WORLDWIDE wwPDB PROTEIN DATA BANK

Full wwPDB EM Validation Report ⓘ

Jul 7, 2025 – 07:15 PM JST

PDB ID	:	8ZHO / pdb_00008zho
EMDB ID	:	EMD-60110
Title	:	SARS-CoV-2 S1 in complex with H18 and R1-32 Fab
Authors	:	Yan, Q.; Gao, X.; Liu, B.; Hou, R.; He, P.; Li, Z.; Chen, Q.; Wang, J.; He, J.; Chen, L.; Zhao, J.; Xiong, X.
Deposited on	:	2024-05-11
Resolution	:	3.54 Å(reported)

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

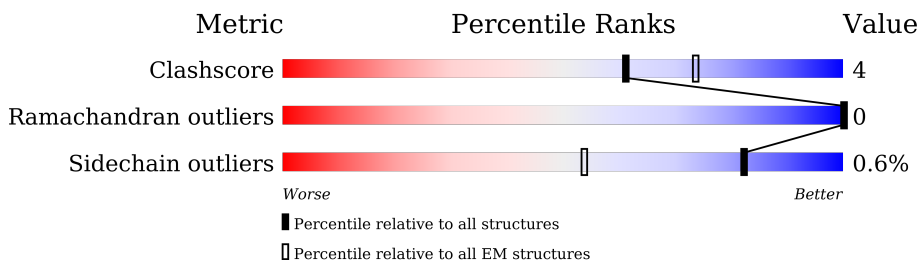|		
EMDB validation analysis	:	FAILED
Mogul	:	1.8.5 (274361), CSD as541be (2020)
MolProbity	:	4-5-2 with Phenix2.0rc1
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ	:	FAILED
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson 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 3.54 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	Percentile Ranks	Value
Clashscore		4
Ramachandran outliers		0
Sidechain outliers		0.6%

Worse   *Better*

▮ Percentile relative to all structures
▯ Percentile relative to all EM structures

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 <=5%

Mol	Chain	Length	Quality of chain
1	C	666	81% 12% 7%
2	D	228	87% 13%
3	E	214	92% 7%
4	L	243	80% 7% 13%
5	H	243	83% 9% 8%

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2　Entry composition ⓘ

There are 6 unique types of molecules in this entry. The entry contains 11423 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 glycoprotein.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	C	622	Total 4932	C 3162	N 822	O 927	S 21	0	0

- Molecule 2 is a protein called Heavy chain of R1-32 Fab.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	D	227	Total 1661	C 1045	N 277	O 332	S 7	0	0

- Molecule 3 is a protein called Light chain of R1-32 Fab.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	E	213	Total 1557	C 971	N 261	O 321	S 4	0	0

- Molecule 4 is a protein called Light chain of H18 Fab.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	L	212	Total 1589	C 987	N 263	O 334	S 5	0	0

- Molecule 5 is a protein called Heavy chain of H18 Fab.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	H	224	Total 1670	C 1058	N 276	O 330	S 6	0	0

- Molecule 6 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).

NAG

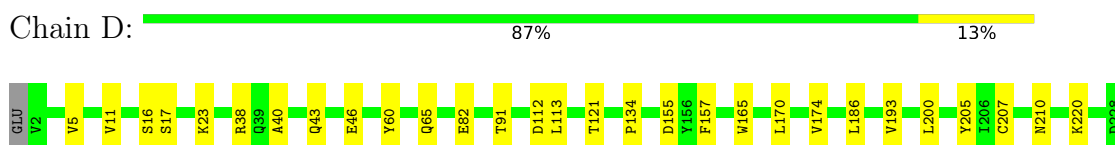| Mol	Chain	Residues	Atoms				AltConf
6	C	1	Total	C	N	O	0
			14	8	1	5	

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 glycoprotein
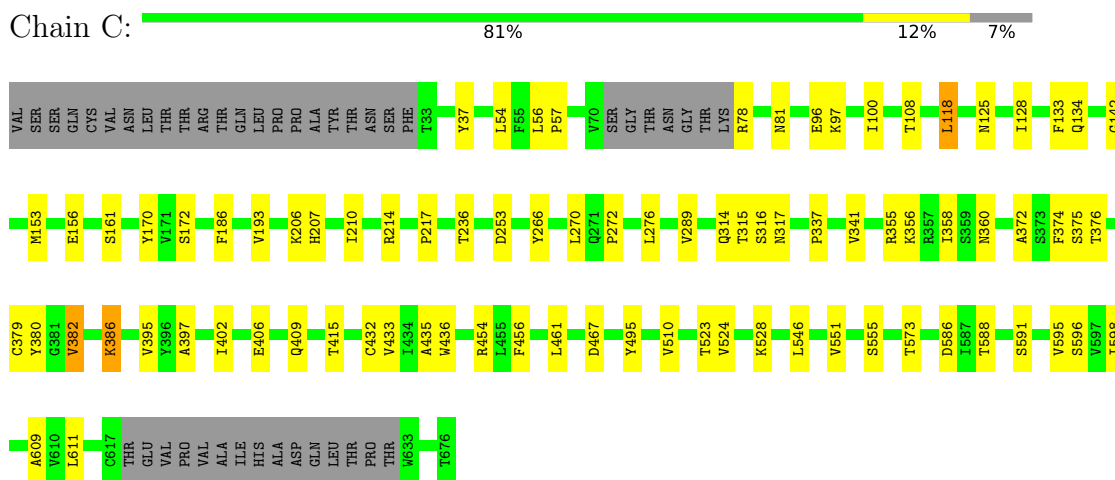
Chain C:

- Molecule 2: Heavy chain of R1-32 Fab

Chain D:

- Molecule 3: Light chain of R1-32 Fab
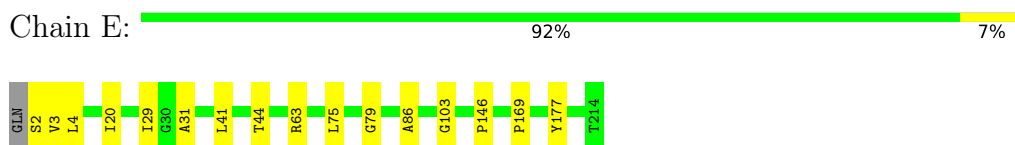
Chain E:

- Molecule 4: Light chain of H18 Fab

Chain L:

E171 Y188 L189 T220 GLU CYS SER
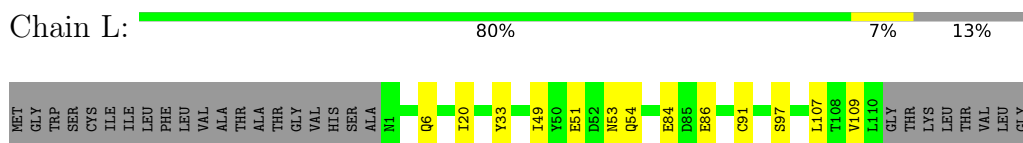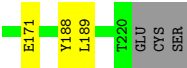
• Molecule 5: Heavy chain of H18 Fab

Chain H:

83%   9%   8%

MET GLY TRP SER LEU ILE LEU LEU PHE LEU VAL ALA VAL ALA THR ARG VAL LEU SER Q1 L11 F35 Q41 L47 T88 A89 T92 R99 Q100 L101 W102 G105 D108 V118 P126 S134 S137 A144 Y152 F153 P154 A175 L185

N211 D224
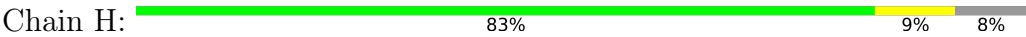
4 Experimental information ⓘ

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	178003	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 $(e^-/\text{Å}^2)$	50	Depositor
Minimum defocus (nm)	600	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	130000	Depositor
Image detector	FEI FALCON IV (4k 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	C	0.17	0/5062	0.31	0/6889
2	D	0.11	0/1698	0.28	0/2312
3	E	0.09	0/1595	0.25	0/2181
4	L	0.18	0/1626	0.38	0/2220
5	H	0.11	0/1713	0.30	0/2339
All	All	0.15	0/11694	0.31	0/15941

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	C	4932	0	4748	50	0
2	D	1661	0	1631	16	0
3	E	1557	0	1498	11	0
4	L	1589	0	1521	10	0
5	H	1670	0	1643	11	0
6	C	14	0	13	0	0
All	All	11423	0	11054	95	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 (95) 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:L:171:GLU:HG2	4:L:188:TYR:HB2	1.76	0.67
4:L:53:ASN:ND2	4:L:54:GLN:OE1	2.31	0.64
5:H:175:ALA:HB2	5:H:185:LEU:HD23	1.79	0.63
5:H:134:SER:H	5:H:137:SER:HB3	1.64	0.62
5:H:92:THR:HG22	5:H:118:VAL:H	1.65	0.60
5:H:41:GLN:HB2	5:H:47:LEU:HD23	1.86	0.58
3:E:41:LEU:HB2	3:E:44:THR:HB	1.85	0.58
1:C:379:CYS:HA	1:C:432:CYS:HB3	1.86	0.58
1:C:551:VAL:HB	1:C:588:THR:HB	1.87	0.57
1:C:546:LEU:HD11	1:C:573:THR:HG21	1.87	0.56
1:C:454:ARG:NH1	1:C:467:ASP:OD2	2.40	0.55
2:D:40:ALA:HB3	2:D:43:GLN:HB2	1.89	0.55
1:C:375:SER:H	1:C:436:TRP:HA	1.71	0.54
4:L:127:THR:HG21	5:H:144:ALA:HB3	1.90	0.54
1:C:454:ARG:NH2	1:C:456:PHE:O	2.41	0.53
1:C:355:ARG:HG2	3:E:31:ALA:HB1	1.89	0.53
1:C:97:LYS:HB3	1:C:186:PHE:HA	1.91	0.52
2:D:174:VAL:HA	2:D:193:VAL:HG12	1.91	0.52
1:C:337:PRO:HD2	1:C:358:ILE:HG23	1.90	0.52
1:C:210:ILE:HG21	1:C:217:PRO:HG3	1.92	0.52
2:D:17:SER:OG	2:D:82:GLU:OE2	2.27	0.51
1:C:555:SER:HB3	1:C:586:ASP:HB2	1.91	0.51
3:E:2:SER:OG	3:E:3:VAL:N	2.31	0.51
1:C:358:ILE:HB	1:C:395:VAL:HB	1.91	0.51
1:C:214:ARG:NH1	1:C:266:TYR:OH	2.44	0.51
5:H:88:THR:OG1	5:H:89:ALA:N	2.43	0.50
1:C:409:GLN:NE2	1:C:415:THR:O	2.44	0.50
1:C:395:VAL:HG23	1:C:524:VAL:HG11	1.93	0.50
4:L:6:GLN:NE2	4:L:91:CYS:SG	2.84	0.50
5:H:99:ARG:NH2	5:H:108:ASP:OD2	2.39	0.50
2:D:91:THR:HG23	2:D:121:THR:HA	1.93	0.50
1:C:317:ASN:H	1:C:591:SER:HB3	1.79	0.48
1:C:81:ASN:N	1:C:81:ASN:OD1	2.47	0.48
3:E:4:LEU:HB3	3:E:103:GLY:HA2	1.95	0.48
1:C:125:ASN:ND2	1:C:172:SER:O	2.41	0.47
1:C:372:ALA:HB1	4:L:97:SER:HB3	1.97	0.47
5:H:11:LEU:HD21	5:H:154:PRO:HG3	1.96	0.47
2:D:134:PRO:HD3	2:D:220:LYS:HD2	1.97	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:E:41:LEU:HD23	3:E:86:ALA:HB2	1.95	0.47
2:D:16:SER:OG	2:D:17:SER:N	2.46	0.46
1:C:598:ILE:HB	1:C:609:ALA:HB3	1.98	0.46
4:L:20:ILE:HD11	4:L:107:LEU:HD22	1.97	0.46
1:C:78:ARG:HD2	1:C:78:ARG:HA	1.70	0.46
1:C:379:CYS:HB3	1:C:382:VAL:HB	1.97	0.46
3:E:20:ILE:HD12	3:E:75:LEU:HD23	1.98	0.46
1:C:134:GLN:HB3	1:C:161:SER:HB2	1.97	0.46
2:D:210:ASN:OD1	2:D:210:ASN:N	2.49	0.46
4:L:84:GLU:OE2	4:L:84:GLU:N	2.38	0.45
4:L:86:GLU:HB2	4:L:109:VAL:HG23	1.97	0.45
1:C:314:GLN:HE22	1:C:595:VAL:H	1.65	0.45
2:D:11:VAL:HG21	2:D:157:PHE:HZ	1.81	0.45
1:C:461:LEU:HD23	1:C:461:LEU:HA	1.84	0.45
5:H:35:PHE:HB2	5:H:100:GLN:HB3	1.99	0.45
1:C:206:LYS:HA	1:C:206:LYS:HD2	1.73	0.45
1:C:376:THR:HB	1:C:435:ALA:HB3	1.97	0.45
3:E:4:LEU:HD21	3:E:29:ILE:HD11	1.99	0.45
1:C:96:GLU:OE2	1:C:100:ILE:N	2.50	0.44
1:C:118:LEU:HD22	1:C:133:PHE:CZ	2.52	0.44
3:E:4:LEU:HD23	3:E:4:LEU:HA	1.88	0.44
1:C:276:LEU:HB2	1:C:289:VAL:HB	1.99	0.44
1:C:206:LYS:NZ	1:C:207:HIS:O	2.50	0.44
1:C:360:ASN:OD1	1:C:523:THR:OG1	2.33	0.44
1:C:528:LYS:HE2	1:C:528:LYS:HB3	1.74	0.44
1:C:402:ILE:HG12	1:C:510:VAL:HG21	2.00	0.44
3:E:63:ARG:NH1	3:E:79:GLY:O	2.51	0.44
1:C:253:ASP:OD1	1:C:253:ASP:N	2.45	0.43
1:C:56:LEU:HD12	1:C:57:PRO:HD2	2.00	0.43
4:L:33:TYR:HD2	4:L:51:GLU:HA	1.83	0.43
1:C:142:GLY:HA3	1:C:156:GLU:HB2	2.01	0.43
1:C:596:SER:HB2	1:C:611:LEU:HB3	2.01	0.43
2:D:155:ASP:HB3	2:D:186:LEU:HD21	2.00	0.43
2:D:165:TRP:HB3	2:D:170:LEU:HB3	2.01	0.43
1:C:153:MET:HA	1:C:153:MET:HE2	2.00	0.42
1:C:193:VAL:HG13	1:C:270:LEU:HD11	2.01	0.42
5:H:126:PRO:HB3	5:H:152:TYR:HB3	2.00	0.42
1:C:54:LEU:HA	1:C:272:PRO:HA	2.02	0.42
2:D:5:VAL:O	2:D:23:LYS:N	2.51	0.42
3:E:146:PRO:HB3	3:E:169:PRO:HG2	2.02	0.42
1:C:37:TYR:OH	1:C:54:LEU:O	2.32	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:386:LYS:HE2	1:C:386:LYS:HB3	1.65	0.42
1:C:128:ILE:HB	1:C:170:TYR:HB3	2.01	0.42
1:C:341:VAL:HG11	1:C:397:ALA:HB1	2.02	0.41
1:C:356:LYS:HB3	1:C:356:LYS:HE3	1.90	0.41
1:C:108:THR:HA	1:C:236:THR:HG22	2.02	0.41
2:D:112:ASP:OD1	2:D:112:ASP:N	2.54	0.41
2:D:38:ARG:HG2	2:D:46:GLU:HB2	2.03	0.41
1:C:315:THR:OG1	1:C:316:SER:N	2.54	0.41
4:L:143:LEU:HB2	4:L:189:LEU:HB3	2.02	0.41
3:E:169:PRO:HB2	3:E:177:TYR:HD2	1.85	0.40
1:C:406:GLU:OE1	1:C:495:TYR:OH	2.37	0.40
2:D:60:TYR:HB2	2:D:65:GLN:HG3	2.02	0.40
5:H:102:TRP:HB3	5:H:105:GLY:HA3	2.03	0.40
2:D:113:LEU:HD23	2:D:113:LEU:HA	1.92	0.40
2:D:200:LEU:HD23	2:D:205:TYR:HE2	1.87	0.40
1:C:374:PHE:HA	1:C:436:TRP:HB3	2.02	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	C	616/666 (92%)	590 (96%)	26 (4%)	0	100	100
2	D	225/228 (99%)	219 (97%)	6 (3%)	0	100	100
3	E	211/214 (99%)	202 (96%)	9 (4%)	0	100	100
4	L	208/243 (86%)	199 (96%)	9 (4%)	0	100	100
5	H	222/243 (91%)	216 (97%)	6 (3%)	0	100	100
All	All	1482/1594 (93%)	1426 (96%)	56 (4%)	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 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	C	548/587 (93%)	543 (99%)	5 (1%)	75	87
2	D	184/186 (99%)	183 (100%)	1 (0%)	86	93
3	E	174/177 (98%)	174 (100%)	0	100	100
4	L	184/208 (88%)	183 (100%)	1 (0%)	86	93
5	H	192/209 (92%)	191 (100%)	1 (0%)	86	93
All	All	1282/1367 (94%)	1274 (99%)	8 (1%)	82	92

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

Mol	Chain	Res	Type
1	C	118	LEU
1	C	380	TYR
1	C	382	VAL
1	C	386	LYS
1	C	433	VAL
2	D	207	CYS
4	L	49	ILE
5	H	211	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	C	87	ASN
1	C	188	ASN
1	C	271	GLN
1	C	409	GLN
1	C	460	ASN
1	C	544	ASN
2	D	59	ASN
2	D	100	ASN
2	D	175	HIS
3	E	40	GLN

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Mol	Chain	Res	Type
3	E	172	GLN
4	L	53	ASN
4	L	54	GLN
4	L	208	HIS
5	H	62	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 ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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	C	701	1	14,14,15	0.27	0	17,19,21	0.46	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	C	701	1	-	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 ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.