



wwPDB EM Validation Summary Report ⓘ

Jul 12, 2023 – 02:19 PM EDT

PDB ID : 8EEV
EMDB ID : EMD-28060
Title : Venezuelan equine encephalitis virus-like particle in complex with Fab SKT-20
Authors : Tsybovsky, Y.; Pletnev, S.; Verardi, R.; Roederer, M.; Kwong, P.D.
Deposited on : 2022-09-07
Resolution : 3.60 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.dev50
MolProbity : 4.02b-467
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ : 1.9.9
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.34

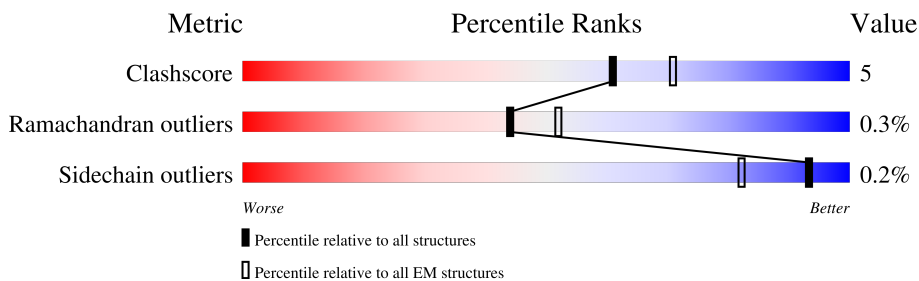
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.60 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.



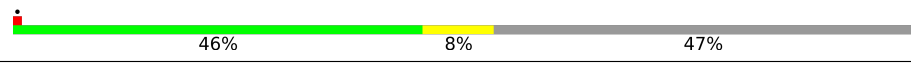
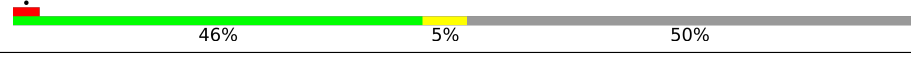
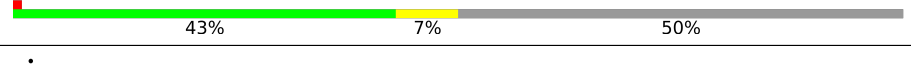
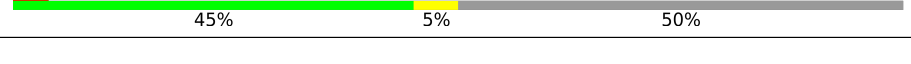
Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826

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	1254	
1	B	1254	
1	F	1254	
1	G	1254	
1	J	1254	
1	K	1254	
2	H	237	
2	S	237	

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Mol	Chain	Length	Quality of chain
2	U	237	 46% 8% 47%
3	L	219	 46% 5% 50%
3	T	219	 43% 7% 50%
3	V	219	 45% 5% 50%

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 20640 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 Coat protein.

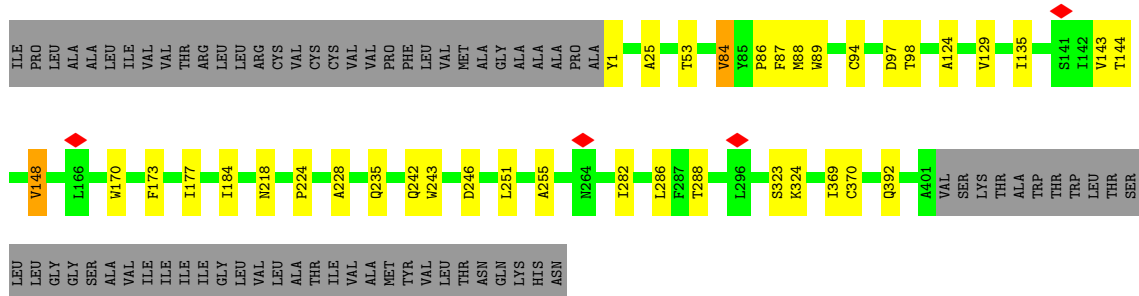
Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	401	3019	1938	489	572	20	0	0
1	B	268	2092	1358	350	370	14	0	0
1	F	401	3019	1938	489	572	20	0	0
1	G	268	2092	1358	350	370	14	0	0
1	J	401	3019	1938	489	572	20	0	0
1	K	268	2092	1358	350	370	14	0	0

- Molecule 2 is a protein called Fab SKT20 heavy chain.

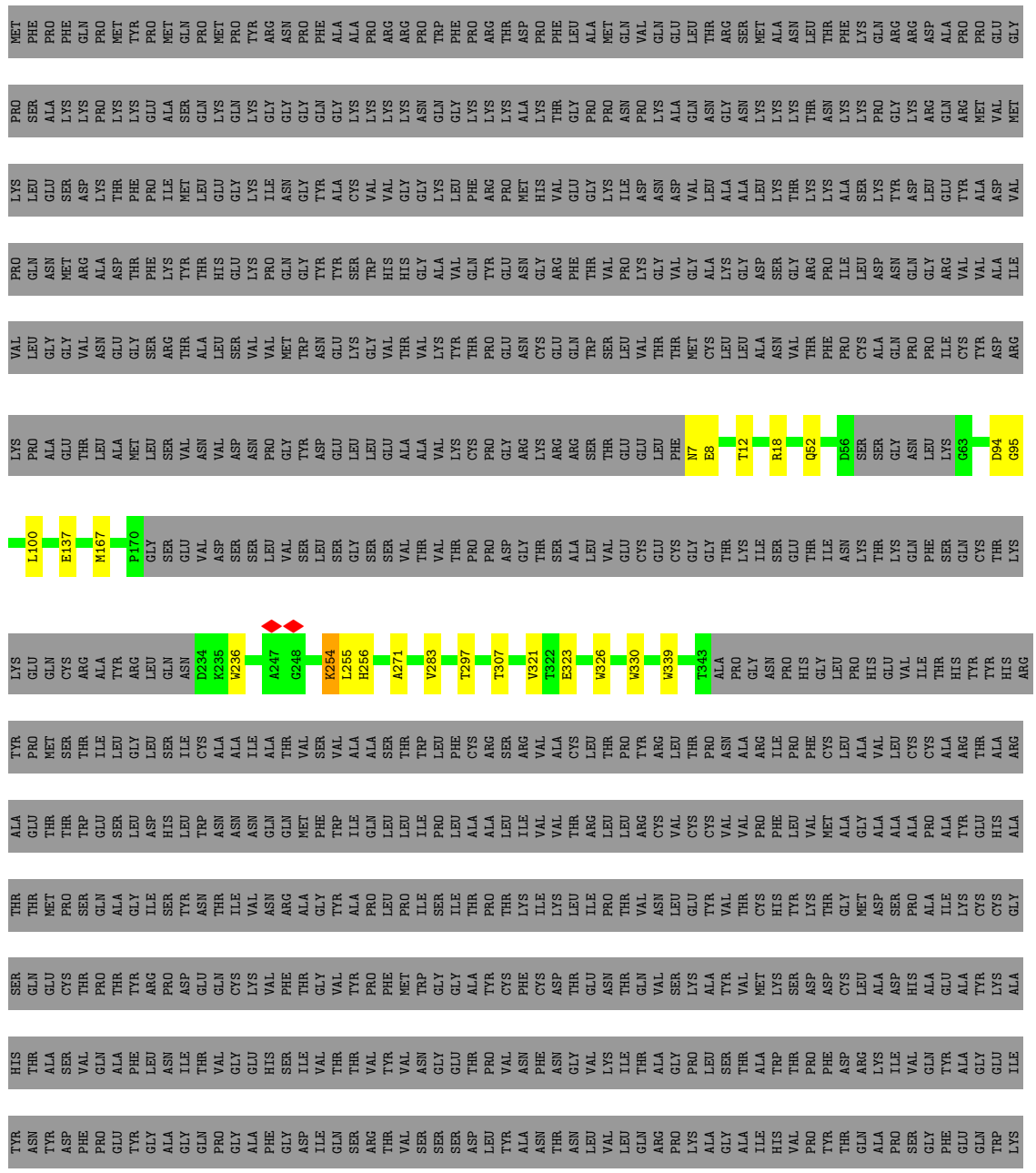
Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	H	124	941	606	151	180	4	0	0
2	S	126	953	612	153	184	4	0	0
2	U	126	953	612	153	184	4	0	0

- Molecule 3 is a protein called Fab SKT20 light chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	L	110	820	528	133	156	3	0	0
3	T	110	820	528	133	156	3	0	0
3	V	110	820	528	133	156	3	0	0



● Molecule 1: Coat protein



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

● Molecule 1: Coat protein



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

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C3	Depositor
Number of particles used	28235	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	47.5	Depositor
Minimum defocus (nm)	750	Depositor
Maximum defocus (nm)	2250	Depositor
Magnification	Not provided	
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	2.070	Depositor
Minimum map value	-0.053	Depositor
Average map value	0.003	Depositor
Map value standard deviation	0.034	Depositor
Recommended contour level	0.06	Depositor
Map size (Å)	295.56, 295.56, 295.56	wwPDB
Map dimensions	240, 240, 240	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.2315, 1.2315, 1.2315	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	0.46	0/3101	0.60	0/4221
1	B	0.53	0/2153	0.61	0/2909
1	F	0.46	0/3101	0.60	0/4221
1	G	0.53	0/2153	0.59	0/2909
1	J	0.46	0/3101	0.63	1/4221 (0.0%)
1	K	0.53	0/2153	0.60	0/2909
2	H	0.39	0/964	0.59	0/1307
2	S	0.41	0/976	0.59	0/1323
2	U	0.41	0/976	0.60	0/1323
3	L	0.34	0/840	0.59	0/1140
3	T	0.34	0/840	0.58	0/1140
3	V	0.35	0/840	0.57	0/1140
All	All	0.46	0/21198	0.60	1/28763 (0.0%)

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	2
1	F	0	3
1	J	0	2
2	H	0	1
2	S	0	1
2	U	0	1
All	All	0	10

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	J	264	ASN	N-CA-C	-6.81	92.62	111.00

There are no chirality outliers.

5 of 10 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	148	VAL	Peptide
1	A	84	VAL	Peptide
1	F	262	TYR	Peptide
1	F	85	TYR	Peptide
1	F	87	PHE	Peptide

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	3019	0	2871	24	0
1	B	2092	0	1988	16	0
1	F	3019	0	2871	27	0
1	G	2092	0	1988	21	0
1	J	3019	0	2871	27	0
1	K	2092	0	1990	15	0
2	H	941	0	868	10	0
2	S	953	0	878	15	0
2	U	953	0	878	12	0
3	L	820	0	789	9	0
3	T	820	0	789	11	0
3	V	820	0	789	8	0
All	All	20640	0	19570	185	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 185 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:K:339:TRP:CZ2	1:K:339:TRP:CZ3	2.41	1.04
2:S:103:TRP:CZ3	2:S:103:TRP:CZ2	2.39	1.04
2:S:47:TRP:CZ3	2:S:47:TRP:CZ2	2.40	1.04
1:A:89:TRP:CZ3	1:A:89:TRP:CZ2	2.41	1.03

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:J:243:TRP:CZ3	1:J:243:TRP:CZ2	2.40	1.03

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	399/1254 (32%)	350 (88%)	47 (12%)	2 (0%)	29	68
1	B	262/1254 (21%)	231 (88%)	31 (12%)	0	100	100
1	F	399/1254 (32%)	356 (89%)	43 (11%)	0	100	100
1	G	262/1254 (21%)	238 (91%)	24 (9%)	0	100	100
1	J	399/1254 (32%)	348 (87%)	46 (12%)	5 (1%)	12	50
1	K	262/1254 (21%)	233 (89%)	29 (11%)	0	100	100
2	H	122/237 (52%)	103 (84%)	19 (16%)	0	100	100
2	S	124/237 (52%)	107 (86%)	17 (14%)	0	100	100
2	U	124/237 (52%)	108 (87%)	16 (13%)	0	100	100
3	L	108/219 (49%)	94 (87%)	14 (13%)	0	100	100
3	T	108/219 (49%)	94 (87%)	14 (13%)	0	100	100
3	V	108/219 (49%)	97 (90%)	11 (10%)	0	100	100
All	All	2677/8892 (30%)	2359 (88%)	311 (12%)	7 (0%)	44	75

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	87	PHE
1	J	264	ASN
1	J	87	PHE
1	J	370	CYS

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Mol	Chain	Res	Type
1	J	86	PRO

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	334/1060 (32%)	334 (100%)	0	100	100
1	B	232/1060 (22%)	231 (100%)	1 (0%)	91	97
1	F	334/1060 (32%)	333 (100%)	1 (0%)	92	97
1	G	232/1060 (22%)	231 (100%)	1 (0%)	91	97
1	J	334/1060 (32%)	333 (100%)	1 (0%)	92	97
1	K	232/1060 (22%)	231 (100%)	1 (0%)	91	97
2	H	107/207 (52%)	107 (100%)	0	100	100
2	S	109/207 (53%)	109 (100%)	0	100	100
2	U	109/207 (53%)	109 (100%)	0	100	100
3	L	93/192 (48%)	93 (100%)	0	100	100
3	T	93/192 (48%)	93 (100%)	0	100	100
3	V	93/192 (48%)	93 (100%)	0	100	100
All	All	2302/7557 (30%)	2297 (100%)	5 (0%)	93	98

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	254	LYS
1	F	267	ARG
1	G	254	LYS
1	J	264	ASN
1	K	254	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
1	K	121	HIS
3	L	34	HIS
1	G	52	GLN
1	J	264	ASN
1	J	360	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 monosaccharides 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](#)

There are no chain breaks in this entry.

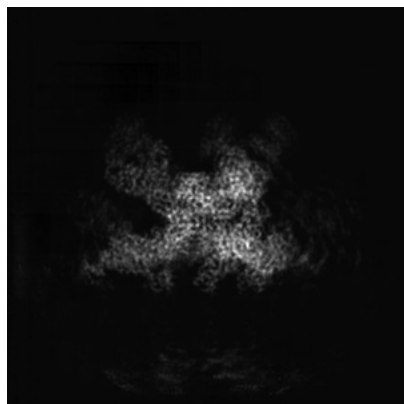
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-28060. These allow visual inspection of the internal detail of the map and identification of artifacts.

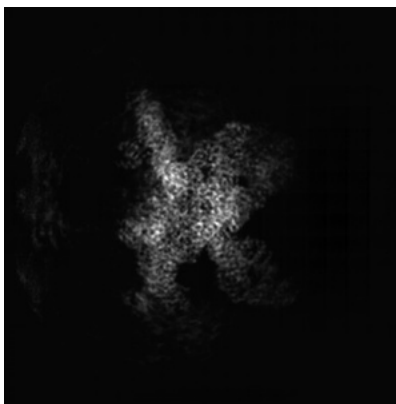
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

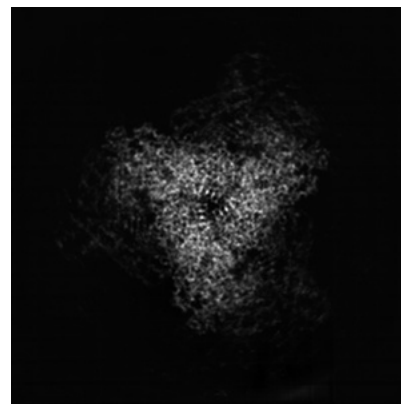
6.1.1 Primary map



X

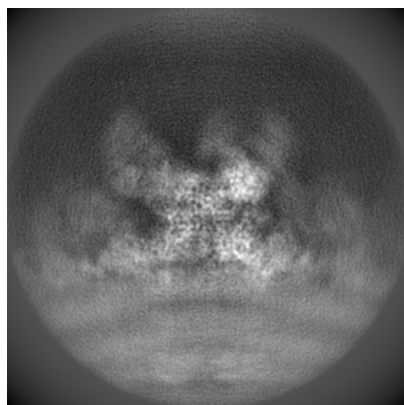


Y

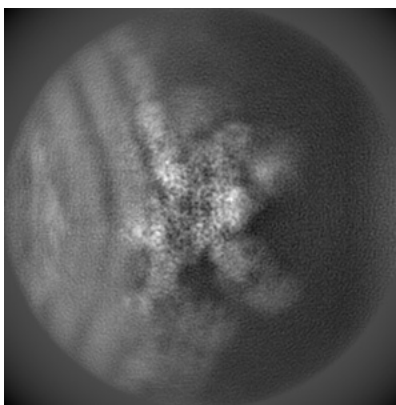


Z

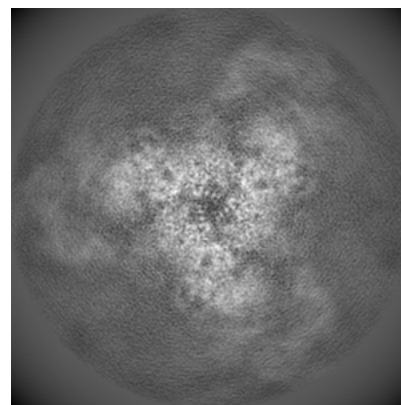
6.1.2 Raw map



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: 120

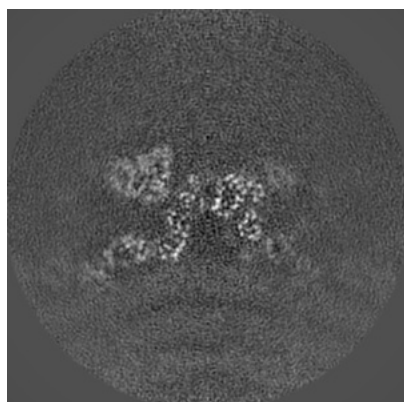


Y Index: 120

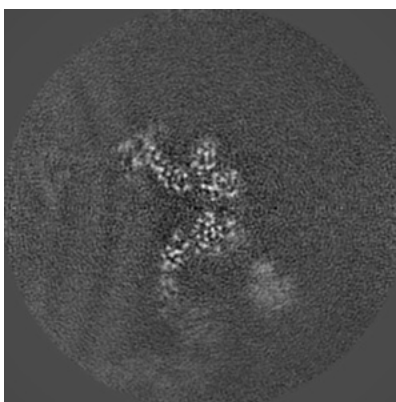


Z Index: 120

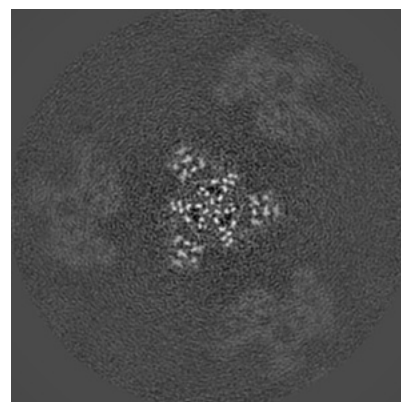
6.2.2 Raw map



X Index: 120



Y Index: 120



Z Index: 120

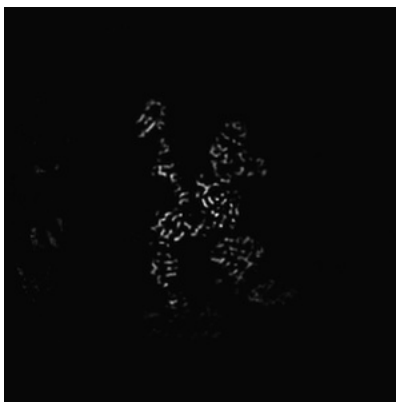
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

6.3.1 Primary map



X Index: 109

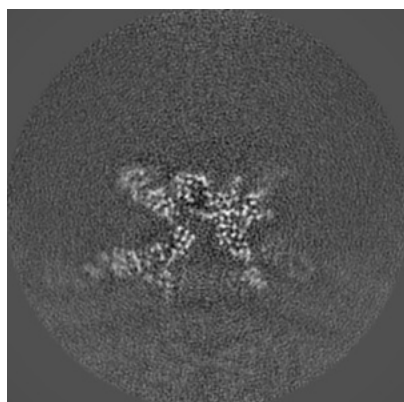


Y Index: 136

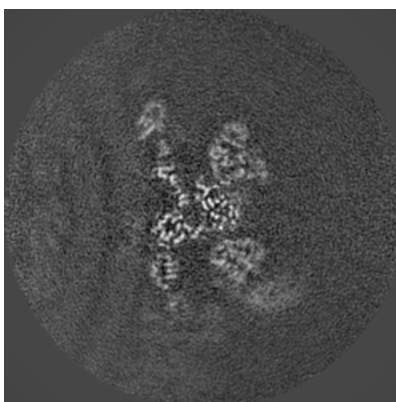


Z Index: 100

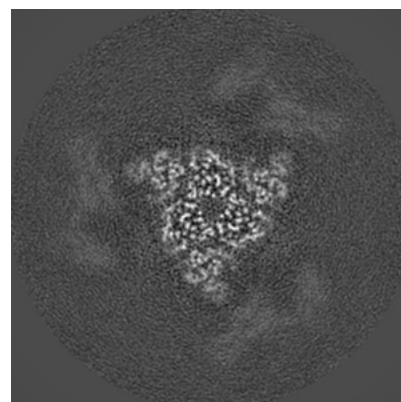
6.3.2 Raw map



X Index: 109



Y Index: 136

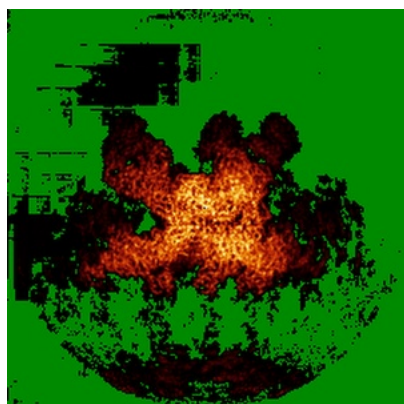


Z Index: 128

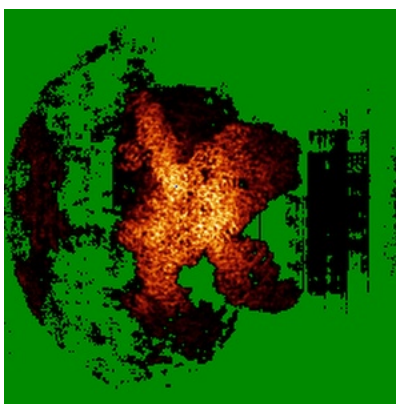
The images above show the largest variance slices of the map in three orthogonal directions.

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

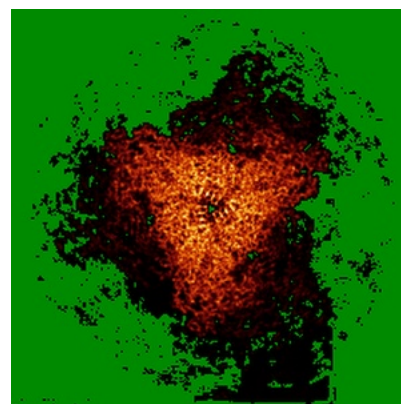
6.4.1 Primary map



X

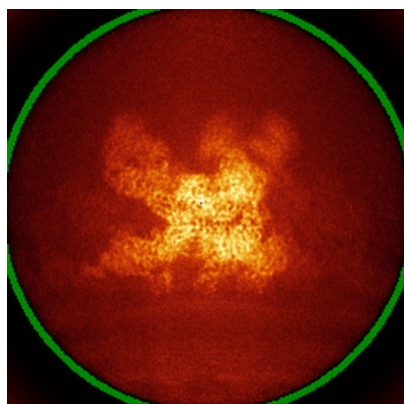


Y

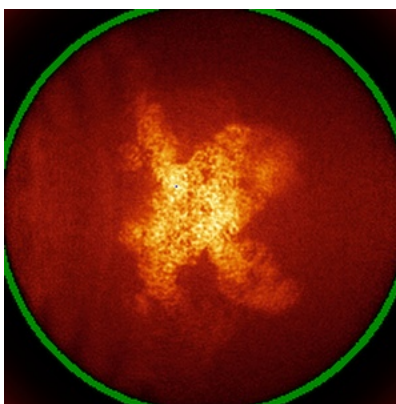


Z

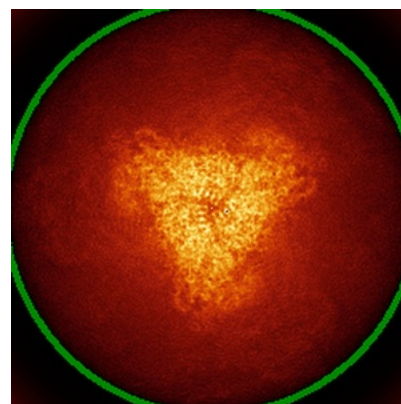
6.4.2 Raw map



X



Y

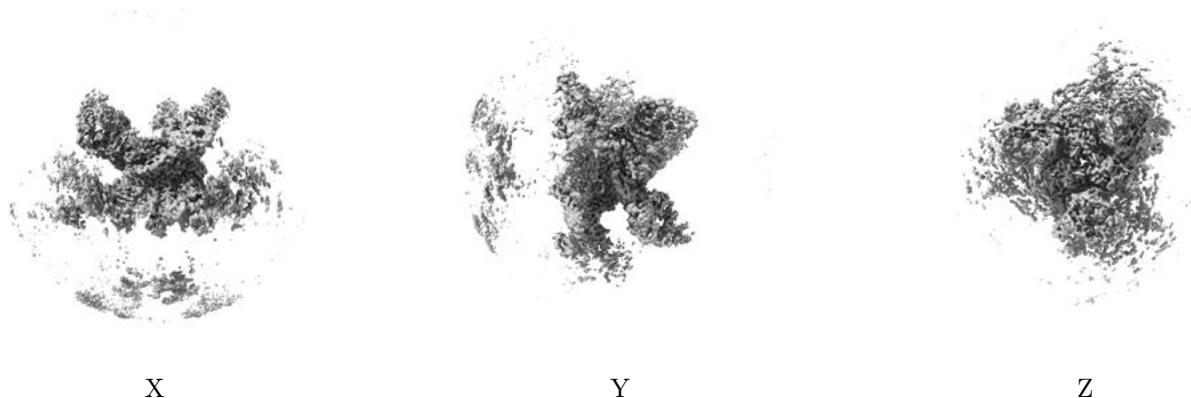


Z

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.

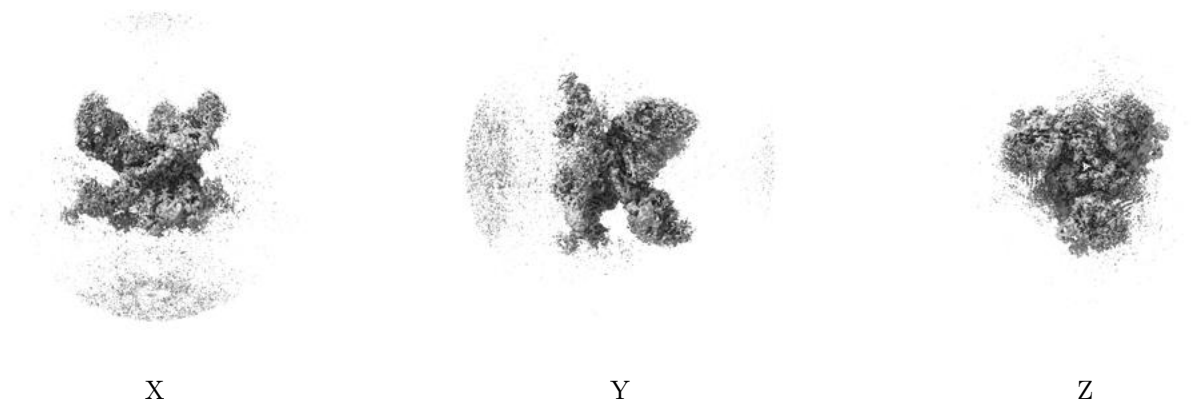
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.06. 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.

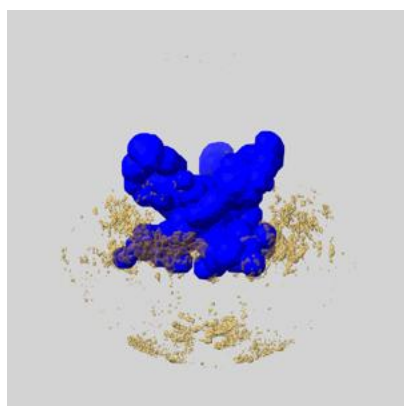
6.6 Mask visualisation [i](#)

This section shows the 3D surface view of the primary map at 50% transparency overlaid with the specified mask at 0% transparency

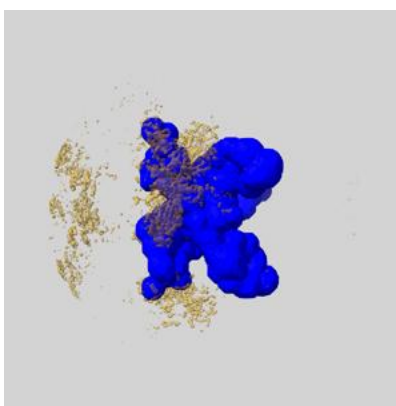
A mask typically either:

- Encompasses the whole structure
- Separates out a domain, a functional unit, a monomer or an area of interest from a larger structure

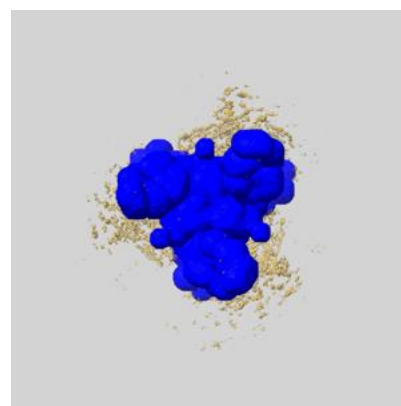
6.6.1 emd_28060_msk_1.map [i](#)



X



Y

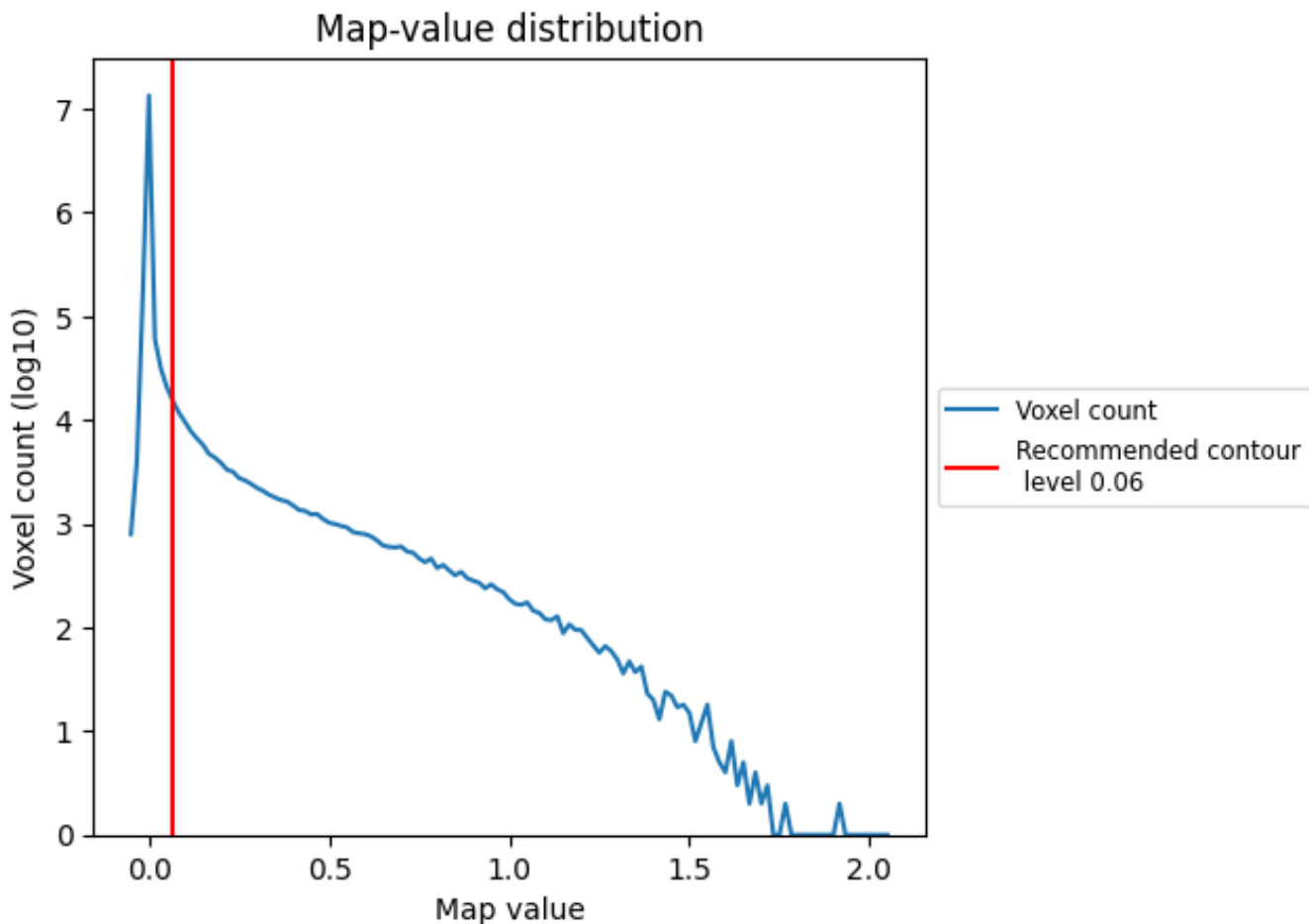


Z

7 Map analysis [i](#)

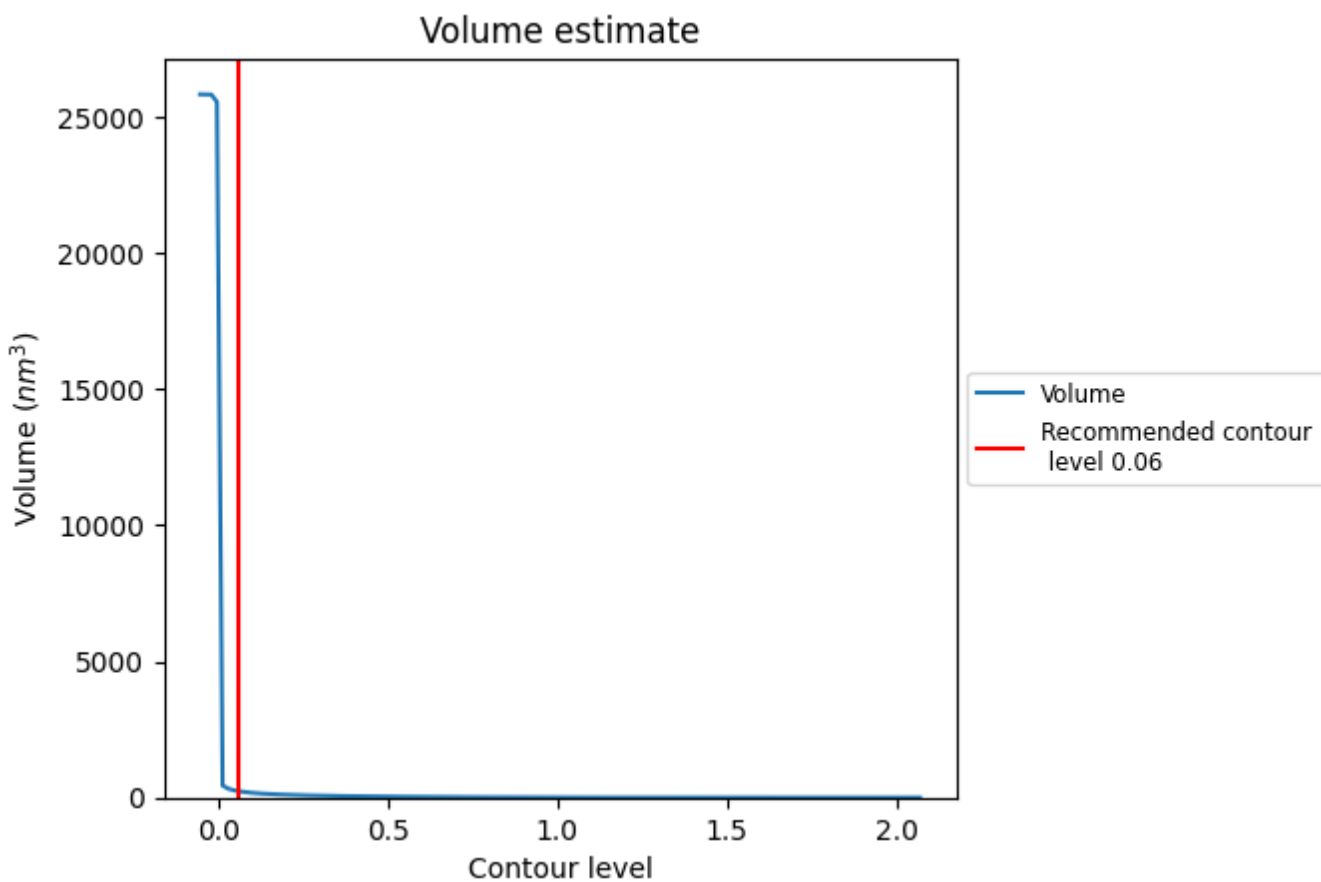
This section contains the results of statistical analysis of the map.

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.

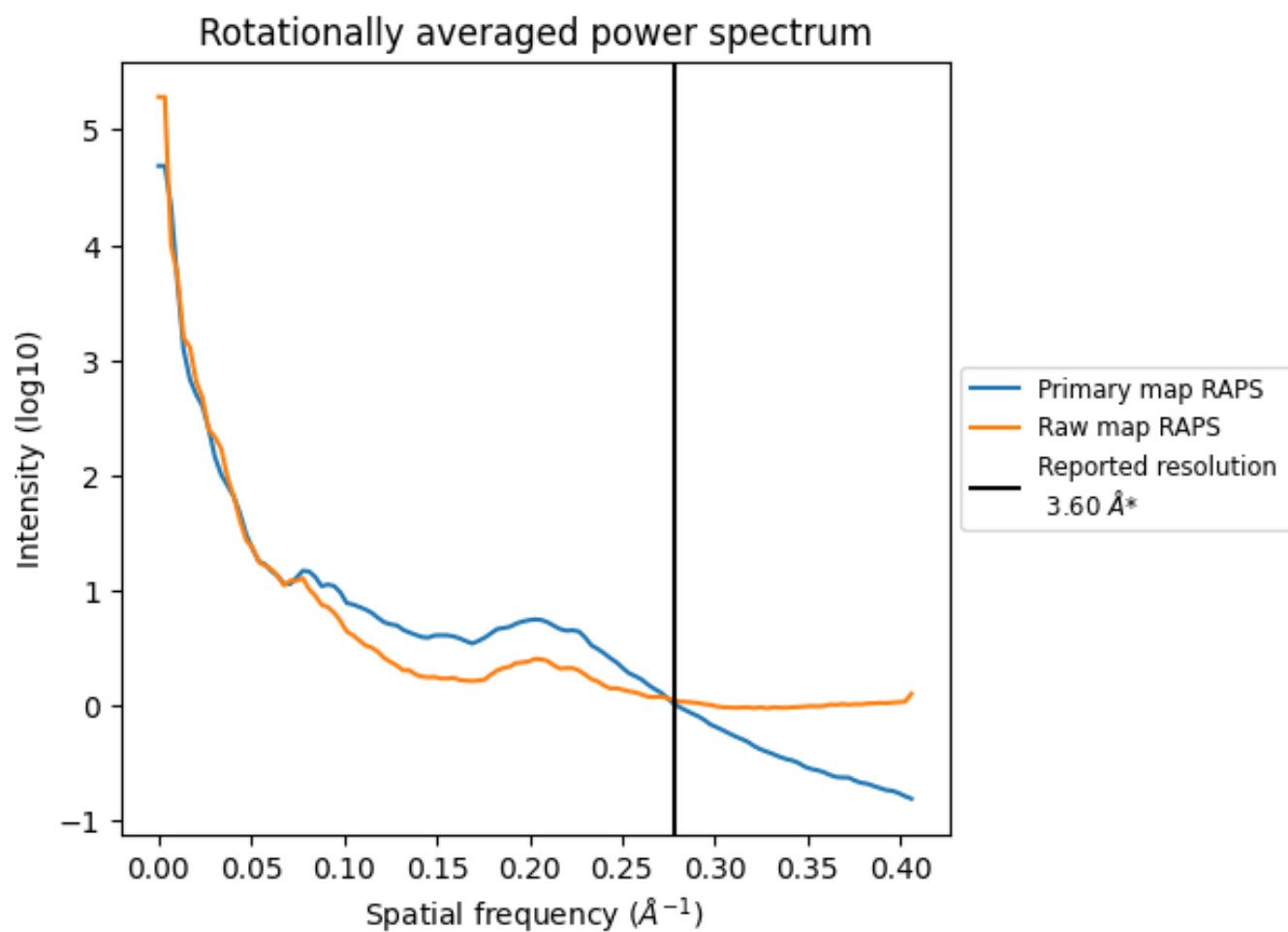
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 236 nm³; this corresponds to an approximate mass of 213 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

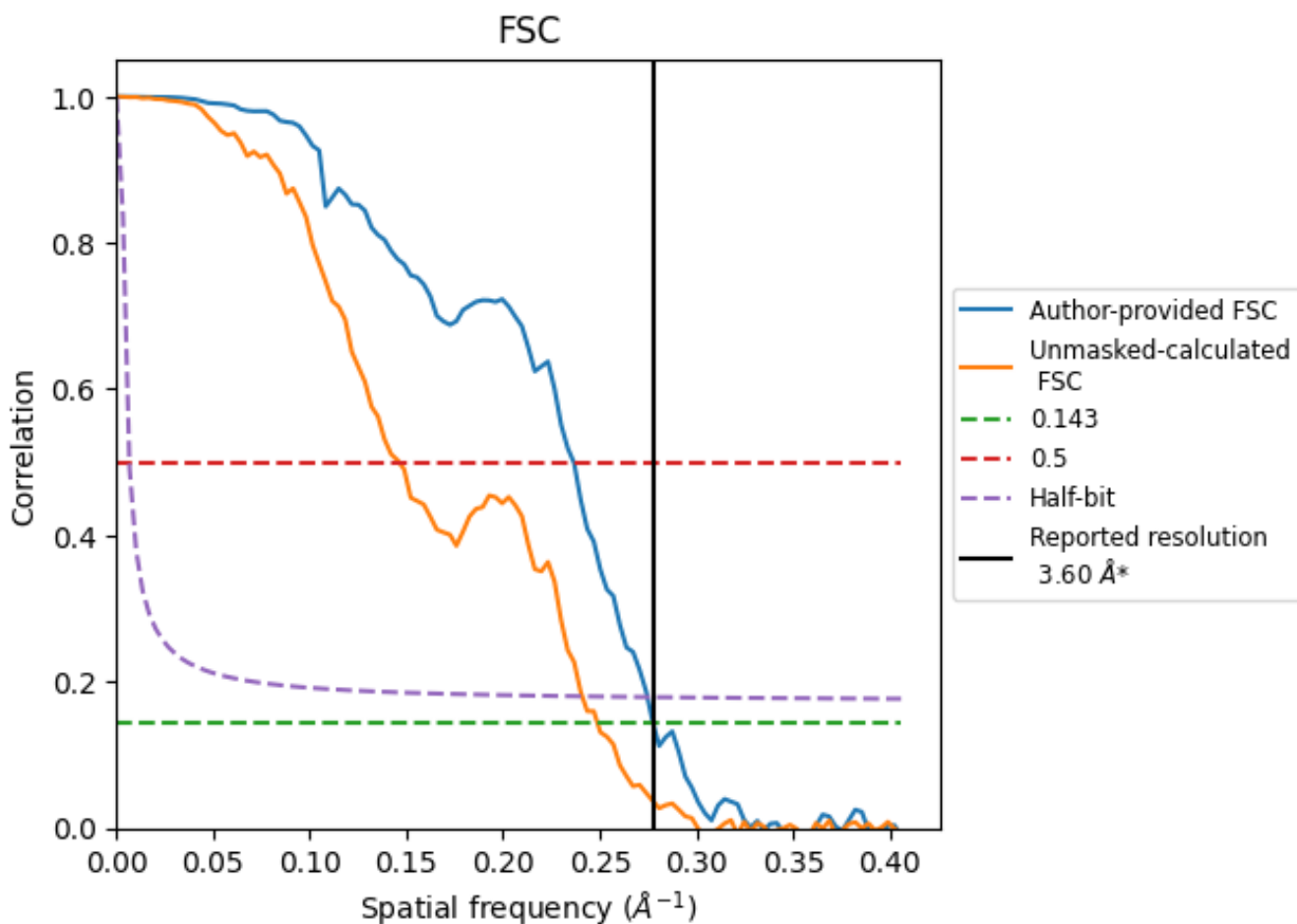


*Reported resolution corresponds to spatial frequency of 0.278 Å⁻¹

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 0.278 Å⁻¹

8.2 Resolution estimates [i](#)

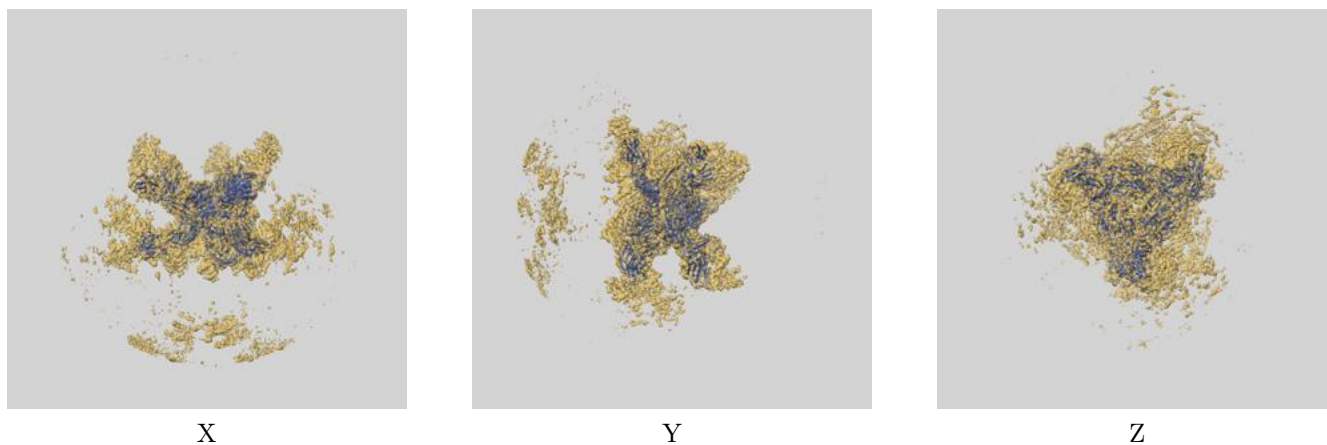
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.60	-	-
Author-provided FSC curve	3.60	4.22	3.64
Unmasked-calculated*	4.02	6.84	4.15

*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 4.02 differs from the reported value 3.6 by more than 10 %

9 Map-model fit [i](#)

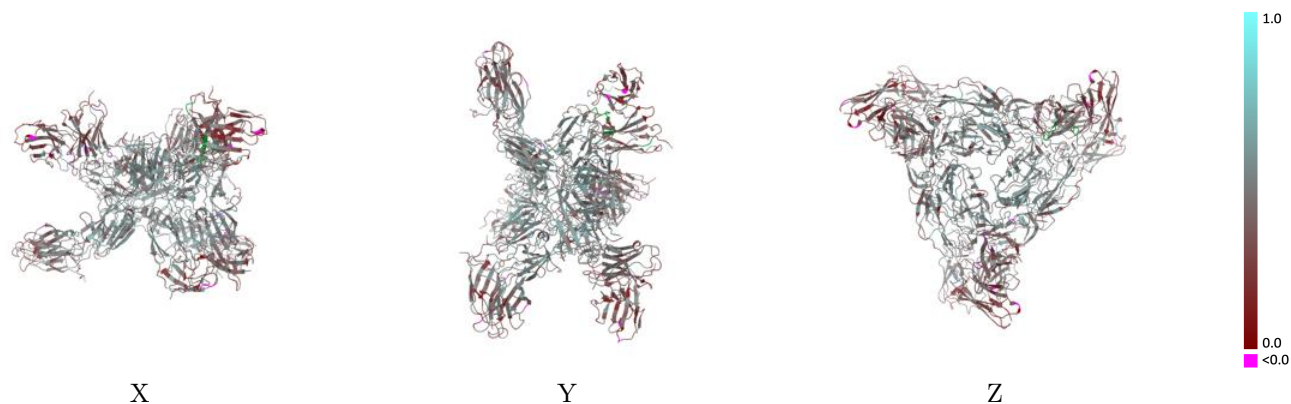
This section contains information regarding the fit between EMD map EMD-28060 and PDB model 8EEV. Per-residue inclusion information can be found in section 3 on page 5.

9.1 Map-model overlay [i](#)



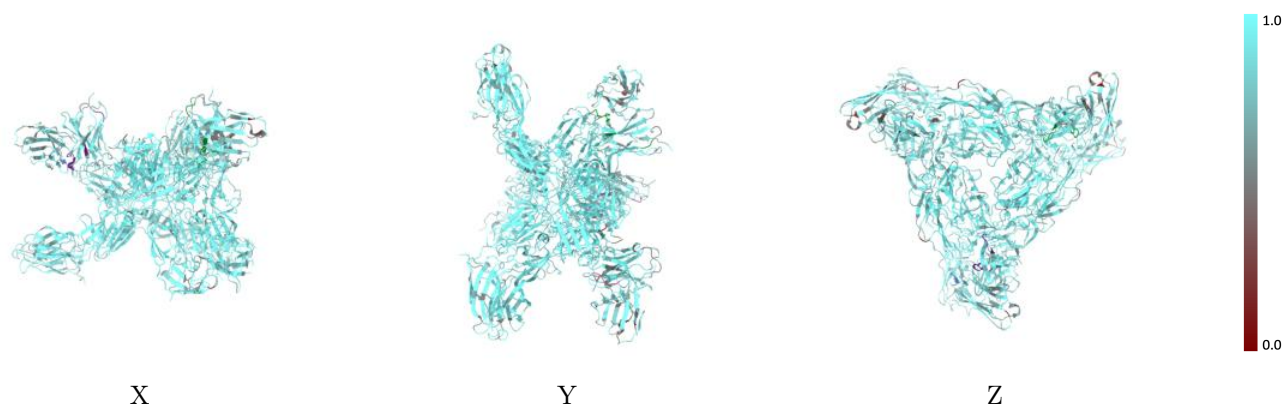
The images above show the 3D surface view of the map at the recommended contour level 0.06 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



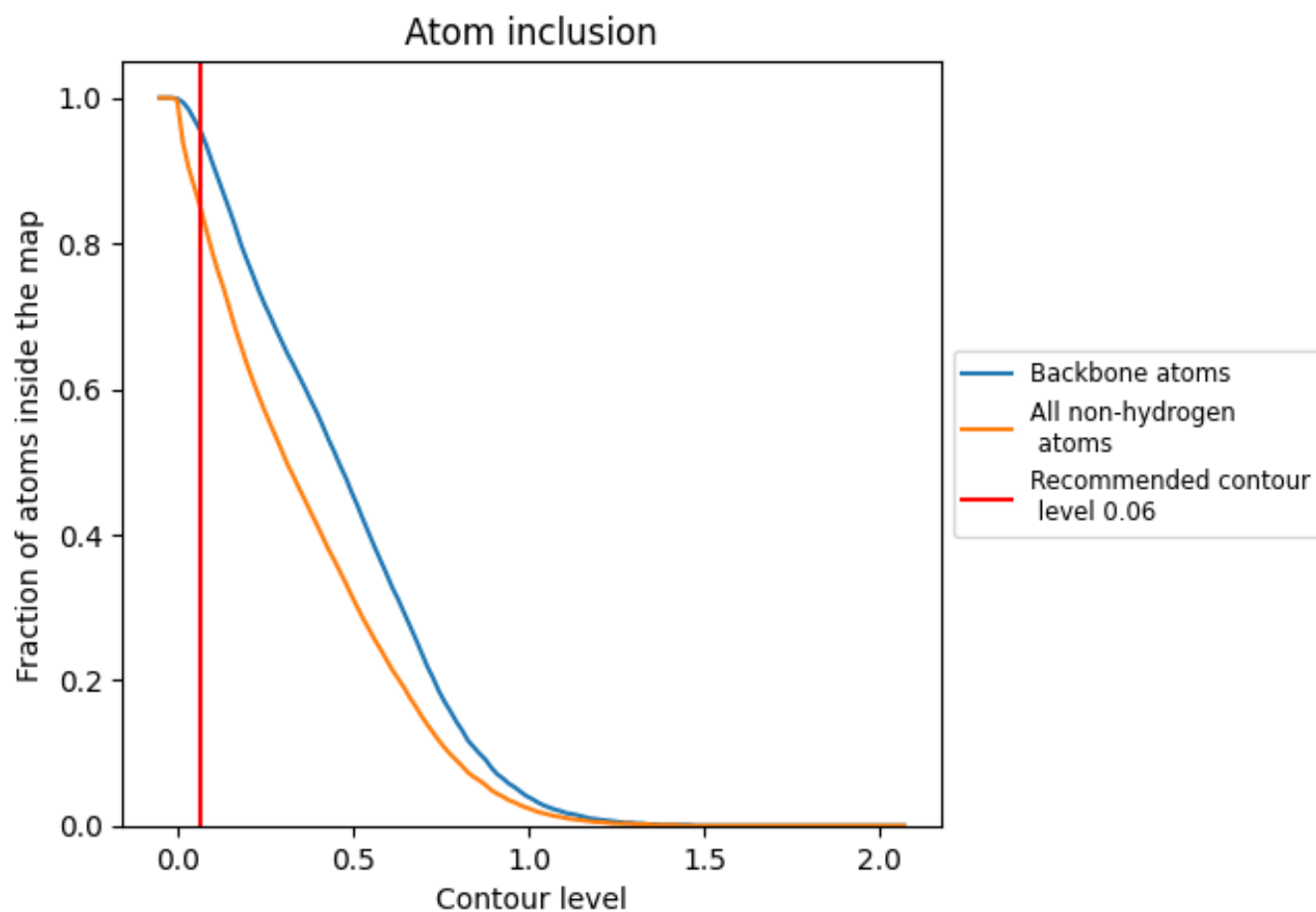
The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.06).



























9.4 Atom inclusion [i](#)



At the recommended contour level, 96% of all backbone atoms, 85% 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 (0.06) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8530	 0.4400
A	 0.8630	 0.4420
B	 0.8980	 0.4970
F	 0.8650	 0.4410
G	 0.9010	 0.4980
H	 0.8000	 0.3860
J	 0.8650	 0.4470
K	 0.9040	 0.5040
L	 0.7420	 0.3270
S	 0.8210	 0.3890
T	 0.7570	 0.3330
U	 0.8030	 0.3930
V	 0.7370	 0.3310

