



wwPDB EM Validation Summary Report ⓘ

Jul 8, 2025 – 03:30 PM JST

PDB ID : 9L1N / pdb_00009l1n
EMDB ID : EMD-62749
Title : Structure of Western equine encephalitis virus 71V1658 strain VLP in complex with human PCDH10 EC1
Authors : Cao, D.; Ma, B.; Cao, Z.; Zhang, X.; Xiang, Y.
Deposited on : 2024-12-15
Resolution : 3.30 Å(reported)

This is a wwPDB EM 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/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

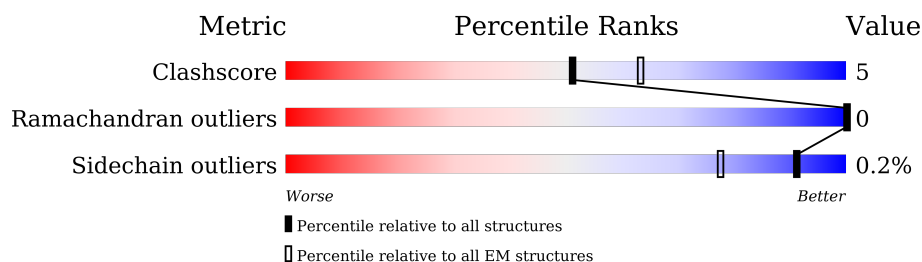
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.30 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	439	87% 12%
1	D	439	85% 15%
1	G	439	86% 14%
1	J	439	90% 10%
2	B	416	85% 14%
2	E	416	84% 16%
2	H	416	89% 10%
2	K	416	84% 15%
3	C	150	89% 11%

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Mol	Chain	Length	Quality of chain
3	F	150	 78%22%
3	I	150	 86%14%
3	L	150	 79%21%
4	M	95	 81%17%.

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 31688 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 E1 glycoprotein.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	438	Total	C	N	O	S	0	0
			3310	2103	556	630	21		
1	D	438	Total	C	N	O	S	0	0
			3310	2103	556	630	21		
1	G	438	Total	C	N	O	S	0	0
			3310	2103	556	630	21		
1	J	438	Total	C	N	O	S	0	0
			3310	2103	556	630	21		

- Molecule 2 is a protein called E2 glycoprotein.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	415	Total	C	N	O	S	0	0
			3240	2058	567	594	21		
2	E	415	Total	C	N	O	S	0	0
			3240	2058	567	594	21		
2	H	415	Total	C	N	O	S	0	0
			3240	2058	567	594	21		
2	K	415	Total	C	N	O	S	0	0
			3240	2058	567	594	21		

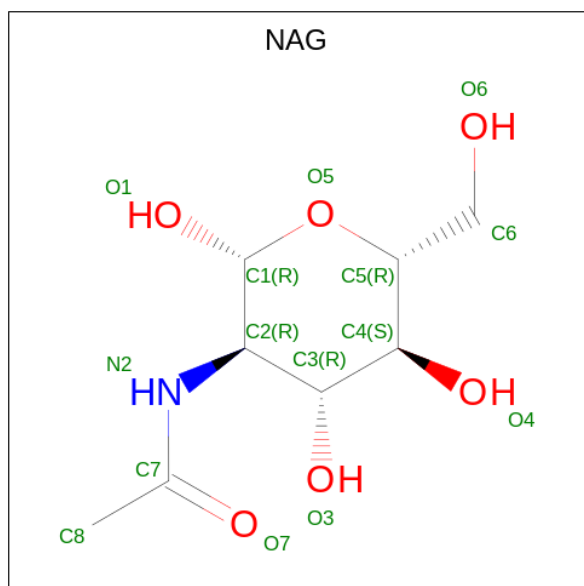
- Molecule 3 is a protein called Capsid glycoprotein.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	C	150	Total	C	N	O	S	0	0
			1153	724	208	216	5		
3	F	150	Total	C	N	O	S	0	0
			1153	724	208	216	5		
3	I	150	Total	C	N	O	S	0	0
			1153	724	208	216	5		
3	L	150	Total	C	N	O	S	0	0
			1153	724	208	216	5		

- Molecule 4 is a protein called Protocadherin-10.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	M	95	Total	C	N	O	S	0	0
			764	485	125	152	2		

- Molecule 5 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).

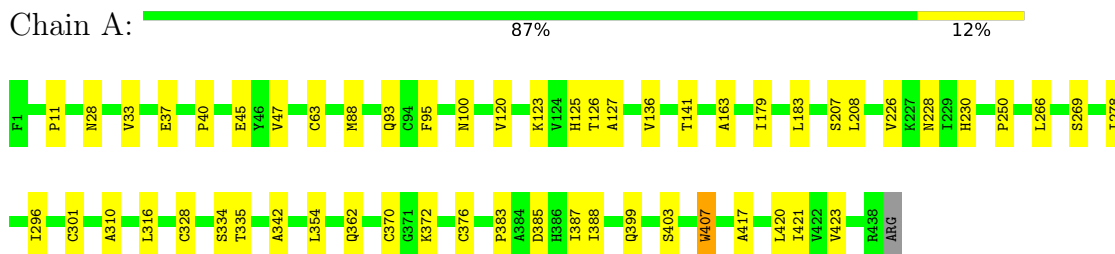


Mol	Chain	Residues	Atoms				AltConf
5	A	1	Total	C	N	O	0
			14	8	1	5	
5	B	1	Total	C	N	O	0
			14	8	1	5	
5	D	1	Total	C	N	O	0
			14	8	1	5	
5	E	1	Total	C	N	O	0
			14	8	1	5	
5	G	1	Total	C	N	O	0
			14	8	1	5	
5	H	1	Total	C	N	O	0
			14	8	1	5	
5	J	1	Total	C	N	O	0
			14	8	1	5	
5	K	1	Total	C	N	O	0
			14	8	1	5	

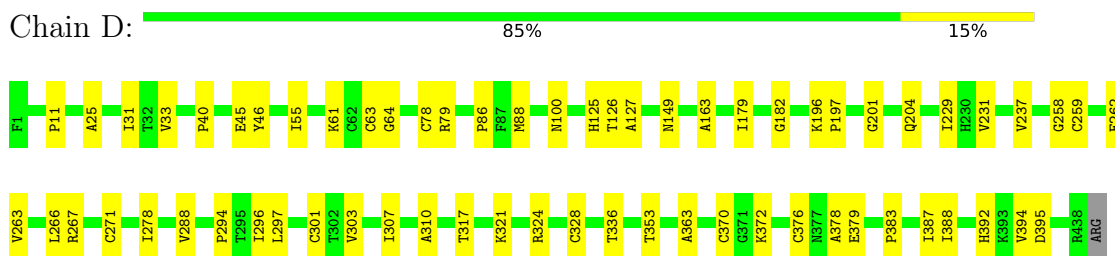
3 Residue-property plots

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.

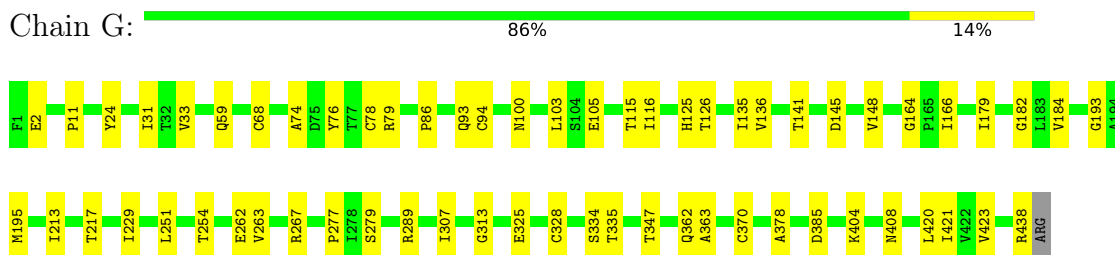
- Molecule 1: E1 glycoprotein



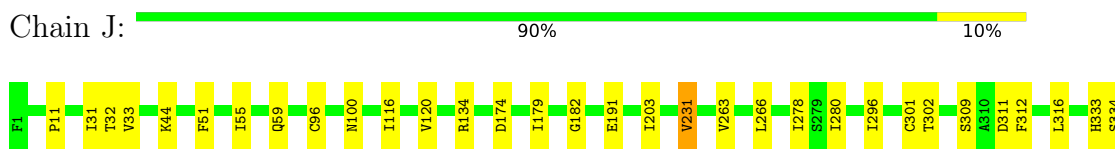
- Molecule 1: E1 glycoprotein



- Molecule 1: E1 glycoprotein

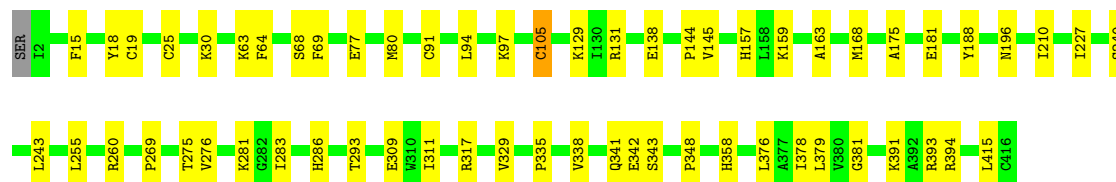
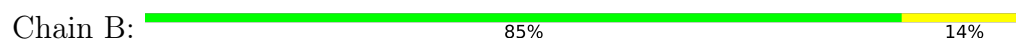


- Molecule 1: E1 glycoprotein

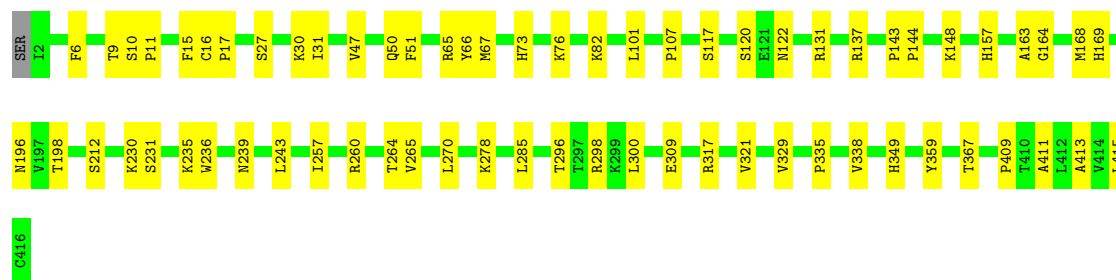
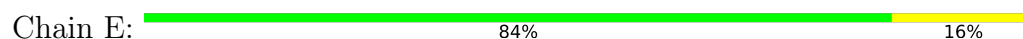




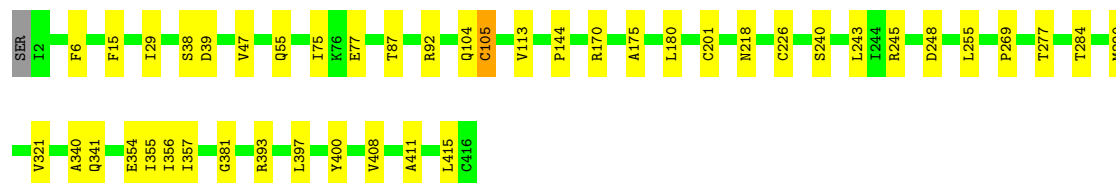
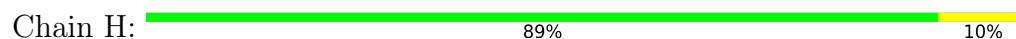
• Molecule 2: E2 glycoprotein



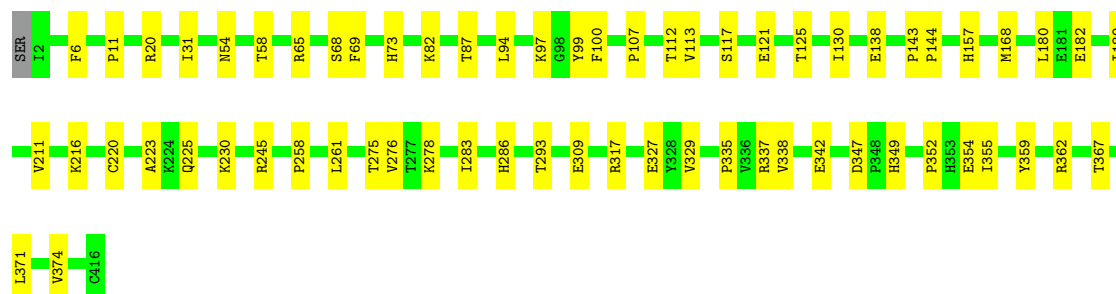
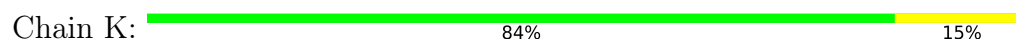
• Molecule 2: E2 glycoprotein



• Molecule 2: E2 glycoprotein



• Molecule 2: E2 glycoprotein




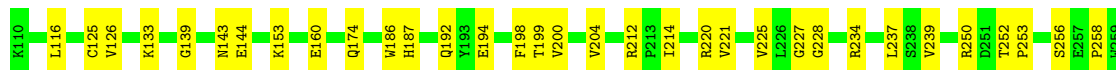
- Molecule 3: Capsid glycoprotein

Chain C:  89% 11%




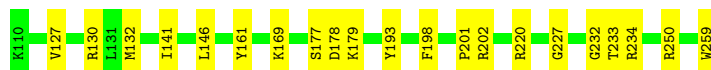
- Molecule 3: Capsid glycoprotein

Chain F:  78% 22%




- Molecule 3: Capsid glycoprotein

Chain I:  86% 14%




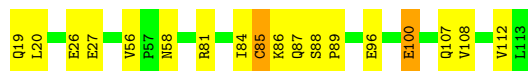
- Molecule 3: Capsid glycoprotein

Chain L:  79% 21%



- Molecule 4: Protocadherin-10

Chain M:  81% 17% .



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	516874	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	1200	Depositor
Maximum defocus (nm)	1700	Depositor
Magnification	Not provided	
Image detector	GATAN K2 SUMMIT (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	A	0.35	0/3392	0.63	0/4627
1	D	0.32	0/3392	0.61	0/4627
1	G	0.33	0/3392	0.63	2/4627 (0.0%)
1	J	0.26	0/3392	0.58	2/4627 (0.0%)
2	B	0.36	0/3333	0.62	0/4539
2	E	0.33	0/3333	0.60	0/4539
2	H	0.35	0/3333	0.66	3/4539 (0.1%)
2	K	0.26	0/3333	0.58	0/4539
3	C	0.21	0/1179	0.53	0/1597
3	F	0.22	0/1179	0.60	0/1597
3	I	0.21	0/1179	0.54	0/1597
3	L	0.21	0/1179	0.55	0/1597
4	M	0.31	0/777	0.75	4/1056 (0.4%)
All	All	0.31	0/32393	0.61	11/44108 (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(°)
2	H	397	LEU	CA-C-N	10.31	132.98	120.09
2	H	397	LEU	C-N-CA	10.31	132.98	120.09
4	M	100	GLU	N-CA-C	8.28	123.56	113.38
2	H	397	LEU	O-C-N	-6.31	112.03	121.63
4	M	85	CYS	N-CA-C	-5.95	104.71	111.07

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	3310	0	3256	32	0
1	D	3310	0	3258	38	0
1	G	3310	0	3256	39	0
1	J	3310	0	3256	26	0
2	B	3240	0	3179	37	0
2	E	3240	0	3179	43	0
2	H	3240	0	3179	35	0
2	K	3240	0	3179	38	0
3	C	1153	0	1138	9	0
3	F	1153	0	1138	19	0
3	I	1153	0	1138	16	0
3	L	1153	0	1138	17	0
4	M	764	0	748	18	0
5	A	14	0	13	0	0
5	B	14	0	13	0	0
5	D	14	0	13	0	0
5	E	14	0	13	0	0
5	G	14	0	13	0	0
5	H	14	0	13	0	0
5	J	14	0	13	0	0
5	K	14	0	13	0	0
All	All	31688	0	31146	333	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 5.

The worst 5 of 333 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:85:CYS:O	4:M:88:SER:O	2.05	0.75
1:J:432:SER:O	1:J:436:ASN:HB2	1.87	0.74
2:E:163:ALA:HB2	2:E:260:ARG:HD2	1.70	0.74
2:E:157:HIS:CD2	4:M:58:ASN:HA	2.24	0.73
4:M:86:LYS:HD2	4:M:86:LYS:C	2.16	0.71

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	436/439 (99%)	390 (89%)	46 (11%)	0	100	100
1	D	436/439 (99%)	396 (91%)	40 (9%)	0	100	100
1	G	436/439 (99%)	397 (91%)	39 (9%)	0	100	100
1	J	436/439 (99%)	399 (92%)	37 (8%)	0	100	100
2	B	413/416 (99%)	368 (89%)	45 (11%)	0	100	100
2	E	413/416 (99%)	370 (90%)	43 (10%)	0	100	100
2	H	413/416 (99%)	367 (89%)	46 (11%)	0	100	100
2	K	413/416 (99%)	363 (88%)	50 (12%)	0	100	100
3	C	148/150 (99%)	140 (95%)	8 (5%)	0	100	100
3	F	148/150 (99%)	143 (97%)	5 (3%)	0	100	100
3	I	148/150 (99%)	136 (92%)	12 (8%)	0	100	100
3	L	148/150 (99%)	137 (93%)	11 (7%)	0	100	100
4	M	93/95 (98%)	87 (94%)	6 (6%)	0	100	100
All	All	4081/4115 (99%)	3693 (90%)	388 (10%)	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	A	368/369 (100%)	367 (100%)	1 (0%)	91	94
1	D	368/369 (100%)	368 (100%)	0	100	100
1	G	368/369 (100%)	368 (100%)	0	100	100
1	J	368/369 (100%)	367 (100%)	1 (0%)	91	94
2	B	356/357 (100%)	354 (99%)	2 (1%)	84	90
2	E	356/357 (100%)	355 (100%)	1 (0%)	91	94
2	H	356/357 (100%)	355 (100%)	1 (0%)	91	94
2	K	356/357 (100%)	356 (100%)	0	100	100
3	C	122/122 (100%)	122 (100%)	0	100	100
3	F	122/122 (100%)	122 (100%)	0	100	100
3	I	122/122 (100%)	122 (100%)	0	100	100
3	L	122/122 (100%)	122 (100%)	0	100	100
4	M	88/88 (100%)	88 (100%)	0	100	100
All	All	3472/3480 (100%)	3466 (100%)	6 (0%)	91	95

5 of 6 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	E	285	LEU
2	H	105	CYS
1	J	231	VAL
2	B	18	TYR
1	A	407	TRP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 64 such sidechains are listed below:

Mol	Chain	Res	Type
2	K	349	HIS
3	L	230	ASN
2	E	174	HIS
2	E	169	HIS
4	M	19	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](#)

8 ligands are 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	$\# Z > 2$
5	NAG	D	501	1	14,14,15	0.35	0	17,19,21	0.52	0
5	NAG	K	501	2	14,14,15	0.35	0	17,19,21	0.47	0
5	NAG	G	501	1	14,14,15	0.57	0	17,19,21	0.49	0
5	NAG	E	501	2	14,14,15	0.33	0	17,19,21	0.55	0
5	NAG	A	501	1	14,14,15	0.40	0	17,19,21	0.60	1 (5%)
5	NAG	B	501	2	14,14,15	0.35	0	17,19,21	0.57	0
5	NAG	J	501	1	14,14,15	0.43	0	17,19,21	0.59	1 (5%)
5	NAG	H	501	2	14,14,15	0.32	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
5	NAG	D	501	1	-	2/6/23/26	0/1/1/1
5	NAG	K	501	2	-	1/6/23/26	0/1/1/1
5	NAG	G	501	1	-	1/6/23/26	0/1/1/1
5	NAG	E	501	2	-	0/6/23/26	0/1/1/1
5	NAG	A	501	1	-	2/6/23/26	0/1/1/1
5	NAG	B	501	2	-	2/6/23/26	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	NAG	J	501	1	-	0/6/23/26	0/1/1/1
5	NAG	H	501	2	-	2/6/23/26	0/1/1/1

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	J	501	NAG	C1-O5-C5	2.08	115.01	112.19
5	A	501	NAG	C1-O5-C5	2.02	114.93	112.19

There are no chirality outliers.

5 of 10 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	H	501	NAG	O5-C5-C6-O6
5	A	501	NAG	O5-C5-C6-O6
5	D	501	NAG	O5-C5-C6-O6
5	A	501	NAG	C4-C5-C6-O6
5	B	501	NAG	O5-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.