



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 14, 2017 – 09:43 pm GMT

PDB ID : 4XPD  
Title : Crystal structure of yeast N-terminal acetyltransferase NatE (ppGpp) in complex with a bisubstrate  
Authors : Dong, J.; Wang, S.; York, J.D.  
Deposited on : 2015-01-16  
Resolution : 2.81 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](mailto:validation@mail.wwpdb.org)

A user guide is available at

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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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 : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : 1.9-1692  
EDS : trunk28620  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : recalc28949

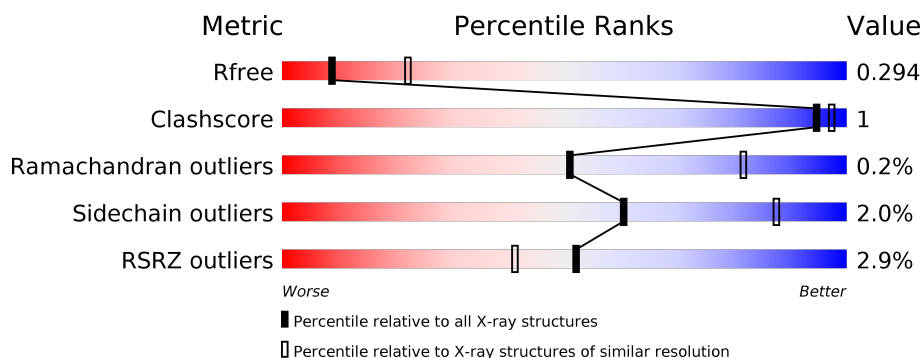
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.81 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))
$R_{free}$	100719	2917 (2.84-2.80)
Clashscore	112137	3382 (2.84-2.80)
Ramachandran outliers	110173	3324 (2.84-2.80)
Sidechain outliers	110143	3326 (2.84-2.80)
RSRZ outliers	101464	2948 (2.84-2.80)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	854	<div> <div>3%</div> <div>86%</div> <div>9%</div> </div>
2	B	238	<div> <div>2%</div> <div>71%</div> <div>8%</div> <div>21%</div> </div>
3	C	176	<div> <div>%</div> <div>82%</div> <div>6%</div> <div>12%</div> </div>
4	F	8	<div> <div>63%</div> <div>13%</div> <div>25%</div> </div>

## 2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 9262 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 N-terminal acetyltransferase A complex subunit NAT1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	774	Total	C	N	O	S	0	0	0
			6311	4071	1046	1172	22			

- Molecule 2 is a protein called N-terminal acetyltransferase A complex catalytic subunit ARD1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	187	Total	C	N	O	S	0	0	0
			1527	966	264	287	10			

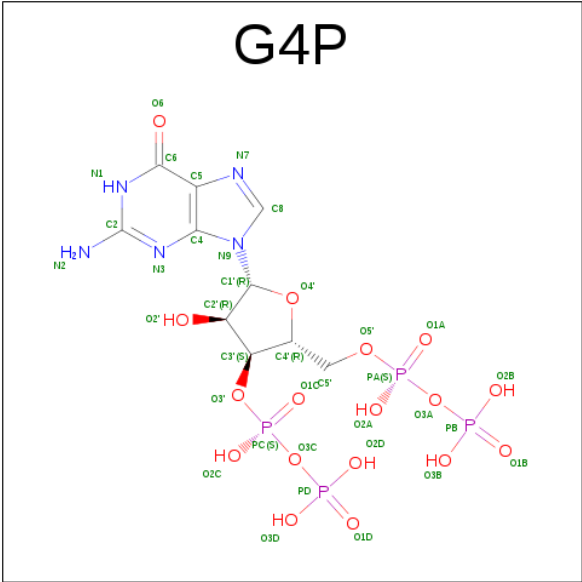
- Molecule 3 is a protein called N-terminal acetyltransferase A complex subunit NAT5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	155	Total	C	N	O	S	0	0	0
			1222	793	203	221	5			

- Molecule 4 is a protein called human ACTH8.

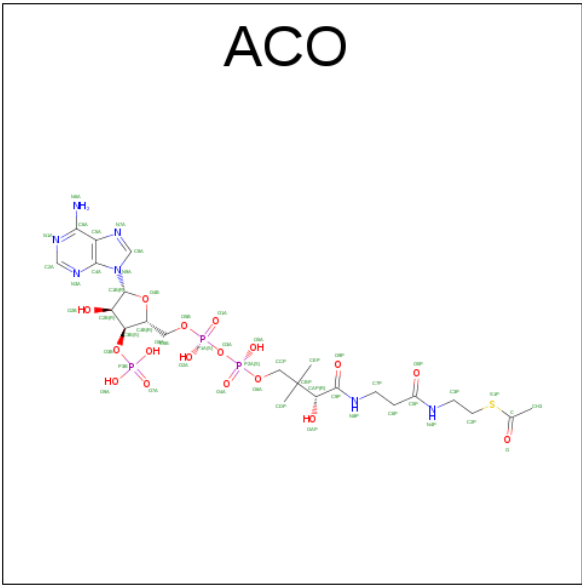
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	F	6	Total	C	N	O	S	0	0	0
			51	31	8	11	1			

- Molecule 5 is GUANOSINE-5',3'-TETRAPHOSPHATE (three-letter code: G4P) (formula: C<sub>10</sub>H<sub>17</sub>N<sub>5</sub>O<sub>17</sub>P<sub>4</sub>).



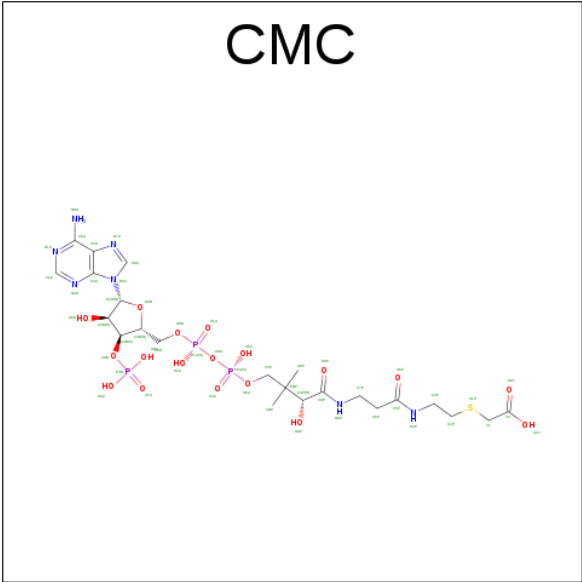
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
5	A	1	36	10	5	17	4	0	0

- Molecule 6 is ACETYL COENZYME \*A (three-letter code: ACO) (formula:  $C_{23}H_{38}N_7O_{17}P_3S$ ).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
			Total	C	N	O	P	S		
6	C	1	51	23	7	17	3	1	0	0

- Molecule 7 is CARBOXYMETHYL COENZYME \*A (three-letter code: CMC) (formula:  $C_{23}H_{38}N_7O_{18}P_3S$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
7	F	1	Total	C	N	O	P	S	0	0
			51	23	7	17	3	1		

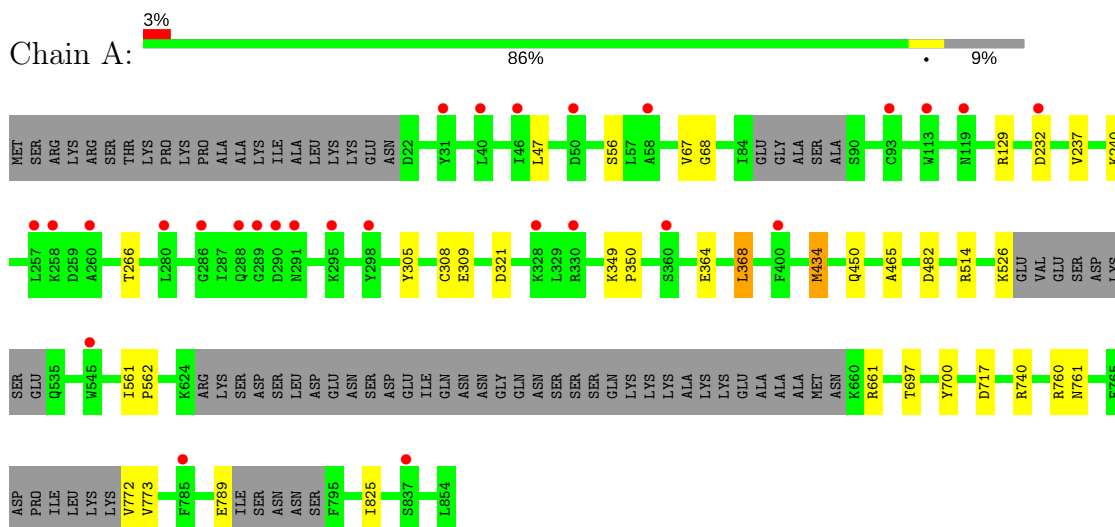
- Molecule 8 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	9	Total O 9 9	0	0
8	B	3	Total O 3 3	0	0
8	C	1	Total O 1 1	0	0

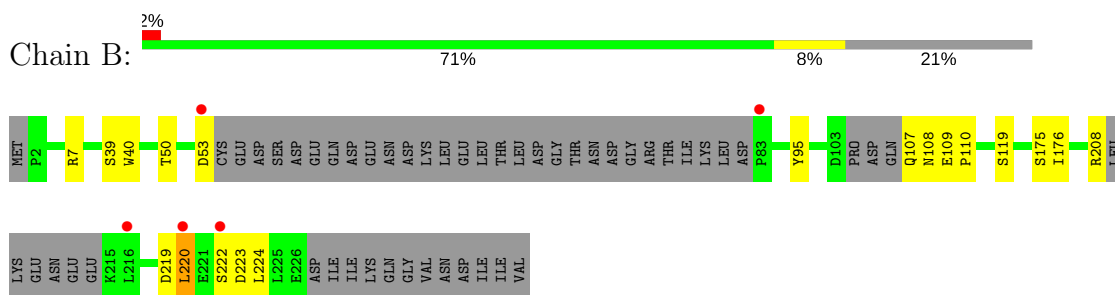
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

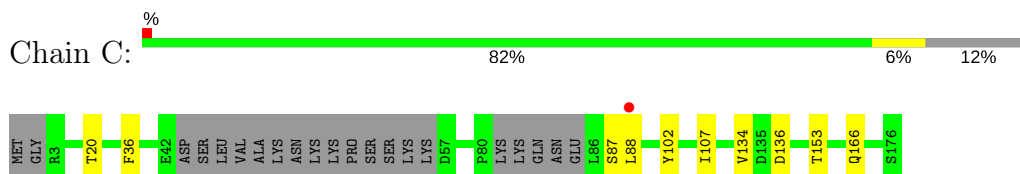
- Molecule 1: N-terminal acetyltransferase A complex subunit NAT1



- Molecule 2: N-terminal acetyltransferase A complex catalytic subunit ARD1



- Molecule 3: N-terminal acetyltransferase A complex subunit NAT5



- Molecule 4: human ACTH8





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	85.56Å 113.65Å 146.72Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.81 50.01 – 2.81	Depositor EDS
% Data completeness (in resolution range)	86.0 (50.00-2.81) 86.1 (50.01-2.81)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.06 (at 2.81Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, $R_{free}$	0.236 , 0.297 0.236 , 0.294	Depositor DCC
$R_{free}$ test set	1557 reflections (5.34%)	DCC
Wilson B-factor (Å <sup>2</sup> )	44.6	Xtriage
Anisotropy	0.198	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 38.0	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	0.89	EDS
Total number of atoms	9262	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	48.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.41% 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: G4P, CMC, ACO

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	0.30	0/6447	0.46	0/8692
2	B	0.29	0/1555	0.51	0/2099
3	C	0.29	0/1249	0.45	0/1689
4	F	0.30	0/52	0.38	0/68
All	All	0.29	0/9303	0.46	0/12548

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	A	6311	0	6246	14	0
2	B	1527	0	1506	8	0
3	C	1222	0	1210	4	0
4	F	51	0	41	0	0
5	A	36	0	11	0	0
6	C	51	0	34	1	0
7	F	51	0	32	0	0
8	A	9	0	0	0	0
8	B	3	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
8	C	1	0	0	0	0
All	All	9262	0	9080	27	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 (27) 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)
2:B:223:ASP:OD1	2:B:224:LEU:N	2.39	0.55
3:C:20:THR:HG22	3:C:36:PHE:CG	2.44	0.52
1:A:321:ASP:N	1:A:321:ASP:OD1	2.44	0.51
2:B:222:SER:HB3	2:B:223:ASP:HB2	1.93	0.51
3:C:102:TYR:O	3:C:107:ILE:HD12	2.13	0.48
1:A:305:TYR:HB3	1:A:308:CYS:SG	2.55	0.47
1:A:47:LEU:HD21	1:A:56:SER:HB2	1.96	0.46
1:A:561:ILE:HB	1:A:562:PRO:HD3	1.96	0.46
1:A:700:TYR:OH	1:A:717:ASP:HB3	2.16	0.45
1:A:772:VAL:HG13	1:A:773:VAL:HG23	1.99	0.45
2:B:107:GLN:HA	2:B:108:ASN:HA	1.74	0.45
1:A:364:GLU:O	1:A:368:LEU:HB2	2.16	0.44
2:B:39:SER:HB2	2:B:40:TRP:CE3	2.53	0.43
1:A:349:LYS:N	1:A:350:PRO:HD2	2.34	0.43
6:C:201:ACO:H61	6:C:201:ACO:O9P	2.18	0.43
2:B:175:SER:OG	2:B:176:ILE:N	2.52	0.43
1:A:434:MET:HB3	1:A:465:ALA:HB2	2.00	0.42
1:A:760:ARG:HA	1:A:761:ASN:HA	1.88	0.42
3:C:87:SER:N	3:C:88:LEU:HB2	2.35	0.42
1:A:67:VAL:N	1:A:68:GLY:HA2	2.35	0.41
2:B:95:TYR:CE2	2:B:119:SER:HB2	2.55	0.41
3:C:134:VAL:HG22	3:C:166:GLN:OE1	2.20	0.41
1:A:237:VAL:O	1:A:240:LYS:CE	2.69	0.41
2:B:109:GLU:HB3	2:B:110:PRO:HD2	2.03	0.41
1:A:700:TYR:OH	1:A:717:ASP:CB	2.70	0.40
1:A:482:ASP:N	1:A:482:ASP:OD1	2.54	0.40
2:B:219:ASP:O	2:B:220:LEU:HB2	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	762/854 (89%)	730 (96%)	32 (4%)	0	100	100
2	B	179/238 (75%)	171 (96%)	7 (4%)	1 (1%)	28	61
3	C	149/176 (85%)	145 (97%)	3 (2%)	1 (1%)	25	57
4	F	4/8 (50%)	4 (100%)	0	0	100	100
All	All	1094/1276 (86%)	1050 (96%)	42 (4%)	2 (0%)	51	82

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	220	LEU
3	C	153	THR

### 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	674/759 (89%)	660 (98%)	14 (2%)	59	87
2	B	167/216 (77%)	163 (98%)	4 (2%)	54	84
3	C	132/153 (86%)	131 (99%)	1 (1%)	85	95
4	F	6/8 (75%)	5 (83%)	1 (17%)	2	7
All	All	979/1136 (86%)	959 (98%)	20 (2%)	60	87

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	129	ARG
1	A	232	ASP
1	A	266	THR
1	A	309	GLU
1	A	368	LEU
1	A	434	MET
1	A	450	GLN
1	A	514	ARG
1	A	526	LYS
1	A	661	ARG
1	A	697	THR
1	A	740	ARG
1	A	789	GLU
1	A	825	ILE
2	B	7	ARG
2	B	50	THR
2	B	53	ASP
2	B	208	ARG
3	C	136	ASP
4	F	6	HIS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
3	C	101	ASN

### 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 ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry

3 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
5	G4P	A	901	-	32,38,38	1.18	2 (6%)	35,61,61	1.98	7 (20%)
6	ACO	C	201	-	46,53,53	0.88	3 (6%)	53,79,79	1.73	9 (16%)
7	CMC	F	101	4	46,53,54	1.35	3 (6%)	51,78,80	1.55	4 (7%)

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
5	G4P	A	901	-	-	0/23/43/43	0/3/3/3
6	ACO	C	201	-	-	2/47/67/67	0/3/3/3
7	CMC	F	101	4	-	0/46/67/68	0/3/3/3

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	F	101	CMC	C1-S1P	-6.46	1.77	1.81
7	F	101	CMC	C9P-N8P	-3.52	1.26	1.33
7	F	101	CMC	C5P-N4P	-3.09	1.26	1.33
6	C	201	ACO	O4B-C1B	2.05	1.44	1.41
6	C	201	ACO	P3B-O3B	2.05	1.63	1.59
6	C	201	ACO	C5A-C4A	2.83	1.46	1.40
5	A	901	G4P	C5-C4	3.32	1.48	1.40
5	A	901	G4P	C6-C5	4.03	1.49	1.41

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
7	F	101	CMC	N3A-C2A-N1A	-7.88	121.99	128.86

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	C	201	ACO	N3A-C2A-N1A	-7.81	122.05	128.86
5	A	901	G4P	C4'-O4'-C1'	-5.19	104.24	109.77
6	C	201	ACO	C1B-N9A-C4A	-3.95	119.81	126.64
5	A	901	G4P	C5-C6-N1	-3.65	118.28	123.48
6	C	201	ACO	C4A-C5A-N7A	-3.13	106.39	109.41
5	A	901	G4P	C6-C5-C4	-3.08	117.78	120.84
5	A	901	G4P	N3-C2-N1	-3.08	122.97	127.46
5	A	901	G4P	C4-C5-N7	-2.85	106.66	109.41
6	C	201	ACO	C3P-C2P-S1P	-2.74	103.27	111.23
6	C	201	ACO	C7P-C6P-C5P	-2.29	108.53	112.22
7	F	101	CMC	C2P-C3P-N4P	-2.00	108.08	112.49
6	C	201	ACO	C6P-C7P-N8P	2.05	116.11	111.87
6	C	201	ACO	C2P-S1P-C	2.15	113.76	101.67
6	C	201	ACO	C2A-N1A-C6A	2.21	122.64	118.77
7	F	101	CMC	C7P-N8P-C9P	2.34	126.95	122.59
7	F	101	CMC	C2P-S1P-C1	3.38	107.41	101.77
6	C	201	ACO	C2P-C3P-N4P	3.86	121.00	112.49
5	A	901	G4P	C6-N1-C2	4.03	121.85	116.06
5	A	901	G4P	C2-N3-C4	5.33	121.39	115.16

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	C	201	ACO	O-C-S1P-C2P
6	C	201	ACO	P3B-O3B-C3B-C4B

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	C	201	ACO	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

### 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<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	A	774/854 (90%)	0.21	27 (3%) 44 33	21, 51, 84, 99	0
2	B	187/238 (78%)	-0.00	5 (2%) 55 44	16, 34, 84, 97	0
3	C	155/176 (88%)	0.05	1 (0%) 89 86	29, 50, 72, 80	0
4	F	6/8 (75%)	0.60	0 100 100	25, 37, 77, 84	0
All	All	1122/1276 (87%)	0.15	33 (2%) 52 41	16, 48, 83, 99	0

All (33) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	220	LEU	5.1
3	C	88	LEU	3.8
2	B	53	ASP	3.8
1	A	328	LYS	3.8
1	A	330	ARG	3.4
1	A	289	GLY	3.4
1	A	93	CYS	3.3
2	B	216	LEU	3.2
1	A	31	TYR	3.1
2	B	222	SER	3.0
1	A	280	LEU	3.0
1	A	258	LYS	2.9
1	A	260	ALA	2.9
1	A	46	ILE	2.9
1	A	286	GLY	2.9
1	A	291	ASN	2.8
1	A	58	ALA	2.8
1	A	50	ASP	2.5
1	A	290	ASP	2.5
1	A	837	SER	2.4
1	A	232	ASP	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	113	TRP	2.4
1	A	360	SER	2.4
1	A	40	LEU	2.3
1	A	119	ASN	2.3
2	B	83	PRO	2.3
1	A	298	TYR	2.3
1	A	257	LEU	2.2
1	A	785	PHE	2.2
1	A	295	LYS	2.1
1	A	288	GLN	2.0
1	A	545	TRP	2.0
1	A	400	PHE	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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
5	G4P	A	901	36/36	0.76	0.28	1.12	78,101,109,109	0
6	ACO	C	201	51/51	0.91	0.21	0.11	39,46,72,73	0
7	CMC	F	101	51/52	0.96	0.15	-1.08	26,29,35,36	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.