Full wwPDB X-ray Structure Validation Report ⓘ

Oct 15, 2023 – 01:58 AM EDT

PDB ID	:	8CS6
Title	:	[AGG/CTC] Self-Assembled 3D DNA Hexagonal Tensegrity Triangle
Authors	:	Lu, B.; Vecchioni, S.; Ohayon, Y.P.; Seeman, N.C.; Mao, C.; Sha, R.
Deposited on	:	2022-05-12
Resolution	:	6.76 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 ⓘ 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 ⓘ) were used in the production of this report:

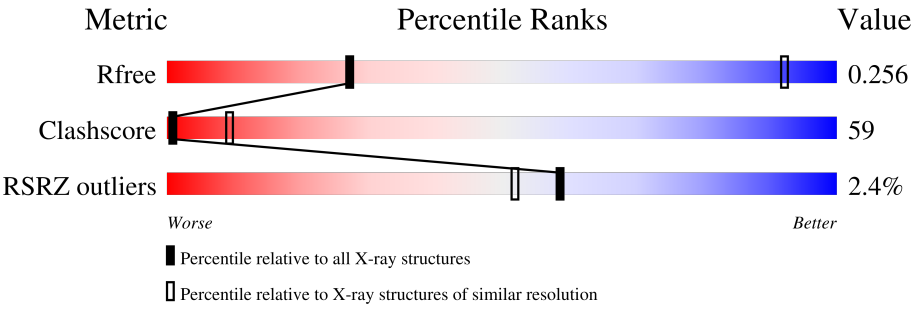
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 6.76 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	1002 (9.50-3.90)
Clashscore	141614	1066 (9.50-3.90)
RSRZ outliers	127900	1004 (9.50-3.80)

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	21	5%, 5%, 57%, 38%
2	B	7	29%, 71%
3	C	5	80%, 20%
4	D	9	11%, 56%, 33%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 855 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(*AP*GP*GP*CP*AP*GP*CP*CP*TP*GP*TP*AP*CP*GP*GP*AP*CP*AP*TP*CP*A)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	A	21	429	204	84	121	20	0	0	0

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	B	7	141	67	26	41	7	0	0	0

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
3	C	5	105	49	20	31	5	0	0	0

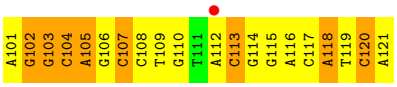
- Molecule 4 is a DNA chain called DNA (5'-D(*CP*TP*CP*TP*GP*AP*TP*GP*T)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
4	D	9	180	88	29	55	8	0	0	0

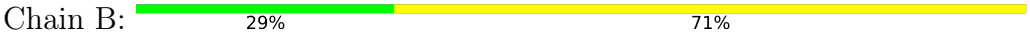
3 Residue-property plots (i)

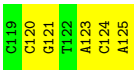
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: DNA (5'-D(*AP*GP*GP*CP*AP*GP*CP*CP*TP*GP*TP*AP*CP*GP*GP*AP*CP*AP*TP*CP*A)-3')

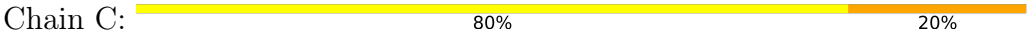


• Molecule 2: DNA (5'-D(P*CP*CP*GP*TP*AP*CP*A)-3')

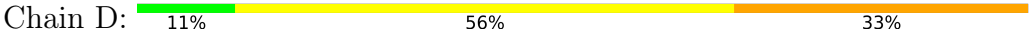




• Molecule 3: DNA (5'-D(P*GP*GP*CP*TP*G)-3')



• Molecule 4: DNA (5'-D(*CP*TP*CP*TP*GP*AP*TP*GP*T)-3')



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 63	Depositor
Cell constants a, b, c, α, β, γ	121.26Å 121.26Å 59.28Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	60.63 – 6.76 60.63 – 6.76	Depositor EDS
% Data completeness (in resolution range)	83.1 (60.63-6.76) 73.2 (60.63-6.76)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	0.39 (at 6.70Å)	Xtriage
Refinement program	PHENIX 1.19.2_4158	Depositor
R, R_{free}	0.215 , 0.256 0.218 , 0.256	Depositor DCC
R_{free} test set	39 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å^2)	205.6	Xtriage
Anisotropy	1.231	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.10 , 999.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.40$, $< L^2 > = 0.25$	Xtriage
Estimated twinning fraction	0.211 for h,-h-k,-l	Xtriage
F_o,F_c correlation	0.89	EDS
Total number of atoms	855	wwPDB-VP
Average B, all atoms (Å^2)	459.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.59% of the height of the origin peak. No significant pseudotranslation is detected.*

[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)

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	3.10	32/482 (6.6%)	1.61	9/742 (1.2%)
2	B	1.45	1/157 (0.6%)	1.26	0/239
3	C	1.42	0/117	1.47	1/179 (0.6%)
4	D	1.78	7/200 (3.5%)	1.38	1/307 (0.3%)
All	All	2.47	40/956 (4.2%)	1.49	11/1467 (0.7%)

All (40) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	101	DA	C5-C4	20.68	1.53	1.38
1	A	101	DA	C5-C6	16.91	1.56	1.41
1	A	101	DA	N9-C4	14.58	1.46	1.37
1	A	101	DA	C6-N6	14.18	1.45	1.33
1	A	102	DG	C5-C6	14.13	1.56	1.42
1	A	102	DG	C6-O6	13.62	1.36	1.24
1	A	101	DA	C8-N7	13.25	1.40	1.31
1	A	103	DG	N3-C4	13.06	1.44	1.35
1	A	101	DA	N1-C2	12.46	1.45	1.34
1	A	102	DG	C6-N1	11.65	1.47	1.39
1	A	102	DG	C5-C4	11.10	1.46	1.38
1	A	101	DA	C6-N1	11.03	1.43	1.35
1	A	102	DG	N1-C2	10.86	1.46	1.37
1	A	102	DG	N7-C5	10.46	1.45	1.39
1	A	101	DA	N7-C5	9.74	1.45	1.39
1	A	103	DG	C6-N1	9.73	1.46	1.39
1	A	102	DG	N3-C4	9.04	1.41	1.35
4	D	201	DT	C1'-N1	8.65	1.60	1.49
1	A	101	DA	N3-C4	8.49	1.40	1.34
1	A	103	DG	N9-C4	8.22	1.44	1.38
1	A	107	DC	C1'-N1	7.50	1.59	1.49
4	D	200	DC	C2-N3	7.03	1.41	1.35
1	A	101	DA	C2-N3	6.86	1.39	1.33
1	A	103	DG	C5-C4	6.76	1.43	1.38

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	103	DG	C6-O6	6.74	1.30	1.24
1	A	103	DG	C2-N3	6.69	1.38	1.32
1	A	120	DC	C1'-N1	6.69	1.57	1.49
4	D	200	DC	N3-C4	6.57	1.38	1.33
1	A	104	DC	C1'-N1	6.08	1.57	1.49
2	B	123	DA	C3'-O3'	-6.01	1.36	1.44
1	A	113	DC	C3'-O3'	-5.87	1.36	1.44
4	D	200	DC	C4-N4	5.86	1.39	1.33
1	A	103	DG	N9-C8	5.73	1.41	1.37
4	D	203	DT	C1'-N1	5.57	1.56	1.49
1	A	103	DG	N1-C2	5.56	1.42	1.37
1	A	103	DG	C2-N2	5.54	1.40	1.34
1	A	103	DG	N7-C5	5.50	1.42	1.39
1	A	102	DG	C2-N3	5.50	1.37	1.32
4	D	200	DC	C2-O2	5.47	1.29	1.24
4	D	200	DC	N1-C2	5.30	1.45	1.40

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	120	DC	O4'-C1'-N1	8.37	113.86	108.00
1	A	101	DA	C5-C6-N1	-8.02	113.69	117.70
1	A	102	DG	O4'-C1'-N9	-6.86	103.20	108.00
1	A	101	DA	C4-C5-N7	-6.39	107.50	110.70
1	A	102	DG	C4-C5-N7	-6.20	108.32	110.80
1	A	102	DG	C6-C5-N7	6.19	134.11	130.40
1	A	101	DA	N1-C2-N3	6.01	132.30	129.30
1	A	105	DA	OP1-P-OP2	-5.83	110.85	119.60
1	A	118	DA	O4'-C1'-N9	-5.45	104.19	108.00
4	D	207	DG	C1'-O4'-C4'	-5.34	104.76	110.10
3	C	211	DC	O4'-C1'-N1	-5.08	104.45	108.00

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	429	0	236	38	1
2	B	141	0	79	4	0
3	C	105	0	57	24	0
4	D	180	0	105	14	1
All	All	855	0	477	75	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 59.

All (75) 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:107:DC:O2	1:A:108:DC:N4	2.06	0.88
3:C:210:DG:H2'	3:C:211:DC:C6	2.19	0.77
1:A:103:DG:H1'	1:A:104:DC:H5'	1.67	0.76
1:A:105:DA:C2	3:C:213:DG:N2	2.58	0.70
3:C:211:DC:H2'	3:C:212:DT:C6	2.26	0.70
3:C:209:DG:N2	3:C:210:DG:H1'	2.09	0.68
1:A:121:DA:H8	1:A:121:DA:H5'	1.59	0.66
1:A:104:DC:H1'	1:A:105:DA:C8	2.30	0.65
3:C:209:DG:C2	3:C:210:DG:C4	2.85	0.63
2:B:120:DC:H2"	2:B:121:DG:N7	2.14	0.62
1:A:121:DA:H5'	1:A:121:DA:C8	2.34	0.62
4:D:204:DG:C2	4:D:205:DA:C4	2.90	0.60
3:C:209:DG:H2'	3:C:210:DG:C8	2.37	0.60
1:A:107:DC:O2	1:A:108:DC:C4	2.54	0.60
3:C:211:DC:H2'	3:C:212:DT:C5	2.37	0.59
3:C:209:DG:C6	3:C:210:DG:C6	2.92	0.57
1:A:103:DG:H1'	1:A:104:DC:C5'	2.34	0.56
1:A:113:DC:H3'	1:A:113:DC:OP2	2.05	0.56
1:A:105:DA:N1	3:C:213:DG:N2	2.53	0.55
3:C:209:DG:C8	3:C:209:DG:OP1	2.61	0.54
1:A:114:DG:H5"	1:A:114:DG:H8	1.73	0.54
4:D:203:DT:H2"	4:D:204:DG:H8	1.73	0.53
4:D:201:DT:C2	4:D:202:DC:C5	2.97	0.52
1:A:121:DA:C6	4:D:204:DG:C2	2.97	0.52
1:A:115:DG:C2	1:A:116:DA:C5	2.98	0.52
1:A:115:DG:H2"	1:A:116:DA:H8	1.74	0.52
4:D:207:DG:H2"	4:D:208:DT:H6	1.75	0.52
1:A:109:DT:H2'	1:A:110:DG:C8	2.44	0.51
1:A:105:DA:C6	3:C:213:DG:N2	2.78	0.51
1:A:119:DT:H4'	1:A:120:DC:OP1	2.10	0.51

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:D:204:DG:C6	4:D:205:DA:C6	2.98	0.51
4:D:204:DG:H1'	4:D:205:DA:H5'	1.93	0.51
3:C:212:DT:H2'	3:C:213:DG:C8	2.45	0.50
3:C:210:DG:H2'	3:C:211:DC:N1	2.26	0.50
1:A:108:DC:H2'	1:A:109:DT:O4'	2.12	0.49
3:C:209:DG:C5	3:C:210:DG:C5	3.01	0.48
3:C:209:DG:N1	3:C:210:DG:C4	2.82	0.48
2:B:124:DC:H2'	2:B:125:DA:C8	2.49	0.47
1:A:107:DC:H2"	1:A:108:DC:H5	1.80	0.47
1:A:116:DA:H1'	1:A:117:DC:H5'	1.97	0.46
1:A:116:DA:C5	1:A:117:DC:C4	3.03	0.46
4:D:202:DC:H2"	4:D:203:DT:OP1	2.16	0.46
3:C:212:DT:H2'	3:C:213:DG:N9	2.31	0.46
1:A:112:DA:C4	1:A:113:DC:C5	3.06	0.44
3:C:209:DG:N1	3:C:210:DG:N3	2.66	0.44
1:A:112:DA:H1'	1:A:113:DC:O5'	2.18	0.44
1:A:104:DC:H4'	1:A:105:DA:OP1	2.16	0.43
3:C:210:DG:O5'	3:C:210:DG:H8	2.01	0.43
1:A:114:DG:H5"	1:A:114:DG:C8	2.52	0.43
4:D:201:DT:C2	4:D:202:DC:C4	3.07	0.43
3:C:209:DG:C6	3:C:210:DG:N1	2.87	0.43
1:A:120:DC:O2	1:A:121:DA:N7	2.51	0.42
4:D:207:DG:H2"	4:D:208:DT:O4'	2.19	0.42
1:A:119:DT:N3	1:A:120:DC:C4	2.88	0.42
4:D:204:DG:N2	4:D:205:DA:N3	2.67	0.42
1:A:115:DG:C4	1:A:116:DA:N7	2.88	0.42
2:B:120:DC:H6	2:B:120:DC:H2'	1.66	0.42
3:C:209:DG:H2'	3:C:209:DG:N3	2.35	0.42
4:D:204:DG:N1	4:D:205:DA:C6	2.87	0.42
3:C:209:DG:C6	3:C:210:DG:C2	3.07	0.42
1:A:114:DG:H2"	1:A:115:DG:OP2	2.19	0.42
3:C:209:DG:N1	3:C:210:DG:C2	2.88	0.42
1:A:112:DA:H4'	1:A:113:DC:OP1	2.20	0.41
4:D:203:DT:OP1	4:D:203:DT:C6	2.74	0.41
1:A:112:DA:C4	1:A:113:DC:C4	3.09	0.41
3:C:209:DG:C5	3:C:210:DG:C6	3.08	0.41
1:A:113:DC:H6	1:A:113:DC:H2'	1.49	0.41
1:A:117:DC:H4'	1:A:118:DA:OP1	2.21	0.41
1:A:109:DT:H5"	1:A:110:DG:OP2	2.21	0.41
1:A:104:DC:H1'	1:A:105:DA:N7	2.36	0.41
1:A:105:DA:C2	1:A:106:DG:C4	3.10	0.40

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:121:DA:N6	4:D:204:DG:C6	2.88	0.40
3:C:209:DG:C6	3:C:210:DG:C5	3.09	0.40
2:B:121:DG:H8	2:B:121:DG:O5'	2.05	0.40
1:A:116:DA:C2	1:A:117:DC:C2	3.10	0.40

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:102:DG:N2	4:D:202:DC:O2[5_555]	2.17	0.03

5.3 Torsion angles

5.3.1 Protein backbone

There are no protein molecules in this entry.

5.3.2 Protein sidechains

There are no protein molecules in this entry.

5.3.3 RNA

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 monosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

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

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, 95^{th} 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	21/21 (100%)	-0.48	1 (4%) 30 29	265, 430, 667, 796	0
2	B	7/7 (100%)	-0.64	0 100 100	266, 301, 401, 418	0
3	C	5/5 (100%)	-1.02	0 100 100	443, 445, 470, 477	0
4	D	9/9 (100%)	-0.83	0 100 100	278, 476, 589, 636	0
All	All	42/42 (100%)	-0.65	1 (2%) 59 52	265, 445, 665, 796	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	112	DA	2.4

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

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

6.3 Carbohydrates

There are no monosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.