



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 13, 2017 – 03:06 am GMT

PDB ID : 3HW8
Title : ternary complex of DNA polymerase lambda of a two nucleotide gapped DNA substrate with a C in the scrunch site
Authors : Garcia-Diaz, M.; Bebenek, K.; Larrea, A.A.; Havener, J.M.; Perera, L.; Krahn, J.M.; Pedersen, L.C.; Ramsden, D.A.; Kunkel, T.A.
Deposited on : 2009-06-17
Resolution : 1.95 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix)	:	1.9-1692
EDS	:	trunk28620
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	recalc28949

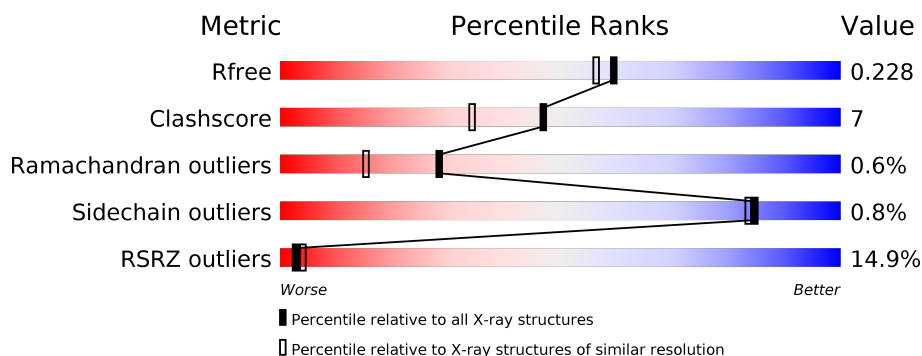
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.95 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}	100719	2004 (1.96-1.96)
Clashscore	112137	2136 (1.96-1.96)
Ramachandran outliers	110173	2117 (1.96-1.96)
Sidechain outliers	110143	2117 (1.96-1.96)
RSRZ outliers	101464	2018 (1.96-1.96)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	335	<div> <div>16%</div> <div> <div></div> <div>81%</div> <div>16%</div> <div>.</div> </div> </div>
2	B	12	<div> <div>75%</div> <div>17%</div> <div>8%</div> </div>
3	C	6	<div> <div>100%</div> </div>
4	D	4	<div> <div>50%</div> <div>25%</div> <div>25%</div> </div>

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 crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
8	EDO	A	1	-	-	-	X

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 3340 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 protein called DNA polymerase lambda.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	327	Total	C	N	O	S	0	1	0
			2528	1586	462	469	11			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	241	MET	-	EXPRESSION TAG	UNP Q9UGP5
A	543	ALA	CYS	ENGINEERED	UNP Q9UGP5

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	12	Total	C	N	O	P	0	0	0
			242	116	46	69	11			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	6	Total	C	N	O	P	0	0	0
			119	59	22	33	5			

- Molecule 4 is a DNA chain called 5'-D(P*GP*CP*CP*G)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	4	Total	C	N	O	P	0	0	0
			83	38	16	25	4			

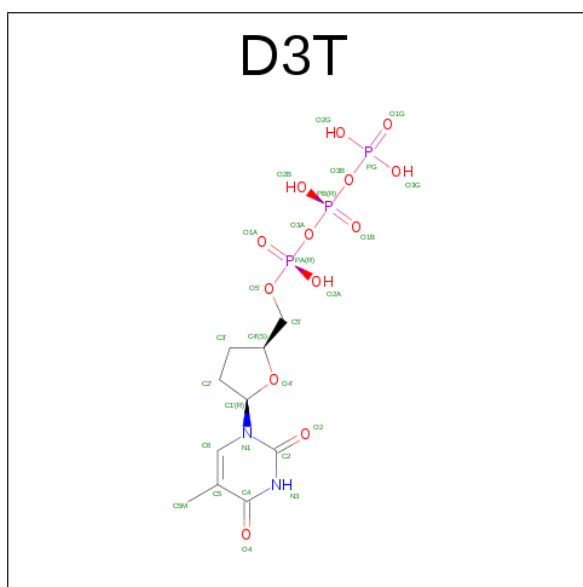
- Molecule 5 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	Mg	0	0
			1	1		

- Molecule 6 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	4	Total	Na	0	0
			4	4		

- Molecule 7 is 2',3'-DIDEOXY-THYMIDINE-5'-TRIPHOSPHATE (three-letter code: D3T) (formula: C₁₀H₁₇N₂O₁₃P₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
7	A	1	Total	C	N	O	P	0	0
			28	10	2	13	3		

- Molecule 8 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	A	1	Total	C	O	0	0
			4	2	2		

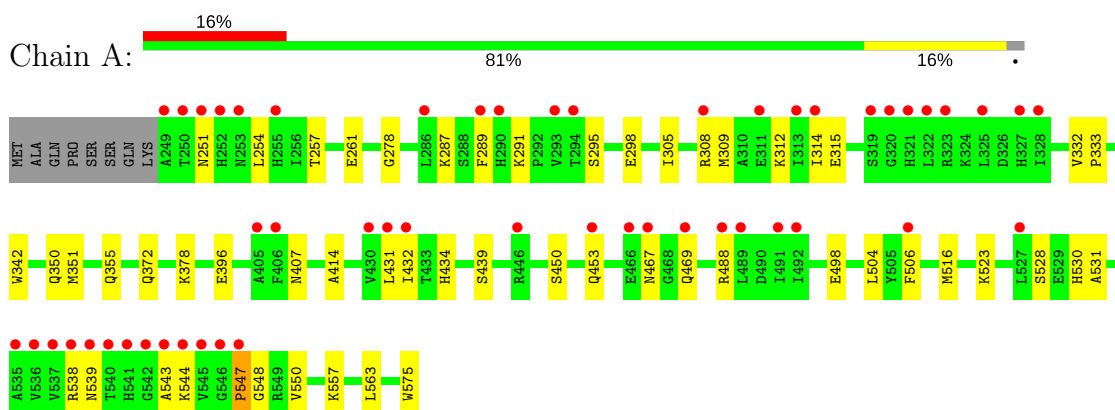
- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	237	Total	O	0	0
			237	237		
9	B	54	Total	O	0	0
			54	54		
9	C	29	Total	O	0	0
			29	29		
9	D	11	Total	O	0	0
			11	11		

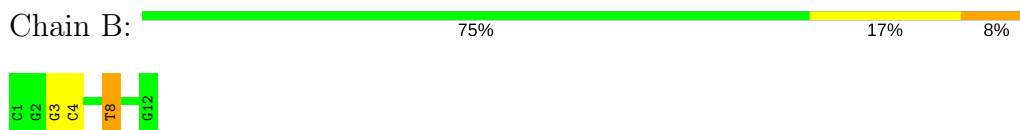
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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 polymerase lambda



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



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



There are no outlier residues recorded for this chain.

- Molecule 4: 5'-D(P*GP*CP*CP*G)-3'



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	56.25Å 68.39Å 137.11Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	24.32 – 1.95 24.32 – 1.95	Depositor EDS
% Data completeness (in resolution range)	91.2 (24.32-1.95) 91.3 (24.32-1.95)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.13 (at 1.95Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.212 , 0.233 0.210 , 0.228	Depositor DCC
R_{free} test set	1794 reflections (5.25%)	DCC
Wilson B-factor (Å ²)	28.4	Xtriage
Anisotropy	0.612	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 51.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	3340	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.91% 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

Bond lengths and bond angles in the following residue types are not validated in this section: NA, D3T, MG, EDO

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	0.31	0/2580	0.54	0/3487
2	B	0.36	0/271	0.76	1/416 (0.2%)
3	C	0.41	0/133	0.76	0/203
4	D	0.93	1/92 (1.1%)	0.74	0/138
All	All	0.35	1/3076 (0.0%)	0.58	1/4244 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	1	DG	OP3-P	-7.14	1.52	1.61

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	8	DT	C1'-O4'-C4'	-5.04	105.06	110.10

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	2528	0	2468	40	0
2	B	242	0	136	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	119	0	68	0	0
4	D	83	0	45	2	0
5	A	1	0	0	0	0
6	A	4	0	0	0	0
7	A	28	0	13	0	0
8	A	4	0	6	0	0
9	A	237	0	0	3	0
9	B	54	0	0	1	0
9	C	29	0	0	0	0
9	D	11	0	0	0	0
All	All	3340	0	2736	41	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 7.

All (41) 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:396:GLU:HG3	1:A:414:ALA:HB2	1.29	1.11
1:A:314:ILE:HD12	1:A:315:GLU:N	1.85	0.90
1:A:539:ASN:HD21	1:A:543:ALA:HB3	1.40	0.86
1:A:251:ASN:HD21	1:A:254:LEU:HA	1.51	0.76
1:A:504:LEU:HD21	1:A:516:MET:CE	2.16	0.76
1:A:504:LEU:HD21	1:A:516:MET:HE1	1.74	0.68
1:A:251:ASN:HD21	1:A:254:LEU:CA	2.06	0.68
1:A:378:LYS:HD2	9:A:593:HOH:O	2.02	0.60
1:A:504:LEU:HD21	1:A:516:MET:HE2	1.84	0.59
2:B:3:DG:H2''	2:B:4:DC:H5'	1.86	0.58
1:A:547:PRO:HG2	1:A:548:GLY:H	1.69	0.58
1:A:538:ARG:HG2	1:A:544:LYS:HA	1.87	0.57
1:A:539:ASN:ND2	1:A:543:ALA:HB3	2.16	0.56
1:A:332:VAL:HB	1:A:333:PRO:HD3	1.87	0.55
1:A:251:ASN:HB2	1:A:287:LYS:HG2	1.91	0.53
1:A:287:LYS:C	1:A:289:PHE:H	2.13	0.52
1:A:305:ILE:HG23	1:A:309:MET:HB3	1.91	0.52
1:A:528:SER:HB2	2:B:8:DT:H5'	1.92	0.51
1:A:431:LEU:HD23	1:A:431:LEU:C	2.30	0.51
1:A:450:SER:O	1:A:453:GLN:HB3	2.10	0.50
1:A:523:LYS:HE3	1:A:563:LEU:O	2.11	0.50
1:A:350:GLN:NE2	9:A:85:HOH:O	2.47	0.48
1:A:278:GLY:HA3	4:D:1:DG:H1'	1.95	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:498:GLU:HG2	1:A:530:HIS:O	2.16	0.46
1:A:308:ARG:HB2	4:D:2:DC:P	2.57	0.45
1:A:251:ASN:HD21	1:A:254:LEU:N	2.14	0.45
1:A:372:GLN:HG3	9:B:22:HOH:O	2.16	0.45
1:A:467:ASN:OD1	1:A:469:GLN:N	2.46	0.45
1:A:342:TRP:HE1	1:A:488[A]:ARG:NH1	2.15	0.44
1:A:557:LYS:HG3	9:A:118:HOH:O	2.17	0.44
1:A:251:ASN:ND2	1:A:254:LEU:CA	2.78	0.44
1:A:351:MET:O	1:A:355:GLN:HG3	2.17	0.44
1:A:434:HIS:CD2	1:A:439:SER:HB2	2.52	0.44
1:A:531:ALA:HB1	1:A:550:VAL:HG13	2.01	0.42
1:A:295:SER:OG	1:A:298:GLU:HB2	2.20	0.42
1:A:251:ASN:ND2	1:A:254:LEU:HA	2.27	0.42
1:A:575:TRP:N	1:A:575:TRP:CD1	2.87	0.42
1:A:287:LYS:C	1:A:289:PHE:N	2.74	0.41
1:A:257:THR:O	1:A:261:GLU:HB2	2.21	0.41
1:A:431:LEU:HD23	1:A:432:ILE:N	2.36	0.41
1:A:309:MET:O	1:A:312:LYS:HB2	2.21	0.40

There are no symmetry-related clashes.

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
1	A	326/335 (97%)	315 (97%)	9 (3%)	2 (1%)	28 15

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	547	PRO
1	A	407	ASN

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	
1	A	259/280 (92%)	257 (99%)	2 (1%)	85	83

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	291	LYS
1	A	506	PHE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	350	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 7 ligands modelled in this entry, 5 are monoatomic - leaving 2 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link

column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
8	EDO	A	1	-	3,3,3	2.19	2 (66%)	2,2,2	0.45	0
7	D3T	A	581	5,6	21,29,29	1.42	2 (9%)	20,45,45	3.76	3 (15%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
8	EDO	A	1	-	-	0/1/1/1	0/0/0/0
7	D3T	A	581	5,6	-	0/18/31/31	0/2/2/2

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	A	581	D3T	PG-O3B	-3.13	1.55	1.60
8	A	1	EDO	O1-C1	2.30	1.54	1.42
8	A	1	EDO	O2-C2	2.89	1.57	1.42
7	A	581	D3T	C4-N3	4.35	1.40	1.33

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
7	A	581	D3T	C5-C4-N3	-8.77	115.58	125.24
7	A	581	D3T	C5M-C5-C6	2.01	122.68	118.67
7	A	581	D3T	C4-N3-C2	13.69	127.13	115.16

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 ⓘ

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 ⓘ

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	A	327/335 (97%)	0.86	52 (15%) 2 3	19, 36, 77, 89	0
2	B	12/12 (100%)	-0.59	0 100 100	24, 26, 39, 45	0
3	C	6/6 (100%)	-0.58	0 100 100	18, 21, 23, 26	0
4	D	4/4 (100%)	-0.30	0 100 100	36, 39, 39, 39	0
All	All	349/357 (97%)	0.77	52 (14%) 3 4	18, 36, 77, 89	0

All (52) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	249	ALA	8.9
1	A	537	VAL	7.4
1	A	540	THR	7.2
1	A	319	SER	6.1
1	A	321	HIS	6.0
1	A	541	HIS	5.5
1	A	320	GLY	5.0
1	A	543	ALA	5.0
1	A	542	GLY	5.0
1	A	547	PRO	4.9
1	A	546	GLY	4.7
1	A	545	VAL	4.4
1	A	491	ILE	4.4
1	A	327	HIS	4.2
1	A	469	GLN	4.1
1	A	314	ILE	3.9
1	A	539	ASN	3.9
1	A	430	VAL	3.8
1	A	293	VAL	3.6
1	A	406	PHE	3.5
1	A	313	ILE	3.3

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Mol	Chain	Res	Type	RSRZ
1	A	492	ILE	3.3
1	A	308	ARG	3.3
1	A	289	PHE	3.3
1	A	290	HIS	3.3
1	A	467	ASN	3.2
1	A	255	HIS	3.1
1	A	536	VAL	3.0
1	A	286	LEU	3.0
1	A	323	ARG	3.0
1	A	252	HIS	3.0
1	A	250	THR	2.8
1	A	453	GLN	2.8
1	A	405	ALA	2.6
1	A	294	THR	2.6
1	A	322	LEU	2.5
1	A	489	LEU	2.5
1	A	431	LEU	2.5
1	A	432	ILE	2.4
1	A	251	ASN	2.4
1	A	535	ALA	2.4
1	A	538	ARG	2.4
1	A	325	LEU	2.3
1	A	466	GLU	2.3
1	A	488[A]	ARG	2.3
1	A	506	PHE	2.2
1	A	328	ILE	2.2
1	A	253	ASN	2.2
1	A	446	ARG	2.1
1	A	544	LYS	2.1
1	A	527	LEU	2.0
1	A	311	GLU	2.0

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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å ²)	Q<0.9
8	EDO	A	1	4/4	0.83	0.36	7.60	58,58,59,61	0
7	D3T	A	581	28/28	0.98	0.08	-0.76	19,22,25,27	0
6	NA	A	578	1/1	0.96	0.07	-1.18	22,22,22,22	0
6	NA	A	580	1/1	0.88	0.11	-1.24	51,51,51,51	0
6	NA	A	579	1/1	0.97	0.06	-	39,39,39,39	0
5	MG	A	576	1/1	1.00	0.07	-	24,24,24,24	0
6	NA	A	577	1/1	0.99	0.10	-	25,25,25,25	0

6.5 Other polymers [i](#)

There are no such residues in this entry.