



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 04:42 PM UTC

PDB ID : 3WH7 / pdb_00003wh7
Title : Crystal structure of GH1 beta-glucosidase Td2F2 L-fucose complex
Authors : Jo, T.; Fushinobu, S.; Uchiyama, T.; Yaoi, K.
Deposited on : 2013-08-21
Resolution : 1.10 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 ⓘ 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	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

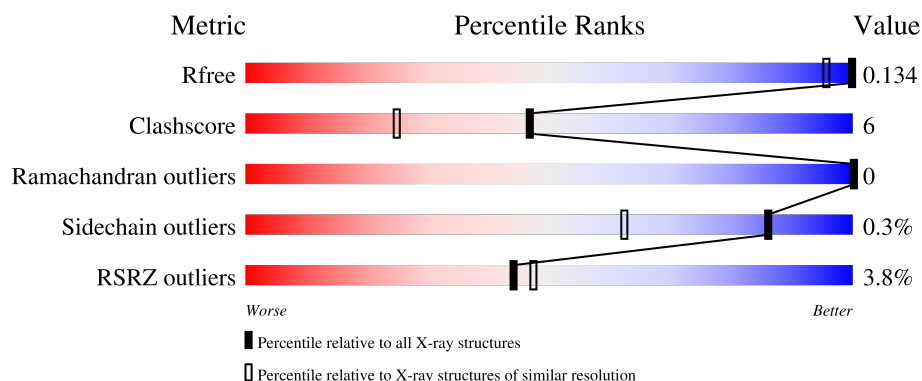
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.10 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}	180053	1625 (1.12-1.08)
Clashscore	190562	1656 (1.12-1.08)
Ramachandran outliers	187476	1616 (1.12-1.08)
Sidechain outliers	187428	1612 (1.12-1.08)
RSRZ outliers	180081	1625 (1.12-1.08)

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 $\leq 5\%$. 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	457	4% 84% 12% ..

2 Entry composition [i](#)

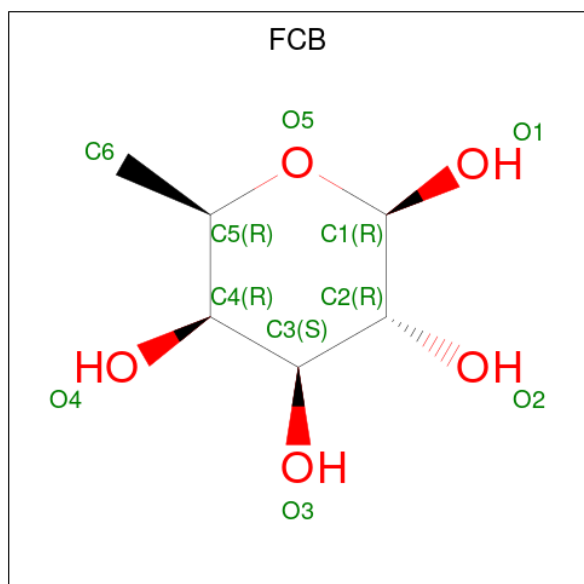
There are 5 unique types of molecules in this entry. The entry contains 4251 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 beta-glucosidase.

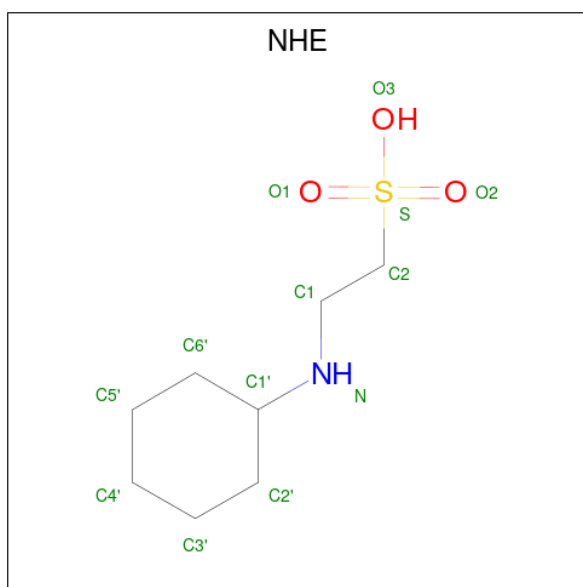
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	443	3577	2284	616	662	15	0	18	0

- Molecule 2 is beta-D-fucopyranose (CCD ID: FCB) (formula: C₆H₁₂O₅).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	11	6	5	0	0

- Molecule 3 is 2-[N-CYCLOHEXYLAMINO]ETHANE SULFONIC ACID (CCD ID: NHE) (formula: C₈H₁₇NO₃S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	0	0
			13	8	1	3	1		

- Molecule 4 is SODIUM ION (CCD ID: NA) (formula: Na).

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

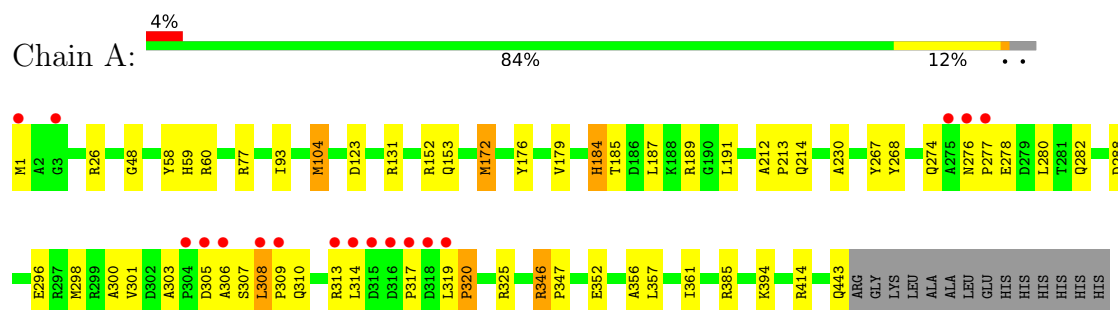
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	649	Total	O	0	0
			649	649		

3 Residue-property plots

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: beta-glucosidase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	69.05Å 69.69Å 96.21Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	24.05 – 1.10 24.05 – 1.10	Depositor EDS
% Data completeness (in resolution range)	98.4 (24.05-1.10) 98.4 (24.05-1.10)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.24 (at 1.10Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.113 , 0.134 0.114 , 0.134	Depositor DCC
R_{free} test set	9307 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å ²)	7.8	Xtriage
Anisotropy	0.039	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 45.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.007 for k,h,-l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	4251	wwPDB-VP
Average B, all atoms (Å ²)	11.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.30% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: NA, FCB, NHE

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	1.32	24/3713 (0.6%)	1.15	17/5069 (0.3%)

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	A	0	5

All (24) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	104	MET	SD-CE	-17.41	1.36	1.79
1	A	346	ARG	CZ-NH1	11.08	1.48	1.32
1	A	319	LEU	C-N	-9.71	1.21	1.33
1	A	320	PRO	N-CA	-9.14	1.36	1.47
1	A	1	MET	SD-CE	-8.66	1.57	1.79
1	A	319	LEU	C-O	7.87	1.34	1.24
1	A	26	ARG	CZ-NH1	7.13	1.42	1.32
1	A	131	ARG	CZ-NH1	6.43	1.41	1.32
1	A	152	ARG	CD-NE	-6.43	1.37	1.46
1	A	179	VAL	CB-CG2	-6.38	1.31	1.52
1	A	303	ALA	C-O	6.35	1.31	1.24
1	A	443	GLN	CD-OE1	-6.19	1.11	1.23
1	A	93	ILE	CA-CB	-6.10	1.46	1.54
1	A	59	HIS	CD2-NE2	5.98	1.44	1.37
1	A	303	ALA	C-N	5.78	1.40	1.33
1	A	172	MET	SD-CE	-5.61	1.65	1.79
1	A	361	ILE	CB-CG1	5.59	1.64	1.53
1	A	314	LEU	C-O	5.55	1.30	1.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	280	LEU	CA-C	-5.53	1.45	1.52
1	A	131	ARG	CA-CB	5.41	1.60	1.53
1	A	319	LEU	N-CA	-5.40	1.38	1.45
1	A	153	GLN	CA-CB	-5.24	1.45	1.53
1	A	179	VAL	CA-CB	-5.08	1.48	1.54
1	A	313	ARG	CZ-NH2	5.02	1.40	1.33

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	346	ARG	NE-CZ-NH2	-15.25	105.48	119.20
1	A	131	ARG	NE-CZ-NH1	9.75	131.25	121.50
1	A	131	ARG	NE-CZ-NH2	-9.55	110.60	119.20
1	A	346	ARG	NE-CZ-NH1	8.14	129.64	121.50
1	A	319	LEU	CA-C-N	-8.00	112.11	120.03
1	A	319	LEU	C-N-CA	-8.00	112.11	120.03
1	A	184	HIS	CB-CG-CD2	-6.45	122.81	131.20
1	A	189	ARG	NE-CZ-NH1	-6.42	115.08	121.50
1	A	319	LEU	N-CA-C	-6.37	101.50	110.29
1	A	131	ARG	CD-NE-CZ	6.33	133.26	124.40
1	A	385	ARG	NE-CZ-NH2	6.12	124.71	119.20
1	A	385	ARG	CD-NE-CZ	5.67	132.34	124.40
1	A	313	ARG	NE-CZ-NH2	5.42	124.07	119.20
1	A	123	ASP	CA-CB-CG	5.22	117.82	112.60
1	A	26	ARG	NE-CZ-NH2	-5.18	114.53	119.20
1	A	213	PRO	N-CA-CB	5.18	108.12	103.20
1	A	443	GLN	CG-CD-NE2	5.08	124.02	116.40

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	184	HIS	Sidechain
1	A	274	GLN	Peptide
1	A	305	ASP	Mainchain
1	A	346	ARG	Sidechain
1	A	77	ARG	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	3577	0	3422	40	0
2	A	11	0	12	1	0
3	A	13	0	16	0	0
4	A	1	0	0	0	0
5	A	649	0	0	12	0
All	All	4251	0	3450	40	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 (40) 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:278[B]:GLU:HG3	5:A:1038:HOH:O	1.44	1.14
1:A:267:TYR:CE2	1:A:308[A]:LEU:HG	1.98	0.98
1:A:317:PRO:HB3	5:A:1193:HOH:O	1.72	0.89
1:A:268:TYR:CD1	1:A:308[A]:LEU:HD21	2.23	0.74
1:A:277[B]:PRO:O	1:A:278[B]:GLU:CB	2.29	0.72
1:A:276[A]:ASN:HB2	1:A:277[A]:PRO:HD2	1.75	0.68
1:A:306[A]:ALA:O	1:A:310:GLN:NE2	2.23	0.68
1:A:394:LYS:HE3	5:A:1202:HOH:O	1.93	0.68
1:A:48:GLY:HA2	5:A:895:HOH:O	1.96	0.66
1:A:267:TYR:HE2	1:A:308[A]:LEU:HG	1.55	0.64
1:A:104:MET:HE1	5:A:1156:HOH:O	1.97	0.64
1:A:276[A]:ASN:HB2	1:A:277[A]:PRO:CD	2.28	0.63
1:A:268:TYR:CE1	1:A:308[A]:LEU:HD21	2.35	0.62
1:A:320:PRO:HG3	5:A:901:HOH:O	2.04	0.57
1:A:277[B]:PRO:O	1:A:278[B]:GLU:HB2	2.07	0.54
1:A:187:LEU:CD2	1:A:308[A]:LEU:HD22	2.40	0.52
1:A:172:MET:HE1	1:A:191:LEU:HD23	1.92	0.51
1:A:296[B]:GLU:HG3	1:A:325:ARG:HD3	1.91	0.51
1:A:307[A]:SER:HB2	5:A:1031:HOH:O	2.10	0.51
1:A:357:LEU:HD22	5:A:761:HOH:O	2.09	0.51
1:A:267:TYR:CZ	1:A:308[A]:LEU:HG	2.42	0.50
1:A:268:TYR:HD1	1:A:308[A]:LEU:HD21	1.73	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:277[B]:PRO:O	1:A:278[B]:GLU:HB3	2.11	0.48
1:A:282[B]:GLN:CG	5:A:1038:HOH:O	2.62	0.47
1:A:282[B]:GLN:HG3	5:A:1038:HOH:O	2.15	0.46
1:A:267:TYR:OH	1:A:308[A]:LEU:HA	2.17	0.45
1:A:268:TYR:CE1	1:A:308[A]:LEU:CD2	3.00	0.45
1:A:172:MET:HE1	1:A:191:LEU:CD2	2.48	0.44
1:A:58:TYR:HB3	5:A:988:HOH:O	2.18	0.44
1:A:352:GLU:OE1	2:A:501:FCB:H1	2.18	0.43
1:A:288:ASP:O	1:A:347:PRO:HD2	2.20	0.42
1:A:212:ALA:HB1	1:A:214:GLN:O	2.19	0.41
1:A:356:ALA:HA	1:A:414:ARG:O	2.21	0.41
1:A:230:ALA:CB	1:A:301:VAL:HG22	2.50	0.41
1:A:176:TYR:O	1:A:185:THR:HA	2.21	0.41
1:A:308[A]:LEU:HA	1:A:309[A]:PRO:HA	1.94	0.41
1:A:308[B]:LEU:C	1:A:308[B]:LEU:HD23	2.45	0.41
1:A:187:LEU:HD21	1:A:308[A]:LEU:HD22	2.03	0.41
1:A:60:ARG:NH1	5:A:729:HOH:O	2.54	0.40
1:A:298[B]:MET:SD	1:A:300:ALA:HB2	2.61	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	459/457 (100%)	443 (96%)	16 (4%)	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	361/356 (101%)	359 (99%)	2 (1%)	78	49

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	308[A]	LEU
1	A	308[B]	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	94	ASN
1	A	217	GLN
1	A	312	GLN
1	A	353	ASN
1	A	371	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](#)

Of 3 ligands modelled in this entry, 1 is monoatomic - leaving 2 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
3	NHE	A	502	-	13,13,13	1.53	3 (23%)	16,17,17	1.89	4 (25%)
2	FCB	A	501	-	11,11,11	1.35	2 (18%)	16,16,16	3.15	7 (43%)

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 Torsions and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	NHE	A	502	-	-	1/7/15/15	0/1/1/1
2	FCB	A	501	-	-	-	0/1/1/1

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	502	NHE	C4'-C5'	-3.01	1.40	1.51
3	A	502	NHE	C2-S	-2.92	1.73	1.77
3	A	502	NHE	C1-N	2.80	1.52	1.47
2	A	501	FCB	O1-C1	2.70	1.48	1.39
2	A	501	FCB	C1-C2	2.16	1.57	1.52

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	501	FCB	O1-C1-O5	-6.07	92.37	110.41
2	A	501	FCB	O5-C5-C4	-5.69	99.31	109.55
2	A	501	FCB	O2-C2-C1	5.23	121.31	109.25
3	A	502	NHE	C4'-C5'-C6'	4.13	119.91	111.42
2	A	501	FCB	O4-C4-C5	-4.05	100.80	109.74
2	A	501	FCB	O5-C1-C2	3.77	116.92	110.30
3	A	502	NHE	C6'-C1'-C2'	3.72	117.23	110.80
2	A	501	FCB	C6-C5-C4	3.71	119.87	113.08
2	A	501	FCB	C3-C4-C5	2.97	114.33	109.81
3	A	502	NHE	C5'-C4'-C3'	2.88	119.75	111.19
3	A	502	NHE	C2'-C1'-N	2.01	120.58	110.56

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	502	NHE	C2'-C1'-N-C1

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	501	FCB	1	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, 95th 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	443/457 (96%)	-0.22	17 (3%)	44 47	4, 8, 17, 46	18 (4%)

All (17) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	275[A]	ALA	5.4
1	A	277[A]	PRO	5.2
1	A	308[A]	LEU	4.2
1	A	316	ASP	4.0
1	A	317	PRO	3.9
1	A	304	PRO	3.8
1	A	315	ASP	3.6
1	A	1	MET	3.2
1	A	306[A]	ALA	3.0
1	A	314	LEU	3.0
1	A	319	LEU	2.8
1	A	313	ARG	2.8
1	A	276[A]	ASN	2.7
1	A	3	GLY	2.6
1	A	318	ASP	2.5
1	A	305	ASP	2.3
1	A	309[A]	PRO	2.3

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 oligosaccharides 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, 95th 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
2	FCB	A	501	11/11	0.95	0.11	5,9,20,38	0
3	NHE	A	502	13/13	0.99	0.05	6,7,14,15	0
4	NA	A	503	1/1	1.00	0.10	12,12,12,12	0

6.5 Other polymers [i](#)

There are no such residues in this entry.