

Full wwPDB NMR Structure Validation Report (i)

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PDB ID	:	2HK4
Title	:	Dimeric solution structure of the cyclic octamer d(CCGTCCGT)
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Deposited on	:	2006-07-03

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 (i) symbol.

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

MolProbity	:	4.02b-467
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	:	2.27
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.27

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure: $SOLUTION\ NMR$

The overall completeness of chemical shifts assignment was not calculated.

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	Percentile Ranks	Value
Clashscore		1
	Worse	Better
	Percentile relative to all structures	
	Percentile relative to all NMR structures	
	Whole archive NMB archive	

Metric	$egin{array}{c} { m Whole \ archive} \ (\#{ m Entries}) \end{array}$	${f NMR} { m archive} \ (\#{ m Entries})$
Clashscore	158937	12864

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and 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%

Mol	Chain	Length	Quality of chain			
1	А	8	25%	75%		
1	В	8	25%	50%	25%	



2 Ensemble composition and analysis (i)

This entry contains 10 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 is only 1 type of molecule in this entry. The entry contains 500 atoms, of which 180 are hydrogens and 0 are deuteriums.

• Molecule 1 is a DNA chain called 5'-D(P*CP*CP*GP*TP*CP*CP*GP*T)-3'.

Mol	Chain	Residues		I	Aton	ns			Trace
1 1	0	Total	С	Η	Ν	0	Р	0	
		0	250	76	90	26	50	8	0
1 B	8	Total	С	Η	Ν	Ο	Р	0	
		250	76	90	26	50	8	U	



4 Residue-property plots (i)

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(P*CP*CP*GP*TP*CP*CP*GP*T)-3'

Chain A:	25%	75%	
8 3 8 <mark>8 1 8 3 7</mark>	2		
• Molecule	e 1: 5'-D(P*CP*	CP*GP*TP*CP*CP*GP*T)-3'	
Chain B:	25%	50%	25%
C C C C C C C C C C C C C C C C C C C	2		

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(P*CP*CP*GP*TP*CP*CP*GP*T)-3'

Chain A:	25%	38%	38%
<mark>52 1</mark> 14 1 18 1 18 1 18 1 18 1 18 1 18 1 18 1			
• Molecule 1:	5'-D(P*CP*CP*GI	P*TP*CP*CP*GP*T)-3'	
Chain B:			
Ullain D.	25%	38%	38%
588 <mark>788858</mark>	25%	38%	38%



4.2.2 Score per residue for model 2

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

Chain A:	25%	38%	38%
12 22 23 23 23 23 23 23 23 23 23 23 23 23			
• Molecule	1: 5'-D(P*CP*	*CP*GP*TP*CP*CP*GP	*T)-3'
Chain B:	25%	50%	25%
<mark>63 65 65 65 64 78 78 78 78 78 78 78 78 77 78 78 78 78 </mark>			

- 4.2.3 Score per residue for model 3
- Molecule 1: 5'-D(P*CP*CP*GP*TP*CP*CP*GP*T)-3'

Chain A:	50%	50%
C1 C2 C3 C3 C3 C3 C3 C3 C3 T4 T8		

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

Chain B:	25%	50%	25%
C2 C3 C3 C5 C5 C5 C5 C5 C5 C5 C5 C5 C5 C5 C5 C5			

- 4.2.4 Score per residue for model 4
- Molecule 1: 5'-D(P*CP*CP*GP*TP*CP*CP*GP*T)-3'

Chain A:	25%	50%	25%					
C1 C2 G3 T8 T8								
• Molecule 1: 5'-D(P*CP*CP*GP*TP*CP*CP*GP*T)-3'								
Chain B:	25%	50%	25%					
C2 C2 C2 C2 C2 C2 C2 C2 C2 C2 C2 C2 C2 C								



4.2.5 Score per residue for model 5

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

Chain A:	25%	50%	25%
<mark>3 3 8 3 1 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3</mark>			
• Molecule 1:	5'-D(P*CP*0	CP*GP*TP*CP*CP*GP*T)-3	,
Chain B:	25%	50%	25%
C C C C C C C C C C C C C C C C C C C			
126 Sec.	non noridu	o for model 6	
4.2.6 Score	e per residuo	e for model 6	
• Molecule 1:	5'-D(P*CP*0	CP*GP*TP*CP*CP*GP*T)-3	,
Chain A:	25%	38%	38%
C C C C C C C C C C C C C C C C C C C			
• Molecule 1:	5'-D(P*CP*0	CP*GP*TP*CP*CP*GP*T)-3	,
Chain B:	25%	62%	12%
C 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			
4.2.7 Score	e per residu	e for model 7	

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

Chain A:	25%	50%	25%
13 13 13 14 13 14 14 15 15 15 15 15 15 15 15 15 15 15 15 15			
• Molecule	1: 5'-D(P*CP*C	P*GP*TP*CP*CP*GP*T)-;	3'
Chain B:	25%	62%	12%
C2 C2 C2 C5 C6 C6 C6 C6 C6 C6 C6 C6 C7			



4.2.8	Score	e per resid	ue for mode	18		
• Mole	ecule 1:	5'-D(P*CP	*CP*GP*TP	*CP*CP*GP	*T)-3'	
Chain	A:	25%	25%		50%	
63 C1 14 C2 74 C3	C6 G7 T8					
• Mole	ecule 1:	5'-D(P*CP	*CP*GP*TP	*CP*CP*GP	*T)-3'	
Chain	B:	25%		62%		12%
C2 C2 T4	18 18 18					
4.2.9	Score	e per resid	ue for mode	19		
• Mole	ecule 1:	5'-D(P*CP	*CP*GP*TP	*CP*CP*GP	*T)-3'	
Chain	A:	25%		62%		12%
<mark>5 17 63 7</mark>	²⁰					
• Mole	ecule 1:	5'-D(P*CP	*CP*GP*TP	*CP*CP*GP	*T)-3'	
Chain	B:	25%		50%		25%
C2 63 14 64	C6 G7 T8					
4.2.10) Scoi	re per resi	due for mod	el 10		
• Mole	ecule 1:	5'-D(P*CP	*CP*GP*TP	*CP*CP*GP	*T)-3'	
Chain	A:	25%		50%		25%
C1 C2 C2 C3 C3 C1 C1 C1 C1 C1 C1 C1 C1 C1 C1 C2 C2 C2 C2 C2 C2 C2 C2 C2 C2 C2 C2 C2	C6 G7 T8					
• Mole	ecule 1:	5'-D(P*CP	*CP*GP*TP	*CP*CP*GP	*T)-3'	
Chain	B:	25%		50%		25%
63 C2 C3	C6 G7 T8					



5 Refinement protocol and experimental data overview (i)

The models were refined using the following method: *relaxation matrix calculation restrained molecular dynamics*.

Of the 10 calculated structures, 10 were deposited, based on the following criterion: $all \ calculated \ structures \ submitted.$

The following table shows the software used for structure solution, optimisation and refinement.

Software name	Classification	Version
Amber	refinement	7.0

No chemical shift data was provided.



6 Model quality (i)

6.1 Standard geometry (i)

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	B	ond lengths	Bond angles		
		RMSZ	$\#Z{>}5$	RMSZ	#Z > 5
1	А	$1.33 {\pm} 0.02$	$0{\pm}0/177~(~0.0{\pm}~0.0\%)$	$1.82 {\pm} 0.05$	$3{\pm}1/270~(~1.2{\pm}~0.3\%)$
1	В	$1.38 {\pm} 0.01$	$0{\pm}0/177~(~0.0{\pm}~0.0\%)$	$1.95 {\pm} 0.02$	$5{\pm}1/270~(~1.8{\pm}~0.4\%)$
All	All	1.35	0/3540 ($0.0%$)	1.89	80/5400~(~1.5%)

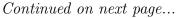
Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain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

Mol	Chain	Chirality	Planarity
1	А	$0.0{\pm}0.0$	$3.5 {\pm} 0.7$
1	В	$0.0{\pm}0.0$	4.0 ± 0.0
All	All	0	75

There are no bond-length outliers.

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

Mal	Mol Chain Res		Turne	Atoms	Z	Observed(0)	Ideal(0)	Models	
	Unam	nes	Type	Atoms		$Observed(^{o})$	$\mathrm{Ideal}(^{o})$	Worst	Total
1	В	8	DT	O4'-C1'-N1	9.54	114.68	108.00	4	10
1	В	4	DT	O4'-C1'-N1	9.23	114.46	108.00	5	10
1	А	8	DT	O4'-C1'-N1	8.67	114.07	108.00	6	10
1	А	4	DT	O4'-C1'-N1	8.08	113.66	108.00	6	10
1	А	6	DC	O4'-C4'-C3'	6.45	109.87	106.00	5	4
1	В	2	DC	O4'-C4'-C3'	6.41	109.85	106.00	4	8
1	А	5	DC	P-O3'-C3'	6.02	126.92	119.70	2	1
1	А	1	DC	P-O3'-C3'	5.97	126.86	119.70	4	1
1	А	2	DC	O4'-C4'-C3'	5.96	109.58	106.00	6	4
1	В	6	DC	O4'-C4'-C3'	5.90	109.54	106.00	7	7
1	В	8	DT	C5-C6-N1	-5.47	120.42	123.70	10	5
1	В	3	DG	O4'-C1'-N9	-5.38	104.23	108.00	1	2
1	В	4	DT	C5-C6-N1	-5.27	120.54	123.70	7	5





Mal	Chain	Dec	Trune	Atoma	7	Observed ⁽⁰⁾	Idea1(0)	Mod	lels	
Mol	Chain	nes	Type	Atoms		$\mathbf{C} = \mathbf{Observed}(^{o})$	$\mathbf{Z} \left \begin{array}{c} \mathbf{Observed}(^{o}) \\ \mathbf{Ideal}(^{o}) \end{array} \right \mathbf{Ideal}(^{o})$	Ideal(*)	Worst	Total
1	А	6	DC	O4'-C1'-N1	-5.10	104.43	108.00	2	1	
1	В	7	DG	O4'-C1'-N9	-5.08	104.44	108.00	10	1	
1	А	4	DT	C6-C5-C7	-5.01	119.89	122.90	5	1	

Continued from previous page...

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)
1	А	3	DG	Sidechain	10
1	А	7	DG	Sidechain	10
1	В	2	DC	Sidechain	10
1	В	3	DG	Sidechain	10
1	В	6	DC	Sidechain	10
1	В	7	DG	Sidechain	10
1	А	2	DC	Sidechain	8
1	А	6	DC	Sidechain	7

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	А	160	90	90	1 ± 0
All	All	3200	1800	1800	7

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	
Atom-1	Atom-2	Clash(A)	Distance(A)	Worst	Total
1:A:7:DG:H2"	1:A:8:DT:H73	0.47	1.86	1	4
1:A:3:DG:H2"	1:A:4:DT:H73	0.44	1.89	6	3



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 (i)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains (i)

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

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 (i)

No chemical shift data were provided

