



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 18, 2026 – 01:56 PM UTC

PDB ID : 3BMX / pdb_00003bmx
Title : Beta-N-hexosaminidase (YbbD) from Bacillus subtilis
Authors : Fischer, S.
Deposited on : 2007-12-13
Resolution : 1.40 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

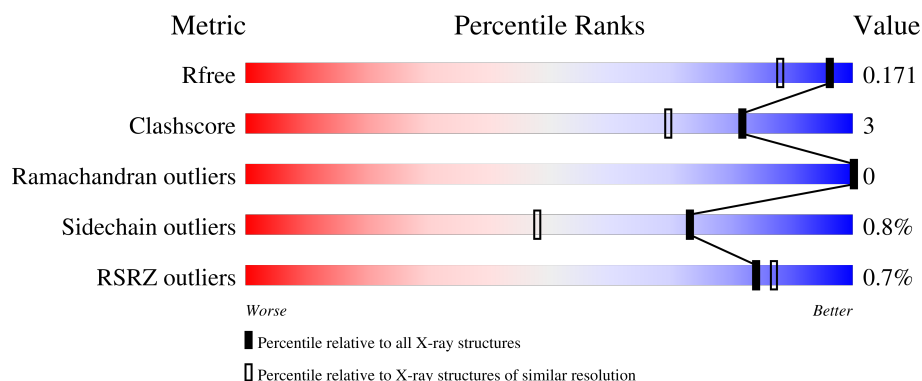
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

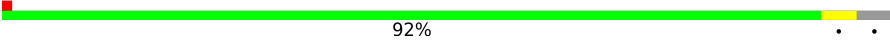
The reported resolution of this entry is 1.40 Å.

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	2563 (1.40-1.40)
Clashscore	190562	2660 (1.40-1.40)
Ramachandran outliers	187476	2611 (1.40-1.40)
Sidechain outliers	187428	2610 (1.40-1.40)
RSRZ outliers	180081	2561 (1.40-1.40)

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	642	 91%
1	B	642	 92%

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
2	ACT	A	643	-	-	X	-
2	ACT	B	646	-	-	X	-

2 Entry composition [i](#)

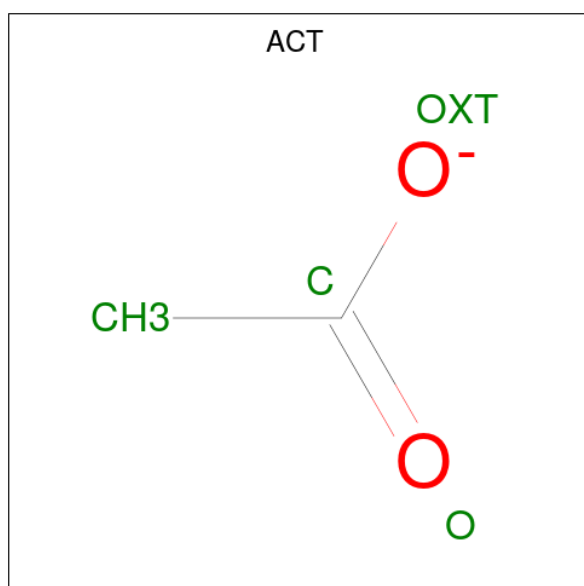
There are 5 unique types of molecules in this entry. The entry contains 11059 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Uncharacterized lipoprotein ybbD.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	617	Total	C	N	O	S	18	6	0
			4803	3041	836	906	20			
1	B	617	Total	C	N	O	S	27	6	0
			4803	3043	835	905	20			

- Molecule 2 is ACETATE ION (CCD ID: ACT) (formula: $C_2H_3O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			4	2	2		
2	A	1	Total	C	O	0	0
			4	2	2		
2	A	1	Total	C	O	0	0
			4	2	2		
2	B	1	Total	C	O	0	0
			4	2	2		

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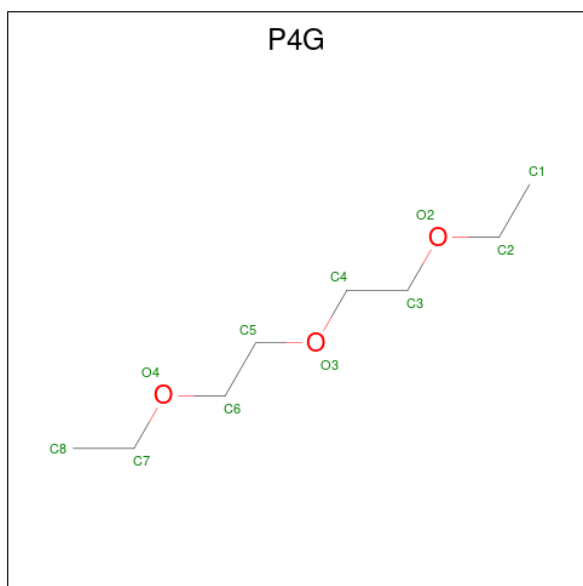
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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	B	1	Total	C	O	0	0
			4	2	2		
2	B	1	Total	C	O	0	0
			4	2	2		
2	B	1	Total	C	O	0	0
			4	2	2		

- Molecule 3 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	Na	0	0
			2	2		
3	B	2	Total	Na	0	0
			2	2		

- Molecule 4 is 1-ETHOXY-2-(2-ETHOXYETHOXY)ETHANE (CCD ID: P4G) (formula: C₈H₁₈O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			11	8	3		
4	A	1	Total	C	O	0	0
			11	8	3		
4	B	1	Total	C	O	0	0
			11	8	3		

- Molecule 5 is water.

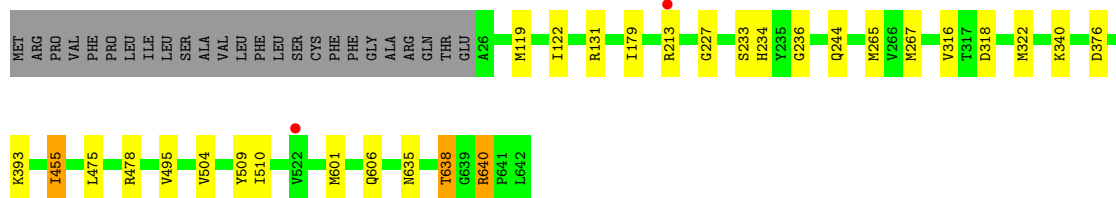
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	739	Total 739	O 739	0	0
5	B	649	Total 649	O 649	0	0

3 Residue-property plots

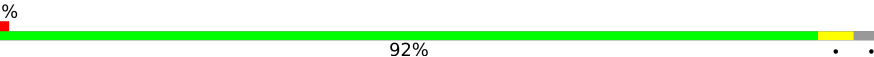
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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.

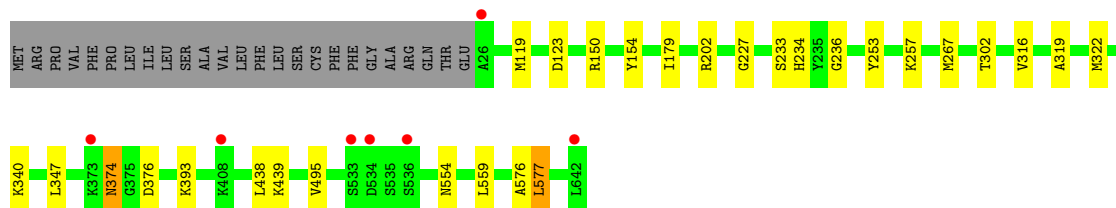
• Molecule 1: Uncharacterized lipoprotein ybbD

Chain A:  91%



• Molecule 1: Uncharacterized lipoprotein ybbD

Chain B:  92%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	58.38Å 73.08Å 83.57Å 79.79° 69.61° 88.25°	Depositor
Resolution (Å)	42.84 – 1.40 42.84 – 1.40	Depositor EDS
% Data completeness (in resolution range)	90.8 (42.84-1.40) 90.8 (42.84-1.40)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.32 (at 1.40Å)	Xtriage
Refinement program	PHENIX (phenix.refine)	Depositor
R, R_{free}	0.127 , 0.166 0.135 , 0.171	Depositor DCC
R_{free} test set	11453 reflections (4.56%)	wwPDB-VP
Wilson B-factor (Å ²)	12.8	Xtriage
Anisotropy	0.045	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 48.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	0.039 for h,-k,h-l	Xtriage
F_o, F_c correlation	0.98	EDS
Total number of atoms	11059	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.17% 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: NA, P4G, ACT

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	0.64	0/4893	0.75	0/6604
1	B	0.59	0/4893	0.74	1/6604 (0.0%)
All	All	0.61	0/9786	0.74	1/13208 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	302	THR	OG1-CB-CG2	5.38	120.05	109.30

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	4803	0	4923	29	0
1	B	4803	0	4936	20	0
2	A	12	0	9	4	0
2	B	16	0	12	5	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	22	0	36	2	0
4	B	11	0	18	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	739	0	0	1	0
5	B	649	0	0	0	0
All	All	11059	0	9934	49	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 3.

All (49) 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:318:ASP:OD2	2:A:643:ACT:H1	1.51	1.11
1:B:319:ALA:HB2	2:B:646:ACT:CH3	2.06	0.85
1:A:638:THR:HG21	1:A:640:ARG:HD2	1.73	0.68
1:B:319:ALA:HB2	2:B:646:ACT:H2	1.77	0.66
1:A:635:ASN:HB3	1:A:638:THR:HG22	1.80	0.64
1:A:638:THR:CG2	1:A:640:ARG:HD2	2.30	0.60
1:A:638:THR:CG2	1:A:640:ARG:H	2.15	0.59
1:A:119:MET:HE1	1:A:265:MET:CE	2.35	0.57
1:B:374:ASN:O	1:B:374:ASN:OD1	2.24	0.56
1:A:119:MET:HE1	1:A:265:MET:HE1	1.87	0.55
1:B:119:MET:HG3	1:B:393:LYS:HE2	1.90	0.53
1:A:455:ILE:HD13	1:A:509:TYR:HB2	1.91	0.53
1:A:119:MET:HG3	1:A:393:LYS:HE2	1.91	0.53
1:B:347:LEU:CD2	2:B:646:ACT:H1	2.41	0.51
1:B:123:ASP:OD2	2:B:646:ACT:O	2.29	0.50
1:A:340:LYS:HE2	1:A:376:ASP:HB3	1.93	0.49
1:A:638:THR:HG22	1:A:640:ARG:H	1.77	0.48
1:B:253:TYR:CZ	1:B:257:LYS:HE2	2.49	0.48
1:B:340:LYS:HE2	1:B:376:ASP:HB3	1.94	0.48
1:A:475:LEU:HD22	1:A:606:GLN:HG3	1.96	0.47
4:A:649:P4G:H32	1:B:154:TYR:CD2	2.49	0.47
1:A:638:THR:HG21	1:A:640:ARG:CD	2.42	0.47
1:A:638:THR:HG23	1:A:640:ARG:H	1.79	0.46
1:A:234:HIS:NE2	1:A:322[B]:MET:HE2	2.31	0.46
1:B:234:HIS:NE2	1:B:322[B]:MET:HE2	2.30	0.46
1:A:213:ARG:HH11	1:A:213:ARG:HA	1.80	0.46
1:B:150:ARG:NE	1:B:202:ARG:HD3	2.31	0.46
1:A:318:ASP:OD2	2:A:643:ACT:CH3	2.43	0.45
1:B:347:LEU:HD21	2:B:646:ACT:H1	1.97	0.45
1:B:559:LEU:HB3	1:B:577[B]:LEU:HD22	1.98	0.45
1:A:322[B]:MET:HE1	2:A:643:ACT:H2	1.99	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:319:ALA:HB3	1:B:322[B]:MET:HE3	1.99	0.44
1:B:438:LEU:HD12	1:B:577[B]:LEU:HD12	2.00	0.43
1:B:179:ILE:O	1:B:227:GLY:HA3	2.19	0.42
1:A:267:MET:HA	1:A:316:VAL:O	2.19	0.42
1:A:233:SER:HA	1:A:236:GLY:O	2.20	0.42
1:A:179:ILE:O	1:A:227:GLY:HA3	2.20	0.41
1:A:478:ARG:HE	1:A:478:ARG:HB3	1.56	0.41
1:A:638:THR:HG23	1:A:640:ARG:HB3	2.03	0.41
1:B:439[B]:LYS:O	1:B:576:ALA:HA	2.21	0.41
1:A:213:ARG:HB3	5:A:1230:HOH:O	2.22	0.40
1:A:318:ASP:CG	2:A:643:ACT:H1	2.38	0.40
1:A:504:VAL:HG13	1:A:510:ILE:CD1	2.51	0.40
1:A:122:ILE:HD11	1:A:131:ARG:HB2	2.04	0.40
1:A:244:GLN:HB3	4:A:649:P4G:H51	2.04	0.40
1:B:374:ASN:OD1	1:B:374:ASN:C	2.63	0.40
1:A:475:LEU:HD21	1:A:601:MET:SD	2.62	0.40
1:B:233:SER:HA	1:B:236:GLY:O	2.22	0.40
1:B:267:MET:HA	1:B:316:VAL:O	2.21	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	620/642 (97%)	605 (98%)	15 (2%)	0	100	100
1	B	621/642 (97%)	605 (97%)	16 (3%)	0	100	100
All	All	1241/1284 (97%)	1210 (98%)	31 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	A	525/541 (97%)	521 (99%)	4 (1%)	73	48
1	B	525/541 (97%)	520 (99%)	5 (1%)	68	40
All	All	1050/1082 (97%)	1041 (99%)	9 (1%)	73	44

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	455	ILE
1	A	495	VAL
1	A	638	THR
1	A	640	ARG
1	B	374	ASN
1	B	495	VAL
1	B	554	ASN
1	B	577[A]	LEU
1	B	577[B]	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	137	ASN
1	A	181	ASN
1	A	312	ASN
1	A	331	GLN
1	A	359	GLN
1	A	494	GLN
1	B	36	ASN
1	B	104	GLN
1	B	331	GLN
1	B	374	ASN
1	B	380	GLN
1	B	442	GLN
1	B	519	ASN

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Mol	Chain	Res	Type
1	B	570	ASN
1	B	588	ASN
1	B	625	ASN

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 14 ligands modelled in this entry, 4 are monoatomic - leaving 10 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	P4G	A	648	-	10,10,10	0.47	0	9,9,9	0.26	0
2	ACT	A	645	-	3,3,3	1.03	0	3,3,3	0.77	0
4	P4G	B	649	-	10,10,10	0.51	0	9,9,9	0.26	0
2	ACT	B	646	-	3,3,3	0.48	0	3,3,3	1.51	1 (33%)
4	P4G	A	649	-	10,10,10	0.48	0	9,9,9	0.24	0
2	ACT	B	645	-	3,3,3	0.64	0	3,3,3	1.49	1 (33%)
2	ACT	B	644	-	3,3,3	0.67	0	3,3,3	1.26	0
2	ACT	B	643	-	3,3,3	0.81	0	3,3,3	1.23	0
2	ACT	A	643	-	3,3,3	0.95	0	3,3,3	1.94	1 (33%)
2	ACT	A	644	-	3,3,3	0.78	0	3,3,3	1.67	1 (33%)

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	P4G	A	649	-	-	5/8/8/8	-
4	P4G	A	648	-	-	6/8/8/8	-
4	P4G	B	649	-	-	2/8/8/8	-

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	643	ACT	O-C-CH3	-2.67	111.59	122.53
2	A	644	ACT	OXT-C-O	-2.27	113.60	122.03
2	B	646	ACT	OXT-C-CH3	2.10	123.86	115.05
2	B	645	ACT	OXT-C-CH3	2.03	123.56	115.05

There are no chirality outliers.

All (13) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	649	P4G	O2-C3-C4-O3
4	A	649	P4G	O3-C5-C6-O4
4	A	648	P4G	O2-C3-C4-O3
4	A	648	P4G	C1-C2-O2-C3
4	B	649	P4G	C1-C2-O2-C3
4	B	649	P4G	C8-C7-O4-C6
4	A	648	P4G	C4-C3-O2-C2
4	A	648	P4G	C8-C7-O4-C6
4	A	649	P4G	C3-C4-O3-C5
4	A	649	P4G	C5-C6-O4-C7
4	A	648	P4G	C5-C6-O4-C7
4	A	649	P4G	C6-C5-O3-C4
4	A	648	P4G	O3-C5-C6-O4

There are no ring outliers.

3 monomers are involved in 11 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	646	ACT	5	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	649	P4G	2	0
2	A	643	ACT	4	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	617/642 (96%)	-0.51	2 (0%)	90 92	5, 14, 29, 44	14 (2%)
1	B	617/642 (96%)	-0.41	7 (1%)	78 81	7, 16, 32, 43	13 (2%)
All	All	1234/1284 (96%)	-0.46	9 (0%)	84 87	5, 15, 31, 44	27 (2%)

All (9) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	26	ALA	4.3
1	B	536	SER	2.5
1	A	213	ARG	2.5
1	B	534	ASP	2.4
1	B	533	SER	2.3
1	B	642	LEU	2.3
1	B	373	LYS	2.2
1	B	408[A]	LYS	2.2
1	A	522	VAL	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(Å ²)	Q<0.9
3	NA	A	647	1/1	0.75	0.18	34,34,34,34	0
4	P4G	A	649	11/11	0.77	0.18	45,46,47,47	0
4	P4G	B	649	11/11	0.78	0.18	36,41,45,45	0
2	ACT	B	646	4/4	0.83	0.14	31,33,33,34	0
4	P4G	A	648	11/11	0.84	0.15	38,40,44,44	0
3	NA	B	648	1/1	0.89	0.11	39,39,39,39	0
2	ACT	A	645	4/4	0.90	0.12	24,28,29,30	0
2	ACT	B	644	4/4	0.91	0.11	26,29,29,33	0
2	ACT	A	643	4/4	0.92	0.06	6,9,10,15	0
2	ACT	A	644	4/4	0.95	0.10	19,21,22,23	0
2	ACT	B	645	4/4	0.95	0.09	25,26,28,29	0
3	NA	A	646	1/1	0.99	0.03	16,16,16,16	0
3	NA	B	647	1/1	0.99	0.05	17,17,17,17	0
2	ACT	B	643	4/4	1.00	0.02	10,11,11,11	0

6.5 Other polymers

There are no such residues in this entry.