



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jan 18, 2017 – 12:04 PM EST

PDB ID : 5HRH  
Title : The crystal structure of AsfvPolX(H115F/R127A mutant): 1nt-gap(P)  
DNA2:dGTP ternary complex  
Authors : Chen, Y.Q.; Zhang, J.; Gan, J.H.  
Deposited on : 2016-01-23  
Resolution : 3.00 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 1.7.1 (RC1), CSD as537be (2016)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20028442  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
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) : rb-20028442

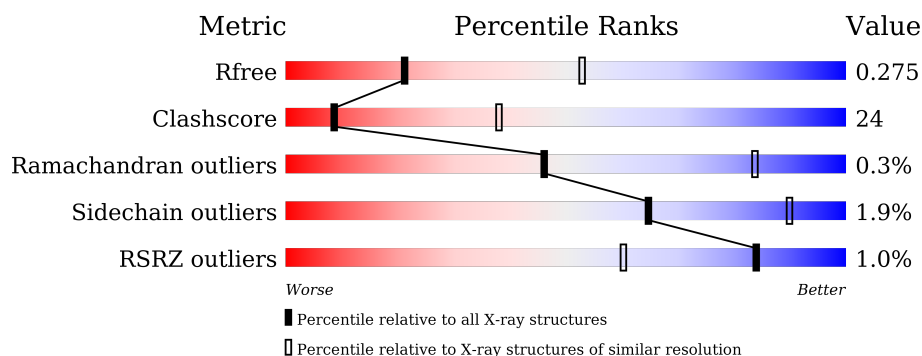
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.00 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.




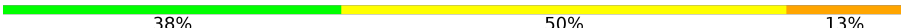
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	91344	1578 (3.00-3.00)
Clashscore	102246	1912 (3.00-3.00)
Ramachandran outliers	100387	1853 (3.00-3.00)
Sidechain outliers	100360	1856 (3.00-3.00)
RSRZ outliers	91569	1592 (3.00-3.00)

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	178	<div> <div>63%</div> <div>33%</div> <div>..</div> </div>
1	B	178	<div> <div>57%</div> <div>39%</div> <div>..</div> </div>
2	C	18	<div> <div>50%</div> <div>44%</div> <div>6%</div> </div>
2	F	18	<div> <div>44%</div> <div>50%</div> <div>6%</div> </div>
3	D	9	<div> <div>22%</div> <div>78%</div> </div>
3	G	9	<div> <div>11%</div> <div>78%</div> <div>22%</div> </div>

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Mol	Chain	Length	Quality of chain
4	E	8	 63% 25% 13%
4	H	8	 38% 50% 13%

## 2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 4196 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 DNA polymerase beta-like protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	174	Total	C	N	O	S	0	0	0
			1315	867	217	229	2			
1	B	176	Total	C	N	O	S	0	0	0
			1387	915	231	238	3			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	SER	-	expression tag	UNP A0A0A1E3N6
A	-2	GLY	-	expression tag	UNP A0A0A1E3N6
A	-1	GLY	-	expression tag	UNP A0A0A1E3N6
A	0	GLY	-	expression tag	UNP A0A0A1E3N6
A	115	PHE	HIS	engineered mutation	UNP A0A0A1E3N6
A	127	ALA	ARG	engineered mutation	UNP A0A0A1E3N6
B	-3	SER	-	expression tag	UNP A0A0A1E3N6
B	-2	GLY	-	expression tag	UNP A0A0A1E3N6
B	-1	GLY	-	expression tag	UNP A0A0A1E3N6
B	0	GLY	-	expression tag	UNP A0A0A1E3N6
B	115	PHE	HIS	engineered mutation	UNP A0A0A1E3N6
B	127	ALA	ARG	engineered mutation	UNP A0A0A1E3N6

- Molecule 2 is a DNA chain called DNA (5'-D(\*CP\*GP\*TP\*TP\*CP\*TP\*AP\*TP\*GP\*TP\*GP\*TP\*AP\*CP\*TP\*CP\*AP\*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	18	Total	C	N	O	P	0	0	0
			361	175	59	110	17			
2	F	18	Total	C	N	O	P	0	0	0
			361	175	59	110	17			

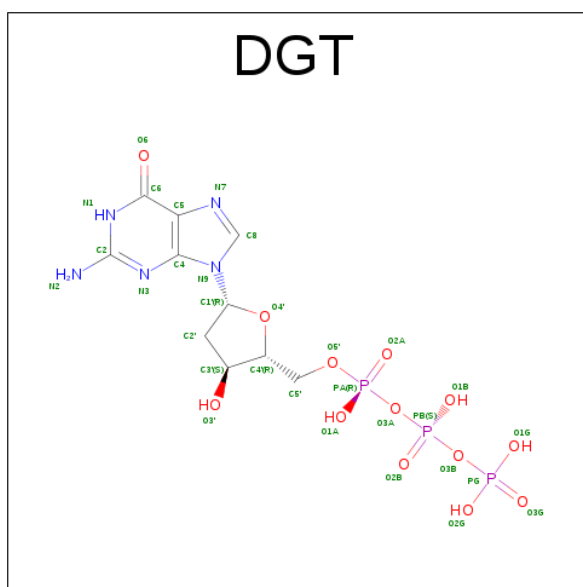
- Molecule 3 is a DNA chain called DNA (5'-D(\*GP\*TP\*GP\*AP\*GP\*TP\*AP\*CP\*A\*)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	9	Total	C	N	O	P	0	0	0
			184	89	37	50	8			
3	G	9	Total	C	N	O	P	0	0	0
			184	89	37	50	8			

- Molecule 4 is a DNA chain called DNA (5'-D(P\*AP\*TP\*AP\*GP\*AP\*AP\*CP\*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	E	8	Total	C	N	O	P	0	0	0
			168	79	35	46	8			
4	H	8	Total	C	N	O	P	0	0	0
			168	79	35	46	8			

- Molecule 5 is 2'-DEOXYGUANOSINE-5'-TRIPHOSPHATE (three-letter code: DGT) (formula: C<sub>10</sub>H<sub>16</sub>N<sub>5</sub>O<sub>13</sub>P<sub>3</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	0	0
			31	10	5	13	3		
5	B	1	Total	C	N	O	P	0	0
			31	10	5	13	3		

- Molecule 6 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	B	2	Total	Mn	0	0
			2	2		

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	2	Total 2	Mn 2	0	0

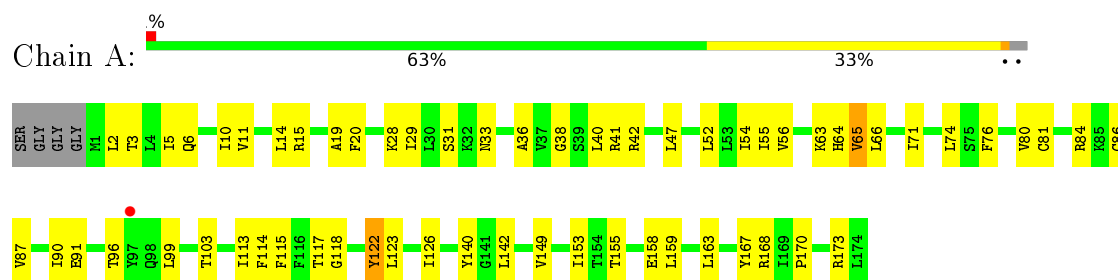
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	2	Total 2	O 2	0	0

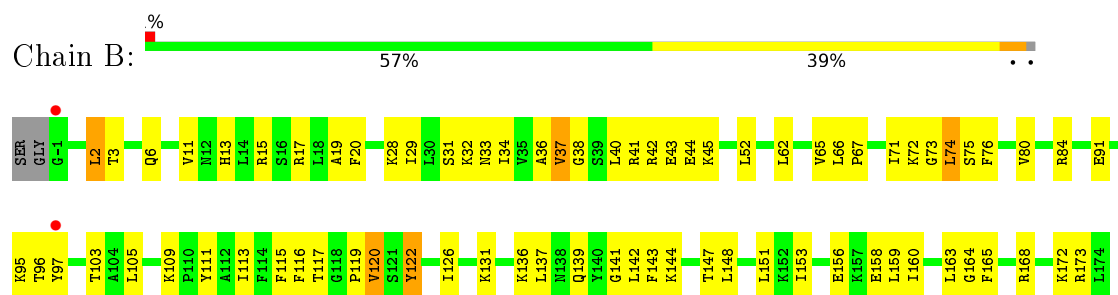
### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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 ( $\text{RSRZ} > 2$ ). 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: DNA polymerase beta-like protein



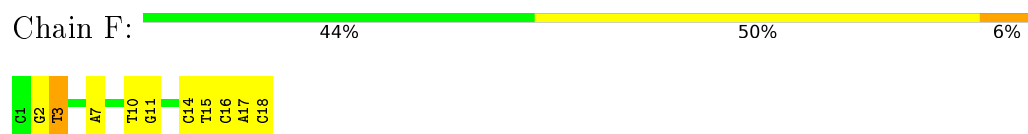
- Molecule 1: DNA polymerase beta-like protein



- Molecule 2: DNA (5'-D(\*CP\*GP\*TP\*TP\*CP\*TP\*AP\*TP\*GP\*TP\*GP\*TP\*AP\*CP\*TP\*CP\*AP\*C)-3')

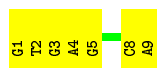


- Molecule 2: DNA (5'-D(\*CP\*GP\*TP\*TP\*CP\*TP\*AP\*TP\*GP\*TP\*GP\*TP\*AP\*CP\*TP\*CP\*AP\*C)-3')




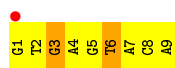
- Molecule 3: DNA (5'-D(\*GP\*TP\*GP\*AP\*GP\*TP\*AP\*CP\*A\*)-3')

Chain D:  22% 78%



- Molecule 3: DNA (5'-D(\*GP\*TP\*GP\*AP\*GP\*TP\*AP\*CP\*A\*)-3')

Chain G:  11% 78% 22%



- Molecule 4: DNA (5'-D(P\*AP\*TP\*AP\*GP\*AP\*AP\*CP\*G)-3')

Chain E:  63% 25% 13%



- Molecule 4: DNA (5'-D(P\*AP\*TP\*AP\*GP\*AP\*AP\*CP\*G)-3')

Chain H:  38% 50% 13%





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	125.50 Å 70.03 Å 86.01 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.99 – 3.00 29.99 – 3.00	Depositor EDS
% Data completeness (in resolution range)	97.3 (29.99-3.00) 98.9 (29.99-3.00)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.70 (at 3.00 Å)	Xtriage
Refinement program	PHENIX (1.10 _2155: ???)	Depositor
R, $R_{free}$	0.232 , 0.273 0.230 , 0.275	Depositor DCC
$R_{free}$ test set	817 reflections (5.34%)	DCC
Wilson B-factor (Å <sup>2</sup> )	59.0	Xtriage
Anisotropy	1.224	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 59.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	4196	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	90.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 36.80 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 4.7307e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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: MN, DGT

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	0.47	0/1340	0.72	0/1831
1	B	0.57	2/1412 (0.1%)	0.81	1/1910 (0.1%)
2	C	1.14	0/402	1.23	4/618 (0.6%)
2	F	0.98	0/402	1.21	2/618 (0.3%)
3	D	0.84	0/207	1.02	1/318 (0.3%)
3	G	0.83	1/207 (0.5%)	1.00	1/318 (0.3%)
4	E	1.18	1/189 (0.5%)	0.89	0/288
4	H	1.18	1/189 (0.5%)	0.93	0/288
All	All	0.75	5/4348 (0.1%)	0.92	9/6189 (0.1%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	H	1	DA	OP3-P	-10.17	1.49	1.61
4	E	1	DA	OP3-P	-9.59	1.49	1.61
1	B	120	VAL	CB-CG1	-7.33	1.37	1.52
1	B	37	VAL	CB-CG1	-5.99	1.40	1.52
3	G	6	DT	C1'-N1	5.26	1.56	1.49

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	9	DG	O5'-P-OP1	-6.64	99.72	105.70
1	B	2	LEU	CA-CB-CG	6.30	129.78	115.30
2	C	3	DT	O5'-P-OP2	6.16	118.09	110.70
2	F	3	DT	O5'-P-OP1	-5.93	100.36	105.70
2	C	3	DT	O5'-P-OP1	-5.88	100.41	105.70

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	1315	0	1288	62	0
1	B	1387	0	1429	75	0
2	C	361	0	207	9	0
2	F	361	0	207	11	0
3	D	184	0	101	8	0
3	G	184	0	101	24	0
4	E	168	0	90	2	0
4	H	168	0	90	3	0
5	A	31	0	12	1	0
5	B	31	0	12	3	0
6	A	2	0	0	0	0
6	B	2	0	0	0	0
7	A	2	0	0	0	0
All	All	4196	0	3537	178	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 24.

The worst 5 of 178 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:17:ARG:HB2	1:B:72:LYS:CB	1.80	1.10
1:A:41:ARG:HH11	1:A:117:THR:HG21	1.27	0.98
1:B:41:ARG:HH11	1:B:117:THR:HG21	1.29	0.98
2:F:18:DC:N3	3:G:1:DG:N2	2.16	0.93
1:B:131:LYS:NZ	2:F:10:DT:OP1	2.02	0.91

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	172/178 (97%)	152 (88%)	19 (11%)	1 (1%)	30	72
1	B	174/178 (98%)	155 (89%)	19 (11%)	0	100	100
All	All	346/356 (97%)	307 (89%)	38 (11%)	1 (0%)	46	84

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	65	VAL

### 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	128/159 (80%)	126 (98%)	2 (2%)	70	92
1	B	141/159 (89%)	138 (98%)	3 (2%)	61	89
All	All	269/318 (85%)	264 (98%)	5 (2%)	65	90

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	99	LEU
1	A	122	TYR
1	B	74	LEU
1	B	75	SER
1	B	122	TYR

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

### 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 ⓘ

Of 6 ligands modelled in this entry, 4 are 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$
5	DGT	A	201	6	25,33,33	1.11	1 (4%)	29,52,52	1.62	5 (17%)
5	DGT	B	201	6	25,33,33	0.99	2 (8%)	29,52,52	1.85	7 (24%)

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	DGT	A	201	6	-	0/18/34/34	0/3/3/3
5	DGT	B	201	6	-	0/18/34/34	0/3/3/3

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	201	DGT	O4'-C4'	-2.27	1.39	1.45

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	201	DGT	C6-N1	2.76	1.38	1.33
5	A	201	DGT	C6-N1	3.41	1.39	1.33

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	201	DGT	N3-C2-N1	-5.21	120.47	127.56
5	A	201	DGT	N3-C2-N1	-4.71	121.16	127.56
5	A	201	DGT	C5-C6-N1	-3.98	118.32	123.52
5	B	201	DGT	C2'-C1'-N9	-2.81	107.21	114.14
5	B	201	DGT	C5-C6-N1	-2.57	120.16	123.52

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	201	DGT	1	0
5	B	201	DGT	3	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, 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	174/178 (97%)	-0.15	1 (0%) 90 73	51, 86, 129, 141	0
1	B	176/178 (98%)	-0.21	2 (1%) 82 58	51, 83, 118, 140	0
2	C	18/18 (100%)	-0.12	0 100 100	66, 78, 133, 137	0
2	F	18/18 (100%)	-0.25	0 100 100	60, 90, 119, 128	0
3	D	9/9 (100%)	-0.02	0 100 100	85, 112, 126, 129	0
3	G	9/9 (100%)	0.17	1 (11%) 7 3	84, 103, 136, 138	0
4	E	8/8 (100%)	-0.26	0 100 100	80, 101, 103, 115	0
4	H	8/8 (100%)	-0.33	0 100 100	81, 106, 122, 136	0
All	All	420/426 (98%)	-0.18	4 (0%) 84 60	51, 86, 128, 141	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	97	TYR	3.0
1	B	97	TYR	2.1
3	G	1	DG	2.0
1	B	-1	GLY	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	DGT	A	201	31/31	0.95	0.25	0.38	45,70,87,95	0
5	DGT	B	201	31/31	0.95	0.22	-0.24	44,68,86,98	0
6	MN	A	203	1/1	0.98	0.23	-0.35	71,71,71,71	0
6	MN	B	202	1/1	0.95	0.21	-	72,72,72,72	0
6	MN	A	202	1/1	0.98	0.21	-	66,66,66,66	0
6	MN	B	203	1/1	0.86	0.25	-	68,68,68,68	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.