



# wwPDB EM Validation Summary Report ⓘ

May 31, 2025 – 02:51 PM EDT

PDB ID : 9NLV / pdb\_00009nlv  
EMDB ID : EMD-49523  
Title : Cryo-EM structure of hexameric SenDRT9 RT-ncRNA complex  
Authors : Burman, N.; Pandey, S.; Wiedenheft, B.; Sternberg, S.H.  
Deposited on : 2025-03-03  
Resolution : 2.60 Å(reported)  
Based on initial model : .

This is a wwPDB EM Validation Summary 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/EMValidationReportHelp>  
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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

EMDB validation analysis : 0.0.1.dev118  
MolProbity : 4-5-2 with Phenix2.0rc1  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
MapQ : 1.9.13  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.43.1

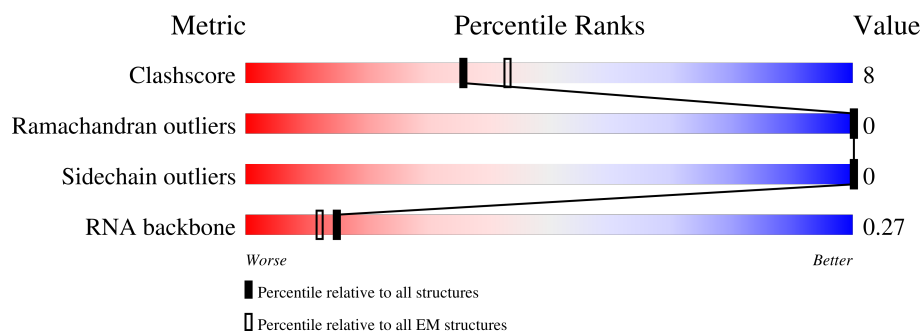
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 2.60 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)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415
RNA backbone	6643	2191

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the EM map (all-atom inclusion  $< 40\%$ ). The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	499	
1	B	499	
1	C	499	
1	D	499	
1	E	499	
1	F	499	
2	G	164	

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Mol	Chain	Length	Quality of chain
2	H	164	<div><div></div><div>27%37%23%14%</div></div>
2	I	164	<div><div></div><div>27%37%23%14%</div></div>
2	J	164	<div><div></div><div>27%37%23%14%</div></div>
2	K	164	<div><div></div><div>27%37%23%14%</div></div>
2	L	164	<div><div></div><div>27%37%23%14%</div></div>

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 40680 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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 RNA-dependent DNA polymerase.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	492	Total	C	N	O	S	0	0
			3779	2470	671	630	8		
1	B	492	Total	C	N	O	S	0	0
			3779	2470	671	630	8		
1	C	492	Total	C	N	O	S	0	0
			3779	2470	671	630	8		
1	D	492	Total	C	N	O	S	0	0
			3779	2470	671	630	8		
1	E	492	Total	C	N	O	S	0	0
			3779	2470	671	630	8		
1	F	492	Total	C	N	O	S	0	0
			3779	2470	671	630	8		

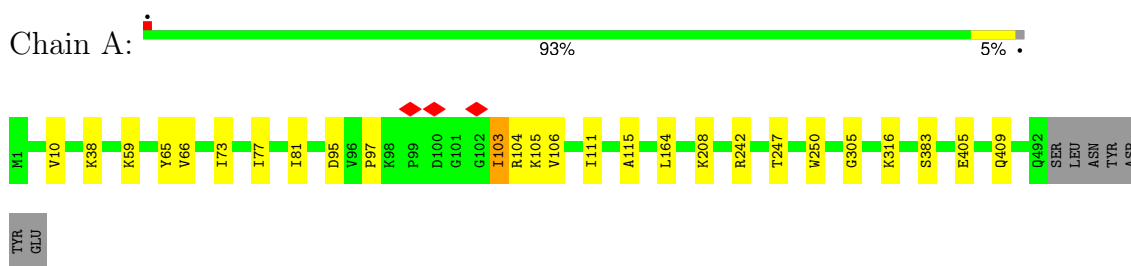
- Molecule 2 is a RNA chain called RNA (141-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
2	G	141	Total	C	N	O	P	0	0
			3001	1340	520	1000	141		
2	H	141	Total	C	N	O	P	0	0
			3001	1340	520	1000	141		
2	I	141	Total	C	N	O	P	0	0
			3001	1340	520	1000	141		
2	J	141	Total	C	N	O	P	0	0
			3001	1340	520	1000	141		
2	K	141	Total	C	N	O	P	0	0
			3001	1340	520	1000	141		
2	L	141	Total	C	N	O	P	0	0
			3001	1340	520	1000	141		

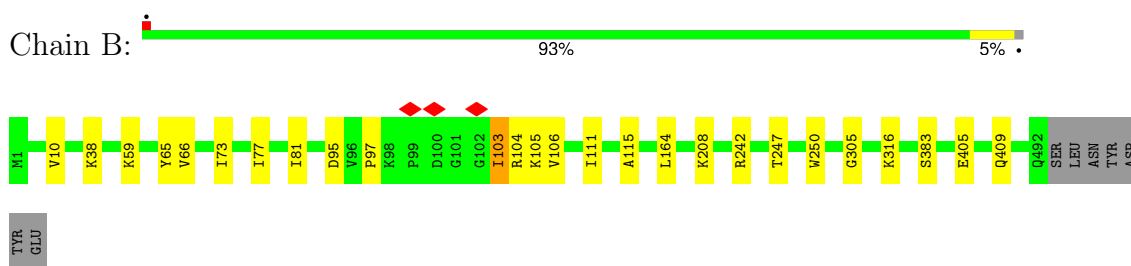
### 3 Residue-property plots [i](#)

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 atom inclusion in map 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 diamond above a residue indicates a poor fit to the EM map for this residue (all-atom inclusion < 40%). 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.

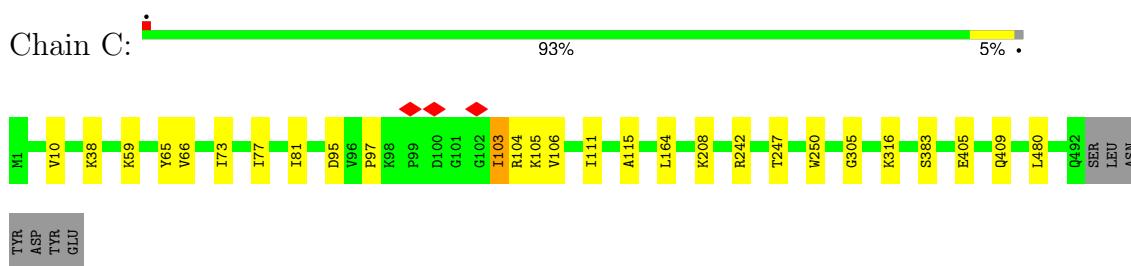
- Molecule 1: RNA-dependent DNA polymerase



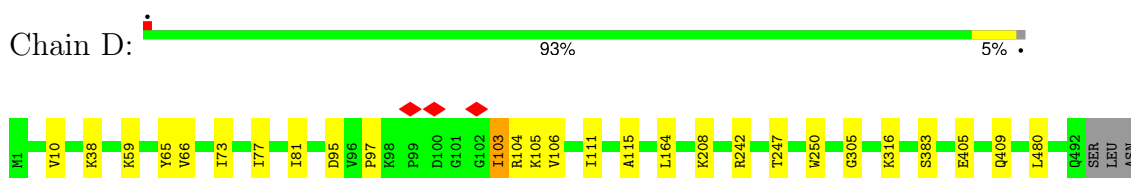
- Molecule 1: RNA-dependent DNA polymerase



- Molecule 1: RNA-dependent DNA polymerase



- Molecule 1: RNA-dependent DNA polymerase



TYR  
ASP  
TYR  
GLU

- Molecule 1: RNA-dependent DNA polymerase

Chain E:  93% 5% .

HI V10 K38 K59 Y65 V66 I73 I77 I81 D95 V96 P97 K98 P99 D100 G101 G102 I103 R104 K105 V106 I111 A115 L164 K208 R242 T247 W250 N276 P277 G305 K316 S383 E405 Q409 Q492 SER LEU

ASN  
TYR  
ASP  
TYR  
GLU


- Molecule 1: RNA-dependent DNA polymerase

Chain F:  93% 5% .

HI V10 K38 K39 L40 K59 Y65 V66 I73 I77 I81 D95 V96 P97 K98 P99 D100 G101 G102 I103 R104 K105 V106 I111 A115 L164 K208 R242 T247 W250 K288 G305 K316 S383 E405 Q409 Q492 SER

LEU  
ASN  
TYR  
ASP  
TYR  
GLU

- Molecule 2: RNA (141-MER)


Chain G:  27% 37% 23% 14%

A U C U C6 U7 C8 A9 U10 A11 G12 G13 G14 A15 U16 A17 A18 C19 G20 G21 U22 G23 G24 G25 G26 C27 C28 U29 U30 C31 U32 A33 U36 G37 U38 U39 A40 G41 A42 A43 A44 U45 U46 A47 U48 G49 G50 G51 U52 U53 C54 U54 U55 C56 A57 G58 U59 U60 A61

U62 A63 A64 U65 U66 C67 G68 U69 A70 U70 G71 A72 A73 A74 A75 U76 U77 A78 G81 U92 C93 A94 A95 U101 U102 U103 C107 U108 A109 A110 A116 A121 C122 U123 U124 U125 U126 U130 G131 G132 G133 U134 U135 U136 A137 U138 A139 U140 C141 G142 U146 A A

A G C C C U G A G U U C C A A C C

- Molecule 2: RNA (141-MER)

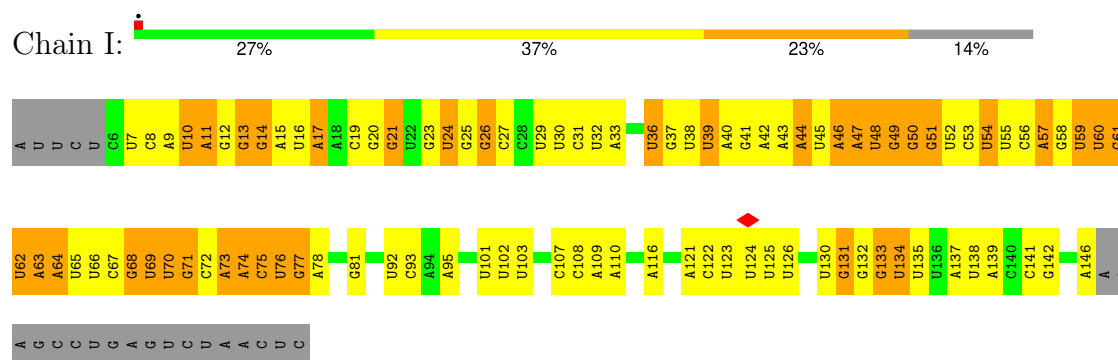
Chain H:  27% 37% 23% 14%

A U C U C6 U7 C8 A9 U10 A11 G12 G13 G14 A15 U16 A17 A18 C19 G20 G21 U22 G23 G24 G25 G26 C27 C28 U29 U30 C31 U32 A33 U36 G37 U38 U39 A40 G41 A42 A43 A44 U45 U46 A47 U48 G49 G50 G51 U52 U53 C54 U54 U55 C56 A57 G58 U59 U60 A61

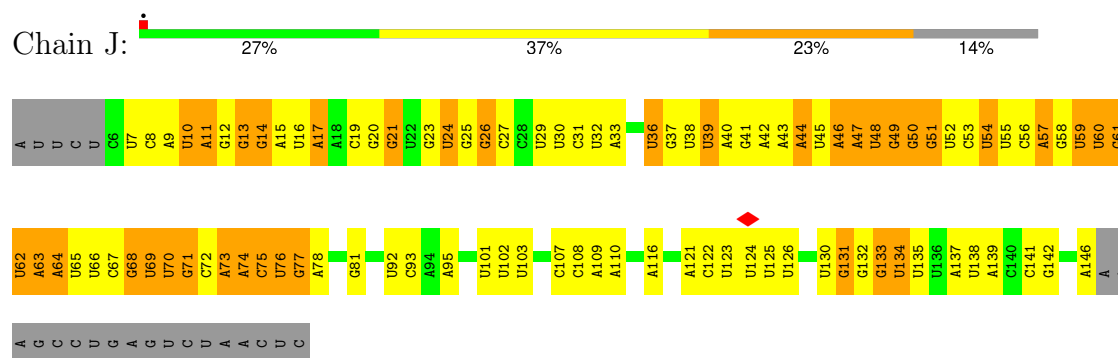
U62 A63 A64 U65 U66 C67 G68 U69 A70 U70 G71 A72 A73 A74 A75 U76 U77 A78 G81 U92 C93 A94 A95 U101 U102 U103 C107 U108 A109 A110 A116 A121 C122 U123 U124 U125 U126 U130 G131 G132 G133 U134 U135 U136 A137 U138 A139 U140 C141 G142 U146 A A

A G C C C U G A G U U C C A A C C

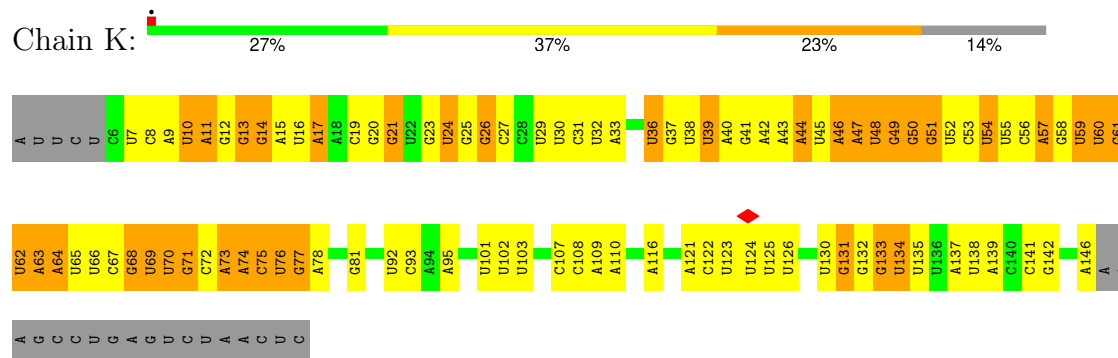
- Molecule 2: RNA (141-MER)



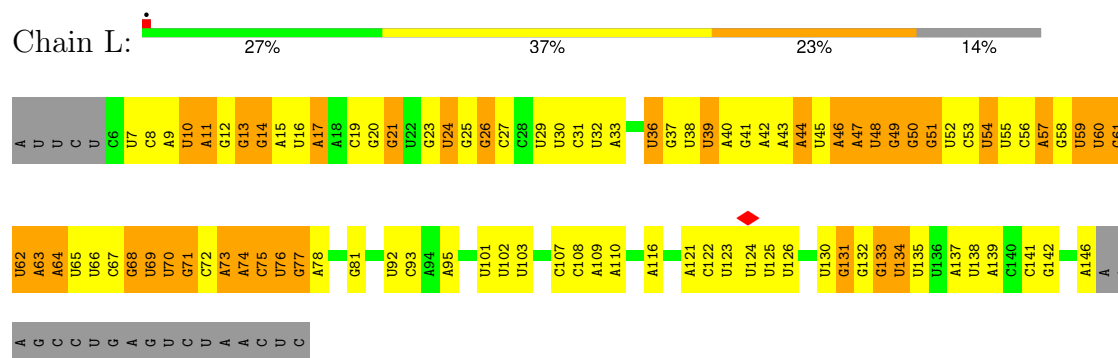
- Molecule 2: RNA (141-MER)



- Molecule 2: RNA (141-MER)



- Molecule 2: RNA (141-MER)



## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, D3	Depositor
Number of particles used	500162	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TALOS ARCTICA	Depositor
Voltage (kV)	200	Depositor
Electron dose ( $e^-/\text{\AA}^2$ )	59.8	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	45000	Depositor
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	0.689	Depositor
Minimum map value	-0.223	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.017	Depositor
Recommended contour level	0.1	Depositor
Map size (Å)	449.4256, 449.4256, 449.4256	wwPDB
Map dimensions	496, 496, 496	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.9061, 0.9061, 0.9061	Depositor



## 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	0.20	0/3867	0.45	1/5237 (0.0%)
1	B	0.20	0/3867	0.45	1/5237 (0.0%)
1	C	0.20	0/3867	0.45	1/5237 (0.0%)
1	D	0.20	0/3867	0.45	1/5237 (0.0%)
1	E	0.20	0/3867	0.45	1/5237 (0.0%)
1	F	0.20	0/3867	0.45	1/5237 (0.0%)
2	G	0.24	0/3353	0.49	0/5223
2	H	0.24	0/3353	0.49	0/5223
2	I	0.24	0/3353	0.49	0/5223
2	J	0.24	0/3353	0.49	0/5223
2	K	0.24	0/3353	0.49	0/5223
2	L	0.24	0/3353	0.49	0/5223
All	All	0.22	0/43320	0.47	6/62760 (0.0%)

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	103	ILE	N-CA-C	-6.82	103.66	110.62
1	C	103	ILE	N-CA-C	-6.80	103.68	110.62
1	A	103	ILE	N-CA-C	-6.80	103.69	110.62
1	E	103	ILE	N-CA-C	-6.79	103.69	110.62
1	B	103	ILE	N-CA-C	-6.79	103.70	110.62

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	3779	0	3622	18	0
1	B	3779	0	3622	18	0
1	C	3779	0	3622	19	0
1	D	3779	0	3622	18	0
1	E	3779	0	3622	19	0
1	F	3779	0	3622	21	0
2	G	3001	0	1507	70	0
2	H	3001	0	1507	72	0
2	I	3001	0	1507	71	0
2	J	3001	0	1507	71	0
2	K	3001	0	1507	70	0
2	L	3001	0	1507	69	0
All	All	40680	0	30774	530	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 8.

The worst 5 of 530 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:C:97:PRO:CA	1:C:103:ILE:HA	1.79	1.13
1:D:97:PRO:CA	1:D:103:ILE:HA	1.79	1.12
1:E:97:PRO:CA	1:E:103:ILE:HA	1.79	1.12
1:B:97:PRO:CA	1:B:103:ILE:HA	1.79	1.11
1:A:97:PRO:CA	1:A:103:ILE:HA	1.79	1.10

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 PDB entries followed by that with respect to all EM entries.

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	490/499 (98%)	482 (98%)	8 (2%)	0	100	100
1	B	490/499 (98%)	482 (98%)	8 (2%)	0	100	100
1	C	490/499 (98%)	482 (98%)	8 (2%)	0	100	100
1	D	490/499 (98%)	482 (98%)	8 (2%)	0	100	100
1	E	490/499 (98%)	482 (98%)	8 (2%)	0	100	100
1	F	490/499 (98%)	482 (98%)	8 (2%)	0	100	100
All	All	2940/2994 (98%)	2892 (98%)	48 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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 PDB entries followed by that with respect to all EM entries.

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	352/456 (77%)	352 (100%)	0	100	100
1	B	352/456 (77%)	352 (100%)	0	100	100
1	C	352/456 (77%)	352 (100%)	0	100	100
1	D	352/456 (77%)	352 (100%)	0	100	100
1	E	352/456 (77%)	352 (100%)	0	100	100
1	F	352/456 (77%)	352 (100%)	0	100	100
All	All	2112/2736 (77%)	2112 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 24 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	182	ASN
1	E	144	ASN
1	E	53	ASN
1	E	182	ASN
1	B	252	GLN

### 5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	G	140/164 (85%)	69 (49%)	7 (5%)
2	H	140/164 (85%)	69 (49%)	7 (5%)
2	I	140/164 (85%)	69 (49%)	7 (5%)
2	J	140/164 (85%)	69 (49%)	7 (5%)
2	K	140/164 (85%)	69 (49%)	7 (5%)
2	L	140/164 (85%)	69 (49%)	7 (5%)
All	All	840/984 (85%)	414 (49%)	42 (5%)

5 of 414 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	G	7	U
2	G	8	C
2	G	10	U
2	G	11	A
2	G	13	G

5 of 42 RNA pucker outliers are listed below:

Mol	Chain	Res	Type
2	K	38	U
2	L	38	U
2	K	46	A
2	K	68	G
2	L	49	G

## 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](#)

There are no chain breaks in this entry.

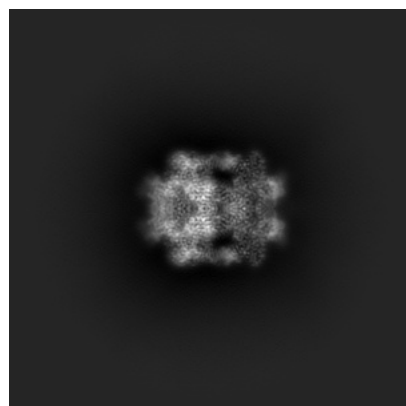
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-49523. These allow visual inspection of the internal detail of the map and identification of artifacts.

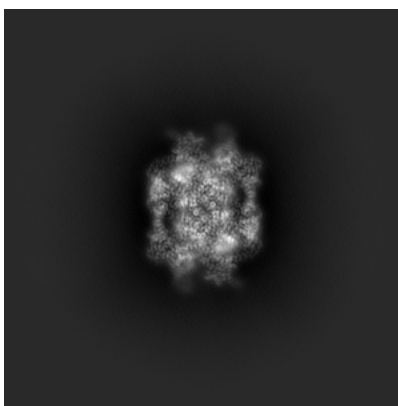
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

### 6.1 Orthogonal projections [i](#)

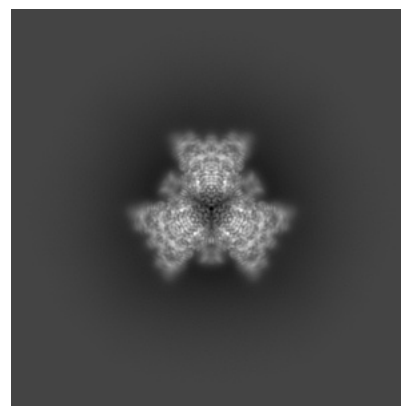
#### 6.1.1 Primary map



X

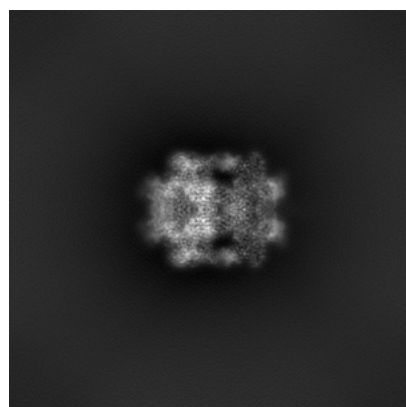


Y

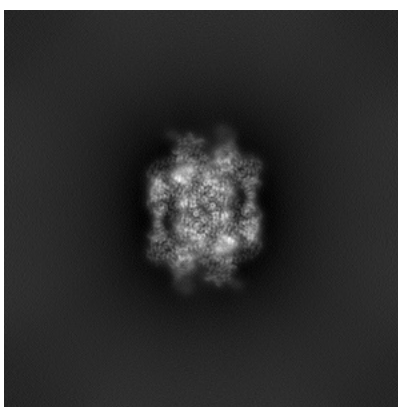


Z

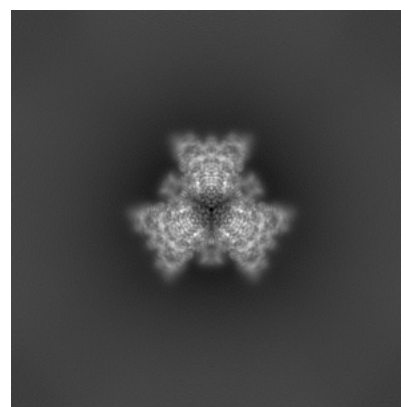
#### 6.1.2 Raw map



X



Y

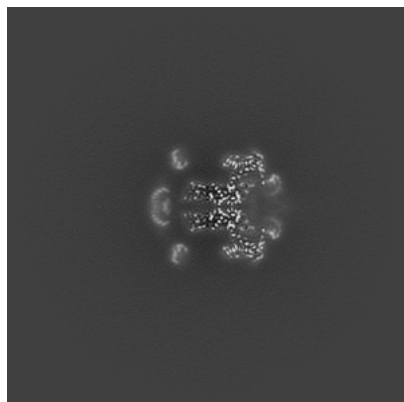


Z

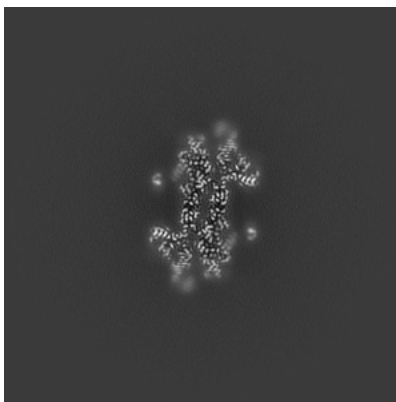
The images above show the map projected in three orthogonal directions.

## 6.2 Central slices [i](#)

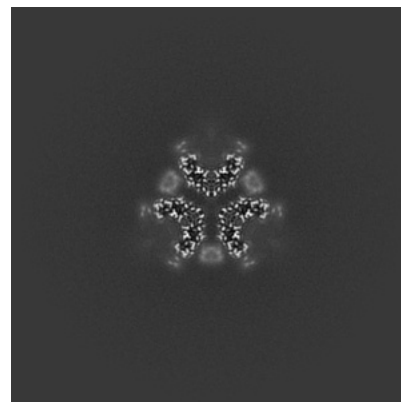
### 6.2.1 Primary map



X Index: 248

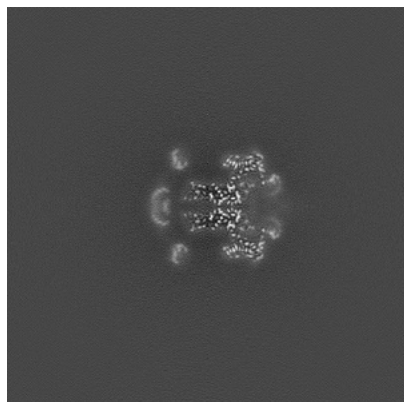


Y Index: 248

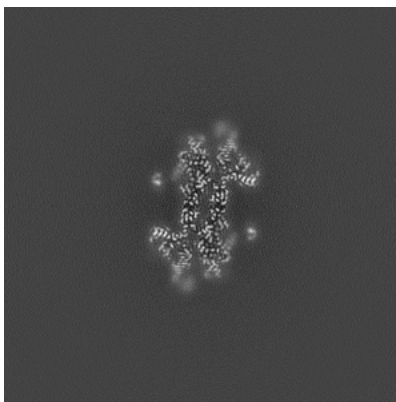


Z Index: 248

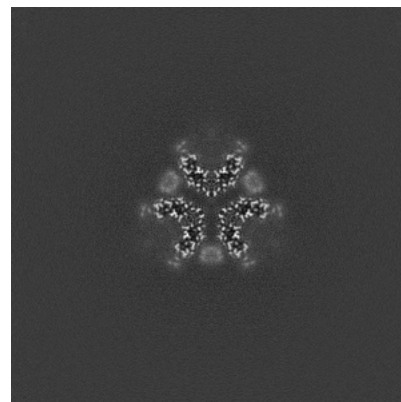
### 6.2.2 Raw map



X Index: 248



Y Index: 248

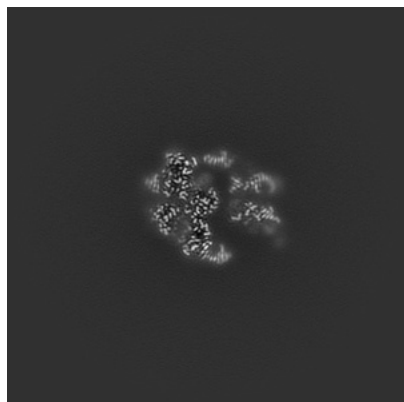


Z Index: 248

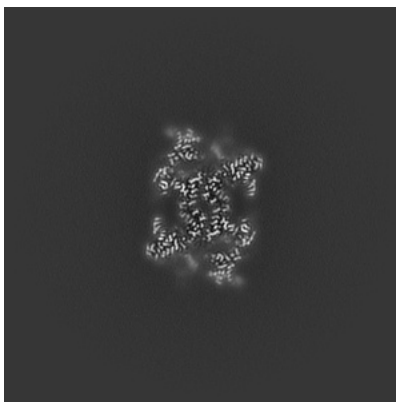
The images above show central slices of the map in three orthogonal directions.

## 6.3 Largest variance slices [i](#)

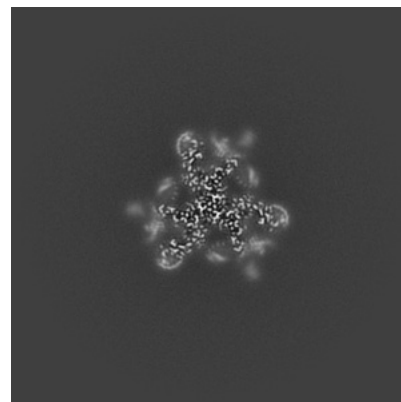
### 6.3.1 Primary map



X Index: 212

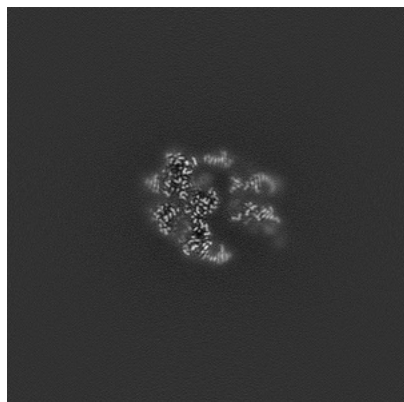


Y Index: 229

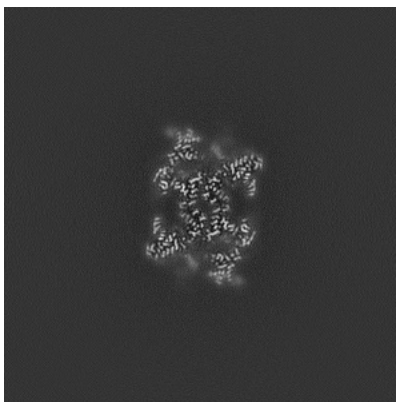


Z Index: 231

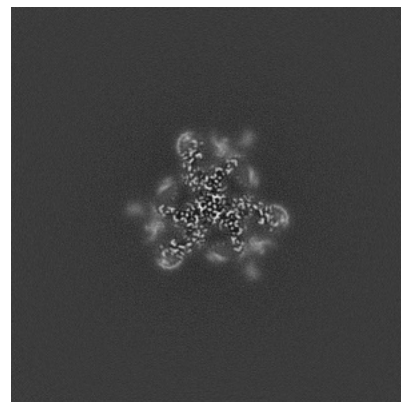
### 6.3.2 Raw map



X Index: 212



Y Index: 229



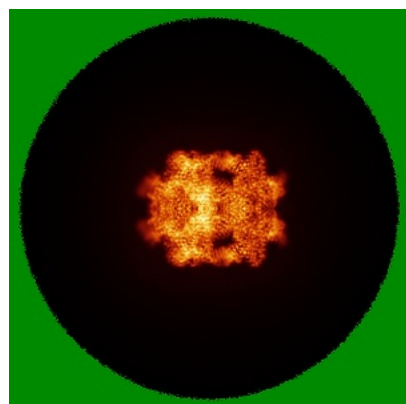
Z Index: 231

The images above show the largest variance slices of the map in three orthogonal directions.

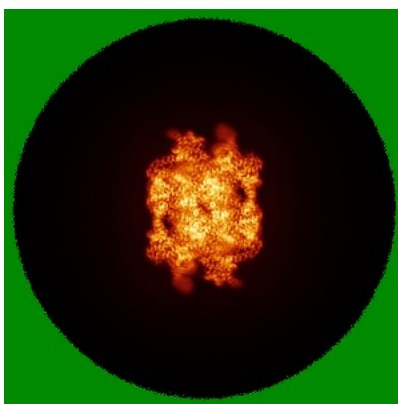


## 6.4 Orthogonal standard-deviation projections (False-color) [i](#)

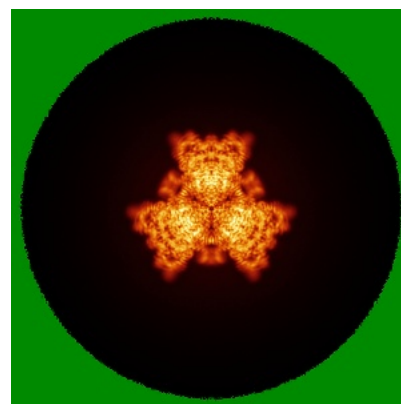
### 6.4.1 Primary map



X

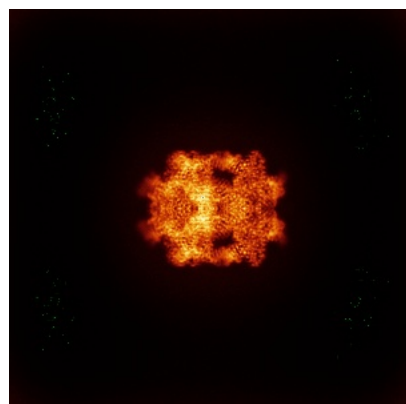


Y

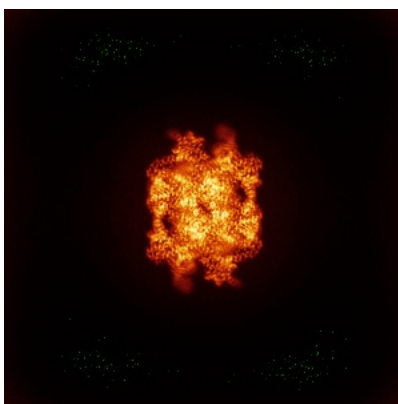


Z

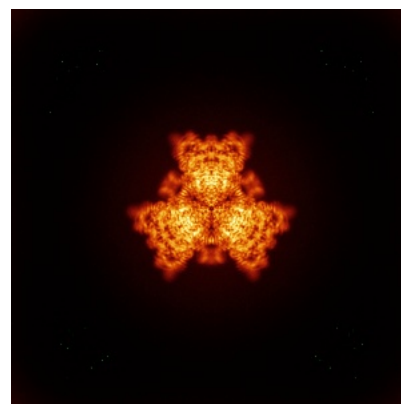
### 6.4.2 Raw map



X



Y

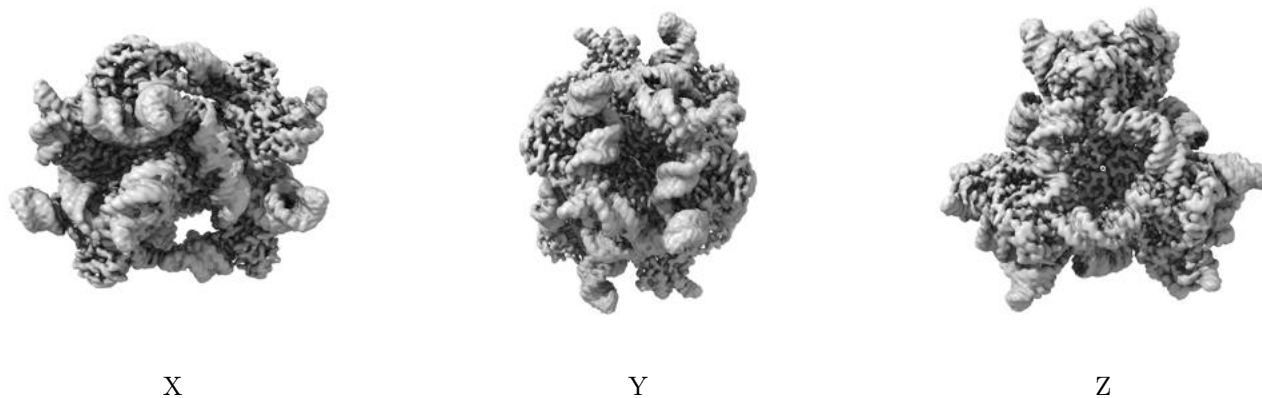


Z

The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

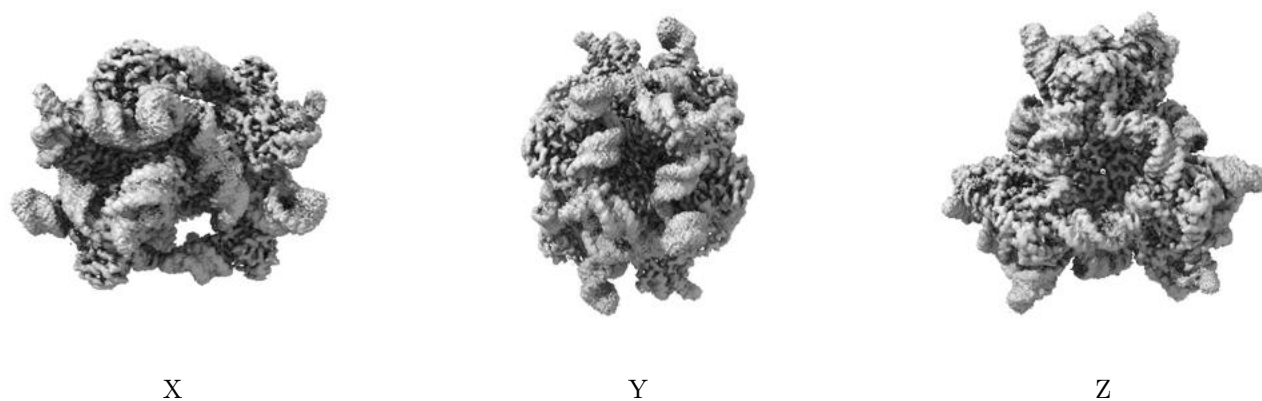
## 6.5 Orthogonal surface views [i](#)

### 6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.1. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

### 6.5.2 Raw map



These images show the 3D surface of the raw map. The raw map's contour level was selected so that its surface encloses the same volume as the primary map does at its recommended contour level.

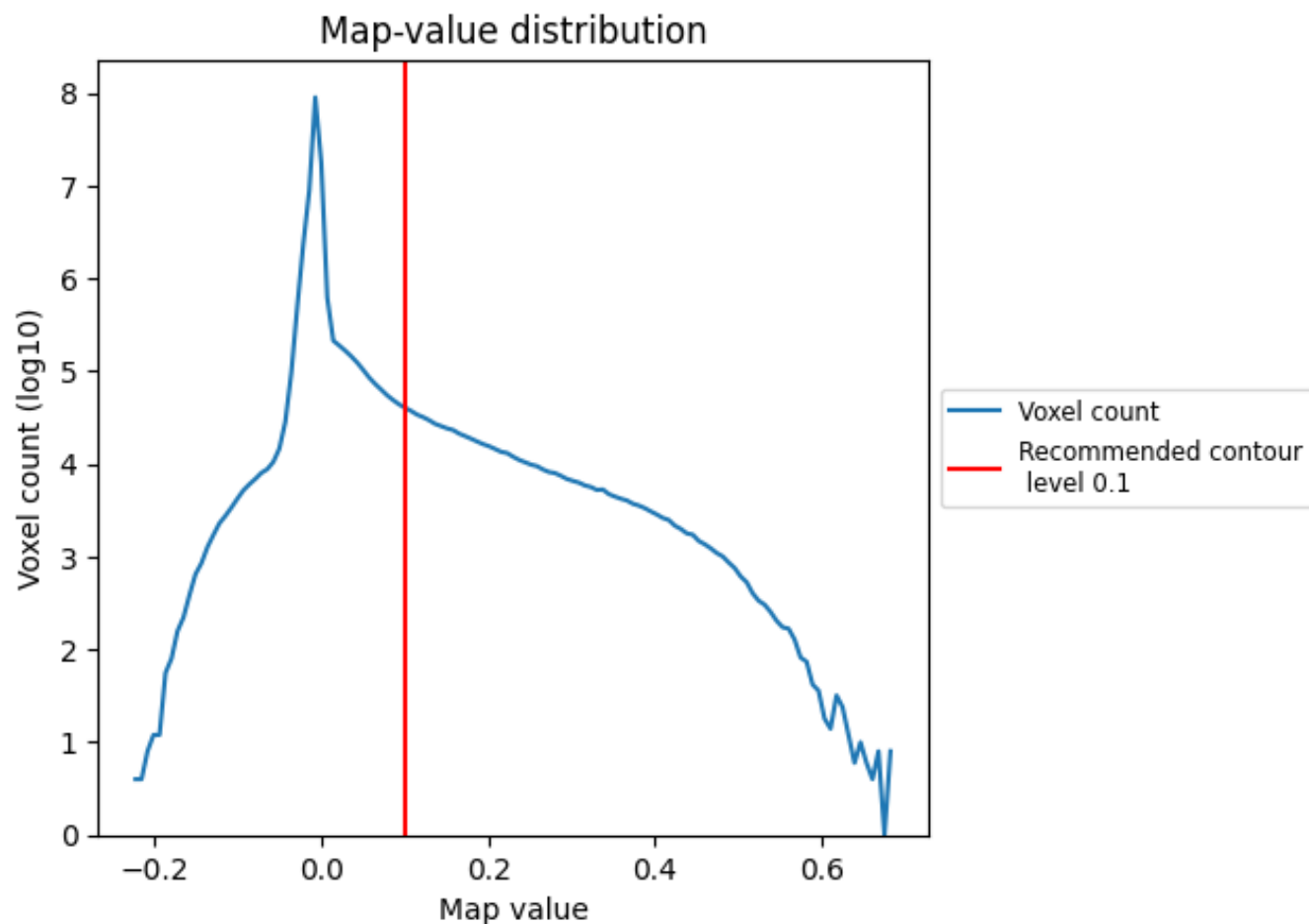
## 6.6 Mask visualisation [i](#)

This section was not generated. No masks/segmentation were deposited.

## 7 Map analysis [i](#)

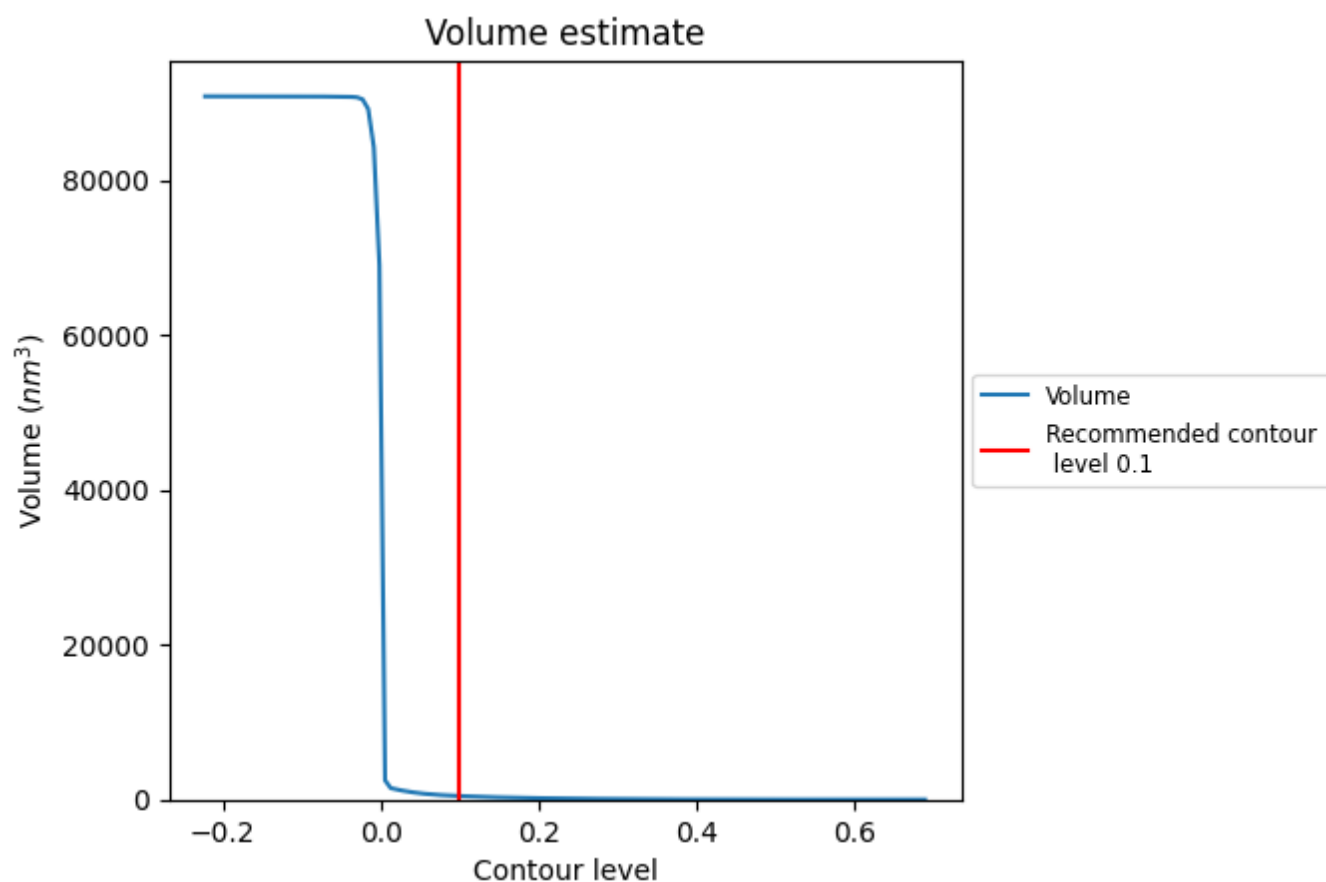
This section contains the results of statistical analysis of the map.

### 7.1 Map-value distribution [i](#)



The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

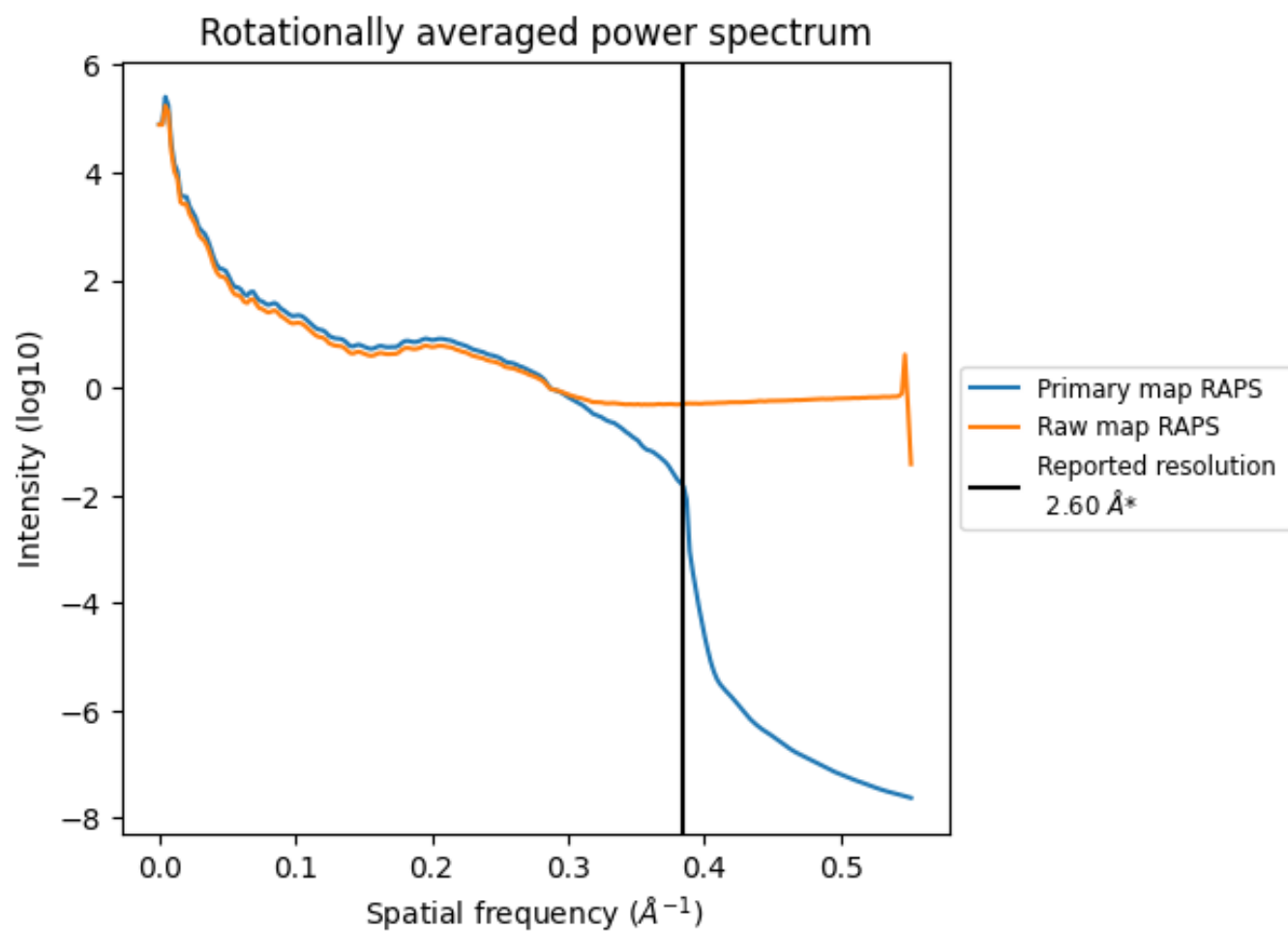
## 7.2 Volume estimate [i](#)



The volume at the recommended contour level is 456  $\text{nm}^3$ ; this corresponds to an approximate mass of 412 kDa.

The volume estimate graph shows how the enclosed volume varies with the contour level. The recommended contour level is shown as a vertical line and the intersection between the line and the curve gives the volume of the enclosed surface at the given level.

### 7.3 Rotationally averaged power spectrum ⓘ

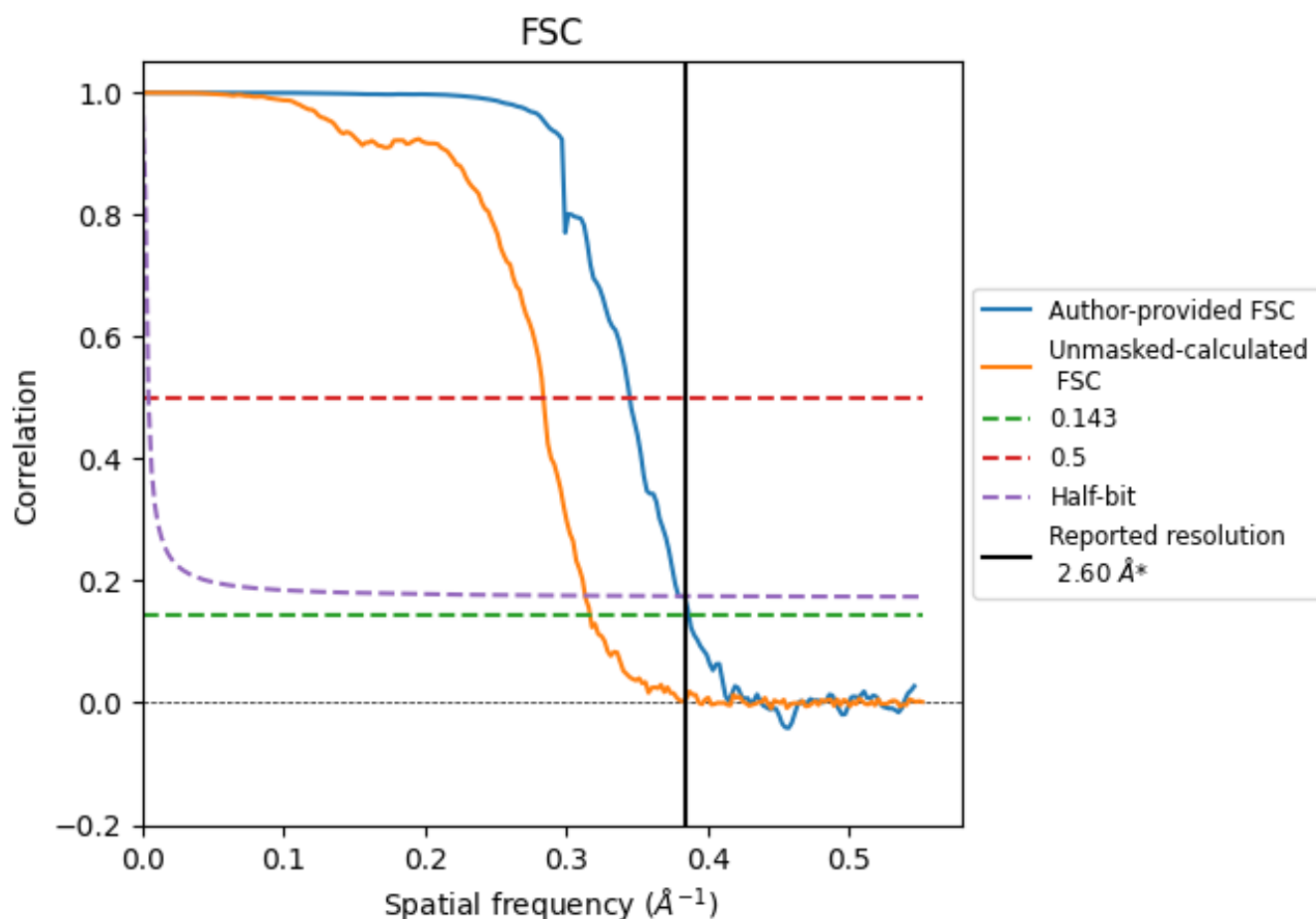


\*Reported resolution corresponds to spatial frequency of 0.385 Å<sup>-1</sup>

## 8 Fourier-Shell correlation [i](#)

Fourier-Shell Correlation (FSC) is the most commonly used method to estimate the resolution of single-particle and subtomogram-averaged maps. The shape of the curve depends on the imposed symmetry, mask and whether or not the two 3D reconstructions used were processed from a common reference. The reported resolution is shown as a black line. A curve is displayed for the half-bit criterion in addition to lines showing the 0.143 gold standard cut-off and 0.5 cut-off.

### 8.1 FSC [i](#)



\*Reported resolution corresponds to spatial frequency of 0.385  $\text{\AA}^{-1}$

## 8.2 Resolution estimates [i](#)

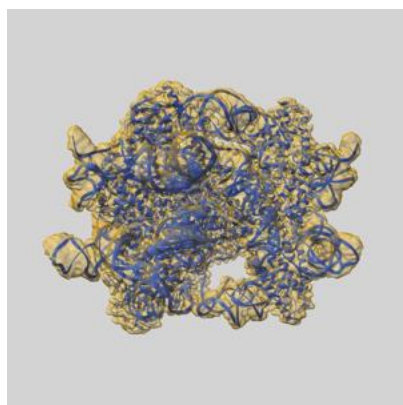
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	2.60	-	-
Author-provided FSC curve	2.59	2.90	2.64
Unmasked-calculated*	3.16	3.52	3.19

\*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from deposited half-maps intersecting FSC 0.143 CUT-OFF 3.16 differs from the reported value 2.6 by more than 10 %

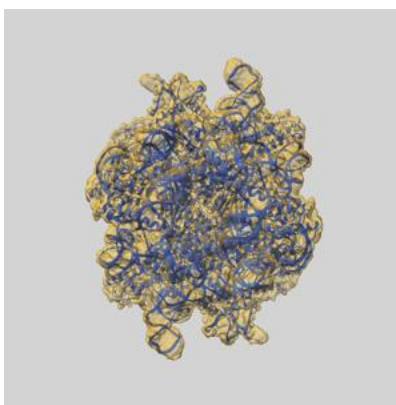
## 9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-49523 and PDB model 9NLV. Per-residue inclusion information can be found in [section 3](#) on [page 5](#).

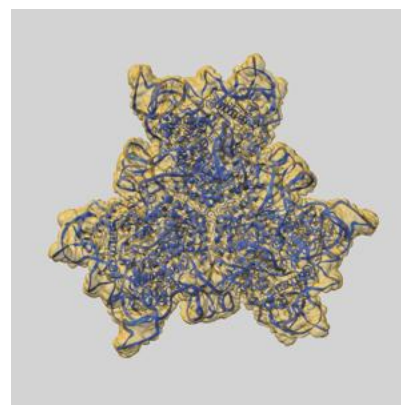
### 9.1 Map-model overlay [i](#)



X



Y

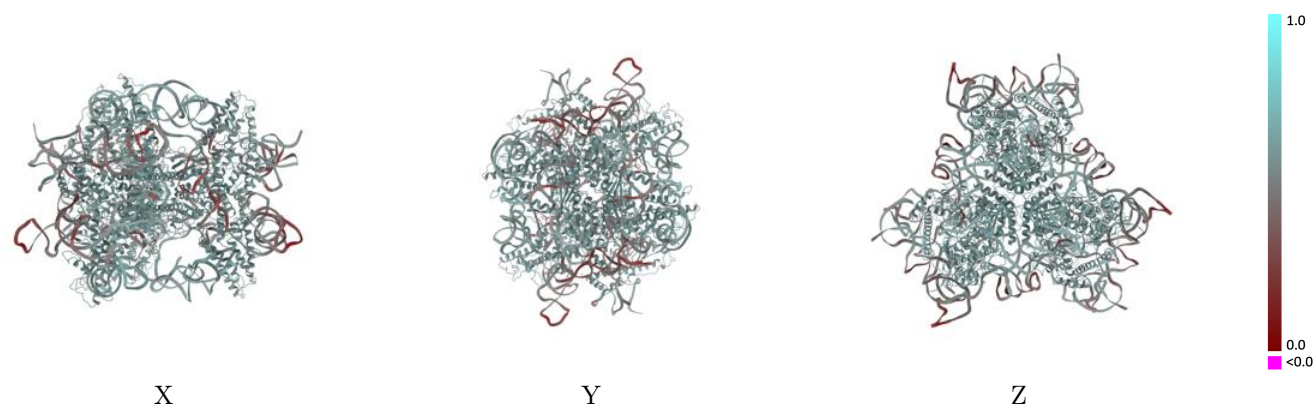


Z

The images above show the 3D surface view of the map at the recommended contour level 0.1 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

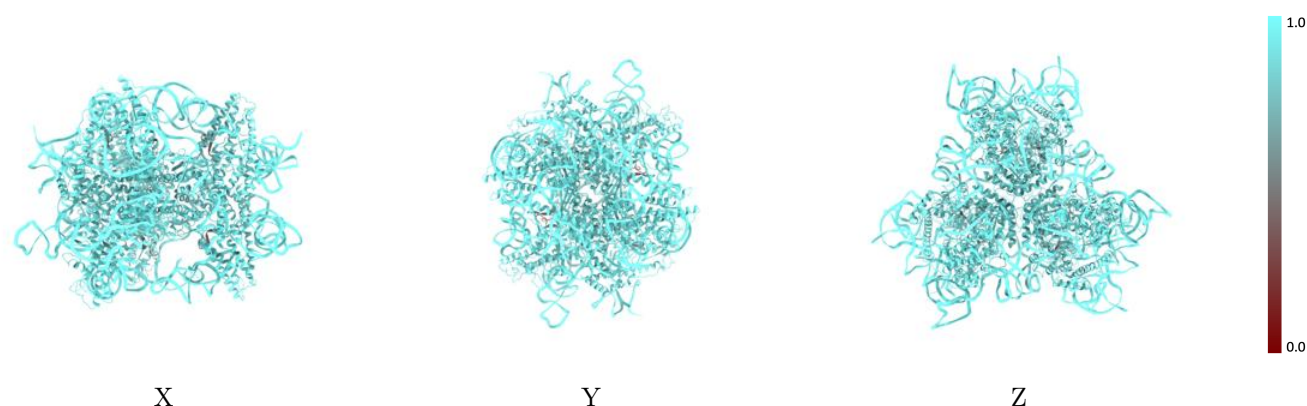


## 9.2 Q-score mapped to coordinate model [i](#)



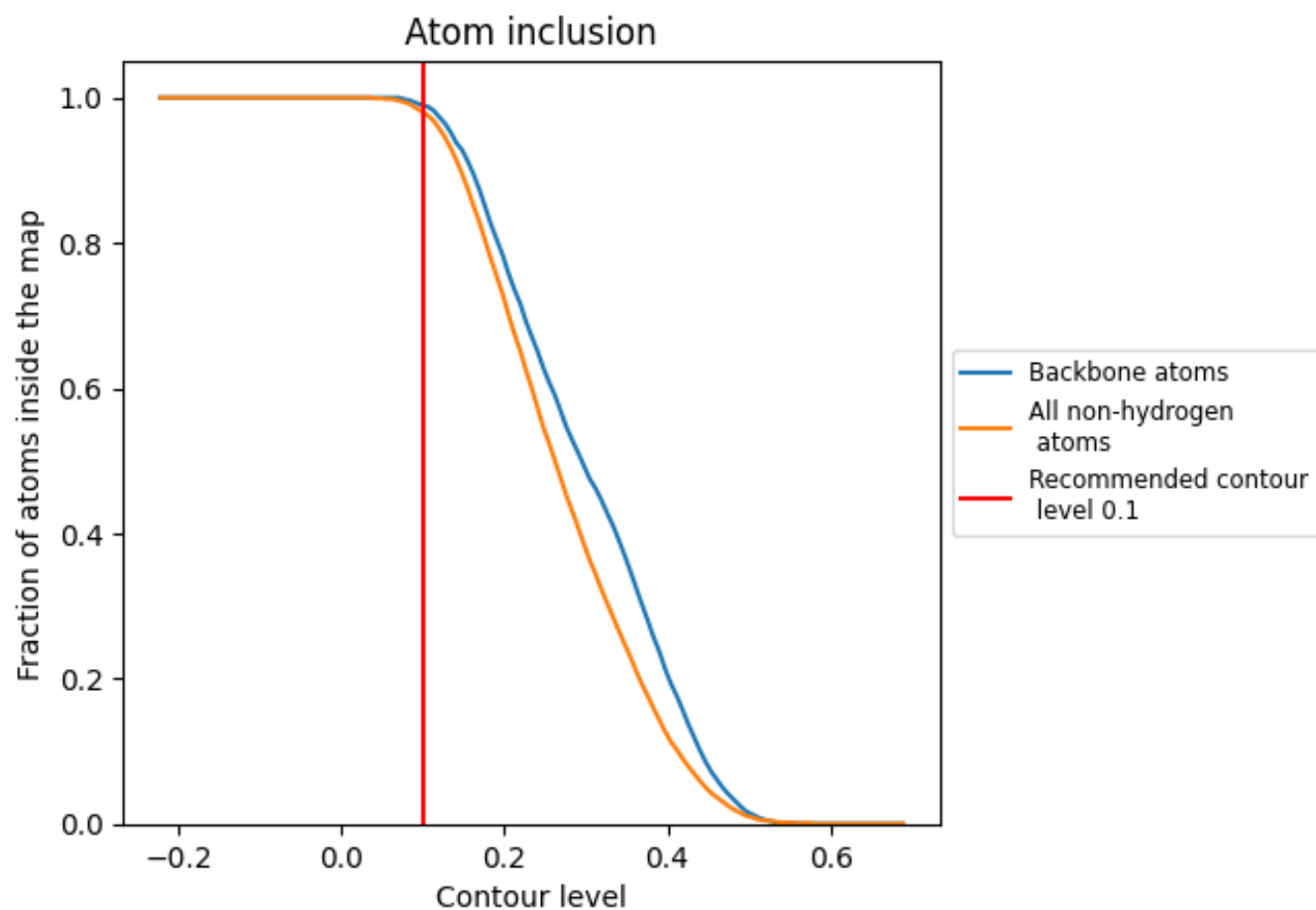
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions at which atoms can be resolved. Low Q-score values may therefore be expected for many entries.

## 9.3 Atom inclusion mapped to coordinate model [i](#)



The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.1).

## 9.4 Atom inclusion [i](#)



At the recommended contour level, 99% of all backbone atoms, 98% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary ⓘ

The table lists the average atom inclusion at the recommended contour level (0.1) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div><div></div></div> 0.9800	<div><div></div></div> 0.5480
A	<div><div></div></div> 0.9780	<div><div></div></div> 0.5980
B	<div><div></div></div> 0.9800	<div><div></div></div> 0.5980
C	<div><div></div></div> 0.9800	<div><div></div></div> 0.5990
D	<div><div></div></div> 0.9790	<div><div></div></div> 0.5980
E	<div><div></div></div> 0.9790	<div><div></div></div> 0.5990
F	<div><div></div></div> 0.9800	<div><div></div></div> 0.5990
G	<div><div></div></div> 0.9810	<div><div></div></div> 0.4830
H	<div><div></div></div> 0.9810	<div><div></div></div> 0.4830
I	<div><div></div></div> 0.9810	<div><div></div></div> 0.4830
J	<div><div></div></div> 0.9820	<div><div></div></div> 0.4820
K	<div><div></div></div> 0.9810	<div><div></div></div> 0.4840
L	<div><div></div></div> 0.9810	<div><div></div></div> 0.4840

1.0

0.0

<0.0