



Full wwPDB NMR Structure Validation Report ⓘ

Feb 19, 2022 – 01:44 PM EST

PDB ID : 1S88
Title : NMR structure of a DNA duplex with two INA nucleotides inserted opposite each other, dCTCAACXCAAGCT:dAGCTTGXGTTGAG
Authors : Nielsen, C.B.; Petersen, M.; Pedersen, E.B.; Hansen, P.E.; Christensen, U.B.
Deposited on : 2004-01-31

This is a Full wwPDB NMR Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/NMRValidationReportHelp>

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 : 1.8.5 (274361), CSD as541be (2020)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
RCI : v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV : Wang et al. (2010)
ShiftChecker : 2.26
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.26

2 Ensemble composition and analysis

This entry contains 20 models. This entry does not contain polypeptide chains, therefore identification of well-defined residues and clustering analysis are not possible. All residues are included in the validation scores.

3 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 844 atoms, of which 306 are hydrogens and 0 are deuteriums.

- Molecule 1 is a DNA chain called 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*G P*CP*T)-3'.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	P	
1	A	13	416	135	152	44	73	12	0

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

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	P	
2	B	13	428	139	154	46	77	12	0

4 Residue-property plots

4.1 Average score per residue in the NMR ensemble

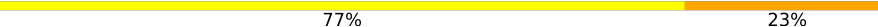
These plots are provided for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic is the same as shown in the summary in section 1 of this report. The second graphic shows the sequence where residues are colour-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outliers are shown as green connectors. Residues which are classified as ill-defined in the NMR ensemble, are shown in cyan with an underline colour-coded according to the previous scheme. Residues which were present in the experimental sample, but not modelled in the final structure are shown in grey.

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 



4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 




4.2.2 Score per residue for model 2

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 




4.2.3 Score per residue for model 3

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 



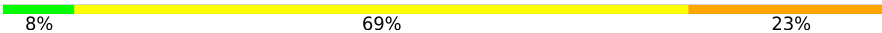
4.2.4 Score per residue for model 4

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 



4.2.5 Score per residue for model 5

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 




4.2.6 Score per residue for model 6

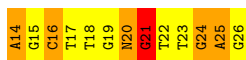
- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 



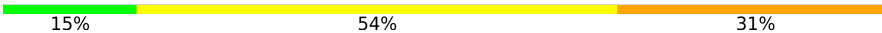
4.2.7 Score per residue for model 7

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

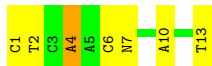
Chain B: 



4.2.8 Score per residue for model 8

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  46% 46% 8%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

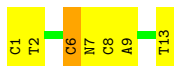
Chain B:  62% 31% 8%



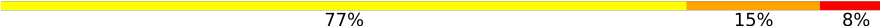
4.2.9 Score per residue for model 9

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  46% 46% 8%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B:  77% 15% 8%



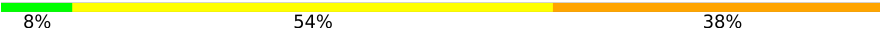
4.2.10 Score per residue for model 10

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  46% 54%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

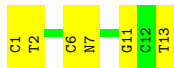
Chain B:  8% 54% 38%



4.2.11 Score per residue for model 11

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  54% 46%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

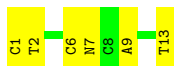
Chain B:  62% 31% 8%



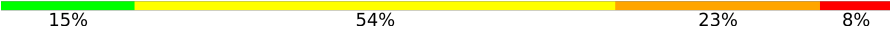
4.2.12 Score per residue for model 12

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  54% 46%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B:  15% 54% 23% 8%



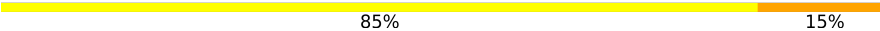
4.2.13 Score per residue for model 13

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  54% 46%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

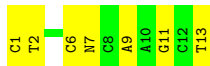
Chain B:  85% 15%




4.2.14 Score per residue for model 14

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 




4.2.15 Score per residue for model 15

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B: 



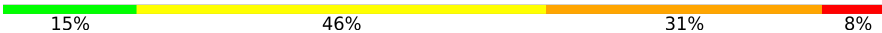
4.2.16 Score per residue for model 16

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A: 



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

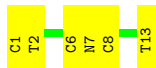
Chain B: 




4.2.17 Score per residue for model 17

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  54% 46%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B:  77% 15% 8%




4.2.18 Score per residue for model 18

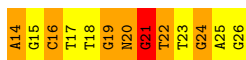
- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  31% 54% 15%



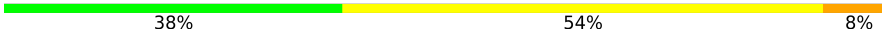
- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

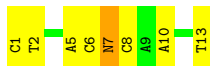
Chain B:  46% 46% 8%



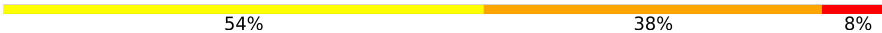
4.2.19 Score per residue for model 19

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  38% 54% 8%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

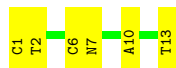
Chain B:  54% 38% 8%



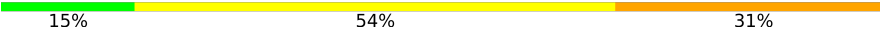
4.2.20 Score per residue for model 20

- Molecule 1: 5'-D(*CP*TP*CP*AP*AP*CP*(2DM)P*CP*AP*AP*GP*CP*T)-3'

Chain A:  54% 46%



- Molecule 2: 5'-D(*AP*GP*CP*TP*TP*GP*(2DM)P*GP*TP*TP*GP*AP*G)-3'

Chain B:  15% 54% 31%



5 Refinement protocol and experimental data overview

The models were refined using the following method: *restraint molecular dynamics*.

Of the 40 calculated structures, 20 were deposited, based on the following criterion: *structures with the lowest energy*.

The authors did not provide any information on software used for structure solution, optimization or refinement.

No chemical shift data was provided.

6 Model quality i

6.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section:
2DM

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 (average) 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	1.38±0.01	0±0/265 (0.0± 0.0%)	1.94±0.03	8±1/403 (2.0± 0.3%)
2	B	1.52±0.01	1±0/277 (0.4± 0.0%)	2.10±0.02	12±1/425 (2.7± 0.3%)
All	All	1.45	20/10840 (0.2%)	2.03	392/16560 (2.4%)

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	Planarity
1	A	0.0±0.0	1.0±0.8
2	B	0.0±0.0	5.3±1.3
All	All	0	127

All unique bond outliers are listed below.

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)	Models	
								Worst	Total
2	B	14	DA	C5'-C4'	5.28	1.57	1.51	19	20

All unique angle outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	2	DT	C6-C5-C7	-11.03	116.28	122.90	10	20
2	B	24	DG	O4'-C1'-N9	10.79	115.55	108.00	14	20
2	B	21	DG	O4'-C1'-N9	10.05	115.03	108.00	9	20
2	B	23	DT	O4'-C1'-N1	9.85	114.89	108.00	3	20
1	A	6	DC	C4'-C3'-C2'	-7.64	96.22	103.10	9	20
1	A	2	DT	O4'-C1'-N1	7.54	113.28	108.00	10	20

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	6	DC	O4'-C1'-N1	7.50	113.25	108.00	5	10
2	B	15	DG	O4'-C1'-N9	7.45	113.22	108.00	8	20
2	B	23	DT	C6-C5-C7	-7.38	118.47	122.90	16	9
1	A	13	DT	C6-C5-C7	-7.11	118.64	122.90	18	20
1	A	4	DA	O4'-C4'-C3'	7.08	110.25	106.00	8	1
1	A	2	DT	C4-C5-C7	6.69	123.02	119.00	10	20
1	A	1	DC	O4'-C1'-N1	6.68	112.68	108.00	6	20
2	B	16	DC	P-O3'-C3'	6.38	127.36	119.70	19	2
2	B	16	DC	C5-C4-N4	6.36	124.66	120.20	2	16
2	B	19	DG	N3-C4-C5	-6.15	125.53	128.60	9	15
1	A	13	DT	O4'-C4'-C3'	6.13	109.68	106.00	12	10
2	B	18	DT	P-O3'-C3'	6.12	127.04	119.70	15	1
2	B	22	DT	O4'-C4'-C3'	6.08	109.65	106.00	10	17
2	B	16	DC	N3-C4-N4	-5.96	113.83	118.00	5	14
1	A	4	DA	O4'-C1'-N9	5.93	112.15	108.00	3	3
2	B	16	DC	O4'-C4'-C3'	5.92	109.55	106.00	7	13
2	B	22	DT	O4'-C1'-N1	5.83	112.08	108.00	20	6
1	A	11	DG	O4'-C4'-C3'	5.82	109.49	106.00	13	4
2	B	24	DG	O4'-C1'-C2'	5.80	110.54	105.90	5	12
2	B	25	DA	C4'-C3'-C2'	-5.53	98.13	103.10	14	16
2	B	19	DG	C8-N9-C4	-5.52	104.19	106.40	9	8
2	B	18	DT	C6-C5-C7	-5.45	119.63	122.90	20	20
1	A	9	DA	O4'-C1'-N9	5.37	111.76	108.00	14	2
1	A	8	DC	N1-C2-O2	5.33	122.09	118.90	18	5
2	B	17	DT	C6-C5-C7	-5.29	119.72	122.90	9	3
1	A	10	DA	O4'-C4'-C3'	5.17	109.10	106.00	1	3
1	A	3	DC	N1-C2-O2	5.03	121.92	118.90	3	2

There are no chirality outliers.

All unique planar outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Group	Models (Total)
2	B	21	DG	Sidechain	20
2	B	25	DA	Sidechain	20
2	B	17	DT	Sidechain	19
2	B	24	DG	Sidechain	14
2	B	26	DG	Sidechain	13
2	B	16	DC	Sidechain	8
2	B	14	DA	Sidechain	7
1	A	3	DC	Sidechain	6

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Mol	Chain	Res	Type	Group	Models (Total)
2	B	22	DT	Sidechain	5
1	A	10	DA	Sidechain	4
1	A	9	DA	Sidechain	4
1	A	6	DC	Sidechain	2
1	A	5	DA	Sidechain	2
1	A	8	DC	Sidechain	1
1	A	4	DA	Sidechain	1
2	B	23	DT	Sidechain	1

6.2 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 each 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 averaged over the ensemble.

Mol	Chain	Non-H	H(model)	H(added)	Clashes
1	A	264	152	152	0±0
2	B	274	154	154	1±1
All	All	10760	6120	6120	11

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 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
2:B:20:2DM:C4'	2:B:21:DG:C8	0.44	3.01	6	9
1:A:7:2DM:C6	2:B:19:DG:H2''	0.41	2.46	18	2

6.3 Torsion angles [i](#)

6.3.1 Protein backbone [i](#)

There are no protein molecules in this entry.

6.3.2 Protein sidechains [i](#)

There are no protein molecules in this entry.

6.3.3 RNA

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains

2 non-standard protein/DNA/RNA residues are modelled in this entry.

In the following table, the Counts columns list the number of bonds for which Mogul statistics could be retrieved, the number of bonds that are observed in the model and the number of bonds 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 is the number of standard deviations the observed value is removed from the expected value. A bond length with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond lengths.

Mol	Type	Chain	Res	Link	Bond lengths		
					Counts	RMSZ	#Z>2
1	2DM	A	7	1	26,29,30	1.10±0.01	3±0 (10±1%)
2	2DM	B	20	2	26,29,30	1.05±0.02	2±0 (9±1%)

In the following table, the Counts columns list the number of angles for which Mogul statistics could be retrieved, the number of angles that are observed in the model and the number of 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 angle is the number of standard deviations the observed value is removed from the expected value. A bond angle with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond angles.

Mol	Type	Chain	Res	Link	Bond angles		
					Counts	RMSZ	#Z>2
1	2DM	A	7	1	36,41,44	0.93±0.02	2±1 (4±1%)
2	2DM	B	20	2	36,41,44	0.81±0.07	0±1 (0±1%)

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	2DM	B	20	2	-	0±0,9,11,12	0±0,4,4,4
1	2DM	A	7	1	-	0±0,9,11,12	0±0,4,4,4

All unique bond outliers are listed below. They are sorted according to the Z-score of the worst

occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)	Models	
								Worst	Total
1	A	7	2DM	C4-C5	2.94	1.43	1.35	17	20
2	B	20	2DM	C2-C1	2.56	1.42	1.37	5	20
1	A	7	2DM	C9-C10	2.29	1.41	1.35	5	20
2	B	20	2DM	C9-C10	2.15	1.41	1.35	1	20
1	A	7	2DM	C2-C1	2.11	1.41	1.37	19	16
2	B	20	2DM	C3-C2	2.07	1.40	1.36	18	5
2	B	20	2DM	C4-C5	2.03	1.40	1.35	6	4

All unique angle outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	7	2DM	C4'-O4'-C3'	2.77	118.98	112.67	2	16
2	B	20	2DM	C4'-O4'-C3'	2.72	118.85	112.67	5	4
2	B	20	2DM	O4'-C4'-C1	2.34	106.30	112.24	4	2
1	A	7	2DM	C4-C5-C13	2.30	117.81	121.36	16	15

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

6.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

6.6 Ligand geometry [i](#)

There are no ligands in this entry.

6.7 Other polymers [i](#)

There are no such molecules in this entry.

6.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

7 Chemical shift validation

No chemical shift data were provided