wwPDB EM Validation Summary Report

Feb 22, 2025 – 03:08 PM EST

PDB ID	:	9E9R
EMDB ID	:	EMD-47801
Title	:	The Structure of ApoB100 from Human Low-Density Lipoprotein
Authors	:	Berndsen, Z.T.; Cassidy, C.K.
Deposited on	:	2024-11-08
Resolution	:	9.00 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*
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:

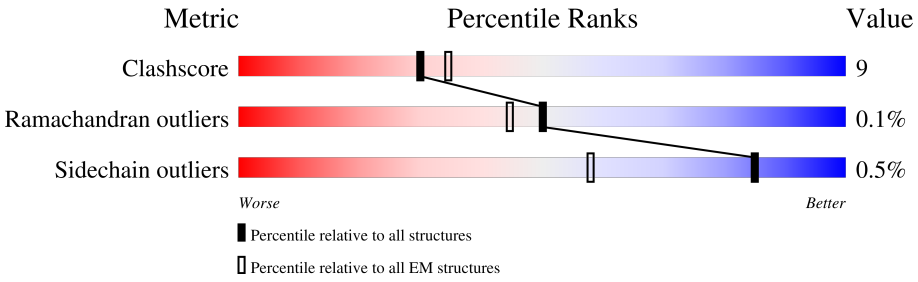
EMDB validation analysis	:	0.0.1.dev117
MolProbity	:	4.02b-467
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ	:	1.9.13
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.4

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)
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 >=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 <=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	4563	21% 64% 17% 19%

2 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 58841 atoms, of which 29424 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 Apolipoprotein B 100.

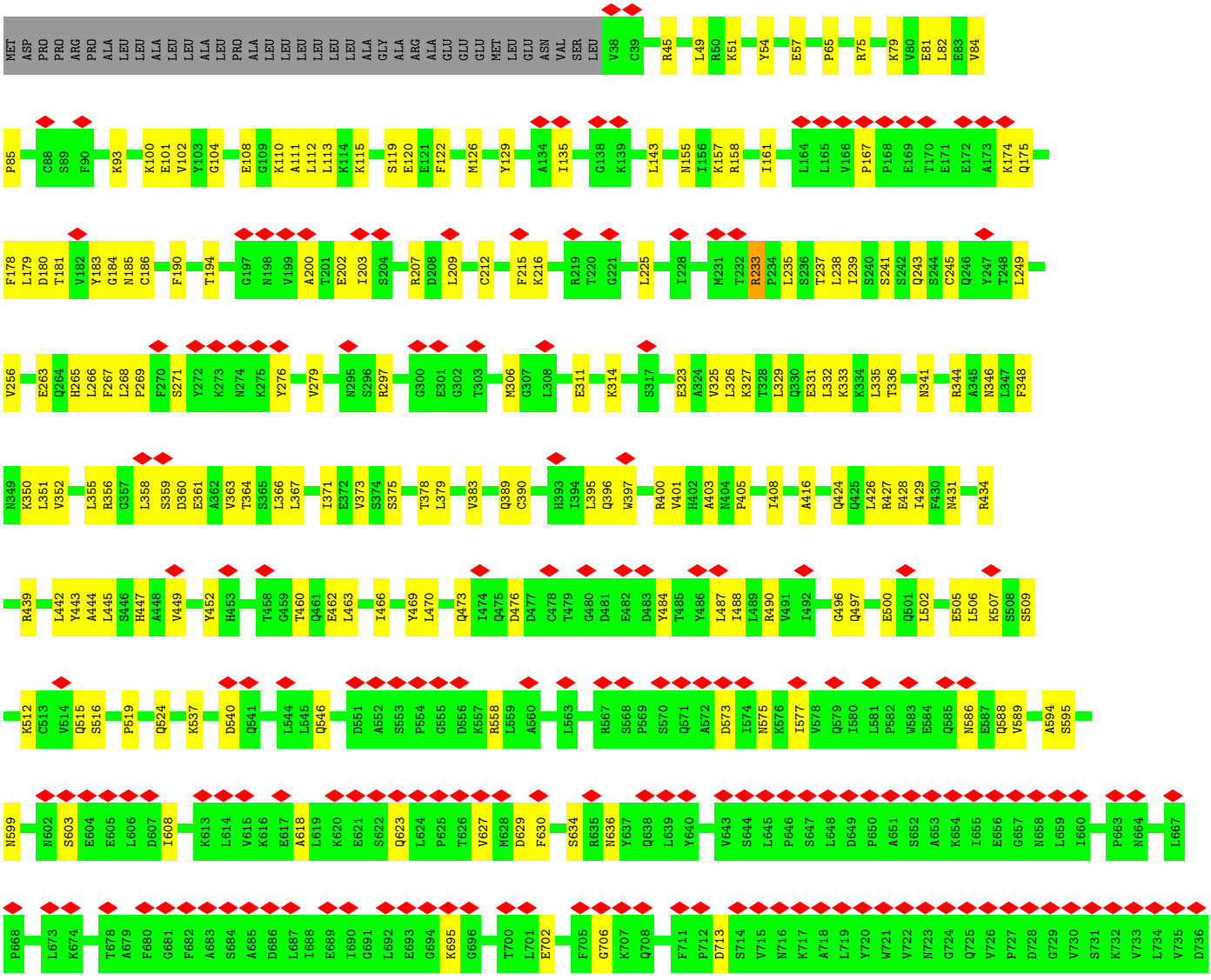
Mol	Chain	Residues	Atoms						AltConf	Trace
			Total	C	H	N	O	S		
1	A	3715	58841	18700	29424	4951	5679	87	0	0

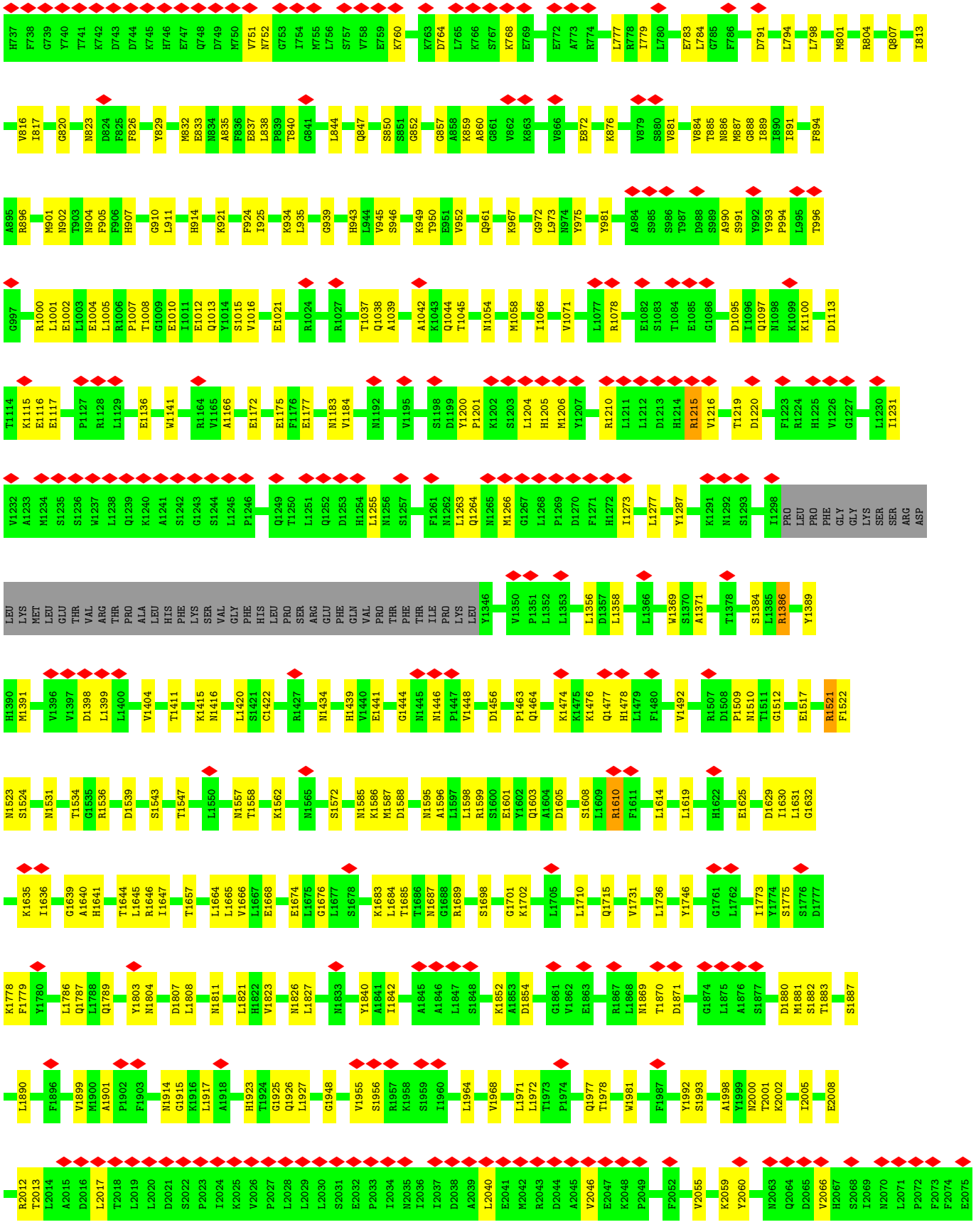
3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and 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: Apolipoprotein B 100

Chain A:

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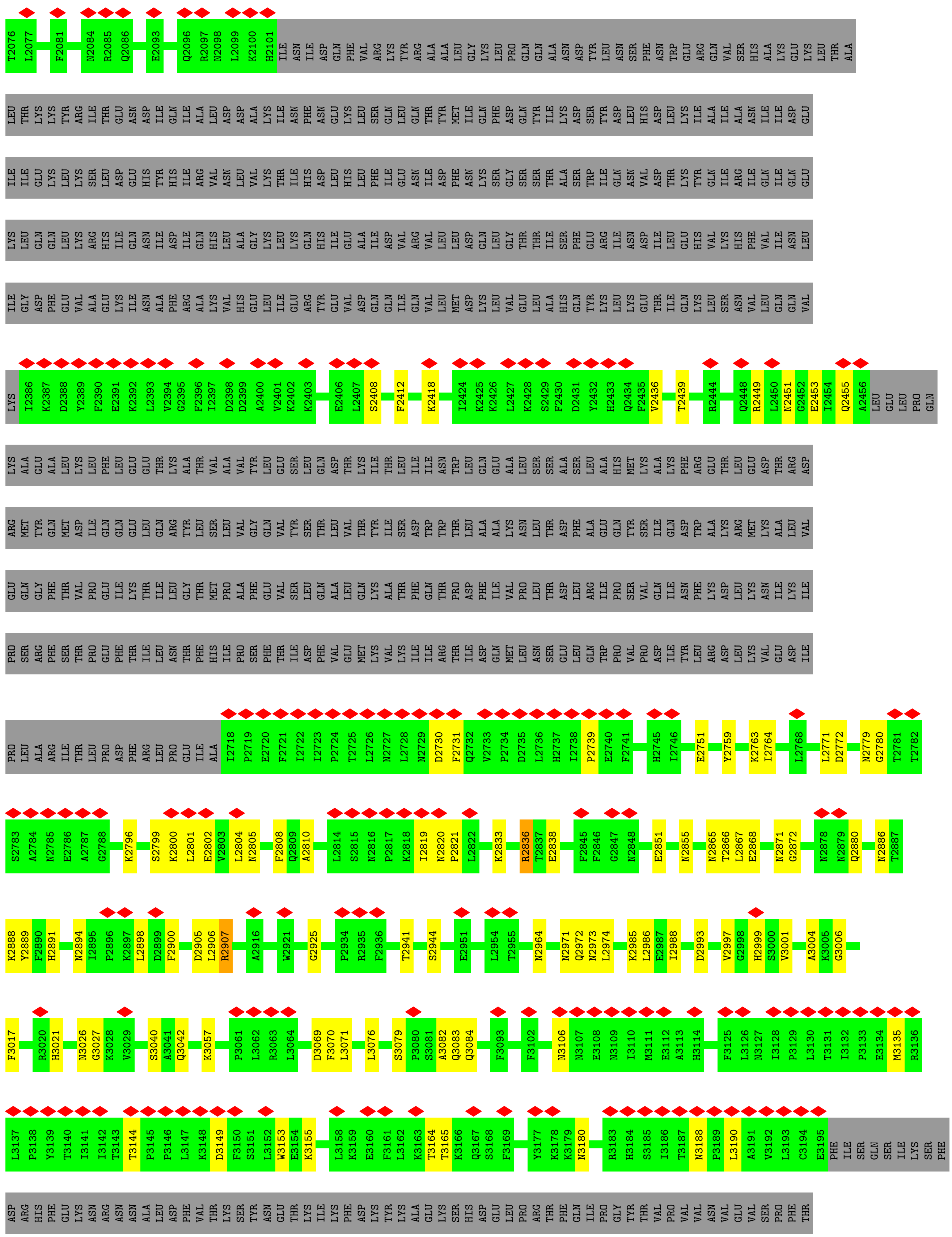
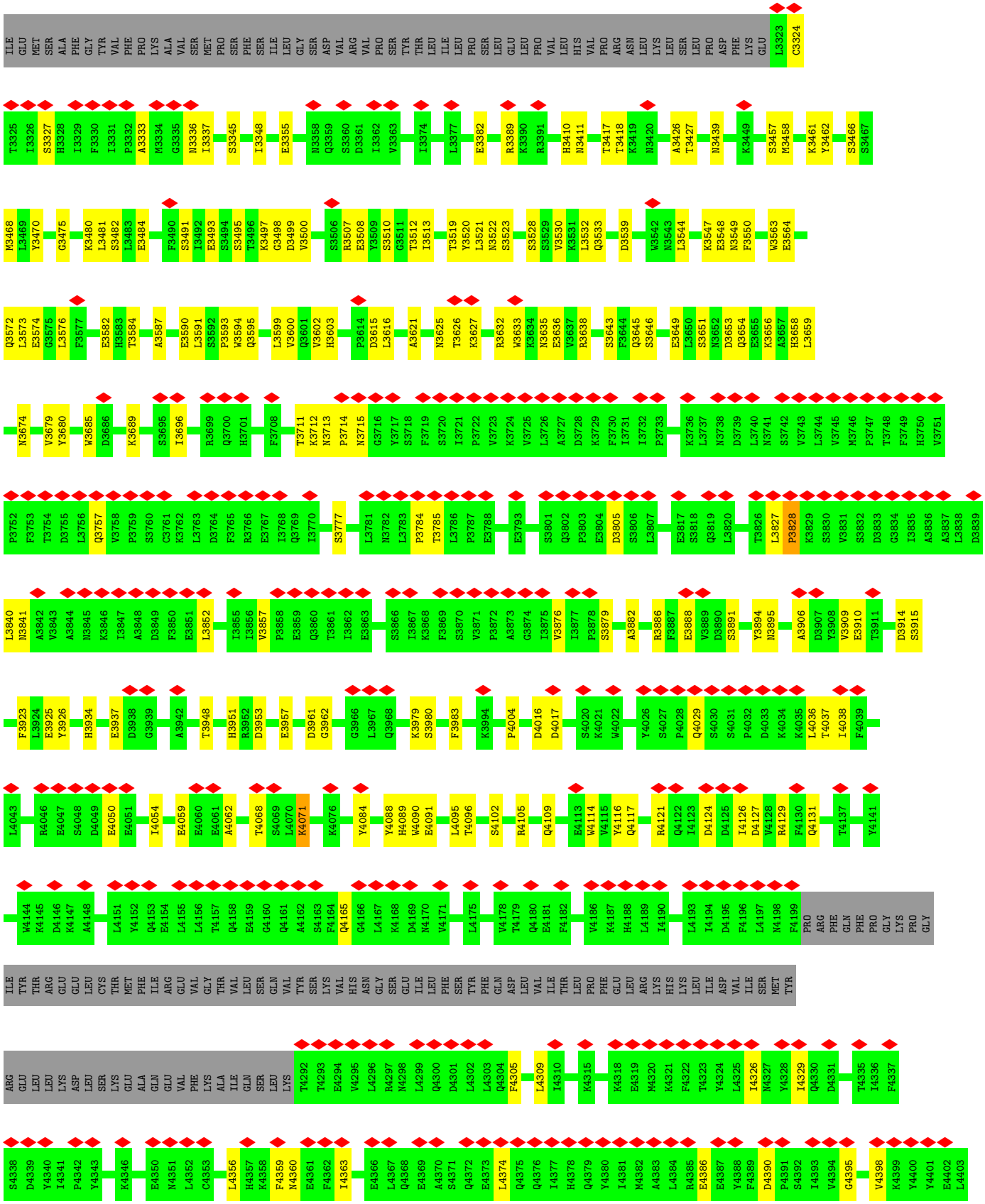
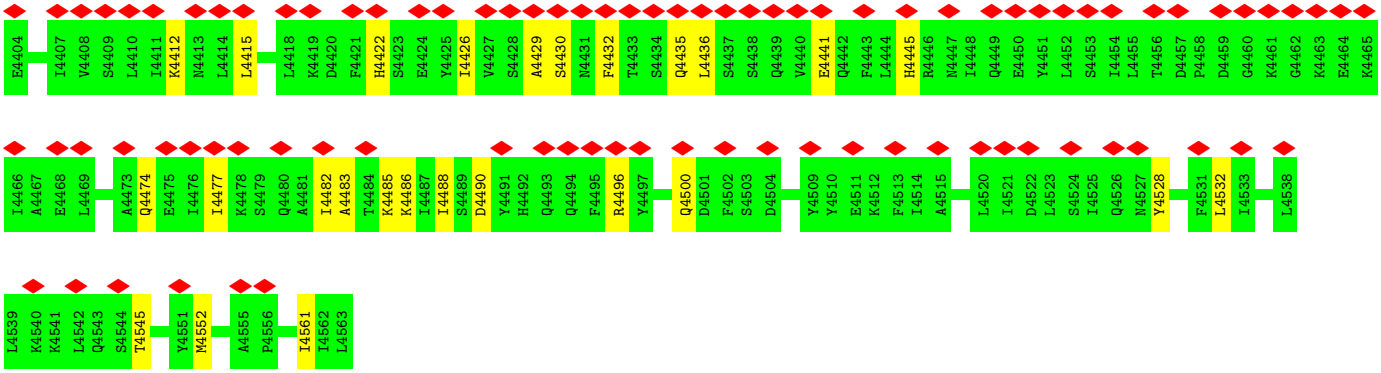
V816 I817 G820 N823 D824 F825 F826 Y829 M832 E833 N834 A835 F836 E837 L838 P839 T840 G841 L844 Q847 S850 S851 G852 G857 A858 K859 A860 G861 V862 K863 V866 E872 K876 V879 S880 V881 V884 T885 N886 M887 G888 I889 I890 I891 F894
A895 R896 N901 N902 T903 N904 F905 F906 H907 G910 L911 H914 K921 F924 I925 K934 L935 G939 H943 L944 V945 S946 K949 T950 E951 V952 Q961 K967 G972 L973 N974 Y975 Y981 A984 S985 S986 T987 D988 S989 A990 S991 Y992 Y993 P994 L995 T996
G997 R1000 L1001 E1002 L1003 E1004 L1005 R1006 P1007 T1008 G1009 E1010 T1011 E1012 Q1013 Y1014 S1015 V1016 E1021 R1024 R1027 T1037 Q1038 A1039 A1042 K1043 Q1044 T1045 N1054 M1058 I1066 V1071 L1077 R1078 E1062 S1083 T1084 E1085 G1086 D1095 I1096 Q1097 N1098 K1099 K1100 D1113
T1114 K1115 E1116 E1117 P1127 R1128 L1129 E1136 W1141 R1164 V1165 A1166 E1172 E1175 F1176 E1177 N1183 V1184 N1192 V1195 S1198 D1199 Y1200 P1201 K1202 S1203 L1204 H1205 M1206 Y1207 R1210 L1211 L1212 D1213 H1214 R1215 V1216 T1219 D1220 F1223 R1224 H1225 V1226 G1227 L1230 I1231
V1232 A1233 M1234 S1235 S1236 W1237 L1238 Q1239 K1240 A1241 S1242 G1243 S1244 L1245 P1246 Q1249 T1250 L1251 Q1252 D1253 H1254 L1255 N1256 S1257 F1261 N1262 L1263 Q1264 N1265 M1266 G1267 L1268 P1269 D1270 F1271 H1272 I1273 L1277 Y1287 K1291 N1292 S1293 I1298 PRO LEU PRO PHE GLY GLY LYS SER SER ARG ASP
LEU LYS MET LEU GLU THR VAL ARG THR PRO ALA LEU HIS PHE LYS SER VAL GLY PHE HIS LEU PRO SER ARG GLU PHE GLN VAL PRO THR PHE THR ILE PRO LYS LEU Y1346 V1350 P1351 L1352 L1353 L1356 D1357 L1358 L1366 W1369 S1370 A1371 T1378 S1384 L1385 R1386 Y1389
H1390 M1391 V1396 V1397 D1398 L1399 L1400 V1404 T1411 K1415 N1416 L1420 S1421 C1422 R1427 N1434 H1439 V1440 E1441 G1444 N1445 N1446 P1447 V1448 D1456 P1463 Q1464 K1474 R1475 K1476 Q1477 H1478 L1479 F1480 V1492 R1507 D1508 P1509 N1510 T1511 G1512 E1517 R1521 F1522
N1523 S1524 N1531 T1534 G1535 R1536 D1539 S1543 T1547 L1550 N1557 T1558 K1562 N1565 S1572 N1585 K1586 M1587 D1588 N1595 A1596 L1597 L1598 R1599 S1600 E1601 Y1602 Q1603 A1604 D1605 S1608 L1609 R1610 F1611 L1614 L1619 H1622 E1625 D1629 I1630 L1631 G1632
K1635 I1636 G1639 A1640 H1641 T1644 L1645 R1646 I1647 T1657 L1664 L1665 V1666 L1667 E1668 E1674 L1675 G1676 L1677 S1678 K1683 L1684 T1685 T1686 N1687 G1688 R1689 S1698 G1701 K1702 L1705 L1710 Q1715 V1731 L1736 Y1746 G1761 L1762 I1773 Y1774 S1775 S1776 D1777
K1778 F1779 Y1780 L1786 Q1787 L1788 Q1789 Y1803 N1804 D1807 L1808 N1811 L1821 H1822 V1823 N1826 L1827 N1833 Y1840 A1841 I1842 A1845 A1846 L1847 S1848 K1852 A1853 D1854 G1861 V1862 E1863 R1867 L1868 N1869 T1870 D1871 G1874 L1875 A1876 S1877 D1880 M1881 S1882 T1883 S1887
L1890 F1896 V1899 M1900 A1901 P1902 F1903 N1914 G1915 K1916 L1917 A1918 H1923 T1924 G1925 Q1926 L1927 G1948 V1955 S1956 R1957 K1958 S1959 I1960 L1964 V1968 L1971 L1972 T1973 P1974 Q1977 T1978 W1981 F1987 Y1992 S1993 A1998 Y1999 N2000 T2001 K2002 I2005 E2008
R2012 T2013 L2014 A2015 D2016 L2017 T2018 L2019 L2020 D2021 S2022 P2023 I2024 K2025 V2026 P2027 L2028 L2029 L2030 S2031 E2032 P2033 I2034 N2035 I2036 I2037 D2038 A2039 L2040 E2041 M2042 R2043 D2044 A2045 V2046 E2047 K2048 P2049 F2052 V2055 K2059 Y2060 N2063 Q2064 D2065 V2066 H2067 S2068 I2069 N2070 L2071 P2072 F2073 F2074 E2075



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N4413 L4414 L4415
L4418 K4419 D4420 F4421 H4422 S4423 E4424 Y4425 I4426 V4427 S4428 A4429 S4430 M4431 F4432 T4433 S4434 Q4435 L4436 S4437 S4438 Q4439 V4440 E4441 Q4442 F4443 L4444 H4445 R4446 M4447 I4448 Q4449 E4450 Y4451 L4452 S4453 I4454 L4455 T4456 D4457 P4458 D4459 G4460 K4461 G4462 K4463 E4464 K4465
I4466 A4467 E4468 L4469
A4473 Q4474 E4475 I4476 I4477 K4478 S4479 Q4480 A4481 I4482 A4483 T4484 K4485 K4486 I4487 I4488 S4489 D4490 Y4491 H4492 Q4493 Q4494 F4495 R4496 Y4497
Q4500 D4501 F4502 S4503 D4504
Y4509 Y4510 E4511 K4512 F4513 I4514 A4515
L4520 I4521 D4522 L4523 S4524 I4525 Q4526 N4527 Y4528
F4531 L4532 I4533 L4538
L4539 K4540 K4541 L4542 Q4543 S4544 T4545
Y4551 M4552
A4555 P4556
I4561 I4562 L4563

4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	52843	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/Å^2$)	50	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	2800	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	1.148	Depositor
Minimum map value	-0.560	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.025	Depositor
Recommended contour level	0.182	Depositor
Map size (Å)	490.5, 490.5, 490.5	wwPDB
Map dimensions	450, 450, 450	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.09, 1.09, 1.09	Depositor

5 Model quality

5.1 Standard geometry

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	0.26	0/29997	0.47	0/40579

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

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	2820	ASN	Peptide

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	29417	29424	29417	524	0
All	All	29417	29424	29417	524	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 9.

The worst 5 of 524 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:A:500:GLU:OE2	1:A:537:LYS:NZ	1.96	0.98
1:A:325:VAL:HG13	1:A:351:LEU:HD11	1.46	0.95
1:A:323:GLU:OE1	1:A:327:LYS:NZ	2.03	0.92
1:A:3632:ARG:NH1	1:A:3633:TRP:O	2.03	0.92
1:A:3482:SER:OG	1:A:3484:GLU:OE2	1.90	0.89

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	3703/4563 (81%)	3543 (96%)	156 (4%)	4 (0%)	48 83

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	3828	PRO
1	A	1477	GLN
1	A	3906	ALA
1	A	1804	ASN

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	3299/4080 (81%)	3283 (100%)	16 (0%)	86 89

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4071	LYS
1	A	3886	ARG
1	A	2418	LYS
1	A	3638	ARG
1	A	1702	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	255	HIS
1	A	1013	GLN
1	A	1478	HIS
1	A	3051	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)

There are no chain breaks in this entry.

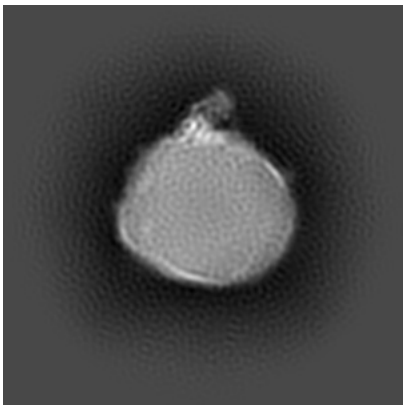
6 Map visualisation

This section contains visualisations of the EMDB entry EMD-47801. These allow visual inspection of the internal detail of the map and identification of artifacts.

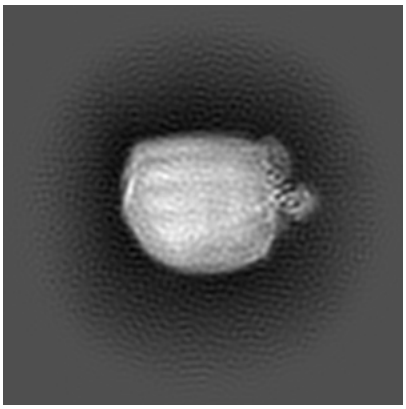
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections

6.1.1 Primary map



X



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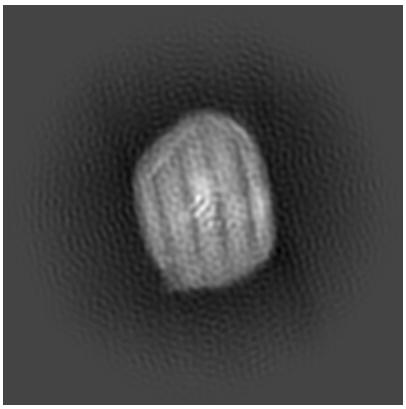
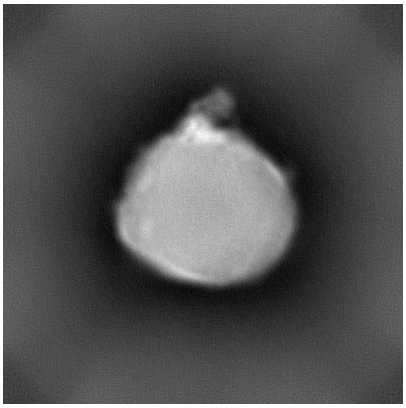


Z

6.1.2 Raw map



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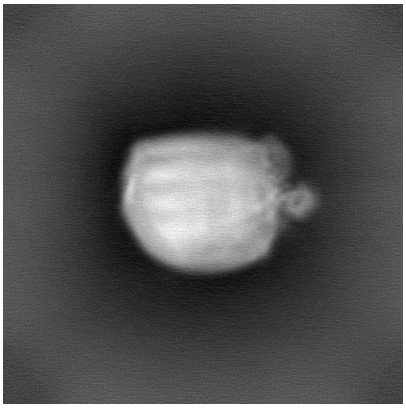

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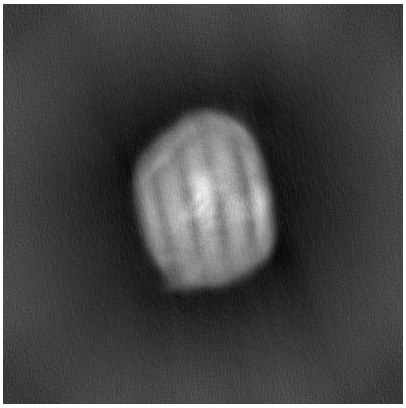
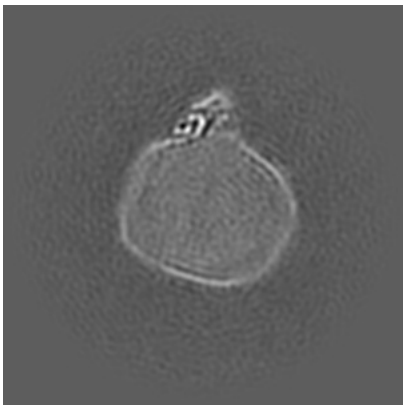


Z

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

6.2 Central slices (i)

6.2.1 Primary map



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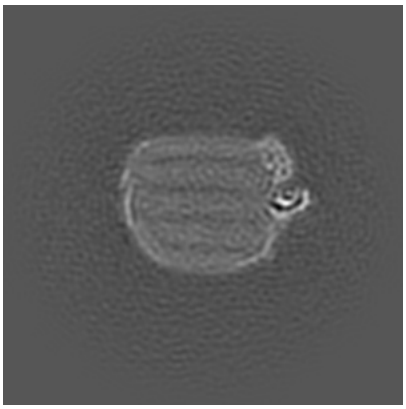
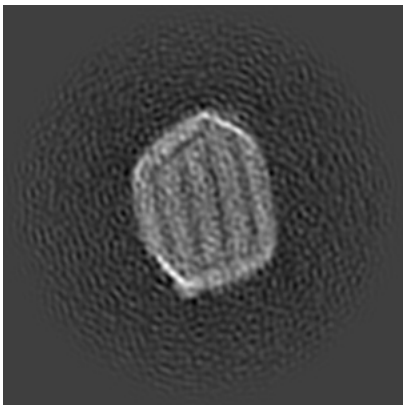
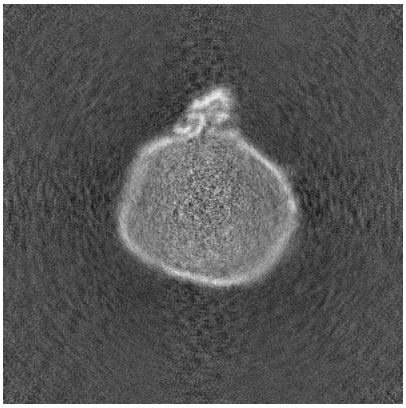


Y Index: 225



Z Index: 225

6.2.2 Raw map



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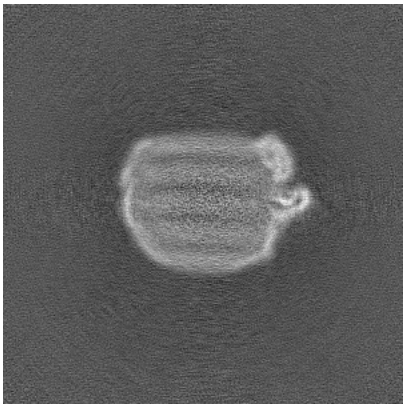

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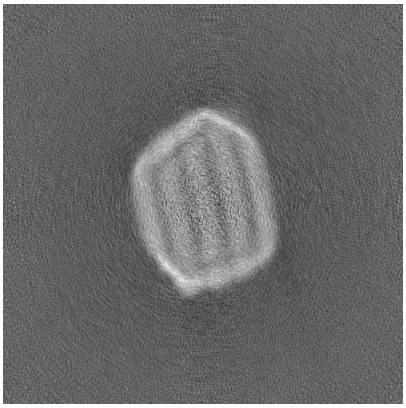
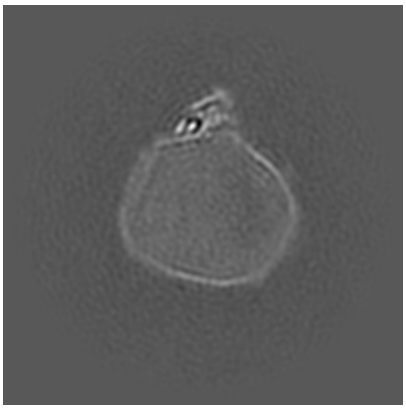


Z Index: 225

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

6.3 Largest variance slices (i)

6.3.1 Primary map



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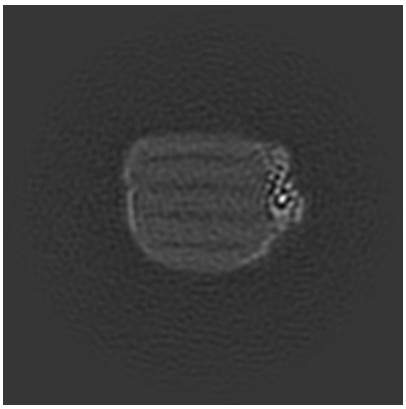
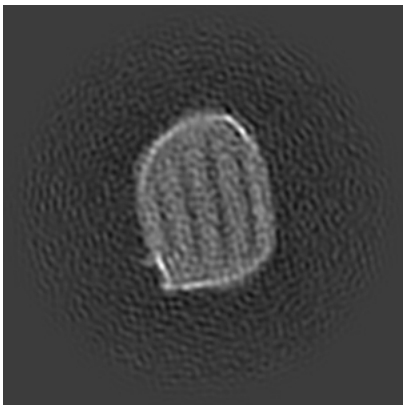
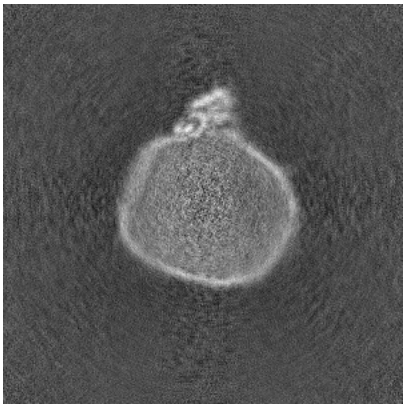


Y Index: 213



Z Index: 196

6.3.2 Raw map



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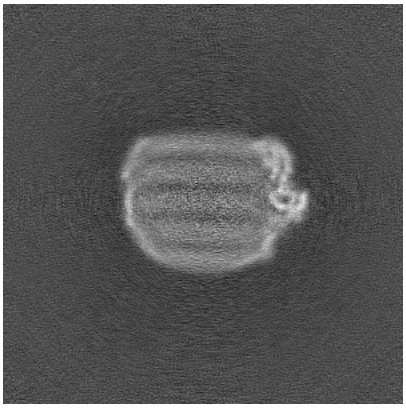
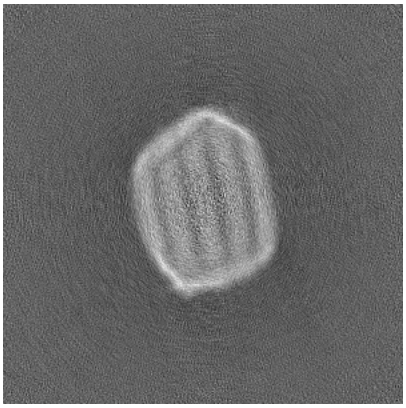


Y Index: 219

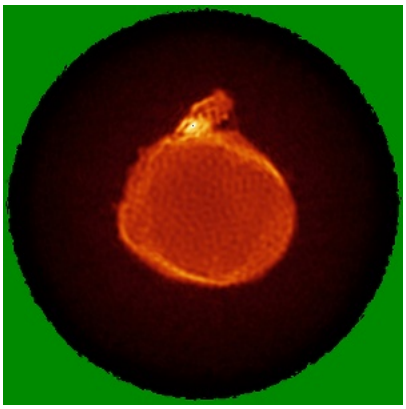


Z Index: 219

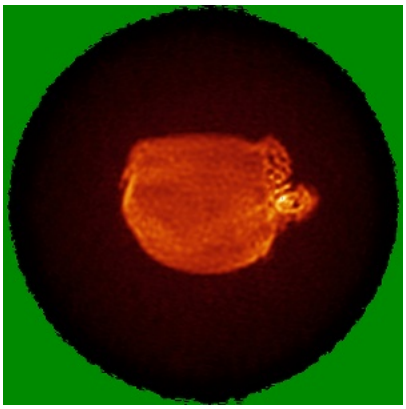
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal standard-deviation projections (False-color) (i)

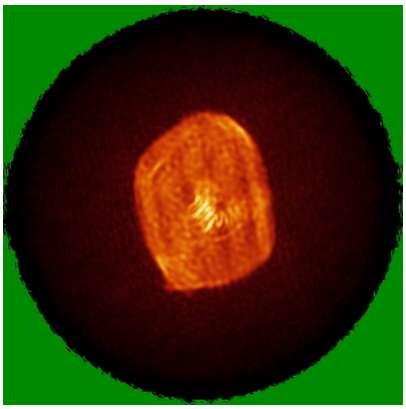
6.4.1 Primary map



X

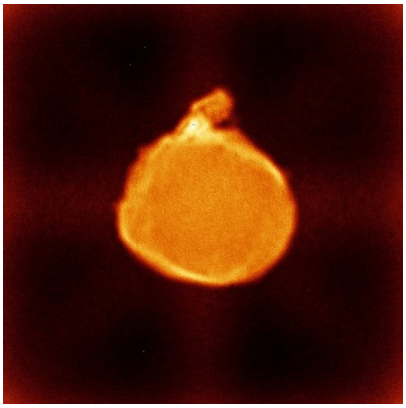


Y

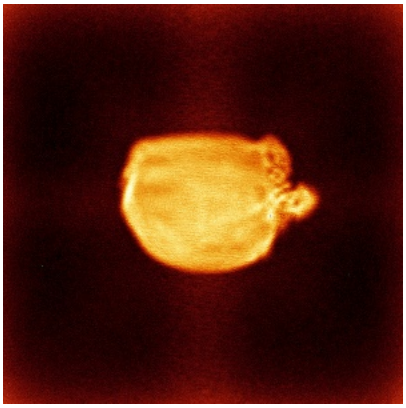


Z

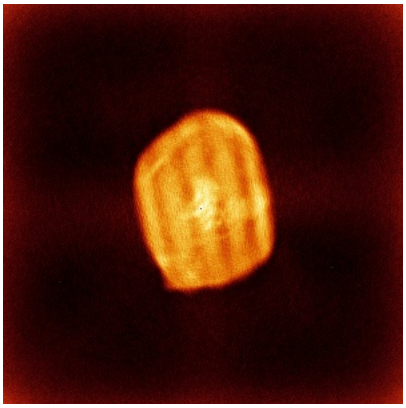
6.4.2 Raw map



X



Y

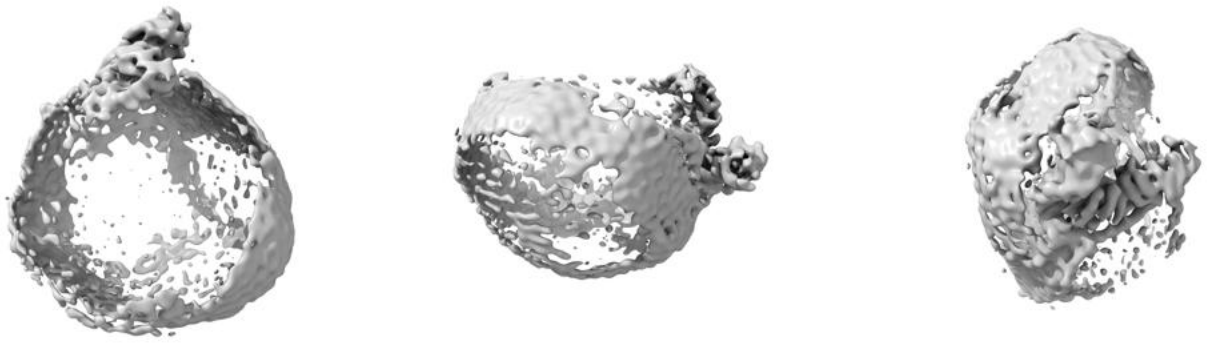


Z

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



X Y Z

The images above show the 3D surface view of the map at the recommended contour level 0.182. 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

X Y Z

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.

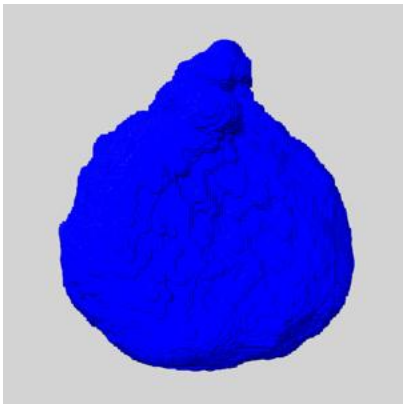
6.6 Mask visualisation (i)

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

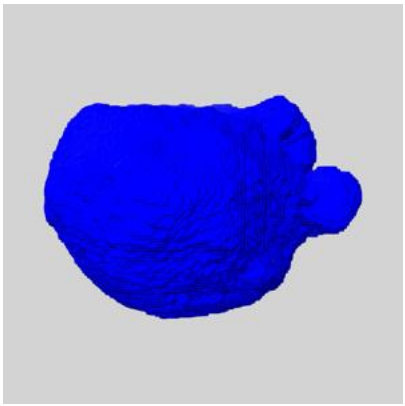
A mask typically either:

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

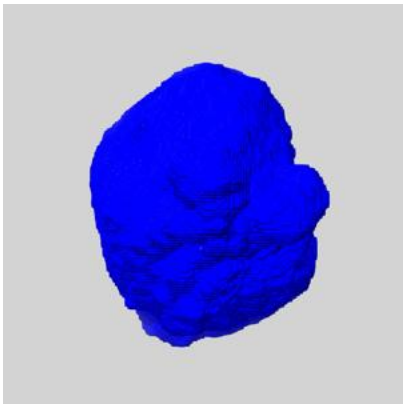
6.6.1 emd_47801_msk_1.map (i)



X



Y

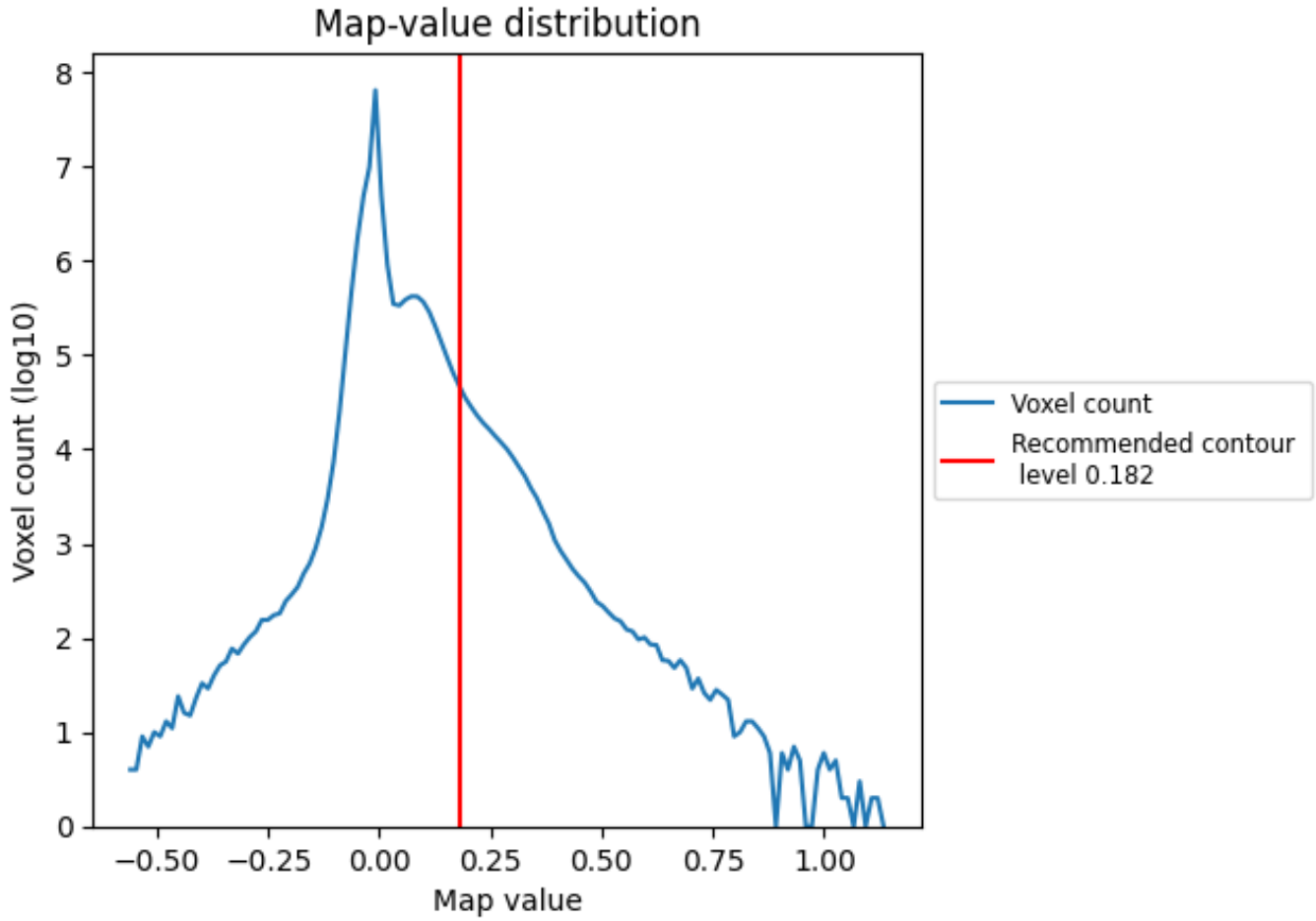


Z

7 Map analysis

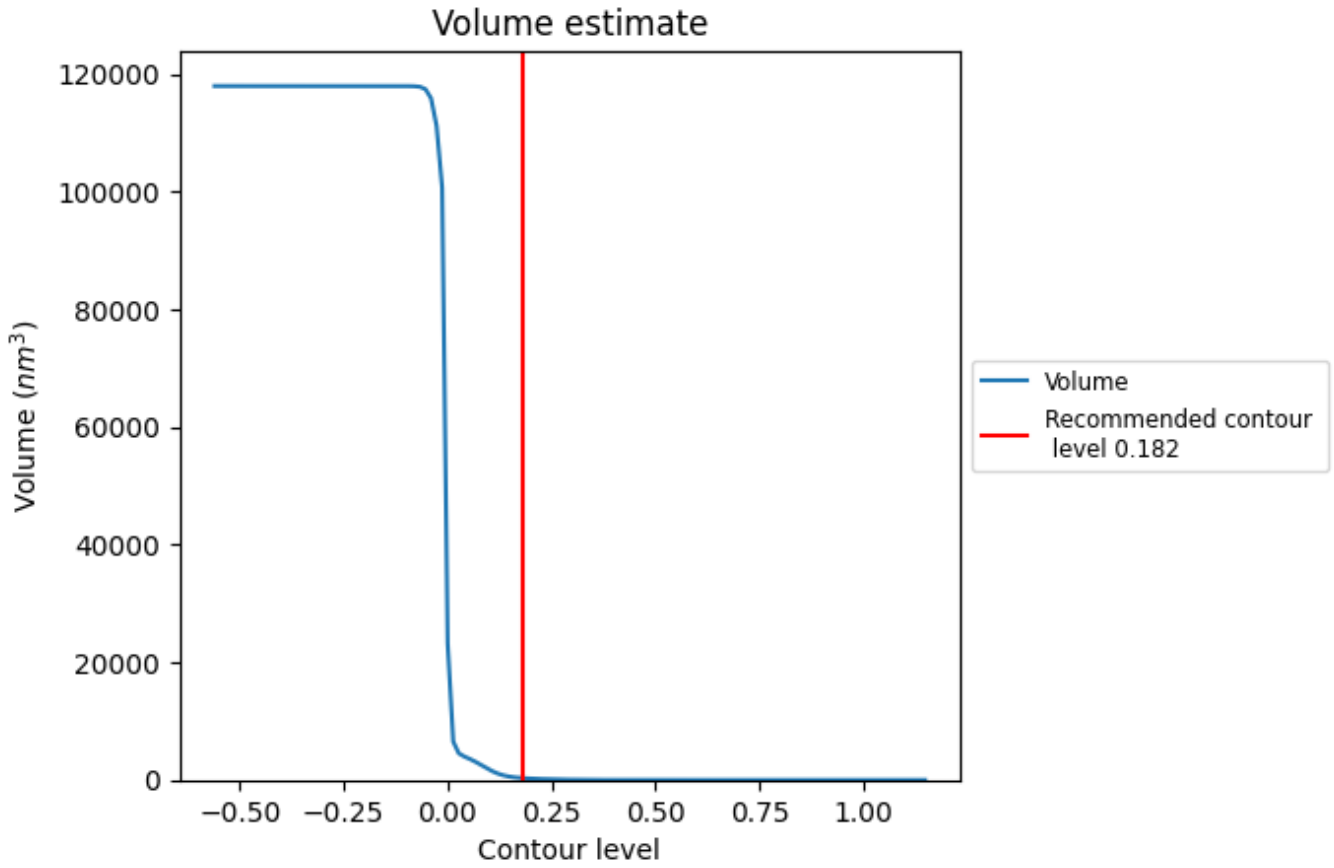
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution



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.

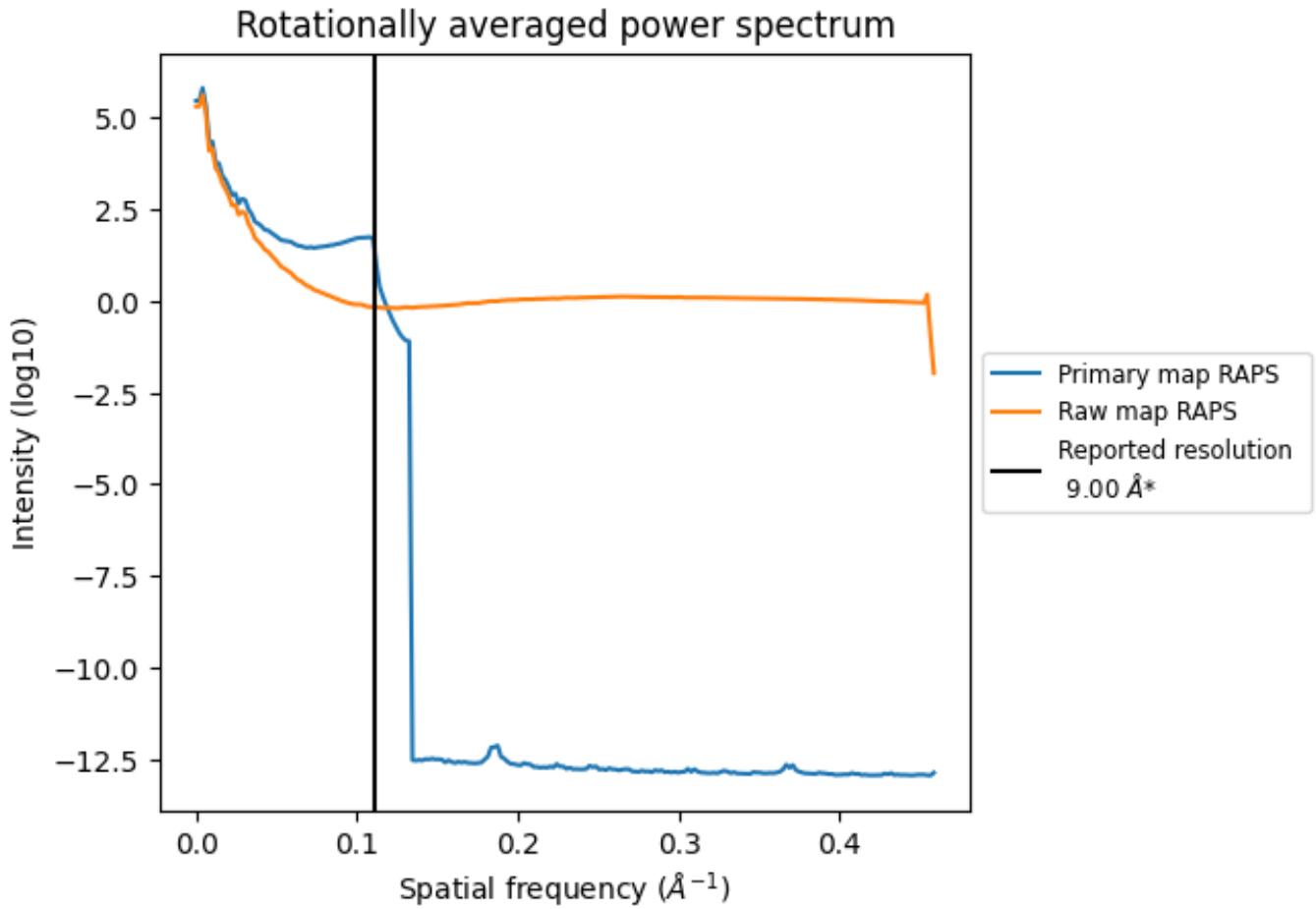
7.2 Volume estimate (i)



The volume at the recommended contour level is 304 nm^3; this corresponds to an approximate mass of 275 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)

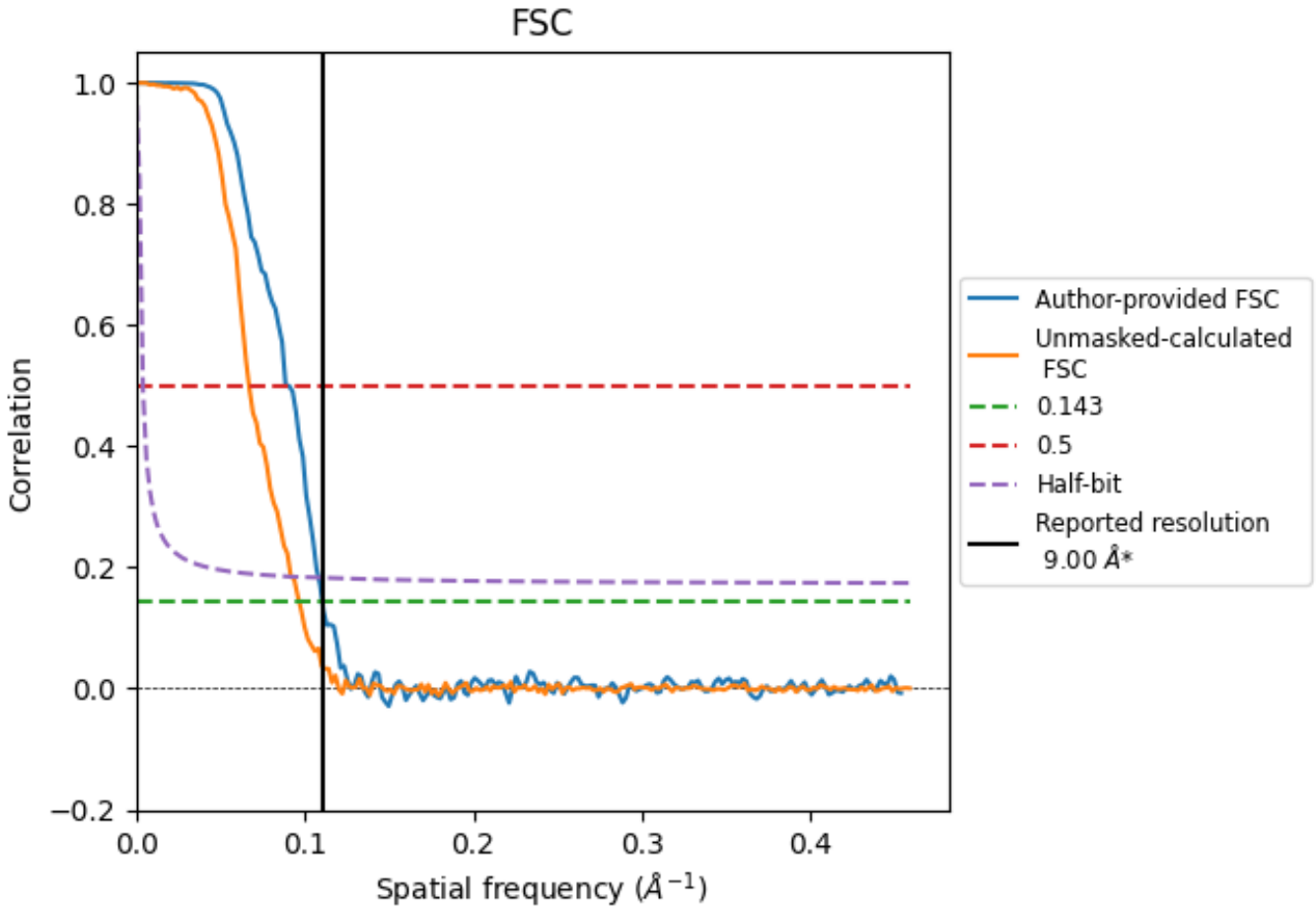


*Reported resolution corresponds to spatial frequency of 0.111 $Å^{-1}$

8 Fourier-Shell correlation

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



*Reported resolution corresponds to spatial frequency of 0.111 Å^{-1}

8.2 Resolution estimates (i)

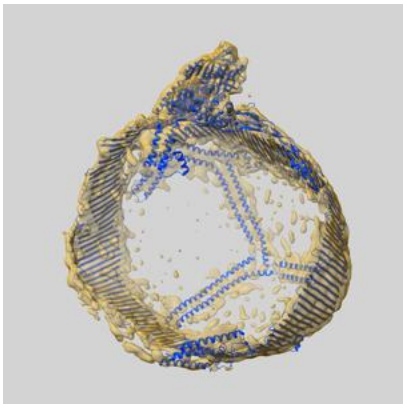
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	9.00	-	-
Author-provided FSC curve	9.06	11.27	9.24
Unmasked-calculated*	10.34	14.93	10.85

*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 10.34 differs from the reported value 9.0 by more than 10 %

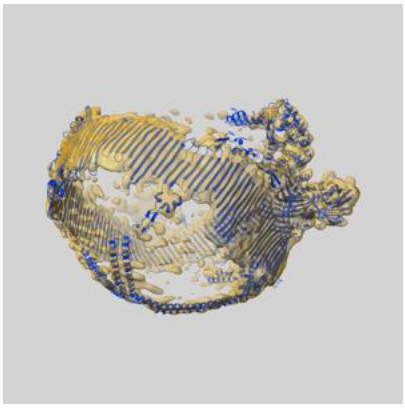
9 Map-model fit

This section contains information regarding the fit between EMDB map EMD-47801 and PDB model 9E9R. Per-residue inclusion information can be found in section 3 on page 4.

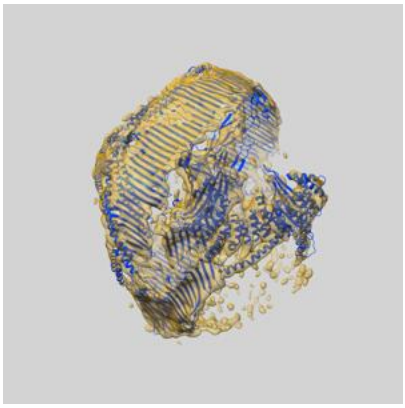
9.1 Map-model overlay



X



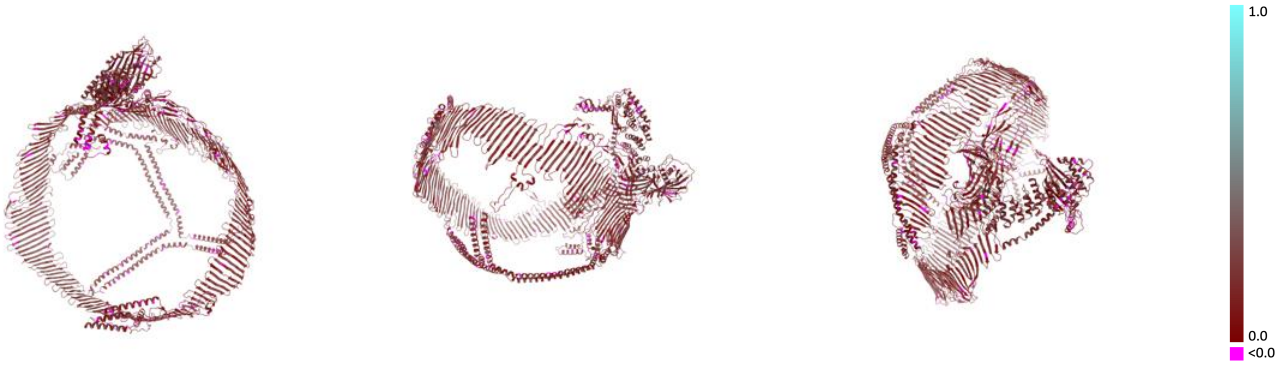
Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.182 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.

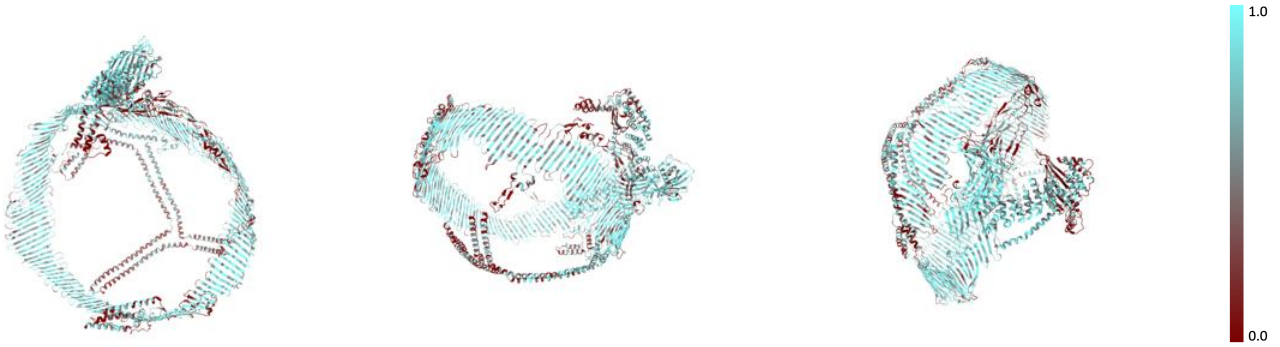
9.2 Q-score mapped to coordinate model (i)



X Y Z

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.

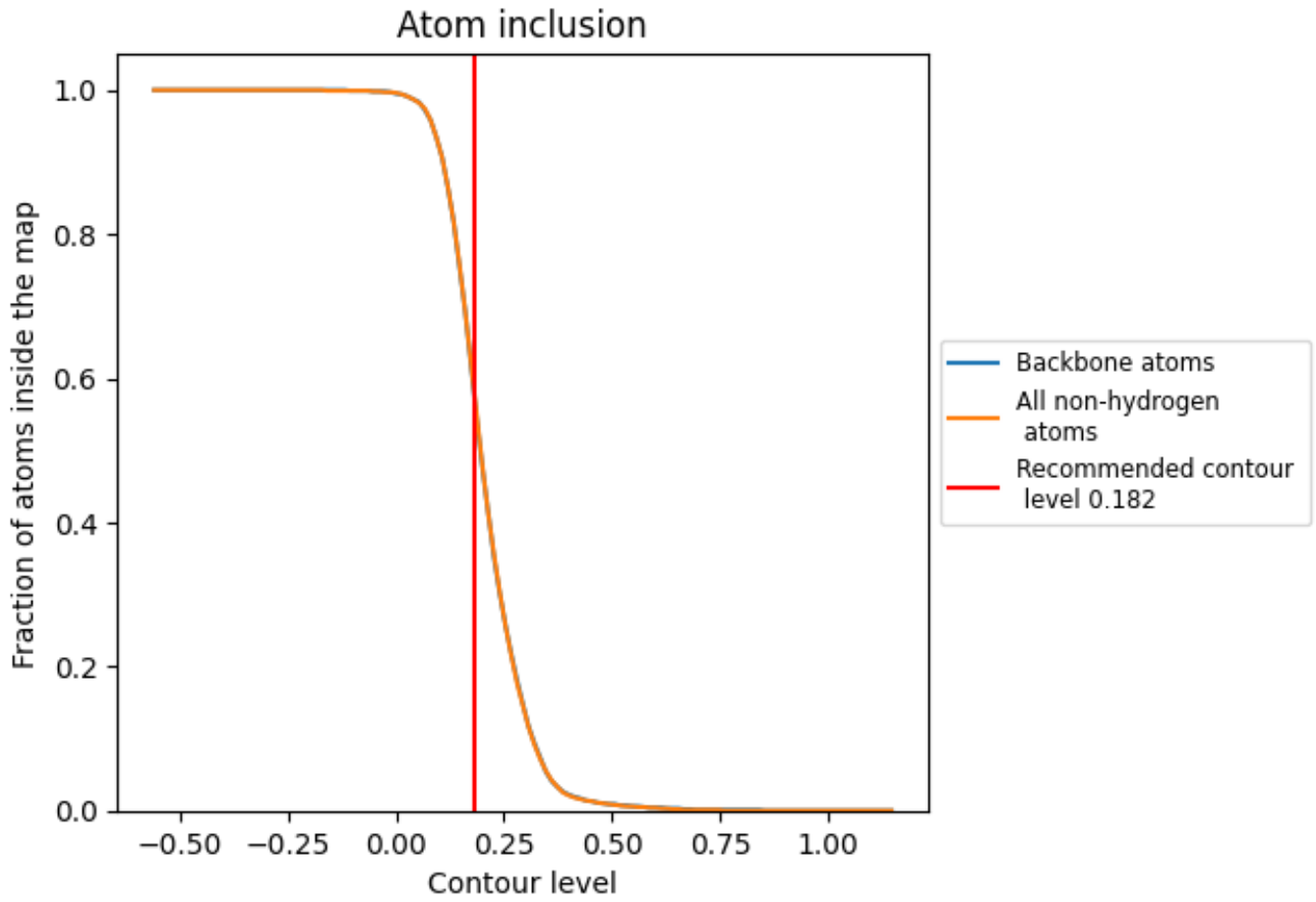
9.3 Atom inclusion mapped to coordinate model (i)



X Y Z

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 (0.182).

9.4 Atom inclusion (i)



At the recommended contour level, 57% of all backbone atoms, 58% 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 (0.182) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.5760	0.1710
A	0.5800	0.1710