



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 16, 2018 – 10:21 am GMT

PDB ID : 2HCA
Title : Crystal structure of bovine lactoferrin C-lobe liganded with Glucose at 2.8 Å resolution
Authors : Mir, R.; Prem Kumar, R.; Ethayathulla, A.S.; Singh, N.; Sinha, M.; Kaur, P.; Sharma, S.; Singh, T.P.
Deposited on : 2006-06-15
Resolution : 2.80 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.7.3 (157068), CSD as539be (2018)
Xtrriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : trunk30686

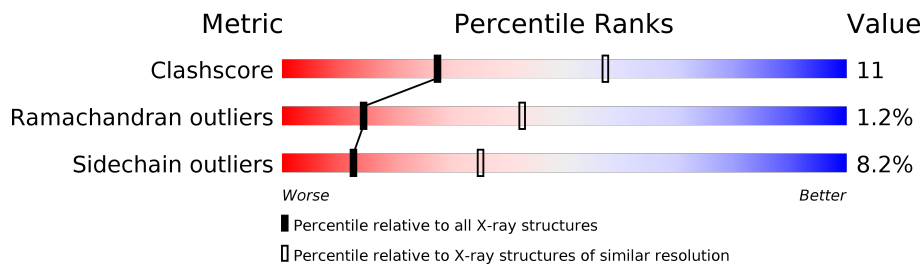
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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))
Clashscore	122078	3207 (2.80-2.80)
Ramachandran outliers	120005	3156 (2.80-2.80)
Sidechain outliers	119972	3158 (2.80-2.80)

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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	345	

2 Entry composition [i](#)

There are 10 unique types of molecules in this entry. The entry contains 3016 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.

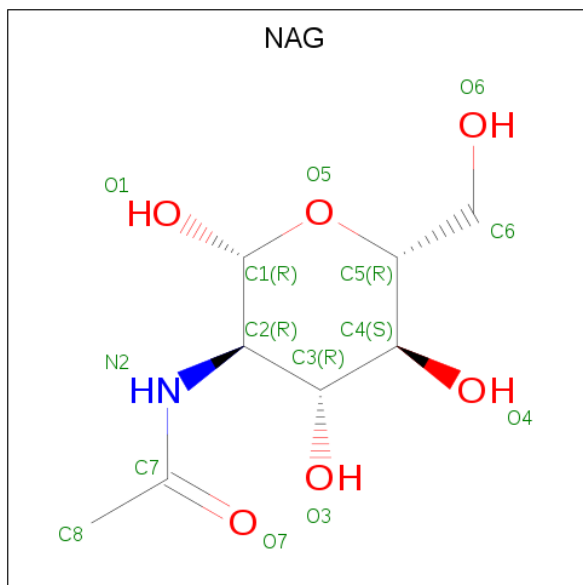
- Molecule 1 is a protein called Lactotransferrin (Lactoferrin).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	341	2604	1622	454	507	21	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	565	LYS	ASN	ENGINEERED	UNP P24627
A	608	GLU	LYS	ENGINEERED	UNP P24627

- Molecule 2 is N-ACETYL-D-GLUCOSAMINE (three-letter code: NAG) (formula: $C_8H_{15}NO_6$).



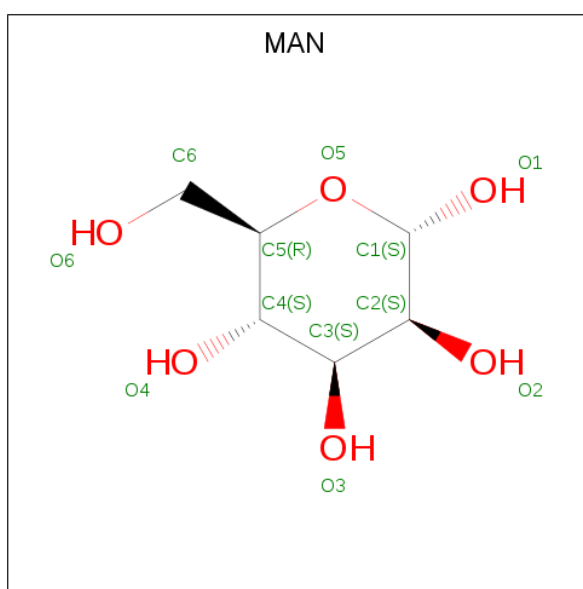
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	14	8	1	5	0	0
2	A	1	14	8	1	5	0	0

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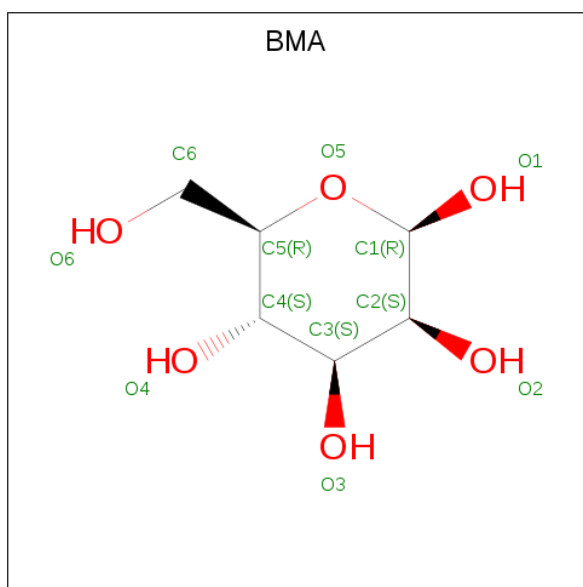
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			14	8	1	5		
2	A	1	Total	C	N	O	0	0
			14	8	1	5		
2	A	1	Total	C	N	O	0	0
			14	8	1	5		
2	A	1	Total	C	N	O	0	0
			14	8	1	5		

- Molecule 3 is ALPHA-D-MANNOSE (three-letter code: MAN) (formula: C₆H₁₂O₆).



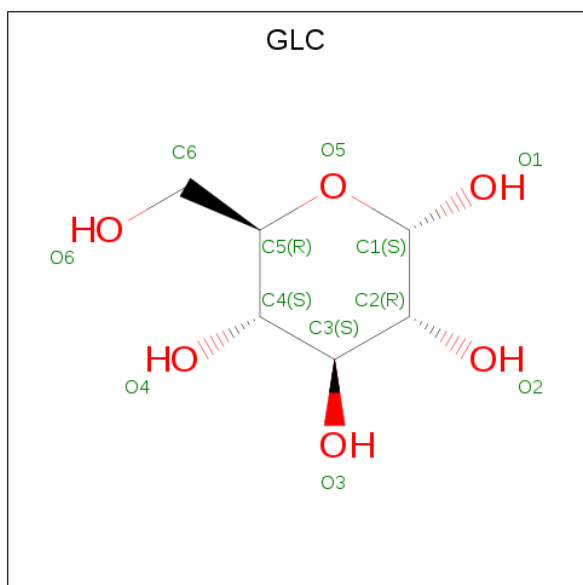
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			11	6	5		
3	A	1	Total	C	O	0	0
			11	6	5		
3	A	1	Total	C	O	0	0
			11	6	5		

- Molecule 4 is BETA-D-MANNOSE (three-letter code: BMA) (formula: C₆H₁₂O₆).



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

- Molecule 5 is ALPHA-D-GLUCOSE (three-letter code: GLC) (formula: C₆H₁₂O₆).

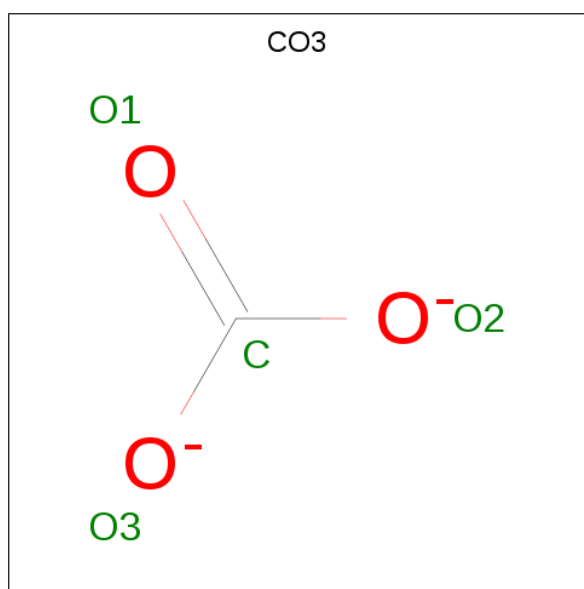


Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	C O	0	0
			12	6 6		

- Molecule 6 is FE (III) ION (three-letter code: FE) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	Fe	0	0
			1	1		

- Molecule 7 is CARBONATE ION (three-letter code: CO3) (formula: CO₃).

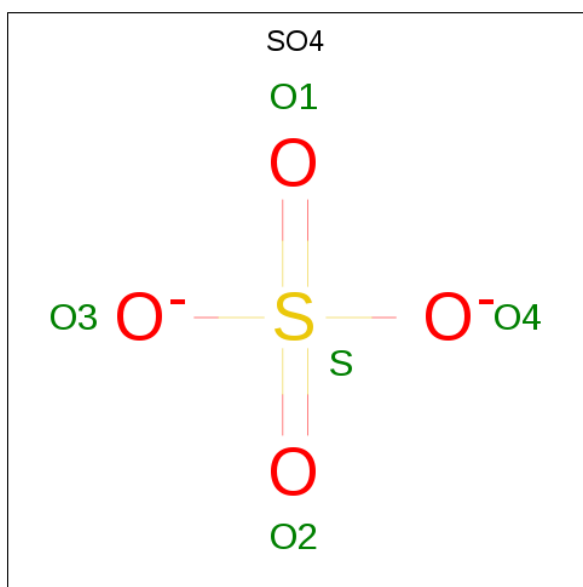


Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	1	Total	C O	0	0
			4	1 3		

- Molecule 8 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	2	Total	Zn	0	0
			2	2		

- Molecule 9 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 10 is water.

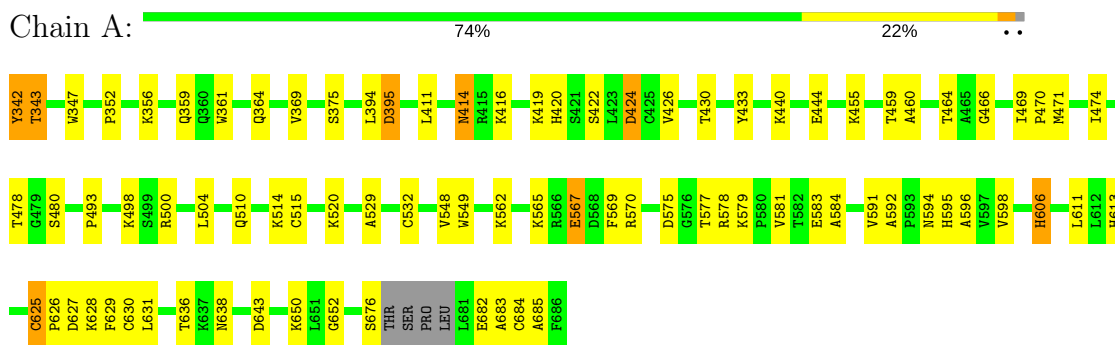
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	227	Total	O	0	0
			227	227		

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 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.

Note EDS was not executed.

- Molecule 1: Lactotransferrin (Lactoferrin)



4 Data and refinement statistics

Xtrriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	63.21Å 50.44Å 65.88Å 90.00° 107.61° 90.00°	Depositor
Resolution (Å)	20.00 – 2.80	Depositor
% Data completeness (in resolution range)	96.3 (20.00-2.80)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.10	Depositor
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.214 , 0.248	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	3016	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

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: CO3, BMA, NAG, GLC, ZN, SO4, MAN, FE

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	0.56	0/2652	0.68	1/3591 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	444	GLU	CB-CG-CD	8.07	136.00	114.20

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	2604	0	2519	51	0
2	A	84	0	73	3	0
3	A	33	0	27	6	0
4	A	44	0	38	7	0
5	A	12	0	12	0	0
6	A	1	0	0	0	0
7	A	4	0	0	0	0
8	A	2	0	0	0	0
9	A	5	0	0	0	0
10	A	227	0	0	10	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	3016	0	2669	59	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 11.

All (59) 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:A:692:BMA:O3	3:A:693:MAN:H2	1.62	0.98
1:A:430:THR:HB	1:A:594:ASN:ND2	2.02	0.74
1:A:455:LYS:HE2	10:A:812:HOH:O	1.88	0.74
1:A:430:THR:HB	1:A:594:ASN:HD22	1.53	0.74
3:A:3:MAN:C6	4:A:4:BMA:C1	2.70	0.69
1:A:424:ASP:HB2	10:A:713:HOH:O	1.93	0.69
1:A:625:CYS:HB3	1:A:626:PRO:HD3	1.74	0.67
1:A:577:THR:HG21	1:A:579:LYS:HZ3	1.59	0.66
1:A:460:ALA:HA	1:A:493:PRO:HD2	1.80	0.64
4:A:691:BMA:H5	4:A:692:BMA:O2	1.98	0.64
1:A:613:HIS:HB2	10:A:860:HOH:O	2.00	0.62
2:A:2:NAG:O3	3:A:3:MAN:H2	2.00	0.61
1:A:359:GLN:HG2	10:A:833:HOH:O	2.00	0.61
1:A:575:ASP:OD1	1:A:577:THR:HB	2.00	0.61
1:A:625:CYS:HA	1:A:629:PHE:O	2.01	0.61
1:A:459:THR:OG1	1:A:466:GLY:HA3	2.02	0.60
1:A:577:THR:CG2	1:A:578:ARG:N	2.65	0.60
1:A:638:ASN:HD22	1:A:643:ASP:H	1.52	0.57
3:A:3:MAN:H61	4:A:4:BMA:C1	2.33	0.57
1:A:414:ASN:HD21	1:A:430:THR:HA	1.69	0.57
1:A:471:MET:HE2	1:A:474:ILE:HD12	1.90	0.54
1:A:683:ALA:HA	10:A:729:HOH:O	2.09	0.52
1:A:628:LYS:HE3	10:A:786:HOH:O	2.09	0.52
1:A:426:VAL:HG12	1:A:650:LYS:HG3	1.92	0.51
4:A:691:BMA:C3	4:A:692:BMA:O5	2.59	0.51
1:A:364:GLN:OE1	1:A:628:LYS:HE2	2.11	0.51
1:A:343:THR:O	1:A:343:THR:HG23	2.12	0.50
1:A:529:ALA:O	1:A:532:CYS:HB3	2.12	0.50
1:A:548:VAL:HG11	1:A:581:VAL:HG11	1.93	0.49
1:A:469:ILE:N	1:A:470:PRO:HD2	2.27	0.49
1:A:478:THR:HG22	1:A:480:SER:HB3	1.94	0.48
1:A:638:ASN:ND2	1:A:643:ASP:H	2.11	0.48
1:A:625:CYS:CB	1:A:626:PRO:HD3	2.43	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:577:THR:HG22	1:A:578:ARG:N	2.28	0.47
1:A:347:TRP:HZ3	1:A:611:LEU:HD11	1.80	0.46
1:A:682:GLU:HG3	1:A:682:GLU:O	2.16	0.46
1:A:395:ASP:HA	1:A:595:HIS:CD2	2.51	0.45
1:A:549:TRP:HB3	2:A:690:NAG:H82	1.98	0.45
1:A:416:LYS:HG3	10:A:780:HOH:O	2.17	0.45
1:A:514:LYS:HD3	10:A:731:HOH:O	2.16	0.45
1:A:464:THR:HG21	1:A:592:ALA:HB1	1.98	0.44
1:A:424:ASP:HA	10:A:743:HOH:O	2.17	0.44
1:A:584:ALA:HB3	2:A:689:NAG:H82	1.99	0.44
1:A:577:THR:HG23	1:A:578:ARG:H	1.83	0.43
1:A:352:PRO:HG3	1:A:520:LYS:HD2	2.01	0.42
1:A:433:TYR:CE1	1:A:592:ALA:HB3	2.54	0.42
1:A:419:LYS:O	1:A:420:HIS:HB2	2.19	0.42
1:A:411:LEU:O	1:A:596:ALA:HB1	2.20	0.42
3:A:3:MAN:O6	4:A:4:BMA:C1	2.67	0.42
1:A:569:PHE:O	1:A:570:ARG:HG2	2.20	0.42
1:A:394:LEU:HD12	1:A:598:VAL:HG21	2.02	0.41
1:A:565:LYS:HD3	1:A:567:GLU:HG2	2.03	0.41
1:A:625:CYS:C	1:A:630:CYS:SG	3.00	0.41
1:A:682:GLU:HB3	10:A:857:HOH:O	2.21	0.41
1:A:342:TYR:O	1:A:606:HIS:ND1	2.54	0.40
1:A:569:PHE:O	1:A:570:ARG:NH1	2.54	0.40
1:A:361:TRP:CZ2	1:A:369:VAL:HG21	2.56	0.40
4:A:692:BMA:O3	3:A:693:MAN:C2	2.50	0.40
1:A:577:THR:CG2	1:A:578:ARG:H	2.33	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	337/345 (98%)	311 (92%)	22 (6%)	4 (1%)	14 42

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	684	CYS
1	A	652	GLY
1	A	685	ALA
1	A	625	CYS

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	282/286 (99%)	259 (92%)	23 (8%)	12 35

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	342	TYR
1	A	343	THR
1	A	356	LYS
1	A	375	SER
1	A	395	ASP
1	A	414	ASN
1	A	422	SER
1	A	424	ASP
1	A	440	LYS
1	A	498	LYS
1	A	500	ARG
1	A	504	LEU
1	A	510	GLN
1	A	515	CYS
1	A	562	LYS
1	A	567	GLU
1	A	583	GLU

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Mol	Chain	Res	Type
1	A	591	VAL
1	A	606	HIS
1	A	627	ASP
1	A	631	LEU
1	A	636	THR
1	A	676	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	414	ASN
1	A	420	HIS
1	A	510	GLN
1	A	594	ASN
1	A	621	ASN
1	A	638	ASN
1	A	671	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](#)

Of 19 ligands modelled in this entry, 3 are monoatomic - leaving 16 for Mogul analysis.

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$
2	NAG	A	1	1,2	14,14,15	0.54	0	17,19,21	0.72	0
2	NAG	A	2	3,2	14,14,15	0.51	0	17,19,21	0.79	0
3	MAN	A	3	3,2,4	11,11,12	0.52	0	15,15,17	1.80	3 (20%)
4	BMA	A	4	3	11,11,12	0.55	0	15,15,17	0.94	1 (6%)
3	MAN	A	5	3	11,11,12	0.54	0	15,15,17	1.41	2 (13%)
2	NAG	A	687	1,2	14,14,15	0.49	0	17,19,21	1.40	2 (11%)
2	NAG	A	688	2	14,14,15	0.50	0	17,19,21	2.05	4 (23%)
2	NAG	A	689	1,2	14,14,15	0.51	0	17,19,21	1.07	1 (5%)
2	NAG	A	690	2,4	14,14,15	0.48	0	17,19,21	1.00	1 (5%)
4	BMA	A	691	2,4	11,11,12	0.52	0	15,15,17	1.21	2 (13%)
4	BMA	A	692	3,4	11,11,12	0.55	0	15,15,17	1.15	2 (13%)
3	MAN	A	693	4	11,11,12	0.61	0	15,15,17	0.78	0
4	BMA	A	694	3	11,11,12	0.78	0	15,15,17	1.87	4 (26%)
5	GLC	A	695	-	12,12,12	0.58	0	17,17,17	1.19	1 (5%)
7	CO3	A	697	6	0,3,3	0.00	-	0,3,3	0.00	-
9	SO4	A	700	-	4,4,4	0.18	0	6,6,6	0.29	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
2	NAG	A	1	1,2	-	0/6/23/26	0/1/1/1
2	NAG	A	2	3,2	-	0/6/23/26	0/1/1/1
3	MAN	A	3	3,2,4	-	0/2/19/22	0/1/1/1
4	BMA	A	4	3	-	0/2/19/22	0/1/1/1
3	MAN	A	5	3	-	0/2/19/22	0/1/1/1
2	NAG	A	687	1,2	-	0/6/23/26	0/1/1/1
2	NAG	A	688	2	-	0/6/23/26	0/1/1/1
2	NAG	A	689	1,2	-	0/6/23/26	0/1/1/1
2	NAG	A	690	2,4	-	0/6/23/26	0/1/1/1
4	BMA	A	691	2,4	-	0/2/19/22	0/1/1/1
4	BMA	A	692	3,4	-	0/2/19/22	0/1/1/1
3	MAN	A	693	4	-	0/2/19/22	0/1/1/1
4	BMA	A	694	3	-	0/2/19/22	0/1/1/1
5	GLC	A	695	-	-	0/2/22/22	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
7	CO3	A	697	6	-	0/0/0/0	0/0/0/0
9	SO4	A	700	-	-	0/0/0/0	0/0/0/0

There are no bond length outliers.

All (23) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	695	GLC	O3-C3-C4	-2.13	105.36	110.34
2	A	689	NAG	C3-C4-C5	-2.04	106.59	110.24
2	A	690	NAG	C1-O5-C5	2.01	114.96	112.19
4	A	694	BMA	O5-C5-C6	2.13	110.52	107.15
4	A	4	BMA	C1-C2-C3	2.14	112.36	109.66
4	A	691	BMA	C1-C2-C3	2.14	112.37	109.66
4	A	692	BMA	O4-C4-C5	2.17	114.75	109.31
4	A	694	BMA	C1-O5-C5	2.23	115.26	112.19
2	A	688	NAG	C8-C7-N2	2.35	120.22	116.10
2	A	687	NAG	C4-C3-C2	2.40	114.54	111.02
4	A	694	BMA	O5-C1-C2	2.53	114.73	110.78
4	A	691	BMA	C1-O5-C5	2.54	115.68	112.19
3	A	3	MAN	O5-C1-C2	2.69	114.97	110.78
3	A	5	MAN	C1-C2-C3	2.78	113.18	109.66
4	A	692	BMA	O5-C5-C6	2.78	111.56	107.15
2	A	688	NAG	C1-C2-N2	2.85	115.36	110.49
2	A	687	NAG	C1-O5-C5	2.94	116.23	112.19
3	A	3	MAN	C1-C2-C3	3.00	113.46	109.66
3	A	5	MAN	C1-O5-C5	3.30	116.73	112.19
2	A	688	NAG	C2-N2-C7	4.32	129.24	122.94
4	A	694	BMA	C1-C2-C3	5.14	116.16	109.66
3	A	3	MAN	C1-O5-C5	5.20	119.34	112.19
2	A	688	NAG	C1-O5-C5	5.34	119.53	112.19

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

8 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	2	NAG	1	0
3	A	3	MAN	4	0
4	A	4	BMA	3	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	689	NAG	1	0
2	A	690	NAG	1	0
4	A	691	BMA	2	0
4	A	692	BMA	4	0
3	A	693	MAN	2	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](#)

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.