Full wwPDB X-ray Structure Validation Report ⓘ

Jun 12, 2024 – 06:30 AM EDT

PDB ID	:	2R2R
Title	:	d(ATTAGTTATAACTAAT) complexed with MMLV RT catalytic fragment
Authors	:	Goodwin, K.D.; Lewis, M.A.; Long, E.C.; Georgiadis, M.M.
Deposited on	:	2007-08-27
Resolution	:	2.10 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:

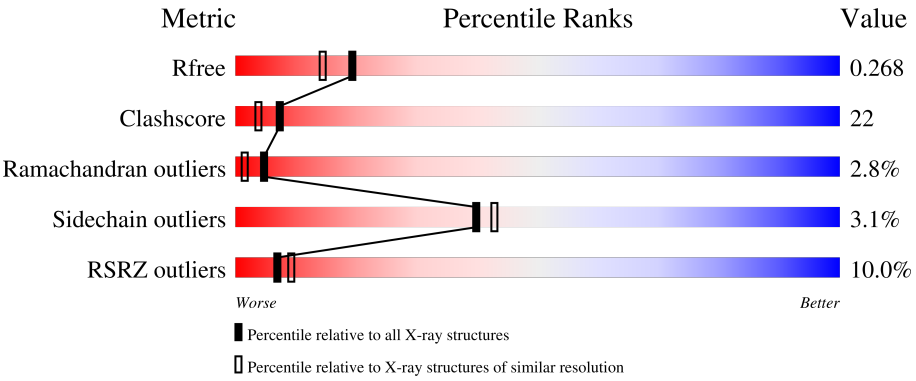
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.20.1
EDS	:	2.36.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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	B	8	100%
2	G	8	88% 12%
3	A	255	11% 68% 29% .

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 2528 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(*DAP*DTP*DTP*DAP*DGP*DTP*DTP*DA)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	8	Total	C	N	O	P	0	0	0
			162	80	28	47	7			

- Molecule 2 is a DNA chain called DNA (5'-D(P*DTP*DAP*DAP*DCP*DTP*DAP*DAP*DT)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	G	8	Total	C	N	O	P	0	0	0
			163	79	29	47	8			

- 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
			2041	1311	356	367	7			

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	6	Total	O	0	0
			6	6		
4	G	7	Total	O	0	0
			7	7		
4	A	149	Total	O	0	0
			149	149		

3 Residue-property plots (i)

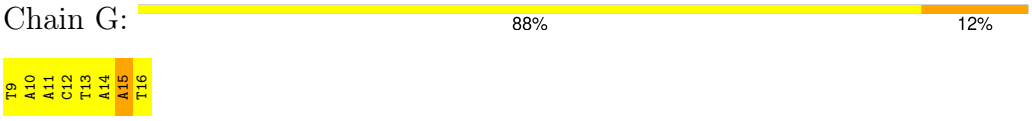
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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(*DAP*DTP*DTP*DAP*DGP*DTP*DTP*DA)-3')

Chain B:

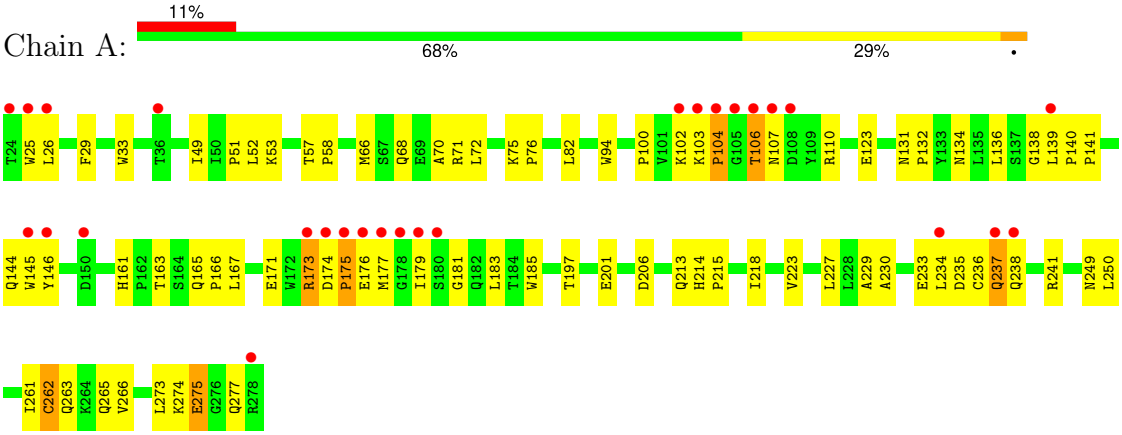
• Molecule 2: DNA (5'-D(P*DTP*DAP*DAP*DCP*DTP*DAP*DAP*DT)-3')

Chain G:



• Molecule 3: Reverse transcriptase

Chain A:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α, β, γ	55.66Å 144.48Å 46.85Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.10 39.31 – 2.10	Depositor EDS
% Data completeness (in resolution range)	91.5 (50.00-2.10) 91.5 (39.31-2.10)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.90 (at 2.10Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.238 , 0.269 0.239 , 0.268	Depositor DCC
R_{free} test set	1069 reflections (4.89%)	wwPDB-VP
Wilson B-factor (Å^2)	32.0	Xtriage
Anisotropy	0.356	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 50.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	2528	wwPDB-VP
Average B, all atoms (Å^2)	42.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.88% 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

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	B	0.35	0/181	0.71	0/278
2	G	0.29	0/182	0.74	0/278
3	A	0.37	0/2097	0.62	0/2858
All	All	0.36	0/2460	0.64	0/3414

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
2	G	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	G	15	DA	Sidechain

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	162	0	94	14	1
2	G	163	0	92	16	1

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	2041	0	2056	73	0
4	A	149	0	0	3	0
4	B	6	0	0	0	0
4	G	7	0	0	0	0
All	All	2528	0	2242	103	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 22.

All (103) 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)
2:G:11:DA:H2"	2:G:12:DC:H5"	1.39	1.03
3:A:179:ILE:HD13	3:A:183:LEU:HD21	1.38	1.00
2:G:12:DC:H2"	2:G:13:DT:H5'	1.46	0.98
1:B:2:DT:H2"	1:B:3:DT:H5'	1.50	0.94
3:A:104:PRO:HG2	3:A:107:ASN:HB2	1.50	0.91
2:G:14:DA:H2"	2:G:15:DA:H5'	1.55	0.87
2:G:11:DA:C2'	2:G:12:DC:H5"	2.05	0.85
3:A:161:HIS:HD2	3:A:163:THR:H	1.23	0.85
2:G:11:DA:H2"	2:G:12:DC:C5'	2.08	0.83
3:A:218:ILE:HB	3:A:229:ALA:HB3	1.60	0.82
3:A:174:ASP:HB3	3:A:177:MET:O	1.85	0.77
2:G:13:DT:H2"	2:G:14:DA:H5"	1.71	0.73
3:A:173:ARG:HG2	3:A:173:ARG:HH11	1.53	0.72
3:A:206:ASP:HB3	3:A:250:LEU:HD13	1.71	0.72
3:A:104:PRO:HB3	3:A:107:ASN:ND2	2.04	0.71
3:A:233:GLU:O	3:A:237:GLN:HB3	1.92	0.69
3:A:102:LYS:NZ	3:A:106:THR:HA	2.09	0.67
3:A:161:HIS:CD2	3:A:163:THR:HG22	2.31	0.66
3:A:161:HIS:CD2	3:A:163:THR:H	2.11	0.66
3:A:261:ILE:O	3:A:263:GLN:HG2	1.95	0.66
1:B:1:DA:H2"	1:B:2:DT:C5'	2.28	0.64
2:G:13:DT:C2'	2:G:14:DA:H5"	2.28	0.64
1:B:1:DA:H2"	1:B:2:DT:H5"	1.80	0.63
3:A:274:LYS:C	3:A:275:GLU:HG3	2.19	0.63
3:A:174:ASP:O	3:A:176:GLU:N	2.33	0.61
3:A:179:ILE:HG21	3:A:183:LEU:HD21	1.82	0.61
3:A:265:GLN:OE1	3:A:274:LYS:HD2	2.01	0.60
3:A:230:ALA:HB3	3:A:236:CYS:HB2	1.84	0.59
2:G:13:DT:H2"	2:G:14:DA:C5'	2.32	0.59

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:102:LYS:HZ2	3:A:106:THR:HA	1.67	0.58
1:B:1:DA:C2'	1:B:2:DT:H5"	2.34	0.58
3:A:68:GLN:O	3:A:72:LEU:HD13	2.04	0.58
1:B:1:DA:H1'	1:B:2:DT:H5"	1.86	0.57
3:A:173:ARG:HG2	3:A:173:ARG:NH1	2.19	0.57
3:A:25:TRP:CZ3	3:A:241:ARG:HG2	2.40	0.57
3:A:131:ASN:HD21	3:A:134:ASN:ND2	2.03	0.57
3:A:52:LEU:HD21	3:A:167:LEU:HD11	1.85	0.57
3:A:82:LEU:HD11	3:A:179:ILE:HD11	1.85	0.57
3:A:75:LYS:HB3	3:A:76:PRO:HD3	1.87	0.56
1:B:7:DT:H2"	1:B:8:DA:H5'	1.88	0.55
3:A:104:PRO:CG	3:A:107:ASN:HB2	2.30	0.55
3:A:146:TYR:HB3	3:A:227:LEU:HD11	1.87	0.55
3:A:102:LYS:O	3:A:102:LYS:HG3	2.06	0.54
3:A:234:LEU:HD11	3:A:238:GLN:HE21	1.72	0.54
1:B:4:DA:H2"	1:B:5:DG:H5'	1.89	0.54
3:A:176:GLU:O	3:A:177:MET:HB3	2.09	0.52
3:A:274:LYS:O	3:A:275:GLU:CB	2.58	0.52
2:G:12:DC:C2'	2:G:13:DT:H5'	2.30	0.52
3:A:274:LYS:O	3:A:275:GLU:HB2	2.10	0.52
2:G:10:DA:H1'	2:G:11:DA:H5"	1.92	0.52
3:A:71:ARG:HD2	4:A:306:HOH:O	2.10	0.51
3:A:104:PRO:CB	3:A:107:ASN:ND2	2.73	0.51
1:B:7:DT:H2"	1:B:8:DA:C5'	2.42	0.50
3:A:57:THR:HG22	4:A:309:HOH:O	2.12	0.49
3:A:237:GLN:HG2	3:A:238:GLN:N	2.27	0.49
3:A:145:TRP:CZ3	3:A:233:GLU:HB2	2.47	0.49
3:A:70:ALA:HB1	3:A:100:PRO:HB3	1.94	0.49
3:A:136:LEU:HD12	3:A:139:LEU:HD12	1.95	0.49
3:A:94:TRP:CE2	3:A:167:LEU:HD12	2.48	0.48
3:A:104:PRO:HB3	3:A:107:ASN:HD22	1.77	0.48
3:A:145:TRP:CH2	3:A:233:GLU:HB2	2.50	0.47
2:G:14:DA:H2"	2:G:15:DA:C5'	2.36	0.46
3:A:177:MET:SD	3:A:177:MET:C	2.94	0.46
3:A:71:ARG:NH1	3:A:175:PRO:HG2	2.30	0.46
2:G:10:DA:H2"	2:G:11:DA:H5'	1.97	0.46
3:A:179:ILE:HD13	3:A:183:LEU:CD2	2.28	0.46
1:B:8:DA:H5'	1:B:8:DA:H8	1.81	0.46
3:A:57:THR:CG2	4:A:309:HOH:O	2.64	0.46
3:A:53:LYS:HG2	3:A:123:GLU:OE2	2.16	0.45
3:A:144:GLN:HE22	3:A:275:GLU:HA	1.80	0.45

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:29:PHE:O	3:A:33:TRP:CD1	2.69	0.45
1:B:6:DT:H2"	1:B:7:DT:C5'	2.47	0.45
3:A:82:LEU:CD1	3:A:179:ILE:HD11	2.47	0.45
3:A:66:MET:CE	3:A:100:PRO:HG3	2.47	0.45
3:A:230:ALA:HB1	3:A:235:ASP:HB2	1.99	0.45
3:A:265:GLN:HA	3:A:273:LEU:O	2.17	0.45
3:A:174:ASP:C	3:A:176:GLU:H	2.19	0.44
1:B:5:DG:H2"	1:B:6:DT:OP2	2.16	0.44
3:A:214:HIS:N	3:A:215:PRO:HD3	2.33	0.44
3:A:49:ILE:O	3:A:51:PRO:HD3	2.17	0.44
3:A:234:LEU:CD1	3:A:238:GLN:HE21	2.30	0.44
3:A:132:PRO:O	3:A:136:LEU:HD23	2.18	0.43
3:A:237:GLN:NE2	3:A:241:ARG:HH22	2.16	0.43
3:A:57:THR:HG23	3:A:58:PRO:HD2	2.01	0.43
1:B:4:DA:H1'	1:B:5:DG:H5"	1.99	0.43
3:A:140:PRO:HA	3:A:141:PRO:HD3	1.86	0.43
3:A:263:GLN:HB2	3:A:266:VAL:HG13	2.01	0.43
3:A:179:ILE:HG21	3:A:183:LEU:CD2	2.45	0.42
3:A:197:THR:O	3:A:201:GLU:HG3	2.19	0.42
3:A:261:ILE:HG22	3:A:262:CYS:N	2.33	0.42
1:B:1:DA:C1'	1:B:2:DT:H5"	2.47	0.42
2:G:11:DA:C1'	2:G:12:DC:H5"	2.48	0.42
3:A:165:GLN:HG2	3:A:185:TRP:O	2.20	0.42
3:A:26:LEU:HD23	3:A:26:LEU:O	2.19	0.42
3:A:261:ILE:O	3:A:262:CYS:C	2.58	0.42
1:B:2:DT:C2'	1:B:3:DT:H5'	2.34	0.41
2:G:15:DA:C2'	2:G:16:DT:H71	2.50	0.41
3:A:138:GLY:O	3:A:140:PRO:HD3	2.20	0.41
3:A:110:ARG:HB2	3:A:110:ARG:CZ	2.51	0.41
3:A:234:LEU:HD11	3:A:238:GLN:NE2	2.35	0.41
2:G:10:DA:H2"	2:G:11:DA:C5'	2.50	0.41
2:G:14:DA:C2'	2:G:15:DA:H5'	2.40	0.41
3:A:165:GLN:N	3:A:166:PRO:CD	2.83	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:B:8:DA:O3'	2:G:9:DT:P[2_765]	1.61	0.59

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

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%)	235 (93%)	11 (4%)	7 (3%)	5 1

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	106	THR
3	A	175	PRO
3	A	262	CYS
3	A	275	GLU
3	A	181	GLY
3	A	223	VAL
3	A	104	PRO

5.3.2 Protein sidechains (i)

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%)	217 (97%)	7 (3%)	40 43

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	A	103	LYS
3	A	171	GLU
3	A	173	ARG
3	A	213	GLN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
3	A	237	GLN
3	A	249	ASN
3	A	277	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
3	A	31	GLN
3	A	77	HIS
3	A	84	GLN
3	A	107	ASN
3	A	134	ASN
3	A	144	GLN
3	A	161	HIS
3	A	190	GLN
3	A	214	HIS
3	A	238	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 monosaccharides 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)

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	B	8/8 (100%)	0.30	0 100 100	36, 49, 60, 61	0
2	G	8/8 (100%)	0.67	0 100 100	30, 58, 64, 67	0
3	A	255/255 (100%)	0.88	27 (10%) 6 7	16, 35, 79, 93	0
All	All	271/271 (100%)	0.86	27 (9%) 7 9	16, 37, 79, 93	0

All (27) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	A	106	THR	11.9
3	A	177	MET	10.2
3	A	105	GLY	7.6
3	A	178	GLY	7.6
3	A	179	ILE	7.0
3	A	180	SER	5.0
3	A	234	LEU	5.0
3	A	103	LYS	4.9
3	A	175	PRO	4.8
3	A	107	ASN	4.6
3	A	108	ASP	4.0
3	A	25	TRP	3.8
3	A	145	TRP	3.7
3	A	278	ARG	3.7
3	A	237	GLN	3.6
3	A	174	ASP	3.1
3	A	24	THR	3.0
3	A	173	ARG	2.9
3	A	104	PRO	2.7
3	A	176	GLU	2.6
3	A	26	LEU	2.6
3	A	139	LEU	2.5
3	A	102	LYS	2.5

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
3	A	36	THR	2.4
3	A	150	ASP	2.4
3	A	238	GLN	2.1
3	A	146	TYR	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 monosaccharides 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.