



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 07:23 AM UTC

PDB ID : 6Z14 / pdb_00006z14
Title : Structure of Bifidobacterium bifidum GH20 beta-N-beta-N-acetylhexosaminidase E553Q variant in complex with 4MU-6SGlcNAc-derived oxazoline
Authors : He, Y.; Jin, Y.; Rizkallah, P.; Chen, P.
Deposited on : 2020-05-12
Resolution : 1.67 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
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
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

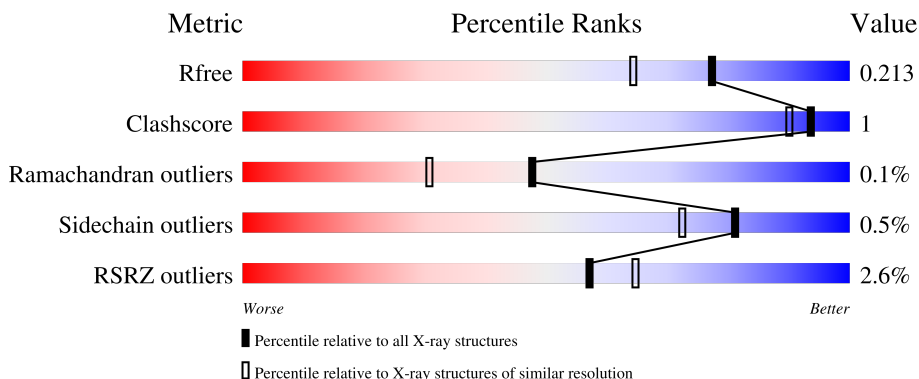
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

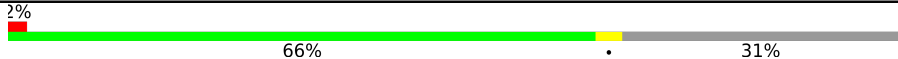
The reported resolution of this entry is 1.67 Å.

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	1054 (1.68-1.68)
Clashscore	190562	1078 (1.68-1.68)
Ramachandran outliers	187476	1068 (1.68-1.68)
Sidechain outliers	187428	1067 (1.68-1.68)
RSRZ outliers	180081	1055 (1.68-1.68)

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	JJJ	1010	

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 5979 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-N-acetylhexosaminidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	JJJ	694	Total	C	N	O	S	0	3	0
			5281	3292	901	1066	22			

There are 10 discrepancies between the modelled and reference sequences:

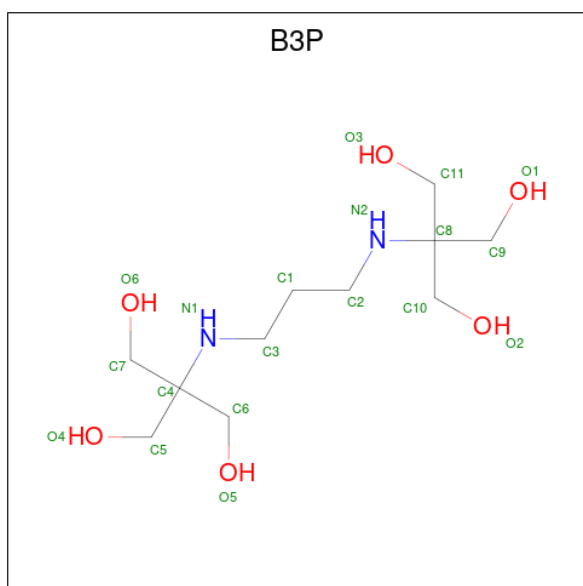
Chain	Residue	Modelled	Actual	Comment	Reference
JJJ	30	MET	-	initiating methionine	UNP D4QAP5
JJJ	553	GLN	GLU	engineered mutation	UNP D4QAP5
JJJ	1032	LEU	-	expression tag	UNP D4QAP5
JJJ	1033	GLU	-	expression tag	UNP D4QAP5
JJJ	1034	HIS	-	expression tag	UNP D4QAP5
JJJ	1035	HIS	-	expression tag	UNP D4QAP5
JJJ	1036	HIS	-	expression tag	UNP D4QAP5
JJJ	1037	HIS	-	expression tag	UNP D4QAP5
JJJ	1038	HIS	-	expression tag	UNP D4QAP5
JJJ	1039	HIS	-	expression tag	UNP D4QAP5

- Molecule 2 is NITRATE ION (CCD ID: NO3) (formula: NO₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	JJJ	1	Total	N	O	0	0
			4	1	3		

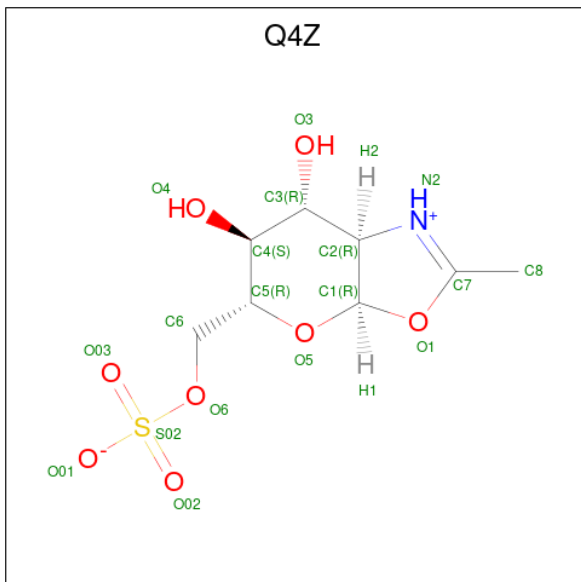
- Molecule 3 is 2-[3-(2-HYDROXY-1,1-DIHYDROXYMETHYL-ETHYLAMINO)-PROPYLAMINO]-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (CCD ID: B3P) (formula: $C_{11}H_{26}N_2O_6$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	JJJ	1	Total	C	N	O	
			19	11	2	6	

- Molecule 4 is [(3 {a} {R}),5 {R},6 {S},7 {R},7 {a} {R})-2-methyl-6,7-bis(oxidanyl)-5,6,7

,7 {a}-tetrahydro-3 {a} {H}-pyrano[3,2-d][1,3]oxazol-1-ium-5-yl)methyl sulfate (CCD ID: Q4Z) (formula: C₈H₁₃NO₈S) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	JJJ	1	Total	C	N	O	S	0	0
			18	8	1	8	1		

- Molecule 5 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	JJJ	2	Total	Na	0	0
			2	2		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	JJJ	653	Total	O	0	2
			655	655		

- Molecule 1: Beta-N-acetylhexosaminidase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	54.42Å 124.88Å 151.68Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	64.82 – 1.67 64.82 – 1.67	Depositor EDS
% Data completeness (in resolution range)	99.9 (64.82-1.67) 99.9 (64.82-1.67)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.25 (at 1.67Å)	Xtriage
Refinement program	REFMAC 5.8.0258	Depositor
R, R_{free}	0.160 , 0.205 0.171 , 0.213	Depositor DCC
R_{free} test set	6031 reflections (4.85%)	wwPDB-VP
Wilson B-factor (Å ²)	22.1	Xtriage
Anisotropy	0.309	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 45.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.44$, $\langle L^2 \rangle = 0.27$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5979	wwPDB-VP
Average B, all atoms (Å ²)	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.61% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: NO3, B3P, Q4Z, 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	JJJ	1.02	0/5395	1.22	1/7351 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	JJJ	287	ASP	CA-CB-CG	5.71	118.31	112.60

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	JJJ	5281	0	5104	15	0
2	JJJ	4	0	0	0	0
3	JJJ	19	0	26	0	0
4	JJJ	18	0	0	0	0
5	JJJ	2	0	0	0	0
6	JJJ	655	0	0	1	0
All	All	5979	0	5130	15	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 1.

All (15) 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:JJJ:245:ARG:HD3	1:JJJ:255:LYS:O	2.01	0.60
1:JJJ:353:LEU:HD12	1:JJJ:382:HIS:CE1	2.38	0.58
1:JJJ:242:ASP:OD1	1:JJJ:245:ARG:NH2	2.37	0.58
1:JJJ:345:PRO:HB3	1:JJJ:711:TRP:CE3	2.39	0.57
1:JJJ:353:LEU:C	1:JJJ:353:LEU:HD23	2.30	0.57
1:JJJ:871:ILE:HG22	1:JJJ:881:THR:HG22	1.95	0.48
1:JJJ:357:ALA:HB1	1:JJJ:387:GLU:HB2	1.98	0.45
1:JJJ:294:SER:HB2	6:JJJ:1564:HOH:O	2.18	0.44
1:JJJ:560:ALA:H	1:JJJ:566:ARG:NH2	2.18	0.42
1:JJJ:388:ASP:HA	1:JJJ:469:PHE:HB3	2.02	0.41
1:JJJ:505:SER:HB2	1:JJJ:554:LEU:HB2	2.02	0.41
1:JJJ:238:LEU:N	1:JJJ:239:PRO:CD	2.83	0.41
1:JJJ:638:PHE:N	1:JJJ:639:PRO:CD	2.84	0.41
1:JJJ:203:PRO:HB2	1:JJJ:337:PRO:HG3	2.02	0.40
1:JJJ:601:GLY:HA2	1:JJJ:625:ASN:O	2.21	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	JJJ	695/1010 (69%)	684 (98%)	10 (1%)	1 (0%)	48 31

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	JJJ	489	ALA

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	JJJ	567/825 (69%)	564 (100%)	3 (0%)	81	72

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

Mol	Chain	Res	Type
1	JJJ	562	ASN
1	JJJ	600	GLU
1	JJJ	624	ARG

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

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 5 ligands modelled in this entry, 2 are monoatomic - leaving 3 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	B3P	JJJ	1102	-	18,18,18	0.38	0	23,23,23	0.56	0
2	NO3	JJJ	1101	-	1,3,3	0.23	0	0,3,3	-	-
4	Q4Z	JJJ	1103	-	18,19,19	1.04	2 (11%)	21,29,29	1.20	3 (14%)

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
3	B3P	JJJ	1102	-	-	6/28/28/28	-
4	Q4Z	JJJ	1103	-	-	0/6/34/34	0/2/2/2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	JJJ	1103	Q4Z	C7-N2	3.14	1.39	1.27
4	JJJ	1103	Q4Z	C1-C2	-2.29	1.48	1.52

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	JJJ	1103	Q4Z	C2-N2-C7	3.08	108.58	106.43
4	JJJ	1103	Q4Z	O01-S02-O02	2.28	116.52	108.56
4	JJJ	1103	Q4Z	C3-C2-N2	-2.12	107.60	110.56

There are no chirality outliers.

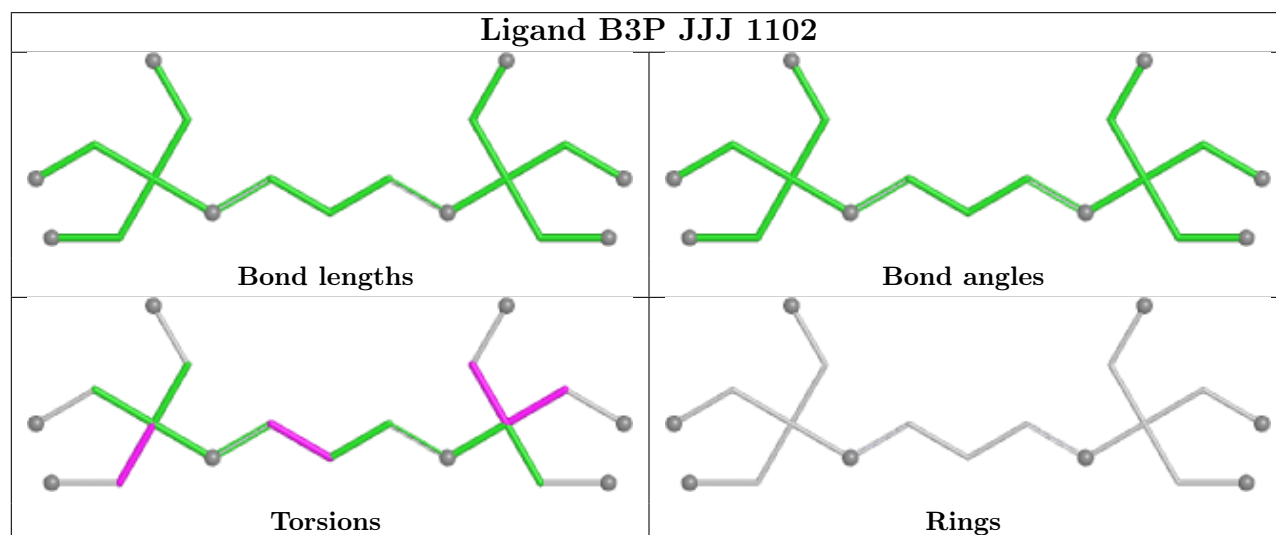
All (6) torsion outliers are listed below:

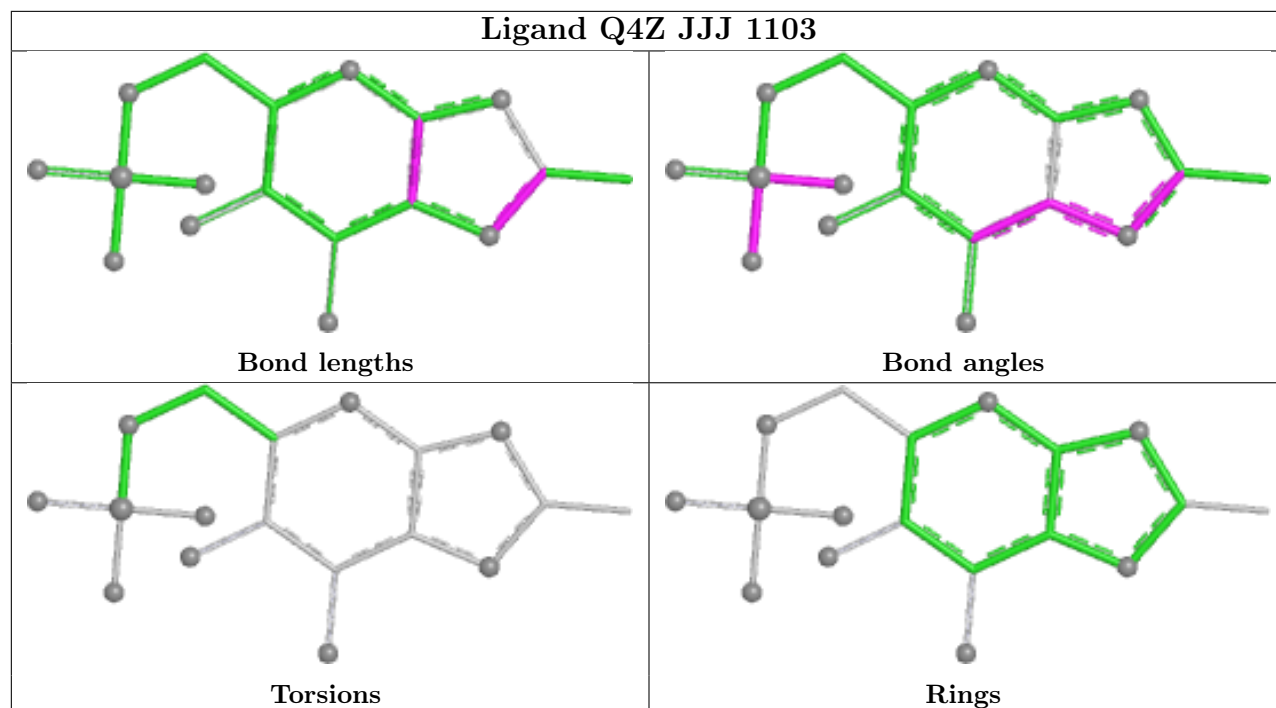
Mol	Chain	Res	Type	Atoms
3	JJJ	1102	B3P	O2-C10-C8-N2
3	JJJ	1102	B3P	O2-C10-C8-C9
3	JJJ	1102	B3P	O2-C10-C8-C11
3	JJJ	1102	B3P	C2-C1-C3-N1
3	JJJ	1102	B3P	N1-C4-C7-O6
3	JJJ	1102	B3P	O3-C11-C8-N2

There are no ring outliers.

No monomer is involved in short contacts.

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





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	JJJ	694/1010 (68%)	-0.04	18 (2%) 57 65	13, 26, 49, 95	6 (0%)

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	JJJ	558	GLY	9.9
1	JJJ	560	ALA	9.3
1	JJJ	557	SER	6.5
1	JJJ	196	ILE	5.6
1	JJJ	199	VAL	5.5
1	JJJ	198	ALA	4.8
1	JJJ	844	ALA	4.7
1	JJJ	559	GLY	4.0
1	JJJ	554	LEU	4.0
1	JJJ	200	ALA	3.1
1	JJJ	889	THR	3.0
1	JJJ	489	ALA	2.8
1	JJJ	556	LEU	2.8
1	JJJ	561	GLY	2.7
1	JJJ	845	ASP	2.6
1	JJJ	536	THR	2.2
1	JJJ	197	SER	2.2
1	JJJ	886	GLU	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](#)

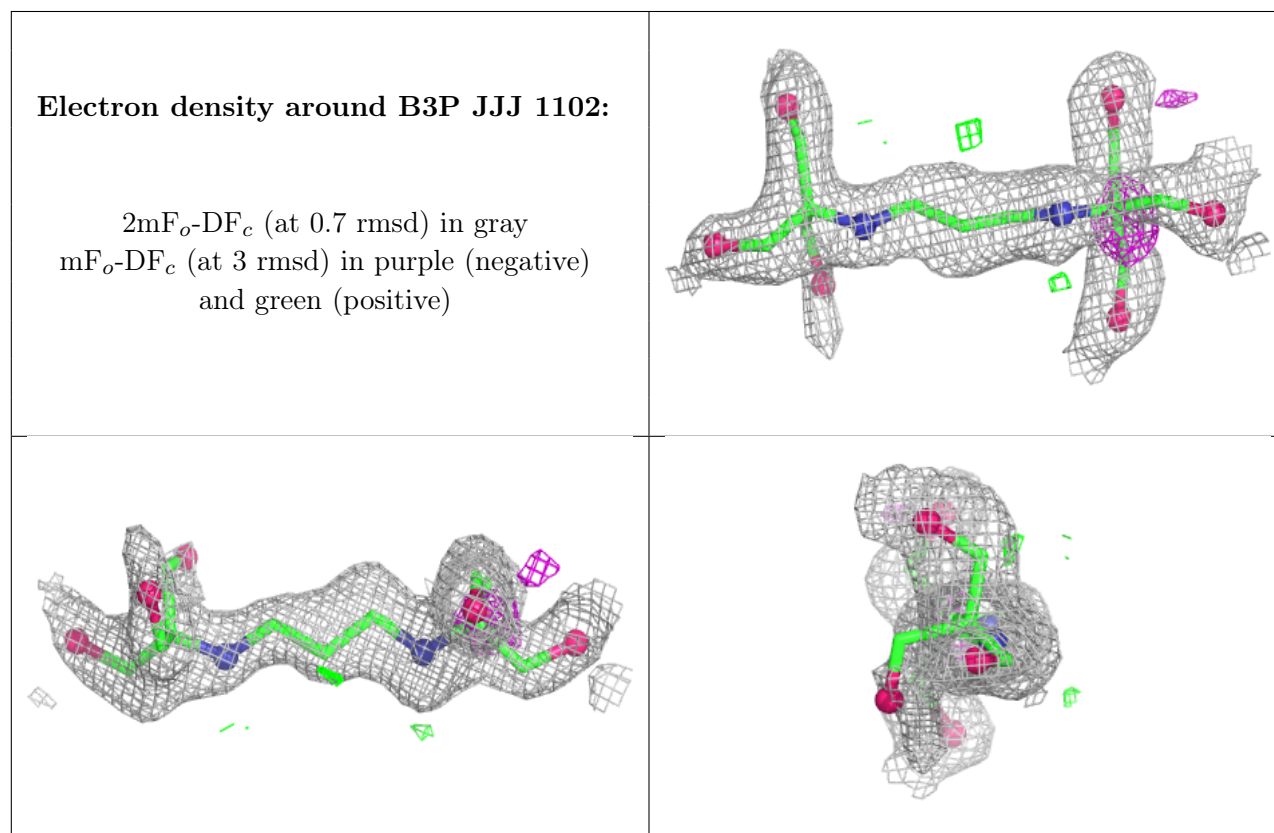
There are no oligosaccharides in this entry.

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.

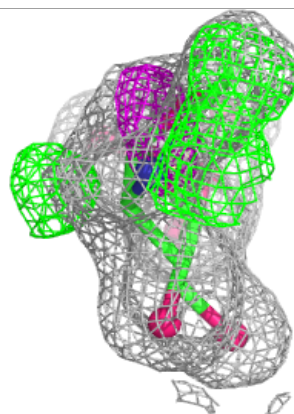
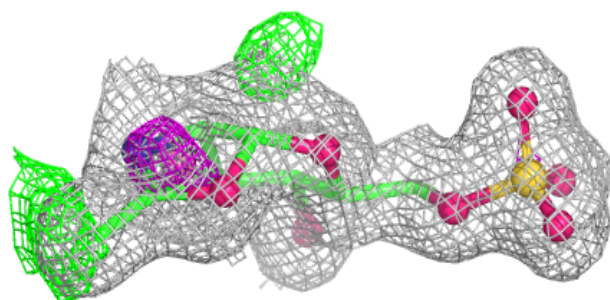
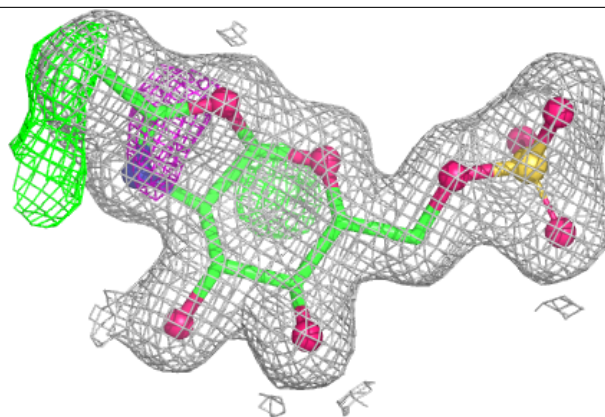
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	B3P	JJJ	1102	19/19	0.88	0.14	34,42,63,70	0
2	NO3	JJJ	1101	4/4	0.96	0.15	27,28,33,37	0
4	Q4Z	JJJ	1103	18/18	0.97	0.07	20,22,30,31	0
5	NA	JJJ	1104	1/1	0.99	0.04	30,30,30,30	0
5	NA	JJJ	1105	1/1	0.99	0.05	21,21,21,21	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.



Electron density around Q4Z JJJ 1103:

$2mF_o - DF_c$ (at 0.7 rmsd) in gray
 $mF_o - DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)



6.5 Other polymers [i](#)

There are no such residues in this entry.