



Full wwPDB X-ray Structure Validation Report ⓘ

Sep 26, 2023 – 05:13 PM EDT

PDB ID : 6C6Z
Title : Crystal structure of potent neutralizing antibody CDC2-C2 in complex with MERS-CoV S1 RBD
Authors : Wang, N.; McLellan, J.S.
Deposited on : 2018-01-19
Resolution : 2.10 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.35.1
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.35.1

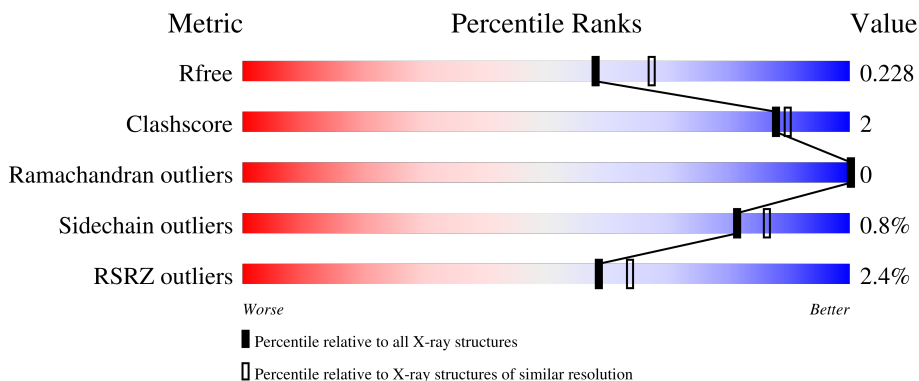
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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.



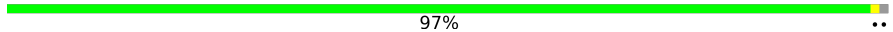
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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	A	231	 5% 75% 6% 19%
1	B	231	 5% 74% 7% 19%
2	C	239	 % 86% 7% 7%
2	H	239	 % 90% 6% 6%
3	D	218	 % 94% 5% 5%

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Mol	Chain	Length	Quality of chain
3	L	218	 97%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	NAG	B	601	-	-	-	X

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 10280 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 Spike protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	187	1465	941	231	284	9	0	0	0
1	B	188	1469	943	232	285	9	0	0	0

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	506	PHE	LEU	conflict	UNP A0A0U2MS80
A	590	GLY	-	expression tag	UNP A0A0U2MS80
A	591	SER	-	expression tag	UNP A0A0U2MS80
A	592	LEU	-	expression tag	UNP A0A0U2MS80
A	593	GLU	-	expression tag	UNP A0A0U2MS80
A	594	VAL	-	expression tag	UNP A0A0U2MS80
A	595	LEU	-	expression tag	UNP A0A0U2MS80
A	596	PHE	-	expression tag	UNP A0A0U2MS80
A	597	GLN	-	expression tag	UNP A0A0U2MS80
B	506	PHE	LEU	conflict	UNP A0A0U2MS80
B	590	GLY	-	expression tag	UNP A0A0U2MS80
B	591	SER	-	expression tag	UNP A0A0U2MS80
B	592	LEU	-	expression tag	UNP A0A0U2MS80
B	593	GLU	-	expression tag	UNP A0A0U2MS80
B	594	VAL	-	expression tag	UNP A0A0U2MS80
B	595	LEU	-	expression tag	UNP A0A0U2MS80
B	596	PHE	-	expression tag	UNP A0A0U2MS80
B	597	GLN	-	expression tag	UNP A0A0U2MS80

- Molecule 2 is a protein called Antibody CDC2-C2 heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	C	222	1644	1039	273	324	8	0	0	0

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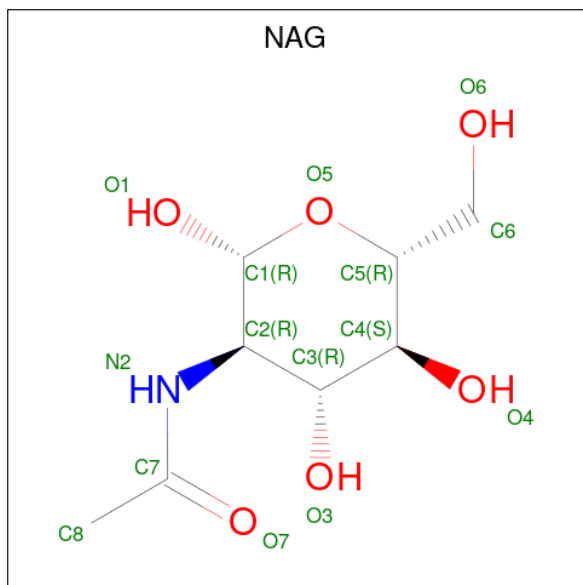
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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	H	224	Total 1659	C 1048	N 276	O 327	S 8	0	0	0

- Molecule 3 is a protein called Antibody CDC2-C2 light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	D	215	Total 1641	C 1029	N 277	O 329	S 6	0	0	0
3	L	215	Total 1641	C 1029	N 277	O 329	S 6	0	0	0

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: $C_8H_{15}NO_6$).



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

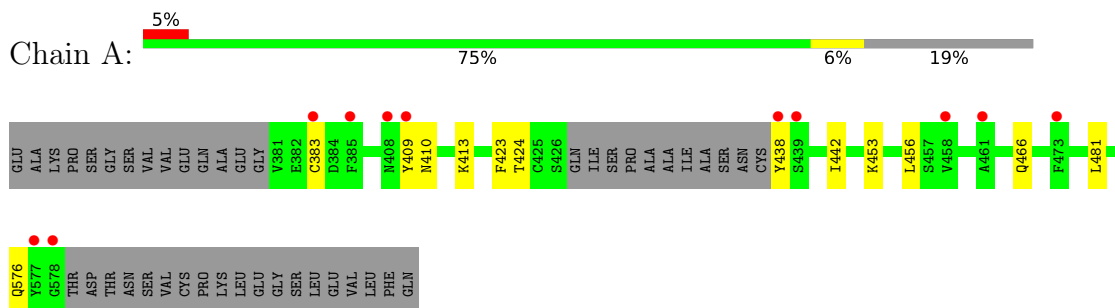
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	111	Total O 111 111	0	0
5	B	96	Total O 96 96	0	0
5	C	117	Total O 117 117	0	0
5	D	88	Total O 88 88	0	0
5	H	164	Total O 164 164	0	0
5	L	143	Total O 143 143	0	0

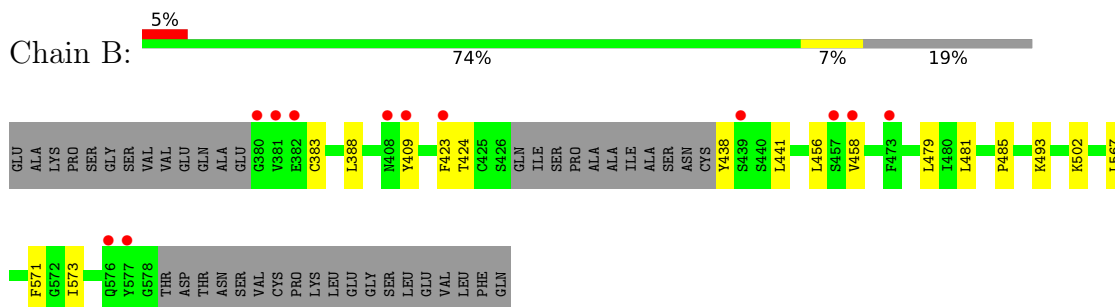
3 Residue-property plots [i](#)

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.

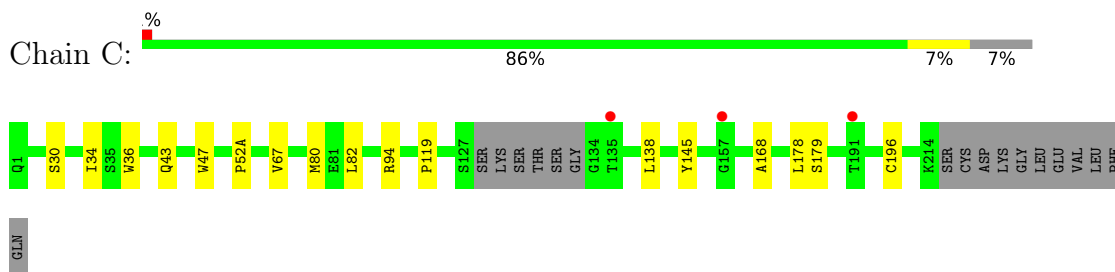
- Molecule 1: Spike protein



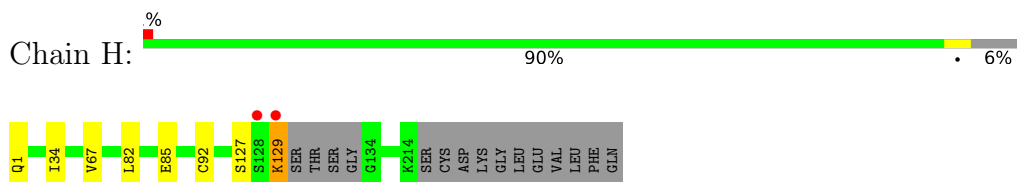
- Molecule 1: Spike protein



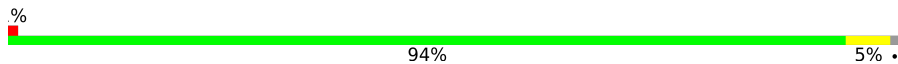
- Molecule 2: Antibody CDC2-C2 heavy chain

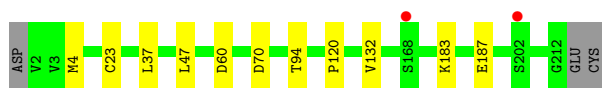


- Molecule 2: Antibody CDC2-C2 heavy chain



- Molecule 3: Antibody CDC2-C2 light chain

Chain D:  %
94% 5%



- Molecule 3: Antibody CDC2-C2 light chain

Chain L:  %
97% 2%



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	60.82Å 166.85Å 184.82Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.65 – 2.10 47.65 – 2.10	Depositor EDS
% Data completeness (in resolution range)	97.3 (47.65-2.10) 97.3 (47.65-2.10)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.48 (at 2.10Å)	Xtrriage
Refinement program	PHENIX 1.12_2829	Depositor
R, R_{free}	0.191 , 0.228 0.191 , 0.228	Depositor DCC
R_{free} test set	5387 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	31.9	Xtrriage
Anisotropy	0.494	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 44.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	10280	wwPDB-VP
Average B, all atoms (Å ²)	42.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 56.21 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 2.8269e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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 [i](#)

5.1 Standard geometry [i](#)

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	0.34	0/1502	0.54	0/2047
1	B	0.32	0/1506	0.53	0/2052
2	C	0.40	0/1683	0.53	0/2289
2	H	0.36	0/1698	0.53	0/2308
3	D	0.31	0/1677	0.51	0/2278
3	L	0.33	0/1677	0.53	0/2278
All	All	0.35	0/9743	0.53	0/13252

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 [i](#)

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	1465	0	1425	9	0
1	B	1469	0	1427	11	0
2	C	1644	0	1606	8	0
2	H	1659	0	1624	5	0
3	D	1641	0	1602	7	0
3	L	1641	0	1602	2	0
4	A	14	0	13	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	28	0	26	1	0
5	A	111	0	0	1	0
5	B	96	0	0	0	0
5	C	117	0	0	1	0
5	D	88	0	0	0	0
5	H	164	0	0	0	0
5	L	143	0	0	0	0
All	All	10280	0	9325	38	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 2.

All (38) 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:D:4:MET:CE	3:D:23:CYS:SG	2.69	0.80
3:D:4:MET:HE3	3:D:23:CYS:SG	2.27	0.75
1:A:466:GLN:NE2	5:A:702:HOH:O	2.28	0.67
2:H:85:GLU:OE2	2:H:85:GLU:N	2.32	0.59
3:D:4:MET:HE2	3:D:23:CYS:SG	2.42	0.58
1:B:456:LEU:HD23	1:B:481:LEU:HD11	1.84	0.58
1:B:441:LEU:HD11	1:B:573:ILE:HG23	1.88	0.56
2:H:34:ILE:HD11	2:H:92:CYS:HB2	1.87	0.56
3:D:183:LYS:NZ	3:D:187:GLU:OE2	2.36	0.54
2:C:30:SER:HA	2:C:52(A):PRO:HB2	1.90	0.54
1:B:485:PRO:HB3	4:B:602:NAG:H82	1.90	0.54
1:A:456:LEU:HD23	1:A:481:LEU:HD21	1.91	0.53
2:C:43:GLN:NE2	5:C:303:HOH:O	2.43	0.51
1:B:388:LEU:HD11	1:B:571:PHE:HE2	1.76	0.50
1:A:409:TYR:HE1	1:A:438:TYR:CZ	2.29	0.50
2:C:67:VAL:HG22	2:C:82:LEU:HD13	1.94	0.50
3:L:142:ARG:NH2	3:L:163:VAL:HG11	2.27	0.49
1:A:424:THR:HG23	1:B:424:THR:HB	1.96	0.48
3:D:37:LEU:HB2	3:D:47:LEU:HD11	1.96	0.48
2:H:1:GLN:OE1	2:H:1:GLN:N	2.46	0.47
2:H:67:VAL:HG22	2:H:82:LEU:HD13	1.96	0.47
2:C:119:PRO:HB3	2:C:145:TYR:HB3	1.97	0.47
1:B:383:CYS:SG	1:B:409:TYR:HB3	2.55	0.46
1:A:410:ASN:HB3	1:A:413:LYS:HB2	1.97	0.46
2:C:47:TRP:CZ3	3:D:94:THR:HG23	2.50	0.46
2:C:36:TRP:CE2	2:C:80:MET:HB2	2.52	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:409:TYR:HE1	1:B:438:TYR:CZ	2.36	0.44
1:A:453:LYS:NZ	1:B:458:VAL:HG13	2.33	0.43
1:A:442:ILE:HD12	1:A:576:GLN:HE22	1.83	0.43
1:B:409:TYR:CE2	1:B:441:LEU:HD22	2.53	0.43
3:L:37:LEU:HB2	3:L:47:LEU:HD11	2.01	0.43
1:B:493:LYS:HG2	1:B:567:LEU:HB2	2.01	0.43
1:A:383:CYS:SG	1:A:409:TYR:HB3	2.59	0.42
2:C:168:ALA:HA	2:C:178:LEU:HB3	2.00	0.42
3:D:120:PRO:HD3	3:D:132:VAL:HG22	2.03	0.41
2:C:34:ILE:HG12	2:C:94:ARG:HG3	2.02	0.41
1:A:423:PHE:HE1	1:B:423:PHE:CE2	2.40	0.40
2:H:127:SER:OG	2:H:129:LYS:HG3	2.21	0.40

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	A	183/231 (79%)	181 (99%)	2 (1%)	0	100	100
1	B	184/231 (80%)	181 (98%)	3 (2%)	0	100	100
2	C	218/239 (91%)	215 (99%)	3 (1%)	0	100	100
2	H	220/239 (92%)	218 (99%)	2 (1%)	0	100	100
3	D	213/218 (98%)	209 (98%)	4 (2%)	0	100	100
3	L	213/218 (98%)	210 (99%)	3 (1%)	0	100	100
All	All	1231/1376 (90%)	1214 (99%)	17 (1%)	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	A	172/208 (83%)	172 (100%)	0	100	100
1	B	172/208 (83%)	170 (99%)	2 (1%)	71	77
2	C	182/197 (92%)	179 (98%)	3 (2%)	62	69
2	H	184/197 (93%)	183 (100%)	1 (0%)	88	92
3	D	187/190 (98%)	185 (99%)	2 (1%)	73	79
3	L	187/190 (98%)	186 (100%)	1 (0%)	88	92
All	All	1084/1190 (91%)	1075 (99%)	9 (1%)	81	86

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	479	LEU
1	B	502	LYS
2	C	138	LEU
2	C	179	SER
2	C	196	CYS
3	D	60	ASP
3	D	70	ASP
2	H	129	LYS
3	L	142	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

3 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
4	NAG	B	602	1	14,14,15	0.53	0	17,19,21	0.50	0
4	NAG	A	601	1	14,14,15	0.38	0	17,19,21	0.43	0
4	NAG	B	601	1	14,14,15	0.33	0	17,19,21	0.41	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
4	NAG	B	602	1	-	4/6/23/26	0/1/1/1
4	NAG	A	601	1	-	0/6/23/26	0/1/1/1
4	NAG	B	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 (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	B	602	NAG	C8-C7-N2-C2
4	B	602	NAG	O7-C7-N2-C2
4	B	602	NAG	C4-C5-C6-O6
4	B	602	NAG	O5-C5-C6-O6

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Mol	Chain	Res	Type	Atoms
4	B	601	NAG	C4-C5-C6-O6
4	B	601	NAG	O5-C5-C6-O6

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	602	NAG	1	0

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	A	187/231 (80%)	-0.16	11 (5%) 22 27	24, 36, 75, 106	0
1	B	188/231 (81%)	-0.06	12 (6%) 19 24	26, 38, 75, 118	0
2	C	222/239 (92%)	-0.19	3 (1%) 75 78	23, 40, 71, 101	0
2	H	224/239 (93%)	-0.29	2 (0%) 84 86	22, 35, 57, 90	0
3	D	215/218 (98%)	-0.15	2 (0%) 84 86	26, 49, 76, 96	0
3	L	215/218 (98%)	-0.43	0 100 100	25, 38, 58, 84	0
All	All	1251/1376 (90%)	-0.22	30 (2%) 59 64	22, 39, 72, 118	0

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	381	VAL	5.1
1	A	578	GLY	3.9
1	B	409	TYR	3.9
1	B	457	SER	3.8
1	A	409	TYR	3.7
1	B	577	TYR	3.7
1	B	458	VAL	3.6
1	A	473	PHE	3.5
2	H	128	SER	3.4
1	A	577	TYR	3.3
3	D	202	SER	3.1
1	B	380	GLY	3.1
2	C	157	GLY	3.1
2	C	135	THR	3.1
1	B	473	PHE	3.0
2	C	191	THR	2.8
1	B	423	PHE	2.7
1	A	438	TYR	2.7
1	B	439	SER	2.6

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Mol	Chain	Res	Type	RSRZ
2	H	129	LYS	2.5
1	A	458	VAL	2.4
1	B	408	ASN	2.4
1	A	408	ASN	2.3
1	B	382	GLU	2.3
1	A	383	CYS	2.3
3	D	168	SER	2.3
1	A	385	PHE	2.2
1	A	461	ALA	2.0
1	B	576	GLN	2.0
1	A	439	SER	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 monosaccharides 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
4	NAG	B	601	14/15	0.74	0.41	69,86,91,92	0
4	NAG	A	601	14/15	0.78	0.22	56,69,77,79	0
4	NAG	B	602	14/15	0.80	0.25	63,69,73,76	0

6.5 Other polymers [i](#)

There are no such residues in this entry.