wwPDB NMR Structure Validation Summary Report (i)

Nov 7, 2023 – 09:20 AM EST

PDB ID	:	2K4G
Title	:	Solution Structure of a Peptide Nucleic Acid Duplex, 10 structures
Authors	:	He, W.; Hatcher, E.; Balaeff, A.; Beratan, D.; Gil, R.; Madrid, M.; Achim, C.
Deposited on	:	2008-06-07

This is a wwPDB NMR 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
https://www.wwpdb.org/validation/2017/NMRValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

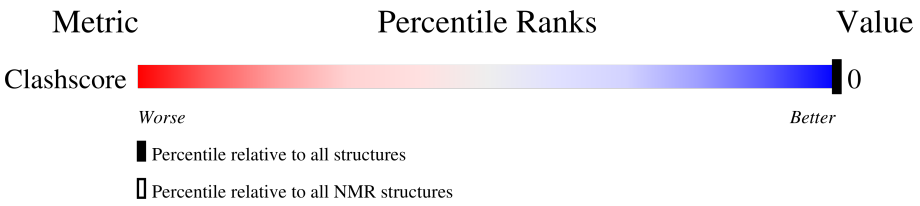
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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	Whole archive (#Entries)	NMR archive (#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	A	9	11% 89%
1	B	9	11% 89%

2 Ensemble composition and analysis (i)

This entry contains 11 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.

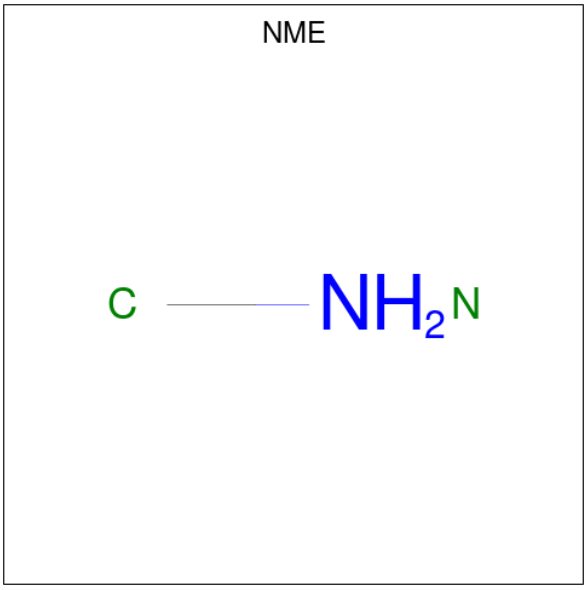
3 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 546 atoms, of which 224 are hydrogens and 0 are deuteriums.

- Molecule 1 is a DNA chain called PNA (N'-(*(GPN)*(GPN)*(CPN)*(APN)*(TPN)*(GPN)*(CPN)*(CPN))-C').

Mol	Chain	Residues	Atoms					Trace
			Total	C	H	N	O	
1	A	9	267	87	108	47	25	0
1	B	9	267	87	108	47	25	0

- Molecule 2 is METHYLAMINE (three-letter code: NME) (formula: CH_5N).



Mol	Chain	Residues	Atoms			
			Total	C	H	N
2	A	1	6	1	4	1
2	B	1	6	1	4	1

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: PNA (N'-(*(GPN)*(GPN)*(CPN)*(APN)*(TPN)*(GPN)*(CPN)*(CPN))-C')

Chain A: 11% 89%

ACE1 GPN2 GPN3 CPN4 APN5 TPN6 GPN7 CPN8 CPN9

• Molecule 1: PNA (N'-(*(GPN)*(GPN)*(CPN)*(APN)*(TPN)*(GPN)*(CPN)*(CPN))-C')

Chain B: 11% 89%

ACE1 GPN2 GPN3 CPN4 APN5 TPN6 GPN7 CPN8 CPN9

4.2 Residue scores for the representative (author defined) model from the NMR ensemble

The representative model is number 1. Colouring as in section 4.1 above.

• Molecule 1: PNA (N'-(*(GPN)*(GPN)*(CPN)*(APN)*(TPN)*(GPN)*(CPN)*(CPN))-C')

Chain A: 11% 89%

ACE1 GPN2 GPN3 CPN4 APN5 TPN6 GPN7 CPN8 CPN9

• Molecule 1: PNA (N'-(*(GPN)*(GPN)*(CPN)*(APN)*(TPN)*(GPN)*(CPN)*(CPN))-C')

Chain B: 11% 89%

ACE1
GPN2
GPN3
CPN4
APN5
TPN6
GPN7
CPN8
CPN9

5 Refinement protocol and experimental data overview (i)

The models were refined using the following method: *SIMULATED ANNEALING, MOLECULAR DYNAMICS IN EXPLICIT SOLVENT*.

Of the 11 calculated structures, 11 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	9

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: NME, APN, ACE, GPN, CPN, TPN

There are no covalent bond-length or bond-angle outliers.

There are no bond-length outliers.

There are no bond-angle outliers.

There are no chirality outliers.

There are no planarity outliers.

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
All	All	3542	2464	1496	-

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 -.

There are no clashes.

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)

16 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	APN	B	5	1	18,21,22	0.82±0.01	1±0 (4±2%)
1	CPN	B	8	1	18,18,19	0.91±0.03	1±0 (5±0%)
1	TPN	A	6	1	19,19,20	0.97±0.02	1±0 (5±0%)
1	GPN	A	7	1	18,22,23	1.03±0.02	1±0 (5±0%)
1	CPN	B	9	2,1	18,18,19	0.91±0.02	1±0 (5±0%)
1	CPN	A	9	2,1	18,18,19	0.91±0.02	1±0 (5±0%)
1	GPN	B	3	1	18,22,23	1.01±0.02	1±0 (5±0%)
1	CPN	B	4	1	18,18,19	0.99±0.02	1±0 (5±0%)
1	CPN	A	4	1	18,18,19	1.00±0.02	1±0 (5±0%)
1	GPN	B	2	1	18,22,23	1.01±0.02	1±0 (5±0%)
1	GPN	A	3	1	18,22,23	1.02±0.01	1±0 (5±0%)
1	APN	A	5	1	18,21,22	0.83±0.02	1±0 (3±2%)
1	CPN	A	8	1	18,18,19	0.92±0.03	1±0 (5±0%)
1	GPN	B	7	1	18,22,23	1.02±0.01	1±0 (5±0%)
1	GPN	A	2	1	18,22,23	1.00±0.02	1±0 (5±0%)
1	TPN	B	6	1	19,19,20	0.99±0.01	1±0 (5±0%)

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	APN	B	5	1	15,28,30	1.63±0.04	5±0 (33±2%)

Mol	Type	Chain	Res	Link	Bond angles		
					Counts	RMSZ	#Z>2
1	CPN	B	8	1	20,23,25	1.69±0.05	5±1 (26±3%)
1	TPN	A	6	1	23,25,27	1.49±0.01	4±0 (19±2%)
1	GPN	A	7	1	17,30,32	1.61±0.04	5±0 (29±0%)
1	CPN	B	9	2,1	20,23,25	1.79±0.05	6±1 (30±4%)
1	CPN	A	9	2,1	20,23,25	1.76±0.06	6±1 (28±4%)
1	GPN	B	3	1	17,30,32	1.54±0.04	5±0 (26±2%)
1	CPN	B	4	1	20,23,25	1.66±0.02	6±0 (32±2%)
1	CPN	A	4	1	20,23,25	1.65±0.02	6±0 (32±2%)
1	GPN	B	2	1	17,30,32	1.53±0.06	4±0 (25±2%)
1	GPN	A	3	1	17,30,32	1.54±0.07	4±1 (26±5%)
1	APN	A	5	1	15,28,30	1.68±0.05	5±1 (36±5%)
1	CPN	A	8	1	20,23,25	1.69±0.04	6±1 (27±3%)
1	GPN	B	7	1	17,30,32	1.62±0.04	5±0 (28±2%)
1	GPN	A	2	1	17,30,32	1.55±0.11	4±1 (24±4%)
1	TPN	B	6	1	23,25,27	1.50±0.03	5±0 (22±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
1	GPN	B	7	1	-	0±0,13,14,15	0±0,2,2,2
1	TPN	A	6	1	-	0±0,13,14,15	0±0,1,1,1
1	CPN	A	4	1	-	0±0,13,14,15	0±0,1,1,1
1	CPN	A	9	2,1	-	0±0,13,14,15	0±0,1,1,1
1	GPN	B	3	1	-	0±0,13,14,15	0±0,2,2,2
1	GPN	B	2	1	-	0±0,13,14,15	0±0,2,2,2
1	GPN	A	3	1	-	0±0,13,14,15	0±0,2,2,2
1	GPN	A	2	1	-	0±0,13,14,15	0±0,2,2,2
1	CPN	B	9	2,1	-	0±0,13,14,15	0±0,1,1,1
1	CPN	A	8	1	-	0±0,13,14,15	0±0,1,1,1
1	CPN	B	8	1	-	0±0,13,14,15	0±0,1,1,1
1	APN	B	5	1	-	0±0,13,14,15	0±0,2,2,2
1	GPN	A	7	1	-	0±0,13,14,15	0±0,2,2,2
1	APN	A	5	1	-	0±0,13,14,15	0±0,2,2,2
1	TPN	B	6	1	-	0±0,13,14,15	0±0,1,1,1
1	CPN	B	4	1	-	0±0,13,14,15	0±0,1,1,1

5 of 16 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	4	CPN	C8'-N1	3.05	1.50	1.46	7	11
1	B	4	CPN	C8'-N1	2.94	1.50	1.46	5	11
1	B	9	CPN	C8'-N1	2.75	1.49	1.46	4	11
1	A	8	CPN	C8'-N1	2.68	1.49	1.46	7	11
1	B	8	CPN	C8'-N1	2.64	1.49	1.46	4	11

5 of 105 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(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	A	9	CPN	C8'-C7'-N4'	3.92	122.02	117.08	5	9
1	B	9	CPN	C8'-C7'-N4'	3.68	121.71	117.08	4	8
1	A	6	TPN	C6-C5-C4	3.57	121.02	118.03	2	11
1	B	8	CPN	C7'-C8'-N1	3.56	114.14	110.99	7	4
1	B	6	TPN	C6-C5-C4	3.52	120.97	118.03	3	11

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)

2 ligands 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
2	NME	A	10	1	0,1,1	0.00±0.00	-
2	NME	B	10	1	0,1,1	0.00±0.00	-

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
2	NME	A	10	1	-	-	-
2	NME	B	10	1	-	-	-

There are no bond-length outliers.

There are no bond-angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

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