



# wwPDB X-ray Structure Validation Summary Report ⓘ

Sep 29, 2024 – 06:03 PM EDT

PDB ID : 4LSS  
Title : Crystal structure of broadly and potently neutralizing antibody VRC01 in complex with HIV-1 clade A strain KER\_2018\_11 gp120  
Authors : Zhou, T.; Moquin, S.; Kwong, P.D.  
Deposited on : 2013-07-23  
Resolution : 2.59 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](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>.

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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	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.39

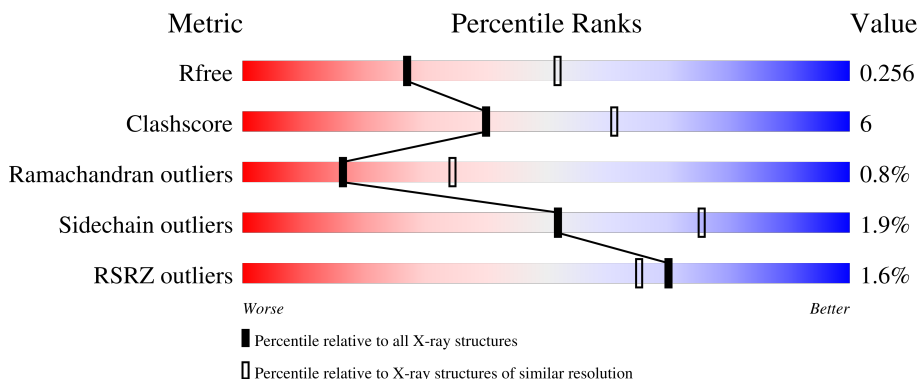
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.59 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))
$R_{free}$	164625	3775 (2.60-2.60)
Clashscore	180529	4181 (2.60-2.60)
Ramachandran outliers	177936	4129 (2.60-2.60)
Sidechain outliers	177891	4129 (2.60-2.60)
RSRZ outliers	164620	3775 (2.60-2.60)

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	G	359	
2	H	224	
3	L	210	

## 2 Entry composition [i](#)

There are 8 unique types of molecules in this entry. The entry contains 6316 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 envelope glycoprotein GP120.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	G	335	Total	C	N	O	S	0	0	0
			2640	1661	462	498	19			

- Molecule 2 is a protein called HEAVY CHAIN OF ANTIBODY VRC01.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	H	224	Total	C	N	O	S	0	0	0
			1712	1079	297	325	11			

- Molecule 3 is a protein called LIGHT CHAIN OF ANTIBODY VRC01 with N72T mutation.

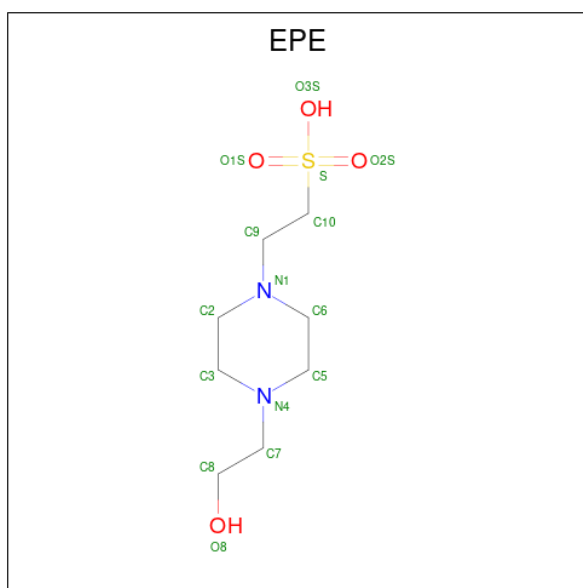
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	L	208	Total	C	N	O	S	0	0	0
			1614	1011	276	322	5			

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula:  $C_8H_{15}NO_6$ ).



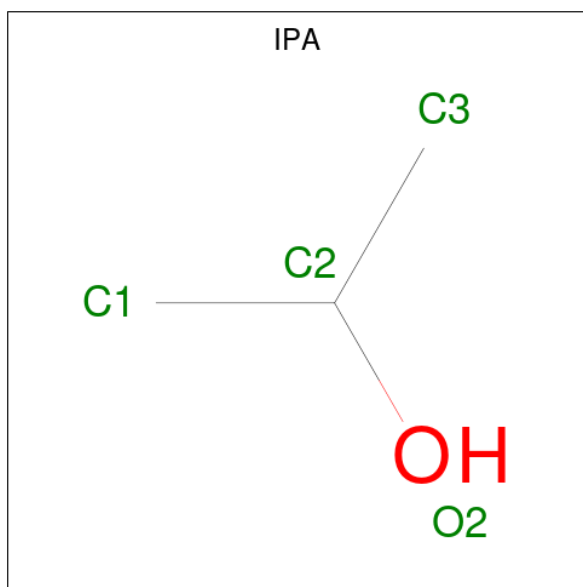
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	G	1	Total C N O 14 8 1 5	0	0
4	G	1	Total C N O 14 8 1 5	0	0
4	G	1	Total C N O 14 8 1 5	0	0
4	G	1	Total C N O 14 8 1 5	0	0
4	G	1	Total C N O 14 8 1 5	0	0
4	G	1	Total C N O 14 8 1 5	0	0
4	G	1	Total C N O 14 8 1 5	0	0
4	G	1	Total C N O 14 8 1 5	0	0
4	G	1	Total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

- Molecule 5 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (three-letter code: EPE) (formula:  $C_8H_{18}N_2O_4S$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	G	1	Total	C	N	O	S	0	0
			15	8	2	4	1		
5	H	1	Total	C	N	O	S	0	0
			15	8	2	4	1		

- Molecule 6 is ISOPROPYL ALCOHOL (three-letter code: IPA) (formula: C<sub>3</sub>H<sub>8</sub>O).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	G	1	Total	C	O	0	0
			4	3	1		

- Molecule 7 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	G	2	Total	Na	0	0
			2	2		
7	L	1	Total	Na	0	0
			1	1		

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	G	85	Total	O	0	0
			85	85		
8	H	26	Total	O	0	0
			26	26		

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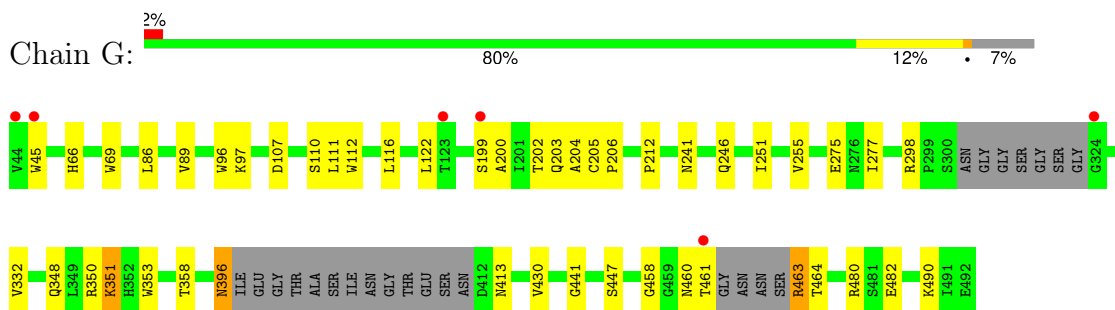
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	L	34	Total	O	0	0
			34	34		

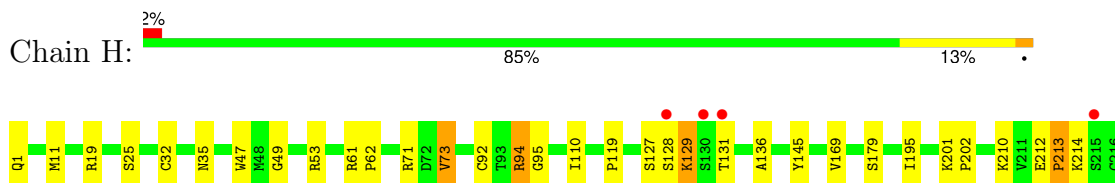
### 3 Residue-property plots [i](#)

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.

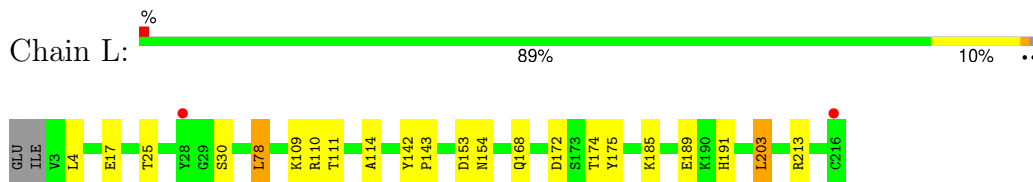
- Molecule 1: envelope glycoprotein GP120



- Molecule 2: HEAVY CHAIN OF ANTIBODY VRC01



- Molecule 3: LIGHT CHAIN OF ANTIBODY VRC01 with N72T mutation



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	54.64Å 65.27Å 259.15Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.39 – 2.59 32.39 – 2.59	Depositor EDS
% Data completeness (in resolution range)	90.9 (32.39-2.59) 90.7 (32.39-2.59)	Depositor EDS
$R_{merge}$	0.13	Depositor
$R_{sym}$	0.10	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.58 (at 2.57Å)	Xtriage
Refinement program	PHENIX dev_998	Depositor
R, $R_{free}$	0.192 , 0.263 0.183 , 0.256	Depositor DCC
$R_{free}$ test set	1386 reflections (5.10%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	42.1	Xtriage
Anisotropy	0.107	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 36.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	6316	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.66% 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: IPA, EPE, NAG, NA

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	G	0.30	0/2696	0.49	0/3662
2	H	0.27	0/1757	0.48	0/2390
3	L	0.28	0/1651	0.47	0/2241
All	All	0.29	0/6104	0.48	0/8293

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	G	2640	0	2572	48	0
2	H	1712	0	1683	24	0
3	L	1614	0	1555	12	0
4	G	168	0	156	5	0
5	G	15	0	17	0	0
5	H	15	0	17	0	0
6	G	4	0	8	1	0
7	G	2	0	0	0	0
7	L	1	0	0	0	0
8	G	85	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
8	H	26	0	0	1	0
8	L	34	0	0	1	0
All	All	6316	0	6008	79	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 6.

The worst 5 of 79 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:G:358:THR:OG1	4:G:512:NAG:H82	1.76	0.84
3:L:191:HIS:O	3:L:213:ARG:NH1	2.17	0.77
1:G:463:ARG:N	1:G:464:THR:HA	2.01	0.76
2:H:19:ARG:NH1	8:H:605:HOH:O	2.21	0.74
2:H:127:SER:O	2:H:129:LYS:N	2.27	0.68

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	G	327/359 (91%)	308 (94%)	17 (5%)	2 (1%)	22	43
2	H	222/224 (99%)	203 (91%)	15 (7%)	4 (2%)	7	14
3	L	206/210 (98%)	192 (93%)	14 (7%)	0	100	100
All	All	755/793 (95%)	703 (93%)	46 (6%)	6 (1%)	16	34

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	H	128	SER

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Mol	Chain	Res	Type
2	H	129	LYS
1	G	199	SER
1	G	351	LYS
2	H	53	ARG

### 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	G	296/312 (95%)	292 (99%)	4 (1%)	62	82
2	H	193/193 (100%)	186 (96%)	7 (4%)	30	56
3	L	180/182 (99%)	178 (99%)	2 (1%)	70	86
All	All	669/687 (97%)	656 (98%)	13 (2%)	52	75

5 of 13 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	H	73	VAL
2	H	94	ARG
3	L	203	LEU
2	H	179	SER
3	L	78	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 18 ligands modelled in this entry, 3 are monoatomic - leaving 15 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	G	503	1	14,14,15	0.51	0	17,19,21	0.75	0
6	IPA	G	514	-	3,3,3	0.55	0	3,3,3	0.27	0
4	NAG	G	501	1	14,14,15	0.46	0	17,19,21	1.01	0
4	NAG	G	508	1	14,14,15	0.54	0	17,19,21	0.96	2 (11%)
4	NAG	G	505	1	14,14,15	0.53	0	17,19,21	0.58	0
4	NAG	G	511	1	14,14,15	0.46	0	17,19,21	1.54	2 (11%)
5	EPE	G	513	-	15,15,15	0.72	1 (6%)	19,20,20	2.11	5 (26%)
5	EPE	H	501	-	15,15,15	0.84	1 (6%)	19,20,20	1.57	3 (15%)
4	NAG	G	512	1	14,14,15	0.57	0	17,19,21	0.66	0
4	NAG	G	502	1	14,14,15	0.69	0	17,19,21	1.04	2 (11%)
4	NAG	G	506	1	14,14,15	0.50	0	17,19,21	1.17	2 (11%)
4	NAG	G	507	1	14,14,15	0.48	0	17,19,21	1.22	1 (5%)
4	NAG	G	510	1	14,14,15	0.50	0	17,19,21	0.88	1 (5%)
4	NAG	G	504	1	14,14,15	0.55	0	17,19,21	0.98	1 (5%)
4	NAG	G	509	1	14,14,15	0.49	0	17,19,21	0.65	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
4	NAG	G	503	1	-	3/6/23/26	0/1/1/1
4	NAG	G	501	1	-	2/6/23/26	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	NAG	G	508	1	-	4/6/23/26	0/1/1/1
4	NAG	G	505	1	-	2/6/23/26	0/1/1/1
4	NAG	G	511	1	-	0/6/23/26	0/1/1/1
5	EPE	G	513	-	-	3/9/19/19	0/1/1/1
5	EPE	H	501	-	-	1/9/19/19	0/1/1/1
4	NAG	G	512	1	-	2/6/23/26	0/1/1/1
4	NAG	G	502	1	-	2/6/23/26	0/1/1/1
4	NAG	G	506	1	-	0/6/23/26	0/1/1/1
4	NAG	G	507	1	-	2/6/23/26	0/1/1/1
4	NAG	G	510	1	-	3/6/23/26	0/1/1/1
4	NAG	G	504	1	-	0/6/23/26	0/1/1/1
4	NAG	G	509	1	-	2/6/23/26	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	H	501	EPE	C10-S	2.88	1.81	1.77
5	G	513	EPE	C10-S	2.30	1.80	1.77

The worst 5 of 19 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	G	513	EPE	C5-N4-C3	6.35	122.52	108.84
4	G	511	NAG	C1-O5-C5	4.91	118.76	112.19
5	H	501	EPE	C5-N4-C3	4.00	117.45	108.84
4	G	507	NAG	C1-O5-C5	3.79	117.27	112.19
5	G	513	EPE	C7-N4-C5	3.02	119.28	111.24

There are no chirality outliers.

5 of 26 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	G	501	NAG	C8-C7-N2-C2
4	G	501	NAG	O7-C7-N2-C2
4	G	502	NAG	C8-C7-N2-C2
4	G	502	NAG	O7-C7-N2-C2
4	G	503	NAG	O7-C7-N2-C2

There are no ring outliers.

4 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	G	503	NAG	2	0
6	G	514	IPA	1	0
4	G	505	NAG	1	0
4	G	512	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 [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	G	335/359 (93%)	-0.34	6 (1%) 67 62	19, 37, 90, 146	0
2	H	224/224 (100%)	-0.32	4 (1%) 67 62	19, 45, 80, 191	0
3	L	208/210 (99%)	-0.40	2 (0%) 79 75	24, 40, 72, 131	0
All	All	767/793 (96%)	-0.35	12 (1%) 70 65	19, 40, 81, 191	0

The worst 5 of 12 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	H	131	THR	5.5
1	G	324	GLY	4.0
2	H	128	SER	3.3
1	G	44	VAL	3.3
2	H	130	SER	3.3

### 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
4	NAG	G	512	14/15	0.55	0.17	113,136,148,153	0
4	NAG	G	501	14/15	0.56	0.17	75,124,150,153	0
4	NAG	G	510	14/15	0.59	0.16	64,93,108,114	0
4	NAG	G	503	14/15	0.65	0.13	77,96,105,107	0
4	NAG	G	505	14/15	0.70	0.19	96,105,124,127	0
4	NAG	G	511	14/15	0.74	0.12	56,73,80,81	0
4	NAG	G	507	14/15	0.78	0.12	50,64,71,72	0
4	NAG	G	508	14/15	0.84	0.10	49,71,76,79	0
6	IPA	G	514	4/4	0.84	0.15	22,32,33,35	0
5	EPE	H	501	15/15	0.88	0.13	78,85,92,94	0
4	NAG	G	502	14/15	0.88	0.09	34,53,70,79	0
7	NA	G	515	1/1	0.92	0.15	42,42,42,42	0
4	NAG	G	509	14/15	0.93	0.07	17,36,44,51	0
4	NAG	G	506	14/15	0.94	0.07	27,43,50,52	0
7	NA	G	516	1/1	0.95	0.07	54,54,54,54	0
4	NAG	G	504	14/15	0.96	0.05	20,32,57,59	0
7	NA	L	601	1/1	0.96	0.09	39,39,39,39	0
5	EPE	G	513	15/15	0.97	0.07	22,35,49,55	0

## 6.5 Other polymers

There are no such residues in this entry.