



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 04:49 PM UTC

PDB ID : 1N4L / pdb_00001n4l
Title : A DNA analogue of the polypurine tract of HIV-1
Authors : Cote, M.L.; Pflomm, M.; Georgiadis, M.M.
Deposited on : 2002-10-31
Resolution : 2.00 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

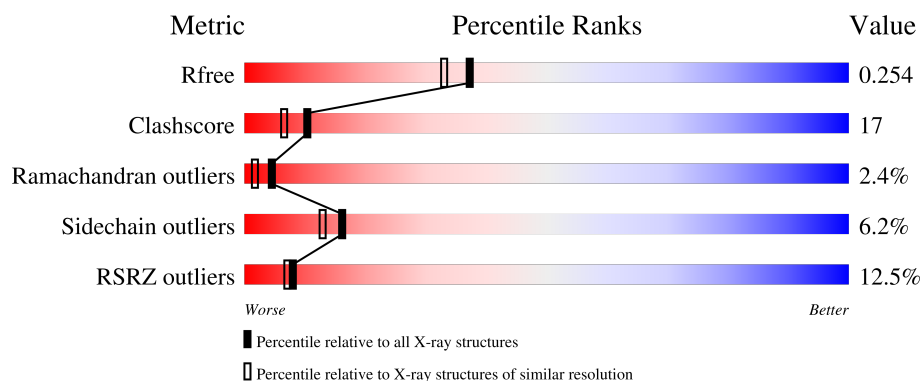
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	B	16	31% 38% 62%
2	D	16	25% 12% 88%
3	A	255	11% 69% 25% 5%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2834 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 5'-D(*CP*TP*TP*TP*TP*TP*AP*AP*AP*AP*GP*AP*AP*AP*AP*G)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	16	Total	C	N	O	P	0	16	0
			328	159	63	91	15			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	D	16	Total	C	N	O	P	0	16	0
			322	158	52	97	15			

- Molecule 3 is a protein called Reverse Transcriptase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	255	Total	C	N	O	S	0	0	0
			2039	1311	356	365	7			

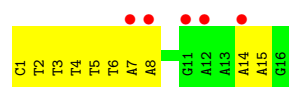
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	D	2	Total	O	0	0
			2	2		
4	A	143	Total	O	0	0
			143	143		

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.

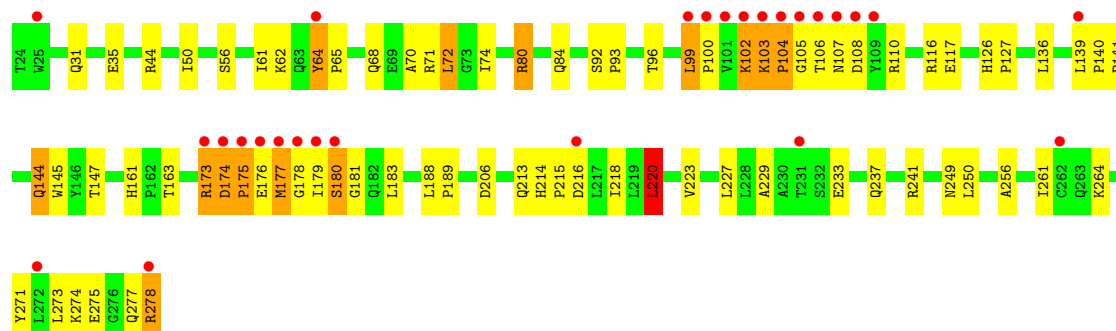
- Molecule 1: 5'-D(*CP*TP*TP*TP*TP*TP*AP*AP*AP*AP*GP*AP*AP*AP*AP*G)-3'



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



- Molecule 3: Reverse Transcriptase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	54.41Å 146.22Å 46.78Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.00 50.00 – 2.00	Depositor EDS
% Data completeness (in resolution range)	93.2 (50.00-2.00) 93.6 (50.00-2.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.91 (at 2.01Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.240 , 0.269 0.226 , 0.254	Depositor DCC
R_{free} test set	1249 reflections (5.12%)	wwPDB-VP
Wilson B-factor (Å ²)	32.0	Xtriage
Anisotropy	0.178	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 39.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	2834	wwPDB-VP
Average B, all atoms (Å ²)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.59% 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 [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	$\# Z > 5$
3	A	0.91	0/2095	1.53	20/2857 (0.7%)

There are no bond length outliers.

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	278	ARG	CD-NE-CZ	7.28	134.59	124.40
3	A	174	ASP	N-CA-C	-6.84	94.69	109.81
3	A	96	THR	O-C-N	6.36	126.51	121.55
3	A	116	ARG	CA-C-O	-6.27	113.90	120.55
3	A	139	LEU	CA-C-N	6.17	124.10	119.66
3	A	139	LEU	C-N-CA	6.17	124.10	119.66
3	A	44	ARG	NE-CZ-NH2	5.94	124.54	119.20
3	A	220	LEU	CA-C-O	-5.91	114.45	120.71
3	A	261	ILE	N-CA-C	5.78	116.63	108.36
3	A	56	SER	CA-C-O	5.65	127.54	121.55
3	A	264	LYS	N-CA-C	-5.53	106.21	113.17
3	A	180	SER	O-C-N	5.32	127.76	122.12
3	A	277	GLN	OE1-CD-NE2	-5.31	117.29	122.60
3	A	80	ARG	NE-CZ-NH2	5.23	123.91	119.20
3	A	93	PRO	CA-C-O	5.21	126.05	118.86
3	A	84	GLN	OE1-CD-NE2	-5.20	117.41	122.60
3	A	92	SER	CA-C-N	5.14	125.22	119.87
3	A	92	SER	C-N-CA	5.14	125.22	119.87
3	A	50	ILE	CA-C-N	5.03	125.19	119.90
3	A	50	ILE	C-N-CA	5.03	125.19	119.90

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	B	328	0	183	9	0
2	D	322	0	186	16	0
3	A	2039	0	2056	63	1
4	A	143	0	0	12	0
4	D	2	0	0	0	0
All	All	2834	0	2425	87	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 17.

All (87) 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:A:177:MET:HE2	3:A:178:GLY:CA	1.69	1.21
3:A:177:MET:HE2	3:A:178:GLY:N	1.62	1.15
3:A:177:MET:HE2	3:A:178:GLY:HA2	1.31	1.11
1:B:5[B]:DT:H4'	1:B:6[B]:DT:OP1	1.38	1.07
1:B:14[B]:DA:H2''	1:B:15[B]:DA:H5'	1.41	1.03
2:D:24[D]:DT:H4'	2:D:25[D]:DT:OP1	1.58	1.02
3:A:278:ARG:HD2	4:A:377:HOH:O	1.58	1.01
2:D:30[D]:DA:H2''	2:D:31[D]:DA:H5'	1.41	0.99
3:A:177:MET:CE	3:A:178:GLY:HA2	1.93	0.96
3:A:100:PRO:HG2	4:A:366:HOH:O	1.71	0.91
3:A:103:LYS:HB3	3:A:104:PRO:HD3	1.53	0.90
2:D:23[D]:DT:H1'	2:D:24[D]:DT:O5'	1.70	0.90
3:A:161:HIS:HD2	3:A:163:THR:H	1.20	0.89
3:A:278:ARG:CD	4:A:377:HOH:O	2.18	0.86
2:D:23[D]:DT:C1'	2:D:24[D]:DT:O5'	2.31	0.79
3:A:103:LYS:CB	3:A:104:PRO:HD3	2.12	0.79
3:A:177:MET:HE2	3:A:178:GLY:H	1.46	0.79
3:A:177:MET:CE	3:A:178:GLY:N	2.46	0.76
3:A:80:ARG:NH1	4:A:330:HOH:O	2.19	0.76
3:A:177:MET:CE	3:A:178:GLY:CA	2.56	0.75
3:A:174:ASP:HB3	3:A:177:MET:O	1.89	0.72
3:A:161:HIS:CD2	3:A:163:THR:H	2.08	0.70

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:14[B]:DA:C2'	1:B:15[B]:DA:H5'	2.21	0.69
2:D:30[D]:DA:C2'	2:D:31[D]:DA:H5'	2.21	0.68
3:A:61:ILE:HD11	3:A:117:GLU:HG3	1.77	0.67
1:B:5[B]:DT:C4'	1:B:6[B]:DT:OP1	2.28	0.65
3:A:71:ARG:HD2	3:A:175:PRO:HD3	1.81	0.63
3:A:103:LYS:CB	3:A:104:PRO:CD	2.77	0.63
3:A:100:PRO:HD2	4:A:366:HOH:O	1.99	0.62
3:A:103:LYS:HE3	3:A:110:ARG:NH1	2.14	0.62
3:A:220:LEU:HD22	3:A:227:LEU:HD23	1.81	0.62
3:A:179:ILE:HD13	3:A:183:LEU:HD21	1.84	0.60
3:A:103:LYS:HB3	3:A:104:PRO:CD	2.29	0.60
2:D:24[D]:DT:C4'	2:D:25[D]:DT:OP1	2.25	0.60
3:A:206:ASP:HB3	3:A:250:LEU:HD13	1.83	0.60
2:D:25[D]:DT:H1'	2:D:26[D]:DT:H5''	1.83	0.59
3:A:99:LEU:HD12	3:A:99:LEU:N	2.18	0.58
3:A:233:GLU:O	3:A:237:GLN:HG3	2.04	0.57
2:D:27[D]:DA:H2''	2:D:28[D]:DA:C8	2.41	0.56
3:A:100:PRO:CG	4:A:366:HOH:O	2.42	0.56
3:A:100:PRO:CD	4:A:366:HOH:O	2.53	0.56
3:A:177:MET:HE1	3:A:178:GLY:HA2	1.87	0.55
2:D:23[D]:DT:C2'	2:D:24[D]:DT:O5'	2.55	0.55
2:D:17[D]:DC:H2'	2:D:18[D]:DT:H72	1.90	0.54
2:D:25[D]:DT:H1'	2:D:26[D]:DT:C5'	2.38	0.54
2:D:21[D]:DT:H1'	2:D:22[D]:DC:C6	2.44	0.53
3:A:173:ARG:CZ	3:A:180:SER:O	2.57	0.53
3:A:71:ARG:NH1	4:A:316:HOH:O	2.39	0.52
1:B:1[B]:DC:H2'	1:B:2[B]:DT:H72	1.90	0.52
3:A:216:ASP:HB3	4:A:381:HOH:O	2.08	0.52
3:A:71:ARG:NH1	3:A:175:PRO:HG3	2.27	0.50
3:A:102:LYS:HB2	3:A:105:GLY:O	2.12	0.50
3:A:274:LYS:HG2	3:A:275:GLU:HG3	1.93	0.50
3:A:174:ASP:O	3:A:175:PRO:C	2.54	0.50
3:A:233:GLU:HG2	3:A:237:GLN:HE21	1.77	0.49
3:A:173:ARG:HA	3:A:173:ARG:HE	1.78	0.48
3:A:70:ALA:HB1	3:A:100:PRO:CG	2.44	0.48
3:A:68:GLN:HG2	3:A:72:LEU:HD22	1.95	0.48
3:A:173:ARG:NH2	3:A:179:ILE:O	2.46	0.48
3:A:278:ARG:HG3	4:A:377:HOH:O	2.13	0.48
3:A:237:GLN:CD	4:A:398:HOH:O	2.58	0.47
1:B:5[B]:DT:C6	1:B:6[B]:DT:H72	2.51	0.46
2:D:26[D]:DT:H2''	2:D:27[D]:DA:O5'	2.15	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:3[B]:DT:H1'	1:B:4[B]:DT:H5'	1.99	0.45
1:B:7[B]:DA:H2''	1:B:8[B]:DA:O5'	2.17	0.45
2:D:27[D]:DA:H2''	2:D:28[D]:DA:H8	1.79	0.45
3:A:173:ARG:NH1	3:A:180:SER:O	2.50	0.45
3:A:214:HIS:N	3:A:215:PRO:HD3	2.31	0.45
3:A:31:GLN:NE2	3:A:249:ASN:OD1	2.50	0.45
2:D:24[D]:DT:H2''	2:D:25[D]:DT:H71	1.98	0.44
3:A:106:THR:HG23	3:A:107:ASN:OD1	2.17	0.44
3:A:188:LEU:HA	3:A:189:PRO:HD3	1.80	0.44
3:A:213:GLN:HA	3:A:213:GLN:HE21	1.82	0.44
2:D:19[D]:DT:H1'	2:D:20[D]:DT:H5'	1.99	0.43
3:A:74:ILE:HD11	3:A:100:PRO:HB3	2.00	0.43
3:A:237:GLN:O	3:A:241:ARG:HG3	2.19	0.43
3:A:64:TYR:HE2	3:A:99:LEU:HG	1.84	0.42
3:A:213:GLN:C	3:A:215:PRO:HD3	2.44	0.42
3:A:145:TRP:CH2	3:A:233:GLU:HB2	2.55	0.42
3:A:144:GLN:HE21	3:A:144:GLN:HB3	1.61	0.41
1:B:1[B]:DC:N3	3:A:99:LEU:HD23	2.35	0.41
3:A:216:ASP:OD2	3:A:216:ASP:N	2.54	0.41
3:A:218:ILE:HB	3:A:229:ALA:HB3	2.03	0.40
3:A:35:GLU:CD	3:A:256:ALA:HB3	2.45	0.40
3:A:278:ARG:CG	4:A:377:HOH:O	2.59	0.40
3:A:140:PRO:HA	3:A:141:PRO:HD3	1.88	0.40
3:A:126:HIS:HA	3:A:127:PRO:HD3	1.98	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)
3:A:271:TYR:OH	3:A:271:TYR:OH[2_665]	2.07	0.13

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was

analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
3	A	253/255 (99%)	241 (95%)	6 (2%)	6 (2%)	4 2

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	103	LYS
3	A	175	PRO
3	A	104	PRO
3	A	223	VAL
3	A	108	ASP
3	A	181	GLY

5.3.2 Protein sidechains ⓘ

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
3	A	224/224 (100%)	210 (94%)	14 (6%)	16 13

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	A	62	LYS
3	A	64	TYR
3	A	65	PRO
3	A	72	LEU
3	A	99	LEU
3	A	102	LYS
3	A	136	LEU
3	A	144	GLN
3	A	147	THR
3	A	173	ARG
3	A	176	GLU
3	A	177	MET
3	A	220	LEU
3	A	273	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
3	A	31	GLN
3	A	77	HIS
3	A	79	GLN
3	A	126	HIS
3	A	131	ASN
3	A	144	GLN
3	A	161	HIS
3	A	213	GLN
3	A	237	GLN
3	A	245	GLN
3	A	249	ASN
3	A	277	GLN

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 [i](#)

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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
2	D	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	D	24[D]:DT	O3'	25[D]:DT	P	1.34

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, 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	B	16/16 (100%)	1.61	5 (31%)	1 1	23, 35, 36, 36	16 (100%)
2	D	16/16 (100%)	1.55	4 (25%)	2 1	23, 35, 36, 37	16 (100%)
3	A	255/255 (100%)	0.61	27 (10%)	11 10	25, 40, 73, 88	0
All	All	287/287 (100%)	0.72	36 (12%)	8 7	23, 38, 70, 88	32 (11%)

All (36) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	A	178	GLY	8.0
3	A	105	GLY	7.5
3	A	106	THR	7.2
3	A	99	LEU	7.0
3	A	176	GLU	5.7
3	A	179	ILE	5.7
3	A	107	ASN	5.2
3	A	175	PRO	5.1
3	A	108	ASP	4.9
3	A	177	MET	4.8
3	A	278	ARG	3.7
3	A	104	PRO	3.7
3	A	173	ARG	3.5
3	A	180	SER	3.3
3	A	64	TYR	3.2
3	A	174	ASP	3.1
1	B	11[B]	DG	2.9
3	A	101	VAL	2.8
3	A	102	LYS	2.7
3	A	272	LEU	2.6
3	A	231	THR	2.6
3	A	109	TYR	2.6
3	A	100	PRO	2.5

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Mol	Chain	Res	Type	RSRZ
3	A	103	LYS	2.5
2	D	27[D]	DA	2.5
1	B	14[B]	DA	2.3
2	D	30[D]	DA	2.3
3	A	262	CYS	2.3
3	A	25	TRP	2.3
1	B	12[B]	DA	2.2
2	D	28[D]	DA	2.2
3	A	216	ASP	2.2
1	B	8[B]	DA	2.2
3	A	139	LEU	2.1
1	B	7[B]	DA	2.0
2	D	24[D]	DT	2.0

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.