



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 6, 2024 – 01:59 pm GMT

PDB ID : 5MR2  
Title : Crystal structure of red abalone VERL repeat 2 with linker at 2.5 Å resolution  
Authors : Sadat Al-Hosseini, H.; Raj, I.; Nishimura, K.; De Sanctis, D.; Jovine, L.  
Deposited on : 2016-12-21  
Resolution : 2.50 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

<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 : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
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) : 2.36

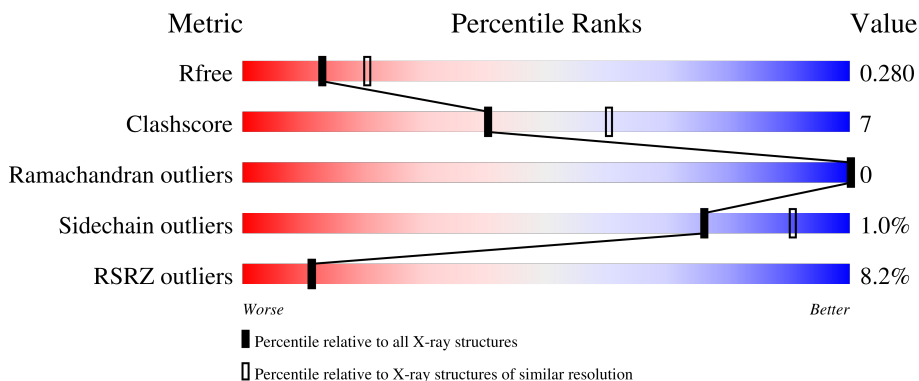
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.50 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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)

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  $\geq 3$ , 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	134	 6% 66% 13% 20%
1	B	134	 7% 68% 10% 21%
1	C	134	 7% 66% 12% 22%

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 5056 atoms, of which 2484 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 Vitelline envelope sperm lysin receptor.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	107	1663	541	821	136	155	10	0	0	0
1	B	106	1645	536	809	136	155	9	0	0	0
1	C	105	1642	534	812	136	151	9	0	0	0

There are 42 discrepancies between the modelled and reference sequences:

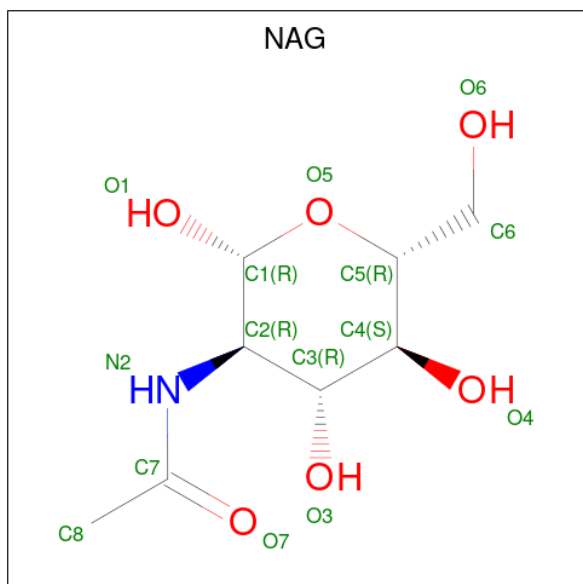
Chain	Residue	Modelled	Actual	Comment	Reference
A	173	GLU	-	expression tag	UNP Q8WR62
A	174	THR	-	expression tag	UNP Q8WR62
A	175	GLY	-	expression tag	UNP Q8WR62
A	293	ALA	SER	engineered mutation	UNP Q8WR62
A	296	ALA	SER	engineered mutation	UNP Q8WR62
A	297	ALA	SER	engineered mutation	UNP Q8WR62
A	299	LEU	-	expression tag	UNP Q8WR62
A	300	GLU	-	expression tag	UNP Q8WR62
A	301	HIS	-	expression tag	UNP Q8WR62
A	302	HIS	-	expression tag	UNP Q8WR62
A	303	HIS	-	expression tag	UNP Q8WR62
A	304	HIS	-	expression tag	UNP Q8WR62
A	305	HIS	-	expression tag	UNP Q8WR62
A	306	HIS	-	expression tag	UNP Q8WR62
B	173	GLU	-	expression tag	UNP Q8WR62
B	174	THR	-	expression tag	UNP Q8WR62
B	175	GLY	-	expression tag	UNP Q8WR62
B	293	ALA	SER	engineered mutation	UNP Q8WR62
B	296	ALA	SER	engineered mutation	UNP Q8WR62
B	297	ALA	SER	engineered mutation	UNP Q8WR62
B	299	LEU	-	expression tag	UNP Q8WR62
B	300	GLU	-	expression tag	UNP Q8WR62
B	301	HIS	-	expression tag	UNP Q8WR62

*Continued on next page...*

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
B	302	HIS	-	expression tag	UNP Q8WR62
B	303	HIS	-	expression tag	UNP Q8WR62
B	304	HIS	-	expression tag	UNP Q8WR62
B	305	HIS	-	expression tag	UNP Q8WR62
B	306	HIS	-	expression tag	UNP Q8WR62
C	173	GLU	-	expression tag	UNP Q8WR62
C	174	THR	-	expression tag	UNP Q8WR62
C	175	GLY	-	expression tag	UNP Q8WR62
C	293	ALA	SER	engineered mutation	UNP Q8WR62
C	296	ALA	SER	engineered mutation	UNP Q8WR62
C	297	ALA	SER	engineered mutation	UNP Q8WR62
C	299	LEU	-	expression tag	UNP Q8WR62
C	300	GLU	-	expression tag	UNP Q8WR62
C	301	HIS	-	expression tag	UNP Q8WR62
C	302	HIS	-	expression tag	UNP Q8WR62
C	303	HIS	-	expression tag	UNP Q8WR62
C	304	HIS	-	expression tag	UNP Q8WR62
C	305	HIS	-	expression tag	UNP Q8WR62
C	306	HIS	-	expression tag	UNP Q8WR62

- Molecule 2 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	H	N			O
2	A	1	28	8	14	1	5	0	0

Continued on next page...

*Continued from previous page...*

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	B	1	Total	C	H	N	O	0	0
			28	8	14	1	5		
2	C	1	Total	C	H	N	O	0	0
			28	8	14	1	5		

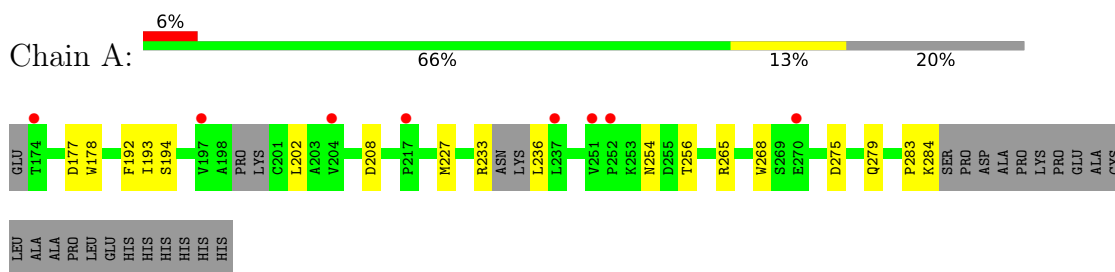
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	3	Total	O	0	0
			3	3		
3	B	6	Total	O	0	0
			6	6		
3	C	13	Total	O	0	0
			13	13		

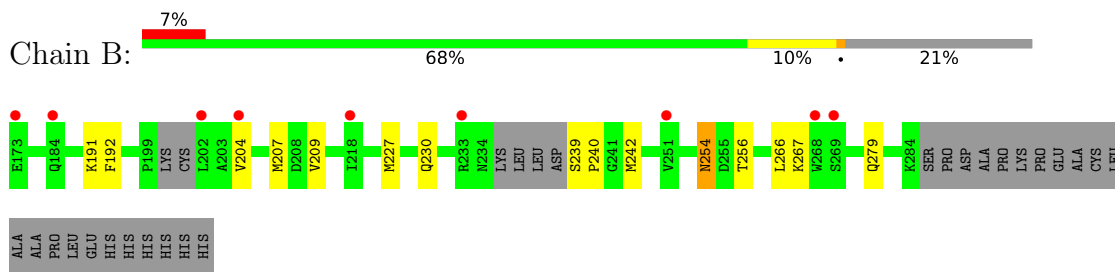
### 3 Residue-property plots [i](#)

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.

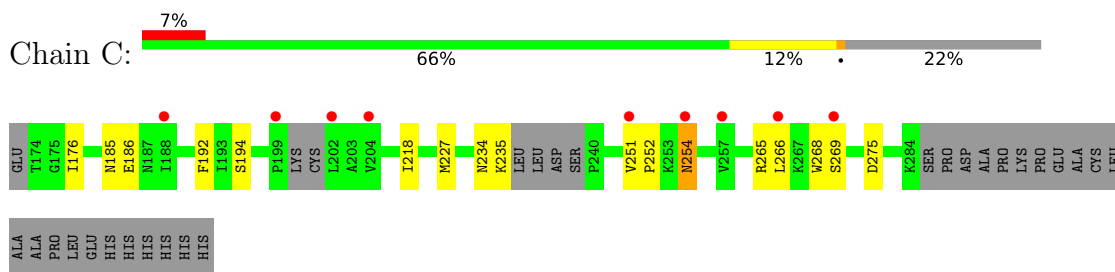
- Molecule 1: Vitelline envelope sperm lysin receptor



- Molecule 1: Vitelline envelope sperm lysin receptor



- Molecule 1: Vitelline envelope sperm lysin receptor



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	69.92Å 79.19Å 81.24Å 90.00° 102.62° 90.00°	Depositor
Resolution (Å)	47.01 – 2.50 47.01 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.6 (47.01-2.50) 99.9 (47.01-2.50)	Depositor EDS
$R_{merge}$	0.14	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.02 (at 2.51Å)	Xtrriage
Refinement program	PHENIX (1.11.1_2575: ???)	Depositor
R, $R_{free}$	0.234 , 0.280 0.234 , 0.280	Depositor DCC
$R_{free}$ test set	1504 reflections (10.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	70.0	Xtrriage
Anisotropy	0.256	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 55.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	5056	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	83.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.29% 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, 0.333 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	0.40	0/863	0.58	0/1174
1	B	0.44	0/858	0.60	0/1168
1	C	0.44	0/852	0.63	0/1158
All	All	0.43	0/2573	0.61	0/3500

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	842	821	821	11	0
1	B	836	809	809	14	1
1	C	830	812	812	10	1
2	A	14	14	13	2	0
2	B	14	14	13	0	0
2	C	14	14	13	0	0
3	A	3	0	0	1	0
3	B	6	0	0	1	0
3	C	13	0	0	0	0
All	All	2572	2484	2481	36	1



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 7.

All (36) 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:233:ARG:O	1:A:236:LEU:N	2.15	0.79
2:A:900:NAG:O7	2:A:900:NAG:O3	2.04	0.74
1:A:254:ASN:OD1	1:A:256:THR:N	2.27	0.65
1:C:254:ASN:OD1	1:C:254:ASN:N	2.29	0.64
1:B:239:SER:HA	1:B:242:MET:SD	2.43	0.59
1:B:254:ASN:OD1	1:B:256:THR:N	2.33	0.58
1:A:279:GLN:OE1	1:B:279:GLN:NE2	2.35	0.56
1:B:191:LYS:NZ	3:B:1001:HOH:O	2.38	0.54
1:C:192:PHE:HD2	1:C:227:MET:HE2	1.74	0.53
1:B:239:SER:N	1:B:240:PRO:CD	2.73	0.51
1:C:234:ASN:O	1:C:235:LYS:CB	2.59	0.50
1:A:254:ASN:OD1	1:A:254:ASN:C	2.49	0.49
1:A:283:PRO:O	1:A:284:LYS:HB2	2.13	0.49
1:A:202:LEU:CD1	1:A:268:TRP:CE3	2.96	0.48
1:C:185:ASN:OD1	1:C:186:GLU:N	2.47	0.48
1:B:254:ASN:OD1	1:B:254:ASN:C	2.52	0.48
2:A:900:NAG:HO3	2:A:900:NAG:C7	2.12	0.47
1:B:207:MET:HB2	1:B:266:LEU:HD13	1.96	0.47
1:B:204:VAL:HG13	1:B:266:LEU:HD11	1.97	0.46
1:B:209:VAL:HG21	1:B:227:MET:HE1	1.96	0.46
1:B:192:PHE:HD2	1:B:227:MET:HE2	1.81	0.46
1:C:266:LEU:HD11	1:C:268:TRP:CZ2	2.51	0.45
1:B:230:GLN:OE1	1:B:242:MET:CE	2.63	0.45
1:C:218:ILE:HD11	1:C:227:MET:HE2	1.98	0.45
1:B:204:VAL:CG1	1:B:266:LEU:HD11	2.48	0.44
1:C:192:PHE:HD2	1:C:227:MET:CE	2.30	0.44
1:A:177:ASP:O	1:A:194:SER:HA	2.18	0.44
1:C:251:VAL:HG13	1:C:252:PRO:HD2	1.99	0.44
1:A:265:ARG:NH1	1:A:275:ASP:OD1	2.51	0.43
1:B:230:GLN:OE1	1:B:242:MET:HE2	2.17	0.43
1:A:192:PHE:HD2	1:A:227:MET:HE2	1.83	0.43
1:B:192:PHE:HD2	1:B:227:MET:CE	2.30	0.43
1:A:233:ARG:NH2	3:A:1001:HOH:O	2.31	0.42
1:A:178:TRP:HA	1:A:193:ILE:O	2.21	0.41
1:C:176:ILE:HD11	1:C:194:SER:HB2	2.03	0.41
1:C:265:ARG:NH1	1:C:275:ASP:OD1	2.54	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the sym-

metry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:267:LYS:HZ1	1:C:269:SER:O[2_655]	1.48	0.12

## 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	101/134 (75%)	99 (98%)	2 (2%)	0	100	100
1	B	100/134 (75%)	98 (98%)	2 (2%)	0	100	100
1	C	99/134 (74%)	98 (99%)	1 (1%)	0	100	100
All	All	300/402 (75%)	295 (98%)	5 (2%)	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	97/120 (81%)	96 (99%)	1 (1%)	76	90
1	B	96/120 (80%)	95 (99%)	1 (1%)	76	90
1	C	95/120 (79%)	94 (99%)	1 (1%)	73	89
All	All	288/360 (80%)	285 (99%)	3 (1%)	76	90

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	208	ASP
1	B	254	ASN
1	C	254	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	187	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 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	$\# Z  > 2$
2	NAG	A	900	1	14,14,15	0.69	0	17,19,21	0.79	1 (5%)
2	NAG	C	900	1	14,14,15	0.54	0	17,19,21	0.33	0
2	NAG	B	900	1	14,14,15	0.52	0	17,19,21	0.63	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	900	1	-	4/6/23/26	0/1/1/1
2	NAG	C	900	1	-	1/6/23/26	0/1/1/1
2	NAG	B	900	1	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	900	NAG	C1-O5-C5	2.57	115.67	112.19

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	900	NAG	O5-C5-C6-O6
2	A	900	NAG	C1-C2-N2-C7
2	A	900	NAG	C3-C2-N2-C7
2	A	900	NAG	C4-C5-C6-O6
2	C	900	NAG	O5-C5-C6-O6

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	900	NAG	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

### 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, 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	107/134 (79%)	0.73	8 (7%) 14 14	49, 70, 117, 157	0
1	B	106/134 (79%)	0.83	9 (8%) 10 10	48, 68, 128, 142	0
1	C	105/134 (78%)	0.79	9 (8%) 10 10	49, 64, 110, 145	0
All	All	318/402 (79%)	0.78	26 (8%) 11 11	48, 67, 124, 157	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	233	ARG	4.0
1	C	202	LEU	3.6
1	B	202	LEU	3.4
1	B	268	TRP	3.3
1	B	251	VAL	3.1
1	A	174	THR	3.1
1	A	197	VAL	3.0
1	C	257	VAL	2.9
1	A	252	PRO	2.9
1	C	251	VAL	2.6
1	C	204	VAL	2.6
1	B	218	ILE	2.6
1	A	251	VAL	2.5
1	A	237	LEU	2.3
1	C	199	PRO	2.3
1	B	269	SER	2.3
1	C	254	ASN	2.2
1	C	266	LEU	2.2
1	C	188	ILE	2.2
1	B	173	GLU	2.2
1	A	270	GLU	2.1
1	B	184	GLN	2.1
1	B	204	VAL	2.0

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	RSRZ
1	C	269	SER	2.0
1	A	217	PRO	2.0
1	A	204	VAL	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, 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	B-factors(Å <sup>2</sup> )	Q<0.9
2	NAG	A	900	14/15	0.76	0.21	111,133,158,159	0
2	NAG	C	900	14/15	0.76	0.27	101,121,147,149	0
2	NAG	B	900	14/15	0.77	0.24	127,147,174,177	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.