



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 27, 2017 – 10:27 PM EDT

PDB ID : 407D
Title : STRUCTURAL BASIS FOR RECOGNITION OF A-T AND T-A BASE
PAIRS IN THE MINOR GROOVE OF B-DNA
Authors : Rees, D.C.
Deposited on : 1998-06-24
Resolution : 2.20 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	:	1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20029077

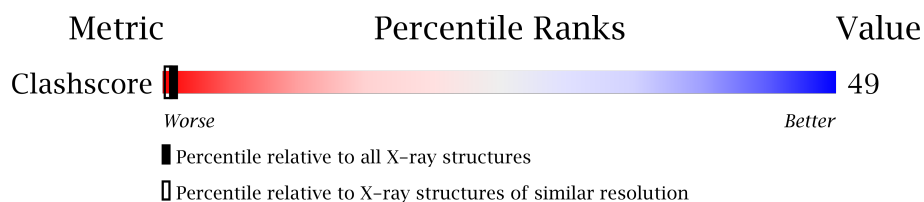
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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))
Clashscore	112137	4730 (2.20-2.20)

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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	10	
1	B	10	

2 Entry composition [i](#)

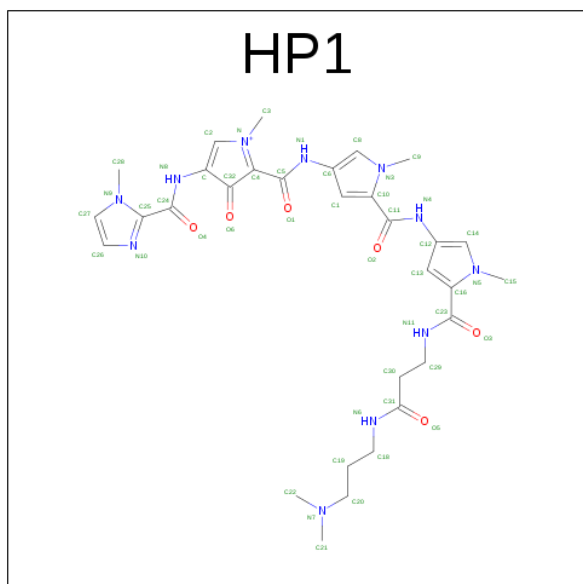
There are 4 unique types of molecules in this entry. The entry contains 593 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 DNA chain called DNA (5'-D(*CP*CP*AP*GP*TP*AP*CP*TP*GP*G)-3').

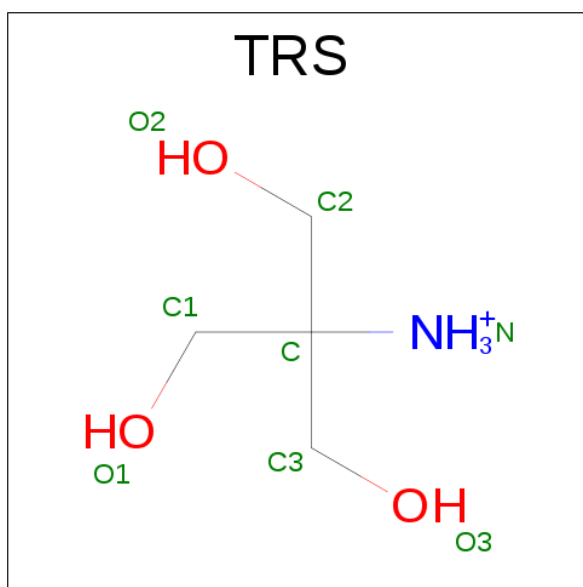
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	10	Total	C	N	O	P	0	0	0
			202	97	38	58	9			
1	B	10	Total	C	N	O	P	0	0	0
			202	97	38	58	9			

- Molecule 2 is IMIDAZOLE-PYRROLE-HYDROXYPYRROLE POLYAMIDE (three-letter code: HP1) (formula: C₃₁H₄₀N₁₁O₆).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	1
			58	38	13	7		
2	B	1	Total	C	N	O	0	1
			58	38	13	7		

- Molecule 3 is 2-AMINO-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (three-letter code: TRS) (formula: C₄H₁₂NO₃).



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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	36	Total	O	0	0
			36	36		
4	B	29	Total	O	0	0
			29	29		

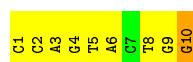
3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of 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.

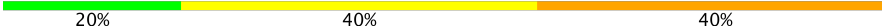
Note EDS was not executed.

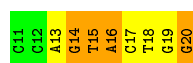
- Molecule 1: DNA (5'-D(*CP*CP*AP*GP*TP*AP*CP*TP*GP*G)-3')

Chain A: 



- Molecule 1: DNA (5'-D(*CP*CP*AP*GP*TP*AP*CP*TP*GP*G)-3')

Chain B: 



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	60.44 Å 30.51 Å 42.76 Å 90.00° 120.47° 90.00°	Depositor
Resolution (Å)	20.00 – 2.20	Depositor
% Data completeness (in resolution range)	91.6 (20.00-2.20)	Depositor
R_{merge}	0.03	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.210 , 0.236	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	593	wwPDB-VP
Average B, all atoms (Å ²)	63.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: TRS, HP1

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	0.96	0/226	0.95	0/347
1	B	1.47	3/226 (1.3%)	1.67	5/347 (1.4%)
All	All	1.24	3/452 (0.7%)	1.36	5/694 (0.7%)

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	2
1	B	0	2
All	All	0	4

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	15	DT	P-O5'	-5.64	1.54	1.59
1	B	15	DT	C1'-N1	-5.49	1.39	1.47
1	B	20	DG	C2-N2	-5.12	1.29	1.34

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	15	DT	C6-N1-C1'	-13.50	100.15	120.40
1	B	15	DT	C2-N1-C1'	11.92	137.27	118.20
1	B	15	DT	C3'-C2'-C1'	-6.62	94.56	102.50
1	B	15	DT	O5'-P-OP1	-5.45	100.80	105.70
1	B	15	DT	N1-C2-O2	5.07	127.15	123.10

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	10	DG	Sidechain
1	A	4	DG	Sidechain
1	B	14	DG	Sidechain
1	B	16	DA	Sidechain

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	202	0	114	12	1
1	B	202	0	112	22	0
2	A	58	0	34	5	0
2	B	58	0	34	4	0
3	A	8	0	12	2	0
4	A	36	0	0	3	0
4	B	29	0	0	4	1
All	All	593	0	306	34	1

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 49.

All (34) 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:9:DG:H2''	1:A:10:DG:H5'	1.42	1.01
2:A:22[A]:HP1:H191	4:A:75:HOH:O	1.77	0.84
1:A:2:DC:OP2	4:A:35:HOH:O	1.97	0.83
2:B:21[B]:HP1:H212	2:B:21[B]:HP1:O5	1.85	0.77
2:A:22[A]:HP1:H301	1:B:13:DA:H2	1.53	0.73
1:A:6:DA:N7	3:A:200:TRS:N	2.37	0.73
1:B:18:DT:H71	4:B:28:HOH:O	1.91	0.69
1:A:1:DC:N4	4:A:95:HOH:O	2.27	0.67
1:B:20:DG:H4'	2:B:21[B]:HP1:H213	1.77	0.66
1:B:15:DT:OP2	1:B:15:DT:H71	1.97	0.65

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:A:22[B]:HP1:H301	1:B:13:DA:H2	1.61	0.64
1:B:19:DG:H3'	4:B:54:HOH:O	1.99	0.62
1:A:1:DC:H2''	1:A:2:DC:O5'	1.99	0.61
1:A:8:DT:H2''	1:A:9:DG:N7	2.17	0.59
1:B:18:DT:H73	4:B:37:HOH:O	2.02	0.59
1:A:9:DG:C2'	1:A:10:DG:H5'	2.26	0.56
1:A:9:DG:H2''	1:A:10:DG:C5'	2.27	0.55
1:B:20:DG:C5'	2:B:21[B]:HP1:H213	2.39	0.52
1:B:16:DA:H1'	1:B:17:DC:H5'	1.91	0.51
1:A:5:DT:C7	3:A:200:TRS:H12	2.40	0.50
1:B:19:DG:C3'	4:B:54:HOH:O	2.60	0.48
1:A:6:DA:N6	1:B:14:DG:C6	2.82	0.47
1:B:14:DG:H2''	1:B:15:DT:H71	1.97	0.46
2:A:22[A]:HP1:H301	1:B:13:DA:C2	2.43	0.44
1:A:3:DA:C2	1:B:19:DG:N2	2.86	0.44
1:B:20:DG:C4'	2:B:21[B]:HP1:H213	2.47	0.43
1:A:1:DC:H6	1:A:1:DC:HO5'	1.65	0.42
2:A:22[B]:HP1:H301	1:B:13:DA:C2	2.50	0.41

All (1) 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:10:DG:O6	4:B:26:HOH:O[3_545]	2.16	0.04

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

There are no protein molecules in this entry.

5.3.2 Protein sidechains [i](#)

There are no protein molecules in this entry.

5.3.3 RNA [i](#)

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 ⓘ

5 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$
3	TRS	A	200	-	7,7,7	2.26	4 (57%)	9,9,9	2.14	2 (22%)
2	HP1	A	22[A]	-	44,51,51	3.04	10 (22%)	43,72,72	1.78	13 (30%)
2	HP1	A	22[B]	-	44,51,51	3.01	10 (22%)	43,72,72	1.86	15 (34%)
2	HP1	B	21[A]	-	44,51,51	3.00	12 (27%)	43,72,72	1.74	9 (20%)
2	HP1	B	21[B]	-	44,51,51	3.00	12 (27%)	43,72,72	1.73	9 (20%)

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	TRS	A	200	-	-	0/9/9/9	0/0/0/0
2	HP1	A	22[A]	-	-	0/26/57/57	0/4/4/4
2	HP1	A	22[B]	-	-	0/26/57/57	0/4/4/4
2	HP1	B	21[A]	-	-	0/26/57/57	0/4/4/4
2	HP1	B	21[B]	-	-	0/26/57/57	0/4/4/4

All (48) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	22[A]	HP1	C25-C24	-15.03	1.42	1.53
2	A	22[B]	HP1	C25-C24	-15.03	1.42	1.53
2	B	21[A]	HP1	C25-C24	-13.59	1.43	1.53
2	B	21[B]	HP1	C25-C24	-13.59	1.43	1.53
2	B	21[A]	HP1	C4-C5	-5.48	1.40	1.48
2	B	21[B]	HP1	C4-C5	-5.48	1.40	1.48
2	A	22[A]	HP1	C-C32	-4.52	1.38	1.49
2	A	22[B]	HP1	C-C32	-4.52	1.38	1.49
2	B	21[A]	HP1	C-C32	-3.94	1.39	1.49
2	B	21[B]	HP1	C-C32	-3.94	1.39	1.49
3	A	200	TRS	C2-C	-3.31	1.44	1.52
2	B	21[A]	HP1	C1-C6	-3.26	1.36	1.39
2	B	21[B]	HP1	C1-C6	-3.26	1.36	1.39
2	B	21[A]	HP1	C24-N8	-3.04	1.32	1.37
2	B	21[B]	HP1	C24-N8	-3.04	1.32	1.37
2	A	22[A]	HP1	C1-C6	-2.97	1.36	1.39
2	A	22[B]	HP1	C1-C6	-2.97	1.36	1.39
2	A	22[A]	HP1	C16-C23	-2.83	1.32	1.50
2	A	22[B]	HP1	C16-C23	-2.83	1.32	1.50
2	A	22[A]	HP1	C4-C5	-2.45	1.44	1.48
2	A	22[B]	HP1	C4-C5	-2.45	1.44	1.48
2	B	21[A]	HP1	C16-C23	-2.01	1.38	1.50
2	B	21[B]	HP1	C16-C23	-2.01	1.38	1.50
3	A	200	TRS	O3-C3	2.14	1.49	1.42
2	B	21[A]	HP1	C27-N9	2.17	1.41	1.37
2	B	21[B]	HP1	C27-N9	2.17	1.41	1.37
3	A	200	TRS	C1-C	2.27	1.58	1.52
2	B	21[A]	HP1	C28-N9	2.37	1.52	1.47
2	B	21[B]	HP1	C28-N9	2.37	1.52	1.47
2	A	22[A]	HP1	C13-C16	2.91	1.43	1.39
2	A	22[B]	HP1	C13-C16	2.91	1.43	1.39
2	A	22[A]	HP1	C13-C12	2.99	1.42	1.39
2	A	22[B]	HP1	C13-C12	2.99	1.42	1.39
2	B	21[A]	HP1	C3-N	3.10	1.52	1.47
2	B	21[B]	HP1	C3-N	3.10	1.52	1.47
2	A	22[A]	HP1	C3-N	3.14	1.52	1.47
2	A	22[B]	HP1	C3-N	3.14	1.52	1.47
3	A	200	TRS	C3-C	3.47	1.61	1.52
2	A	22[A]	HP1	C2-C	3.50	1.39	1.36
2	A	22[B]	HP1	C2-C	3.50	1.39	1.36
2	B	21[A]	HP1	C13-C12	3.57	1.42	1.39
2	B	21[B]	HP1	C13-C12	3.57	1.42	1.39
2	B	21[A]	HP1	C2-C	6.00	1.42	1.36

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	21[B]	HP1	C2-C	6.00	1.42	1.36
2	B	21[A]	HP1	O6-C32	6.61	1.38	1.23
2	B	21[B]	HP1	O6-C32	6.61	1.38	1.23
2	A	22[A]	HP1	O6-C32	7.94	1.41	1.23
2	A	22[B]	HP1	O6-C32	7.94	1.41	1.23

All (48) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	21[A]	HP1	C6-N1-C5	-3.18	122.17	127.58
2	B	21[B]	HP1	C6-N1-C5	-3.18	122.17	127.58
2	A	22[A]	HP1	C6-N1-C5	-3.00	122.47	127.58
2	A	22[B]	HP1	C6-N1-C5	-3.00	122.47	127.58
2	A	22[A]	HP1	C8-N3-C10	-2.98	105.37	108.71
2	A	22[B]	HP1	C8-N3-C10	-2.98	105.37	108.71
2	A	22[A]	HP1	C27-N9-C25	-2.89	105.27	108.56
2	A	22[B]	HP1	C27-N9-C25	-2.89	105.27	108.56
2	B	21[A]	HP1	C8-N3-C10	-2.86	105.50	108.71
2	B	21[B]	HP1	C8-N3-C10	-2.86	105.50	108.71
2	A	22[A]	HP1	C29-N11-C23	-2.74	115.85	122.11
2	A	22[B]	HP1	C29-N11-C23	-2.74	115.85	122.11
2	A	22[A]	HP1	O5-C31-C30	-2.60	117.13	122.01
2	B	21[A]	HP1	O1-C5-C4	-2.56	115.47	121.26
2	B	21[B]	HP1	O1-C5-C4	-2.56	115.47	121.26
2	B	21[A]	HP1	O5-C31-C30	-2.38	117.54	122.01
2	A	22[B]	HP1	O5-C31-C30	-2.26	117.76	122.01
2	B	21[B]	HP1	O5-C31-C30	-2.24	117.81	122.01
2	A	22[A]	HP1	O1-C5-N1	-2.20	119.02	123.84
2	A	22[B]	HP1	O1-C5-N1	-2.20	119.02	123.84
2	B	21[A]	HP1	C27-N9-C25	-2.18	106.08	108.56
2	B	21[B]	HP1	C27-N9-C25	-2.18	106.08	108.56
2	A	22[B]	HP1	O5-C31-N6	-2.17	118.84	122.97
2	A	22[A]	HP1	O4-C24-C25	-2.04	117.52	120.37
2	A	22[B]	HP1	O4-C24-C25	-2.04	117.52	120.37
3	A	200	TRS	C1-C-N	-2.00	103.47	107.73
2	A	22[A]	HP1	C30-C29-N11	2.09	116.19	111.87
2	A	22[A]	HP1	C29-C30-C31	2.12	115.62	112.22
2	A	22[B]	HP1	C21-N7-C20	2.29	119.75	110.75
2	B	21[A]	HP1	C19-C20-N7	2.36	120.19	113.77
2	A	22[B]	HP1	C22-N7-C20	2.48	120.51	110.75
2	A	22[B]	HP1	C30-C29-N11	2.53	117.10	111.87
2	A	22[B]	HP1	C19-C20-N7	2.65	120.98	113.77

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	22[A]	HP1	C19-C20-N7	2.69	121.09	113.77
2	B	21[A]	HP1	C28-N9-C25	2.81	130.37	126.39
2	B	21[B]	HP1	C28-N9-C25	2.81	130.37	126.39
2	A	22[A]	HP1	C19-C18-N6	3.19	121.36	112.18
2	A	22[B]	HP1	C22-N7-C21	3.28	118.52	109.72
2	B	21[B]	HP1	C30-C31-N6	3.29	122.17	116.49
2	B	21[B]	HP1	C19-C20-N7	3.30	122.75	113.77
2	B	21[A]	HP1	C30-C31-N6	3.61	122.72	116.49
2	A	22[A]	HP1	C30-C31-N6	3.67	122.82	116.49
2	A	22[B]	HP1	C30-C31-N6	3.98	123.36	116.49
2	A	22[A]	HP1	C28-N9-C25	3.99	132.05	126.39
2	A	22[B]	HP1	C28-N9-C25	3.99	132.05	126.39
2	B	21[B]	HP1	C29-C30-C31	4.88	120.06	112.22
2	B	21[A]	HP1	C29-C30-C31	5.45	120.99	112.22
3	A	200	TRS	C2-C-N	5.54	119.51	107.73

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 11 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	200	TRS	2	0
2	A	22[A]	HP1	3	0
2	A	22[B]	HP1	2	0
2	B	21[B]	HP1	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 ⓘ

6.1 Protein, DNA and RNA chains ⓘ

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.