



# Full wwPDB X-ray Structure Validation Report ⓘ

May 17, 2020 – 08:26 am BST

PDB ID : 5VU5  
Title : TNA polymerase, apo  
Authors : Chim, N.; Chaput, J.C.  
Deposited on : 2017-05-18  
Resolution : 2.80 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](mailto: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.

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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	:	2.11
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)	:	2.11

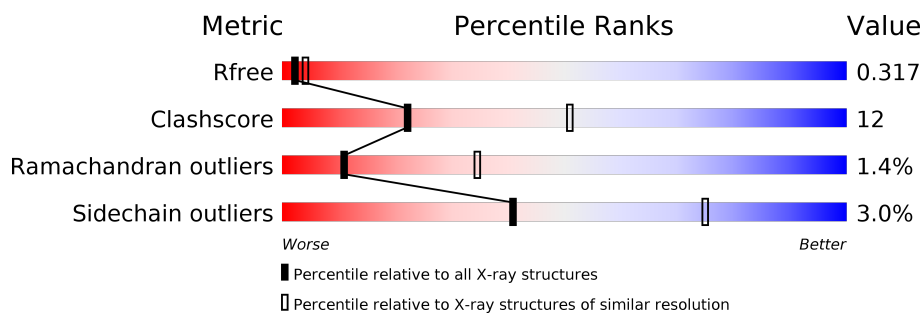
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.80 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	3140 (2.80-2.80)
Clashscore	141614	3569 (2.80-2.80)
Ramachandran outliers	138981	3498 (2.80-2.80)
Sidechain outliers	138945	3500 (2.80-2.80)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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  $\leq 5\%$ .

Mol	Chain	Length	Quality of chain
1	A	774	<div>65% 24% 9%</div>

## 2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 5738 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.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	707	Total	C	N	O	S	0	0	0
			5738	3696	967	1059	16			

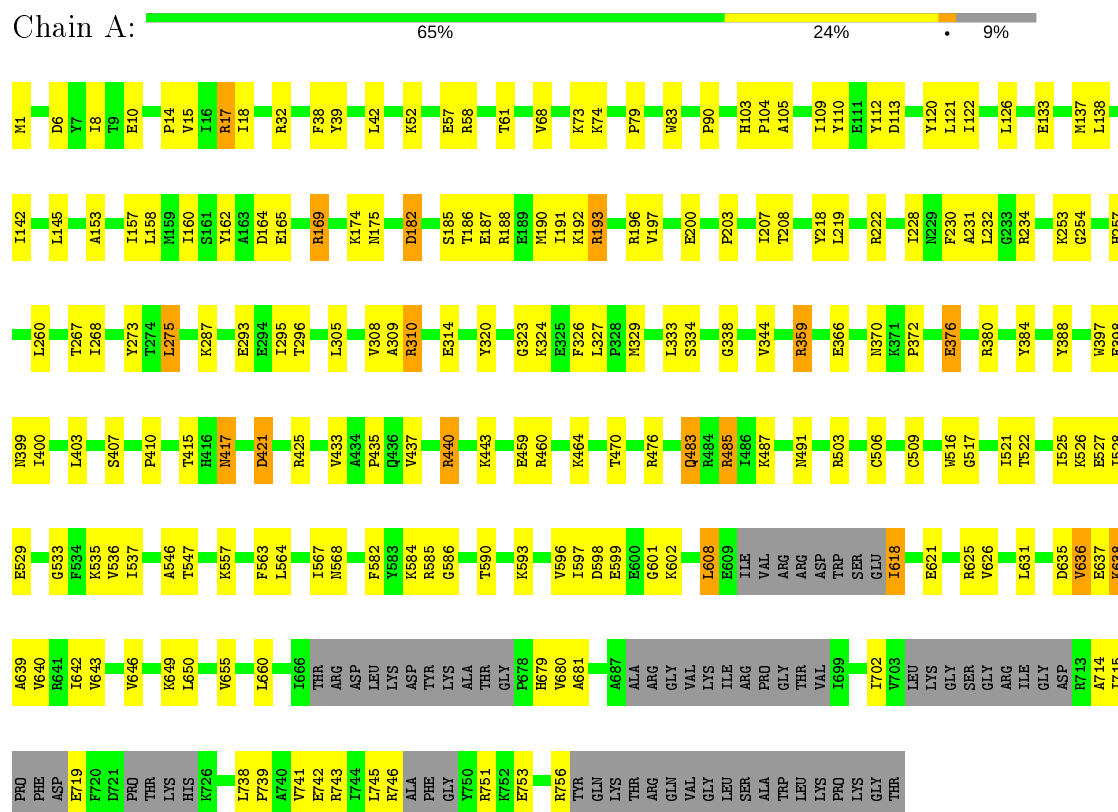
There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	141	ALA	ASP	engineered mutation	UNP D0VWU9
A	143	ALA	GLU	engineered mutation	UNP D0VWU9
A	147	HIS	GLU	engineered mutation	UNP D0VWU9
A	485	ARG	ALA	engineered mutation	UNP D0VWU9
A	584	LYS	GLU	engineered mutation	UNP D0VWU9
A	664	ILE	GLU	engineered mutation	UNP D0VWU9

### 3 Residue-property plots

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. 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. 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



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	72.82Å 110.62Å 111.80Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	55.31 – 2.80 61.02 – 2.50	Depositor EDS
% Data completeness (in resolution range)	86.4 (55.31-2.80) 70.7 (61.02-2.50)	Depositor EDS
$R_{merge}$	0.32	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.02 (at 2.51Å)	Xtriage
Refinement program	PHENIX (1.11.1_2575: ???)	Depositor
R, $R_{free}$	0.268 , 0.317 0.268 , 0.317	Depositor DCC
$R_{free}$ test set	1989 reflections (7.22%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	44.6	Xtriage
Anisotropy	0.488	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.22 , 35.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.022 for -h,l,k	Xtriage
$F_o, F_c$ correlation	0.90	EDS
Total number of atoms	5738	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	111.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.95% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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	$\# Z  > 5$
1	A	0.25	0/5860	0.43	0/7906

There are no bond length outliers.

There are no bond angle outliers.

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	5738	0	5661	133	0
All	All	5738	0	5661	133	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 12.

All (133) 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:267:THR:HG23	1:A:268:ILE:HG13	1.70	0.73
1:A:384:TYR:OH	1:A:388:TYR:OH	2.07	0.70
1:A:169:ARG:NH1	1:A:182:ASP:OD1	2.26	0.69
1:A:521:ILE:O	1:A:525:ILE:N	2.26	0.68
1:A:529:GLU:HA	1:A:533:GLY:O	1.93	0.67

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:586:GLY:HA3	1:A:596:VAL:HG13	1.76	0.67
1:A:593:LYS:HD3	1:A:608:LEU:HD13	1.77	0.66
1:A:460:ARG:HE	1:A:483:GLN:HG2	1.61	0.66
1:A:638:LYS:O	1:A:642:ILE:N	2.29	0.65
1:A:643:VAL:HG11	1:A:741:VAL:HG21	1.78	0.65
1:A:126:LEU:O	1:A:359:ARG:NH2	2.30	0.65
1:A:626:VAL:HG13	1:A:639:ALA:HB1	1.78	0.65
1:A:376:GLU:OE2	1:A:380:ARG:NE	2.29	0.65
1:A:333:LEU:HD13	1:A:485:ARG:HD2	1.79	0.64
1:A:751:ARG:HG3	1:A:753:GLU:H	1.61	0.64
1:A:608:LEU:HD11	1:A:743:ARG:HB3	1.81	0.63
1:A:338:GLY:O	1:A:359:ARG:NH1	2.32	0.62
1:A:109:ILE:O	1:A:370:ASN:ND2	2.31	0.61
1:A:397:TRP:HB2	1:A:400:ILE:HD11	1.82	0.61
1:A:39:TYR:HB2	1:A:110:TYR:HB2	1.83	0.60
1:A:137:MET:HE2	1:A:207:ILE:HD11	1.84	0.60
1:A:596:VAL:HG12	1:A:597:ILE:H	1.67	0.59
1:A:203:PRO:O	1:A:234:ARG:NH1	2.35	0.59
1:A:164:ASP:OD1	1:A:165:GLU:N	2.35	0.59
1:A:590:THR:OG1	1:A:746:ARG:NH1	2.35	0.59
1:A:157:ILE:HD12	1:A:222:ARG:HH21	1.67	0.59
1:A:464:LYS:HG3	1:A:483:GLN:HG3	1.85	0.58
1:A:537:ILE:HD11	1:A:547:THR:HG22	1.83	0.58
1:A:208:THR:OG1	1:A:257:HIS:NE2	2.36	0.58
1:A:417:ASN:HB2	1:A:443:LYS:HE3	1.85	0.58
1:A:6:ASP:OD2	1:A:253:LYS:NZ	2.31	0.58
1:A:8:ILE:HG13	1:A:17:ARG:HD3	1.85	0.58
1:A:169:ARG:HB3	1:A:169:ARG:HH11	1.69	0.57
1:A:10:GLU:OE1	1:A:32:ARG:NH2	2.38	0.56
1:A:526:LYS:C	1:A:528:ILE:H	2.08	0.56
1:A:415:THR:O	1:A:443:LYS:NZ	2.37	0.56
1:A:637:GLU:O	1:A:639:ALA:N	2.39	0.56
1:A:186:THR:OG1	1:A:187:GLU:N	2.38	0.55
1:A:160:ILE:H	1:A:190:MET:HE1	1.71	0.55
1:A:287:LYS:HE2	1:A:314:GLU:HG2	1.88	0.55
1:A:470:THR:O	1:A:476:ARG:NH1	2.35	0.55
1:A:421:ASP:OD1	1:A:421:ASP:N	2.23	0.55
1:A:741:VAL:O	1:A:745:LEU:N	2.36	0.54
1:A:142:ILE:HD13	1:A:219:LEU:HG	1.90	0.54
1:A:407:SER:HB3	1:A:410:PRO:HG2	1.90	0.54
1:A:557:LYS:HE2	1:A:582:PHE:CG	2.43	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:74:LYS:HE3	1:A:366:GLU:HG2	1.89	0.53
1:A:598:ASP:OD1	1:A:599:GLU:N	2.32	0.52
1:A:165:GLU:HG3	1:A:320:TYR:OH	2.10	0.52
1:A:74:LYS:HA	1:A:79:PRO:HA	1.92	0.52
1:A:121:LEU:O	1:A:359:ARG:NH2	2.43	0.52
1:A:196:ARG:O	1:A:200:GLU:HG2	2.10	0.51
1:A:188:ARG:HE	1:A:192:LYS:HD3	1.75	0.51
1:A:529:GLU:OE1	1:A:535:LYS:NZ	2.44	0.51
1:A:122:ILE:HG23	1:A:359:ARG:HA	1.93	0.50
1:A:739:PRO:HA	1:A:743:ARG:HG2	1.93	0.50
1:A:753:GLU:HA	1:A:756:ARG:HG3	1.94	0.50
1:A:113:ASP:OD1	1:A:503:ARG:NH2	2.39	0.49
1:A:174:LYS:HG3	1:A:175:ASN:H	1.76	0.49
1:A:719:GLU:N	1:A:719:GLU:OE1	2.45	0.49
1:A:525:ILE:HG23	1:A:536:VAL:HG21	1.93	0.49
1:A:372:PRO:HG3	1:A:380:ARG:NH1	2.27	0.49
1:A:585:ARG:HD2	1:A:631:LEU:O	2.11	0.49
1:A:646:VAL:O	1:A:650:LEU:N	2.39	0.49
1:A:38:PHE:HE1	1:A:109:ILE:HD12	1.78	0.49
1:A:334:SER:HA	1:A:344:VAL:HG21	1.95	0.49
1:A:397:TRP:O	1:A:586:GLY:N	2.40	0.49
1:A:597:ILE:HG12	1:A:598:ASP:H	1.76	0.49
1:A:460:ARG:HH21	1:A:483:GLN:HE21	1.60	0.48
1:A:1:MET:HG3	1:A:133:GLU:HB2	1.95	0.48
1:A:57:GLU:OE2	1:A:61:THR:N	2.47	0.48
1:A:153:ALA:HA	1:A:218:TYR:CZ	2.49	0.48
1:A:109:ILE:HG22	1:A:112:TYR:CD2	2.49	0.48
1:A:142:ILE:HG22	1:A:160:ILE:HG12	1.95	0.48
1:A:637:GLU:HG2	1:A:638:LYS:H	1.78	0.48
1:A:57:GLU:OE2	1:A:58:ARG:N	2.47	0.47
1:A:751:ARG:HG3	1:A:753:GLU:N	2.29	0.47
1:A:295:ILE:HG13	1:A:308:VAL:HG23	1.97	0.47
1:A:506:CYS:SG	1:A:509:CYS:N	2.86	0.47
1:A:526:LYS:HA	1:A:529:GLU:HG2	1.97	0.46
1:A:14:PRO:HG3	1:A:90:PRO:HD3	1.97	0.46
1:A:517:GLY:O	1:A:521:ILE:HG12	2.16	0.46
1:A:679:HIS:C	1:A:681:ALA:H	2.19	0.46
1:A:679:HIS:O	1:A:681:ALA:N	2.49	0.46
1:A:267:THR:HG21	1:A:326:PHE:HE2	1.80	0.46
1:A:267:THR:HG21	1:A:326:PHE:CE2	2.50	0.46
1:A:597:ILE:HD11	1:A:601:GLY:HA2	1.98	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:618:ILE:HD13	1:A:660:LEU:HA	1.98	0.45
1:A:649:LYS:O	1:A:655:VAL:N	2.49	0.45
1:A:268:ILE:O	1:A:273:TYR:OH	2.26	0.45
1:A:260:LEU:HD21	1:A:323:GLY:HA2	1.99	0.45
1:A:738:LEU:O	1:A:742:GLU:N	2.46	0.45
1:A:103:HIS:CE1	1:A:105:ALA:HB3	2.51	0.45
1:A:192:LYS:HG2	1:A:228:ILE:HD12	1.99	0.45
1:A:536:VAL:HG12	1:A:546:ALA:HB2	1.99	0.45
1:A:637:GLU:O	1:A:640:VAL:N	2.48	0.44
1:A:191:ILE:HD11	1:A:222:ARG:NH2	2.32	0.44
1:A:738:LEU:HB3	1:A:739:PRO:HD3	2.00	0.44
1:A:234:ARG:NH2	1:A:254:GLY:O	2.43	0.44
1:A:433:VAL:HG22	1:A:440:ARG:HG3	1.99	0.44
1:A:403:LEU:HD22	1:A:564:LEU:HD21	2.00	0.44
1:A:563:PHE:O	1:A:567:ILE:HG13	2.17	0.44
1:A:15:VAL:HG22	1:A:32:ARG:HG2	1.99	0.43
1:A:186:THR:HG23	1:A:188:ARG:H	1.83	0.43
1:A:145:LEU:HB2	1:A:158:LEU:HD11	1.99	0.43
1:A:398:GLU:HA	1:A:584:LYS:O	2.18	0.43
1:A:702:ILE:O	1:A:714:ALA:HB3	2.19	0.42
1:A:309:ALA:O	1:A:310:ARG:HB2	2.19	0.42
1:A:329:MET:H	1:A:329:MET:HG2	1.71	0.42
1:A:526:LYS:O	1:A:528:ILE:N	2.45	0.42
1:A:18:ILE:HD11	1:A:120:TYR:HE2	1.85	0.42
1:A:187:GLU:OE1	1:A:222:ARG:HD2	2.19	0.42
1:A:275:LEU:HD23	1:A:275:LEU:HA	1.92	0.42
1:A:399:ASN:HA	1:A:582:PHE:CZ	2.54	0.42
1:A:621:GLU:O	1:A:625:ARG:HG3	2.20	0.42
1:A:567:ILE:HD12	1:A:568:ASN:N	2.35	0.42
1:A:103:HIS:CD2	1:A:104:PRO:HD2	2.55	0.42
1:A:305:LEU:HA	1:A:308:VAL:HG12	2.02	0.41
1:A:138:LEU:HD21	1:A:162:TYR:HB2	2.01	0.41
1:A:162:TYR:CE2	1:A:169:ARG:HB2	2.55	0.41
1:A:435:PRO:O	1:A:437:VAL:N	2.43	0.41
1:A:160:ILE:N	1:A:190:MET:HE1	2.35	0.41
1:A:39:TYR:CZ	1:A:73:LYS:HE3	2.56	0.41
1:A:635:ASP:OD1	1:A:636:VAL:N	2.53	0.41
1:A:193:ARG:O	1:A:197:VAL:HG23	2.20	0.41
1:A:293:GLU:HA	1:A:296:THR:HG22	2.02	0.41
1:A:715:ILE:H	1:A:719:GLU:HB2	1.86	0.41
1:A:68:VAL:HG22	1:A:83:TRP:HE3	1.85	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:232:LEU:HA	1:A:232:LEU:HD23	1.90	0.40
1:A:324:LYS:HB3	1:A:324:LYS:HE2	1.96	0.40
1:A:522:THR:HA	1:A:525:ILE:HB	2.03	0.40
1:A:52:LYS:HD3	1:A:68:VAL:HG11	2.03	0.40
1:A:487:LYS:O	1:A:491:ASN:ND2	2.35	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	691/774 (89%)	636 (92%)	45 (6%)	10 (1%)	11	34

All (10) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	638	LYS
1	A	185	SER
1	A	310	ARG
1	A	459	GLU
1	A	636	VAL
1	A	680	VAL
1	A	231	ALA
1	A	602	LYS
1	A	608	LEU
1	A	527	GLU

### 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	592/673 (88%)	574 (97%)	18 (3%)	41 75

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	17	ARG
1	A	42	LEU
1	A	169	ARG
1	A	182	ASP
1	A	193	ARG
1	A	230	PHE
1	A	275	LEU
1	A	327	LEU
1	A	359	ARG
1	A	376	GLU
1	A	417	ASN
1	A	421	ASP
1	A	425	ARG
1	A	440	ARG
1	A	483	GLN
1	A	485	ARG
1	A	516	TRP
1	A	618	ILE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 [i](#)

There are no carbohydrates 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 ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.3 Carbohydrates ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.4 Ligands ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.5 Other polymers ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.