



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 7, 2020 – 12:53 AM BST

PDB ID : 3FL7  
Title : Crystal structure of the human ephrin A2 ectodomain  
Authors : Walker, J.R.; Yermekbayeva, L.; Seitova, A.; Butler-Cole, C.; Bountra, C.; Weigelt, J.; Arrowsmith, C.H.; Edwards, A.M.; Bochkarev, A.; Dhe-Paganon, S.; Structural Genomics Consortium (SGC)  
Deposited on : 2008-12-18  
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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.13.1  
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) : 2.13.1

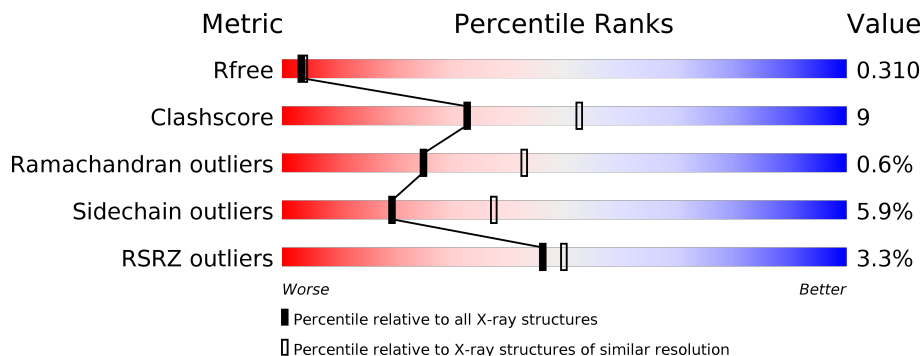
# 1 Overall quality at a glance

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 on 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	536	

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
4	NAG	A	1005	X	-	-	-

## 2 Entry composition i

There are 5 unique types of molecules in this entry. The entry contains 3741 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 Ephrin receptor.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	482	3677	2319	619	713	26	0	2	0

There are 27 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-4	ALA	-	expression tag	UNP Q8N3Z2
A	-3	ALA	-	expression tag	UNP Q8N3Z2
A	-2	PRO	-	expression tag	UNP Q8N3Z2
A	-1	GLU	-	expression tag	UNP Q8N3Z2
A	0	HIS	-	expression tag	UNP Q8N3Z2
A	1	HIS	-	expression tag	UNP Q8N3Z2
A	2	HIS	-	expression tag	UNP Q8N3Z2
A	3	HIS	-	expression tag	UNP Q8N3Z2
A	4	HIS	-	expression tag	UNP Q8N3Z2
A	5	HIS	-	expression tag	UNP Q8N3Z2
A	6	ASP	-	expression tag	UNP Q8N3Z2
A	7	TYR	-	expression tag	UNP Q8N3Z2
A	8	ASP	-	expression tag	UNP Q8N3Z2
A	9	ILE	-	expression tag	UNP Q8N3Z2
A	10	PRO	-	expression tag	UNP Q8N3Z2
A	11	THR	-	expression tag	UNP Q8N3Z2
A	12	THR	-	expression tag	UNP Q8N3Z2
A	13	GLU	-	expression tag	UNP Q8N3Z2
A	14	ASN	-	expression tag	UNP Q8N3Z2
A	15	LEU	-	expression tag	UNP Q8N3Z2
A	16	TYR	-	expression tag	UNP Q8N3Z2
A	17	PHE	-	expression tag	UNP Q8N3Z2
A	18	GLN	-	expression tag	UNP Q8N3Z2
A	19	GLY	-	expression tag	UNP Q8N3Z2
A	20	ALA	-	expression tag	UNP Q8N3Z2
A	21	MET	-	expression tag	UNP Q8N3Z2
A	22	ASP	-	expression tag	UNP Q8N3Z2

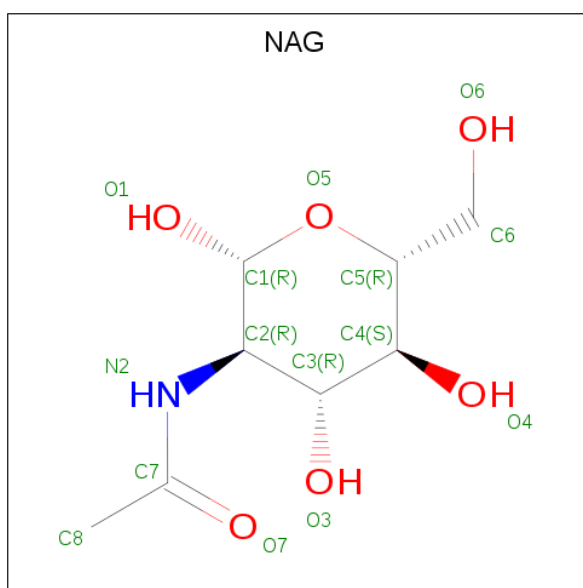
- Molecule 2 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	Na		0	0
			1	1			

- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	3	Total	Cl		0	0
			3	3			

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: C<sub>8</sub>H<sub>15</sub>NO<sub>6</sub>).



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

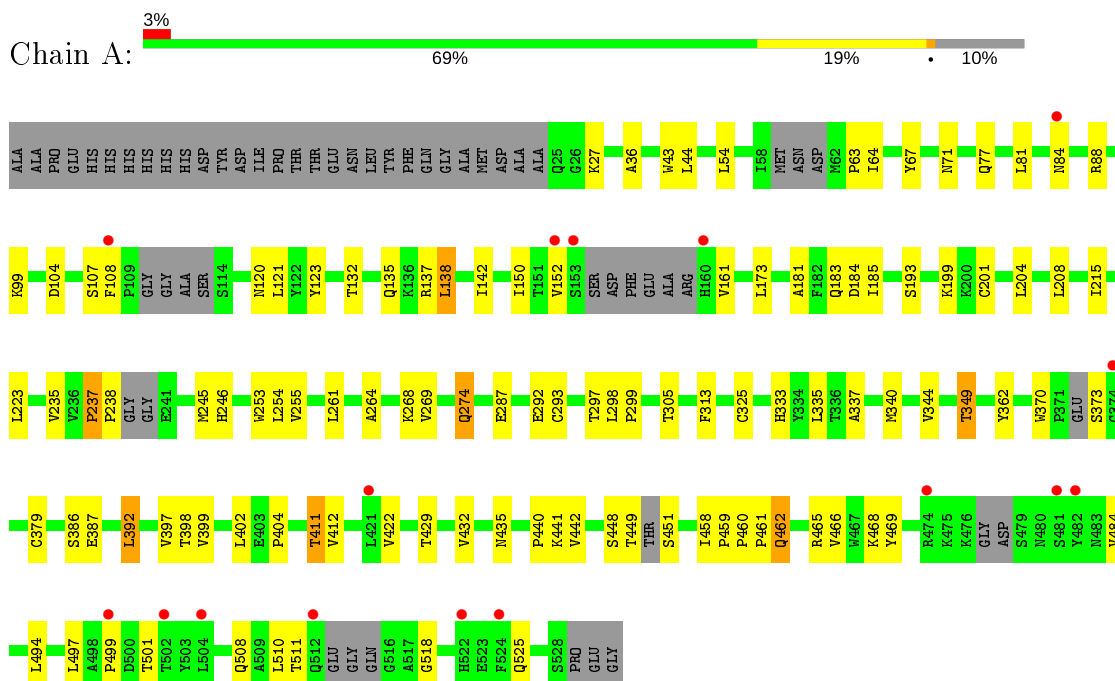
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	46	Total	O	0	0
			46	46		

### 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: Ephrin receptor



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	59.36Å 89.99Å 136.48Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.59 – 2.50 40.60 – 2.50	Depositor EDS
% Data completeness (in resolution range)	98.5 (40.59-2.50) 98.5 (40.60-2.50)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.07	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.11 (at 2.51Å)	Xtrriage
Refinement program	REFMAC 5.5.0063	Depositor
R, $R_{free}$	0.246 , 0.299 0.255 , 0.310	Depositor DCC
$R_{free}$ test set	1311 reflections (5.11%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	53.2	Xtrriage
Anisotropy	0.331	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 64.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	3741	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	68.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.94% 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: NA, NAG, CL

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	0.48	0/3769	0.61	0/5138

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	3677	0	3423	62	0
2	A	1	0	0	0	0
3	A	3	0	0	0	0
4	A	14	0	13	0	0
5	A	46	0	0	0	0
All	All	3741	0	3436	62	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 (62) 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:208:LEU:HD21	1:A:268:LYS:HG3	1.68	0.75
1:A:293:CYS:HB3	1:A:297:THR:HG21	1.69	0.74
1:A:71:ASN:HB2	1:A:77:GLN:OE1	1.90	0.71
1:A:370:TRP:HB3	1:A:373:SER:HB3	1.72	0.71
1:A:104:ASP:HB3	1:A:107:SER:HB3	1.78	0.65
1:A:71:ASN:CB	1:A:77:GLN:OE1	2.46	0.63
1:A:185:ILE:HG22	1:A:185:ILE:O	1.98	0.62
1:A:411:THR:HG22	1:A:429:THR:HG22	1.82	0.61
1:A:237:PRO:HD2	1:A:238:PRO:HD3	1.82	0.59
1:A:335:LEU:HD22	1:A:412:VAL:HG12	1.84	0.59
1:A:269:VAL:HB	1:A:274:GLN:HG3	1.86	0.58
1:A:313:PHE:HB3	1:A:325:CYS:HB3	1.86	0.58
1:A:293:CYS:HB3	1:A:297:THR:CG2	2.34	0.58
1:A:337:ALA:HB1	1:A:432:VAL:CG2	2.34	0.57
1:A:43:TRP:HE1	1:A:84[A]:ASN:HD22	1.54	0.56
1:A:99:LYS:HB2	1:A:193:SER:HB3	1.89	0.55
1:A:201:CYS:HB3	1:A:253:TRP:CE2	2.41	0.55
1:A:344:VAL:CG2	1:A:399:VAL:HB	2.38	0.54
1:A:448:SER:O	1:A:449:THR:HB	2.09	0.53
1:A:237:PRO:CD	1:A:238:PRO:HD3	2.39	0.53
1:A:465:ARG:O	1:A:511:THR:HG22	2.09	0.53
1:A:223:LEU:HD21	1:A:254:LEU:HD12	1.91	0.51
1:A:43:TRP:HE1	1:A:84[A]:ASN:ND2	2.07	0.51
1:A:466:VAL:HG21	1:A:469:TYR:OH	2.11	0.51
1:A:183:GLN:NE2	1:A:185:ILE:HD11	2.25	0.50
1:A:261:LEU:HD22	1:A:287:GLU:HB3	1.94	0.50
1:A:449:THR:OG1	1:A:499:PRO:HA	2.11	0.50
1:A:246:HIS:ND1	1:A:255:VAL:HG23	2.27	0.49
1:A:508:GLN:HA	1:A:518:GLY:HA2	1.93	0.49
1:A:468:LYS:O	1:A:510:LEU:HB2	2.12	0.48
1:A:137:ARG:HG3	1:A:138:LEU:HD23	1.96	0.48
1:A:440:PRO:HA	1:A:458:ILE:HG23	1.95	0.47
1:A:333:HIS:HB3	1:A:349:THR:HG22	1.96	0.47
1:A:344:VAL:HG22	1:A:402:LEU:HD11	1.96	0.47
1:A:123:TYR:HB3	1:A:142:ILE:HD11	1.97	0.47
1:A:404:PRO:HB3	1:A:435:ASN:O	2.16	0.46
1:A:71:ASN:HB2	1:A:77:GLN:CD	2.37	0.45
1:A:333:HIS:HB3	1:A:349:THR:CG2	2.46	0.45
1:A:63:PRO:O	1:A:64:ILE:HD13	2.16	0.45
1:A:81:LEU:O	1:A:181:ALA:HA	2.17	0.45
1:A:344:VAL:HG23	1:A:399:VAL:HB	1.99	0.45
1:A:120:ASN:HB2	1:A:183:GLN:HB3	1.99	0.44

*Continued on next page...*



Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:451:SER:HB3	1:A:497:LEU:HD12	1.99	0.44
1:A:344:VAL:HG12	1:A:432:VAL:HG11	2.00	0.44
1:A:245:MET:HB3	1:A:253:TRP:CE3	2.53	0.44
1:A:27:LYS:O	1:A:199:LYS:HA	2.18	0.44
1:A:298:LEU:HA	1:A:299:PRO:HD2	1.79	0.44
1:A:460:PRO:N	1:A:461:PRO:HD2	2.33	0.43
1:A:54:LEU:HD13	1:A:67:TYR:CZ	2.51	0.43
1:A:335:LEU:HD13	1:A:412:VAL:HG11	1.99	0.43
1:A:88:ARG:HD2	1:A:173:LEU:HB2	2.01	0.43
1:A:246:HIS:CE1	1:A:255:VAL:HG23	2.55	0.42
1:A:459:PRO:HG2	1:A:462:GLN:OE1	2.20	0.42
1:A:264:ALA:HB1	1:A:305:THR:HG22	2.01	0.42
1:A:44:LEU:HD12	1:A:132:THR:HA	2.01	0.42
1:A:71:ASN:HB2	1:A:77:GLN:NE2	2.35	0.41
1:A:362:TYR:O	1:A:392:LEU:HB2	2.20	0.41
1:A:386:SER:HB3	1:A:398:THR:HB	2.03	0.41
1:A:501:THR:O	1:A:525:GLN:HA	2.21	0.41
1:A:466:VAL:HG21	1:A:469:TYR:CZ	2.56	0.41
1:A:121:LEU:HG	1:A:142:ILE:HD12	2.03	0.40
1:A:135:GLN:HB2	1:A:138:LEU:HG	2.03	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	466/536 (87%)	426 (91%)	37 (8%)	3 (1%)	25 43

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	36	ALA

Continued on next page...

*Continued from previous page...*

Mol	Chain	Res	Type
1	A	340	MET
1	A	237	PRO

### 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	395/455 (87%)	372 (94%)	23 (6%)	20   38

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

Mol	Chain	Res	Type
1	A	108	PHE
1	A	138	LEU
1	A	150	ILE
1	A	152	VAL
1	A	161	VAL
1	A	184	ASP
1	A	204	LEU
1	A	215	ILE
1	A	235	VAL
1	A	274	GLN
1	A	292	GLU
1	A	349	THR
1	A	379	CYS
1	A	387	GLU
1	A	392	LEU
1	A	397	VAL
1	A	411	THR
1	A	422	VAL
1	A	441	LYS
1	A	442	VAL
1	A	462	GLN
1	A	484	VAL
1	A	494	LEU

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

Mol	Chain	Res	Type
1	A	259	GLN

### 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](#)

Of 5 ligands modelled in this entry, 4 are monoatomic - leaving 1 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$
4	NAG	A	1005	1	14,14,15	1.02	1 (7%)	17,19,21	2.59	7 (41%)

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
4	NAG	A	1005	1	1/1/5/7	1/6/23/26	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	1005	NAG	C1-C2	3.12	1.57	1.52

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	1005	NAG	C2-N2-C7	7.92	134.19	122.90
4	A	1005	NAG	C1-O5-C5	3.15	116.46	112.19
4	A	1005	NAG	C3-C4-C5	-3.00	104.89	110.24
4	A	1005	NAG	O3-C3-C2	2.42	114.47	109.47
4	A	1005	NAG	C4-C3-C2	-2.16	107.85	111.02
4	A	1005	NAG	O7-C7-C8	-2.12	118.11	122.06
4	A	1005	NAG	O7-C7-N2	2.07	125.76	121.95

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
4	A	1005	NAG	C1

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	1005	NAG	C3-C2-N2-C7

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	482/536 (89%)	0.36	16 (3%) 46 50	36, 69, 92, 114	0

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	160	HIS	6.6
1	A	504	LEU	4.1
1	A	502	THR	3.2
1	A	153	SER	2.7
1	A	421	LEU	2.7
1	A	474	ARG	2.5
1	A	482	TYR	2.4
1	A	522	HIS	2.3
1	A	512	GLN	2.2
1	A	108	PHE	2.2
1	A	374	GLY	2.2
1	A	499	PRO	2.1
1	A	84[A]	ASN	2.1
1	A	152	VAL	2.0
1	A	481	SER	2.0
1	A	524	PHE	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( $\text{\AA}^2$ )	Q<0.9
3	CL	A	1004	1/1	0.73	0.38	108,108,108,108	0
4	NAG	A	1005	14/15	0.74	0.17	59,62,65,65	0
3	CL	A	1002	1/1	0.86	0.26	83,83,83,83	0
3	CL	A	1003	1/1	0.87	0.28	75,75,75,75	0
2	NA	A	1001	1/1	0.91	0.20	48,48,48,48	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.