



## wwPDB EM Validation Summary Report ⓘ

Jan 27, 2025 – 03:15 PM EST

PDB ID : 9BW7  
EMDB ID : EMD-44957  
Title : Human Vault Cage in complex with PARP4 and NAD+  
Authors : Lodwick, J.E.; Zhao, M.  
Deposited on : 2024-05-20  
Resolution : 2.90 Å(reported)  
Based on initial models : ., 4v60

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.dev113  
Mogul : 2022.3.0, CSD as543be (2022)  
MolProbity : 4.02b-467  
buster-report : 1.1.7 (2018)  
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) : 2.40



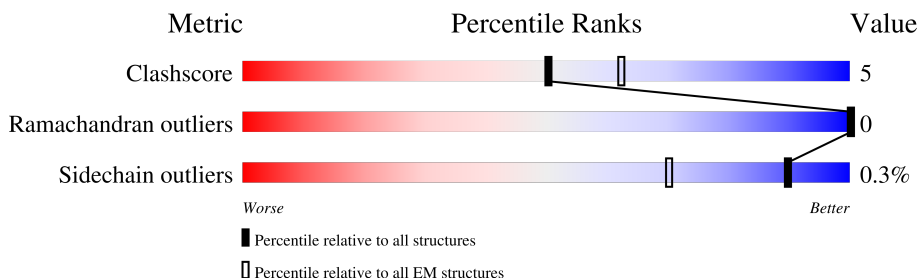
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 2.90 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

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	893	
1	C	893	
2	B	1724	
2	D	1724	



## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 14692 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.

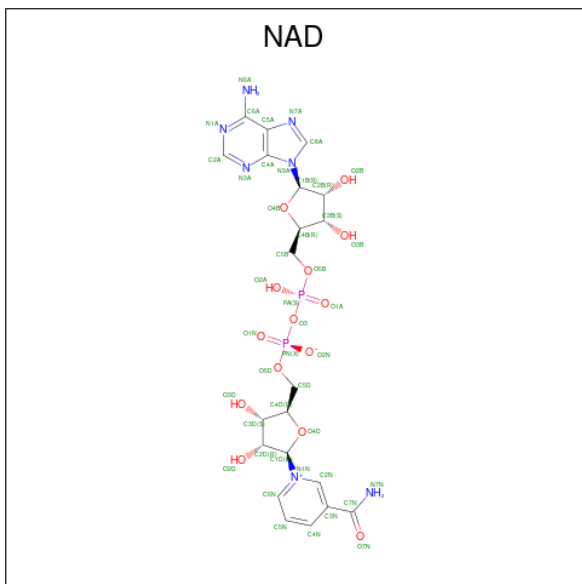
- Molecule 1 is a protein called Major vault protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	783	Total 6212	C 3909	N 1111	O 1182	S 10	0	0
1	C	783	Total 6212	C 3909	N 1111	O 1182	S 10	0	0

- Molecule 2 is a protein called Protein mono-ADP-ribosyltransferase PARP4.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	136	Total 1090	C 701	N 188	O 196	S 5	0	0
2	D	136	Total 1090	C 701	N 188	O 196	S 5	0	0

- Molecule 3 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula:  $C_{21}H_{27}N_7O_{14}P_2$ ) (labeled as "Ligand of Interest" by depositor).





Mol	Chain	Residues	Atoms					AltConf
3	A	1	Total 44	C 21	N 7	O 14	P 2	0
3	C	1	Total 44	C 21	N 7	O 14	P 2	0







- Molecule 2: Protein mono-ADP-ribosyltransferase PARP4



ALA	SER	HIS	PRO	GLN	LEU	LEU	PRO	THR	THR	SER	ASN	GLU	THR	LEU	LEU	ALA	ASP	ASP	LEU	MET
GLY	LEU	ALA	ARG	SER	PRO	ASP	ALA	ASP	ASP	LEU	GLU	THR	THR	LEU	LEU	SER	SER	ASN	MET	
PHE	LEU	LEU	MET	PHE	ASP	ASP	ALA	PHE	SER	THR	THR	THR	THR	LEU	LEU	GLU	ALA	PRO	SER	
THR	PRO	LEU	VAL	LEU	ALA	THR	LYS	GLU	LEU	GLY	PHE	LYS	LYS	SER	VAL	LEU	GLU	GLN	ILE	
TYR	ALA	VAL	GLU	THR	VAL	VAL	SER	ASP	LYS	LEU	LEU	LEU	PRO	ALA	ALA	GLN	GLU	ASN	PHE	
PHE	ARG	GLY	LYS	SER	LEU	CYS	THR	PHE	THR	ASN	SER	ASN	ASN	LEU	LEU	ALA	GLU	ASN	ALA	
ASN	GLY	GLU	HIS	SER	GLY	CYS	SER	PHE	TYR	LEU	THR	ASN	LEU	LEU	LEU	LEU	ASP	ASN	ASN	
VAL	ARG	LYS	PRO	ILE	ILE	GLY	THR	VAL	THR	GLY	ARG	PRO	PRO	LEU	LEU	LEU	VAL	HIS	VAL	
ARG	SER	GLN	GLY	PHE	GLY	GLY	ALA	VAL	GLY	LEU	LEU	VAL	PRO	ASN	ASN	GLU	THR	VAL	ASN	
ASN	ASN	VAL	GLU	PRO	THR	THR	LYS	LYS	THR	ARG	HIS	VAL	ALA	GLY	GLY	VAL	GLU	GLU	GLY	
LYS	ILE	ASN	SER	TYR	PHE	PHE	ASN	GLY	LYS	GLY	ASN	ASN	ALA	THR	THR	ASP	THR	ASN	TRP	
HIS	LEU	ASN	SER	PRO	ILE	ILE	HIS	LEU	LYS	LEU	GLY	ARG	ALA	GLY	GLY	LEU	GLN	LEU	TYR	
VAL	LEU	ILE	GLU	ILE	THR	VAL	ASN	ASN	LEU	GLY	THR	CYS	LYS	GLY	ALA	LEU	ARG	LYS	PRO	
TRP	VAL	ILE	ALA	ILE	THR	VAL	GLN	GLN	LEU	VAL	GLY	VAL	GLY	GLY	GLY	GLY	PHE	GLY	VAL	
ARG	SER	GLN	CYS	PHE	GLY	GLY	ALA	VAL	LYS	THR	ASN	VAL	ILE	ALA	THR	GLY	GLY	GLY	THR	
LYS	ASP	PHE	GLY	ILE	SER	ILE	GLY	LYS	GLY	LEU	HIS	ASN	GLY	THR	THR	GLY	GLY	LEU	ASN	
GLN	GLY	THR	VAL	PHE	LEU	VAL	GLY	THR	LEU	GLY	ASN	ILE	VAL	ALA	GLY	THR	GLY	GLY	GLY	
ILE	HIS	THR	VAL	THR	LEU	GLY	ASN	LYS	LEU	GLY	ASN	VAL	GLY	THR	THR	GLY	GLY	GLY	THR	
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THR	LEU	PHE	ASP	GLY	GLY	GLY	VAL	ASP	LEU	GLY	ASN	VAL	GLY	THR	THR	GLY	GLY	GLY	THR	
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THR	LEU	THR	VAL	THR	LEU	VAL	GLY	THR	LEU	GLY	ASN	VAL	GLY	THR	THR	GLY	GLY	GLY	THR	
ASP	LEU	THR	VAL	THR	LEU	VAL	GLY													











I1669	K1670	Q1671	E1674	Q1682	Y1683	P1684	R1689	Q1702	L1703	L1704	G1705	L1706	Q1707	P1708	I1709	S1710	T1711	V1712	S1713	P1714	L1715	H1716	R1717	V1718	L1719	H1720	Y1721	S1722	Q1723	G1724
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## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, D39	Depositor
Number of particles used	93859	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION; CTF correction was performed when movies were imported into cryoSPARC Live	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ( $e^-/\text{\AA}^2$ )	45	Depositor
Minimum defocus (nm)	700	Depositor
Maximum defocus (nm)	1700	Depositor
Magnification	53000	Depositor
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	1.436	Depositor
Minimum map value	-0.711	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.043	Depositor
Recommended contour level	0.17	Depositor
Map size ( $\text{\AA}$ )	1056.0, 1056.0, 1056.0	wwPDB
Map dimensions	800, 800, 800	wwPDB
Map angles ( $^\circ$ )	90.0, 90.0, 90.0	wwPDB
Pixel spacing ( $\text{\AA}$ )	1.32, 1.32, 1.32	Depositor



## 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: NAD

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	0.35	0/6321	0.54	0/8572
1	C	0.35	0/6321	0.54	0/8572
2	B	0.26	0/1111	0.51	0/1501
2	D	0.26	0/1111	0.51	0/1501
All	All	0.34	0/14864	0.54	0/20146

There are no bond length outliers.

There are no bond angle outliers.

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	6212	0	6236	76	0
1	C	6212	0	6236	73	0
2	B	1090	0	1108	11	0
2	D	1090	0	1108	10	0
3	A	44	0	26	5	0
3	C	44	0	26	5	0
All	All	14692	0	14740	158	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 5.



The worst 5 of 158 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:434:LEU:HD13	1:C:437:ARG:HH11	1.08	1.14
1:A:518:LEU:HD12	1:A:518:LEU:O	1.50	1.10
1:C:518:LEU:HD12	1:C:518:LEU:O	1.50	1.09
1:A:434:LEU:HD13	1:A:437:ARG:HH11	1.08	1.08
1:C:560:LYS:HA	1:C:563:SER:OG	1.61	1.00

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 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	777/893 (87%)	742 (96%)	35 (4%)	0	100	100
1	C	777/893 (87%)	742 (96%)	35 (4%)	0	100	100
2	B	128/1724 (7%)	121 (94%)	7 (6%)	0	100	100
2	D	128/1724 (7%)	121 (94%)	7 (6%)	0	100	100
All	All	1810/5234 (35%)	1726 (95%)	84 (5%)	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 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	669/755 (89%)	667 (100%)	2 (0%)	91	97
1	C	669/755 (89%)	667 (100%)	2 (0%)	91	97
2	B	120/1534 (8%)	120 (100%)	0	100	100
2	D	120/1534 (8%)	120 (100%)	0	100	100
All	All	1578/4578 (34%)	1574 (100%)	4 (0%)	90	97

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	39	ASP
1	A	516	LEU
1	C	39	ASP
1	C	516	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	234	ASN
1	C	280	ASN
2	D	1613	GLN
1	A	280	ASN
1	A	234	ASN

### 5.3.3 RNA [i](#)

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](#)

2 ligands are modelled in this entry.



In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z  > 2$	Counts	RMSZ	$\# Z  > 2$
3	NAD	A	901	-	42,48,48	0.76	0	50,73,73	1.19	4 (8%)
3	NAD	C	901	-	42,48,48	0.75	0	50,73,73	1.20	4 (8%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	NAD	A	901	-	-	7/26/62/62	0/5/5/5
3	NAD	C	901	-	-	7/26/62/62	0/5/5/5

There are no bond length outliers.

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	901	NAD	N3A-C2A-N1A	-3.84	123.46	128.67
3	A	901	NAD	N3A-C2A-N1A	-3.83	123.48	128.67
3	C	901	NAD	C4D-O4D-C1D	-3.40	106.81	109.92
3	A	901	NAD	C4D-O4D-C1D	-3.38	106.83	109.92
3	C	901	NAD	C4A-C5A-N7A	-2.76	106.42	109.34

There are no chirality outliers.

5 of 14 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	901	NAD	C5D-O5D-PN-O3
3	A	901	NAD	C5D-O5D-PN-O1N
3	A	901	NAD	C5D-O5D-PN-O2N
3	A	901	NAD	C2D-C1D-N1N-C2N
3	A	901	NAD	C2D-C1D-N1N-C6N

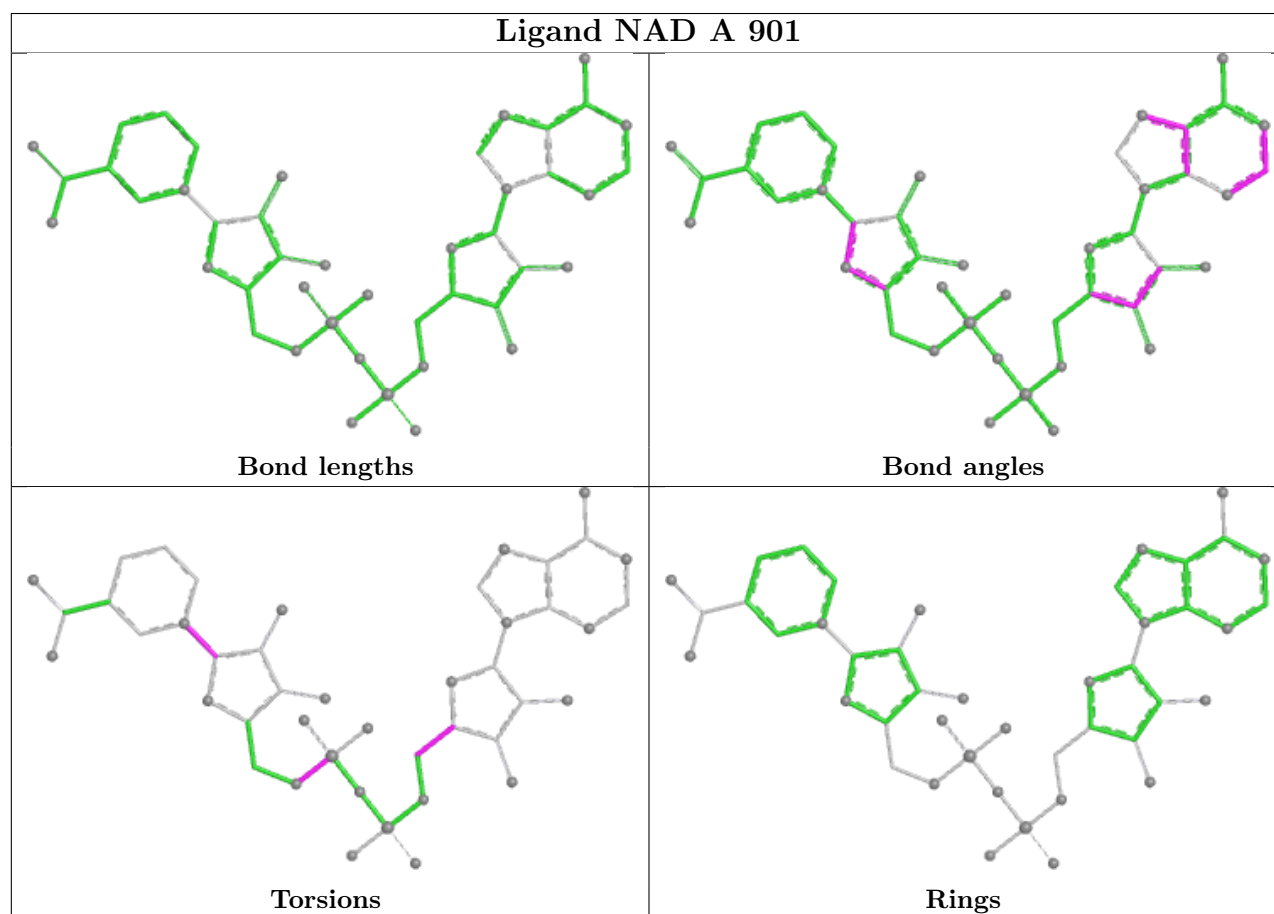
There are no ring outliers.



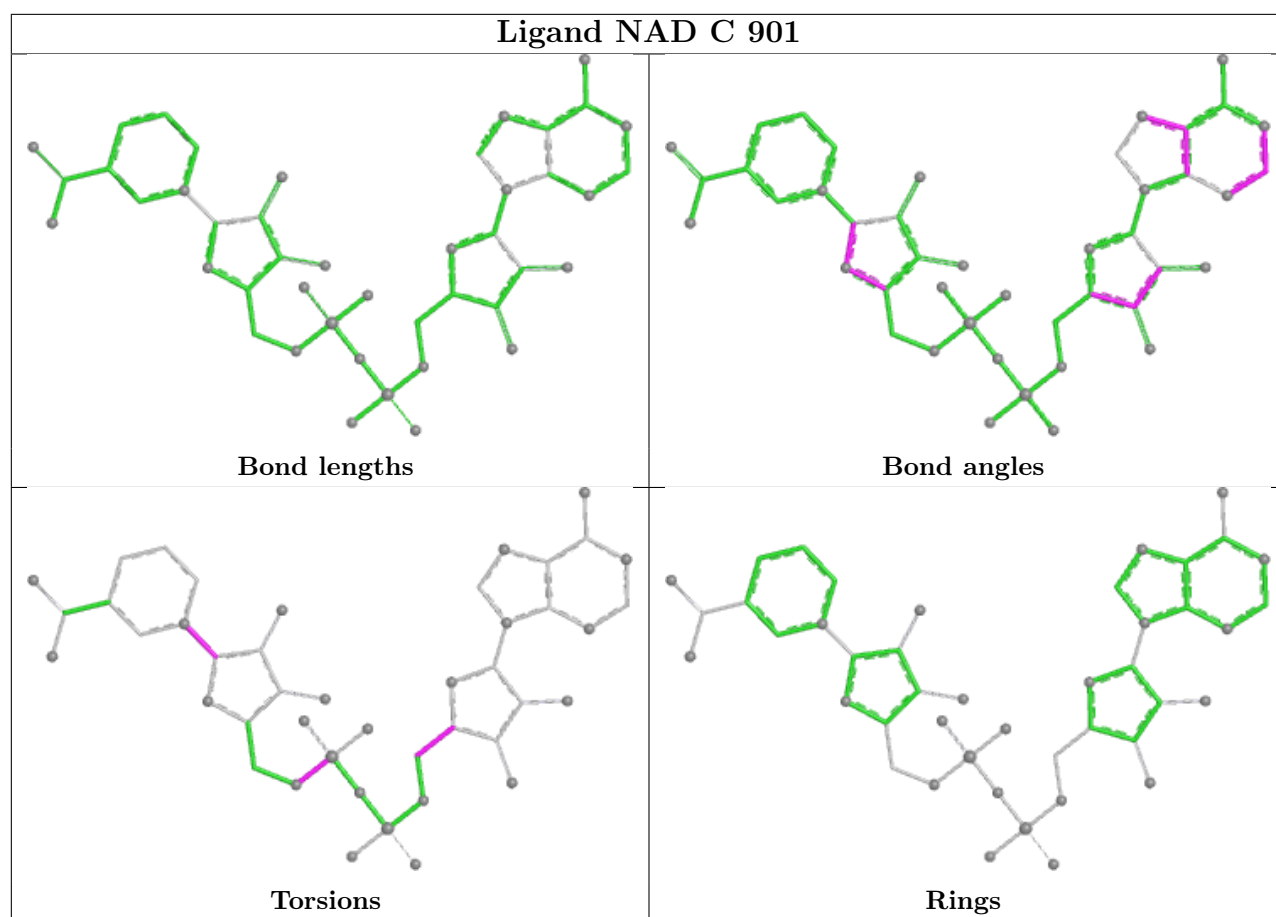
2 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	901	NAD	5	0
3	C	901	NAD	5	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.







## 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.



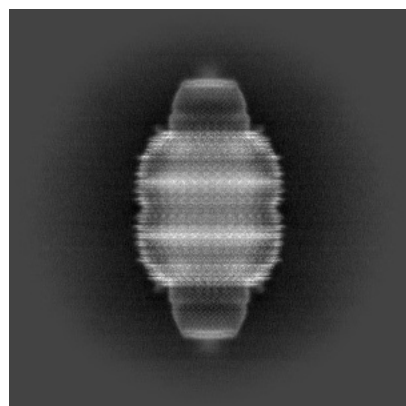
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-44957. These allow visual inspection of the internal detail of the map and identification of artifacts.

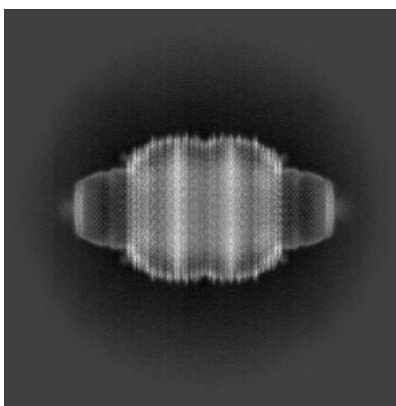
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

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

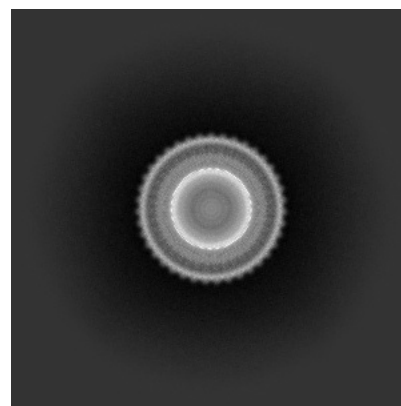
#### 6.1.1 Primary map



X

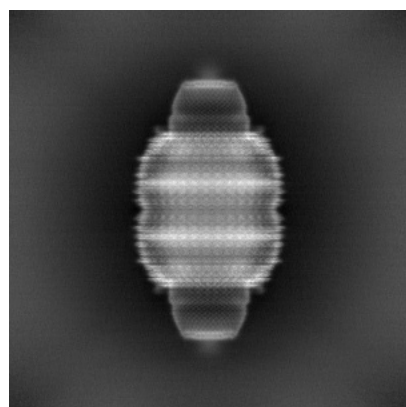


Y

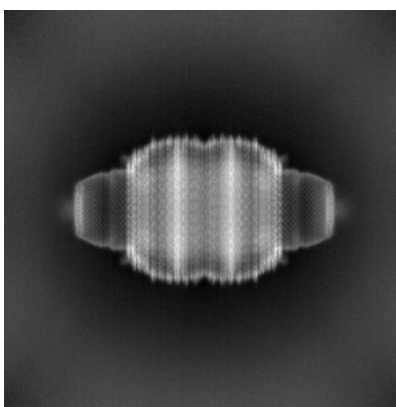


Z

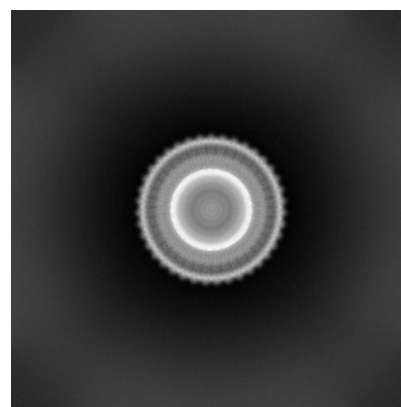
#### 6.1.2 Raw map



X



Y



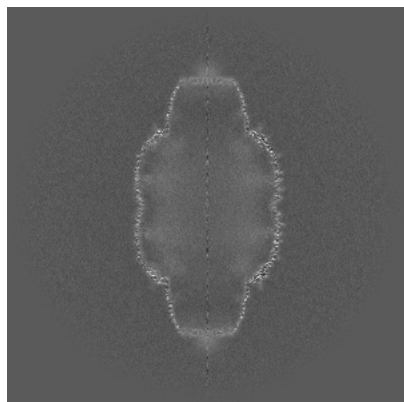
Z

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

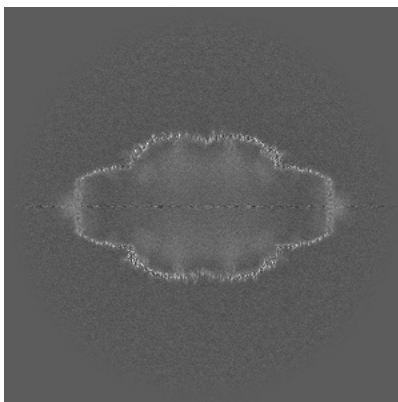


## 6.2 Central slices [i](#)

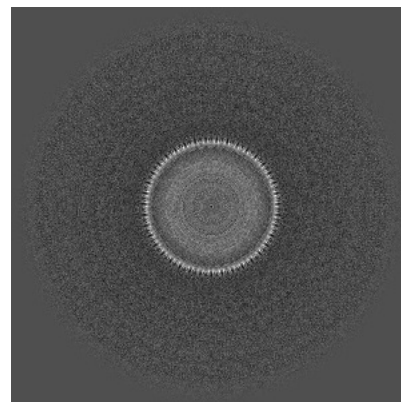
### 6.2.1 Primary map



X Index: 400

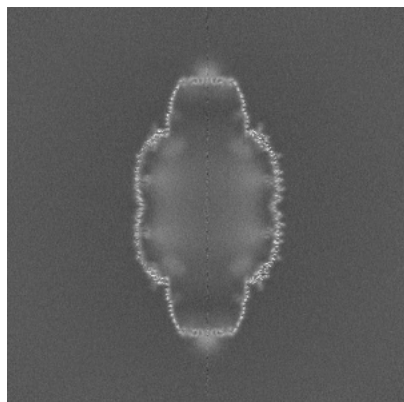


Y Index: 400

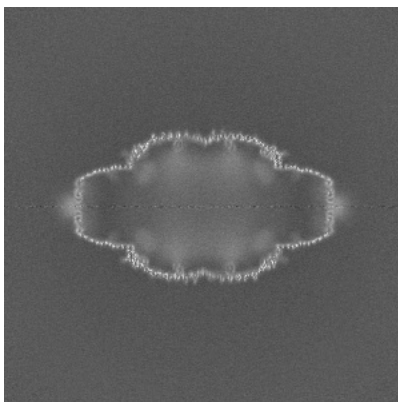


Z Index: 400

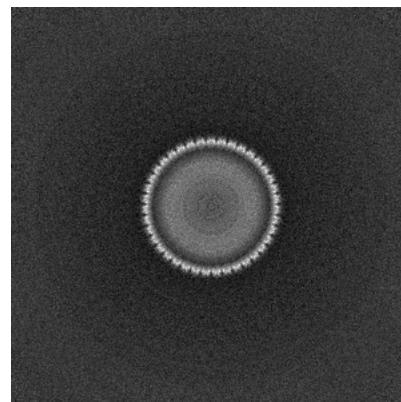
### 6.2.2 Raw map



X Index: 400



Y Index: 400



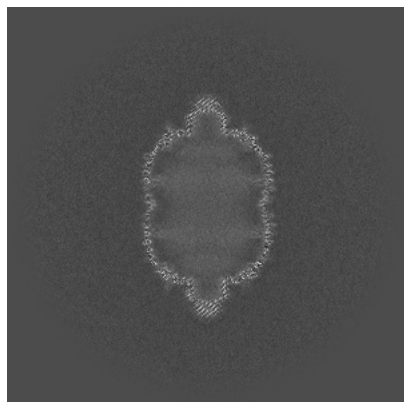
Z Index: 400

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

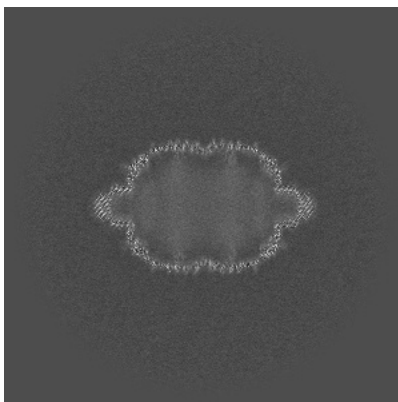


## 6.3 Largest variance slices [i](#)

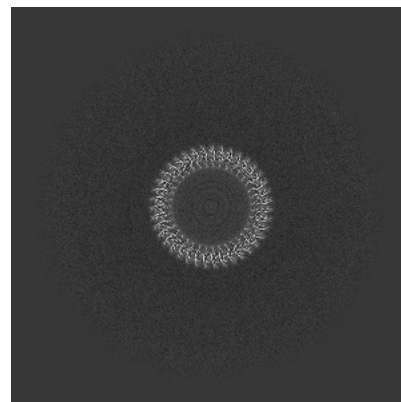
### 6.3.1 Primary map



X Index: 472

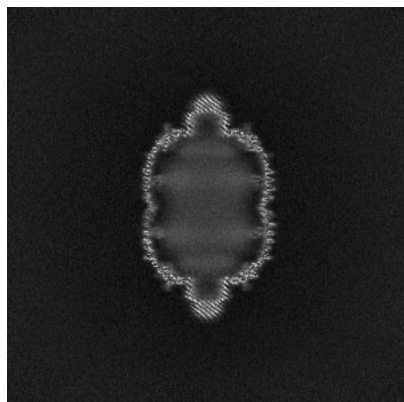


Y Index: 328

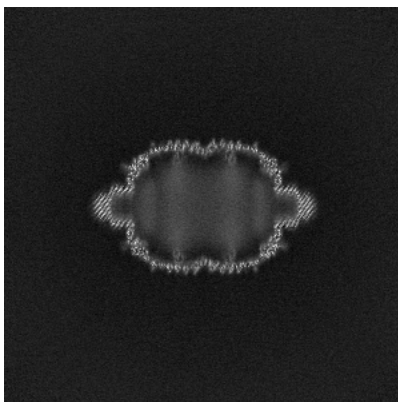


Z Index: 259

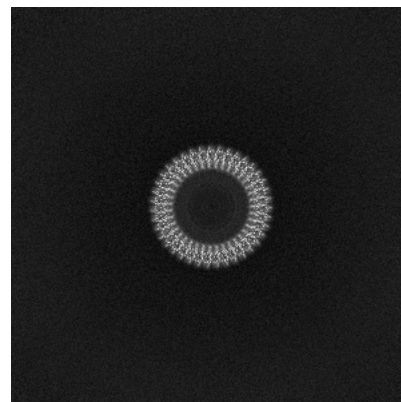
### 6.3.2 Raw map



X Index: 329



Y Index: 328



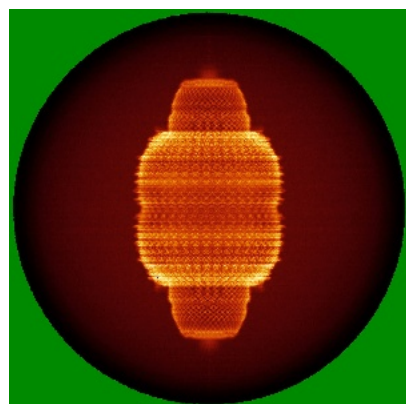
Z Index: 542

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

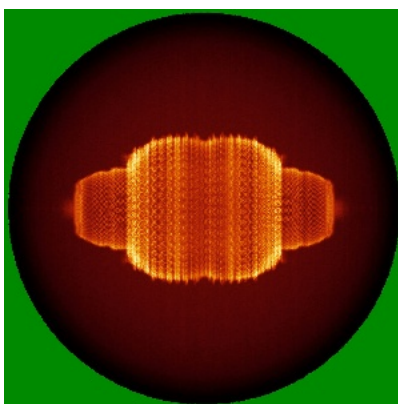


## 6.4 Orthogonal standard-deviation projections (False-color) [i](#)

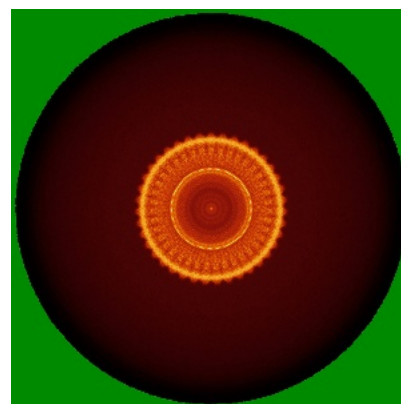
### 6.4.1 Primary map



X

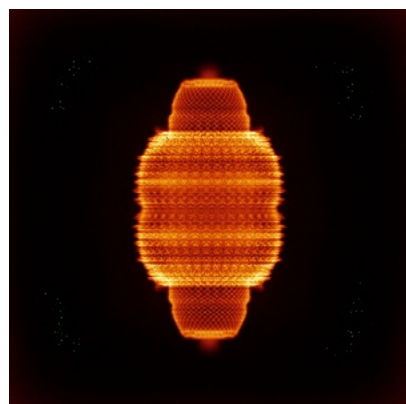


Y

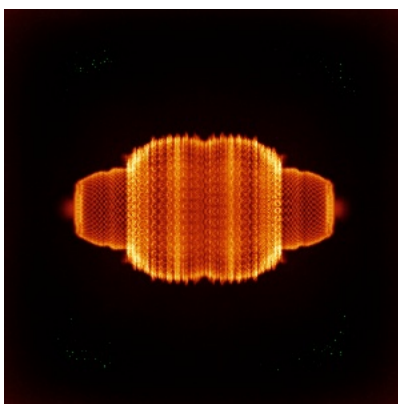


Z

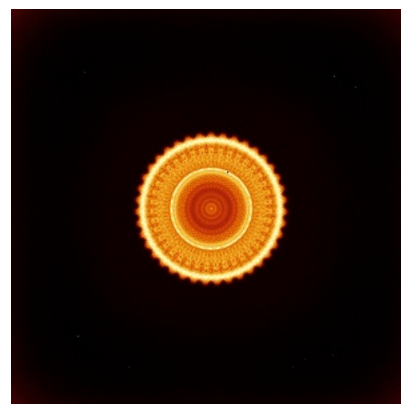
### 6.4.2 Raw map



X



Y



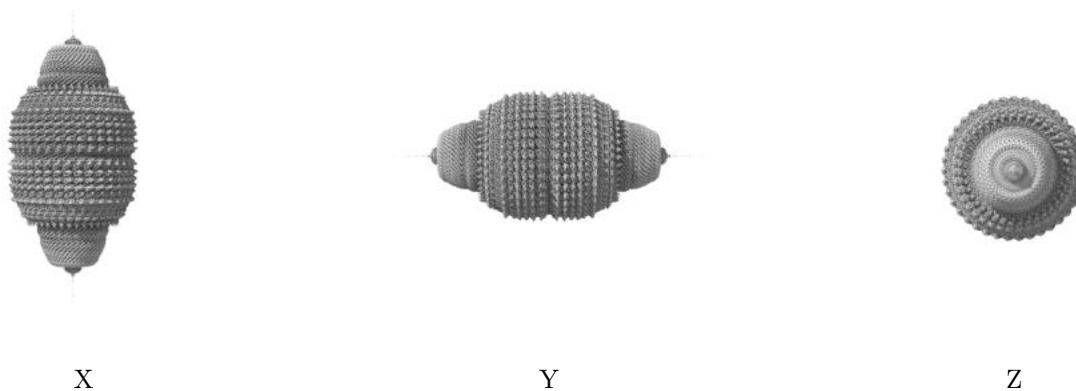
Z

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.



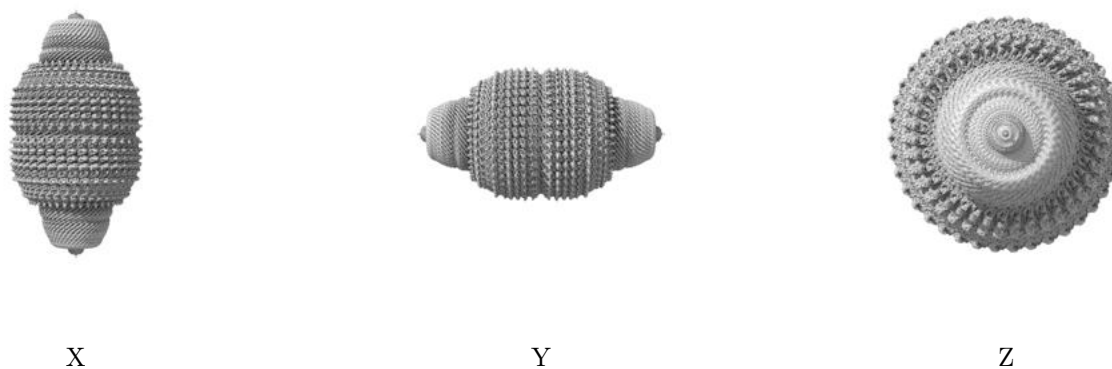
## 6.5 Orthogonal surface views [i](#)

### 6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.17. 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](#)

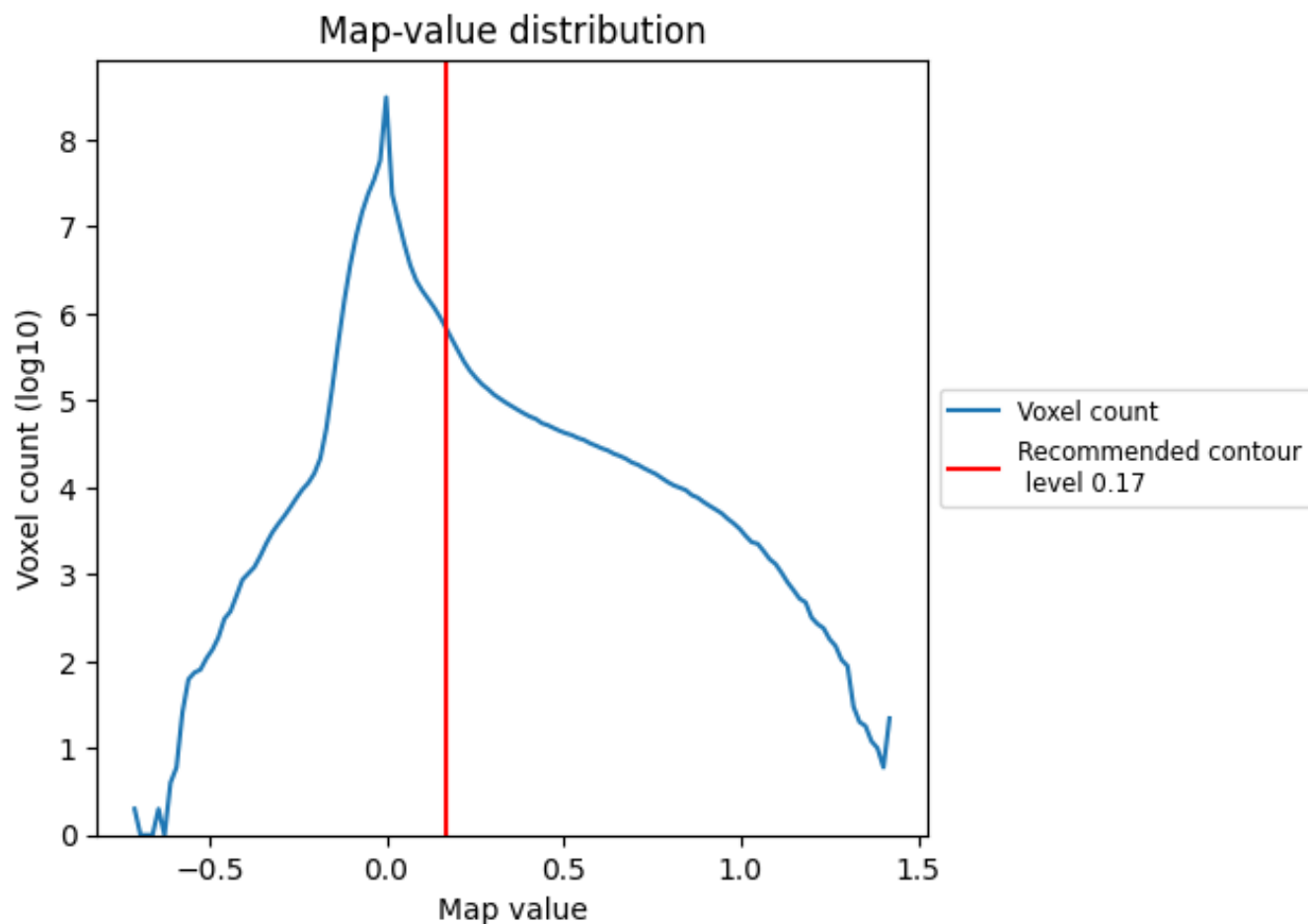
This section was not generated. No masks/segmentation were deposited.



## 7 Map analysis [i](#)

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

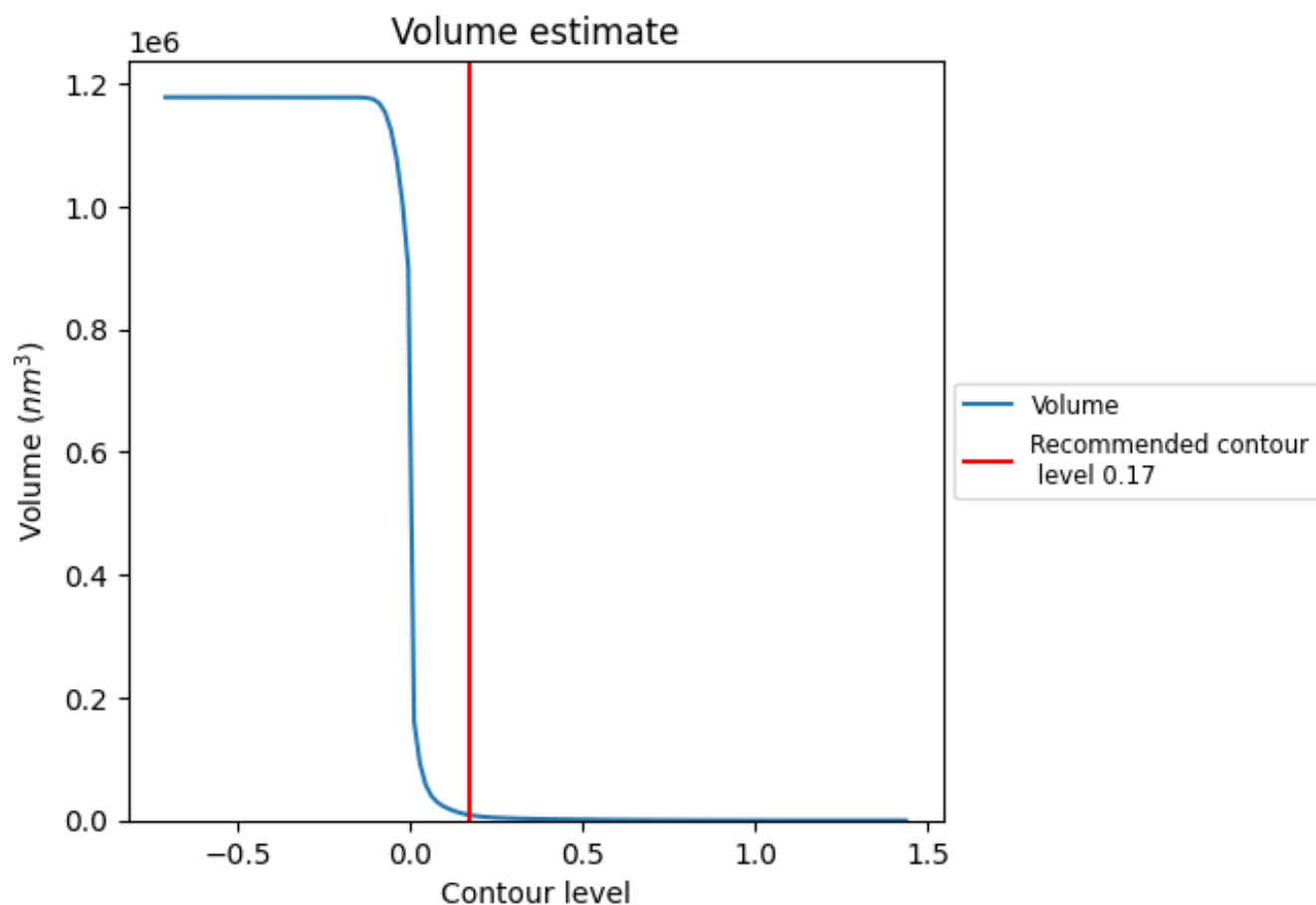
### 7.1 Map-value distribution [i](#)



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](#)

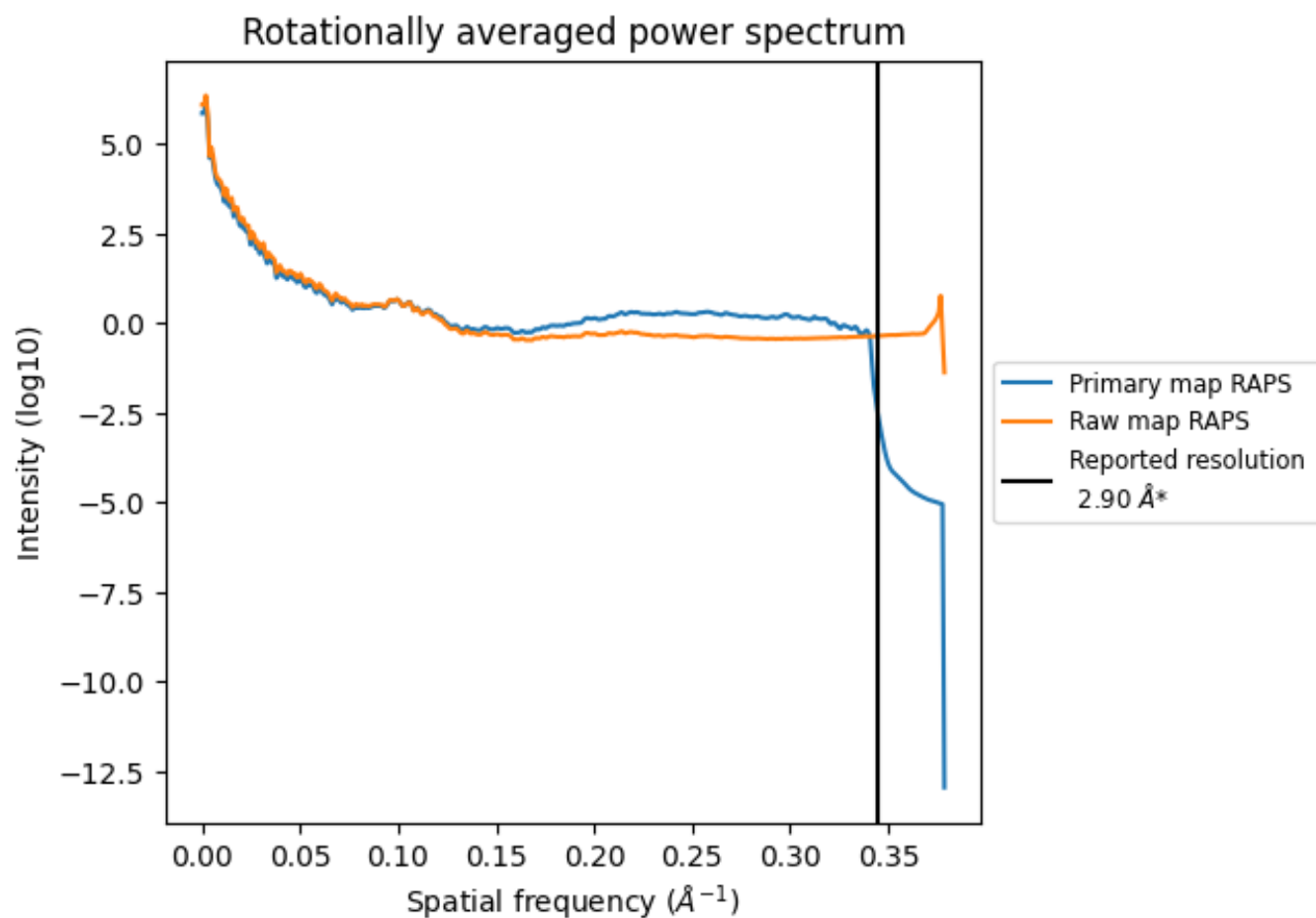


The volume at the recommended contour level is  $8991 \text{ nm}^3$ ; this corresponds to an approximate mass of 8122 kDa.

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 [i](#)



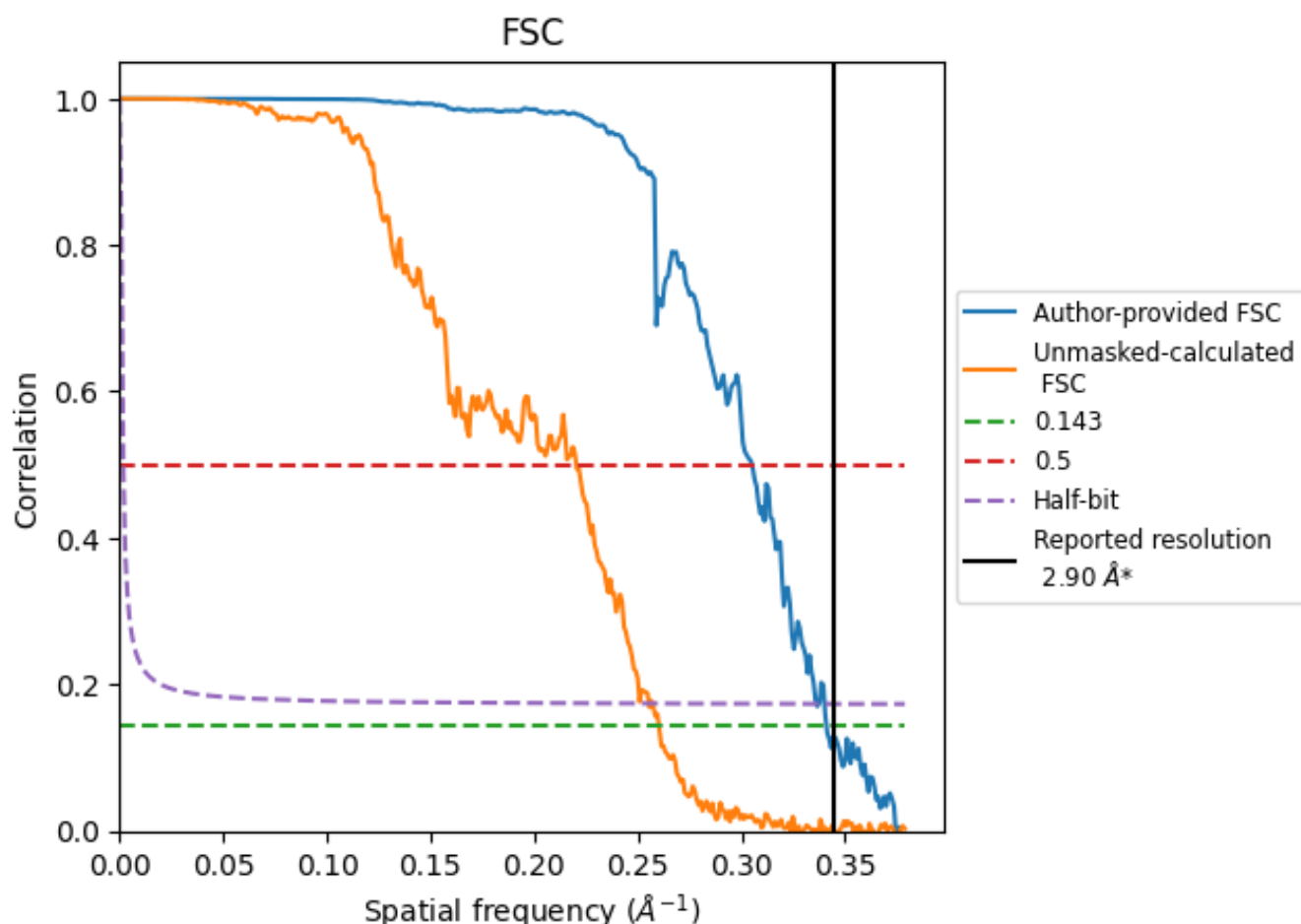
\*Reported resolution corresponds to spatial frequency of 0.345 Å<sup>-1</sup>



## 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 0.345  $\text{\AA}^{-1}$



## 8.2 Resolution estimates [i](#)

Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	2.90	-	-
Author-provided FSC curve	2.93	3.28	2.97
Unmasked-calculated*	3.84	4.54	3.92

\*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 3.84 differs from the reported value 2.9 by more than 10 %

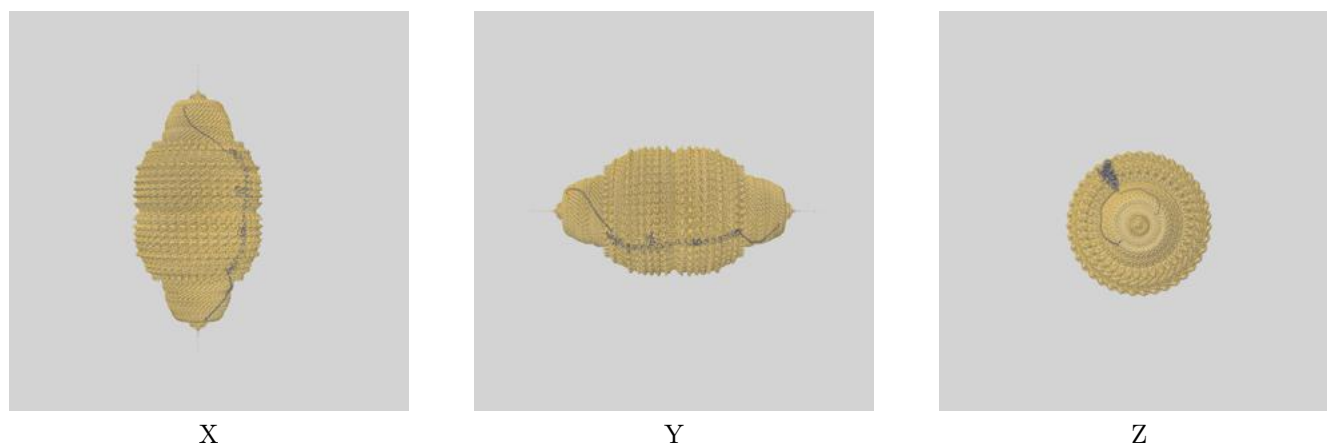


## 9 Map-model fit [i](#)

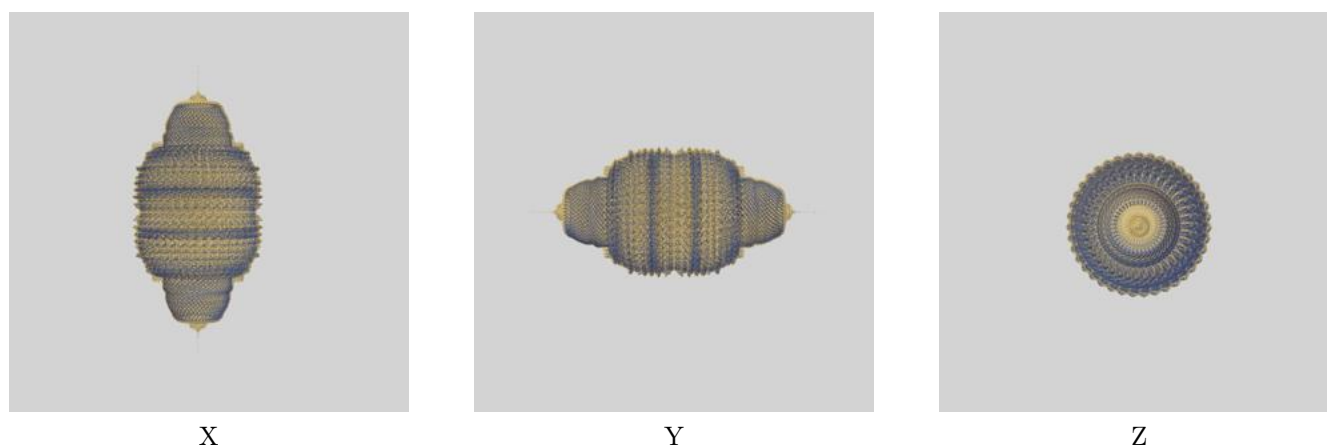
This section contains information regarding the fit between EMDB map EMD-44957 and PDB model 9BW7. Per-residue inclusion information can be found in section [3](#) on page [5](#).

### 9.1 Map-model overlays

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



#### 9.1.2 Map-model assembly overlay [i](#)



The images above show the 3D surface view of the map at the recommended contour level 0.17 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.

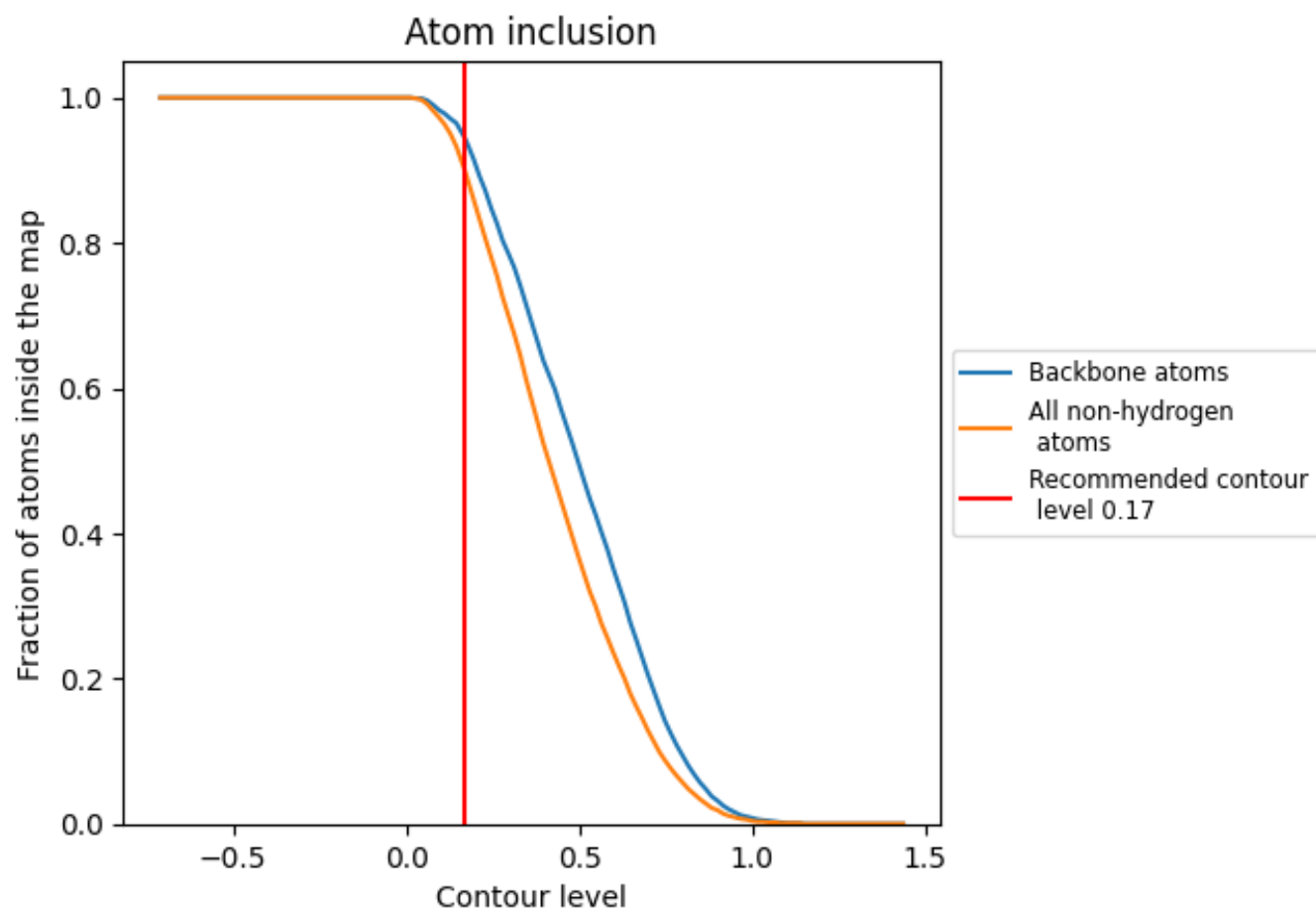
## 9.3 Atom inclusion mapped to coordinate model [i](#)



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 (0.17).



## 9.4 Atom inclusion [i](#)



At the recommended contour level, 94% of all backbone atoms, 90% 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 (0.17) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div></div> 0.8990	<div></div> 0.4850
A	<div></div> 0.9590	<div></div> 0.5150
B	<div></div> 0.5530	<div></div> 0.3170
C	<div></div> 0.9590	<div></div> 0.5150
D	<div></div> 0.5560	<div></div> 0.3130

