



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 02:48 AM GMT

PDB ID : 2IRY
Title : Crystal Structure of the Polymerase Domain from Mycobacterium tuberculosis
Ligase D with dGTP and Manganese.
Authors : Brissett, N.C.; Pitcher, R.S.; Doherty, A.J.
Deposited on : 2006-10-16
Resolution : 1.78 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
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026688
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) : trunk26865

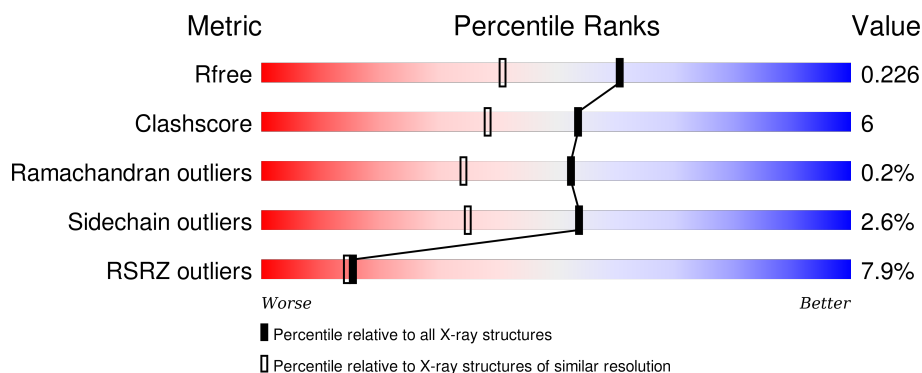
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.78 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	6655 (1.80-1.76)
Clashscore	102246	7658 (1.80-1.76)
Ramachandran outliers	100387	7570 (1.80-1.76)
Sidechain outliers	100360	7569 (1.80-1.76)
RSRZ outliers	91569	6671 (1.80-1.76)

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 ≥ 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	303	<div> <div>8%</div> <div>82%</div> <div>13%</div> <div>5%</div> </div>
1	B	303	<div> <div>7%</div> <div>84%</div> <div>9%</div> <div>7%</div> </div>

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
3	DGT	A	1102	-	-	-	X
3	DGT	B	1103	-	-	-	X

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 5083 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 ligase-like protein Rv0938/MT0965.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	288	Total	C	N	O	S	0	2	0
			2203	1390	392	416	5			
1	B	283	Total	C	N	O	S	0	0	0
			2168	1370	386	407	5			

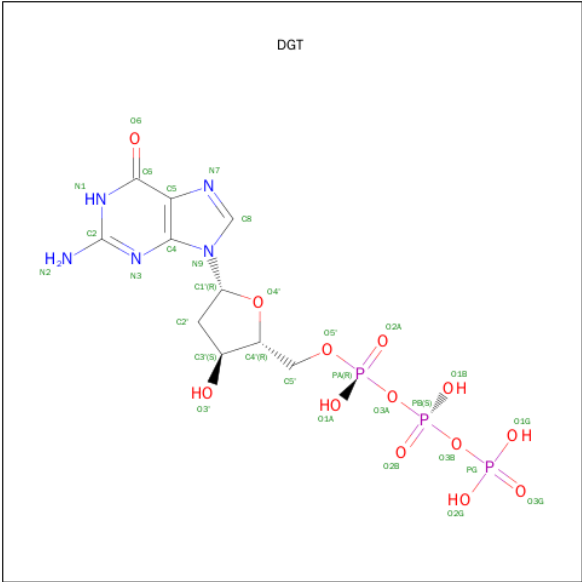
There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	GLY	-	EXPRESSION TAG	UNP P71571
A	2	SER	-	EXPRESSION TAG	UNP P71571
A	3	HIS	-	EXPRESSION TAG	UNP P71571
B	1	GLY	-	EXPRESSION TAG	UNP P71571
B	2	SER	-	EXPRESSION TAG	UNP P71571
B	3	HIS	-	EXPRESSION TAG	UNP P71571

- Molecule 2 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Mn	0	0
			1	1		
2	A	1	Total	Mn	0	0
			1	1		

- Molecule 3 is 2'-DEOXYGUANOSINE-5'-TRIPHOSPHATE (three-letter code: DGT) (formula: C₁₀H₁₆N₅O₁₃P₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			31	10	5	13	3		
3	B	1	Total	C	O	P		0	0
			20	5	12	3			

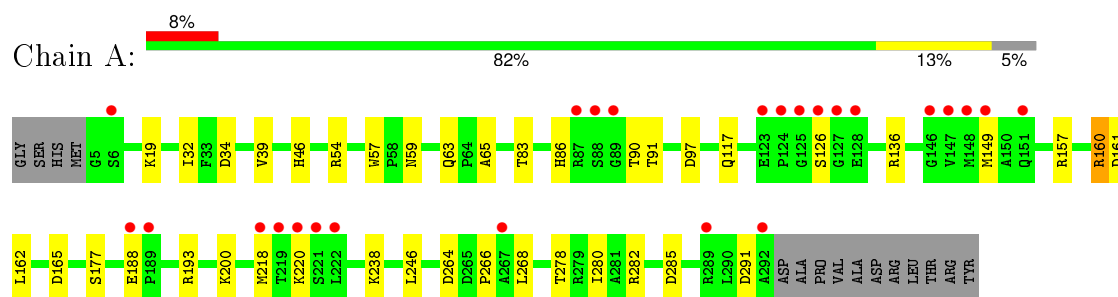
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	337	Total	O	0	0
			337	337		
4	B	322	Total	O	0	0
			322	322		

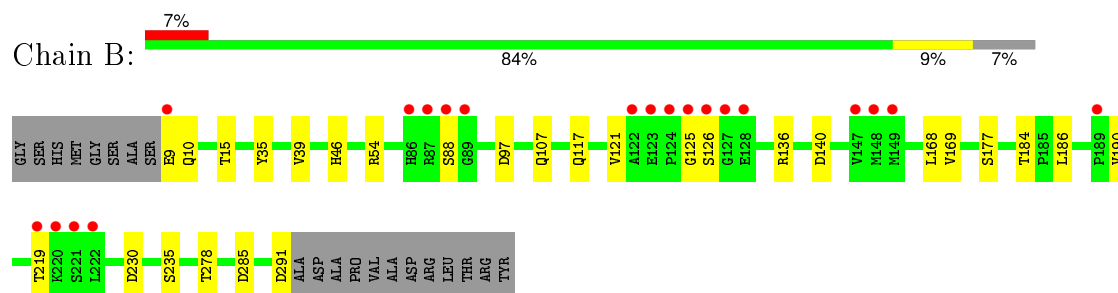
3 Residue-property plots

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 ligase-like protein Rv0938/MT0965



- Molecule 1: DNA ligase-like protein Rv0938/MT0965



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	41.22Å 75.87Å 95.81Å 90.00° 92.59° 90.00°	Depositor
Resolution (Å)	40.49 – 1.78 35.27 – 1.78	Depositor EDS
% Data completeness (in resolution range)	100.0 (40.49-1.78) 100.0 (35.27-1.78)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.18 (at 1.78Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.182 , 0.230 0.180 , 0.226	Depositor DCC
R_{free} test set	2868 reflections (5.34%)	DCC
Wilson B-factor (Å ²)	18.6	Xtriage
Anisotropy	0.194	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 40.6	EDS
Estimated twinning fraction	0.047 for h,-k,-l	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Outliers	0 of 56528 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5083	wwPDB-VP
Average B, all atoms (Å ²)	17.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.45% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: 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	0.70	0/2259	0.67	0/3084
1	B	0.68	0/2218	0.71	0/3029
All	All	0.69	0/4477	0.69	0/6113

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

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	2203	0	2209	34	1
1	B	2168	0	2173	19	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	31	0	12	5	0
3	B	20	0	7	1	0
4	A	337	0	0	13	1
4	B	322	0	0	4	2
All	All	5083	0	4401	57	2

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 (57) 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:19:LYS:HE2	1:A:59:ASN:HD22	1.26	1.01
1:A:19:LYS:CE	1:A:59:ASN:HD22	1.84	0.90
1:A:157:ARG:O	1:A:160:ARG:HG3	1.70	0.90
3:A:1102:DGT:H8	4:A:1404:HOH:O	1.75	0.85
3:A:1102:DGT:O1A	3:A:1102:DGT:H4'	1.77	0.84
3:A:1102:DGT:H5'	4:A:1401:HOH:O	1.77	0.83
1:A:160:ARG:HD2	1:A:161:ASP:OD1	1.81	0.80
1:B:278:THR:HG22	4:B:1289:HOH:O	1.83	0.79
1:A:193:ARG:HD3	4:A:1419:HOH:O	1.83	0.79
1:B:117:GLN:NE2	1:B:136:ARG:HE	1.81	0.78
1:A:19:LYS:HE2	1:A:59:ASN:ND2	2.01	0.76
1:A:278:THR:HG22	4:A:1315:HOH:O	1.84	0.76
1:A:268:LEU:HD23	4:A:1219:HOH:O	1.91	0.71
1:B:15:THR:H	1:B:107:GLN:HE22	1.38	0.70
1:A:117:GLN:NE2	1:A:136:ARG:HE	1.92	0.67
1:B:46:HIS:HD2	1:B:291:ASP:OD2	1.78	0.66
1:A:19:LYS:CE	1:A:59:ASN:ND2	2.62	0.59
1:A:149:MET:HB3	4:A:1219:HOH:O	2.02	0.59
1:B:46:HIS:HE1	1:B:285:ASP:OD2	1.86	0.59
1:A:46:HIS:HD2	1:A:291:ASP:OD1	1.86	0.58
1:B:117:GLN:HE22	1:B:136:ARG:HE	1.51	0.56
1:A:19:LYS:NZ	1:A:59:ASN:ND2	2.53	0.56
1:A:32:ILE:HD12	1:A:246:LEU:CD1	2.36	0.56
1:A:46:HIS:HB2	4:A:1129:HOH:O	2.05	0.55
1:A:46:HIS:HE1	1:A:285:ASP:OD2	1.89	0.55
1:B:169:VAL:O	1:B:184:THR:HG23	2.06	0.55
1:B:15:THR:H	1:B:107:GLN:NE2	2.04	0.54
1:A:83:THR:CG2	1:A:90:THR:HG23	2.38	0.53
1:B:97:ASP:HA	4:B:1347:HOH:O	2.10	0.51
1:B:121:VAL:HG23	4:B:1223:HOH:O	2.10	0.51
1:A:117:GLN:HE22	1:A:136:ARG:HE	1.57	0.51
1:A:63:GLN:HG3	4:A:1356:HOH:O	2.12	0.50
1:A:19:LYS:NZ	1:A:59:ASN:HD22	2.10	0.50
1:B:177:SER:HB3	3:B:1103:DGT:PG	2.52	0.49
1:A:57:TRP:CD1	1:A:65:ALA:HB2	2.47	0.49
1:A:282:ARG:NH1	4:A:1275:HOH:O	2.44	0.49
1:B:46:HIS:CD2	1:B:291:ASP:OD2	2.63	0.48
1:A:157:ARG:HA	1:A:160:ARG:HG2	1.96	0.47
1:A:32:ILE:HD12	1:A:246:LEU:HD13	1.96	0.47
1:A:86:HIS:HE1	1:A:91:THR:OG1	1.98	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:162:LEU:O	1:A:165:ASP:HB2	2.16	0.46
1:A:39:VAL:HG12	1:A:280:ILE:CD1	2.47	0.45
1:A:149:MET:SD	1:A:266:PRO:O	2.75	0.44
1:B:46:HIS:CE1	1:B:285:ASP:OD2	2.70	0.44
3:A:1102:DGT:C8	4:A:1404:HOH:O	2.49	0.44
1:A:238:LYS:HE2	4:A:1435:HOH:O	2.18	0.43
1:B:186:LEU:HD13	1:B:190:VAL:HG12	1.99	0.43
1:A:200:LYS:HE2	4:A:1210:HOH:O	2.18	0.43
1:B:278:THR:HG21	4:B:1160:HOH:O	2.18	0.43
1:B:140:ASP:HB3	1:B:230:ASP:HB3	2.01	0.43
1:A:32:ILE:HD12	1:A:246:LEU:HD11	2.01	0.42
1:A:97:ASP:HA	4:A:1231:HOH:O	2.20	0.41
1:A:46:HIS:CE1	1:A:285:ASP:OD2	2.72	0.41
1:B:9:GLU:HG2	1:B:10:GLN:HG3	2.03	0.41
1:A:177[A]:SER:OG	3:A:1102:DGT:PG	2.78	0.41
1:B:35:TYR:CZ	1:B:39:VAL:HG11	2.56	0.41
1:B:168:LEU:HB3	1:B:184:THR:CG2	2.51	0.41

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:34:ASP:OD2	4:B:1408:HOH:O[1_665]	2.16	0.04
4:A:1245:HOH:O	4:B:1289:HOH:O[1_565]	2.19	0.01

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	A	288/303 (95%)	281 (98%)	7 (2%)	0	100	100
1	B	281/303 (93%)	271 (96%)	9 (3%)	1 (0%)	39	22

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	569/606 (94%)	552 (97%)	16 (3%)	1 (0%)	52 34

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	125	GLY

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	232/242 (96%)	225 (97%)	7 (3%)	48 29
1	B	228/242 (94%)	223 (98%)	5 (2%)	60 42
All	All	460/484 (95%)	448 (97%)	12 (3%)	54 35

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	54	ARG
1	A	126	SER
1	A	160	ARG
1	A	188	GLU
1	A	218	MET
1	A	220	LYS
1	A	264	ASP
1	B	54	ARG
1	B	88	SER
1	B	126	SER
1	B	219	THR
1	B	235	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	16	ASN
1	A	46	HIS
1	A	59	ASN
1	A	86	HIS
1	A	117	GLN
1	B	10	GLN
1	B	46	HIS
1	B	107	GLN
1	B	117	GLN
1	B	208	GLN
1	B	233	GLN
1	B	251	HIS

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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 2 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	$\# Z > 2$
3	DGT	A	1102	2	25,33,33	1.12	2 (8%)	35,52,52	1.57	6 (17%)
3	DGT	B	1103	2	16,20,33	2.12	3 (18%)	23,31,52	1.30	2 (8%)

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	DGT	A	1102	2	-	0/18/34/34	0/3/3/3
3	DGT	B	1103	2	-	0/18/28/34	0/1/1/3

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1102	DGT	C5-C4	3.27	1.47	1.40
3	B	1103	DGT	C2'-C1'	3.58	1.61	1.51
3	A	1102	DGT	C6-C5	3.61	1.48	1.41
3	B	1103	DGT	O3'-C3'	5.11	1.54	1.43
3	B	1103	DGT	C2'-C3'	5.29	1.61	1.52

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1102	DGT	C5-C6-N1	-3.70	118.53	123.59
3	A	1102	DGT	PA-O3A-PB	-3.66	122.46	132.73
3	B	1103	DGT	PA-O3A-PB	-3.55	122.77	132.73
3	A	1102	DGT	C6-C5-C4	-3.04	117.27	120.90
3	A	1102	DGT	N3-C2-N1	-2.92	122.99	127.44
3	B	1103	DGT	PB-O3B-PG	-2.75	123.44	132.67
3	A	1102	DGT	C4-C5-N7	-2.10	107.55	109.48
3	A	1102	DGT	C6-N1-C2	4.21	121.78	115.94

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1102	DGT	5	0
3	B	1103	DGT	1	0

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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, 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	288/303 (95%)	0.60	25 (8%) 13 12	4, 14, 24, 34	0
1	B	283/303 (93%)	0.58	20 (7%) 19 18	7, 14, 25, 33	0
All	All	571/606 (94%)	0.59	45 (7%) 15 14	4, 14, 25, 34	0

All (45) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	125	GLY	9.9
1	A	124	PRO	9.1
1	A	126	SER	6.8
1	B	88	SER	6.5
1	A	87	ARG	6.4
1	A	125	GLY	6.3
1	B	126	SER	6.1
1	B	124	PRO	5.9
1	A	88	SER	4.9
1	B	148	MET	4.8
1	B	87	ARG	4.6
1	B	219	THR	4.5
1	B	189	PRO	4.4
1	A	127	GLY	4.4
1	B	86	HIS	4.3
1	B	222	LEU	4.2
1	A	149	MET	3.8
1	B	123	GLU	3.8
1	B	89	GLY	3.8
1	B	122	ALA	3.6
1	A	219	THR	3.6
1	A	292	ALA	3.5
1	B	127	GLY	3.4
1	A	220	LYS	3.4

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Mol	Chain	Res	Type	RSRZ
1	B	149	MET	3.4
1	A	147	VAL	3.3
1	B	9	GLU	3.3
1	A	148	MET	3.3
1	B	220	LYS	3.2
1	A	123	GLU	3.2
1	A	188	GLU	3.1
1	A	218	MET	3.1
1	A	289	ARG	3.1
1	A	222	LEU	3.0
1	A	189	PRO	2.8
1	A	6	SER	2.8
1	B	128	GLU	2.6
1	A	128	GLU	2.5
1	A	267	ALA	2.4
1	B	221	SER	2.3
1	A	89	GLY	2.3
1	A	151	GLN	2.2
1	A	146	GLY	2.2
1	B	147	VAL	2.2
1	A	221	SER	2.1

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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, 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	LLDF	B-factors(Å ²)	Q<0.9
3	DGT	A	1102	31/31	0.70	0.38	9.53	35,38,40,42	31

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors(\AA^2)	Q<0.9
3	DGT	B	1103	20/31	0.57	0.41	7.74	70,71,72,73	20
2	MN	A	1100	1/1	0.89	0.28	-	71,71,71,71	0
2	MN	B	1101	1/1	0.65	0.33	-	120,120,120,120	0

6.5 Other polymers [i](#)

There are no such residues in this entry.