



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 03:21 AM UTC

PDB ID : 3K7A / pdb_00003k7a
Title : Crystal Structure of an RNA polymerase II-TFIIB complex
Authors : Liu, X.; Bushnell, D.A.; Wang, D.; Calero, G.; Kornberg, R.D.
Deposited on : 2009-10-12
Resolution : 3.80 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

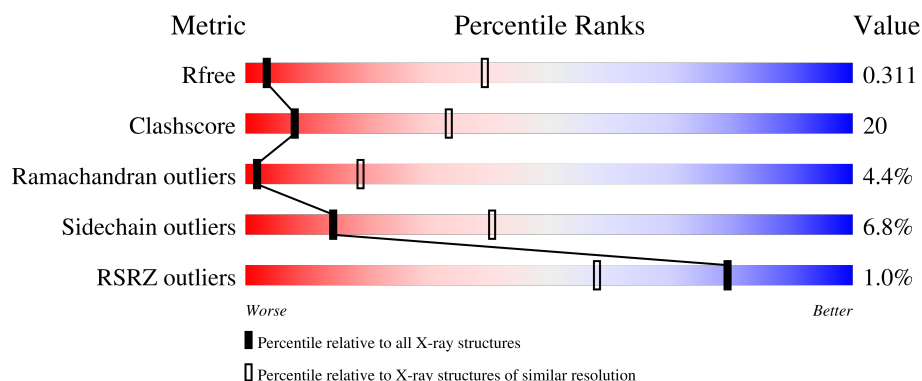
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.80 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}	180053	1065 (3.96-3.64)
Clashscore	190562	1012 (3.94-3.66)
Ramachandran outliers	187476	1048 (3.96-3.64)
Sidechain outliers	187428	1043 (3.96-3.64)
RSRZ outliers	180081	1064 (3.96-3.64)

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	% 47% 30% 5% 19%
2	B	1224	% 52% 34% 5% 8%
3	C	318	% 54% 27% • 16%
4	E	215	79% 20% •
5	F	155	% 32% 20% • 46%

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Mol	Chain	Length	Quality of chain
6	H	146	48% 37% 5% 9%
7	I	122	53% 37% 7%
8	J	70	60% 27% 6% 7%
9	K	120	58% 28% 9% 5%
10	L	70	33% 23% 10% 34%
11	M	345	42% 11% 46%

2 Entry composition [i](#)

There are 12 unique types of molecules in this entry. The entry contains 29029 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	1408	Total	C	N	O	S	0	0	0
			11052	6966	1936	2089	61			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	1122	Total	C	N	O	S	0	0	0
			8845	5595	1551	1644	55			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	266	Total	C	N	O	S	0	0	0
			2095	1317	348	417	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	214	Total	C	N	O	S	0	0	0
			1752	1111	309	321	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	84	Total	C	N	O	S	0	0	0
			679	434	115	127	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	133	Total	C	N	O	S	0	0	0
			1068	673	180	211	4			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	I	118	Total	C	N	O	S	0	0	0
			967	594	178	185	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 protein called Transcription initiation factor IIB.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
11	M	187	Total	C	N	O	0	0	0
			748	374	187	187			

- Molecule 12 is ZINC ION (CCD ID: ZN) (formula: Zn).

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

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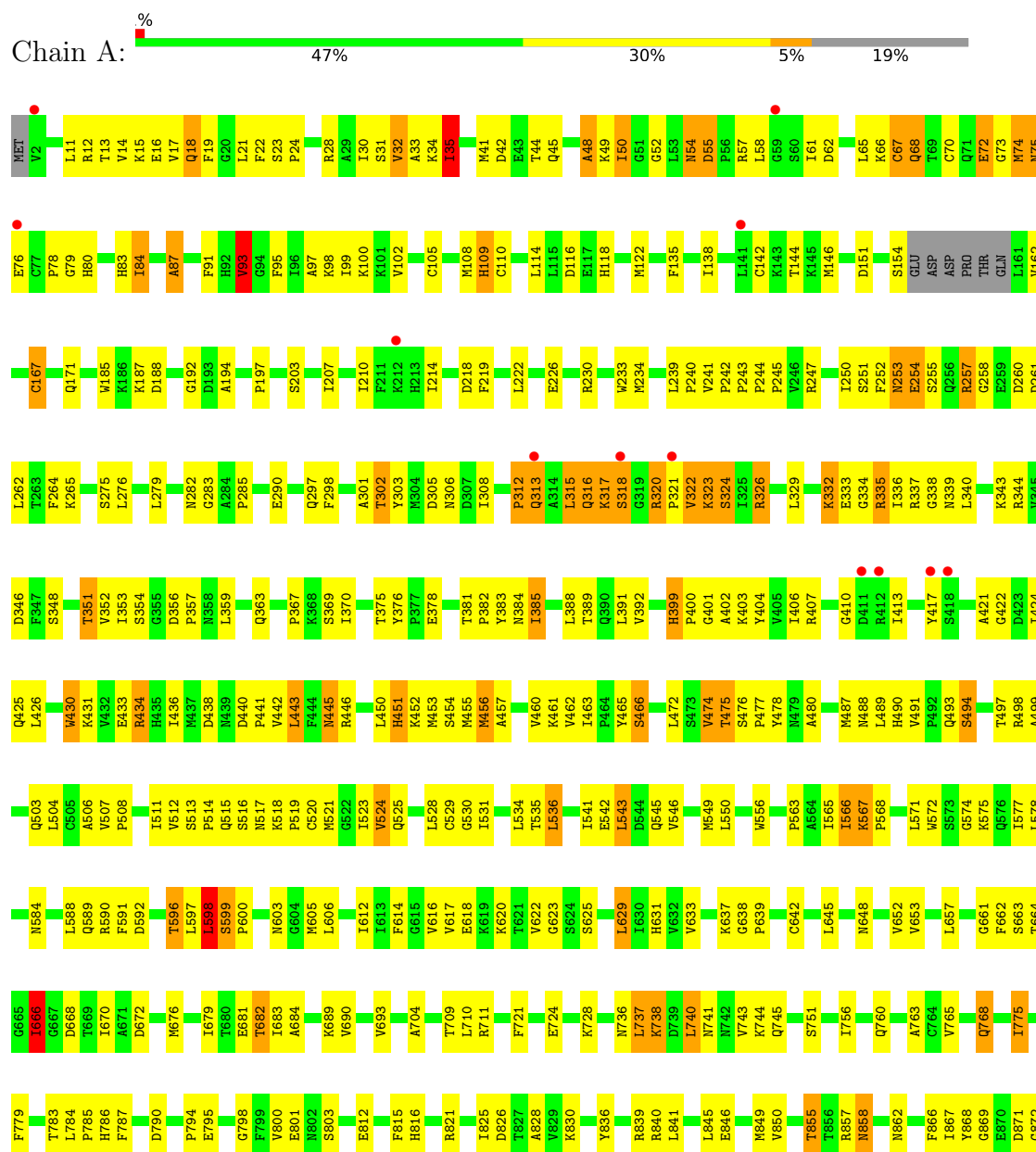
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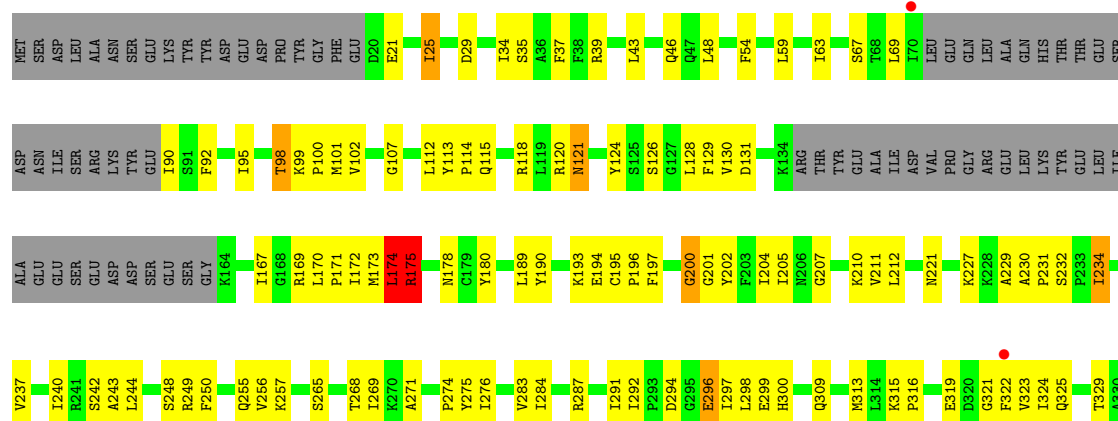
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
12	L	1	Total 1	Zn 1	0	0
12	M	1	Total 1	Zn 1	0	0

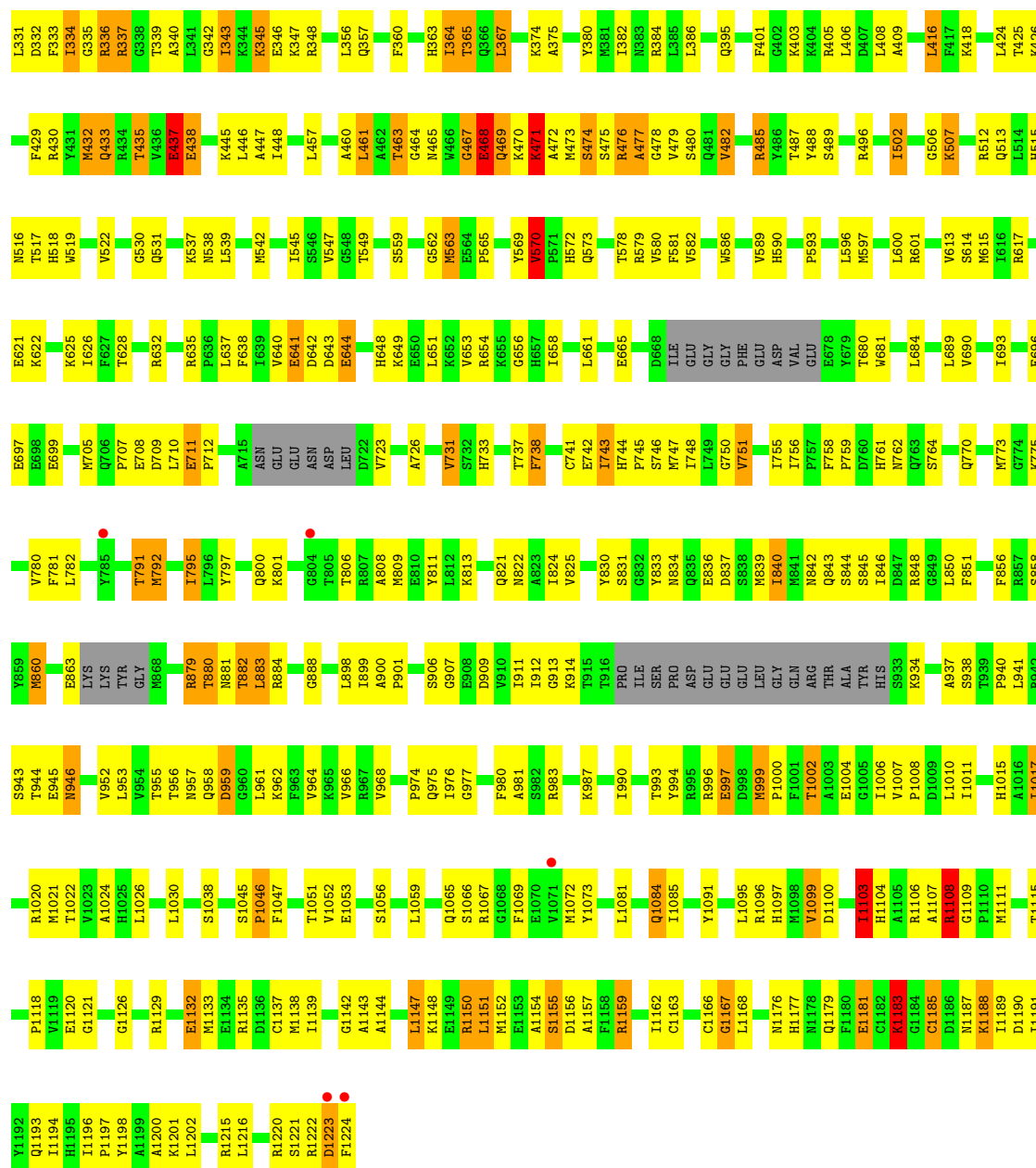
3 Residue-property plots

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.

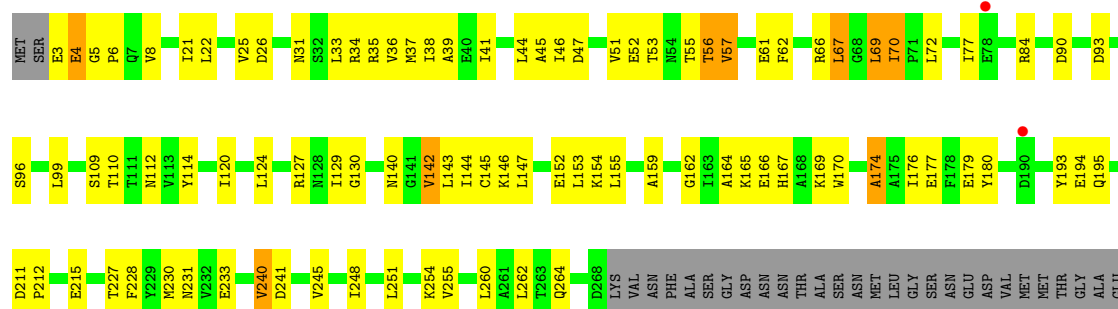
- Molecule 1: DNA-directed RNA polymerase II subunit RPB1







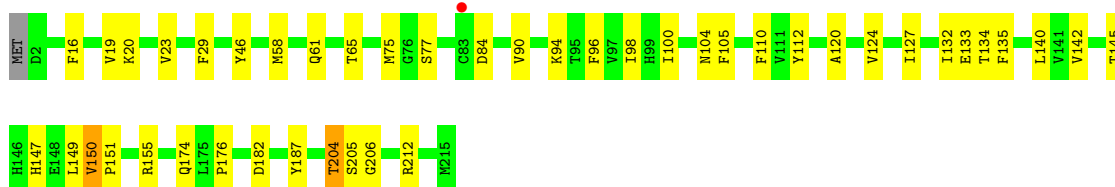
• Molecule 3: DNA-directed RNA polymerase II subunit RPB3



GLN
ASP
PRO
TYR
SER
ASN
ALA
SER
GLN
MET
GLY
ASN
THR
GLY
SER
GLY
TYR
GLY
ASP
ASN
ALA
TRP

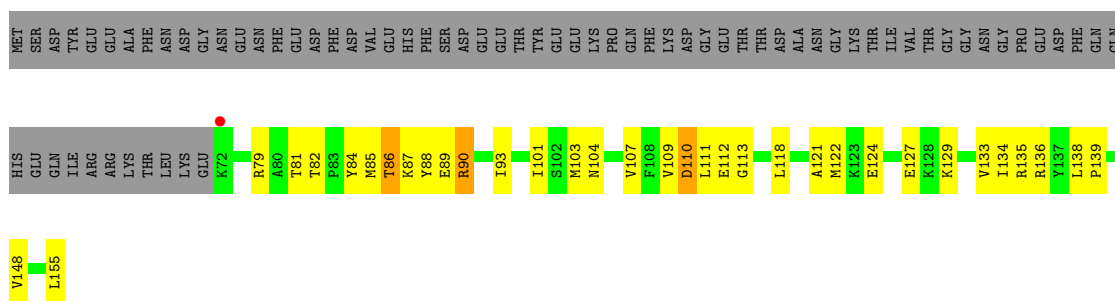
- Molecule 4: DNA-directed RNA polymerases I, II, and III subunit RPABC1

Chain E: 



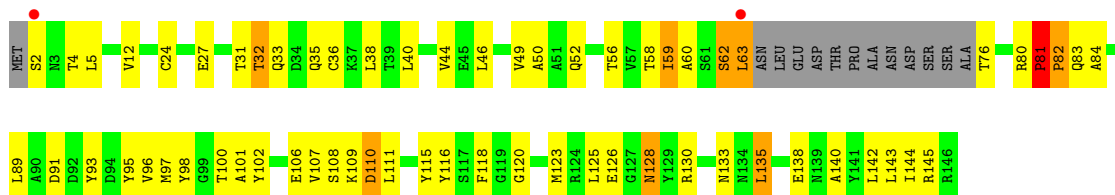
- Molecule 5: DNA-directed RNA polymerases I, II, and III subunit RPABC2

Chain F: 



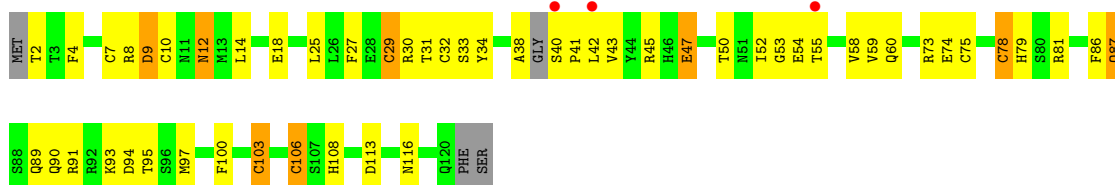
- Molecule 6: DNA-directed RNA polymerases I, II, and III subunit RPABC3

Chain H: 



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

Chain I: 

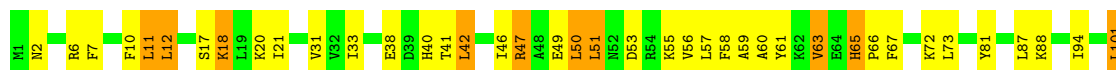


- Molecule 8: DNA-directed RNA polymerases I, II, and III subunit RPABC5

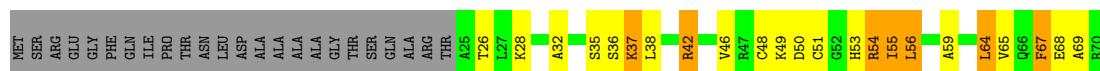
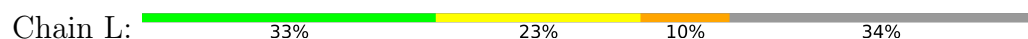
Chain J: 



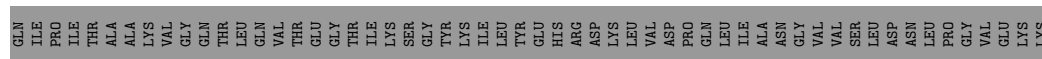
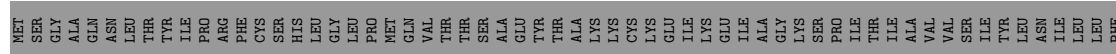
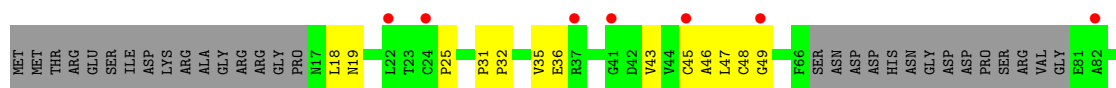
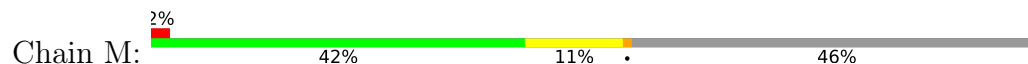
- Molecule 9: DNA-directed RNA polymerase II subunit RPB11



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



- Molecule 11: Transcription initiation factor IIB



4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, α , β , γ	204.15Å 216.21Å 420.98Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 3.80 50.00 – 3.80	Depositor EDS
% Data completeness (in resolution range)	95.5 (50.00-3.80) 95.5 (50.00-3.80)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.55 (at 3.78Å)	Xtriage
Refinement program	REFMAC 5.5.0088, CNS 1.2	Depositor
R, R_{free}	0.263 , 0.313 0.261 , 0.311	Depositor DCC
R_{free} test set	8341 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å ²)	126.3	Xtriage
Anisotropy	0.598	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 171.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.41$, $\langle L^2 \rangle = 0.24$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	29029	wwPDB-VP
Average B, all atoms (Å ²)	188.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 1.98% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section:
ZN

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	0.66	0/11248	0.99	20/15211 (0.1%)
2	B	0.63	1/9016 (0.0%)	0.94	12/12165 (0.1%)
3	C	0.60	0/2133	0.97	7/2891 (0.2%)
4	E	0.52	0/1788	0.88	1/2406 (0.0%)
5	F	0.78	0/691	1.01	0/933
6	H	0.56	1/1086 (0.1%)	0.87	1/1470 (0.1%)
7	I	0.54	0/984	0.84	1/1323 (0.1%)
8	J	0.62	0/541	0.93	0/727
9	K	0.67	0/937	1.00	2/1265 (0.2%)
10	L	0.70	0/365	1.05	4/485 (0.8%)
11	M	0.61	0/746	1.54	14/929 (1.5%)
All	All	0.64	2/29535 (0.0%)	0.98	62/39805 (0.2%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1157	ALA	CA-C	-5.36	1.46	1.52
6	H	81	PRO	CA-C	5.26	1.57	1.52

The worst 5 of 62 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
11	M	120	ASP	N-CA-C	11.64	123.53	111.07
11	M	161	LYS	N-CA-C	9.70	124.73	111.54
11	M	165	GLY	N-CA-C	-9.22	100.03	113.48
11	M	46	ALA	N-CA-C	-9.00	102.85	112.93
2	B	900	ALA	CA-C-N	7.99	129.82	119.84

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	11052	0	11130	499	0
2	B	8845	0	8816	397	0
3	C	2095	0	2051	72	0
4	E	1752	0	1776	33	0
5	F	679	0	701	25	0
6	H	1068	0	1040	57	0
7	I	967	0	925	45	0
8	J	532	0	542	31	0
9	K	919	0	929	49	0
10	L	363	0	386	12	0
11	M	748	0	200	22	0
12	A	2	0	0	0	0
12	B	1	0	0	0	0
12	C	1	0	0	0	0
12	I	2	0	0	0	0
12	J	1	0	0	0	0
12	L	1	0	0	0	0
12	M	1	0	0	0	0
All	All	29029	0	28496	1122	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 20.

The worst 5 of 1122 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:B:839:MET:HE3	2:B:1010:LEU:HD11	1.29	1.10
2:B:899:ILE:HD11	2:B:911:ILE:HA	1.23	1.10
6:H:81:PRO:HB2	6:H:82:PRO:HD3	1.29	1.07
1:A:567:LYS:HB2	1:A:568:PRO:CD	1.83	1.06
1:A:441:PRO:HD2	1:A:498:ARG:NH2	1.69	1.05

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	1398/1733 (81%)	1184 (85%)	154 (11%)	60 (4%)	2	19
2	B	1108/1224 (90%)	943 (85%)	105 (10%)	60 (5%)	1	16
3	C	264/318 (83%)	236 (89%)	20 (8%)	8 (3%)	3	25
4	E	212/215 (99%)	194 (92%)	18 (8%)	0	100	100
5	F	82/155 (53%)	74 (90%)	7 (8%)	1 (1%)	10	40
6	H	129/146 (88%)	98 (76%)	22 (17%)	9 (7%)	1	12
7	I	114/122 (93%)	97 (85%)	15 (13%)	2 (2%)	6	33
8	J	63/70 (90%)	56 (89%)	5 (8%)	2 (3%)	3	24
9	K	112/120 (93%)	106 (95%)	6 (5%)	0	100	100
10	L	44/70 (63%)	22 (50%)	14 (32%)	8 (18%)	0	2
11	M	183/345 (53%)	152 (83%)	19 (10%)	12 (7%)	1	13
All	All	3709/4518 (82%)	3162 (85%)	385 (10%)	162 (4%)	2	19

5 of 162 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	48	ALA
1	A	54	ASN
1	A	55	ASP
1	A	109	HIS
1	A	250	ILE

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	1224/1520 (80%)	1141 (93%)	83 (7%)	14	40
2	B	953/1061 (90%)	881 (92%)	72 (8%)	12	37
3	C	234/274 (85%)	224 (96%)	10 (4%)	26	50
4	E	196/197 (100%)	192 (98%)	4 (2%)	48	65
5	F	74/137 (54%)	68 (92%)	6 (8%)	11	35
6	H	117/128 (91%)	110 (94%)	7 (6%)	17	43
7	I	113/116 (97%)	106 (94%)	7 (6%)	16	42
8	J	60/65 (92%)	56 (93%)	4 (7%)	15	41
9	K	99/102 (97%)	88 (89%)	11 (11%)	6	24
10	L	40/57 (70%)	33 (82%)	7 (18%)	2	12
All	All	3110/3657 (85%)	2899 (93%)	211 (7%)	14	40

5 of 211 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	547	VAL
2	B	1108	ARG
9	K	50	LEU
2	B	680	THR
2	B	860	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 88 such sidechains are listed below:

Mol	Chain	Res	Type
2	B	1015	HIS
3	C	242	GLN
2	B	1076	HIS
3	C	112	ASN
4	E	104	ASN

5.3.3 RNA ⓘ

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

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	1408/1733 (81%)	-0.14	13 (0%) 81 60	82, 172, 267, 498	0
2	B	1122/1224 (91%)	-0.12	7 (0%) 85 68	68, 183, 297, 489	0
3	C	266/318 (83%)	-0.24	2 (0%) 82 62	93, 166, 244, 317	0
4	E	214/215 (99%)	-0.20	1 (0%) 87 71	109, 202, 304, 500	0
5	F	84/155 (54%)	-0.46	1 (1%) 76 54	82, 135, 188, 256	0
6	H	133/146 (91%)	-0.11	2 (1%) 72 50	118, 220, 305, 358	0
7	I	118/122 (96%)	0.05	3 (2%) 58 40	132, 237, 353, 412	0
8	J	65/70 (92%)	-0.40	0 100 100	106, 169, 237, 266	0
9	K	114/120 (95%)	-0.43	1 (0%) 81 60	94, 148, 208, 270	0
10	L	46/70 (65%)	0.05	0 100 100	137, 208, 293, 359	0
11	M	187/345 (54%)	0.09	7 (3%) 45 31	111, 242, 373, 500	0
All	All	3757/4518 (83%)	-0.15	37 (0%) 79 58	68, 181, 296, 500	0

The worst 5 of 37 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
11	M	24	CYS	5.6
11	M	22	LEU	5.3
1	A	1153	TYR	4.4
11	M	41	GLY	4.2
1	A	321	PRO	3.3

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
12	ZN	M	346	1/1	0.89	0.24	193,193,193,193	0
12	ZN	L	105	1/1	0.91	0.09	215,215,215,215	0
12	ZN	B	1307	1/1	0.95	0.07	195,195,195,195	0
12	ZN	I	204	1/1	0.96	0.05	311,311,311,311	0
12	ZN	A	1735	1/1	0.97	0.06	183,183,183,183	0
12	ZN	C	319	1/1	0.98	0.05	191,191,191,191	0
12	ZN	A	1734	1/1	0.98	0.11	205,205,205,205	0
12	ZN	I	203	1/1	0.99	0.05	218,218,218,218	0
12	ZN	J	101	1/1	1.00	0.01	177,177,177,177	0

6.5 Other polymers [i](#)

There are no such residues in this entry.