



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 4, 2026 – 05:18 PM UTC

PDB ID : 2ITL / pdb_00002itl
Title : The origin binding domain of the SV40 large T antigen bound to the functional
pen palindrome DNA (23 bp)
Authors : Bochkareva, E.; Seitova, A.; Bochkarev, A.
Deposited on : 2006-10-19
Resolution : 1.65 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

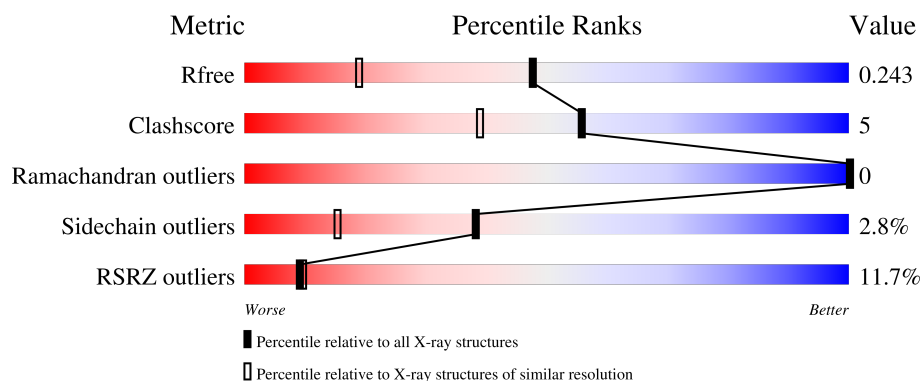
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.65 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	2563 (1.66-1.66)
Clashscore	190562	2662 (1.66-1.66)
Ramachandran outliers	187476	2621 (1.66-1.66)
Sidechain outliers	187428	2621 (1.66-1.66)
RSRZ outliers	180081	2564 (1.66-1.66)

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	W	24	4% 71% 25% .
2	C	24	4% 63% 38%
3	A	133	4% 83% 6% 10%
3	B	133	20% 71% 14% . 14%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 3207 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 24-nt PEN element of the SV40 DNA origin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	W	24	Total	C	N	O	P	0	24	0
			491	231	96	141	23			

- Molecule 2 is a DNA chain called 24-nt PEN element of the SV40 DNA origin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	24	Total	C	N	O	P	0	24	0
			488	230	94	141	23			

- Molecule 3 is a protein called large T antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	120	Total	C	N	O	S	0	0	0
			977	637	163	172	5			
3	B	115	Total	C	N	O	S	0	0	0
			944	617	157	165	5			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	127	GLY	-	cloning artifact	UNP P03070
A	128	SER	-	cloning artifact	UNP P03070
A	129	HIS	-	cloning artifact	UNP P03070
A	130	MET	-	cloning artifact	UNP P03070
B	127	GLY	-	cloning artifact	UNP P03070
B	128	SER	-	cloning artifact	UNP P03070
B	129	HIS	-	cloning artifact	UNP P03070
B	130	MET	-	cloning artifact	UNP P03070

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	W	109	Total 109	O 109	0	0
4	C	3	Total 3	O 3	0	0
4	A	145	Total 145	O 145	0	0
4	B	50	Total 50	O 50	0	0

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.

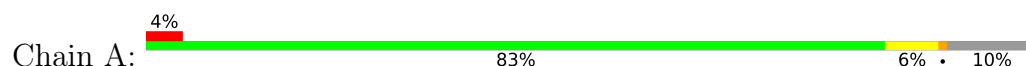
- Molecule 1: 24-nt PEN element of the SV40 DNA origin



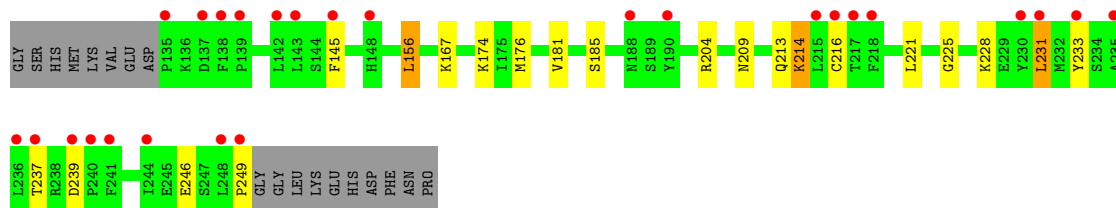
- Molecule 2: 24-nt PEN element of the SV40 DNA origin



- Molecule 3: large T antigen



- Molecule 3: large T antigen



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	83.20Å 64.10Å 79.18Å 90.00° 120.69° 90.00°	Depositor
Resolution (Å)	40.00 – 1.65 40.00 – 1.65	Depositor EDS
% Data completeness (in resolution range)	99.6 (40.00-1.65) 99.6 (40.00-1.65)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.94 (at 1.65Å)	Xtriage
Refinement program	REFMAC 5.2	Depositor
R, R_{free}	0.201 , 0.251 0.194 , 0.243	Depositor DCC
R_{free} test set	2161 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	23.7	Xtriage
Anisotropy	0.062	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 53.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.014 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3207	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.66% 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	W	0.79	0/551	1.48	4/849 (0.5%)
2	C	1.16	2/547 (0.4%)	1.53	6/842 (0.7%)
3	A	0.99	1/1003 (0.1%)	0.93	1/1354 (0.1%)
3	B	0.75	0/970	0.91	0/1310
All	All	0.92	3/3071 (0.1%)	1.18	11/4355 (0.3%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	30[B]	DC	O3'-P	15.19	1.83	1.61
2	C	31[B]	DC	O3'-P	13.07	1.80	1.61
3	A	156	LEU	CA-CB	-5.01	1.47	1.53

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	W	19[A]	DA	C5-C6-N6	-7.66	111.92	123.40
2	C	19[B]	DA	C5-C6-N6	-7.66	111.92	123.40
2	C	31[B]	DC	P-O3'-C3'	-7.06	109.60	120.20
1	W	28[A]	DG	O4'-C1'-N9	6.18	117.67	108.40
2	C	28[B]	DG	O4'-C1'-N9	6.18	117.67	108.40
2	C	31[B]	DC	O3'-P-O5'	-6.14	94.80	104.00
3	A	191	ASN	N-CA-C	6.03	120.44	113.38
1	W	30[A]	DC	C4'-C3'-O3'	-5.26	102.11	110.00
2	C	30[B]	DC	C4'-C3'-O3'	-5.26	102.11	110.00
1	W	19[A]	DA	C4'-C3'-O3'	-5.17	102.24	110.00
2	C	19[B]	DA	C4'-C3'-O3'	-5.17	102.24	110.00

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	W	491	0	268	3	0
2	C	488	0	268	3	0
3	A	977	0	982	7	0
3	B	944	0	949	13	0
4	A	145	0	0	2	0
4	B	50	0	0	0	0
4	C	3	0	0	0	0
4	W	109	0	0	1	1
All	All	3207	0	2467	25	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 5.

All (25) 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:W:19[A]:DA:H5'	4:W:109:HOH:O	1.55	1.05
3:B:176:MET:HA	3:B:181:VAL:HG22	1.84	0.58
3:B:185:SER:HB3	3:B:246:GLU:HG2	1.86	0.57
2:C:38[B]:DG:O6	3:B:204:ARG:NH2	2.33	0.57
3:A:253:LYS:C	4:A:396:HOH:O	2.49	0.55
3:B:176:MET:HG3	3:B:181:VAL:CG2	2.40	0.52
3:A:156:LEU:HD23	3:A:156:LEU:N	2.25	0.51
3:B:209:ASN:HD21	3:B:213:GLN:HE21	1.60	0.50
3:A:216:CYS:SG	3:A:221:LEU:HD12	2.53	0.48
3:B:176:MET:HG3	3:B:181:VAL:HG22	1.97	0.46
3:B:156:LEU:HD11	3:B:225:GLY:HA3	1.98	0.46
3:A:216:CYS:SG	3:A:221:LEU:CD1	3.04	0.45
3:A:160:ALA:HA	3:A:195:LEU:O	2.17	0.44
3:B:233:TYR:O	3:B:237:THR:HG23	2.18	0.44
3:A:150:VAL:O	3:A:150:VAL:HG22	2.19	0.43
3:B:167:LYS:HA	3:B:167:LYS:HD3	1.81	0.42
1:W:40[A]:DC:H2'	1:W:41[A]:DT:C6	2.55	0.41
3:B:145:PHE:HA	3:B:228:LYS:HG3	2.01	0.41
3:A:148:HIS:CD2	4:A:366:HOH:O	2.74	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:B:214:LYS:HD2	3:B:214:LYS:C	2.46	0.41
2:C:40[B]:DC:H2'	2:C:41[B]:DT:C6	2.55	0.41
3:B:145:PHE:CE2	3:B:231:LEU:HB3	2.55	0.41
1:W:34[A]:DC:H2'	1:W:35[A]:DT:C6	2.56	0.40
3:B:216:CYS:SG	3:B:221:LEU:HD13	2.61	0.40
2:C:34[B]:DC:H2'	2:C:35[B]:DT:C6	2.56	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)
4:W:98:HOH:O	4:W:109:HOH:O[1_556]	2.18	0.02

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	118/133 (89%)	115 (98%)	3 (2%)	0	100	100
3	B	113/133 (85%)	108 (96%)	5 (4%)	0	100	100
All	All	231/266 (87%)	223 (96%)	8 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	109/121 (90%)	109 (100%)	0	100	100
3	B	106/121 (88%)	100 (94%)	6 (6%)	18	3
All	All	215/242 (89%)	209 (97%)	6 (3%)	38	15

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	B	156	LEU
3	B	174	LYS
3	B	214	LYS
3	B	231	LEU
3	B	239	ASP
3	B	249	PRO

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
3	A	153	ASN
3	A	192	HIS
3	B	188	ASN
3	B	209	ASN

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 ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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	C	2

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	C	30[B]:DC	O3'	31[B]:DC	P	1.83
1	C	31[B]:DC	O3'	32[B]:DG	P	1.80

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	W	24/24 (100%)	-0.28	1 (4%) 40 44	7, 10, 19, 21	24 (100%)
2	C	24/24 (100%)	-0.29	1 (4%) 40 44	8, 10, 19, 21	24 (100%)
3	A	120/133 (90%)	0.22	5 (4%) 40 44	15, 28, 43, 56	0
3	B	115/133 (86%)	1.31	26 (22%) 2 2	22, 40, 61, 65	0
All	All	283/314 (90%)	0.58	33 (11%) 9 10	7, 31, 58, 65	48 (16%)

All (33) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	A	216	CYS	5.3
3	B	230	TYR	4.6
3	B	249	PRO	4.3
3	B	218	PHE	4.0
3	B	135	PRO	4.0
3	B	235	ALA	3.5
3	A	218	PHE	3.5
3	B	143	LEU	3.4
3	B	217	THR	3.4
3	A	148	HIS	3.3
3	B	244	ILE	3.2
3	B	231	LEU	3.2
3	A	217	THR	3.2
3	B	248	LEU	3.1
3	B	241	PHE	3.1
3	B	240	PRO	3.1
3	B	148	HIS	3.1
3	B	190	TYR	3.0
3	B	236	LEU	3.0
3	B	137	ASP	2.9
3	B	145	PHE	2.9

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Mol	Chain	Res	Type	RSRZ
1	W	19[A]	DA	2.8
2	C	19[B]	DA	2.8
3	B	216	CYS	2.7
3	B	233	TYR	2.7
3	B	237	THR	2.5
3	B	138	PHE	2.5
3	B	142	LEU	2.4
3	B	139	PRO	2.4
3	A	230	TYR	2.4
3	B	188	ASN	2.3
3	B	215	LEU	2.2
3	B	239	ASP	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.