



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 06:42 PM UTC

PDB ID : 3GTJ / pdb_00003gtj
Title : Backtracked RNA polymerase II complex with 13mer RNA
Authors : Wang, D.; Bushnell, D.A.; Huang, X.; Westover, K.D.; Levitt, M.; Kornberg, R.D.
Deposited on : 2009-03-27
Resolution : 3.42 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

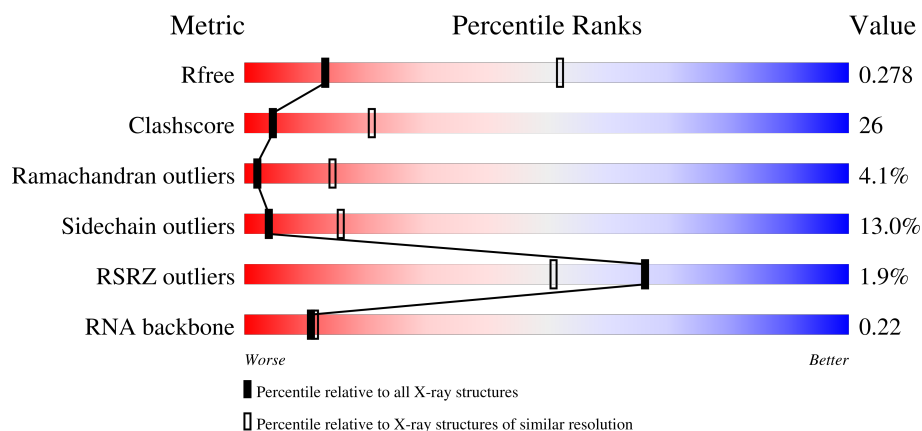
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.42 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	1210 (3.48-3.36)
Clashscore	190562	1234 (3.48-3.36)
Ramachandran outliers	187476	1222 (3.48-3.36)
Sidechain outliers	187428	1222 (3.48-3.36)
RSRZ outliers	180081	1210 (3.48-3.36)
RNA backbone	3983	1162 (3.84-3.00)

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	A	1733	42% 31% 8% 18%
2	B	1224	2% 49% 36% 9% 6%
3	C	318	45% 33% 8% 15%
4	E	215	4% 67% 29%

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Mol	Chain	Length	Quality of chain
5	F	155	
6	H	146	
7	I	122	
8	J	70	
9	K	120	
10	L	70	
11	R	13	
12	T	28	
13	N	14	

2 Entry composition

There are 15 unique types of molecules in this entry. The entry contains 29974 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-directed RNA polymerase II subunit RPB1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	1429	Total	C	N	O	S	0	0	0
			11239	7077	1969	2132	61			

- Molecule 2 is a protein called DNA-directed RNA polymerase II subunit RPB2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	1153	Total	C	N	O	S	0	0	0
			9168	5795	1604	1713	56			

- Molecule 3 is a protein called DNA-directed RNA polymerase II subunit RPB3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	271	Total	C	N	O	S	0	0	0
			2135	1344	355	423	13			

- Molecule 4 is a protein called DNA-directed RNA polymerases I, II, and III subunit RPABC1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	E	215	Total	C	N	O	S	0	0	0
			1757	1114	310	322	11			

- Molecule 5 is a protein called DNA-directed RNA polymerases I, II, and III subunit RPABC2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	F	85	Total	C	N	O	S	0	0	0
			684	437	116	128	3			

- Molecule 6 is a protein called DNA-directed RNA polymerases I, II, and III subunit RPABC3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	H	136	Total	C	N	O	S	0	0	0
			1087	684	183	215	5			

- Molecule 7 is a protein called DNA-directed RNA polymerase II subunit RPB9.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	I	119	Total	C	N	O	S	0	0	0
			971	596	179	186	10			

- Molecule 8 is a protein called DNA-directed RNA polymerases I, II, and III subunit RPABC5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
8	J	65	Total	C	N	O	S	0	0	0
			532	339	93	94	6			

- Molecule 9 is a protein called DNA-directed RNA polymerase II subunit RPB11.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
9	K	114	Total	C	N	O	S	0	0	0
			919	590	156	171	2			

- Molecule 10 is a protein called DNA-directed RNA polymerases I, II, and III subunit RPABC4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
10	L	46	Total	C	N	O	S	0	0	0
			363	224	72	63	4			

- Molecule 11 is a RNA chain called RNA (5'-R(*AP*UP*CP*GP*AP*GP*AP*GP*GP*AP*UP*GP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
11	R	12	Total	C	N	O	P	0	0	0
			260	117	52	80	11			

- Molecule 12 is a DNA chain called DNA (28-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
12	T	28	Total	C	N	O	P	0	0	0
			566	271	104	164	27			

- Molecule 13 is a DNA chain called DNA (5'-D(*CP*TP*GP*CP*TP*TP*AP*TP*CP*GP*GP*TP*AP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
13	N	14	Total	C	N	O	P	0	0	0
			284	137	49	85	13			

- Molecule 14 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
14	A	2	Total 2	Zn 2	0	0
14	B	1	Total 1	Zn 1	0	0
14	C	1	Total 1	Zn 1	0	0
14	I	2	Total 2	Zn 2	0	0
14	J	1	Total 1	Zn 1	0	0
14	L	1	Total 1	Zn 1	0	0

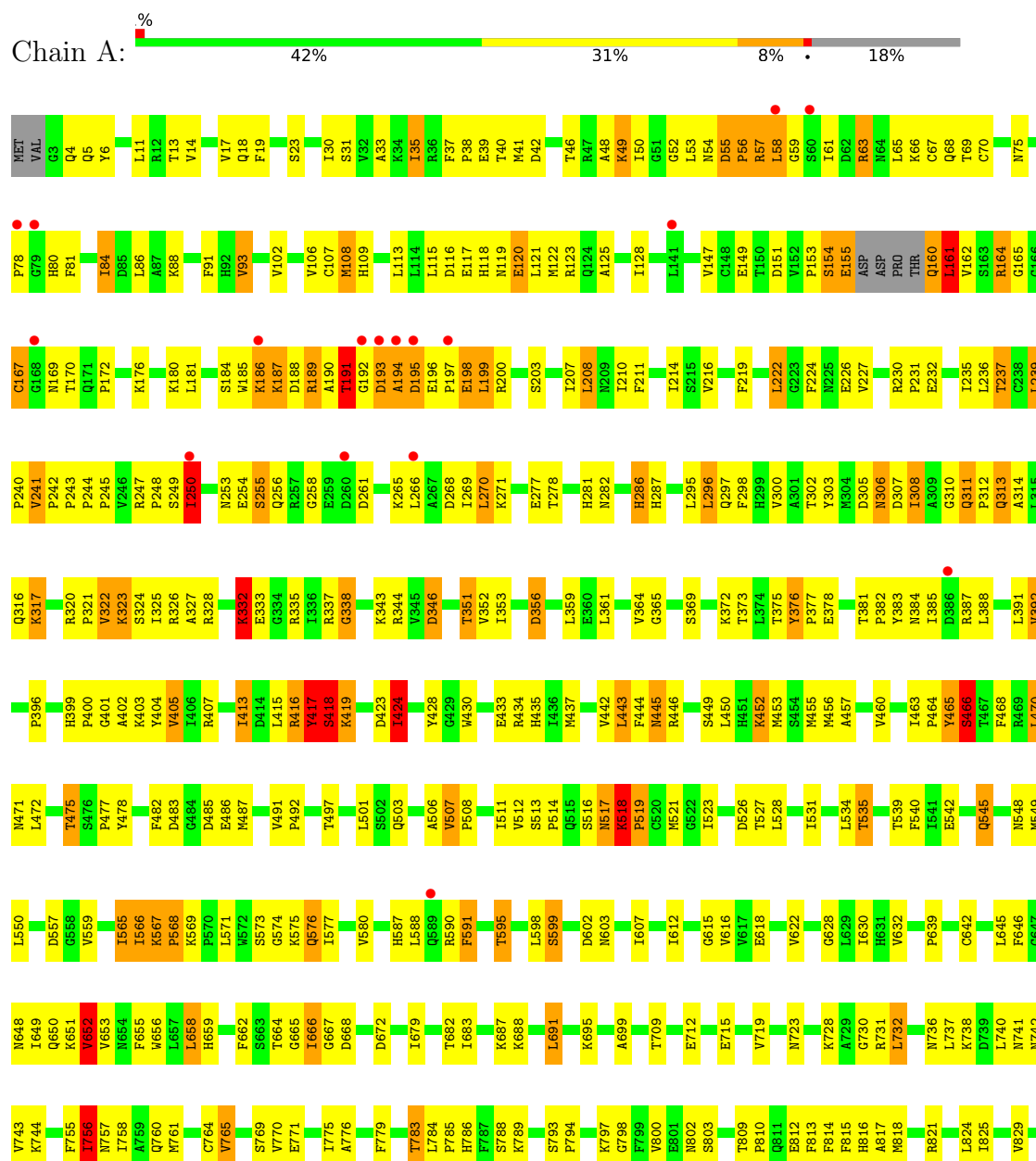
- Molecule 15 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

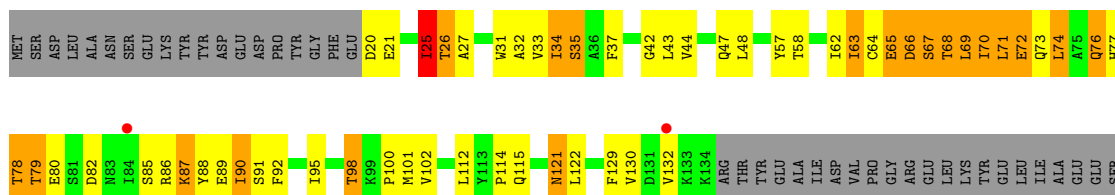
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
15	A	1	Total 1	Mg 1	0	0

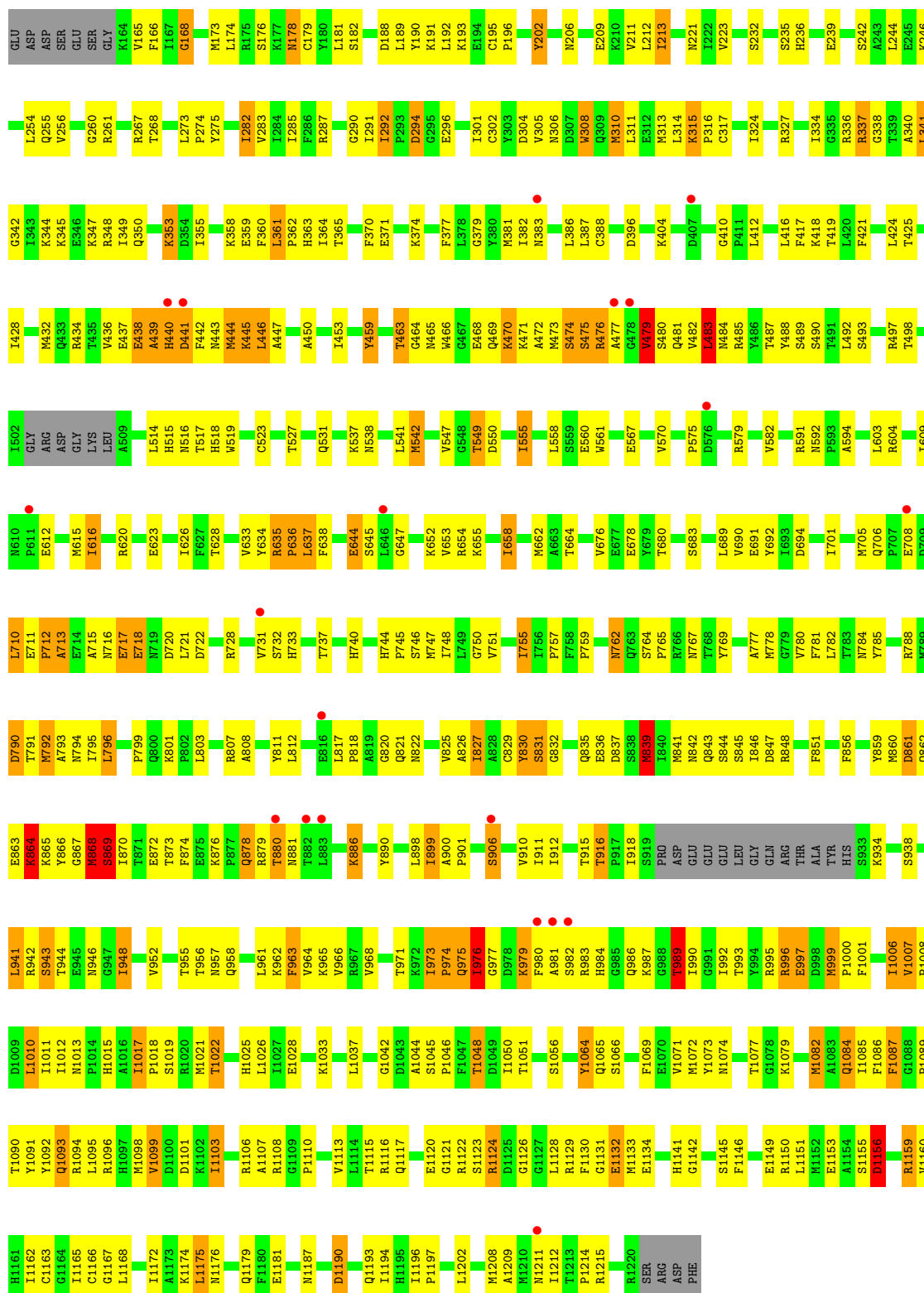
3 Residue-property plots

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.

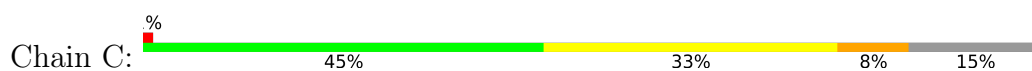
- Molecule 1: DNA-directed RNA polymerase II subunit RPB1

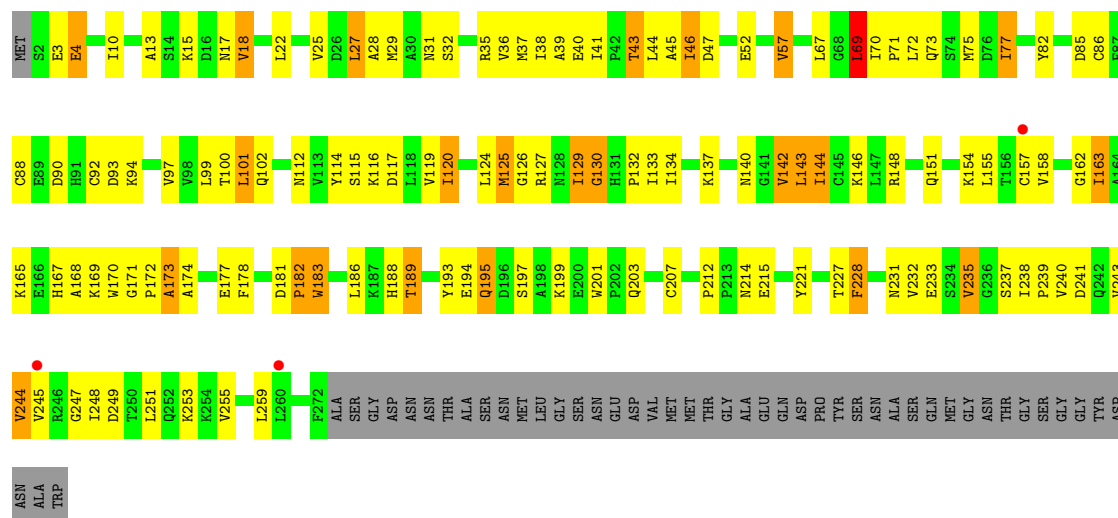




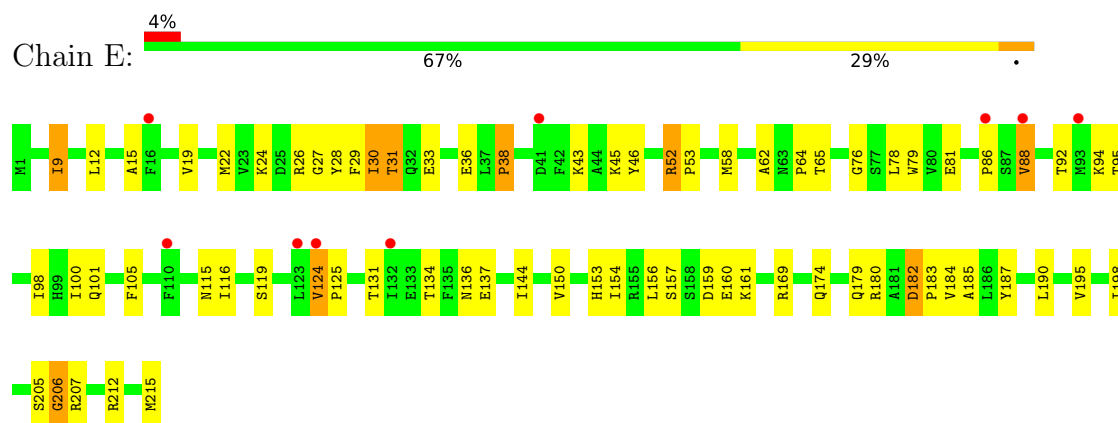


• Molecule 3: DNA-directed RNA polymerase II subunit RPB3

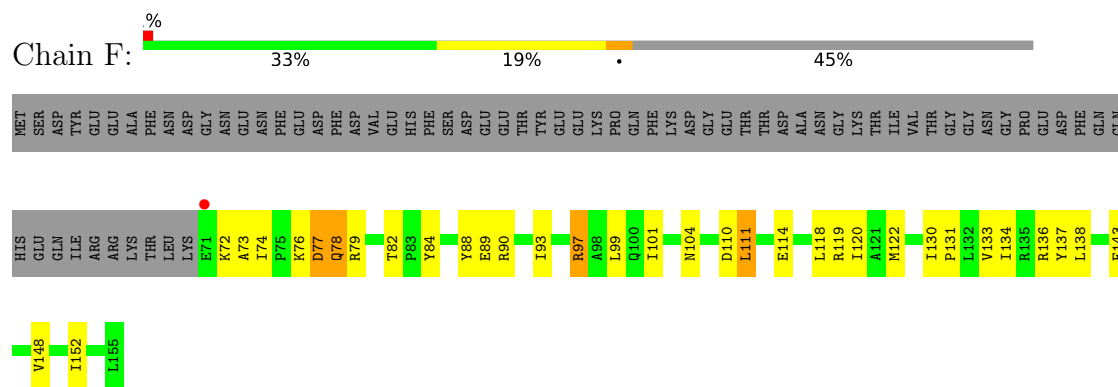




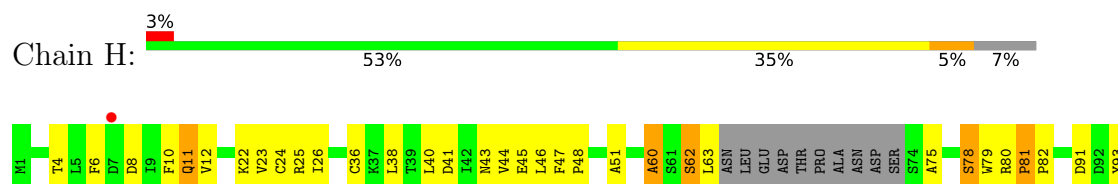
- Molecule 4: DNA-directed RNA polymerases I, II, and III subunit RPABC1



- Molecule 5: DNA-directed RNA polymerases I, II, and III subunit RPABC2

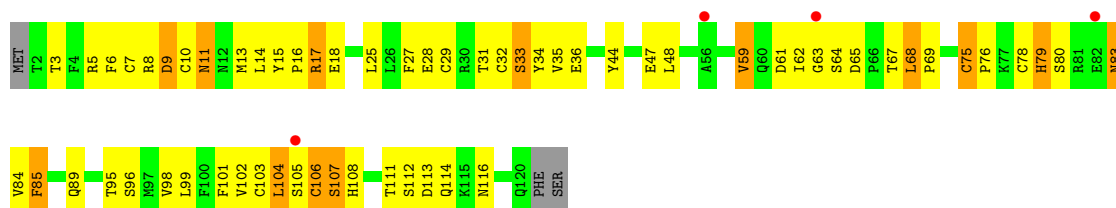


- Molecule 6: DNA-directed RNA polymerases I, II, and III subunit RPABC3





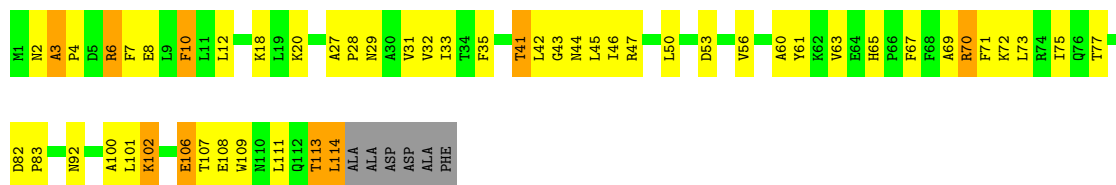
- Molecule 7: DNA-directed RNA polymerase II subunit RPB9



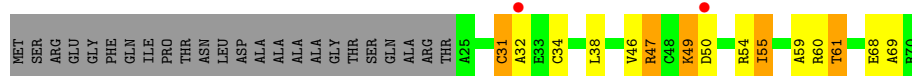
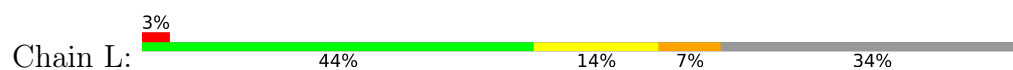
- Molecule 8: DNA-directed RNA polymerases I, II, and III subunit RPABC5



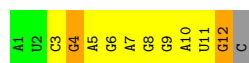
- Molecule 9: DNA-directed RNA polymerase II subunit RPB11



- Molecule 10: DNA-directed RNA polymerases I, II, and III subunit RPABC4



- Molecule 11: RNA (5'-R(*AP*UP*CP*GP*AP*GP*AP*GP*GP*AP*UP*GP*C)-3')

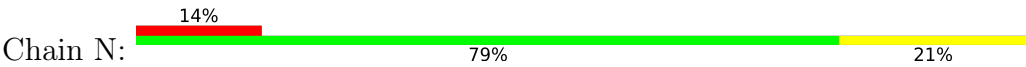


- Molecule 12: DNA (28-MER)





• Molecule 13: DNA (5'-D(*CP*TP*GP*CP*TP*TP*AP*TP*CP*GP*GP*TP*AP*G)-3')



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	170.92Å 225.50Å 195.93Å 90.00° 101.21° 90.00°	Depositor
Resolution (Å)	50.00 – 3.42 50.00 – 3.42	Depositor EDS
% Data completeness (in resolution range)	91.7 (50.00-3.42) 91.8 (50.00-3.42)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.52 (at 3.40Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.282 , 0.292 0.270 , 0.278	Depositor DCC
R_{free} test set	4479 reflections (4.56%)	wwPDB-VP
Wilson B-factor (Å ²)	106.8	Xtriage
Anisotropy	0.267	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 97.3	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	0.91	EDS
Total number of atoms	29974	wwPDB-VP
Average B, all atoms (Å ²)	145.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.87% 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: ZN, MG

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	0.89	3/11438 (0.0%)	1.08	51/15465 (0.3%)
2	B	0.96	3/9348 (0.0%)	1.10	29/12611 (0.2%)
3	C	1.09	3/2174 (0.1%)	1.15	13/2946 (0.4%)
4	E	0.97	2/1793 (0.1%)	1.04	6/2413 (0.2%)
5	F	0.84	0/696	1.00	3/940 (0.3%)
6	H	0.89	0/1105	0.97	1/1495 (0.1%)
7	I	0.97	1/989 (0.1%)	1.04	9/1331 (0.7%)
8	J	1.03	0/541	1.12	1/727 (0.1%)
9	K	0.96	0/937	1.09	1/1265 (0.1%)
10	L	1.10	0/365	1.18	1/485 (0.2%)
11	R	0.53	0/292	0.90	0/455
12	T	0.59	0/634	1.29	6/975 (0.6%)
13	N	0.52	0/317	1.08	1/488 (0.2%)
All	All	0.93	12/30629 (0.0%)	1.09	122/41596 (0.3%)

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	989	THR	CA-CB	6.78	1.64	1.53
2	B	847	ASP	CG-OD2	6.13	1.37	1.25
1	A	756	ILE	CA-CB	6.03	1.62	1.54
7	I	102	VAL	CA-C	5.82	1.59	1.52
3	C	97	VAL	CA-CB	5.57	1.60	1.53

The worst 5 of 122 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	1156	ASP	N-CA-C	10.81	126.60	113.41
2	B	25	ILE	CB-CA-C	-9.42	95.96	111.32
3	C	183	TRP	N-CA-C	-8.73	96.76	109.59

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Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	93	VAL	N-CA-C	8.45	119.23	110.62
1	A	356	ASP	CA-C-N	7.88	127.60	119.56

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	11239	0	11313	708	0
2	B	9168	0	9179	496	0
3	C	2135	0	2090	103	0
4	E	1757	0	1781	44	0
5	F	684	0	703	26	0
6	H	1087	0	1062	55	0
7	I	971	0	930	55	0
8	J	532	0	544	30	0
9	K	919	0	929	47	0
10	L	363	0	387	11	0
11	R	260	0	132	38	0
12	T	566	0	316	13	0
13	N	284	0	161	5	0
14	A	2	0	0	1	0
14	B	1	0	0	0	0
14	C	1	0	0	0	0
14	I	2	0	0	2	0
14	J	1	0	0	1	0
14	L	1	0	0	0	0
15	A	1	0	0	0	0
All	All	29974	0	29527	1529	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 26.

The worst 5 of 1529 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:1169:ILE:CB	1:A:1170:ILE:HB	1.41	1.47
2:B:863:GLU:CA	2:B:864:LYS:HB2	1.43	1.42
2:B:863:GLU:HA	2:B:864:LYS:CB	1.47	1.40
2:B:841:MET:HE1	2:B:980:PHE:CZ	1.61	1.34
1:A:1082:ASN:CA	1:A:1083:THR:HB	1.51	1.33

There are no symmetry-related clashes.

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	
1	A	1419/1733 (82%)	1089 (77%)	270 (19%)	60 (4%)	2	14
2	B	1145/1224 (94%)	896 (78%)	202 (18%)	47 (4%)	2	14
3	C	269/318 (85%)	198 (74%)	63 (23%)	8 (3%)	3	18
4	E	213/215 (99%)	175 (82%)	32 (15%)	6 (3%)	4	19
5	F	83/155 (54%)	68 (82%)	11 (13%)	4 (5%)	2	11
6	H	132/146 (90%)	100 (76%)	25 (19%)	7 (5%)	1	10
7	I	117/122 (96%)	85 (73%)	23 (20%)	9 (8%)	1	5
8	J	63/70 (90%)	52 (82%)	9 (14%)	2 (3%)	3	18
9	K	112/120 (93%)	96 (86%)	15 (13%)	1 (1%)	14	41
10	L	44/70 (63%)	29 (66%)	13 (30%)	2 (4%)	2	13
All	All	3597/4173 (86%)	2788 (78%)	663 (18%)	146 (4%)	2	14

5 of 146 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	57	ARG
1	A	120	GLU
1	A	186	LYS

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Mol	Chain	Res	Type
1	A	191	THR
1	A	193	ASP

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	
1	A	1248/1520 (82%)	1067 (86%)	181 (14%)	3	13
2	B	1000/1061 (94%)	860 (86%)	140 (14%)	3	13
3	C	238/274 (87%)	208 (87%)	30 (13%)	4	17
4	E	196/197 (100%)	183 (93%)	13 (7%)	15	40
5	F	74/137 (54%)	69 (93%)	5 (7%)	14	39
6	H	119/128 (93%)	113 (95%)	6 (5%)	22	48
7	I	113/116 (97%)	102 (90%)	11 (10%)	8	27
8	J	60/65 (92%)	50 (83%)	10 (17%)	2	9
9	K	99/102 (97%)	86 (87%)	13 (13%)	4	16
10	L	40/57 (70%)	35 (88%)	5 (12%)	4	17
All	All	3187/3657 (87%)	2773 (87%)	414 (13%)	4	16

5 of 414 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	440	HIS
2	B	997	GLU
9	K	20	LYS
2	B	470	LYS
2	B	764	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 97 such sidechains are listed below:

Mol	Chain	Res	Type
2	B	648	HIS

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Mol	Chain	Res	Type
2	B	986	GLN
2	B	706	GLN
2	B	822	ASN
3	C	17	ASN

5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
11	R	11/13 (84%)	2 (18%)	0

All (2) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
11	R	4	G
11	R	12	G

There are no RNA pucker outliers to report.

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 ⓘ

Of 9 ligands modelled in this entry, 9 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

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 [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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	1429/1733 (82%)	0.12	21 (1%) 72 58	81, 135, 241, 393	0
2	B	1153/1224 (94%)	0.15	22 (1%) 66 51	80, 120, 251, 398	0
3	C	271/318 (85%)	0.02	3 (1%) 78 65	90, 114, 178, 337	0
4	E	215/215 (100%)	0.21	9 (4%) 40 29	111, 159, 272, 350	0
5	F	85/155 (54%)	-0.15	1 (1%) 76 64	110, 134, 173, 217	0
6	H	136/146 (93%)	0.30	5 (3%) 45 32	124, 172, 301, 360	0
7	I	119/122 (97%)	0.33	4 (3%) 48 35	111, 151, 193, 273	0
8	J	65/70 (92%)	-0.10	1 (1%) 72 58	87, 104, 152, 179	0
9	K	114/120 (95%)	-0.06	0 100 100	87, 119, 153, 172	0
10	L	46/70 (65%)	0.60	2 (4%) 40 29	107, 166, 257, 270	0
11	R	12/13 (92%)	-0.02	0 100 100	93, 123, 178, 190	0
12	T	28/28 (100%)	0.32	0 100 100	96, 205, 312, 314	0
13	N	14/14 (100%)	1.01	2 (14%) 6 7	280, 307, 312, 313	0
All	All	3687/4228 (87%)	0.14	70 (1%) 66 51	80, 131, 253, 398	0

The worst 5 of 70 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	882	THR	4.7
2	B	980	PHE	4.1
2	B	477	ALA	3.9
2	B	982	SER	3.6
13	N	1	DC	3.5

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](#)

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. 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	B-factors($\text{\AA}^2$)	Q<0.9
15	MG	A	1736	1/1	0.90	0.13	91,91,91,91	0
14	ZN	I	204	1/1	0.93	0.07	293,293,293,293	0
14	ZN	A	1735	1/1	0.97	0.06	145,145,145,145	0
14	ZN	A	1734	1/1	0.98	0.04	246,246,246,246	0
14	ZN	J	101	1/1	0.98	0.04	190,190,190,190	0
14	ZN	L	105	1/1	0.98	0.04	151,151,151,151	0
14	ZN	B	1307	1/1	0.98	0.03	160,160,160,160	0
14	ZN	C	319	1/1	0.99	0.02	135,135,135,135	0
14	ZN	I	203	1/1	0.99	0.04	147,147,147,147	0

6.5 Other polymers [i](#)

There are no such residues in this entry.