Full wwPDB X-ray Structure Validation Report (i)

Sep 16, 2023 – 04:29 PM EDT

PDB ID	:	4WKJ
Title	:	Crystallographic Structure of a Dodecameric RNA-DNA Hybrid
Authors	:	Davis, R.R.; Shaban, N.M.; Perrino, F.W.; Hollis, T.
Deposited on	:	2014-10-02
Resolution	:	2.80 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
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
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 (1)) were used in the production of this report:

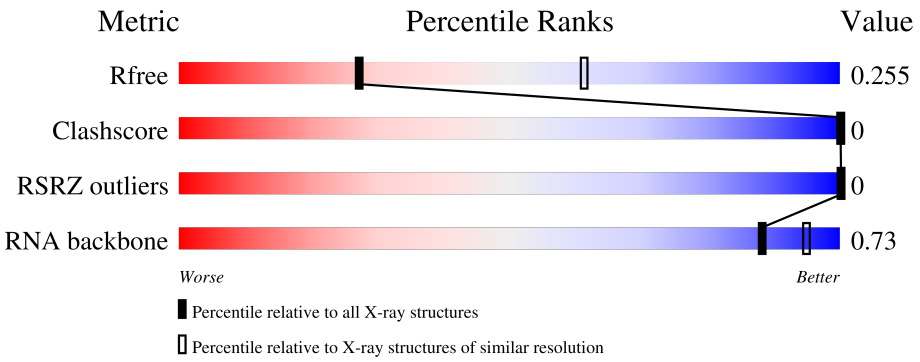
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

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 2.80 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}	130704	3140 (2.80-2.80)
Clashscore	141614	3569 (2.80-2.80)
RSRZ outliers	127900	3078 (2.80-2.80)
RNA backbone	3102	1227 (3.10-2.50)

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 of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. 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	12	100%
1	C	12	92% 8%
1	D	12	92% 8%
1	G	12	75% 25%
2	B	12	92% 8%
2	E	12	92% 8%

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Mol	Chain	Length	Quality of chain
2	F	12	83% 17%
2	H	12	92% 8%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	MG	F	101	-	-	-	X

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 1982 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 RNA chain called RNA (5'-R(*GP*AP*CP*AP*CP*CP*UP*GP*AP*UP*UP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	D	12	249	113	43	82	11	0	0	0
1	A	12	249	113	43	82	11	0	0	0
1	C	12	249	113	43	82	11	0	0	0
1	G	12	249	113	43	82	11	0	0	0

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	E	12	246	118	47	70	11	0	0	0
2	B	12	246	118	47	70	11	0	0	0
2	F	12	246	118	47	70	11	0	0	0
2	H	12	246	118	47	70	11	0	0	0

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mg		
3	F	1	1	1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	H	1	1	1	0	0

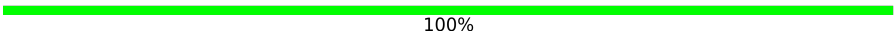
3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide 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.

• Molecule 1: RNA (5'-R(*GP*AP*CP*AP*CP*CP*UP*GP*AP*UP*UP*C)-3')

Chain D:

• Molecule 1: RNA (5'-R(*GP*AP*CP*AP*CP*CP*UP*GP*AP*UP*UP*C)-3')

Chain A: 

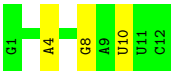
There are no outlier residues recorded for this chain.

• Molecule 1: RNA (5'-R(*GP*AP*CP*AP*CP*CP*UP*GP*AP*UP*UP*C)-3')

Chain C:

• Molecule 1: RNA (5'-R(*GP*AP*CP*AP*CP*CP*UP*GP*AP*UP*UP*C)-3')

Chain G:



• Molecule 2: DNA (5'-D(*GP*AP*AP*TP*CP*AP*GP*GP*TP*GP*TP*C)-3')

Chain E:

• Molecule 2: DNA (5'-D(*GP*AP*AP*TP*CP*AP*GP*GP*TP*GP*TP*C)-3')

Chain B:

• Molecule 2: DNA (5'-D(*GP*AP*AP*TP*CP*AP*GP*GP*TP*GP*TP*C)-3')

Chain F:

• Molecule 2: DNA (5'-D(*GP*AP*AP*TP*CP*AP*GP*GP*TP*GP*TP*C)-3')

Chain H:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	46.65Å 44.46Å 83.35Å 90.00° 105.27° 90.00°	Depositor
Resolution (Å)	26.27 – 2.80 26.27 – 2.80	Depositor EDS
% Data completeness (in resolution range)	99.5 (26.27-2.80) 99.7 (26.27-2.80)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.17 (at 2.80Å)	Xtriage
Refinement program	REFMAC 5.8.0085	Depositor
R, R_{free}	0.238 , 0.242 0.239 , 0.255	Depositor DCC
R_{free} test set	385 reflections (4.65%)	wwPDB-VP
Wilson B-factor (Å^2)	47.6	Xtriage
Anisotropy	0.035	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 40.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.53$, $< L^2 > = 0.37$	Xtriage
Estimated twinning fraction	0.011 for h,-k,-h-l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	1982	wwPDB-VP
Average B, all atoms (Å^2)	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 64.63 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 8.0348e-06. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality (i)

5.1 Standard geometry (i)

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

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	0.61	0/277	0.80	0/429
1	C	0.83	0/277	1.02	1/429 (0.2%)
1	D	0.62	0/277	0.98	2/429 (0.5%)
1	G	0.83	0/277	1.11	3/429 (0.7%)
2	B	0.51	0/276	0.91	1/425 (0.2%)
2	E	0.66	0/276	0.94	1/425 (0.2%)
2	F	1.14	1/276 (0.4%)	1.01	1/425 (0.2%)
2	H	0.69	0/276	1.02	1/425 (0.2%)
All	All	0.76	1/2212 (0.0%)	0.98	10/3416 (0.3%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	F	1	DG	O3'-P	-12.32	1.46	1.61

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	D	9	A	O5'-P-OP2	-9.40	97.24	105.70
1	C	6	C	O5'-P-OP1	-8.45	98.09	105.70
1	G	8	G	O5'-P-OP2	-6.70	99.67	105.70
1	G	4	A	O5'-P-OP2	6.07	117.98	110.70
1	D	9	A	O5'-P-OP1	5.98	117.87	110.70
2	H	11	DT	O5'-P-OP1	-5.43	100.81	105.70
1	G	10	U	O5'-P-OP1	5.39	117.17	110.70
2	E	3	DA	O5'-P-OP1	5.36	117.13	110.70
2	B	6	DA	O5'-P-OP2	-5.27	100.95	105.70
2	F	7	DG	O5'-P-OP2	-5.05	101.15	105.70

There are no chirality outliers.

There are no planarity outliers.

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	249	0	131	0	0
1	C	249	0	131	0	0
1	D	249	0	131	0	0
1	G	249	0	131	0	0
2	B	246	0	137	0	0
2	E	246	0	137	0	0
2	F	246	0	137	0	0
2	H	246	0	137	0	0
3	F	1	0	0	0	0
4	H	1	0	0	0	0
All	All	1982	0	1072	0	0

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 0.

There are no clashes within the asymmetric unit.

There are no symmetry-related clashes.

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)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	A	11/12 (91%)	0	0

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Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	C	11/12 (91%)	0	0
1	D	11/12 (91%)	0	0
1	G	11/12 (91%)	0	0
All	All	44/48 (91%)	0	0

There are no RNA backbone outliers to report.

There are no RNA pucker outliers to report.

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

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

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

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.

No monomer is involved in short contacts.

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 (i)

6.1 Protein, DNA and RNA chains (i)

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, 95th 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	12/12 (100%)	0.10	0	100	100	55, 59, 65, 65	0
1	C	12/12 (100%)	0.29	0	100	100	47, 49, 56, 61	0
1	D	12/12 (100%)	0.37	0	100	100	59, 64, 69, 69	0
1	G	12/12 (100%)	0.41	0	100	100	43, 45, 54, 60	0
2	B	12/12 (100%)	0.07	0	100	100	59, 61, 67, 73	0
2	E	12/12 (100%)	0.12	0	100	100	60, 62, 73, 81	0
2	F	12/12 (100%)	0.01	0	100	100	48, 52, 60, 67	0
2	H	12/12 (100%)	0.01	0	100	100	48, 51, 64, 69	0
All	All	96/96 (100%)	0.17	0	100	100	43, 59, 69, 81	0

There are no RSRZ outliers to report.

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

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

6.3 Carbohydrates (i)

There are no monosaccharides in this entry.

6.4 Ligands (i)

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. The B-factors column lists the minimum, median, 95th 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	B-factors(Å^2)	Q<0.9
3	MG	F	101	1/1	0.77	0.46	44,44,44,44	0

6.5 Other polymers (i)

There are no such residues in this entry.