wwPDB X-ray Structure Validation Summary Report (i)

Feb 1, 2016 – 08:33 PM GMT

PDB ID	:	4TNP
Title	:	Structural basis of cellular dNTP regulation, SAMHD1-GTP-dCTP-cCTP complex
Authors	:	Ji, X.; Tang, C.; Zhao, Q.; Wang, W.; Xiong, Y.
Deposited on	:	2014-06-04
Resolution	:	2.00 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
A user guide is available at
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

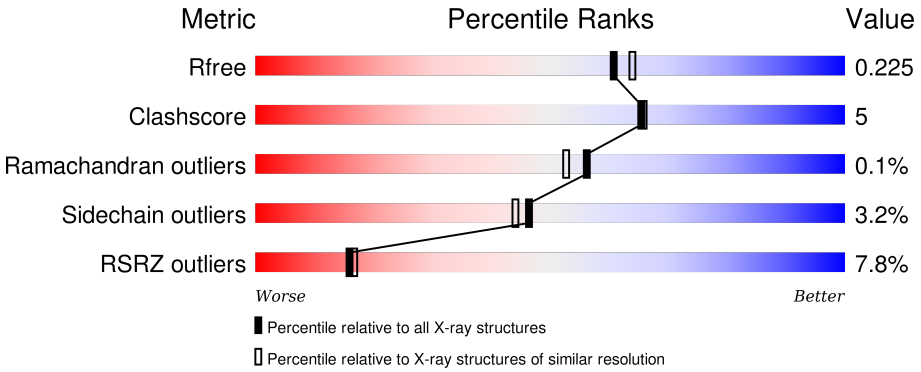
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	6249 (2.00-2.00)
Clashscore	102246	7340 (2.00-2.00)
Ramachandran outliers	100387	7248 (2.00-2.00)
Sidechain outliers	100360	7247 (2.00-2.00)
RSRZ outliers	91569	6262 (2.00-2.00)

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 >=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 <=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	514	6% 84% 7% • 7%
1	B	514	4% 85% 8% • 7%
1	C	514	7% 83% 9% • 6%
1	D	514	12% 84% 9% • 6%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 16430 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.

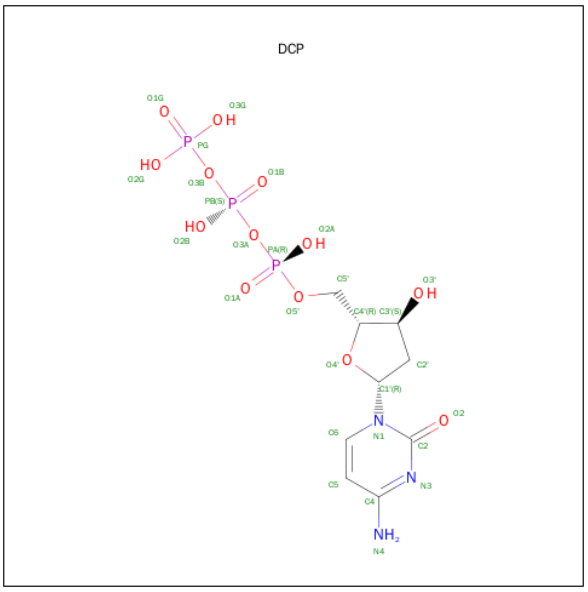
- Molecule 1 is a protein called Deoxynucleoside triphosphate triphosphohydrolase SAMHD1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	479	Total	C	N	O	S	0	1	0
			3919	2510	683	705	21			
1	B	480	Total	C	N	O	S	0	0	0
			3924	2512	684	708	20			
1	C	481	Total	C	N	O	S	0	2	0
			3944	2522	687	715	20			
1	D	484	Total	C	N	O	S	0	0	0
			3953	2530	688	715	20			

There are 8 discrepancies between the modelled and reference sequences:

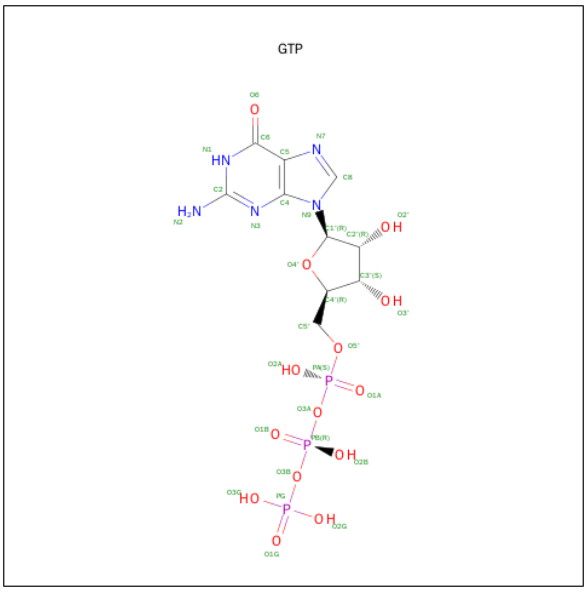
Chain	Residue	Modelled	Actual	Comment	Reference
A	206	ARG	HIS	engineered mutation	UNP Q9Y3Z3
A	207	ASN	ASP	engineered mutation	UNP Q9Y3Z3
B	206	ARG	HIS	engineered mutation	UNP Q9Y3Z3
B	207	ASN	ASP	engineered mutation	UNP Q9Y3Z3
C	206	ARG	HIS	engineered mutation	UNP Q9Y3Z3
C	207	ASN	ASP	engineered mutation	UNP Q9Y3Z3
D	206	ARG	HIS	engineered mutation	UNP Q9Y3Z3
D	207	ASN	ASP	engineered mutation	UNP Q9Y3Z3

- Molecule 2 is 2'-DEOXYCYTIDINE-5'-TRIPHOSPHATE (three-letter code: DCP) (formula: $C_9H_{16}N_3O_{13}P_3$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			28	9	3	13	3		
2	A	1	Total	C	N	O	P	0	0
			28	9	3	13	3		
2	A	1	Total	C	N	O	P	0	0
			28	9	3	13	3		
2	B	1	Total	C	N	O	P	0	0
			28	9	3	13	3		
2	B	1	Total	C	N	O	P	0	0
			28	9	3	13	3		
2	C	1	Total	C	N	O	P	0	0
			28	9	3	13	3		
2	D	1	Total	C	N	O	P	0	0
			28	9	3	13	3		
2	D	1	Total	C	N	O	P	0	0
			28	9	3	13	3		

- Molecule 3 is GUANOSINE-5'-TRIPHOSPHATE (three-letter code: GTP) (formula: $C_{10}H_{16}N_5O_{14}P_3$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
3	B	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
3	B	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
3	D	1	Total	C	N	O	P	0	0
			32	10	5	14	3		

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Mg	0	0
			1	1		
4	A	1	Total	Mg	0	0
			1	1		
4	D	1	Total	Mg	0	0
			1	1		
4	C	1	Total	Mg	0	0
			1	1		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	81	Total	O	0	0
			81	81		

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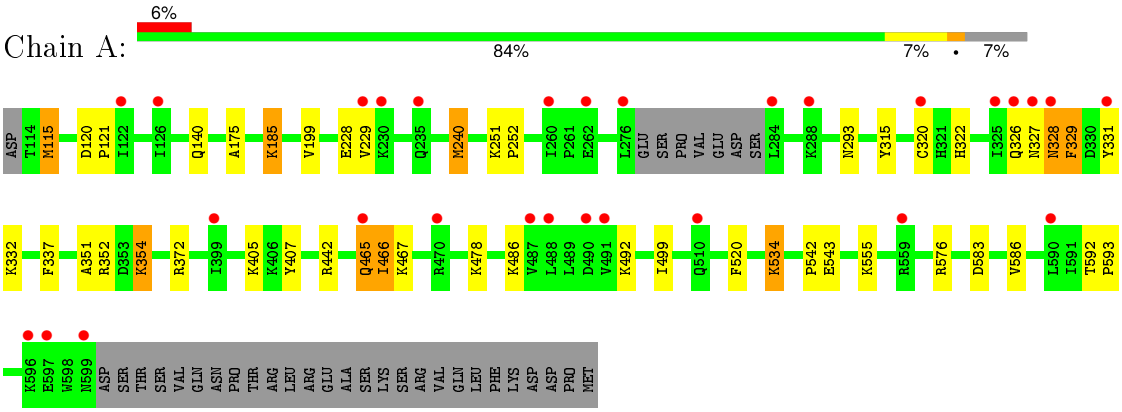
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	B	108	Total O 108 108	0	0
5	C	84	Total O 84 84	0	0
5	D	61	Total O 61 61	0	0

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 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 (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.

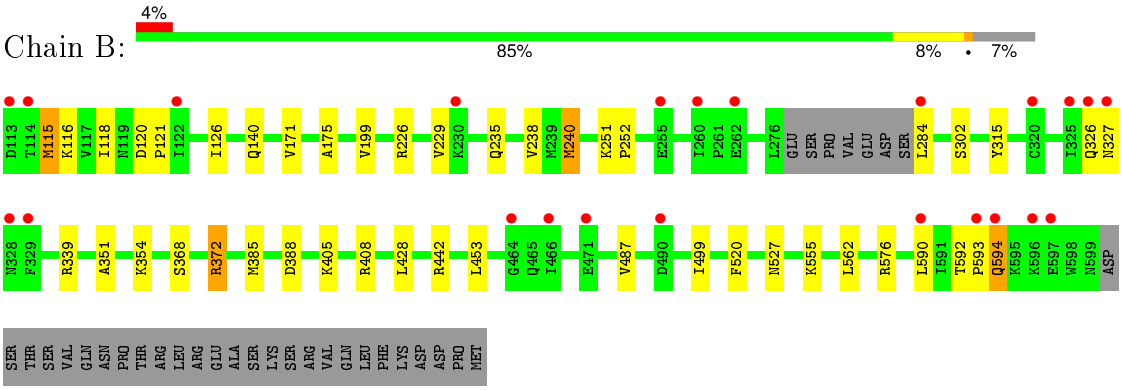
- Molecule 1: Deoxynucleoside triphosphate triphosphohydrolase SAMHD1

Chain A:



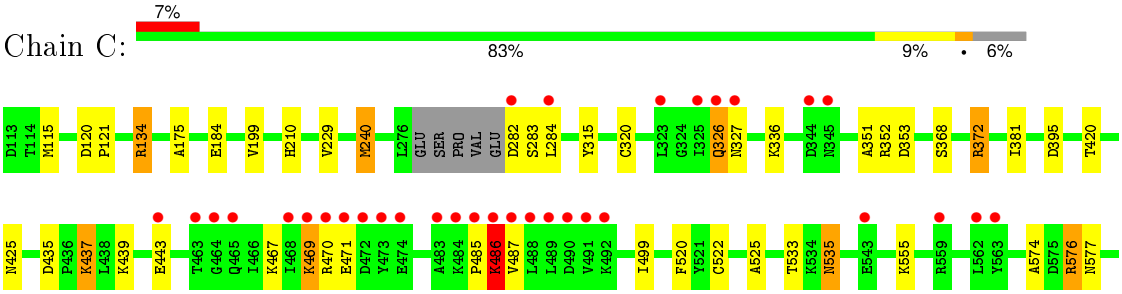
- Molecule 1: Deoxynucleoside triphosphate triphosphohydrolase SAMHD1

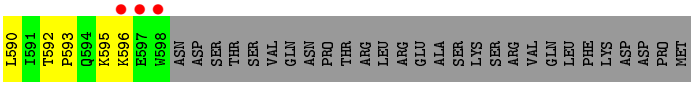
Chain B:



- Molecule 1: Deoxynucleoside triphosphate triphosphohydrolase SAMHD1

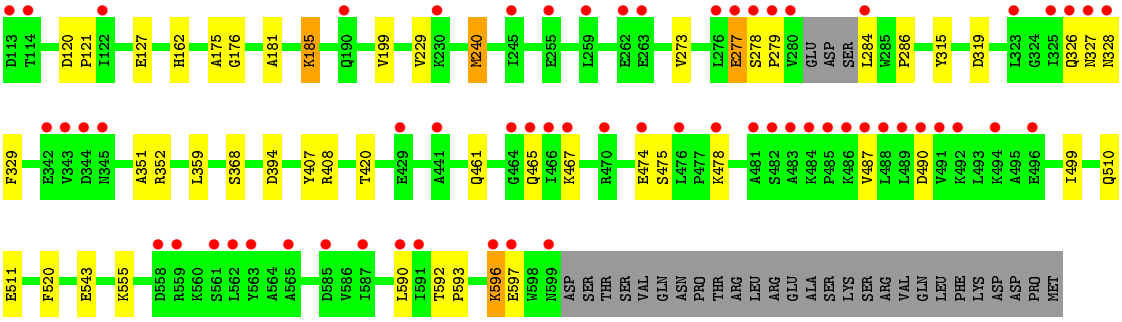
Chain C:





- Molecule 1: Deoxynucleoside triphosphate triphosphohydrolase SAMHD1

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	81.51Å 140.75Å 97.49Å 90.00° 114.79° 90.00°	Depositor
Resolution (Å)	50.00 – 2.00 47.83 – 2.00	Depositor EDS
% Data completeness (in resolution range)	97.8 (50.00-2.00) 97.8 (47.83-2.00)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.89 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, R_{free}	0.198 , 0.222 0.203 , 0.225	Depositor DCC
R_{free} test set	6550 reflections (5.24%)	DCC
Wilson B-factor (Å^2)	33.5	Xtriage
Anisotropy	0.744	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.39 , 52.2	EDS
Estimated twinning fraction	0.024 for h,-k,-h-l	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Outliers	13 of 131610 reflections (0.010%)	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	16430	wwPDB-VP
Average B, all atoms (Å^2)	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.43% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: GTP, MG, DCP

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	0.53	0/4011	0.72	2/5414 (0.0%)
1	B	0.57	0/4016	0.74	4/5421 (0.1%)
1	C	0.58	0/4036	0.74	3/5448 (0.1%)
1	D	0.51	0/4046	0.70	1/5463 (0.0%)
All	All	0.55	0/16109	0.73	10/21746 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

There are no bond length outliers.

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	576	ARG	NE-CZ-NH2	6.87	123.74	120.30
1	B	372	ARG	NE-CZ-NH2	-6.04	117.28	120.30
1	B	442	ARG	NE-CZ-NH1	5.73	123.17	120.30
1	D	352	ARG	CG-CD-NE	-5.65	99.94	111.80
1	B	576	ARG	NE-CZ-NH2	5.45	123.03	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	465	GLN	Peptide

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	3919	0	3911	42	1
1	B	3924	0	3915	39	0
1	C	3944	0	3927	52	1
1	D	3953	0	3942	26	2
2	A	84	0	36	6	0
2	B	56	0	24	0	0
2	C	28	0	12	3	0
2	D	56	0	24	1	0
3	A	32	0	12	0	0
3	B	64	0	24	1	0
3	D	32	0	12	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
5	A	81	0	0	10	0
5	B	108	0	0	5	0
5	C	84	0	0	6	0
5	D	61	0	0	5	0
All	All	16430	0	15839	158	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 5.

The worst 5 of 158 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:C:574:ALA:O	1:C:595:LYS:NZ	1.69	1.25
1:A:465:GLN:HG2	1:A:466:ILE:CD1	1.65	1.24
1:C:372:ARG:HH11	1:C:372:ARG:HG2	1.07	1.08
2:C:702:DCP:O2A	5:C:847:HOH:O	1.70	1.07
1:B:171:VAL:HA	5:B:872:HOH:O	1.55	1.03

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:543:GLU:O	1:D:465:GLN:OE1[1_655]	2.06	0.14
1:C:395:ASP:OD2	1:D:407:TYR:OH[1_554]	2.16	0.04

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	476/514 (93%)	467 (98%)	8 (2%)	1 (0%)	52	48
1	B	476/514 (93%)	467 (98%)	9 (2%)	0	100	100
1	C	479/514 (93%)	471 (98%)	7 (2%)	1 (0%)	52	48
1	D	480/514 (93%)	471 (98%)	9 (2%)	0	100	100
All	All	1911/2056 (93%)	1876 (98%)	33 (2%)	2 (0%)	56	53

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	329	PHE
1	C	486	LYS

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	425/459 (93%)	412 (97%)	13 (3%)	47	46
1	B	426/459 (93%)	415 (97%)	11 (3%)	54	54

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	C	429/459 (94%)	410 (96%)	19 (4%)	35 30
1	D	430/459 (94%)	417 (97%)	13 (3%)	48 47
All	All	1710/1836 (93%)	1654 (97%)	56 (3%)	46 43

5 of 56 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	134	ARG
1	C	284	LEU
1	D	368	SER
1	C	184	GLU
1	C	240	MET

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	599	ASN
1	C	321	HIS
1	D	328	ASN
1	B	527	ASN
1	B	577	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

Of 16 ligands modelled in this entry, 4 are monoatomic - leaving 12 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	$\#\|Z\| > 2$
2	DCP	A	701	-	21,29,29	0.58	0	33,45,45	1.44	4 (12%)
2	DCP	A	702	4	21,29,29	1.21	2 (9%)	33,45,45	1.17	5 (15%)
3	GTP	A	703	4	25,34,34	1.21	3 (12%)	34,54,54	1.80	8 (23%)
2	DCP	A	704	4	21,29,29	0.94	0	33,45,45	1.25	3 (9%)
2	DCP	B	701	-	21,29,29	0.70	0	33,45,45	1.51	3 (9%)
2	DCP	B	702	4	21,29,29	1.13	1 (4%)	33,45,45	1.37	5 (15%)
3	GTP	B	703	4	25,34,34	1.10	2 (8%)	34,54,54	1.86	9 (26%)
3	GTP	B	705	4	25,34,34	1.19	4 (16%)	34,54,54	1.75	9 (26%)
2	DCP	C	702	-	21,29,29	0.73	0	33,45,45	1.38	4 (12%)
2	DCP	D	702	-	21,29,29	0.69	0	33,45,45	1.40	5 (15%)
2	DCP	D	703	4	21,29,29	0.74	0	33,45,45	1.15	2 (6%)
3	GTP	D	704	4	25,34,34	1.12	2 (8%)	34,54,54	1.81	6 (17%)

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
2	DCP	A	701	-	-	0/18/34/34	0/2/2/2
2	DCP	A	702	4	-	0/18/34/34	0/2/2/2
3	GTP	A	703	4	-	0/18/38/38	0/3/3/3
2	DCP	A	704	4	-	0/18/34/34	0/2/2/2
2	DCP	B	701	-	-	0/18/34/34	0/2/2/2
2	DCP	B	702	4	-	0/18/34/34	0/2/2/2
3	GTP	B	703	4	-	0/18/38/38	0/3/3/3
3	GTP	B	705	4	-	0/18/38/38	0/3/3/3
2	DCP	C	702	-	-	0/18/34/34	0/2/2/2
2	DCP	D	702	-	-	0/18/34/34	0/2/2/2
2	DCP	D	703	4	-	0/18/34/34	0/2/2/2
3	GTP	D	704	4	-	0/18/38/38	0/3/3/3

The worst 5 of 14 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	702	DCP	C6-N1	-3.41	1.31	1.35
2	B	702	DCP	C6-N1	-3.30	1.31	1.35
2	A	702	DCP	PG-O3G	-2.32	1.46	1.54
3	B	705	GTP	PG-O2G	-2.13	1.47	1.54
3	B	705	GTP	C6-C5	2.08	1.45	1.41

The worst 5 of 63 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	D	704	GTP	C5-C6-N1	-4.68	117.20	123.59
3	B	703	GTP	C5-C6-N1	-4.55	117.37	123.59
3	B	705	GTP	C5-C6-N1	-4.49	117.44	123.59
3	A	703	GTP	C5-C6-N1	-4.27	117.75	123.59
2	A	701	DCP	PB-O3A-PA	-4.19	120.97	132.73

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5 monomers are involved in 11 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	701	DCP	4	0
2	A	704	DCP	2	0
3	B	705	GTP	1	0
2	C	702	DCP	3	0
2	D	702	DCP	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^{th} 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	479/514 (93%)	0.33	29 (6%)	25	26	24, 45, 75, 94	0
1	B	480/514 (93%)	0.19	23 (4%)	34	36	18, 38, 66, 89	0
1	C	481/514 (93%)	0.29	36 (7%)	17	18	19, 39, 80, 109	0
1	D	484/514 (94%)	0.63	62 (12%)	5	5	26, 48, 81, 150	0
All	All	1924/2056 (93%)	0.36	150 (7%)	16	17	18, 43, 77, 150	0

The worst 5 of 150 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	279	PRO	10.7
1	D	280	VAL	9.7
1	D	489	LEU	8.8
1	D	490	ASP	8.8
1	D	488	LEU	8.5

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, 95^{th} 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
2	DCP	D	702	28/28	0.88	0.13	-0.26	33,39,74,76	0
2	DCP	C	702	28/28	0.91	0.12	-0.31	23,30,56,58	0
2	DCP	B	702	28/28	0.98	0.13	-0.38	21,25,28,32	0
2	DCP	A	704	28/28	0.97	0.13	-0.48	22,26,29,31	0
2	DCP	A	702	28/28	0.97	0.12	-0.55	26,27,30,37	0
3	GTP	A	703	32/32	0.97	0.10	-0.61	27,30,33,34	0
3	GTP	B	705	32/32	0.98	0.10	-0.82	19,23,29,30	0
2	DCP	A	701	28/28	0.92	0.11	-0.94	33,41,73,74	0
3	GTP	B	703	32/32	0.98	0.10	-0.94	22,24,30,34	0
2	DCP	D	703	28/28	0.98	0.12	-0.96	27,30,37,38	0
2	DCP	B	701	28/28	0.94	0.10	-1.00	25,31,64,68	0
3	GTP	D	704	32/32	0.97	0.10	-1.23	31,34,38,40	0
4	MG	D	701	1/1	0.92	0.04	-	30,30,30,30	0
4	MG	C	701	1/1	0.90	0.09	-	30,30,30,30	0
4	MG	A	705	1/1	0.93	0.04	-	40,40,40,40	0
4	MG	B	704	1/1	0.92	0.05	-	25,25,25,25	0

6.5 Other polymers (i)

There are no such residues in this entry.