



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 19, 2016 – 08:53 PM GMT

PDB ID : 4ZH7  
Title : Structural basis of Lewisb antigen binding by the Helicobacter pylori adhesin BabA  
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Deposited on : 2015-04-24  
Resolution : 2.12 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](mailto: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.

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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

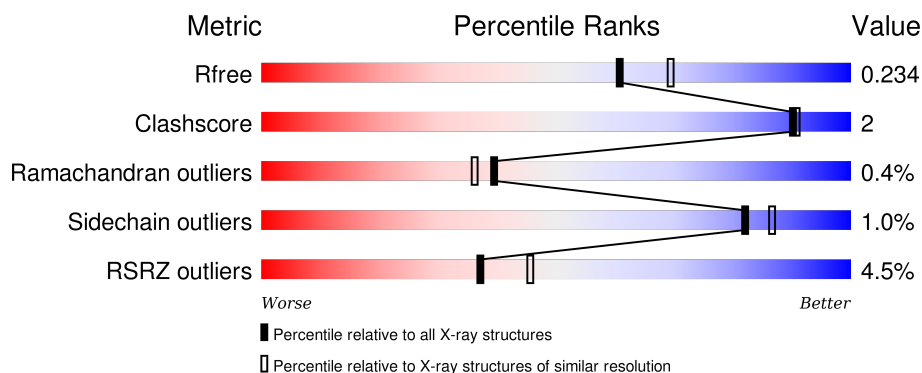
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*


The reported resolution of this entry is 2.12 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	4587 (2.14-2.10)
Clashscore	102246	5132 (2.14-2.10)
Ramachandran outliers	100387	5080 (2.14-2.10)
Sidechain outliers	100360	5081 (2.14-2.10)
RSRZ outliers	91569	4597 (2.14-2.10)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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	543	

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
3	GAL	A	605	-	-	-	X

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 3869 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.

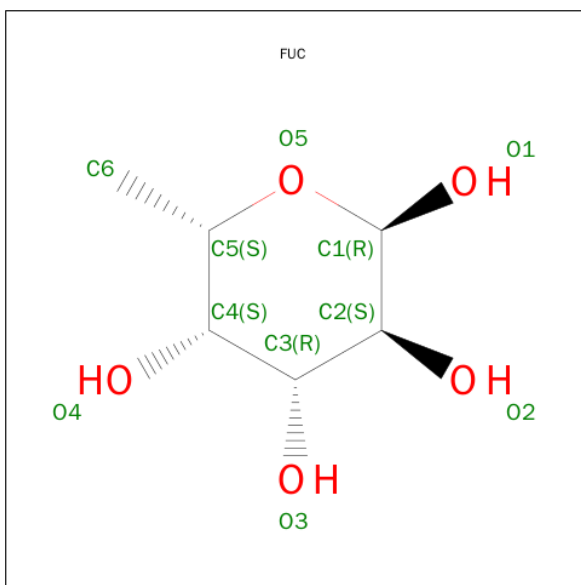
- Molecule 1 is a protein called Outer membrane protein-adhesin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	485	3655	2253	637	753	12	0	0	0

There are 25 discrepancies between the modelled and reference sequences:

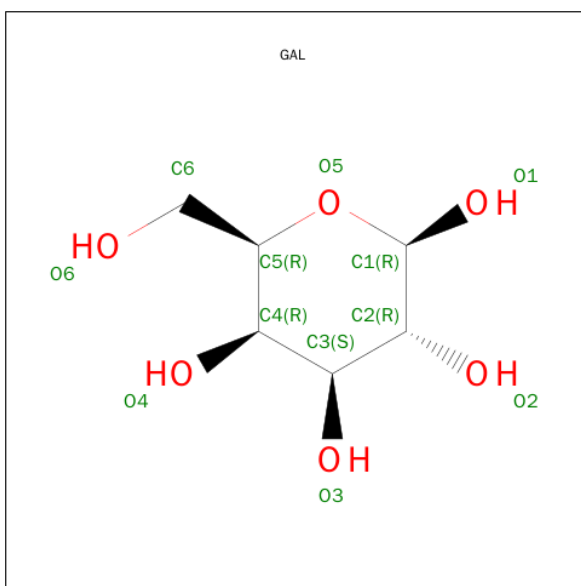
Chain	Residue	Modelled	Actual	Comment	Reference
A	528	LYS	-	expression tag	UNP Q9ZKV2
A	529	LYS	-	expression tag	UNP Q9ZKV2
A	530	LYS	-	expression tag	UNP Q9ZKV2
A	531	LYS	-	expression tag	UNP Q9ZKV2
A	532	LYS	-	expression tag	UNP Q9ZKV2
A	533	LYS	-	expression tag	UNP Q9ZKV2
A	534	GLY	-	expression tag	UNP Q9ZKV2
A	535	SER	-	expression tag	UNP Q9ZKV2
A	536	GLU	-	expression tag	UNP Q9ZKV2
A	537	GLN	-	expression tag	UNP Q9ZKV2
A	538	LYS	-	expression tag	UNP Q9ZKV2
A	539	LEU	-	expression tag	UNP Q9ZKV2
A	540	ILE	-	expression tag	UNP Q9ZKV2
A	541	SER	-	expression tag	UNP Q9ZKV2
A	542	GLU	-	expression tag	UNP Q9ZKV2
A	543	GLU	-	expression tag	UNP Q9ZKV2
A	544	ASP	-	expression tag	UNP Q9ZKV2
A	545	LEU	-	expression tag	UNP Q9ZKV2
A	546	SER	-	expression tag	UNP Q9ZKV2
A	547	HIS	-	expression tag	UNP Q9ZKV2
A	548	HIS	-	expression tag	UNP Q9ZKV2
A	549	HIS	-	expression tag	UNP Q9ZKV2
A	550	HIS	-	expression tag	UNP Q9ZKV2
A	551	HIS	-	expression tag	UNP Q9ZKV2
A	552	HIS	-	expression tag	UNP Q9ZKV2

- Molecule 2 is ALPHA-L-FUCOSE (three-letter code: FUC) (formula: C<sub>6</sub>H<sub>12</sub>O<sub>5</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			10	6	4		
2	A	1	Total	C	O	0	0
			10	6	4		

- Molecule 3 is BETA-D-GALACTOSE (three-letter code: GAL) (formula:  $C_6H_{12}O_6$ ).



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
			12	6	6		

- Molecule 4 is N-ACETYL-D-GLUCOSAMINE (three-letter code: NAG) (formula:  $C_8H_{15}NO_6$ ).



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

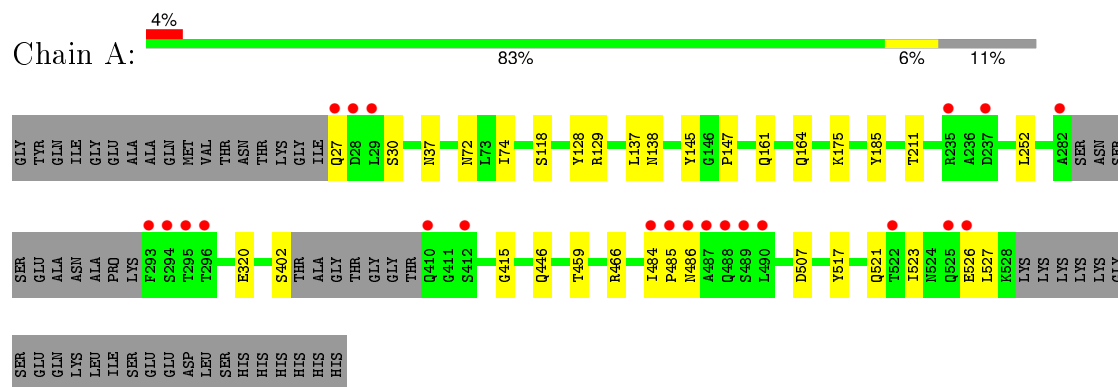
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	157	Total	O	0	0
			157	157		

### 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 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 ( $RSRZ > 2$ ). 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: Outer membrane protein-adhesin



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	60.59Å 91.77Å 96.42Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	44.78 – 2.12 44.78 – 2.12	Depositor EDS
% Data completeness (in resolution range)	98.9 (44.78-2.12) 98.9 (44.78-2.12)	Depositor EDS
$R_{merge}$	0.14	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.99 (at 2.12Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, $R_{free}$	0.171 , 0.223 0.180 , 0.234	Depositor DCC
$R_{free}$ test set	1513 reflections (5.16%)	DCC
Wilson B-factor (Å <sup>2</sup> )	21.8	Xtriage
Anisotropy	0.705	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 42.1	EDS
Estimated twinning fraction	0.019 for -h,l,k	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	0 of 30833 reflections	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	3869	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.79% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: GAL, NAG, FUC

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	0.83	0/3709	0.78	1/5039 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	507	ASP	CB-CG-OD1	5.46	123.21	118.30

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	3655	0	3553	17	0
2	A	20	0	20	0	0
3	A	23	0	20	0	0
4	A	14	0	11	0	0
5	A	157	0	0	1	0
All	All	3869	0	3604	17	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 (17) 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:320:GLU:HG3	5:A:820:HOH:O	1.55	1.03
1:A:74:ILE:HG22	1:A:175:LYS:HB3	1.59	0.84
1:A:118:SER:H	1:A:138:ASN:HD21	1.41	0.69
1:A:37:ASN:HD21	1:A:521:GLN:HG3	1.71	0.55
1:A:72:ASN:ND2	1:A:446:GLN:HE21	2.05	0.54
1:A:459:THR:HA	1:A:466:ARG:HG3	1.93	0.50
1:A:128:TYR:CE2	1:A:129:ARG:HG3	2.49	0.48
1:A:164:GLN:OE1	1:A:415:GLY:HA2	2.13	0.48
1:A:161:GLN:HG3	1:A:185:TYR:HB3	1.95	0.48
1:A:27:GLN:NE2	1:A:27:GLN:HA	2.30	0.47
1:A:252:LEU:N	1:A:252:LEU:HD12	2.31	0.45
1:A:484:ILE:HA	1:A:485:PRO:HD3	1.83	0.45
1:A:517:TYR:CZ	1:A:521:GLN:OE1	2.70	0.44
1:A:523:ILE:O	1:A:527:LEU:HD12	2.19	0.43
1:A:161:GLN:HG3	1:A:185:TYR:CB	2.49	0.42
1:A:517:TYR:CE2	1:A:521:GLN:OE1	2.72	0.42
1:A:137:LEU:HD23	1:A:147:PRO:HG3	2.04	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	479/543 (88%)	464 (97%)	13 (3%)	2 (0%)	39 36

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	486	ASN
1	A	526	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	406/452 (90%)	402 (99%)	4 (1%)	82	86

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	30	SER
1	A	145	TYR
1	A	211	THR
1	A	402	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	27	GLN
1	A	37	ASN
1	A	72	ASN
1	A	123	ASN
1	A	138	ASN
1	A	178	ASN
1	A	369	ASN
1	A	373	GLN
1	A	483	ASN
1	A	491	GLN

### 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 [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

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	$\# Z  > 2$
2	FUC	A	601	3	10,10,11	0.78	0	13,14,16	1.09	0
3	GAL	A	602	2,4	11,11,12	0.72	0	15,15,17	1.33	2 (13%)
4	NAG	A	603	3,2	14,14,15	0.79	0	15,19,21	1.20	2 (13%)
2	FUC	A	604	4	10,10,11	1.20	1 (10%)	13,14,16	2.67	6 (46%)
3	GAL	A	605	4	12,12,12	0.98	0	17,17,17	2.99	9 (52%)

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	FUC	A	601	3	-	0/0/17/20	0/1/1/1
3	GAL	A	602	2,4	-	0/2/19/22	0/1/1/1
4	NAG	A	603	3,2	-	0/6/23/26	0/1/1/1
2	FUC	A	604	4	-	0/0/17/20	0/1/1/1
3	GAL	A	605	4	-	0/2/22/22	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	604	FUC	C4-C5	2.33	1.57	1.53

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	604	FUC	C1-C2-C3	-6.46	101.72	109.55
3	A	605	GAL	O2-C2-C3	-5.32	98.37	110.36
3	A	605	GAL	O2-C2-C1	-4.42	100.06	109.74
3	A	605	GAL	O3-C3-C2	-3.30	102.93	110.36
3	A	602	GAL	O6-C6-C5	-2.92	101.55	111.30
2	A	604	FUC	C2-C3-C4	-2.69	106.36	111.05
2	A	604	FUC	O4-C4-C3	-2.64	104.40	110.36
4	A	603	NAG	O5-C5-C4	-2.50	105.99	110.13
3	A	602	GAL	O3-C3-C2	-2.27	105.85	110.01
4	A	603	NAG	O4-C4-C3	-2.04	105.76	110.36
3	A	605	GAL	O4-C4-C5	2.11	114.78	109.23
2	A	604	FUC	O3-C3-C2	2.43	114.45	110.01
3	A	605	GAL	O1-C1-O5	2.44	117.13	110.33
3	A	605	GAL	C3-C4-C5	3.20	115.92	110.23
2	A	604	FUC	C3-C4-C5	3.27	114.55	109.66
3	A	605	GAL	C4-C3-C2	3.45	117.15	110.79
2	A	604	FUC	O5-C5-C6	3.80	113.09	106.28
3	A	605	GAL	C1-C2-C3	4.24	117.62	110.68
3	A	605	GAL	O3-C3-C4	5.71	123.23	110.36

There are no chirality outliers.

There are no torsion outliers.

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.

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	485/543 (89%)	-0.20	22 (4%)	37 45	14, 23, 55, 82	0

All (22) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	294	SER	6.0
1	A	295	THR	5.7
1	A	486	ASN	5.3
1	A	410	GLN	4.7
1	A	488	GLN	4.2
1	A	237	ASP	4.1
1	A	29	LEU	4.0
1	A	525	GLN	3.9
1	A	293	PHE	3.8
1	A	526	GLU	3.5
1	A	490	LEU	3.3
1	A	28	ASP	3.2
1	A	489	SER	3.1
1	A	412	SER	3.0
1	A	485	PRO	2.9
1	A	235	ARG	2.8
1	A	296	THR	2.7
1	A	487	ALA	2.5
1	A	522	THR	2.4
1	A	484	ILE	2.3
1	A	27	GLN	2.3
1	A	282	ALA	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, 95<sup>th</sup> 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( $\text{\AA}^2$ )	Q<0.9
3	GAL	A	605	12/12	0.84	0.23	5.87	38,48,52,54	0
4	NAG	A	603	14/15	0.94	0.10	-0.31	27,32,34,36	0
2	FUC	A	601	10/11	0.97	0.08	-0.44	22,26,28,28	0
2	FUC	A	604	10/11	0.92	0.13	-	32,35,38,39	0
3	GAL	A	602	11/12	0.96	0.14	-	31,32,34,35	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.