Full wwPDB X-ray Structure Validation Report (i)

Oct 13, 2024 – 09:10 am BST

PDB ID	:	2YQ2
Title	:	Structure of BVDV1 envelope glycoprotein E2, pH8
Authors	:	El Omari, K.; Iourin, O.; Harlos, K.; Grimes, J.M.; Stuart, D.I.
Deposited on	:	2012-11-04
Resolution	:	2.58 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 (i) 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 (1)) were used in the production of this report:

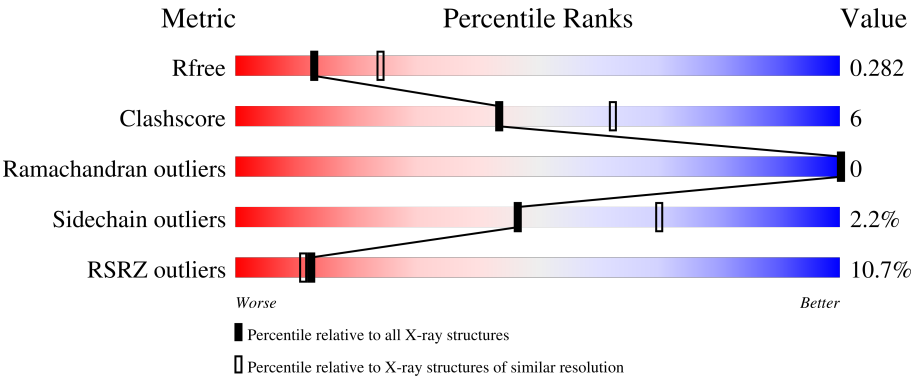
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.39

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.58 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	4456 (2.60-2.56)
Clashscore	180529	4905 (2.60-2.56)
Ramachandran outliers	177936	4847 (2.60-2.56)
Sidechain outliers	177891	4847 (2.60-2.56)
RSRZ outliers	164620	4456 (2.60-2.56)

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 >=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 <=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	337	9% 86% 12%
1	B	337	12% 83% 15%

2 Entry composition

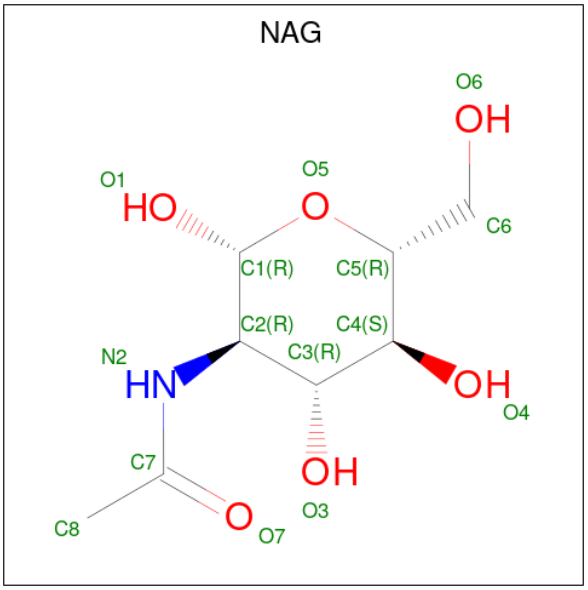
There are 3 unique types of molecules in this entry. The entry contains 5380 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 BVDV1 E2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	332	Total	C	N	O	S	0	0	0
			2631	1669	441	496	25			
1	B	330	Total	C	N	O	S	0	0	0
			2617	1660	439	493	25			

- 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
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	B	1	Total	C	N	O	0	0
			14	8	1	5		

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

- Molecule 3 is water.

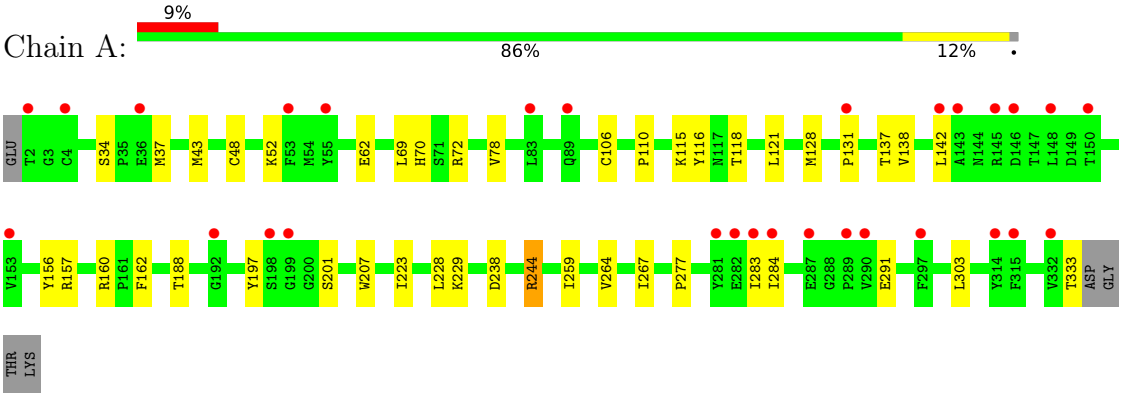
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	25	Total O 25 25	0	0
3	B	23	Total O 23 23	0	0

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.

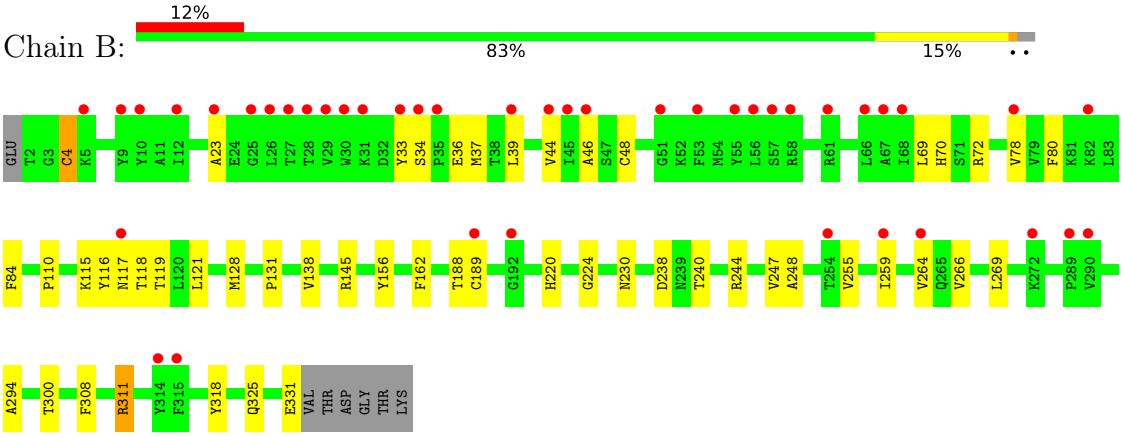
- Molecule 1: BVDV1 E2

Chain A:



- Molecule 1: BVDV1 E2

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	132.18Å 47.59Å 159.29Å 90.00° 108.15° 90.00°	Depositor
Resolution (Å)	38.08 – 2.58 38.08 – 2.58	Depositor EDS
% Data completeness (in resolution range)	98.8 (38.08-2.58) 98.8 (38.08-2.58)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.69 (at 2.58Å)	Xtriage
Refinement program	BUSTER 2.11.2	Depositor
R, R_{free}	0.240 , 0.253 0.258 , 0.282	Depositor DCC
R_{free} test set	1506 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å^2)	56.6	Xtriage
Anisotropy	0.292	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.28 , 41.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	5380	wwPDB-VP
Average B, all atoms (Å^2)	78.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.45% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

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	0.41	0/2693	0.68	0/3646
1	B	0.40	0/2679	0.65	0/3626
All	All	0.40	0/5372	0.66	0/7272

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	117	ASN	Sidechain

5.2 Too-close contacts

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	2631	0	2567	30	0
1	B	2617	0	2550	35	0
2	A	42	0	39	0	0
2	B	42	0	39	0	0
3	A	25	0	0	0	0
3	B	23	0	0	0	0
All	All	5380	0	5195	63	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.

All (63) 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:B:308:PHE:H	1:B:325:GLN:HE22	1.05	0.96
1:B:44:VAL:CG2	1:B:84:PHE:HE2	1.96	0.78
1:B:23:ALA:HB2	1:B:78:VAL:HG21	1.65	0.78
1:B:34:SER:HB2	1:B:37:MET:HB3	1.70	0.74
1:B:44:VAL:HG21	1:B:84:PHE:HE2	1.53	0.73
1:B:247:VAL:HG12	1:B:266:VAL:HG11	1.71	0.73
1:A:118:THR:HG22	1:A:188:THR:HB	1.73	0.70
1:B:308:PHE:N	1:B:325:GLN:HE22	1.88	0.63
1:A:197:TYR:HE1	1:A:228:LEU:HD21	1.64	0.63
1:A:43:MET:HE1	1:A:62:GLU:H	1.64	0.62
1:B:247:VAL:HG12	1:B:266:VAL:CG1	2.31	0.60
1:B:44:VAL:CG2	1:B:84:PHE:CE2	2.80	0.60
1:B:131:PRO:O	1:B:162:PHE:HB2	2.03	0.59
1:B:116:TYR:CE2	1:B:118:THR:HG23	2.38	0.59
1:A:131:PRO:O	1:A:162:PHE:HB2	2.03	0.59
1:A:197:TYR:CE1	1:A:228:LEU:HD21	2.38	0.58
1:A:207:TRP:HH2	1:A:244:ARG:HD3	1.68	0.57
1:B:36:GLU:HA	1:B:48:CYS:O	2.05	0.57
1:B:39:LEU:HB2	1:B:46:ALA:HB3	1.87	0.57
1:A:116:TYR:CE2	1:A:118:THR:HG23	2.41	0.56
1:A:137:THR:HG22	1:A:157:ARG:HG2	1.91	0.52
1:A:106:CYS:HB2	1:A:142:LEU:HD11	1.92	0.52
1:B:44:VAL:HG21	1:B:84:PHE:CE2	2.41	0.51
1:A:43:MET:CE	1:A:62:GLU:H	2.23	0.51
1:A:259:ILE:HD12	1:A:264:VAL:HG21	1.92	0.51
1:B:259:ILE:HD12	1:B:264:VAL:HG21	1.93	0.51
1:A:118:THR:HG22	1:A:188:THR:CB	2.41	0.50
1:A:115:LYS:HB3	1:A:116:TYR:HD1	1.77	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:201:SER:HB3	1:A:229:LYS:HE2	1.94	0.49
1:B:110:PRO:HG2	1:B:121:LEU:HD22	1.95	0.49
1:B:118:THR:HG22	1:B:188:THR:HB	1.95	0.48
1:A:283:ILE:HA	1:B:300:THR:HG22	1.95	0.48
1:A:110:PRO:HG2	1:A:121:LEU:HD22	1.95	0.48
1:A:207:TRP:CH2	1:A:244:ARG:HD3	2.47	0.48
1:B:308:PHE:H	1:B:325:GLN:NE2	1.90	0.47
1:B:138:VAL:HB	1:B:156:TYR:HB2	1.97	0.47
1:A:106:CYS:CB	1:A:142:LEU:HD11	2.45	0.47
1:A:284:ILE:HD11	1:A:291:GLU:HB2	1.96	0.46
1:A:128:MET:HB3	1:A:131:PRO:HG3	1.98	0.46
1:B:224:GLY:H	1:B:238:ASP:HB2	1.81	0.46
1:B:116:TYR:CE2	1:B:118:THR:CG2	2.98	0.45
1:A:138:VAL:HB	1:A:156:TYR:HB2	1.98	0.45
1:A:303:LEU:HG	1:B:255:VAL:HG21	1.98	0.45
1:B:128:MET:HB3	1:B:131:PRO:HG3	1.99	0.45
1:A:223:ILE:HA	1:A:238:ASP:OD2	2.16	0.45
1:B:115:LYS:HB3	1:B:116:TYR:HD1	1.81	0.45
1:B:311:ARG:HG3	1:B:318:TYR:CZ	2.51	0.45
1:A:70:HIS:CD2	1:A:72:ARG:H	2.35	0.45
1:B:70:HIS:CD2	1:B:72:ARG:H	2.35	0.44
1:B:4:CYS:HB2	1:B:33:TYR:CE1	2.53	0.44
1:A:70:HIS:HD2	1:A:72:ARG:H	1.66	0.43
1:A:116:TYR:CE2	1:A:118:THR:CG2	3.02	0.43
1:B:23:ALA:HB1	1:B:80:PHE:HZ	1.84	0.43
1:A:244:ARG:HB3	1:A:277:PRO:HB3	2.01	0.43
1:B:220:HIS:CE1	1:B:240:THR:HG21	2.53	0.43
1:A:34:SER:HB2	1:A:37:MET:HB3	2.01	0.42
1:A:131:PRO:O	1:A:162:PHE:CB	2.67	0.42
1:B:70:HIS:HD2	1:B:72:ARG:H	1.66	0.42
1:B:131:PRO:O	1:B:162:PHE:CB	2.67	0.42
1:B:294:ALA:H	1:B:331:GLU:HB2	1.84	0.42
1:B:69:LEU:HB2	1:B:78:VAL:HG12	2.02	0.41
1:B:248:ALA:HB2	1:B:269:LEU:HD11	2.01	0.41
1:A:69:LEU:HB2	1:A:78:VAL:HG12	2.02	0.41

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	330/337 (98%)	318 (96%)	12 (4%)	0	100	100
1	B	328/337 (97%)	321 (98%)	7 (2%)	0	100	100
All	All	658/674 (98%)	639 (97%)	19 (3%)	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	290/294 (99%)	284 (98%)	6 (2%)	48	71
1	B	288/294 (98%)	281 (98%)	7 (2%)	44	68
All	All	578/588 (98%)	565 (98%)	13 (2%)	47	70

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	48	CYS
1	A	52	LYS
1	A	160	ARG
1	A	244	ARG
1	A	267	ILE
1	A	333	THR
1	B	4	CYS
1	B	119	THR

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Mol	Chain	Res	Type
1	B	145	ARG
1	B	189	CYS
1	B	230	ASN
1	B	244	ARG
1	B	311	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	87	GLN
1	A	122	ASN
1	B	325	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 oligosaccharides in this entry.

5.6 Ligand geometry (i)

6 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	B	1000	1	14,14,15	0.29	0	17,19,21	0.58	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
2	NAG	A	1002	1	14,14,15	0.28	0	17,19,21	0.73	1 (5%)
2	NAG	A	1000	1	14,14,15	0.28	0	17,19,21	0.79	0
2	NAG	A	1001	1	14,14,15	0.33	0	17,19,21	0.74	1 (5%)
2	NAG	B	1001	1	14,14,15	0.27	0	17,19,21	0.49	0
2	NAG	B	1002	1	14,14,15	0.44	0	17,19,21	1.63	2 (11%)

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	B	1000	1	-	0/6/23/26	0/1/1/1
2	NAG	A	1002	1	-	0/6/23/26	0/1/1/1
2	NAG	A	1000	1	-	0/6/23/26	0/1/1/1
2	NAG	A	1001	1	-	0/6/23/26	0/1/1/1
2	NAG	B	1001	1	-	0/6/23/26	0/1/1/1
2	NAG	B	1002	1	-	3/6/23/26	0/1/1/1

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	1002	NAG	C1-O5-C5	6.03	120.36	112.19
2	B	1002	NAG	C1-C2-N2	2.34	114.48	110.49
2	A	1002	NAG	C1-O5-C5	2.29	115.29	112.19
2	A	1001	NAG	O5-C1-C2	2.15	114.69	111.29

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	1002	NAG	C8-C7-N2-C2
2	B	1002	NAG	C4-C5-C6-O6
2	B	1002	NAG	O5-C5-C6-O6

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

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^{th} 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^2)	Q<0.9
1	A	332/337 (98%)	0.74	29 (8%) 17 15	42, 74, 115, 152	0
1	B	330/337 (97%)	0.84	42 (12%) 9 8	37, 76, 120, 147	0
All	All	662/674 (98%)	0.79	71 (10%) 12 11	37, 75, 117, 152	0

All (71) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	315	PHE	4.3
1	B	29	VAL	4.2
1	A	283	ILE	3.7
1	B	46	ALA	3.7
1	A	198	SER	3.5
1	A	145	ARG	3.4
1	A	192	GLY	3.3
1	B	51	GLY	3.2
1	A	199	GLY	3.1
1	B	53	PHE	3.1
1	B	57	SER	3.1
1	B	290	VAL	3.1
1	B	12	ILE	3.1
1	B	192	GLY	3.0
1	B	26	LEU	3.0
1	B	189	CYS	2.9
1	A	142	LEU	2.9
1	A	284	ILE	2.8
1	A	314	TYR	2.8
1	A	55	TYR	2.8
1	A	332	VAL	2.8
1	A	289	PRO	2.8
1	B	44	VAL	2.8
1	B	66	LEU	2.7

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Mol	Chain	Res	Type	RSRZ
1	B	68	ILE	2.7
1	A	89	GLN	2.7
1	B	55	TYR	2.7
1	B	67	ALA	2.7
1	B	45	ILE	2.6
1	A	150	THR	2.6
1	B	56	LEU	2.5
1	B	28	THR	2.5
1	A	148	LEU	2.5
1	B	315	PHE	2.5
1	A	143	ALA	2.5
1	A	287	GLU	2.5
1	B	27	THR	2.5
1	A	297	PHE	2.5
1	A	36	GLU	2.5
1	A	146	ASP	2.5
1	B	39	LEU	2.4
1	B	23	ALA	2.4
1	B	25	GLY	2.4
1	B	61	ARG	2.4
1	B	117	ASN	2.3
1	B	314	TYR	2.3
1	B	35	PRO	2.3
1	A	153	VAL	2.3
1	B	10	TYR	2.3
1	B	264	VAL	2.3
1	B	289	PRO	2.3
1	B	33	TYR	2.3
1	A	290	VAL	2.2
1	A	83	LEU	2.2
1	B	5	LYS	2.2
1	B	9	TYR	2.2
1	B	31	LYS	2.2
1	B	272	LYS	2.2
1	A	2	THR	2.2
1	A	131	PRO	2.2
1	B	78	VAL	2.2
1	A	4	CYS	2.1
1	A	53	PHE	2.1
1	A	282	GLU	2.1
1	A	281	TYR	2.1
1	B	34	SER	2.1

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Mol	Chain	Res	Type	RSRZ
1	B	82	LYS	2.1
1	B	58	ARG	2.1
1	B	254	THR	2.0
1	B	30	TRP	2.0
1	B	259	ILE	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^{th} 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^2)	Q<0.9
2	NAG	A	1001	14/15	0.18	0.18	101,103,104,104	0
2	NAG	A	1002	14/15	0.69	0.12	110,110,111,112	0
2	NAG	B	1000	14/15	0.81	0.15	66,68,69,69	0
2	NAG	B	1001	14/15	0.87	0.11	56,60,61,61	0
2	NAG	B	1002	14/15	0.87	0.14	64,65,66,67	0
2	NAG	A	1000	14/15	0.91	0.09	46,50,53,54	0

6.5 Other polymers (i)

There are no such residues in this entry.