



wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 5, 2017 – 05:03 AM EST

PDB ID : 4EDA
Title : Structures of monomeric hemagglutinin and its complex with an Fab fragment of a neutralizing antibody that binds to H1 subtype influenza viruses: molecular basis of infectivity of 2009 pandemic H1N1 influenza A viruses
Authors : Kim, K.H.; Cho, K.J.; Lee, J.H.; Park, Y.H.; Khan, T.G.; Lee, J.Y.; Kang, S.H.; Alam, I.
Deposited on : unknown
Resolution : 2.70 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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	:	1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20030345
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
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-20030345

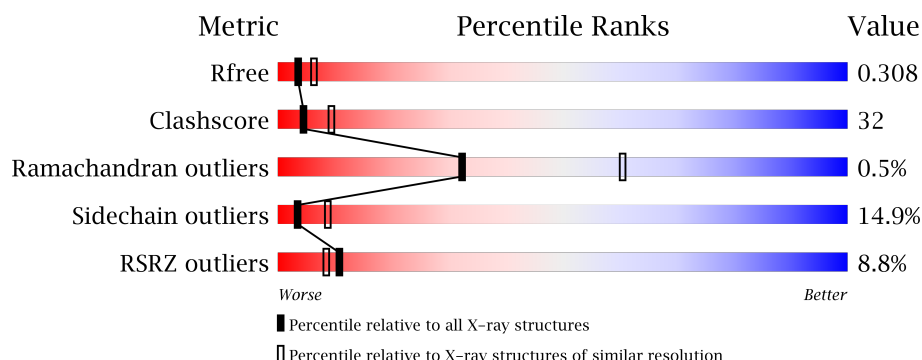
1 Overall quality at a glance

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}	100719	2259 (2.70-2.70)
Clashscore	112137	2590 (2.70-2.70)
Ramachandran outliers	110173	2550 (2.70-2.70)
Sidechain outliers	110143	2550 (2.70-2.70)
RSRZ outliers	101464	2275 (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	336	<div> <div>2%</div> <div>50%</div> <div>43%</div> <div>• •</div> </div>
1	C	336	<div> <div>4%</div> <div>45%</div> <div>40%</div> <div>8%</div> <div>7%</div> </div>
2	B	182	<div> <div>18%</div> <div>36%</div> <div>35%</div> <div>10%</div> <div>•</div> <div>19%</div> </div>
2	D	182	<div> <div>14%</div> <div>20%</div> <div>31%</div> <div>12%</div> <div>•</div> <div>37%</div> </div>

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 crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	NAG	A	401	-	-	X	-
3	NAG	A	403	X	-	-	-
3	NAG	C	401	-	-	X	-

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 7225 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
1	A	321	Total	C	N	O	S	0	0	0
			2508	1585	433	479	11			
1	C	311	Total	C	N	O	S	0	0	0
			2432	1538	420	464	10			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-8	ALA	-	EXPRESSION TAG	UNP C5MQE6
A	-7	ASP	-	EXPRESSION TAG	UNP C5MQE6
A	-6	PRO	-	EXPRESSION TAG	UNP C5MQE6
A	-5	GLY	-	EXPRESSION TAG	UNP C5MQE6
A	-4	TYR	-	EXPRESSION TAG	UNP C5MQE6
A	-3	LEU	-	EXPRESSION TAG	UNP C5MQE6
A	-2	LEU	-	EXPRESSION TAG	UNP C5MQE6
A	-1	GLU	-	EXPRESSION TAG	UNP C5MQE6
A	0	PHE	-	EXPRESSION TAG	UNP C5MQE6
C	-8	ALA	-	EXPRESSION TAG	UNP C5MQE6
C	-7	ASP	-	EXPRESSION TAG	UNP C5MQE6
C	-6	PRO	-	EXPRESSION TAG	UNP C5MQE6
C	-5	GLY	-	EXPRESSION TAG	UNP C5MQE6
C	-4	TYR	-	EXPRESSION TAG	UNP C5MQE6
C	-3	LEU	-	EXPRESSION TAG	UNP C5MQE6
C	-2	LEU	-	EXPRESSION TAG	UNP C5MQE6
C	-1	GLU	-	EXPRESSION TAG	UNP C5MQE6
C	0	PHE	-	EXPRESSION TAG	UNP C5MQE6

- Molecule 2 is a protein called Hemagglutinin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	148	Total	C	N	O	S	0	0	0
			1200	748	200	246	6			

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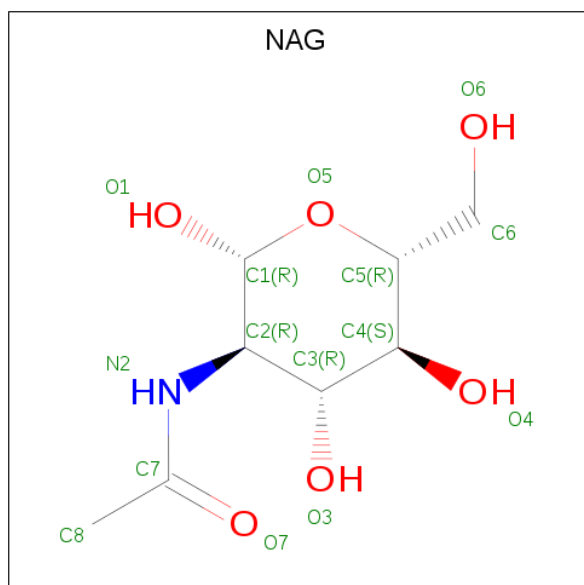
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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	D	115	Total	C	N	O	S	0	0	0
			910	561	153	190	6			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	177	ARG	-	EXPRESSION TAG	UNP C5MQE6
B	178	SER	-	EXPRESSION TAG	UNP C5MQE6
B	179	LEU	-	EXPRESSION TAG	UNP C5MQE6
B	180	VAL	-	EXPRESSION TAG	UNP C5MQE6
B	181	PRO	-	EXPRESSION TAG	UNP C5MQE6
B	182	ARG	-	EXPRESSION TAG	UNP C5MQE6
D	177	ARG	-	EXPRESSION TAG	UNP C5MQE6
D	178	SER	-	EXPRESSION TAG	UNP C5MQE6
D	179	LEU	-	EXPRESSION TAG	UNP C5MQE6
D	180	VAL	-	EXPRESSION TAG	UNP C5MQE6
D	181	PRO	-	EXPRESSION TAG	UNP C5MQE6
D	182	ARG	-	EXPRESSION TAG	UNP C5MQE6

- Molecule 3 is N-ACETYL-D-GLUCOSAMINE (three-letter code: NAG) (formula: $C_8H_{15}NO_6$).



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		

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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	C	1	Total	C	N	O	0	0
			14	8	1	5		
3	C	1	Total	C	N	O	0	0
			14	8	1	5		
3	C	1	Total	C	N	O	0	0
			14	8	1	5		
3	C	1	Total	C	N	O	0	0
			14	8	1	5		

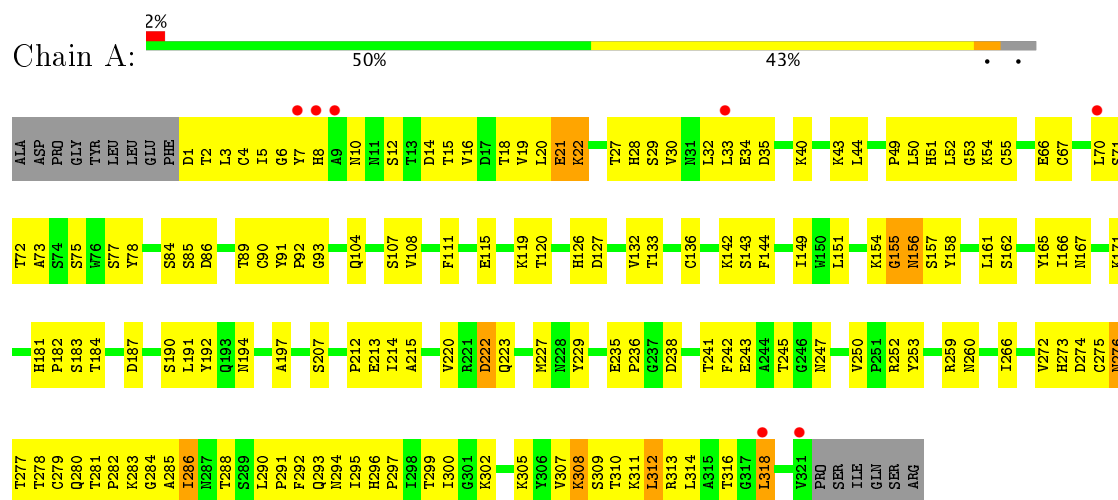
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	30	Total	O	0	0
			30	30		
4	B	3	Total	O	0	0
			3	3		
4	C	25	Total	O	0	0
			25	25		
4	D	5	Total	O	0	0
			5	5		

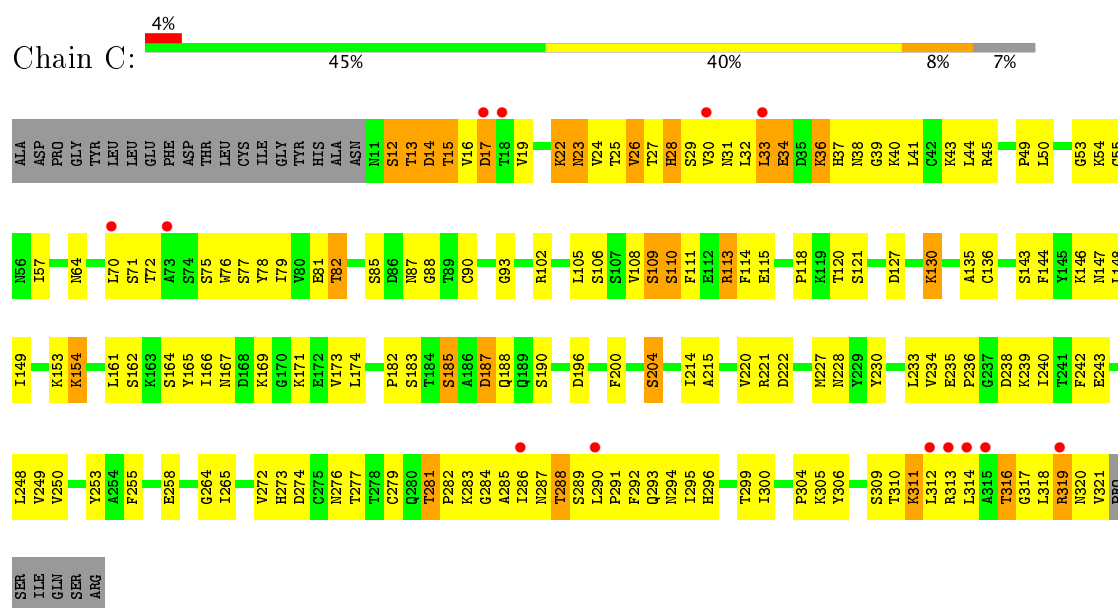
3 Residue-property plots

These plots are drawn for all protein, RNA and DNA 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: Hemagglutinin

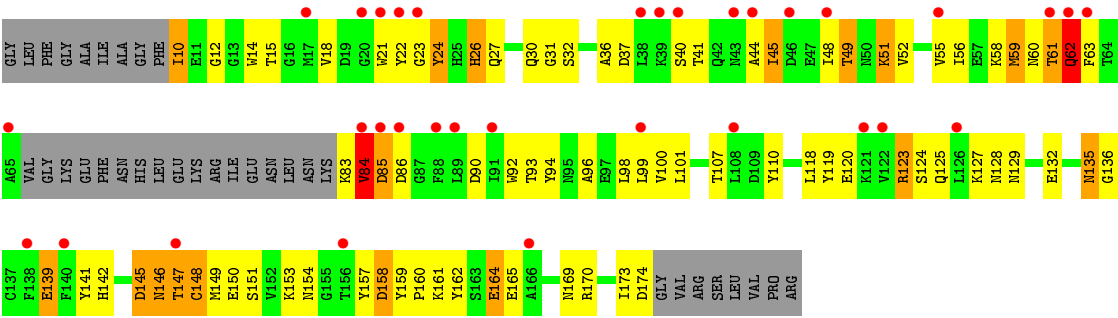


• Molecule 1: Hemagglutinin

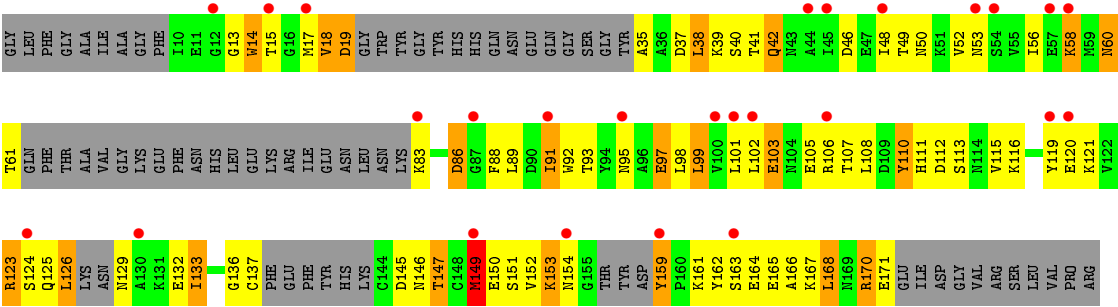


• Molecule 2: Hemagglutinin





• Molecule 2: Hemagglutinin



4 Data and refinement statistics

Property	Value	Source
Space group	P 6	Depositor
Cell constants a, b, c, α , β , γ	208.13 Å 208.13 Å 65.77 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	49.99 – 2.70 49.99 – 2.70	Depositor EDS
% Data completeness (in resolution range)	99.5 (49.99-2.70) 99.5 (49.99-2.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.01 (at 2.69 Å)	Xtriage
Refinement program	PHENIX 1.7.1 _743	Depositor
R, R_{free}	0.237 , 0.289 0.249 , 0.308	Depositor DCC
R_{free} test set	2261 reflections (5.05%)	DCC
Wilson B-factor (Å ²)	59.7	Xtriage
Anisotropy	0.480	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 72.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.042 for h,-h-k,-l	Xtriage
Reported twinning fraction	0.085 for h,-h-k,-l	Depositor
Outliers	0 of 44808 reflections	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	7225	wwPDB-VP
Average B, all atoms (Å ²)	86.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.90% of the height of the origin peak. No significant pseudotranslation is detected.*

¹ Intensities estimated from amplitudes.

² Theoretical 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

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	0.42	1/2570 (0.0%)	0.65	1/3491 (0.0%)
1	C	0.42	0/2492	0.63	0/3384
2	B	0.31	0/1223	0.48	0/1650
2	D	0.29	0/916	0.57	0/1228
All	All	0.39	1/7201 (0.0%)	0.61	1/9753 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1
1	C	0	2
2	B	0	2
2	D	0	2
All	All	0	7

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	276	ASN	CA-C	-5.30	1.39	1.52

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	276	ASN	N-CA-CB	-10.47	91.75	110.60

There are no chirality outliers.

5 of 7 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	155	GLY	Peptide
2	B	62	GLN	Peptide
2	B	84	VAL	Peptide
1	C	154	LYS	Peptide
1	C	72	THR	Peptide

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	2508	0	2457	147	0
1	C	2432	0	2387	153	0
2	B	1200	0	1112	77	0
2	D	910	0	871	87	0
3	A	56	0	51	8	0
3	C	56	0	51	9	0
4	A	30	0	0	0	0
4	B	3	0	0	1	0
4	C	25	0	0	4	0
4	D	5	0	0	0	0
All	All	7225	0	6929	444	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 32.

The worst 5 of 444 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:90:CYS:HB3	3:A:401:NAG:H81	1.39	1.01
1:A:90:CYS:CB	3:A:401:NAG:H81	1.93	0.98
2:B:158:ASP:HB3	2:B:161:LYS:HB2	1.43	0.97
2:D:167:LYS:HD2	2:D:170:ARG:HB2	1.43	0.96
1:C:34:GLU:HG2	1:C:290:LEU:HD12	1.51	0.92

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	319/336 (95%)	298 (93%)	19 (6%)	2 (1%)	28	56
1	C	309/336 (92%)	283 (92%)	26 (8%)	0	100	100
2	B	144/182 (79%)	120 (83%)	23 (16%)	1 (1%)	25	53
2	D	103/182 (57%)	80 (78%)	22 (21%)	1 (1%)	18	43
All	All	875/1036 (84%)	781 (89%)	90 (10%)	4 (0%)	32	60

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	156	ASN
2	B	84	VAL
2	D	18	VAL
1	A	19	VAL

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	281/294 (96%)	255 (91%)	26 (9%)	10	24
1	C	273/294 (93%)	238 (87%)	35 (13%)	5	12
2	B	130/157 (83%)	99 (76%)	31 (24%)	1	2
2	D	102/157 (65%)	77 (76%)	25 (24%)	1	2
All	All	786/902 (87%)	669 (85%)	117 (15%)	3	9

5 of 117 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	147	THR
1	C	28	HIS
2	D	110	TYR
2	B	149	MET
1	C	14	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
2	B	129	ASN
1	C	31	ASN
1	C	273	HIS
1	C	320	ASN

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 carbohydrates 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
3	NAG	A	401	1,3	14,14,15	0.53	0	15,19,21	1.18	2 (13%)
3	NAG	A	402	3	14,14,15	0.67	0	15,19,21	1.45	2 (13%)
3	NAG	A	403	1	14,14,15	0.79	1 (7%)	15,19,21	2.02	5 (33%)
3	NAG	A	404	1	14,14,15	0.50	0	15,19,21	1.16	3 (20%)
3	NAG	C	401	1,3	14,14,15	0.79	0	15,19,21	1.89	4 (26%)
3	NAG	C	402	3	14,14,15	0.50	0	15,19,21	0.54	0
3	NAG	C	403	1	14,14,15	1.70	2 (14%)	15,19,21	2.03	2 (13%)
3	NAG	C	404	1	14,14,15	0.45	0	15,19,21	0.71	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	401	1,3	-	0/6/23/26	0/1/1/1
3	NAG	A	402	3	-	0/6/23/26	0/1/1/1
3	NAG	A	403	1	1/1/5/7	0/6/23/26	0/1/1/1
3	NAG	A	404	1	-	0/6/23/26	0/1/1/1
3	NAG	C	401	1,3	-	0/6/23/26	0/1/1/1
3	NAG	C	402	3	-	0/6/23/26	0/1/1/1
3	NAG	C	403	1	-	0/6/23/26	0/1/1/1
3	NAG	C	404	1	-	0/6/23/26	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	403	NAG	O5-C1	-4.77	1.35	1.43
3	A	403	NAG	C1-C2	2.20	1.55	1.52
3	C	403	NAG	O5-C5	3.67	1.51	1.43

The worst 5 of 18 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	402	NAG	O5-C1-C2	-4.50	105.22	111.47
3	C	401	NAG	O5-C1-C2	-4.37	105.40	111.47
3	C	401	NAG	C2-N2-C7	-3.37	118.02	122.94
3	C	401	NAG	C4-C3-C2	-2.64	107.15	111.02
3	A	403	NAG	C3-C4-C5	-2.62	105.59	110.22

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
3	A	403	NAG	C1

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 17 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	401	NAG	8	0
3	A	402	NAG	1	0
3	C	401	NAG	8	0
3	C	404	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 [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	321/336 (95%)	0.54	7 (2%) 62 63	38, 59, 119, 133	0
1	C	311/336 (92%)	0.56	13 (4%) 37 35	37, 62, 125, 134	0
2	B	148/182 (81%)	1.00	33 (22%) 1 1	98, 118, 137, 159	0
2	D	115/182 (63%)	1.11	26 (22%) 1 1	114, 137, 150, 153	0
All	All	895/1036 (86%)	0.70	79 (8%) 11 8	37, 82, 141, 159	0

The worst 5 of 79 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	D	58	LYS	6.6
2	B	121	LYS	5.7
2	D	119	TYR	4.9
2	B	21	TRP	4.8
1	A	318	LEU	4.8

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(\AA^2)	Q<0.9
3	NAG	A	401	14/15	0.86	0.22	0.89	57,67,77,78	0
3	NAG	C	401	14/15	0.77	0.23	0.24	62,69,77,79	0
3	NAG	A	403	14/15	0.83	0.19	-	110,126,141,147	0
3	NAG	C	404	14/15	0.67	0.44	-	129,134,139,139	0
3	NAG	C	403	14/15	0.79	0.23	-	124,140,145,147	0
3	NAG	A	404	14/15	0.84	0.17	-	112,114,116,116	0
3	NAG	C	402	14/15	0.52	0.32	-	85,94,99,103	0
3	NAG	A	402	14/15	0.77	0.22	-	69,80,83,84	0

6.5 Other polymers [i](#)

There are no such residues in this entry.