



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 01:14 AM UTC

PDB ID : 7U3U / pdb_00007u3u
Title : [L223] Self-assembling tensegrity triangle with two turns, two turns and three turns of DNA per axis by linker addition with P1 symmetry
Authors : Woloszyn, K.; Vecchioni, S.; Seeman, N.C.; Sha, R.; Ohayon, Y.P.
Deposited on : 2022-02-28
Resolution : 4.46 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	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

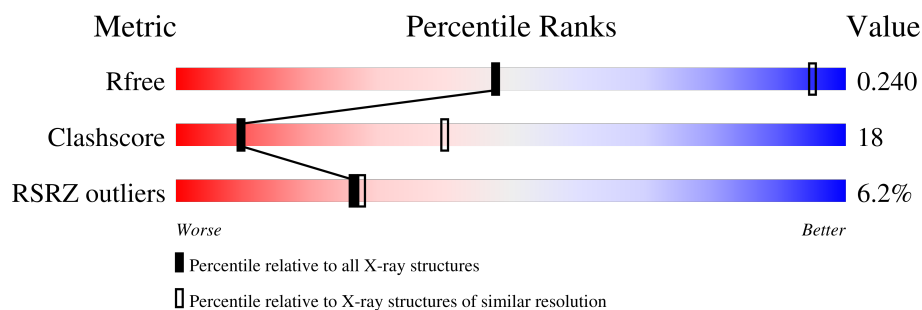
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 4.46 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.



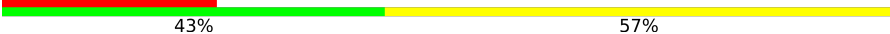
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	1119 (5.02-3.90)
Clashscore	190562	1024 (5.00-3.92)
RSRZ outliers	180081	1114 (5.02-3.90)

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 $\leq 5\%$. 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% 38% 62%
2	C	14	7% 93%
3	D	14	29% 71%
4	E	21	5% 24% 76%
5	H	14	43% 57%
6	I	21	10% 52% 48%
7	Y	10	30% 70%

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Mol	Chain	Length	Quality of chain
8	X	10	 30%60%10%
9	M	21	 24%43%57%

2 Entry composition [i](#)

There are 9 unique types of molecules in this entry. The entry contains 2973 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*AP*CP*CP*TP*AP*CP*TP*TP*GP*GP*CP*AP*GP*GP*AP*CP*GP*AP*CP*T)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	21	Total	C	N	O	P	0	0	0
			427	204	81	122	20			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	14	Total	C	N	O	P	0	0	0
			290	139	53	85	13			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	14	Total	C	N	O	P	0	0	0
			285	137	49	86	13			

- Molecule 4 is a DNA chain called DNA (5'-D(*CP*AP*CP*GP*AP*GP*CP*CP*TP*GP*AP*TP*CP*GP*GP*AP*CP*AP*AP*GP*A)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	E	21	Total	C	N	O	P	0	0	0
			430	204	87	119	20			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	H	14	Total	C	N	O	P	0	0	0
			284	137	46	88	13			

- Molecule 6 is a DNA chain called DNA (5'-D(*AP*CP*GP*CP*GP*AP*CP*CP*TP*GP*TP*AP*CP*GP*GP*AP*CP*AP*TP*CP*A)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	I	21	Total	C	N	O	P	0	0	0
			426	203	82	121	20			

- Molecule 7 is a DNA chain called DNA (5'-D(*GP*AP*CP*TP*CP*TP*GP*CP*TP*A)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	Y	10	Total	C	N	O	P	0	0	0
			200	97	35	59	9			

- Molecule 8 is a DNA chain called DNA (5'-D(P*GP*TP*TP*AP*GP*CP*AP*GP*AP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
8	X	10	Total	C	N	O	P	0	0	0
			210	99	42	59	10			

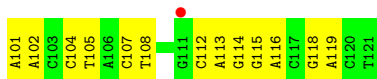
- Molecule 9 is a DNA chain called DNA (5'-D(P*AP*CP*AP*CP*CP*GP*AP*TP*CP*AP*CP*CP*TP*GP*CP*CP*AP*CP*CP*GP*T)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
9	M	21	Total	C	N	O	P	0	0	0
			421	200	76	124	21			

3 Residue-property plots

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.

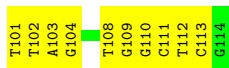
- Molecule 1: DNA (5'-D(*AP*AP*CP*CP*TP*AP*CP*TP*TP*GP*GP*CP*AP*GP*GP*AP*CP*GP*AP*CP*T)-3')



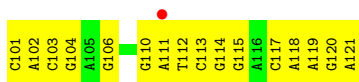
- Molecule 2: DNA (5'-D(*TP*CP*TP*GP*AP*TP*GP*TP*GP*GP*TP*AP*GP*G)-3')



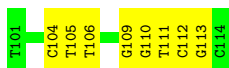
- Molecule 3: DNA (5'-D(*TP*TP*AP*GP*TP*CP*GP*TP*GP*GP*CP*TP*CP*G)-3')



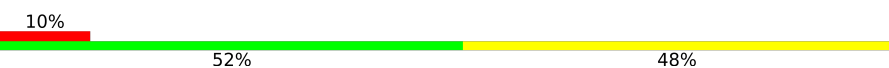
- Molecule 4: DNA (5'-D(*CP*AP*CP*GP*AP*GP*CP*CP*TP*GP*AP*TP*CP*GP*GP*AP*CP*AP*AP*GP*A)-3')

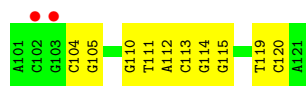


- Molecule 5: DNA (5'-D(*TP*GP*TP*CP*TP*TP*GP*TP*GP*GP*TP*CP*GP*C)-3')

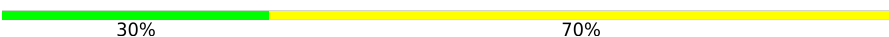


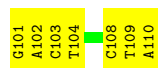
- Molecule 6: DNA (5'-D(*AP*CP*GP*CP*GP*AP*CP*CP*TP*GP*TP*AP*CP*GP*GP*AP*CP*AP*TP*CP*A)-3')

Chain I: 



- Molecule 7: DNA (5'-D(*GP*AP*CP*TP*CP*TP*GP*CP*TP*A)-3')

Chain Y: 



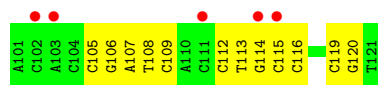
- Molecule 8: DNA (5'-D(P*GP*TP*TP*AP*GP*CP*AP*GP*AP*G)-3')

Chain X: 



- Molecule 9: DNA (5'-D(P*AP*CP*AP*CP*CP*GP*AP*TP*CP*AP*CP*CP*TP*GP*CP*CP*AP*CP*CP*GP*T)-3')

Chain M: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	67.16Å 69.17Å 99.46Å 107.84° 96.45° 97.03°	Depositor
Resolution (Å)	45.60 – 4.46 45.60 – 4.46	Depositor EDS
% Data completeness (in resolution range)	56.5 (45.60-4.46) 52.5 (45.60-4.46)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	0.54 (at 4.46Å)	Xtriage
Refinement program	PHENIX 1.18.2_3874	Depositor
R, R_{free}	0.224 , 0.240 0.223 , 0.240	Depositor DCC
R_{free} test set	282 reflections (2.78%)	wwPDB-VP
Wilson B-factor (Å ²)	213.0	Xtriage
Anisotropy	0.070	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.17 , 171.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	2973	wwPDB-VP
Average B, all atoms (Å ²)	247.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.22% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

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	0.26	0/479	0.54	0/737
2	C	0.27	0/325	0.60	0/502
3	D	0.26	0/318	0.98	1/490 (0.2%)
4	E	0.28	0/484	0.53	0/745
5	H	0.28	0/316	0.63	0/487
6	I	0.27	0/478	0.52	0/735
7	Y	0.27	0/223	0.49	0/342
8	X	0.27	0/236	1.13	3/363 (0.8%)
9	M	0.22	0/470	0.43	0/720
All	All	0.26	0/3329	0.65	4/5121 (0.1%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
3	D	108	DT	P-O3'-C3'	16.15	144.42	120.20
8	X	104	DA	P-O3'-C3'	-15.57	96.85	120.20
8	X	104	DA	OP1-P-O3'	-8.99	81.02	108.00
8	X	104	DA	OP2-P-O3'	6.00	126.02	108.00

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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	427	0	237	9	0
2	C	290	0	161	10	0
3	D	285	0	161	10	0
4	E	430	0	235	16	0
5	H	284	0	162	8	0
6	I	426	0	236	8	0
7	Y	200	0	115	7	0
8	X	210	0	113	7	0
9	M	421	0	235	8	0
All	All	2973	0	1655	81	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 18.

All (81) 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)
3:D:111:DC:H42	4:E:106:DG:H1	1.28	0.82
1:A:104:DC:H2'	1:A:105:DT:H71	1.66	0.77
5:H:112:DC:H2'	5:H:113:DG:C8	2.21	0.74
7:Y:108:DC:H2'	7:Y:109:DT:H72	1.72	0.71
7:Y:109:DT:H2''	7:Y:110:DA:C8	2.29	0.68
7:Y:103:DC:H2''	7:Y:104:DT:H5''	1.77	0.66
3:D:112:DT:H2'	3:D:113:DC:C6	2.31	0.65
5:H:105:DT:H2''	5:H:106:DT:H72	1.80	0.63
3:D:112:DT:H2'	3:D:113:DC:H6	1.64	0.62
3:D:109:DG:H2'	3:D:110:DG:C8	2.34	0.62
5:H:109:DG:H2'	5:H:110:DG:C8	2.36	0.60
6:I:113:DC:H1'	6:I:114:DG:C5	2.37	0.59
2:C:112:DA:H2'	2:C:113:DG:C8	2.38	0.58
3:D:101:DT:H3'	3:D:102:DT:H71	1.86	0.57
4:E:120:DG:N2	5:H:105:DT:O2	2.37	0.57
2:C:105:DA:H2''	2:C:106:DT:H71	1.86	0.57
9:M:119:DC:H2''	9:M:120:DG:C5	2.40	0.57
8:X:103:DT:H2''	8:X:104:DA:C8	2.40	0.56
8:X:107:DA:H2''	8:X:108:DG:O5'	2.05	0.56
8:X:108:DG:H2'	8:X:109:DA:C8	2.42	0.55
1:A:114:DG:H2''	1:A:115:DG:C8	2.41	0.55
2:C:112:DA:H2'	2:C:113:DG:H8	1.73	0.54
5:H:111:DT:H2''	5:H:112:DC:O5'	2.05	0.54
4:E:101:DC:H2'	4:E:102:DA:C4	2.43	0.54
1:A:114:DG:H2''	1:A:115:DG:N7	2.23	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:E:103:DC:H2''	4:E:104:DG:H5''	1.90	0.53
9:M:105:DC:H2''	9:M:106:DG:C5	2.45	0.52
4:E:119:DA:C8	4:E:119:DA:H5'	2.44	0.52
4:E:112:DT:H2'	4:E:113:DC:C6	2.45	0.51
4:E:112:DT:H2''	4:E:113:DC:O5'	2.10	0.51
6:I:112:DA:H8	6:I:112:DA:OP1	1.93	0.50
1:A:118:DG:H2''	1:A:119:DA:C8	2.46	0.50
2:C:111:DT:H2''	2:C:112:DA:O5'	2.11	0.50
7:Y:108:DC:H2'	7:Y:109:DT:C7	2.42	0.50
6:I:112:DA:H8	6:I:112:DA:P	2.35	0.50
4:E:102:DA:H2''	4:E:103:DC:OP1	2.12	0.50
4:E:113:DC:H1'	4:E:114:DG:C5	2.47	0.49
4:E:112:DT:H2'	4:E:113:DC:C5	2.47	0.49
4:E:110:DG:H2'	4:E:111:DA:C8	2.48	0.49
5:H:110:DG:H2''	5:H:111:DT:H71	1.95	0.49
4:E:120:DG:H2''	4:E:121:DA:C8	2.49	0.48
4:E:120:DG:H2''	4:E:121:DA:H8	1.79	0.47
9:M:108:DT:H2''	9:M:109:DC:C6	2.49	0.47
9:M:115:DC:H2''	9:M:116:DC:C5	2.50	0.47
2:C:109:DG:H2'	2:C:110:DG:C8	2.48	0.46
2:C:104:DG:H1'	2:C:105:DA:H5'	1.97	0.46
2:C:113:DG:H2''	2:C:114:DG:H8	1.81	0.46
8:X:105:DG:H2''	8:X:106:DC:C6	2.50	0.46
8:X:108:DG:H2''	8:X:109:DA:H5'	1.97	0.46
2:C:102:DC:H2''	2:C:103:DT:H71	1.98	0.46
3:D:111:DC:H2''	3:D:112:DT:O5'	2.15	0.45
6:I:114:DG:H2''	6:I:115:DG:C8	2.50	0.45
9:M:106:DG:H2''	9:M:107:DA:OP2	2.16	0.45
1:A:112:DC:OP1	1:A:112:DC:H6	2.00	0.45
6:I:110:DG:H2'	6:I:111:DT:C6	2.50	0.45
3:D:101:DT:H2''	3:D:102:DT:OP1	2.17	0.44
8:X:104:DA:H2''	8:X:105:DG:H5''	2.00	0.44
3:D:101:DT:H2'	3:D:102:DT:C6	2.53	0.44
4:E:114:DG:H2''	4:E:115:DG:C8	2.53	0.44
3:D:103:DA:H2''	3:D:104:DG:C8	2.52	0.44
7:Y:101:DG:H2'	7:Y:102:DA:C8	2.52	0.44
4:E:117:DC:H2''	4:E:118:DA:C8	2.53	0.43
6:I:113:DC:H1'	6:I:114:DG:C6	2.54	0.43
9:M:112:DC:H2''	9:M:113:DT:C6	2.53	0.43
9:M:119:DC:H2''	9:M:120:DG:C4	2.52	0.43
4:E:118:DA:H2''	4:E:119:DA:C8	2.54	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:H:104:DC:H4'	5:H:105:DT:H5'	2.00	0.43
9:M:113:DT:H2''	9:M:114:DG:OP2	2.19	0.42
6:I:104:DC:H2''	6:I:105:DG:C8	2.54	0.42
7:Y:103:DC:OP1	7:Y:103:DC:H6	2.01	0.42
2:C:108:DT:H4'	2:C:109:DG:OP2	2.19	0.42
7:Y:109:DT:H2''	7:Y:110:DA:N7	2.35	0.42
1:A:107:DC:H2''	1:A:108:DT:H71	2.01	0.41
1:A:113:DA:H1'	1:A:114:DG:C5	2.55	0.41
1:A:101:DA:H2'	1:A:102:DA:C8	2.56	0.41
2:C:101:DT:H2''	2:C:102:DC:OP1	2.21	0.41
1:A:115:DG:H4'	1:A:116:DA:OP1	2.20	0.40
8:X:106:DC:H2''	8:X:107:DA:OP1	2.20	0.40
3:D:112:DT:H2''	3:D:113:DC:O5'	2.20	0.40
5:H:110:DG:C2'	5:H:111:DT:H71	2.51	0.40
6:I:119:DT:H2''	6:I:120:DC:O5'	2.21	0.40

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](#)

There are no RNA molecules in this entry.

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 oligosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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	21/21 (100%)	0.72	1 (4%) 35 33	172, 212, 257, 263	0
2	C	14/14 (100%)	0.48	0 100 100	208, 247, 309, 322	0
3	D	14/14 (100%)	0.70	0 100 100	179, 230, 262, 266	0
4	E	21/21 (100%)	0.79	1 (4%) 35 33	189, 223, 266, 273	0
5	H	14/14 (100%)	0.47	0 100 100	203, 247, 303, 309	0
6	I	21/21 (100%)	0.80	2 (9%) 14 18	198, 243, 313, 324	0
7	Y	10/10 (100%)	0.33	0 100 100	302, 343, 368, 375	0
8	X	10/10 (100%)	0.54	0 100 100	294, 344, 416, 417	0
9	M	21/21 (100%)	1.42	5 (23%) 2 5	183, 198, 227, 231	0
All	All	146/146 (100%)	0.75	9 (6%) 26 28	172, 230, 365, 417	0

All (9) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
9	M	115	DC	4.0
9	M	103	DA	2.8
4	E	111	DA	2.7
9	M	111	DC	2.6
6	I	102	DC	2.6
9	M	114	DG	2.4
1	A	111	DG	2.2
9	M	102	DC	2.1
6	I	103	DG	2.1

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 oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.