



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 19, 2016 – 10:44 PM GMT

PDB ID : 5E35
Title : Crystal structure of H5 hemagglutinin mutant (N224K, Q226L, N158D and L133a deletion) from the influenza virus A/chicken/Vietnam/NCVD-093/2008 (H5N1) with LSTc
Authors : Zhu, X.; Wilson, I.A.
Deposited on : 2015-10-01
Resolution : 2.70 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
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467
Mogul : 1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026982
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20026982

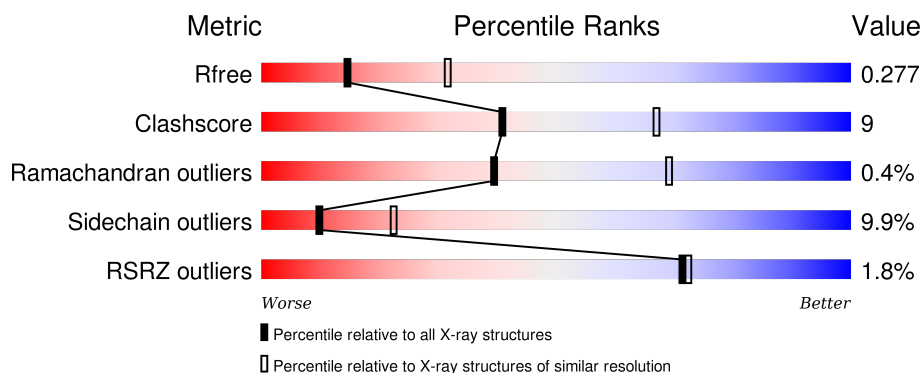
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

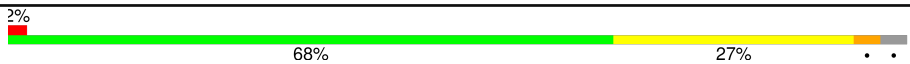
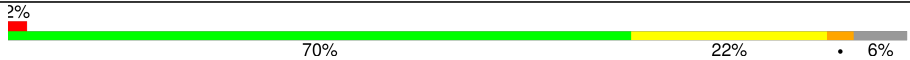
The reported resolution of this entry is 2.70 Å.

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}	91344	2103 (2.70-2.70)
Clashscore	102246	2422 (2.70-2.70)
Ramachandran outliers	100387	2382 (2.70-2.70)
Sidechain outliers	100360	2382 (2.70-2.70)
RSRZ outliers	91569	2107 (2.70-2.70)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	333	 2% 68% 27% • •
2	B	180	 2% 70% 22% • 6%

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 4064 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 Hemagglutinin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	323	2557	1623	437	482	15	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	7	ALA	-	expression tag	UNP C4P282
A	8	ASP	-	expression tag	UNP C4P282
A	9	PRO	-	expression tag	UNP C4P282
A	10	GLY	-	expression tag	UNP C4P282
A	?	-	LEU	deletion	UNP C4P282
A	158	ASP	ASN	engineered mutation	UNP C4P282
A	224	LYS	ASN	engineered mutation	UNP C4P282
A	226	LEU	GLN	engineered mutation	UNP C4P282

- Molecule 2 is a protein called Hemagglutinin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	170	1384	859	239	278	8	0	0	0

There are 5 discrepancies between the modelled and reference sequences:

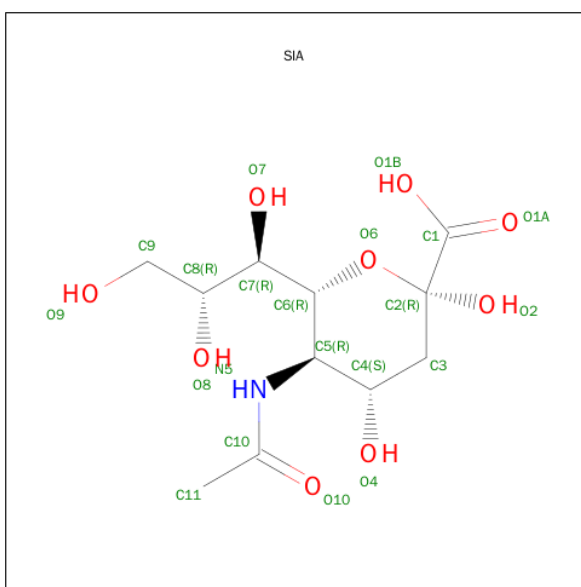
Chain	Residue	Modelled	Actual	Comment	Reference
B	176	ARG	-	expression tag	UNP C4P282
B	177	LEU	-	expression tag	UNP C4P282
B	178	VAL	-	expression tag	UNP C4P282
B	179	PRO	-	expression tag	UNP C4P282
B	180	ARG	-	expression tag	UNP C4P282

- Molecule 3 is N-ACETYL-D-GLUCOSAMINE (three-letter code: NAG) (formula: C₈H₁₅NO₆).



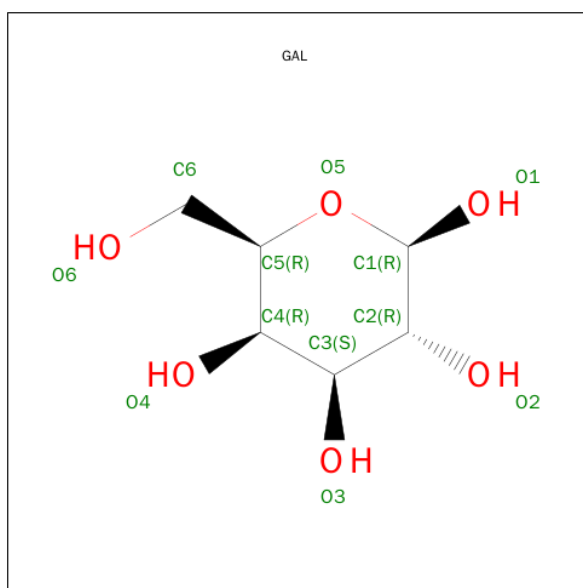
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			14	8	1	5		
3	A	1	Total	C	N	O	0	0
			14	8	1	5		
3	A	1	Total	C	N	O	0	0
			15	8	1	6		

- Molecule 4 is O-SIALIC ACID (three-letter code: SIA) (formula: $C_{11}H_{19}NO_9$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			20	11	1	8		

- Molecule 5 is BETA-D-GALACTOSE (three-letter code: GAL) (formula: C₆H₁₂O₆).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			11	6	5		

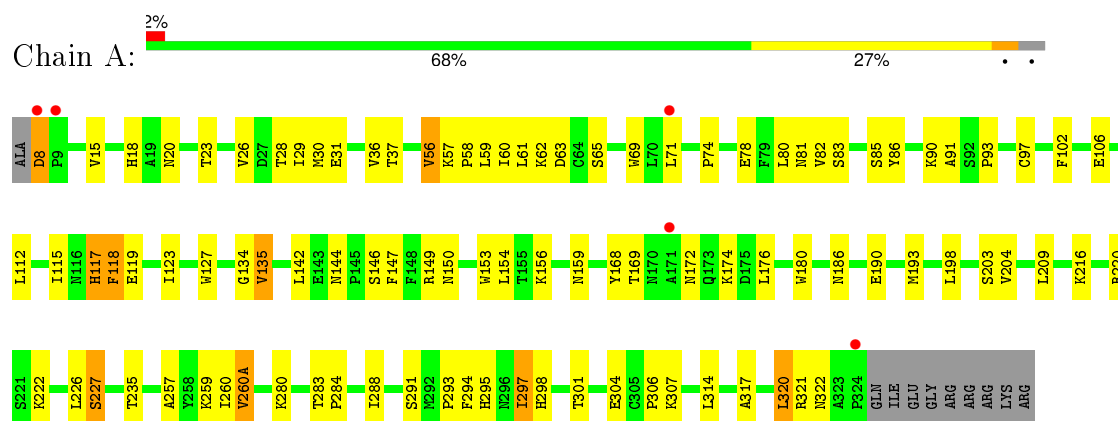
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	38	Total	O	0	0
			38	38		
6	B	11	Total	O	0	0
			11	11		

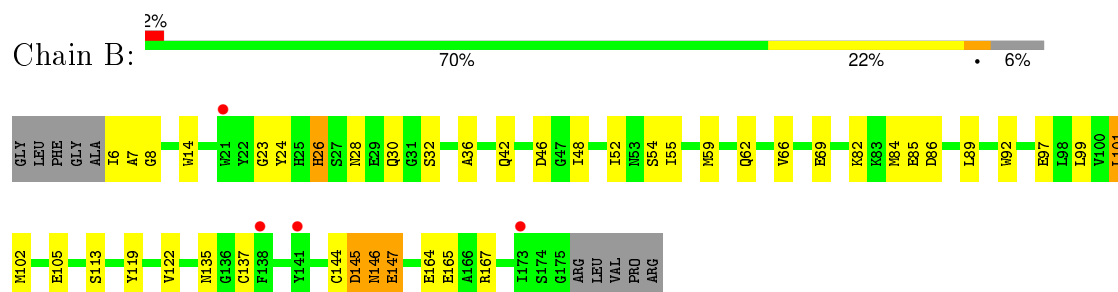
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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 ($\text{RSRZ} > 2$). 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: Hemagglutinin



• Molecule 2: Hemagglutinin



4 Data and refinement statistics

Property	Value	Source
Space group	P 6	Depositor
Cell constants a, b, c, α , β , γ	130.27Å 130.27Å 133.59Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	46.63 – 2.70 46.63 – 2.70	Depositor EDS
% Data completeness (in resolution range)	97.2 (46.63-2.70) 97.7 (46.63-2.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.69 (at 2.69Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.2_1309)	Depositor
R, R_{free}	0.230 , 0.270 0.243 , 0.277	Depositor DCC
R_{free} test set	1745 reflections (5.30%)	DCC
Wilson B-factor (Å ²)	55.0	Xtriage
Anisotropy	0.783	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 33.5	EDS
Estimated twinning fraction	0.064 for h,-h-k,-l	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	0 of 34747 reflections	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	4064	wwPDB-VP
Average B, all atoms (Å ²)	68.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.62% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: SIA, GAL, 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	0.41	0/2620	0.59	0/3560
2	B	0.39	0/1410	0.49	0/1895
All	All	0.41	0/4030	0.56	0/5455

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	A	2557	0	2509	50	0
2	B	1384	0	1287	23	0
3	A	43	0	40	0	0
4	A	20	0	17	1	0
5	A	11	0	9	0	0
6	A	38	0	0	0	0
6	B	11	0	0	2	0
All	All	4064	0	3862	68	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 9.

All (68) 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:A:288:ILE:HD11	1:A:297:ILE:HD11	1.42	1.01
1:A:26:VAL:HG21	1:A:317:ALA:HB2	1.67	0.74
1:A:28:THR:HG22	1:A:30:MET:H	1.53	0.73
2:B:26:HIS:ND1	2:B:26:HIS:O	2.30	0.65
2:B:164:GLU:OE2	2:B:167:ARG:NH2	2.33	0.62
1:A:209:LEU:HD22	1:A:235:THR:HG21	1.83	0.61
1:A:90:LYS:HG3	1:A:91:ALA:N	2.19	0.58
2:B:84:MET:HE2	2:B:85:GLU:HG2	1.86	0.57
1:A:284:PRO:HG2	1:A:298:HIS:CE1	2.41	0.56
1:A:8:ASP:N	1:A:8:ASP:OD1	2.39	0.55
1:A:29:ILE:HD11	2:B:102:MET:HA	1.87	0.55
1:A:56:VAL:HB	1:A:85:SER:HB3	1.89	0.54
2:B:145:ASP:O	2:B:147:GLU:N	2.35	0.54
1:A:307:LYS:HD3	2:B:62:GLN:HB3	1.89	0.54
1:A:112:LEU:HD12	1:A:115:ILE:HD12	1.89	0.54
1:A:29:ILE:H	1:A:29:ILE:HD12	1.74	0.52
1:A:134:GLY:HA3	1:A:153:TRP:HB3	1.91	0.52
1:A:15:VAL:HG21	2:B:119:TYR:HA	1.92	0.52
2:B:62:GLN:HG3	2:B:92:TRP:CD2	2.45	0.51
1:A:216:LYS:O	1:A:220:ARG:NH2	2.43	0.51
1:A:295:HIS:CD2	1:A:306:PRO:HG2	2.45	0.51
1:A:220:ARG:HD2	1:A:227:SER:O	2.10	0.50
1:A:156:LYS:HE2	1:A:193:MET:O	2.11	0.50
1:A:71:LEU:C	1:A:150:ASN:HD22	2.14	0.50
1:A:293:PRO:HG2	1:A:294:PHE:HD1	1.76	0.49
2:B:28:ASN:ND2	2:B:146:ASN:OD1	2.30	0.49
1:A:62:LYS:NZ	1:A:78:GLU:OE2	2.45	0.49
1:A:85:SER:HG	1:A:86:TYR:HD2	1.59	0.48
1:A:20:ASN:OD1	1:A:322:ASN:ND2	2.47	0.48
1:A:142:LEU:O	1:A:144:ASN:N	2.38	0.48
1:A:123:ILE:HG22	1:A:168:TYR:CZ	2.49	0.48
1:A:174:LYS:HD2	1:A:260(A):VAL:HA	1.96	0.47
1:A:65:SER:HB3	1:A:93:PRO:HG2	1.96	0.47
1:A:294:PHE:HZ	2:B:59:MET:HG3	1.79	0.47
2:B:135:ASN:OD1	2:B:137:CYS:HB2	2.15	0.46
2:B:48:ILE:O	2:B:52:ILE:HG12	2.16	0.46
1:A:115:ILE:HD13	1:A:260:ILE:HD12	1.98	0.45
2:B:55:ILE:HG23	2:B:99:LEU:HD23	1.99	0.45
1:A:295:HIS:HD2	1:A:306:PRO:HG2	1.81	0.45
1:A:59:LEU:HD21	1:A:61:LEU:HD21	1.98	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:180:TRP:CE2	1:A:204:VAL:HG21	2.52	0.45
2:B:6:ILE:HG12	2:B:7:ALA:H	1.82	0.45
1:A:314:LEU:HD21	2:B:97:GLU:HG2	1.99	0.44
1:A:222:LYS:HA	1:A:226:LEU:O	2.18	0.44
1:A:74:PRO:HA	1:A:149:ARG:NE	2.33	0.43
1:A:31:GLU:OE1	1:A:321:ARG:NH2	2.52	0.43
2:B:145:ASP:OD1	2:B:145:ASP:N	2.50	0.43
1:A:146:SER:OG	1:A:147:PHE:N	2.44	0.43
1:A:58:PRO:HG2	1:A:60:ILE:HD11	2.00	0.43
1:A:123:ILE:HD13	1:A:257:ALA:HB2	2.00	0.43
2:B:23:GLY:HA3	2:B:36:ALA:HA	2.00	0.43
1:A:83:SER:O	1:A:117:HIS:HA	2.19	0.43
1:A:209:LEU:HD22	1:A:235:THR:CG2	2.49	0.42
1:A:118:PHE:HE1	1:A:260:ILE:HD13	1.83	0.42
2:B:86:ASP:OD2	6:B:201:HOH:O	2.21	0.42
1:A:106:GLU:H	1:A:106:GLU:CD	2.23	0.42
2:B:82:LYS:NZ	6:B:201:HOH:O	2.50	0.42
1:A:127:TRP:CD1	1:A:154:LEU:HD21	2.55	0.42
2:B:26:HIS:O	2:B:32:SER:HA	2.20	0.41
1:A:135:VAL:O	4:A:1003:SIA:H4	2.19	0.41
2:B:42:GLN:NE2	2:B:46:ASP:OD1	2.53	0.41
1:A:119:GLU:HB3	1:A:259:LYS:HB3	2.02	0.41
1:A:112:LEU:HD12	1:A:112:LEU:HA	1.91	0.41
1:A:37:THR:HG23	1:A:320:LEU:O	2.21	0.41
2:B:101:LEU:HA	2:B:101:LEU:HD12	1.87	0.41
1:A:186:ASN:HD22	1:A:190:GLU:CD	2.25	0.41
2:B:8:GLY:HA2	2:B:14:TRP:CZ2	2.56	0.40
1:A:280:LYS:HE3	1:A:304:GLU:H	1.87	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 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	321/333 (96%)	297 (92%)	24 (8%)	0	100	100
2	B	168/180 (93%)	157 (94%)	9 (5%)	2 (1%)	16	39
All	All	489/513 (95%)	454 (93%)	33 (7%)	2 (0%)	39	69

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	146	ASN
2	B	147	GLU

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 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	289/297 (97%)	260 (90%)	29 (10%)	9	22
2	B	147/154 (96%)	133 (90%)	14 (10%)	11	24
All	All	436/451 (97%)	393 (90%)	43 (10%)	10	22

All (43) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	8	ASP
1	A	18	HIS
1	A	23	THR
1	A	36	VAL
1	A	56	VAL
1	A	57	LYS
1	A	63	ASP
1	A	69	TRP
1	A	80	LEU
1	A	81	ASN
1	A	82	VAL
1	A	97	CYS
1	A	102	PHE
1	A	117	HIS

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Mol	Chain	Res	Type
1	A	118	PHE
1	A	135	VAL
1	A	159	ASN
1	A	169	THR
1	A	172	ASN
1	A	176	LEU
1	A	198	LEU
1	A	203	SER
1	A	227	SER
1	A	260(A)	VAL
1	A	283	THR
1	A	291	SER
1	A	297	ILE
1	A	301	THR
1	A	320	LEU
2	B	24	TYR
2	B	26	HIS
2	B	30	GLN
2	B	54	SER
2	B	66	VAL
2	B	69	GLU
2	B	89	LEU
2	B	101	LEU
2	B	105	GLU
2	B	113	SER
2	B	122	VAL
2	B	144	CYS
2	B	145	ASP
2	B	165	GLU

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

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 carbohydrates in this entry.

5.6 Ligand geometry

5 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	$\# Z > 2$
3	NAG	A	1001	1	14,14,15	0.28	0	15,19,21	0.34	0
3	NAG	A	1002	1	14,14,15	0.44	0	15,19,21	0.47	0
4	SIA	A	1003	5	17,20,21	0.36	0	18,28,31	0.98	1 (5%)
5	GAL	A	1004	3,4	11,11,12	0.91	0	15,15,17	1.54	2 (13%)
3	NAG	A	1005	5	15,15,15	0.15	0	17,21,21	0.61	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	1001	1	-	0/6/23/26	0/1/1/1
3	NAG	A	1002	1	-	0/6/23/26	0/1/1/1
4	SIA	A	1003	5	-	0/14/34/38	0/1/1/1
5	GAL	A	1004	3,4	-	0/2/19/22	0/1/1/1
3	NAG	A	1005	5	-	0/6/26/26	0/1/1/1

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	1004	GAL	O5-C5-C6	-3.42	100.03	107.34
4	A	1003	SIA	O6-C6-C5	2.65	112.81	108.48
5	A	1004	GAL	C1-O5-C5	3.03	116.59	112.14

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	1003	SIA	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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	323/333 (96%)	-0.00	5 (1%) 76 76	47, 63, 79, 119	0
2	B	170/180 (94%)	0.18	4 (2%) 62 62	48, 76, 94, 104	0
All	All	493/513 (96%)	0.06	9 (1%) 71 72	47, 67, 92, 119	0

All (9) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	324	PRO	8.3
2	B	173	ILE	3.0
1	A	8	ASP	2.8
2	B	21	TRP	2.7
1	A	171	ALA	2.5
2	B	138	PHE	2.3
2	B	141	TYR	2.3
1	A	9	PRO	2.1
1	A	71	LEU	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 carbohydrates 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. LLDF column lists the quality of electron

density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å ²)	Q<0.9
4	SIA	A	1003	20/21	0.95	0.18	0.54	54,61,72,74	0
3	NAG	A	1005	15/15	0.92	0.27	-	70,89,102,106	0
3	NAG	A	1002	14/15	0.92	0.13	-	76,82,88,89	0
3	NAG	A	1001	14/15	0.87	0.21	-	93,101,105,106	0
5	GAL	A	1004	11/12	0.94	0.13	-	61,79,94,98	0

6.5 Other polymers [i](#)

There are no such residues in this entry.