



wwPDB EM Validation Summary Report ⓘ

Mar 6, 2026 – 08:27 PM UTC

PDB ID : 2XFC / pdb_00002xfc
EMDB ID : EMD-1015
Title : CHIKUNGUNYA E1 E2 ENVELOPE GLYCOPROTEINS FITTED IN SEM-
LIKI FOREST VIRUS cryo-EM MAP
Authors : Voss, J.E.; Vaney, M.C.; Duquerroy, S.; Rey, F.A.
Deposited on : 2010-05-21
Resolution : 9.00 Å(reported)

This is a wwPDB EM 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/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>.

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

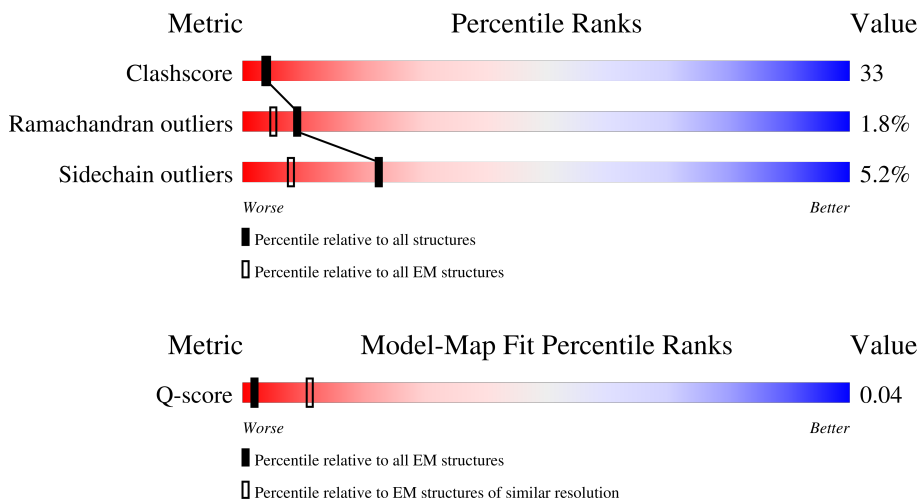
EMDB validation analysis : 0.0.1.dev132
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & 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:
ELECTRON MICROSCOPY

The reported resolution of this entry is 9.00 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.



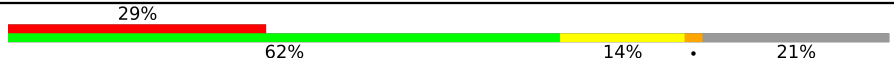
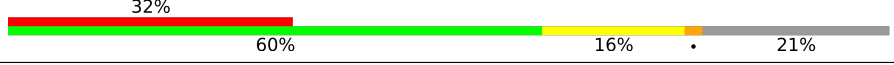
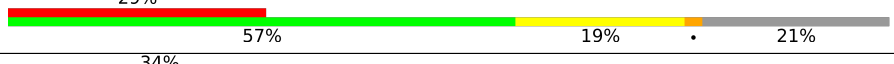

Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	257 (8.50 - 9.50)

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 ≥ 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	439	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>38%</p> </div> <div style="text-align: center;"> <p>66%</p> </div> <div style="text-align: center;"> <p>21%</p> </div> <div style="text-align: center;"> <p>••</p> </div> <div style="text-align: center;"> <p>11%</p> </div> </div>
1	D	439	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>40%</p> </div> <div style="text-align: center;"> <p>67%</p> </div> <div style="text-align: center;"> <p>19%</p> </div> <div style="text-align: center;"> <p>•</p> </div> <div style="text-align: center;"> <p>11%</p> </div> </div>
1	F	439	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>41%</p> </div> <div style="text-align: center;"> <p>65%</p> </div> <div style="text-align: center;"> <p>22%</p> </div> <div style="text-align: center;"> <p>•</p> </div> <div style="text-align: center;"> <p>11%</p> </div> </div>
1	H	439	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>46%</p> </div> <div style="text-align: center;"> <p>65%</p> </div> <div style="text-align: center;"> <p>21%</p> </div> <div style="text-align: center;"> <p>•</p> </div> <div style="text-align: center;"> <p>11%</p> </div> </div>

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Mol	Chain	Length	Quality of chain
2	B	423	
2	E	423	
2	G	423	
2	I	423	

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 22420 atoms, of which 0 are hydrogens and 0 are deuteriums.

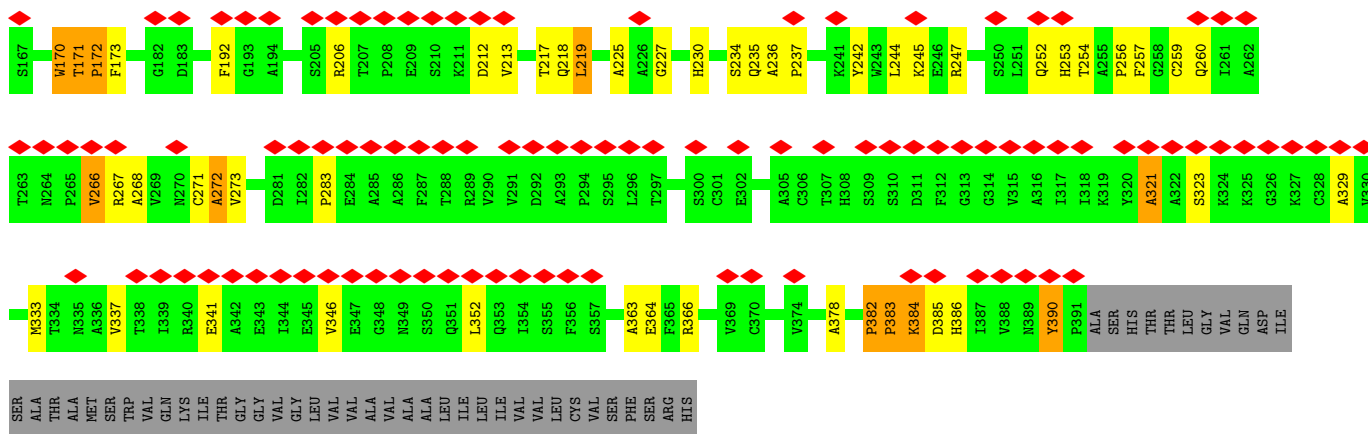
In the tables below, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called E1 ENVELOPE GLYCOPROTEIN.

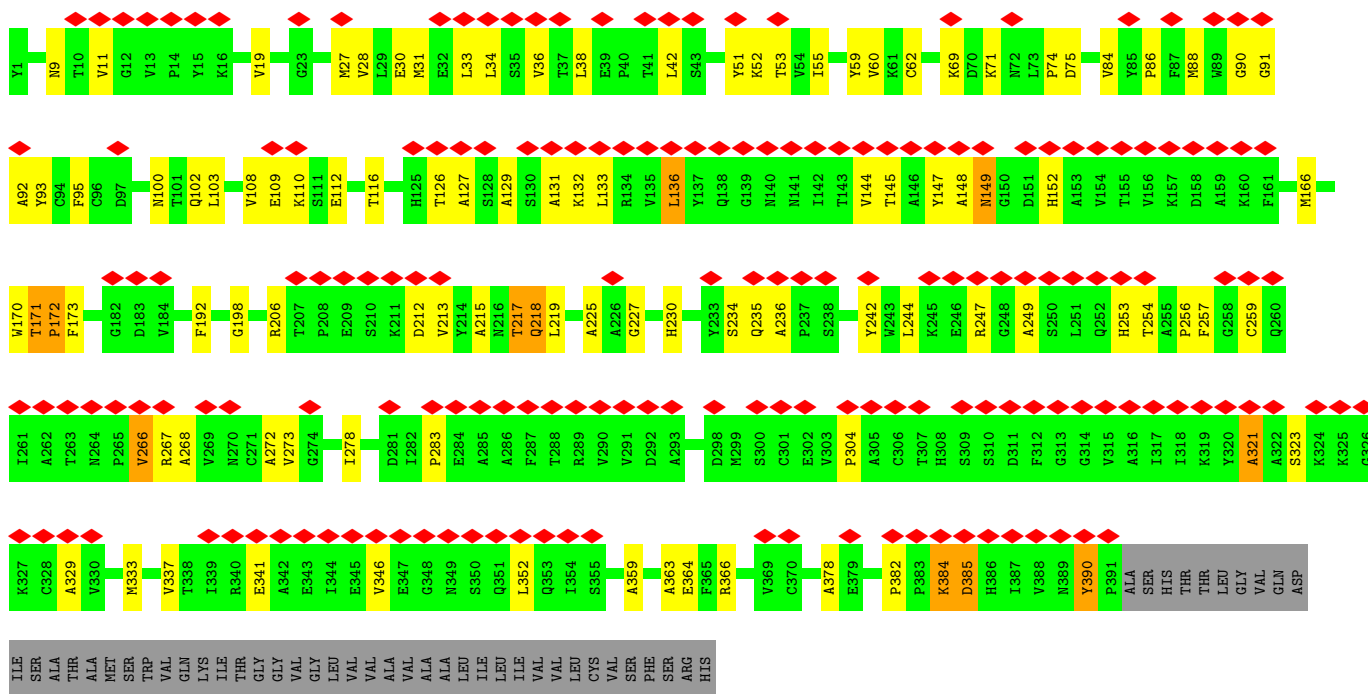
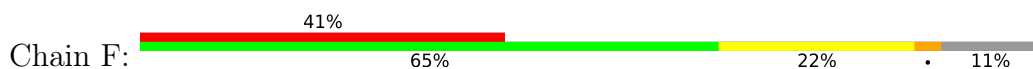
Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	391	2975	1881	499	571	24	0	1
1	D	391	2975	1881	499	571	24	0	1
1	F	391	2975	1881	499	571	24	0	1
1	H	391	2975	1881	499	571	24	0	1

- Molecule 2 is a protein called E2 ENVELOPE GLYCOPROTEIN.

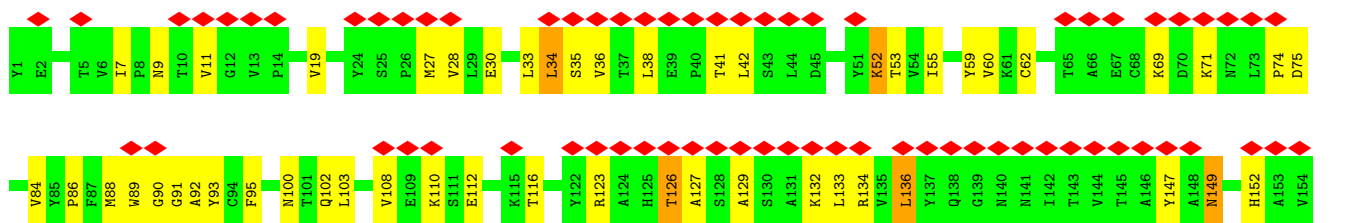
Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	B	335	2630	1641	476	494	19	0	1
2	E	335	2630	1641	476	494	19	0	1
2	G	335	2630	1641	476	494	19	0	1
2	I	335	2630	1641	476	494	19	0	1

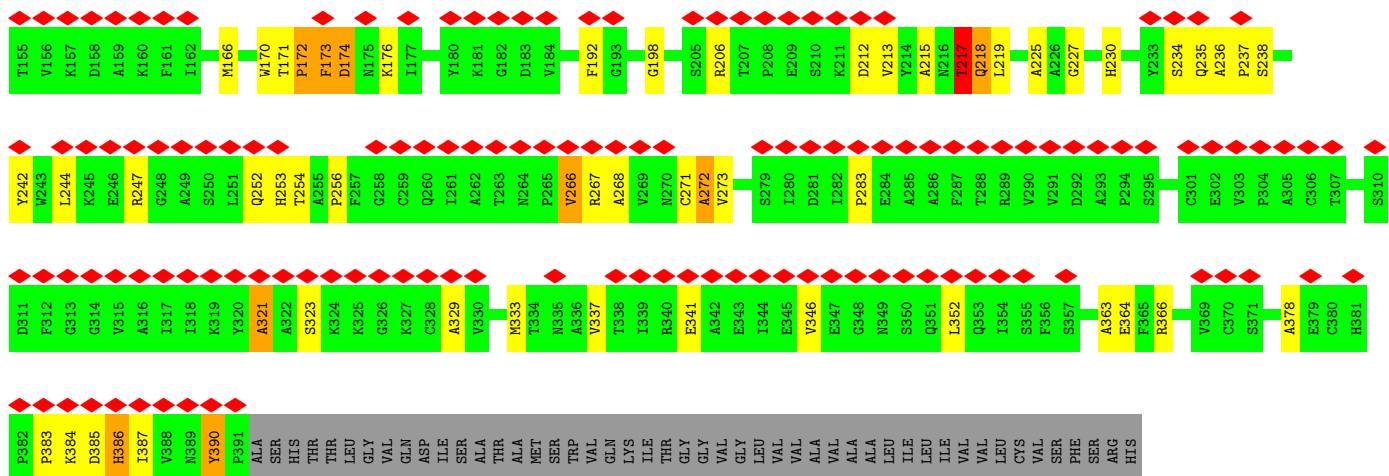


• Molecule 1: E1 ENVELOPE GLYCOPROTEIN



• Molecule 1: E1 ENVELOPE GLYCOPROTEIN





4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, I	Depositor
Number of particles used	6000	Depositor
Resolution determination method	Not provided	
CTF correction method	Not provided	
Microscope	FEI/PHILIPS CM200FEG/ST	Depositor
Voltage (kV)	100	Depositor
Electron dose ($e^-/\text{\AA}^2$)	8	Depositor
Minimum defocus (nm)	975	Depositor
Maximum defocus (nm)	7628	Depositor
Magnification	50000	Depositor
Image detector	KODAK SO-163 FILM	Depositor
Maximum map value	25955.000	Depositor
Minimum map value	-25432.000	Depositor
Average map value	-39.429	Depositor
Map value standard deviation	4659.710	Depositor
Recommended contour level	9460	Depositor
Map size (\AA)	758.52, 758.52, 758.52	wwPDB
Map dimensions	301, 301, 301	wwPDB
Map angles ($^\circ$)	90, 90, 90	wwPDB
Pixel spacing (\AA)	2.52, 2.52, 2.52	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	0.89	3/3046 (0.1%)	1.58	7/4147 (0.2%)
1	D	0.69	3/3047 (0.1%)	1.09	7/4150 (0.2%)
1	F	1.01	4/3048 (0.1%)	1.24	10/4153 (0.2%)
1	H	1.04	6/3050 (0.2%)	1.31	15/4159 (0.4%)
2	B	0.72	1/2697 (0.0%)	1.18	10/3668 (0.3%)
2	E	0.77	4/2698 (0.1%)	1.21	11/3671 (0.3%)
2	G	0.72	1/2698 (0.0%)	1.17	8/3671 (0.2%)
2	I	0.72	1/2699 (0.0%)	1.17	8/3674 (0.2%)
All	All	0.83	23/22983 (0.1%)	1.26	76/31293 (0.2%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1
1	D	0	1
1	F	0	1
1	H	0	2
All	All	0	5

The worst 5 of 23 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	F	217	THR	C-N	41.09	1.91	1.33
1	H	217	THR	C-N	-26.65	0.96	1.33
1	H	108	VAL	C-N	25.27	1.67	1.33
1	A	108	VAL	C-N	24.58	1.67	1.33
1	A	52	LYS	C-N	21.62	1.69	1.33

The worst 5 of 76 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	217	THR	O-C-N	-72.58	31.71	123.16
1	H	217	THR	O-C-N	-33.41	78.15	122.59
1	F	217	THR	O-C-N	-32.22	79.73	122.59
1	H	217	THR	CA-C-N	19.01	157.85	121.54
1	H	217	THR	C-N-CA	19.01	157.85	121.54

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	217	THR	Mainchain
1	D	321	ALA	Mainchain
1	F	321	ALA	Mainchain
1	H	217	THR	Mainchain
1	H	321	ALA	Mainchain

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	2975	0	2877	288	0
1	D	2975	0	2876	278	0
1	F	2975	0	2877	274	0
1	H	2975	0	2878	266	0
2	B	2630	0	2550	180	0
2	E	2630	0	2546	258	0
2	G	2630	0	2546	311	0
2	I	2630	0	2544	322	0
All	All	22420	0	21694	1456	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 33.

The worst 5 of 1456 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:I:274:LEU:HD21	2:I:296:HIS:CE1	1.20	1.70

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:88:MET:HE1	2:E:238:ASP:C	1.21	1.63
1:A:34:LEU:HD12	1:A:132:LYS:CE	1.18	1.58
1:H:88:MET:HB3	2:I:240:PRO:CD	1.29	1.57
1:A:34:LEU:CD1	1:A:132:LYS:HE2	1.27	1.57

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	380/439 (87%)	356 (94%)	16 (4%)	8 (2%)	5	30
1	D	381/439 (87%)	358 (94%)	15 (4%)	8 (2%)	5	30
1	F	383/439 (87%)	365 (95%)	14 (4%)	4 (1%)	12	49
1	H	387/439 (88%)	364 (94%)	14 (4%)	9 (2%)	5	28
2	B	327/423 (77%)	303 (93%)	19 (6%)	5 (2%)	8	40
2	E	329/423 (78%)	301 (92%)	22 (7%)	6 (2%)	6	34
2	G	329/423 (78%)	303 (92%)	19 (6%)	7 (2%)	5	30
2	I	331/423 (78%)	300 (91%)	26 (8%)	5 (2%)	8	40
All	All	2847/3448 (83%)	2650 (93%)	145 (5%)	52 (2%)	9	34

5 of 52 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	34	LEU
1	A	173	PHE
1	A	272	ALA
1	A	386	HIS
1	A	390	TYR

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	327/366 (89%)	312 (95%)	15 (5%)	24	45
1	D	327/366 (89%)	311 (95%)	16 (5%)	22	43
1	F	327/366 (89%)	311 (95%)	16 (5%)	22	43
1	H	327/366 (89%)	312 (95%)	15 (5%)	24	45
2	B	295/372 (79%)	279 (95%)	16 (5%)	20	41
2	E	295/372 (79%)	278 (94%)	17 (6%)	18	40
2	G	295/372 (79%)	279 (95%)	16 (5%)	20	41
2	I	295/372 (79%)	277 (94%)	18 (6%)	17	38
All	All	2488/2952 (84%)	2359 (95%)	129 (5%)	22	42

5 of 129 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	I	238	ASP
2	I	256	VAL
2	E	103	ASN
2	E	88	GLU
2	I	274	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 76 such sidechains are listed below:

Mol	Chain	Res	Type
2	G	396	ASN
2	I	282	ASN
1	H	102	GLN
1	H	260	GLN
2	I	369	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](#)

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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	A	7
1	D	4
1	F	4
1	H	4
2	B	2
2	G	1
2	E	1

The worst 5 of 23 chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	A	321:ALA	C	322:ALA	N	20.90
1	A	323:SER	C	324:LYS	N	19.06
1	A	283:PRO	C	284:GLU	N	13.12
1	A	284:GLU	C	285:ALA	N	12.29
1	D	235:GLN	C	236:ALA	N	4.87

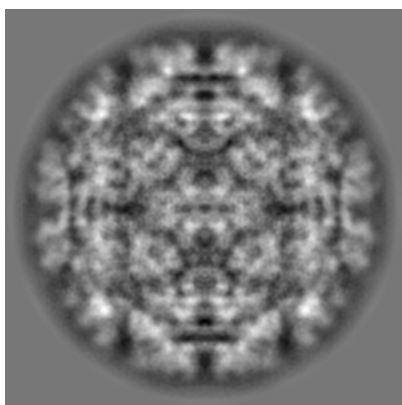
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-1015. These allow visual inspection of the internal detail of the map and identification of artifacts.

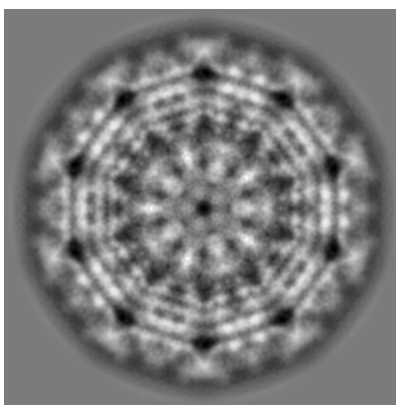
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

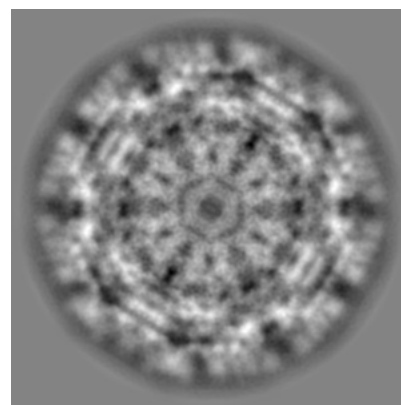
6.1.1 Primary map



X



Y

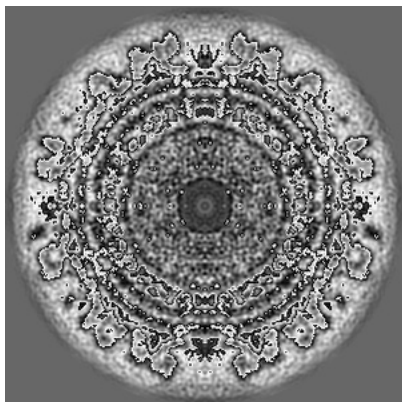


Z

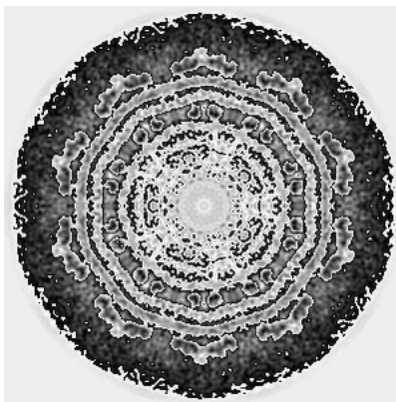
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

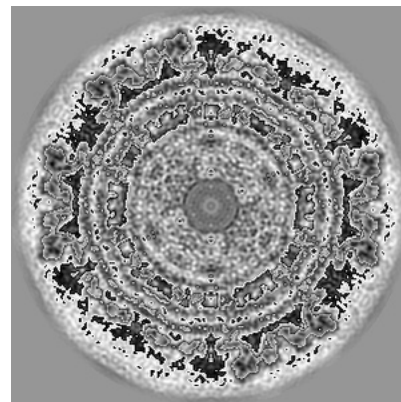
6.2.1 Primary map



X Index: 150



Y Index: 150

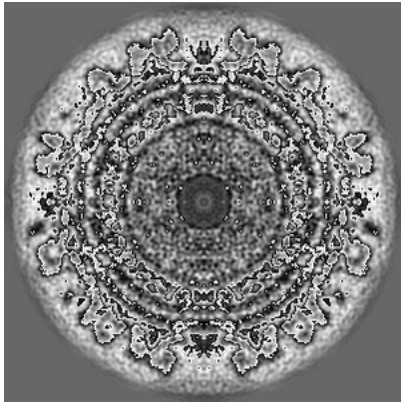


Z Index: 150

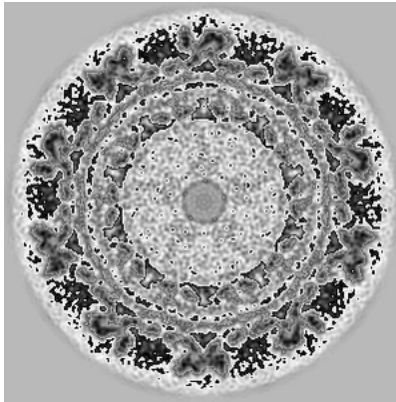
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

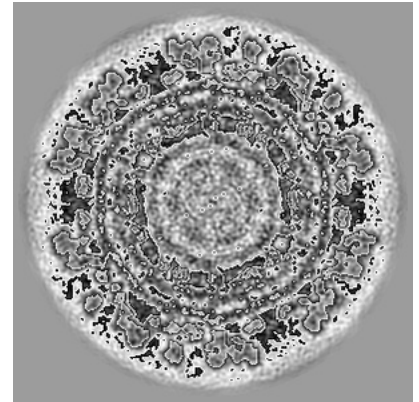
6.3.1 Primary map



X Index: 150



Y Index: 137

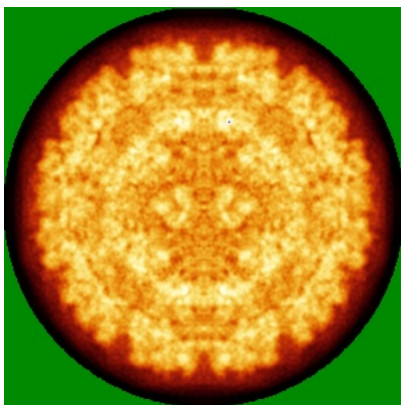


Z Index: 112

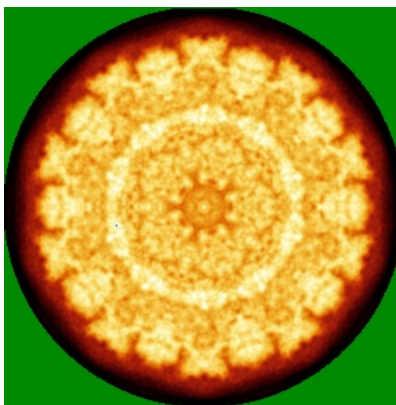
The images above show the largest variance slices of the map in three orthogonal directions.

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

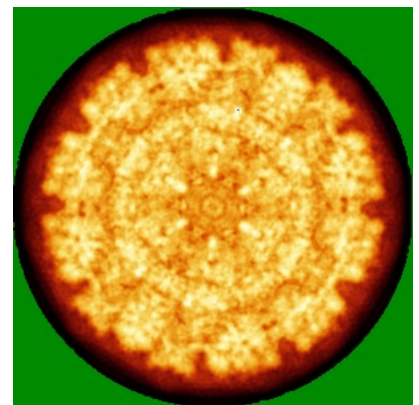
6.4.1 Primary map



X



Y

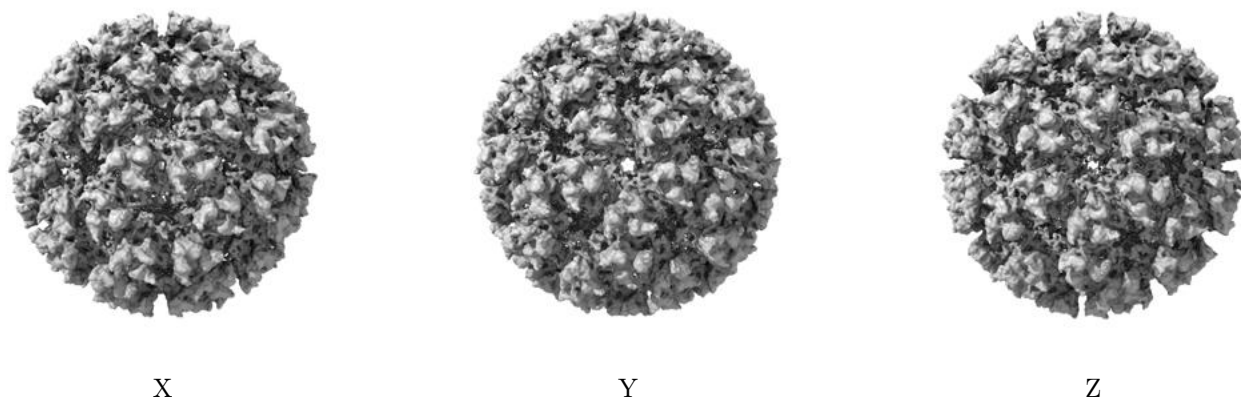


Z

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 9460.0. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

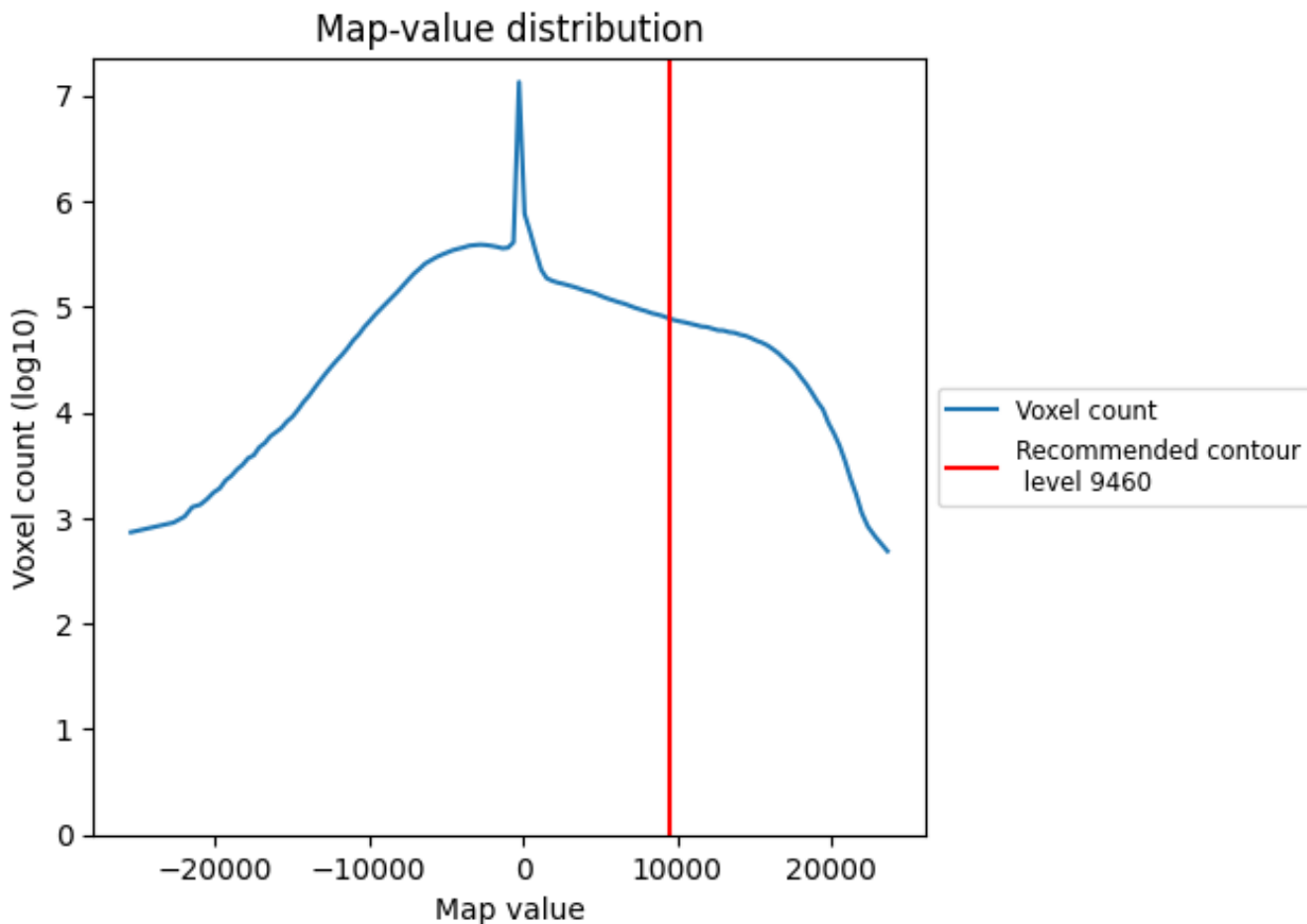
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

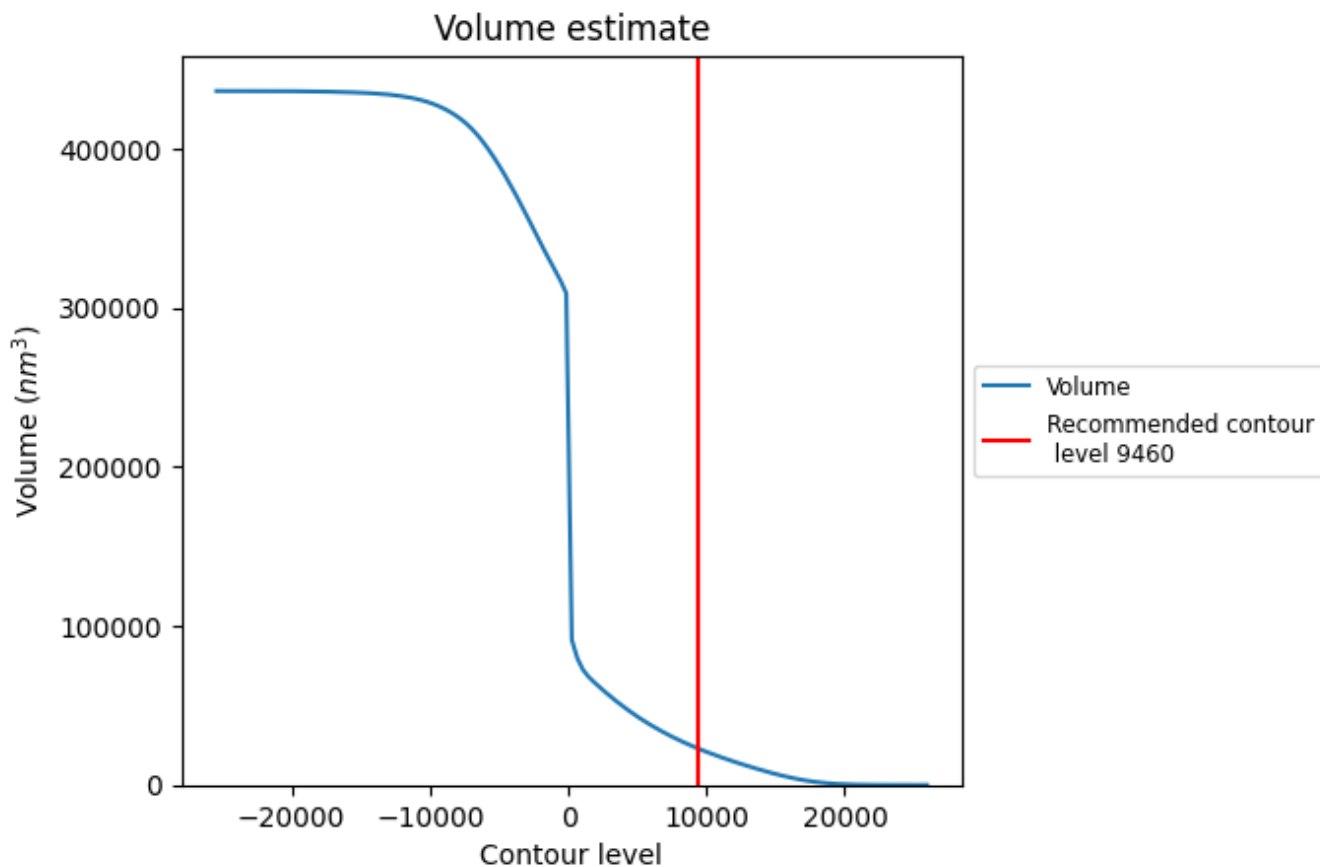
This section contains the results of statistical analysis of the map.

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.

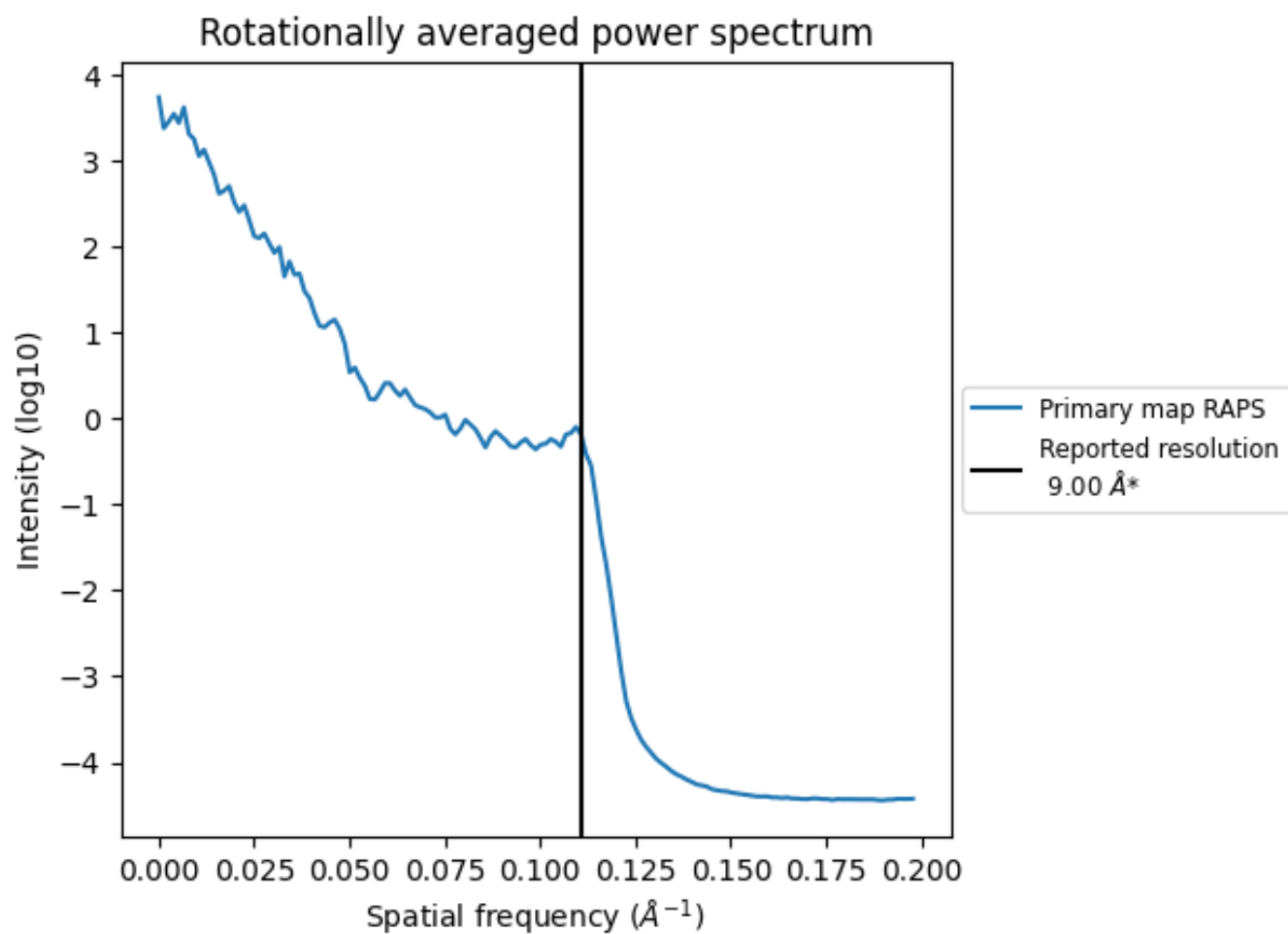
7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 22687 nm³; this corresponds to an approximate mass of 20494 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 0.111 Å⁻¹

8 Fourier-Shell correlation

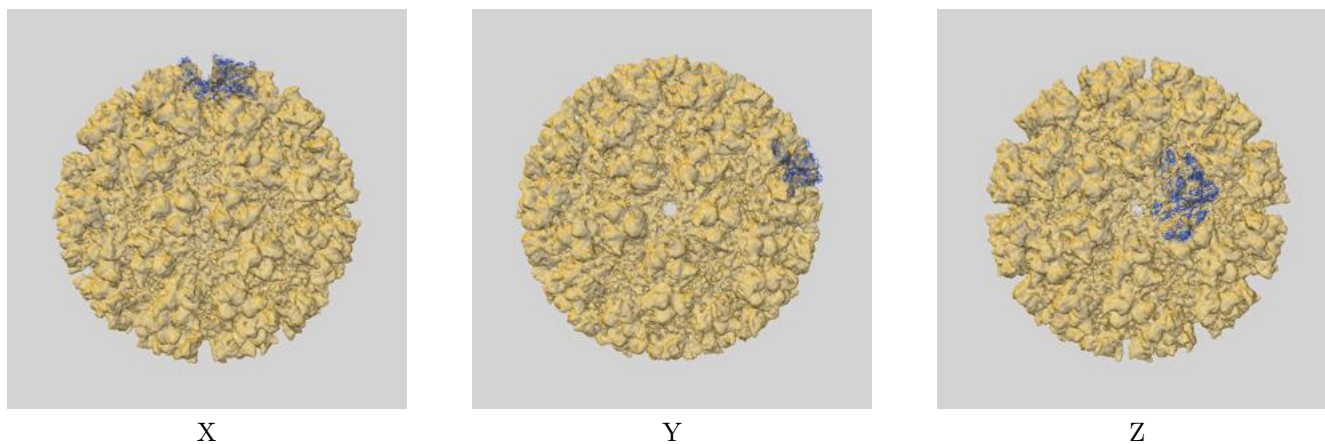
This section was not generated. No FSC curve or half-maps provided.

9 Map-model fit [i](#)

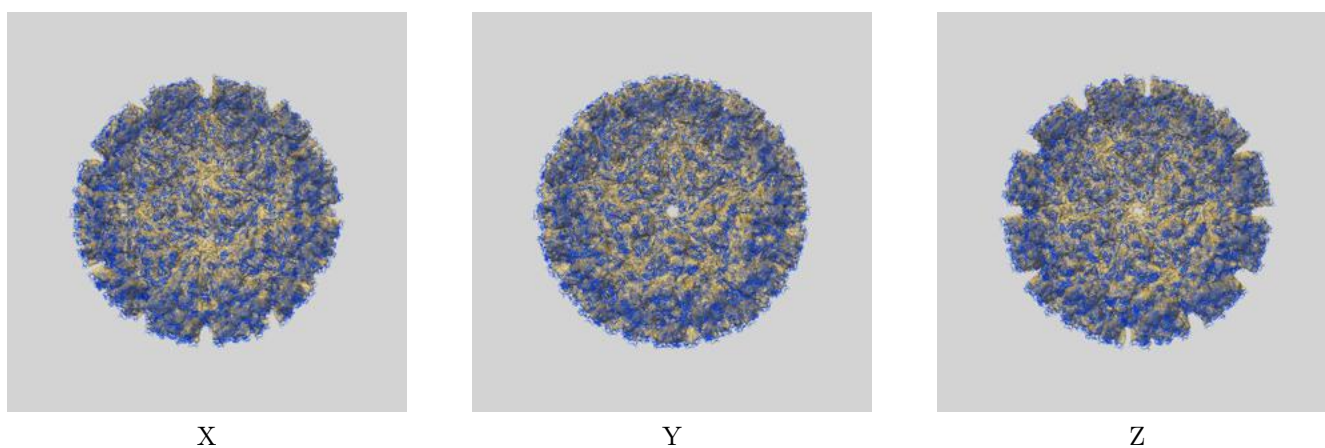
This section contains information regarding the fit between EMDB map EMD-1015 and PDB model 2XFC. Per-residue inclusion information can be found in section 3 on page 5.

9.1 Map-model overlays

9.1.1 Map-model overlay [i](#)

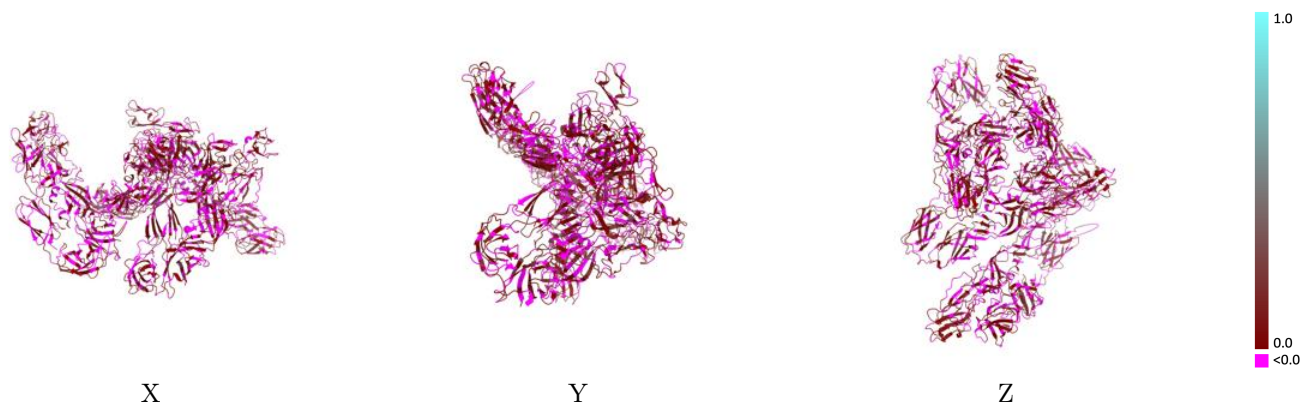


9.1.2 Map-model assembly overlay [i](#)



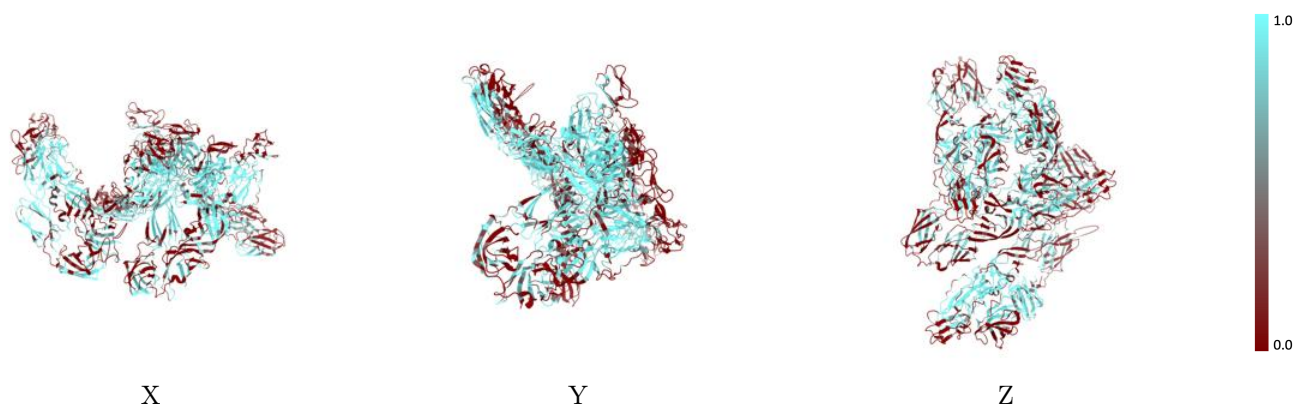
The images above show the 3D surface view of the map at the recommended contour level 9460.0 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



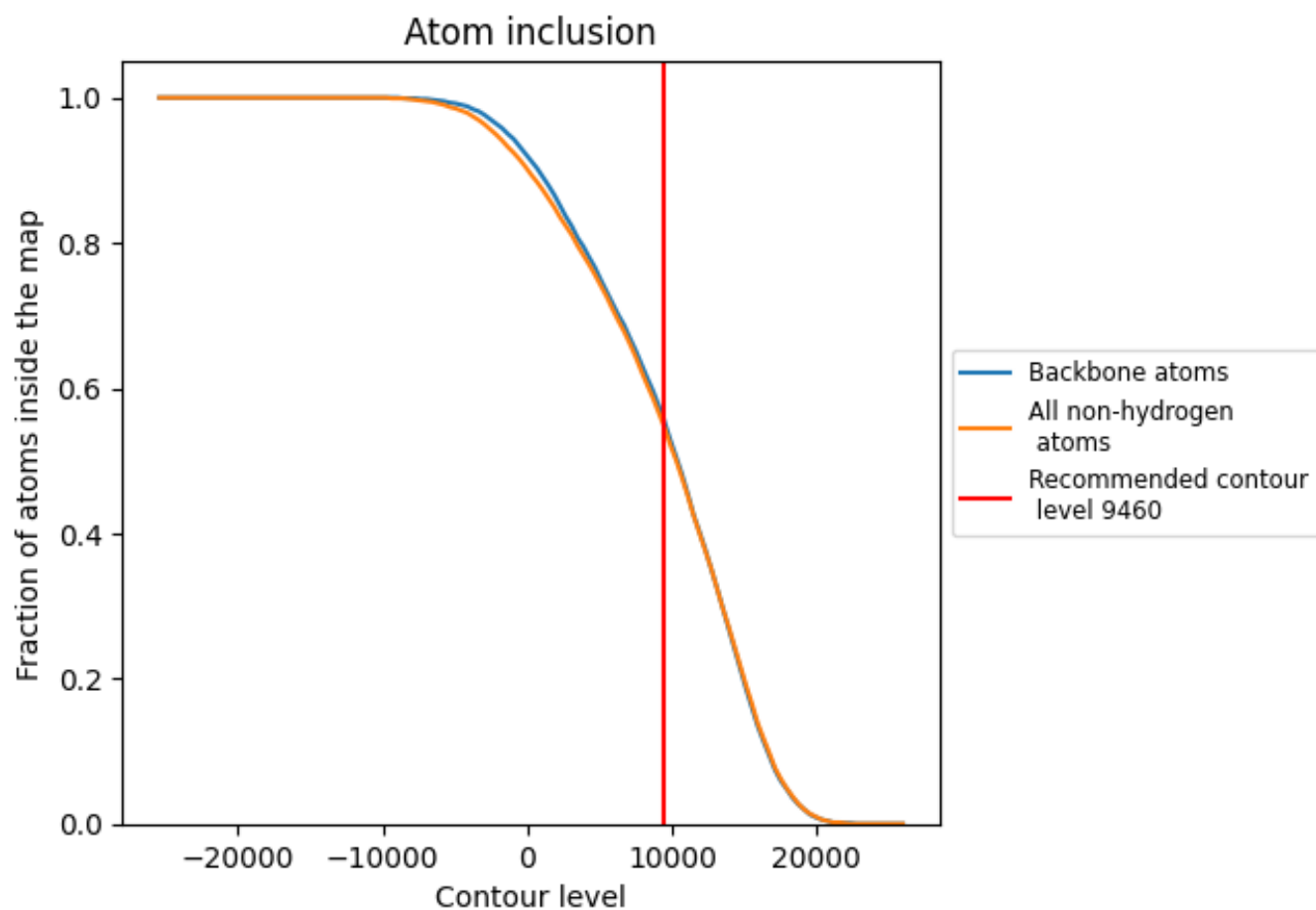
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (9460).



















9.4 Atom inclusion [i](#)



At the recommended contour level, 56% of all backbone atoms, 55% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary [i](#)

The table lists the average atom inclusion at the recommended contour level (9460) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.5470	 0.0400
A	 0.5530	 0.0290
B	 0.5980	 0.0460
D	 0.5240	 0.0400
E	 0.5680	 0.0440
F	 0.5320	 0.0260
G	 0.6170	 0.0530
H	 0.4520	 0.0360
I	 0.5480	 0.0510

