



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 08:41 AM UTC

PDB ID : 3S16 / pdb_00003s16
Title : RNA Polymerase II Initiation Complex with an 8-nt RNA
Authors : Liu, X.; Bushnell, D.A.; Silva, D.A.; Huang, X.; Kornberg, R.D.
Deposited on : 2011-05-14
Resolution : 3.24 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

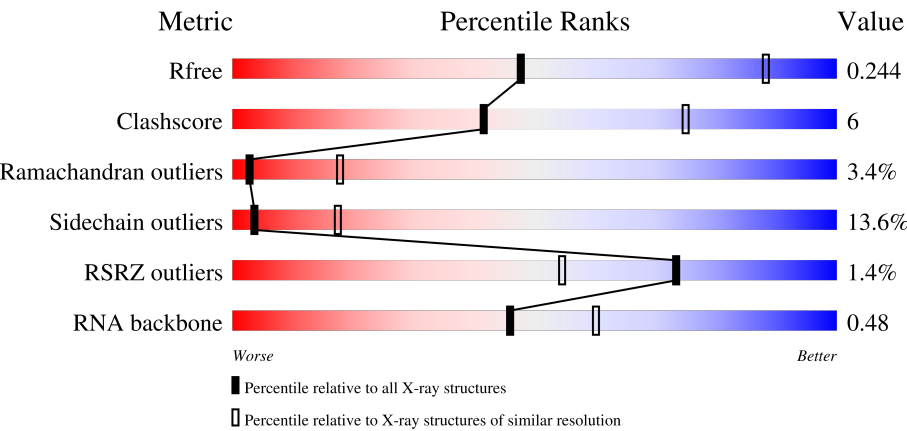
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.24 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.



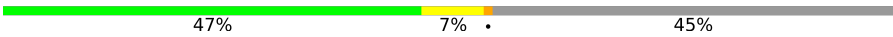
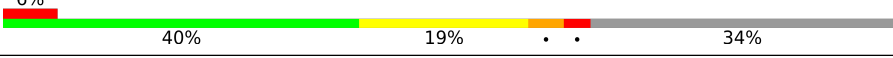
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R _{free}	180053	2153 (3.28-3.20)
Clashscore	190562	2275 (3.28-3.20)
Ramachandran outliers	187476	2233 (3.28-3.20)
Sidechain outliers	187428	2232 (3.28-3.20)
RSRZ outliers	180081	2153 (3.28-3.20)
RNA backbone	3983	1047 (3.52-2.96)

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 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	2% 58% 19% • 19%
2	B	1224	% 63% 24% • 9%
3	C	318	55% 23% 5% 16%
4	E	215	77% 21% •

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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	8	
12	T	29	

2 Entry composition

There are 14 unique types of molecules in this entry. The entry contains 28735 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	1405	Total	C	N	O	S	0	0	0
			11043	6965	1936	2081	61			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	1114	Total	C	N	O	S	0	0	0
			8861	5610	1549	1647	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	85	Total	C	N	O	S	0	0	0
			688	439	116	130	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	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(*UP*CP*GP*AP*GP*AP*GP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
11	R	8	Total	C	N	O	P	0	0	0
			173	78	35	53	7			

- Molecule 12 is a DNA chain called DNA (5'-D(*CP*TP*AP*CP*CP*GP*AP*TP*AP*AP*GP*CP*AP*GP*AP*CP*GP*AP*TP*CP*CP*TP*CP*TP*CP*GP*AP*TP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
12	T	13	Total	C	N	O	P	0	0	0
			261	125	43	80	13			

- Molecule 13 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
13	A	2	Total	Zn	0	0
			2	2		

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

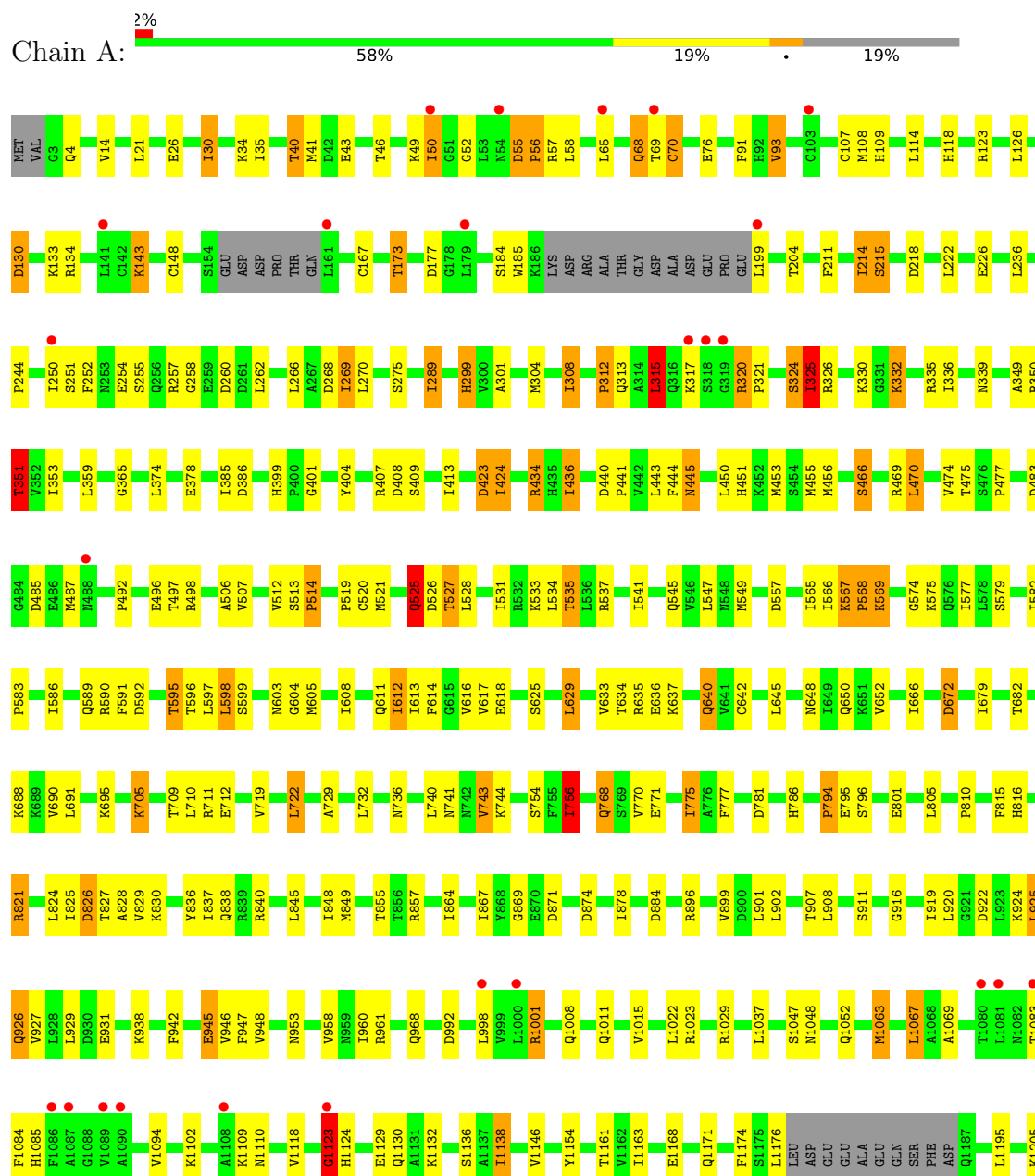
- Molecule 14 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

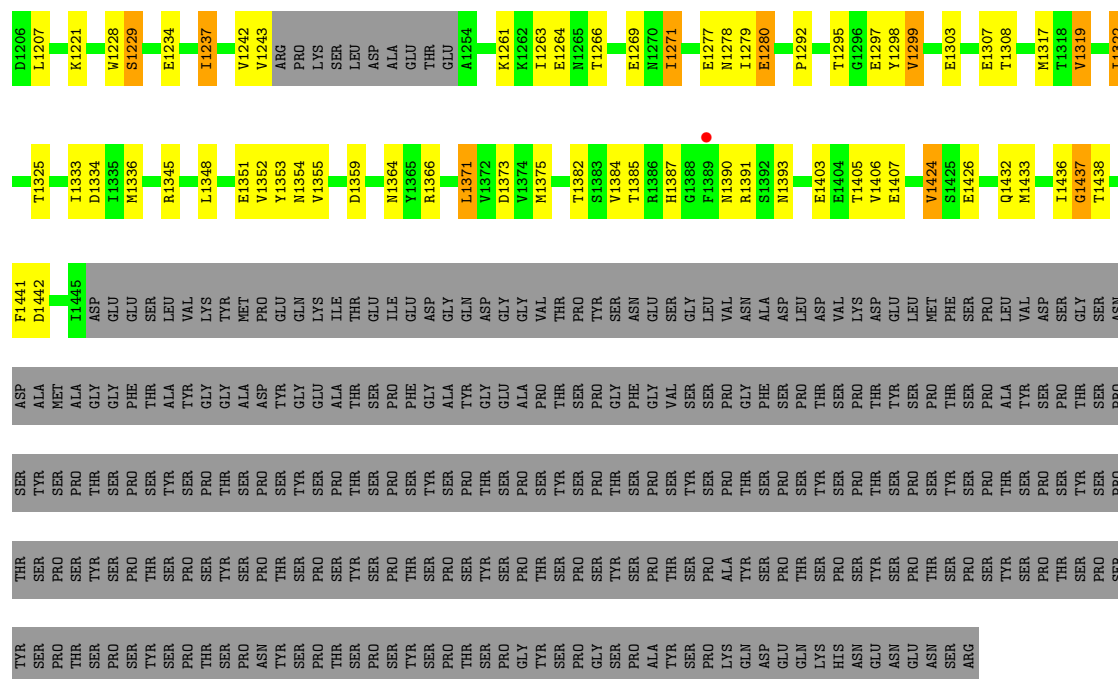
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
14	A	1	Total 1	Mg 1	0	0

3 Residue-property plots [i](#)

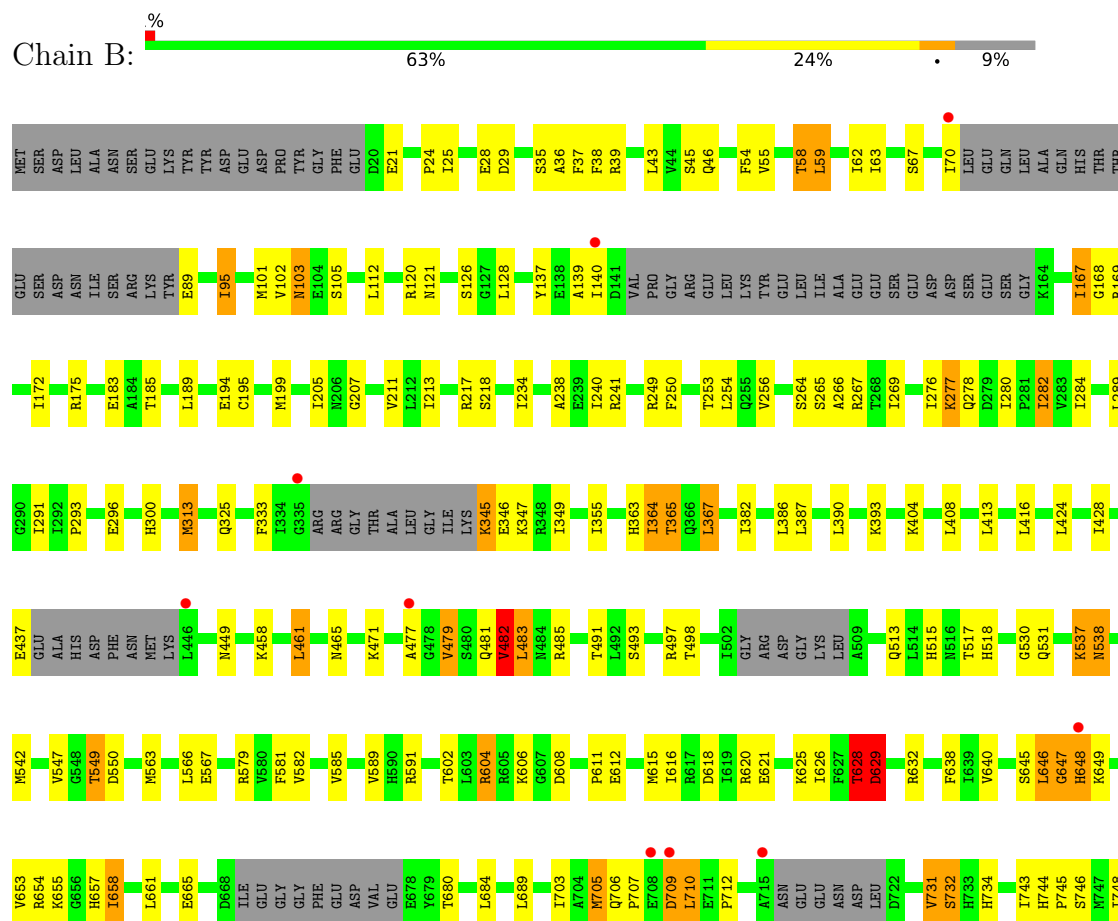
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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.

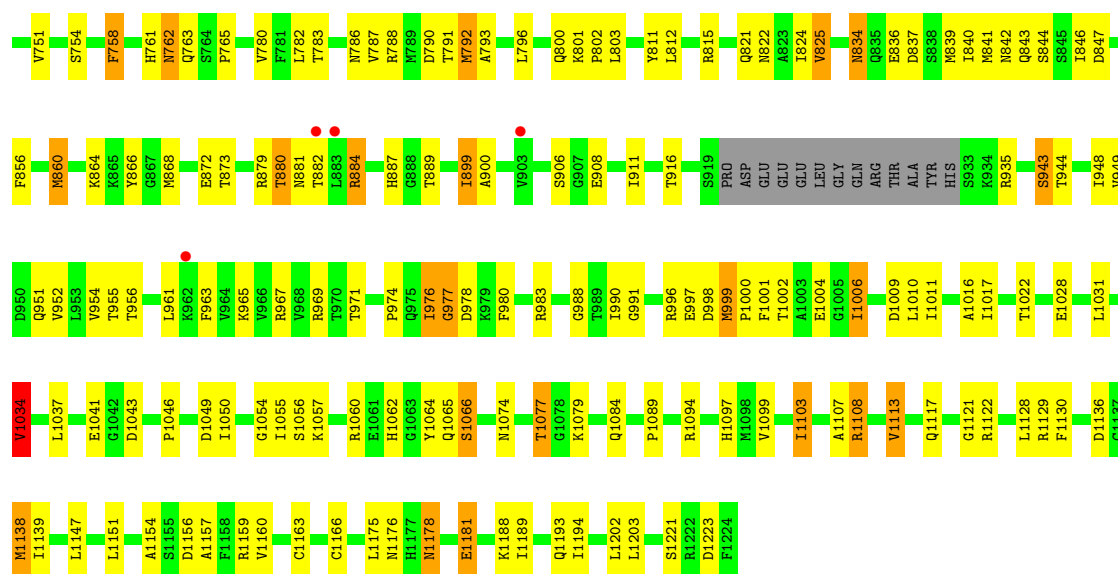
- Molecule 1: DNA-directed RNA polymerase II subunit RPB1





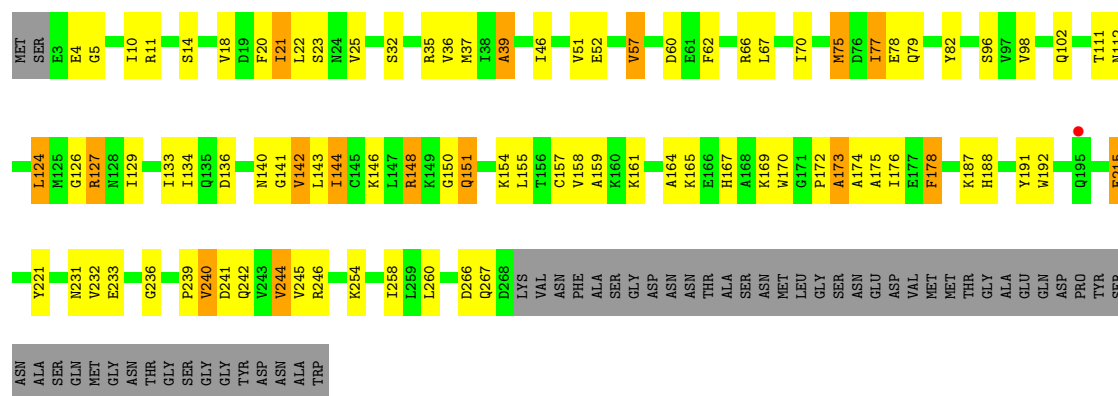
• Molecule 2: DNA-directed RNA polymerase II subunit RPB2





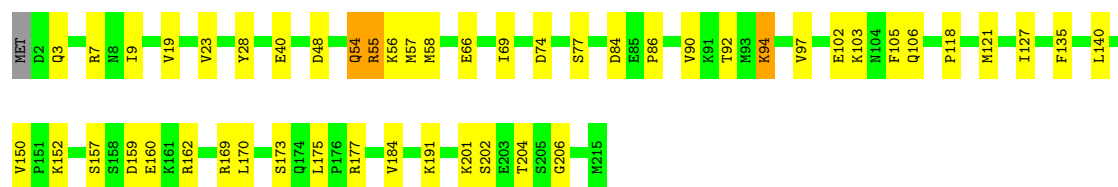
• Molecule 3: DNA-directed RNA polymerase II subunit RPB3

Chain C: 55% 23% 5% 16%



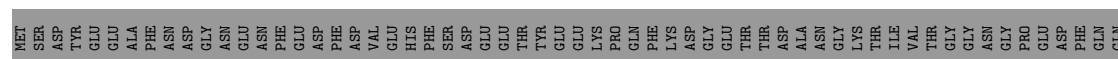
• Molecule 4: DNA-directed RNA polymerases I, II, and III subunit RPABC1

Chain E: 77% 21% 2%



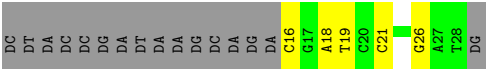
• Molecule 5: DNA-directed RNA polymerases I, II, and III subunit RPABC2

Chain F: 47% 7% 45%





● Molecule 12: DNA (5'-D(*CP*TP*AP*CP*CP*GP*AP*TP*AP*AP*GP*CP*AP*GP*AP*CP*GP*AP*TP*CP*CP*TP*CP*TP*CP*GP*AP*TP*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	157.84Å 221.12Å 192.75Å 90.00° 97.61° 90.00°	Depositor
Resolution (Å)	29.86 – 3.24 29.86 – 3.24	Depositor EDS
% Data completeness (in resolution range)	(Not available) (29.86-3.24) 99.3 (29.86-3.24)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.15	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.78 (at 3.24Å)	Xtriage
Refinement program	BUSTER-TNT BUSTER 2.8.0, BUSTER 2.8.0	Depositor
R, R_{free}	0.183 , 0.227 0.201 , 0.244	Depositor DCC
R_{free} test set	5152 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	84.1	Xtriage
Anisotropy	0.713	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 113.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.44$, $\langle L^2 \rangle = 0.27$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	28735	wwPDB-VP
Average B, all atoms (Å ²)	113.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.41% 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: MG, 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	0.79	2/11241 (0.0%)	1.42	59/15199 (0.4%)
2	B	0.80	2/9033 (0.0%)	1.42	56/12181 (0.5%)
3	C	0.75	0/2133	1.37	14/2891 (0.5%)
4	E	0.74	0/1788	1.36	11/2406 (0.5%)
5	F	0.77	0/700	1.33	0/945
6	H	0.71	0/1086	1.24	7/1470 (0.5%)
7	I	0.75	0/989	1.35	3/1331 (0.2%)
8	J	0.79	0/541	1.53	6/727 (0.8%)
9	K	0.72	0/937	1.40	9/1265 (0.7%)
10	L	0.81	0/365	1.38	5/485 (1.0%)
11	R	0.59	0/194	0.93	0/302
12	T	0.44	0/290	1.28	2/444 (0.5%)
All	All	0.78	4/29297 (0.0%)	1.40	172/39646 (0.4%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	758	PHE	CA-C	6.96	1.58	1.53
2	B	1017	ILE	CA-CB	5.66	1.56	1.54
1	A	605	MET	SD-CE	-5.23	1.66	1.79
1	A	487	MET	SD-CE	-5.19	1.66	1.79

The worst 5 of 172 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	647	GLY	CA-C-N	9.99	139.69	121.70
2	B	647	GLY	C-N-CA	9.99	139.69	121.70
2	B	1016	ALA	CA-C-N	9.91	129.95	120.43
2	B	1016	ALA	C-N-CA	9.91	129.95	120.43
1	A	506	ALA	CA-C-N	7.61	127.74	120.43

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	11043	0	11133	150	0
2	B	8861	0	8884	140	0
3	C	2095	0	2051	49	0
4	E	1752	0	1776	12	0
5	F	688	0	707	4	0
6	H	1068	0	1040	20	0
7	I	971	0	927	9	0
8	J	532	0	542	17	0
9	K	919	0	929	14	0
10	L	363	0	386	7	0
11	R	173	0	88	0	0
12	T	261	0	148	2	0
13	A	2	0	0	0	0
13	B	1	0	0	0	0
13	C	1	0	0	0	0
13	I	2	0	0	0	0
13	J	1	0	0	0	0
13	L	1	0	0	0	0
14	A	1	0	0	0	0
All	All	28735	0	28611	366	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 6.

The worst 5 of 366 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)
3:C:57:VAL:HG11	8:J:60:PHE:HB3	1.38	1.01
1:A:1364:ASN:HD22	1:A:1366:ARG:HG2	1.23	1.00
1:A:1364:ASN:ND2	1:A:1366:ARG:HG2	1.85	0.92
2:B:120:ARG:HG2	2:B:955:THR:HG21	1.61	0.82

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:996:ARG:HH22	3:C:173:ALA:HB1	1.46	0.79

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	1395/1733 (80%)	1212 (87%)	137 (10%)	46 (3%)	3	18
2	B	1096/1224 (90%)	960 (88%)	91 (8%)	45 (4%)	2	14
3	C	264/318 (83%)	234 (89%)	24 (9%)	6 (2%)	5	25
4	E	212/215 (99%)	191 (90%)	18 (8%)	3 (1%)	9	35
5	F	83/155 (54%)	73 (88%)	9 (11%)	1 (1%)	10	38
6	H	129/146 (88%)	100 (78%)	23 (18%)	6 (5%)	2	12
7	I	117/122 (96%)	100 (86%)	14 (12%)	3 (3%)	4	23
8	J	63/70 (90%)	57 (90%)	4 (6%)	2 (3%)	3	19
9	K	112/120 (93%)	102 (91%)	8 (7%)	2 (2%)	6	31
10	L	44/70 (63%)	27 (61%)	11 (25%)	6 (14%)	0	1
All	All	3515/4173 (84%)	3056 (87%)	339 (10%)	120 (3%)	3	18

5 of 120 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	40	THR
1	A	50	ILE
1	A	56	PRO
1	A	257	ARG
1	A	315	LEU

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	1225/1520 (81%)	1048 (86%)	177 (14%)	3	15
2	B	967/1061 (91%)	838 (87%)	129 (13%)	4	18
3	C	234/274 (85%)	208 (89%)	26 (11%)	6	24
4	E	196/197 (100%)	175 (89%)	21 (11%)	6	25
5	F	75/137 (55%)	69 (92%)	6 (8%)	11	37
6	H	117/128 (91%)	102 (87%)	15 (13%)	4	19
7	I	113/116 (97%)	100 (88%)	13 (12%)	5	23
8	J	60/65 (92%)	47 (78%)	13 (22%)	1	5
9	K	99/102 (97%)	84 (85%)	15 (15%)	3	13
10	L	40/57 (70%)	31 (78%)	9 (22%)	1	4
All	All	3126/3657 (86%)	2702 (86%)	424 (14%)	3	17

5 of 424 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	566	LEU
2	B	1022	THR
8	J	64	ASN
2	B	620	ARG
2	B	841	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 82 such sidechains are listed below:

Mol	Chain	Res	Type
2	B	1176	ASN
6	H	133	ASN
2	B	1211	ASN
4	E	61	GLN
7	I	60	GLN

5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
11	R	7/8 (87%)	1 (14%)	0

All (1) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
11	R	10	G

There are no RNA pucker outliers to report.

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	1405/1733 (81%)	-0.06	26 (1%) 66 46	46, 104, 194, 237	0
2	B	1114/1224 (91%)	-0.09	13 (1%) 76 58	45, 98, 166, 201	0
3	C	266/318 (83%)	-0.17	1 (0%) 88 79	67, 96, 146, 180	0
4	E	214/215 (99%)	-0.08	0 100 100	74, 135, 177, 193	0
5	F	85/155 (54%)	-0.26	0 100 100	77, 114, 151, 168	0
6	H	133/146 (91%)	0.13	5 (3%) 44 28	98, 141, 173, 183	0
7	I	119/122 (97%)	-0.01	0 100 100	72, 113, 145, 163	0
8	J	65/70 (92%)	-0.20	0 100 100	60, 88, 127, 138	0
9	K	114/120 (95%)	-0.31	0 100 100	64, 96, 127, 141	0
10	L	46/70 (65%)	0.57	4 (8%) 16 11	84, 137, 162, 175	0
11	R	8/8 (100%)	-0.13	0 100 100	100, 128, 162, 169	0
12	T	13/29 (44%)	0.72	0 100 100	109, 134, 191, 198	0
All	All	3582/4210 (85%)	-0.07	49 (1%) 73 54	45, 105, 180, 237	0

The worst 5 of 49 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	883	LEU	4.4
1	A	65	LEU	4.2
2	B	715	ALA	3.8
10	L	27	LEU	3.7
2	B	70	ILE	3.6

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
13	ZN	A	1734	1/1	0.88	0.08	300,300,300,300	0
13	ZN	A	1735	1/1	0.98	0.04	133,133,133,133	0
13	ZN	B	1307	1/1	0.98	0.04	174,174,174,174	0
13	ZN	I	203	1/1	0.99	0.03	109,109,109,109	0
13	ZN	I	204	1/1	0.99	0.02	79,79,79,79	0
14	MG	A	2001	1/1	0.99	0.04	41,41,41,41	0
13	ZN	J	101	1/1	1.00	0.01	71,71,71,71	0
13	ZN	L	105	1/1	1.00	0.02	139,139,139,139	0
13	ZN	C	319	1/1	1.00	0.01	91,91,91,91	0

6.5 Other polymers [i](#)

There are no such residues in this entry.