, 2025 – 11:47 AM JST

PDB ID : 8XSE / pdb_00008xse
EMDB ID : EMD-38617
Title : SARS-CoV-2 RBD + IMCAS-123 + IMCAS-72 Fab
Authors : Tong, Z.; Cui, Y.; Xie, Y.; Tong, J.; Gao, G.F.; Qi, J.
Deposited on : 2024-01-09
Resolution : 2.50 Å(reported)

This is a Full wwPDB EM 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/EMValidationReportHelp>

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:

EMDB validation analysis : **FAILED**
Mogul : 1.8.5 (274361), CSD as541be (2020)
MolProbity : 4-5-2 with Phenix2.0rc1
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.44

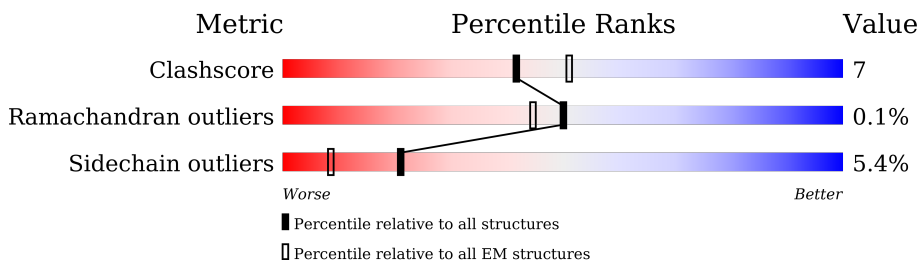
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

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)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	209	82% 11% 7%
2	H	226	76% 21% ..
3	L	215	77% 20% ..
4	M	226	75% 23% .
5	N	215	82% 16% ..

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 8120 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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					AltConf	Trace
1	A	195	Total	C	N	O	S	0	0
			1543	989	257	289	8		

- Molecule 2 is a protein called IMCAS-123 H chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	H	223	Total	C	N	O	S	0	0
			1658	1044	281	326	7		

- Molecule 3 is a protein called IMCAS-123 L chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	L	212	Total	C	N	O	S	0	0
			1611	1008	272	326	5		

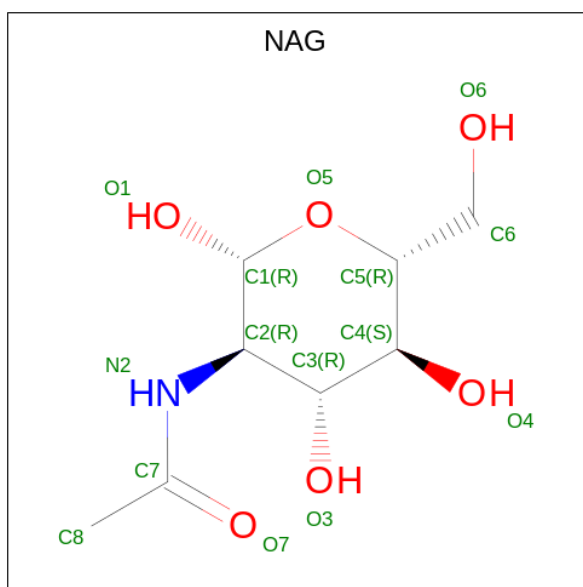
- Molecule 4 is a protein called IMCAS-72 H chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	M	223	Total	C	N	O	S	0	0
			1673	1053	287	327	6		

- Molecule 5 is a protein called IMCAS-72 L chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	N	212	Total	C	N	O	S	0	0
			1621	1015	270	331	5		

- Molecule 6 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C₈H₁₅NO₆).



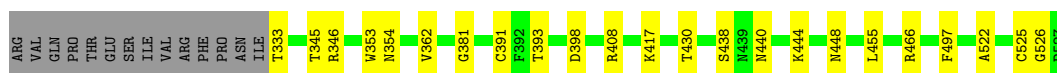
Mol	Chain	Residues	Atoms				AltConf
			Total	C	N	O	
6	A	1	14	8	1	5	0

3 Residue-property plots

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. 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. 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.

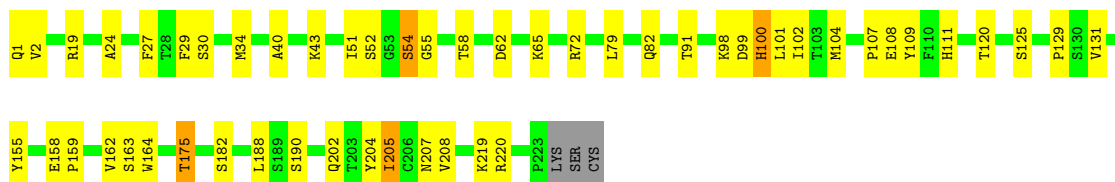
- Molecule 1: Spike protein S1

Chain A: 



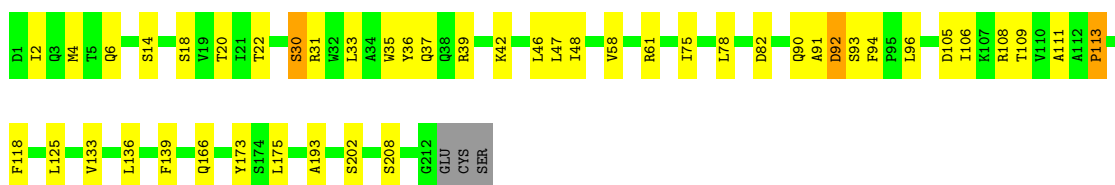
- Molecule 2: IMCAS-123 H chain

Chain H: 



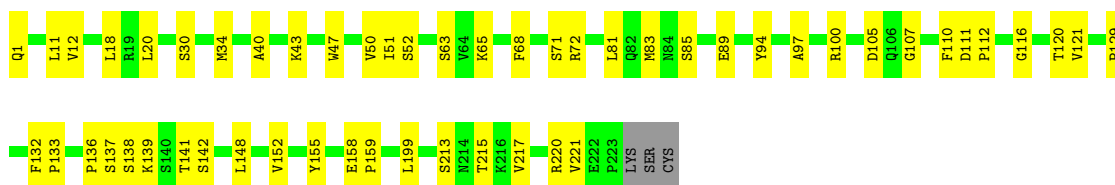
- Molecule 3: IMCAS-123 L chain

Chain L: 



- Molecule 4: IMCAS-72 H chain

Chain M: 



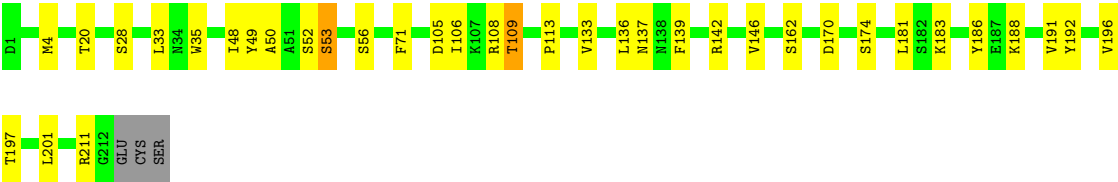
- Molecule 5: IMCAS-72 L chain

Chain N:

82%

16%

••



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	583803	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	40	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor

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	A	0.12	0/1587	0.28	0/2161
2	H	0.14	0/1699	0.41	0/2314
3	L	0.17	0/1645	0.43	2/2234 (0.1%)
4	M	0.14	0/1715	0.34	0/2334
5	N	0.12	0/1657	0.32	0/2251
All	All	0.14	0/8303	0.36	2/11294 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	L	113	PRO	CA-N-CD	-8.90	99.55	112.00
3	L	113	PRO	N-CD-CG	-5.11	95.54	103.20

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	1543	0	1459	16	0
2	H	1658	0	1617	31	0
3	L	1611	0	1563	23	0
4	M	1673	0	1620	26	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	N	1621	0	1576	15	0
6	A	14	0	13	0	0
All	All	8120	0	7848	106	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 7.

All (106) 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)
4:M:20:LEU:HG	4:M:83:MET:HE1	1.69	0.73
4:M:111:ASP:HB3	4:M:112:PRO:HD3	1.75	0.68
1:A:346:ARG:NH1	2:H:108:GLU:OE1	2.28	0.67
2:H:19:ARG:HG3	2:H:82:GLN:HG2	1.75	0.67
2:H:131:VAL:O	2:H:219:LYS:NZ	2.31	0.63
2:H:40:ALA:HB3	2:H:43:LYS:HB2	1.81	0.63
2:H:205:ILE:HG22	2:H:220:ARG:HA	1.81	0.62
4:M:94:TYR:O	4:M:116:GLY:HA2	1.99	0.62
1:A:393:THR:HA	1:A:522:ALA:HA	1.83	0.61
4:M:11:LEU:HD12	4:M:120:THR:HB	1.82	0.60
4:M:52:SER:O	4:M:72:ARG:NH1	2.35	0.59
2:H:29:PHE:O	2:H:72:ARG:NH2	2.35	0.59
3:L:136:LEU:HD22	3:L:175:LEU:HD22	1.83	0.58
3:L:113:PRO:O	3:L:113:PRO:HD2	2.02	0.58
4:M:213:SER:HG	4:M:215:THR:HG1	1.36	0.57
2:H:2:VAL:HG21	2:H:98:LYS:HE2	1.86	0.57
3:L:105:ASP:OD2	3:L:173:TYR:OH	2.22	0.57
5:N:136:LEU:HD21	5:N:196:VAL:HG21	1.87	0.56
1:A:362:VAL:HG13	1:A:526:GLY:HA2	1.88	0.55
2:H:100:HIS:HB2	2:H:111:HIS:CD2	2.42	0.55
3:L:118:PHE:HB2	3:L:133:VAL:HB	1.88	0.55
4:M:97:ALA:HB1	4:M:110:PHE:HB3	1.89	0.54
5:N:137:ASN:OD1	5:N:174:SER:OG	2.25	0.54
2:H:72:ARG:HB3	2:H:79:LEU:HD12	1.89	0.54
3:L:113:PRO:HB3	3:L:139:PHE:HB3	1.90	0.54
5:N:35:TRP:HB2	5:N:48:ILE:HB	1.90	0.54
5:N:113:PRO:HB3	5:N:139:PHE:HB3	1.90	0.53
2:H:162:VAL:HG22	2:H:208:VAL:HG22	1.90	0.53
4:M:141:THR:OG1	4:M:142:SER:N	2.40	0.53
5:N:170:ASP:N	5:N:170:ASP:OD1	2.39	0.53
2:H:52:SER:O	2:H:52:SER:OG	2.26	0.52

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:H:175:THR:HG1	2:H:190:SER:HG	1.58	0.52
1:A:417:LYS:NZ	4:M:105:ASP:OD2	2.35	0.51
2:H:91:THR:HG23	2:H:120:THR:HA	1.91	0.51
2:H:205:ILE:H	2:H:205:ILE:HD12	1.75	0.51
2:H:158:GLU:OE1	2:H:159:PRO:HA	2.10	0.51
5:N:186:TYR:O	5:N:192:TYR:OH	2.29	0.50
2:H:51:ILE:HD12	2:H:58:THR:HG22	1.92	0.50
2:H:51:ILE:HG13	2:H:52:SER:H	1.76	0.50
1:A:440:ASN:O	3:L:30:SER:OG	2.30	0.49
3:L:37:GLN:HB2	3:L:47:LEU:HD11	1.94	0.49
5:N:105:ASP:OD1	5:N:105:ASP:N	2.46	0.49
3:L:106:ILE:HB	3:L:166:GLN:HE22	1.79	0.47
4:M:68:PHE:CZ	4:M:83:MET:HG2	2.50	0.47
1:A:391:CYS:HA	1:A:525:CYS:HA	1.96	0.47
1:A:353:TRP:O	1:A:466:ARG:NH2	2.48	0.46
2:H:54:SER:OG	2:H:55:GLY:N	2.47	0.46
4:M:85:SER:O	4:M:85:SER:OG	2.26	0.46
1:A:345:THR:HG22	1:A:346:ARG:HG2	1.97	0.46
2:H:107:PRO:HD2	3:L:94:PHE:HZ	1.80	0.46
2:H:164:TRP:HE1	2:H:190:SER:HB3	1.80	0.46
2:H:102:ILE:HD11	2:H:104:MET:HE3	1.98	0.46
4:M:47:TRP:HZ2	4:M:50:VAL:HG12	1.81	0.46
3:L:39:ARG:HD2	3:L:42:LYS:HZ1	1.81	0.46
2:H:100:HIS:HB2	2:H:111:HIS:HD2	1.81	0.45
2:H:163:SER:HB2	2:H:207:ASN:OD1	2.16	0.45
3:L:108:ARG:HH12	3:L:111:ALA:HB2	1.81	0.45
1:A:417:LYS:HD3	1:A:455:LEU:HD13	1.97	0.45
5:N:50:ALA:O	5:N:52:SER:N	2.48	0.45
3:L:4:MET:SD	3:L:90:GLN:HB3	2.56	0.45
1:A:353:TRP:H	1:A:353:TRP:CD1	2.35	0.44
4:M:18:LEU:HD12	4:M:18:LEU:HA	1.82	0.44
1:A:354:ASN:O	1:A:398:ASP:HA	2.17	0.44
2:H:34:MET:HG3	2:H:79:LEU:HD13	1.99	0.44
3:L:6:GLN:HE21	3:L:6:GLN:HB3	1.70	0.44
4:M:136:PRO:HG3	4:M:148:LEU:HD23	1.99	0.44
3:L:35:TRP:HB2	3:L:48:ILE:HB	1.99	0.44
1:A:438:SER:O	1:A:438:SER:OG	2.36	0.43
4:M:34:MET:HE3	4:M:34:MET:HB3	1.79	0.43
4:M:129:PRO:HB3	4:M:155:TYR:HB3	2.00	0.43
3:L:91:ALA:HA	3:L:96:LEU:HD22	2.00	0.43
5:N:4:MET:HE3	5:N:4:MET:HB3	1.82	0.43

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:L:30:SER:HB3	3:L:31:ARG:H	1.54	0.43
5:N:211:ARG:HE	5:N:211:ARG:HB3	1.61	0.42
4:M:100:ARG:NH2	4:M:107:GLY:O	2.49	0.42
2:H:65:LYS:HE2	2:H:65:LYS:HB2	1.73	0.42
3:L:18:SER:HA	3:L:75:ILE:O	2.19	0.42
4:M:51:ILE:HG23	4:M:72:ARG:HH11	1.83	0.42
4:M:68:PHE:CE1	4:M:83:MET:HG2	2.55	0.42
4:M:139:LYS:O	4:M:139:LYS:HG2	2.19	0.42
1:A:381:GLY:HA3	1:A:430:THR:HG23	2.01	0.42
2:H:129:PRO:HB3	2:H:155:TYR:HB3	2.01	0.42
4:M:158:GLU:HG2	4:M:159:PRO:HA	2.02	0.42
5:N:49:TYR:O	5:N:53:SER:HB2	2.19	0.42
3:L:193:ALA:HB2	3:L:208:SER:HB3	2.00	0.42
2:H:34:MET:CE	2:H:98:LYS:HB2	2.50	0.42
3:L:2:ILE:HD13	3:L:93:SER:HB2	2.01	0.42
1:A:448:ASN:HB3	1:A:497:PHE:HB2	2.01	0.41
3:L:36:TYR:CE1	3:L:46:LEU:HD12	2.55	0.41
2:H:24:ALA:HB1	2:H:27:PHE:HE1	1.85	0.41
5:N:183:LYS:HA	5:N:183:LYS:HD2	1.87	0.41
3:L:47:LEU:HA	3:L:58:VAL:HG21	2.02	0.41
4:M:132:PHE:HA	4:M:133:PRO:HD3	1.90	0.41
3:L:61:ARG:HH21	3:L:82:ASP:CG	2.28	0.41
4:M:12:VAL:O	4:M:121:VAL:HA	2.21	0.41
5:N:113:PRO:HA	5:N:137:ASN:O	2.20	0.41
1:A:333:THR:O	1:A:333:THR:OG1	2.26	0.41
2:H:108:GLU:HB3	2:H:109:TYR:H	1.68	0.41
4:M:199:LEU:HD23	4:M:199:LEU:HA	1.93	0.41
5:N:33:LEU:HD22	5:N:71:PHE:CG	2.56	0.41
5:N:108:ARG:NH1	5:N:109:THR:O	2.54	0.41
4:M:81:LEU:HG	4:M:83:MET:HE2	2.03	0.40
1:A:444:LYS:HD2	3:L:92:ASP:HA	2.03	0.40
2:H:99:ASP:OD1	2:H:100:HIS:N	2.55	0.40
4:M:40:ALA:HB3	4:M:43:LYS:HB2	2.03	0.40
2:H:62:ASP:OD1	2:H:62:ASP:N	2.54	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 PDB entries followed by that with respect to all EM entries.

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	193/209 (92%)	186 (96%)	7 (4%)	0	100	100
2	H	221/226 (98%)	205 (93%)	15 (7%)	1 (0%)	25	44
3	L	210/215 (98%)	199 (95%)	11 (5%)	0	100	100
4	M	221/226 (98%)	205 (93%)	16 (7%)	0	100	100
5	N	210/215 (98%)	200 (95%)	10 (5%)	0	100	100
All	All	1055/1091 (97%)	995 (94%)	59 (6%)	1 (0%)	50	69

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	H	54	SER

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 PDB entries followed by that with respect to all EM entries.

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	168/182 (92%)	167 (99%)	1 (1%)	84	94
2	H	186/189 (98%)	175 (94%)	11 (6%)	16	33
3	L	180/184 (98%)	170 (94%)	10 (6%)	17	36
4	M	184/188 (98%)	172 (94%)	12 (6%)	14	29
5	N	187/190 (98%)	172 (92%)	15 (8%)	10	20
All	All	905/933 (97%)	856 (95%)	49 (5%)	21	37

All (49) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	408	ARG
2	H	1	GLN
2	H	30	SER
2	H	100	HIS
2	H	101	LEU
2	H	125	SER
2	H	175	THR
2	H	182	SER
2	H	188	LEU
2	H	202	GLN
2	H	204	TYR
2	H	205	ILE
3	L	14	SER
3	L	20	THR
3	L	22	THR
3	L	30	SER
3	L	33	LEU
3	L	78	LEU
3	L	92	ASP
3	L	109	THR
3	L	125	LEU
3	L	202	SER
4	M	1	GLN
4	M	30	SER
4	M	63	SER
4	M	65	LYS
4	M	71	SER
4	M	89	GLU
4	M	137	SER
4	M	138	SER
4	M	152	VAL
4	M	217	VAL
4	M	220	ARG
4	M	221	VAL
5	N	20	THR
5	N	28	SER
5	N	53	SER
5	N	56	SER
5	N	106	ILE
5	N	109	THR
5	N	133	VAL
5	N	142	ARG

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
5	N	146	VAL
5	N	162	SER
5	N	181	LEU
5	N	188	LYS
5	N	191	VAL
5	N	197	THR
5	N	201	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	360	ASN
1	A	474	GLN
1	A	487	ASN
2	H	13	GLN
2	H	209	ASN
3	L	6	GLN
3	L	189	HIS
4	M	3	GLN
4	M	13	GLN
4	M	202	GLN
5	N	6	GLN
5	N	55	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	$\# Z > 2$
6	NAG	A	601	1	14,14,15	0.21	0	17,19,21	0.40	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
6	NAG	A	601	1	-	2/6/23/26	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	601	NAG	O5-C5-C6-O6
6	A	601	NAG	C4-C5-C6-O6

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.