



Full wwPDB EM Validation Report ⓘ

Feb 23, 2022 – 12:19 pm GMT

PDB ID : 7QIO
EMDB ID : EMD-13993
Title : Homology model of myosin neck domain in skeletal sarcomere
Authors : Wang, Z.; Grange, M.; Pospich, S.; Wagner, T.; Kho, A.L.; Gautel, M.;
Raunser, S.
Deposited on : 2021-12-15
Resolution : 9.00 Å (reported)
Based on initial models : 3I5G, 7QIN

This is a Full wwPDB EM Validation 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

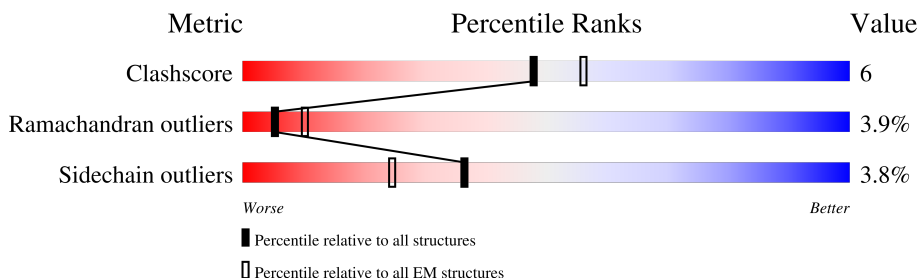
EMDB validation analysis : 0.0.0.dev97
MolProbity : 4.02b-467
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.26

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	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	L	848	
1	M	848	
2	N	188	
2	O	188	
3	P	169	
3	Q	169	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 5424 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 Myosin-4.

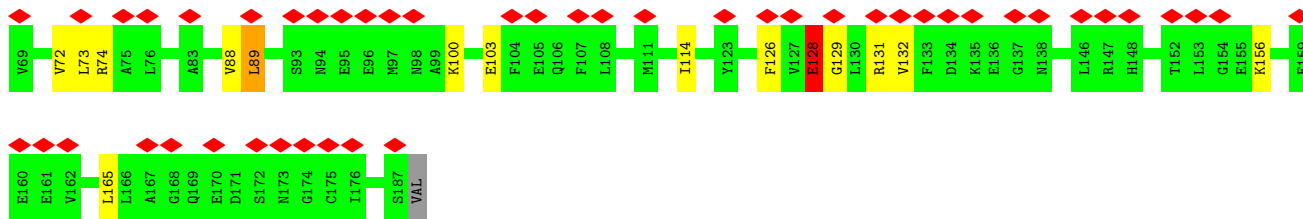
Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	L	48	Total	C	N	O	S	0	0
			419	283	72	59	5		
1	M	48	Total	C	N	O	S	0	0
			419	283	72	59	5		

- Molecule 2 is a protein called Myosin light chain 1/3, skeletal muscle isoform.

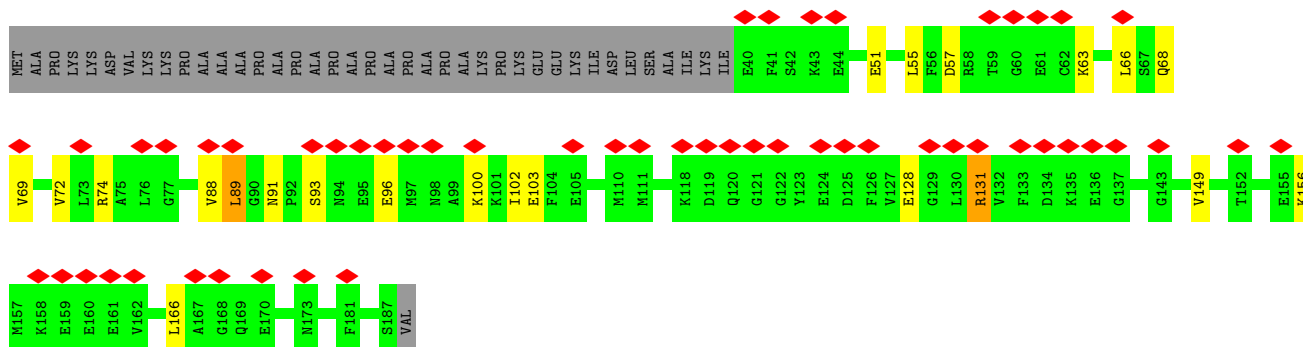
Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	N	148	Total	C	N	O	S	0	0
			1158	722	193	235	8		
2	O	148	Total	C	N	O	S	0	0
			1158	722	193	235	8		

- Molecule 3 is a protein called Myosin regulatory light chain 2, skeletal muscle isoform.

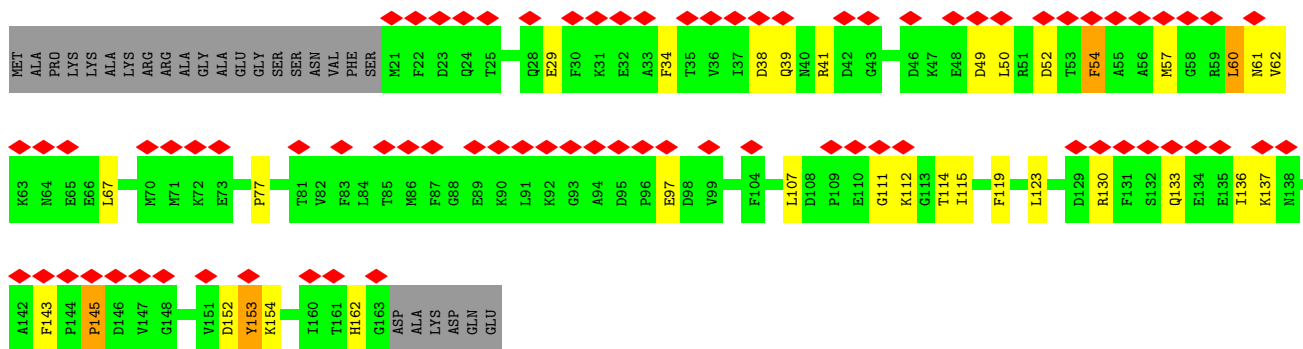
Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	P	143	Total	C	N	O	S	0	0
			1135	720	184	223	8		
3	Q	143	Total	C	N	O	S	0	0
			1135	720	184	223	8		



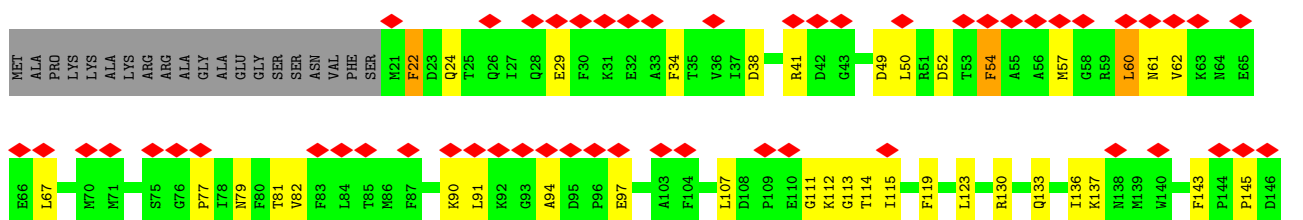
• Molecule 2: Myosin light chain 1/3, skeletal muscle isoform

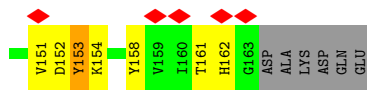


• Molecule 3: Myosin regulatory light chain 2, skeletal muscle isoform



• Molecule 3: Myosin regulatory light chain 2, skeletal muscle isoform





4 Experimental information

Property	Value	Source
EM reconstruction method	SUBTOMOGRAM AVERAGING	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of subtomograms used	44001	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 ($e^-/\text{\AA}^2$)	130	Depositor
Minimum defocus (nm)	2400	Depositor
Maximum defocus (nm)	5000	Depositor
Magnification	81000	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	2.478	Depositor
Minimum map value	-1.877	Depositor
Average map value	0.004	Depositor
Map value standard deviation	0.067	Depositor
Recommended contour level	0.55	Depositor
Map size (Å)	276.8, 276.8, 276.8	wwPDB
Map dimensions	80, 80, 80	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	3.4599998, 3.4599998, 3.4599998	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	L	0.74	0/431	1.12	2/579 (0.3%)
1	M	0.81	0/431	1.24	4/579 (0.7%)
2	N	0.73	0/1173	1.07	5/1571 (0.3%)
2	O	0.75	1/1173 (0.1%)	1.09	1/1571 (0.1%)
3	P	0.76	0/1155	1.18	3/1554 (0.2%)
3	Q	0.73	0/1155	1.23	3/1554 (0.2%)
All	All	0.75	1/5518 (0.0%)	1.15	18/7408 (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	L	0	1
1	M	0	2
3	P	0	1
3	Q	0	2
All	All	0	6

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	O	131	ARG	C-O	-6.49	1.11	1.23

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	P	143	PHE	CB-CG-CD1	7.14	125.80	120.80
1	M	802	ARG	NE-CZ-NH2	-6.61	117.00	120.30
1	M	834	MET	CG-SD-CE	6.43	110.49	100.20
1	M	802	ARG	NE-CZ-NH1	6.38	123.49	120.30
1	L	802	ARG	NE-CZ-NH2	-6.27	117.16	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	N	128	GLU	N-CA-CB	-6.19	99.47	110.60
1	L	802	ARG	NE-CZ-NH1	6.14	123.37	120.30
2	N	74	ARG	NE-CZ-NH2	-5.96	117.32	120.30
3	P	153	TYR	CB-CG-CD1	5.79	124.48	121.00
2	N	74	ARG	NE-CZ-NH1	5.76	123.18	120.30
3	Q	153	TYR	CB-CG-CD1	5.64	124.38	121.00
1	M	797	ARG	NE-CZ-NH1	5.56	123.08	120.30
2	N	126	PHE	CB-CG-CD2	-5.55	116.92	120.80
2	N	126	PHE	CB-CG-CD1	5.47	124.63	120.80
3	Q	158	TYR	CB-CG-CD1	5.36	124.22	121.00
3	Q	158	TYR	CB-CG-CD2	-5.33	117.80	121.00
3	P	143	PHE	CB-CG-CD2	-5.13	117.20	120.80
2	O	74	ARG	NE-CZ-NH1	5.08	122.84	120.30

There are no chirality outliers.

All (6) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	L	802	ARG	Sidechain
1	M	802	ARG	Sidechain
1	M	837	TYR	Sidechain
3	P	54	PHE	Sidechain
3	Q	113	GLY	Peptide
3	Q	54	PHE	Sidechain

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	L	419	0	439	5	0
1	M	419	0	439	9	0
2	N	1158	0	1124	12	0
2	O	1158	0	1124	10	0
3	P	1135	0	1107	21	0
3	Q	1135	0	1107	28	0
All	All	5424	0	5340	68	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 6.

All (68) 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:L:844:LEU:O	3:Q:24:GLN:HG3	1.41	1.16
3:P:39:GLN:HG3	3:Q:79:ASN:HD21	1.19	1.04
1:L:844:LEU:O	3:Q:24:GLN:CG	2.30	0.76
3:P:107:LEU:HD13	3:P:123:LEU:HD21	1.68	0.74
3:P:39:GLN:CD	3:Q:82:VAL:HG23	2.09	0.72
3:P:39:GLN:OE1	3:Q:81:THR:HB	1.94	0.66
3:Q:54:PHE:CG	3:Q:62:VAL:HG21	2.34	0.62
3:P:54:PHE:CG	3:P:62:VAL:HG21	2.36	0.61
3:P:39:GLN:OE1	3:Q:82:VAL:HG23	2.01	0.60
3:Q:143:PHE:CZ	3:Q:151:VAL:HG13	2.38	0.58
2:N:66:LEU:HD22	2:N:100:LYS:HB3	1.85	0.58
1:M:836:LEU:HD21	3:Q:54:PHE:CZ	2.39	0.57
3:Q:54:PHE:CD2	3:Q:62:VAL:HG21	2.41	0.56
3:P:39:GLN:NE2	3:Q:82:VAL:CG2	2.68	0.56
1:M:837:TYR:CZ	1:M:838:PHE:CE1	2.94	0.56
3:P:54:PHE:CD2	3:P:62:VAL:HG21	2.42	0.55
2:O:93:SER:HB2	2:O:96:GLU:HB3	1.89	0.55
1:L:836:LEU:HD21	3:P:54:PHE:CZ	2.42	0.55
3:P:133:GLN:HA	3:P:136:ILE:HD12	1.90	0.54
2:N:66:LEU:HD21	2:N:100:LYS:HD2	1.90	0.53
3:P:152:ASP:OD2	3:P:154:LYS:NZ	2.38	0.53
3:Q:133:GLN:HA	3:Q:136:ILE:HD12	1.91	0.52
2:N:53:PHE:CD2	2:N:64:ILE:HD12	2.44	0.52
2:O:66:LEU:HD11	2:O:89:LEU:HG	1.92	0.52
3:P:107:LEU:HD13	3:P:123:LEU:CD2	2.37	0.51
3:Q:107:LEU:HD13	3:Q:123:LEU:HD21	1.93	0.50
3:Q:50:LEU:HB3	3:Q:67:LEU:HD11	1.94	0.49
3:P:50:LEU:HB3	3:P:67:LEU:HD11	1.94	0.48
3:Q:114:THR:HG21	3:Q:153:TYR:H	1.78	0.48
1:M:828:VAL:HB	1:M:834:MET:HG3	1.96	0.48
2:N:128:GLU:OE1	2:N:131:ARG:HD2	2.14	0.47
3:Q:119:PHE:O	3:Q:123:LEU:HB2	2.14	0.47
2:N:66:LEU:CD2	2:N:100:LYS:HD2	2.45	0.47
3:P:107:LEU:CD1	3:P:123:LEU:HD21	2.43	0.46
2:O:63:LYS:HE2	2:O:103:GLU:OE2	2.15	0.46
1:M:839:LYS:HB2	3:Q:57:MET:SD	2.56	0.45
1:M:825:PHE:HA	1:M:828:VAL:HG22	1.99	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:N:129:GLY:O	2:N:132:VAL:HG12	2.17	0.45
1:M:838:PHE:CE1	3:Q:161:THR:O	2.71	0.44
2:O:66:LEU:HD22	2:O:100:LYS:HD2	1.99	0.44
3:P:114:THR:HG21	3:P:153:TYR:H	1.80	0.44
3:P:119:PHE:O	3:P:123:LEU:HB2	2.17	0.44
2:N:68:GLN:O	2:N:72:VAL:HG23	2.18	0.43
1:M:834:MET:SD	3:Q:90:LYS:HE2	2.58	0.43
3:Q:22:PHE:HB2	3:Q:91:LEU:HD12	2.00	0.43
1:L:839:LYS:HB2	3:P:57:MET:SD	2.58	0.43
2:O:66:LEU:HD12	2:O:69:VAL:HG21	2.01	0.43
1:M:835:LYS:O	1:M:839:LYS:HG3	2.19	0.42
3:Q:143:PHE:HZ	3:Q:151:VAL:HG22	1.84	0.42
2:O:128:GLU:OE1	2:O:131:ARG:HD2	2.18	0.42
3:Q:152:ASP:OD2	3:Q:154:LYS:NZ	2.41	0.42
2:O:89:LEU:HD21	2:O:102:ILE:CD1	2.49	0.42
2:O:68:GLN:O	2:O:72:VAL:HG23	2.20	0.42
3:Q:107:LEU:HD13	3:Q:123:LEU:CD2	2.50	0.42
1:L:796:CYS:HB3	2:N:165:LEU:HD11	2.02	0.42
3:Q:114:THR:HG21	3:Q:153:TYR:N	2.34	0.42
3:Q:60:LEU:HB2	3:Q:61:ASN:HA	2.02	0.41
3:P:60:LEU:HB2	3:P:61:ASN:HA	2.01	0.41
3:P:39:GLN:CD	3:Q:82:VAL:CG2	2.82	0.41
3:P:39:GLN:NE2	3:Q:82:VAL:HG22	2.35	0.41
2:N:73:LEU:CD1	2:N:114:ILE:HD13	2.51	0.41
2:N:88:VAL:O	2:N:89:LEU:CB	2.69	0.41
2:N:88:VAL:HG21	2:N:114:ILE:HD11	2.03	0.41
3:P:50:LEU:CB	3:P:67:LEU:HD11	2.51	0.41
1:M:789:ILE:HD12	2:O:149:VAL:CG1	2.51	0.40
2:N:63:LYS:HE2	2:N:103:GLU:OE2	2.22	0.40
2:O:88:VAL:O	2:O:89:LEU:CB	2.69	0.40
3:Q:50:LEU:CB	3:Q:67:LEU:HD11	2.52	0.40

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	L	44/848 (5%)	42 (96%)	2 (4%)	0	100	100
1	M	44/848 (5%)	42 (96%)	2 (4%)	0	100	100
2	N	146/188 (78%)	140 (96%)	4 (3%)	2 (1%)	11	46
2	O	146/188 (78%)	139 (95%)	4 (3%)	3 (2%)	7	36
3	P	141/169 (83%)	116 (82%)	15 (11%)	10 (7%)	1	14
3	Q	141/169 (83%)	115 (82%)	15 (11%)	11 (8%)	1	13
All	All	662/2410 (28%)	594 (90%)	42 (6%)	26 (4%)	5	23

All (26) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	P	38	ASP
3	P	41	ARG
3	P	77	PRO
3	P	97	GLU
3	P	115	ILE
3	P	145	PRO
3	Q	38	ASP
3	Q	41	ARG
3	Q	77	PRO
3	Q	115	ILE
2	N	89	LEU
2	O	89	LEU
3	Q	97	GLU
3	Q	111	GLY
2	N	156	LYS
2	O	156	LYS
3	P	111	GLY
3	P	130	ARG
3	Q	94	ALA
3	Q	130	ARG
3	Q	145	PRO
3	Q	162	HIS
3	P	162	HIS
3	P	112	LYS
3	Q	112	LYS
2	O	91	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	L	45/727 (6%)	45 (100%)	0	100	100
1	M	45/727 (6%)	45 (100%)	0	100	100
2	N	125/154 (81%)	121 (97%)	4 (3%)	39	61
2	O	125/154 (81%)	121 (97%)	4 (3%)	39	61
3	P	123/142 (87%)	116 (94%)	7 (6%)	20	45
3	Q	123/142 (87%)	116 (94%)	7 (6%)	20	45
All	All	586/2046 (29%)	564 (96%)	22 (4%)	36	57

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	N	51	GLU
2	N	55	LEU
2	N	57	ASP
2	N	128	GLU
2	O	51	GLU
2	O	55	LEU
2	O	57	ASP
2	O	166	LEU
3	P	29	GLU
3	P	34	PHE
3	P	49	ASP
3	P	52	ASP
3	P	60	LEU
3	P	137	LYS
3	P	145	PRO
3	Q	22	PHE
3	Q	29	GLU
3	Q	34	PHE
3	Q	49	ASP
3	Q	52	ASP
3	Q	60	LEU
3	Q	137	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
2	N	112	GLN
2	O	112	GLN

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-13993. 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

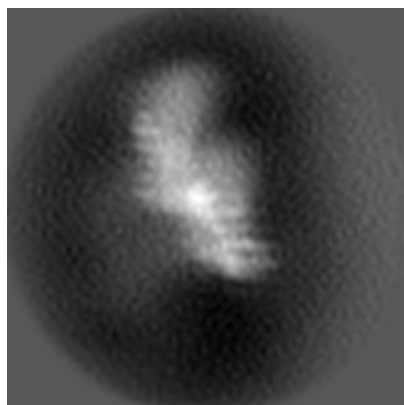


Y

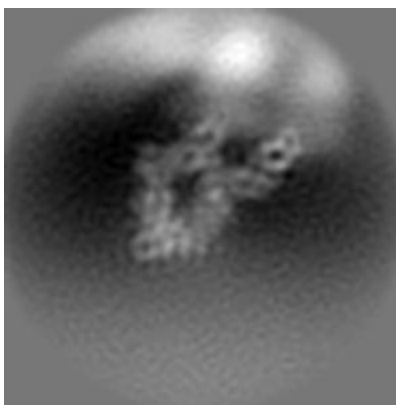


Z

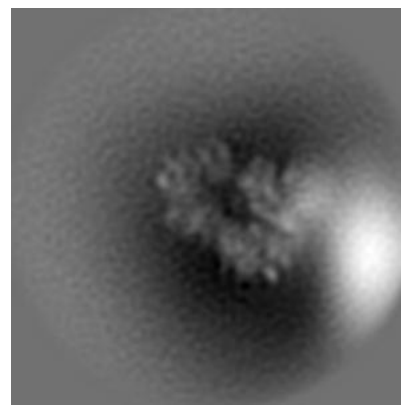
6.1.2 Raw map



X



Y

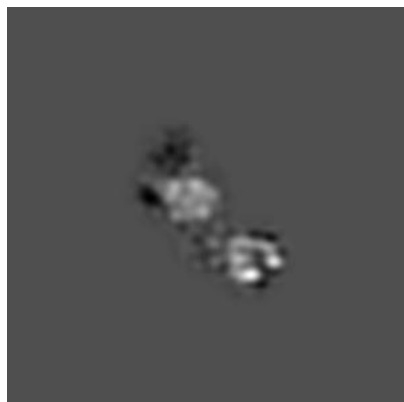


Z

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

6.2 Central slices [i](#)

6.2.1 Primary map



X Index: 40

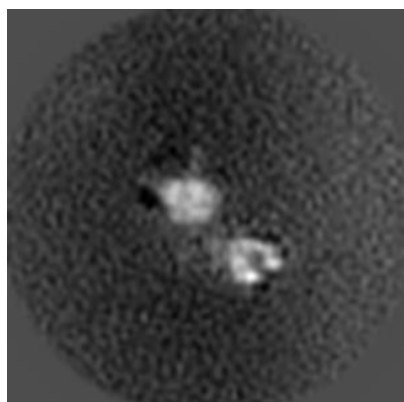


Y Index: 40

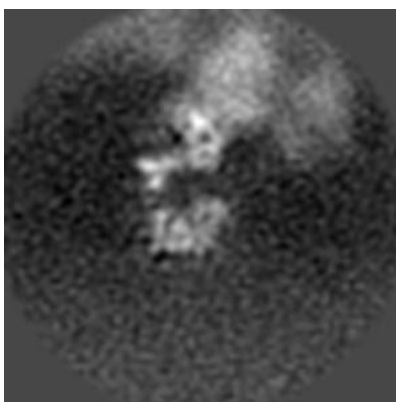


Z Index: 40

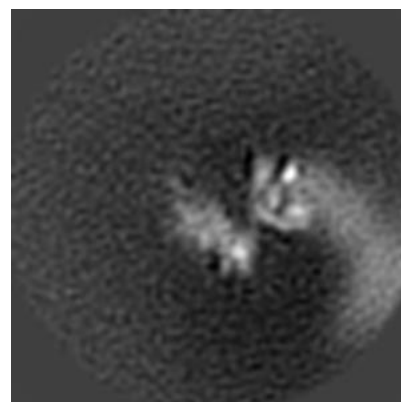
6.2.2 Raw map



X Index: 40



Y Index: 40



Z Index: 40

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

6.3 Largest variance slices [i](#)

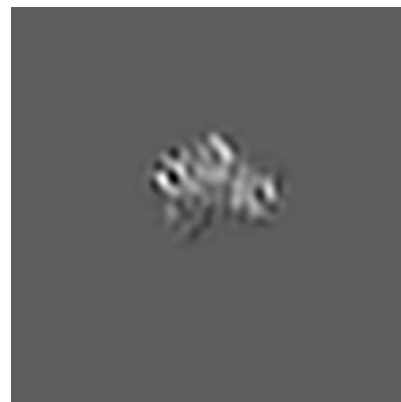
6.3.1 Primary map



X Index: 48

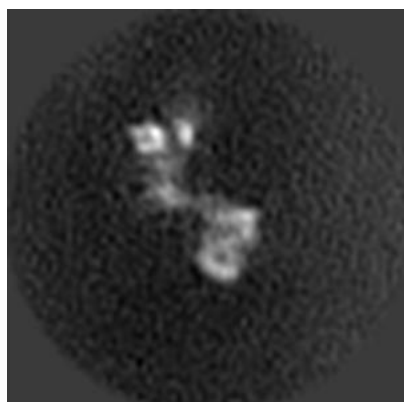


Y Index: 45

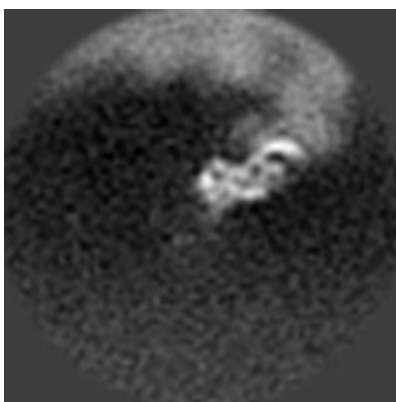


Z Index: 29

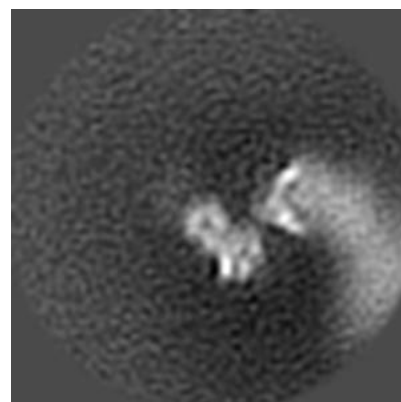
6.3.2 Raw map



X Index: 48



Y Index: 31



Z Index: 42

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

6.4 Orthogonal surface views [i](#)

6.4.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.55. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

6.4.2 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.

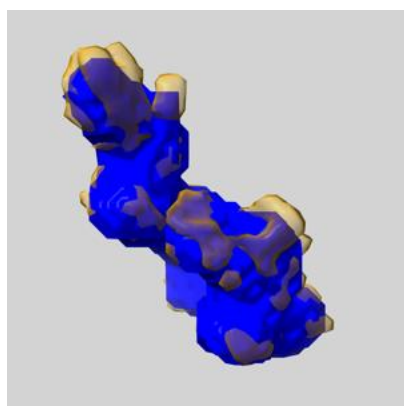
6.5 Mask visualisation [i](#)

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

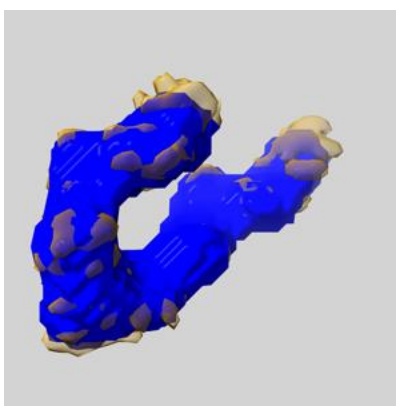
A mask typically either:

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

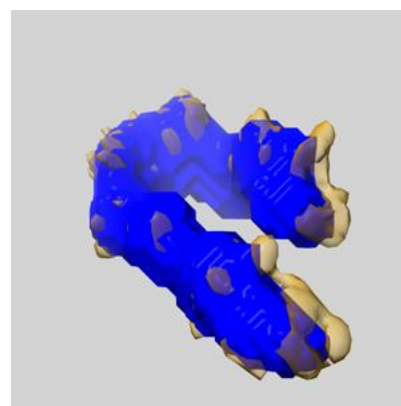
6.5.1 emd_13993_msk_1.map [i](#)



X



Y

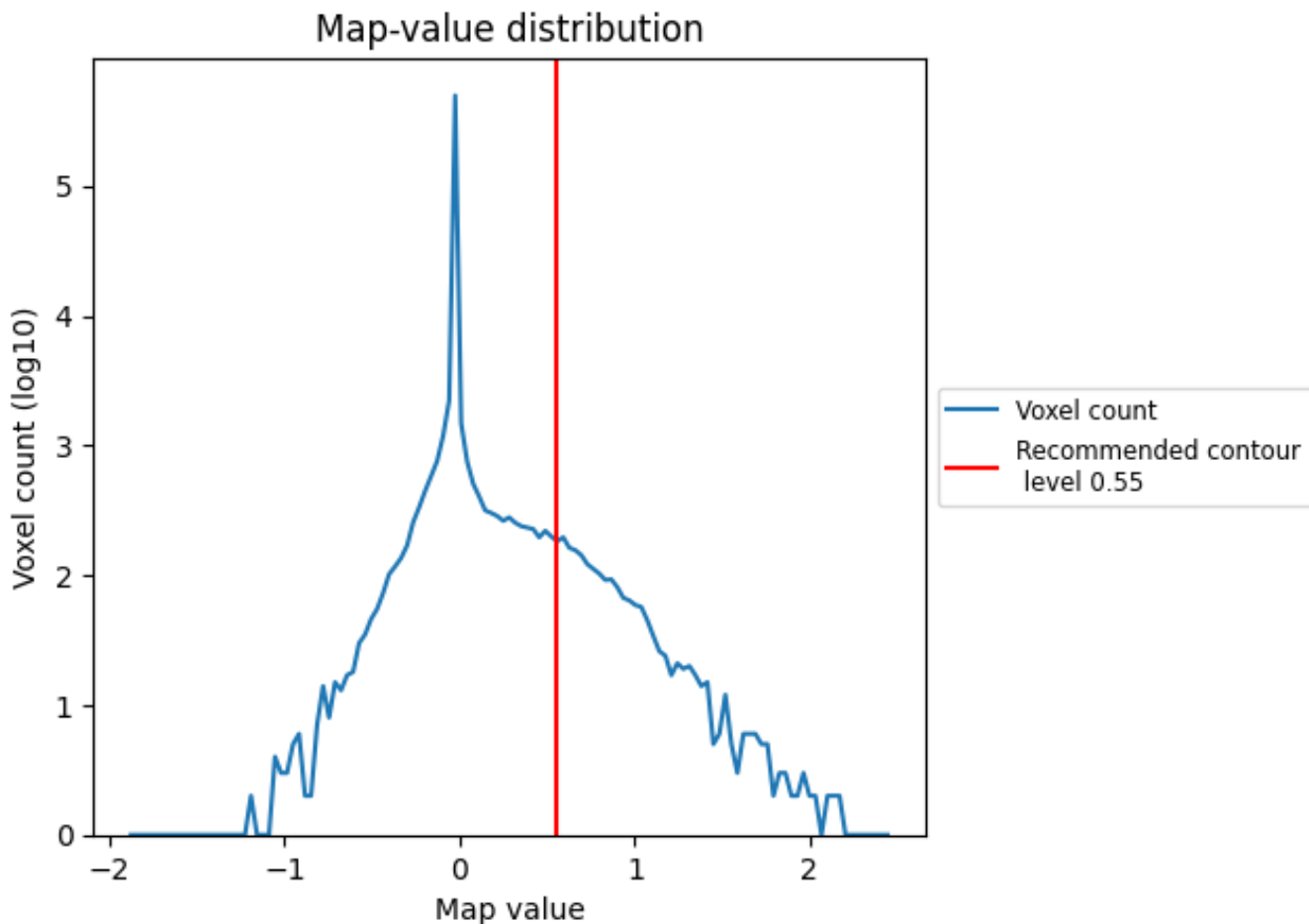


Z

7 Map analysis [i](#)

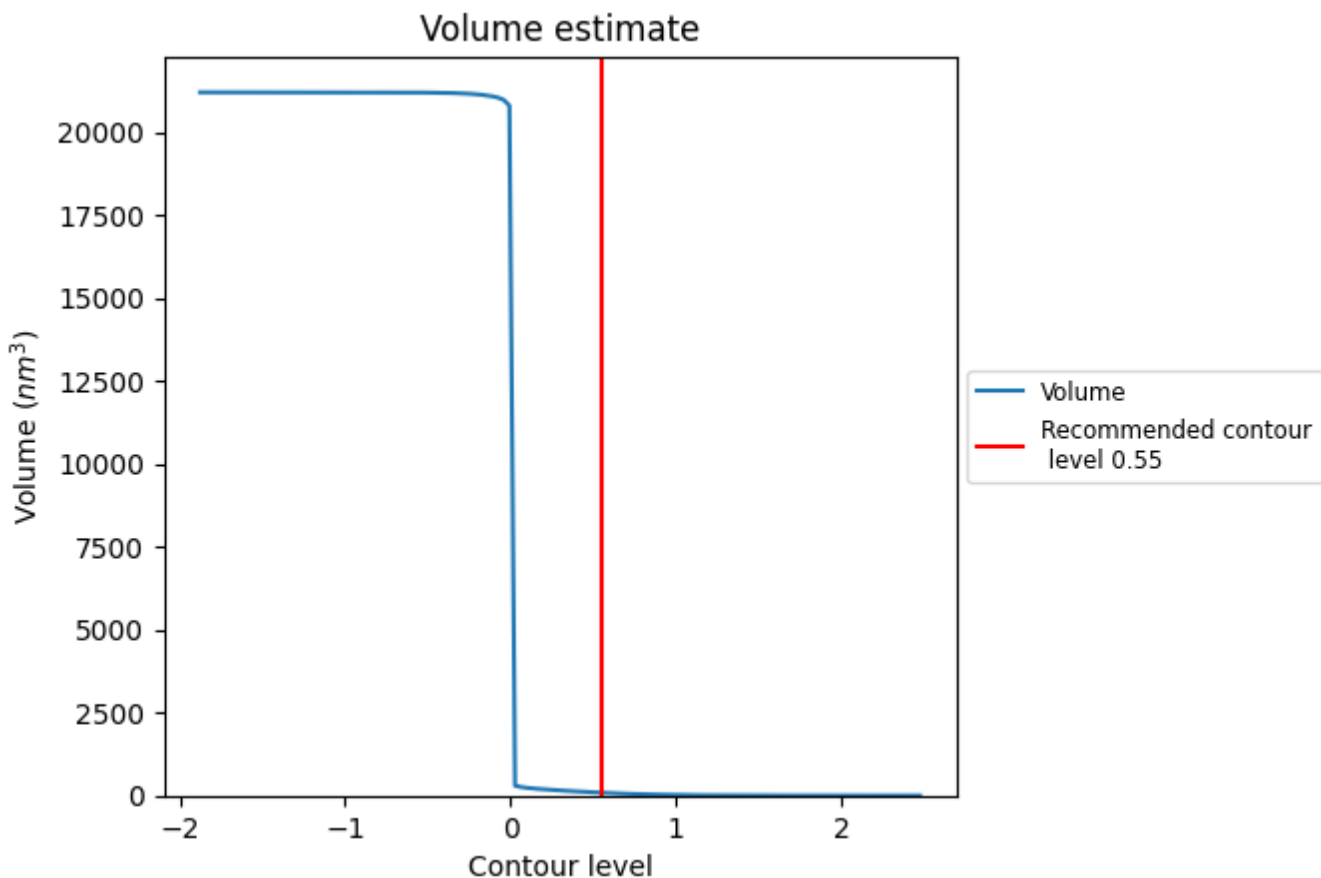
This section contains the results of statistical analysis of the map.

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.

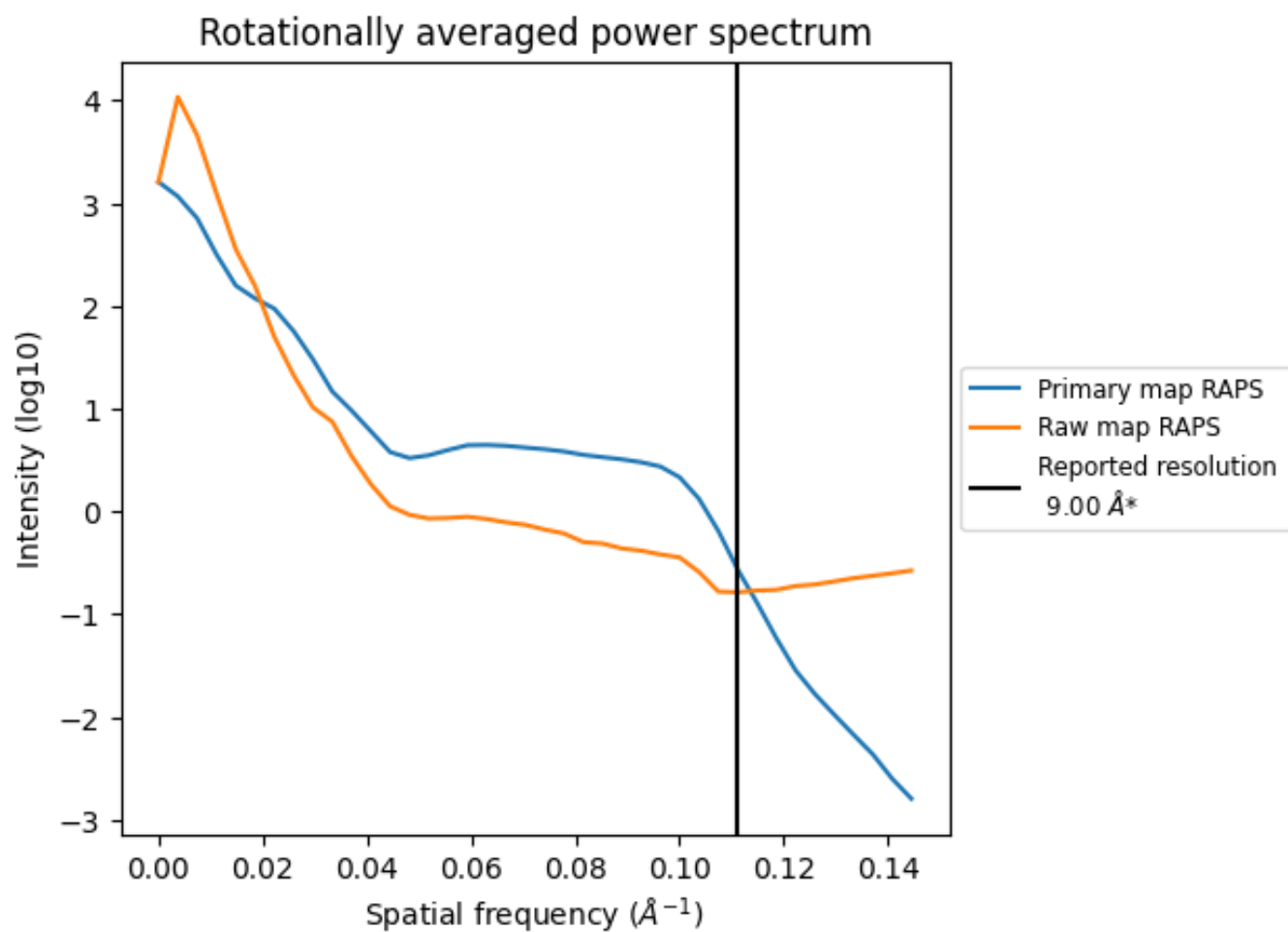
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 86 nm³; this corresponds to an approximate mass of 78 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

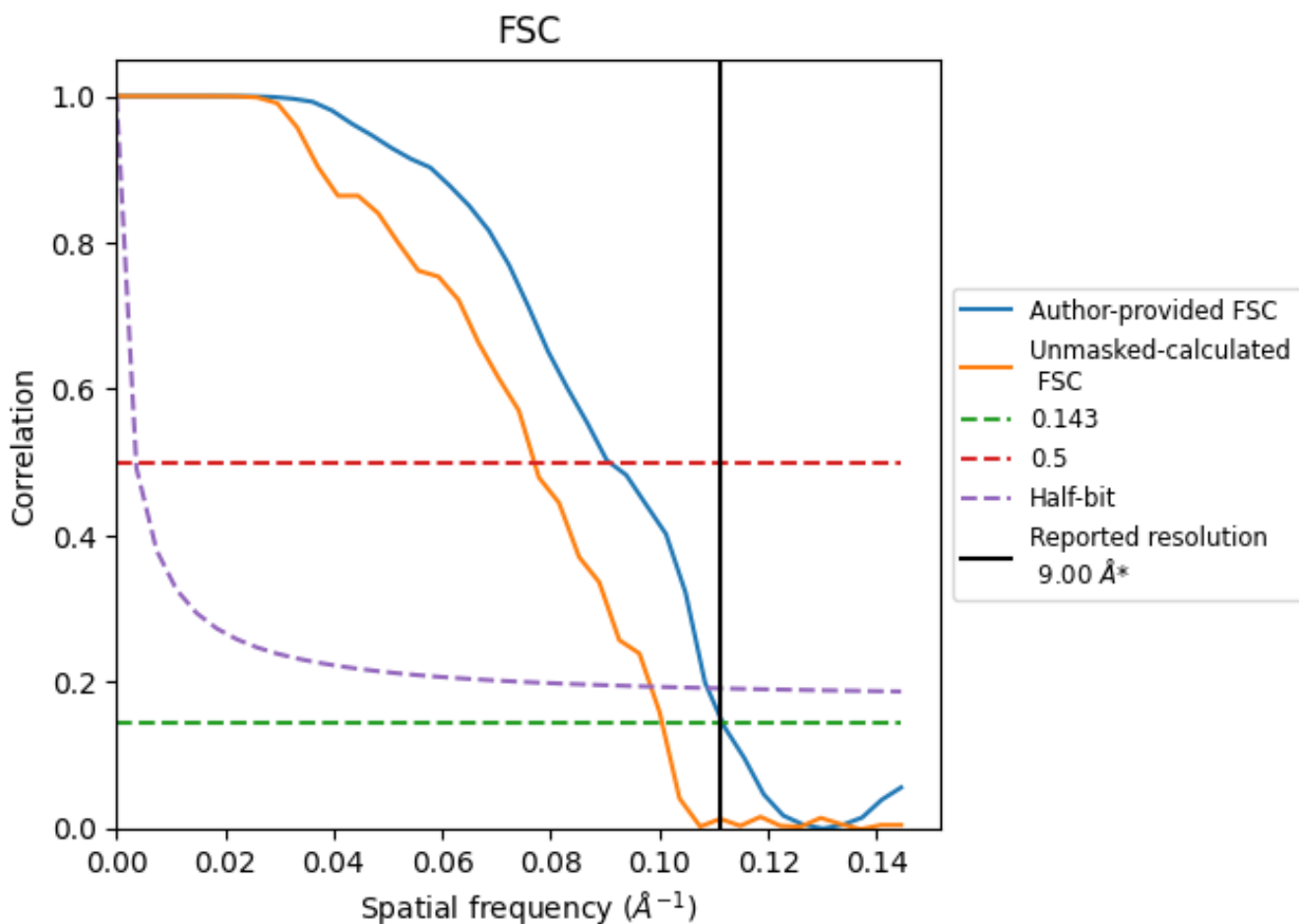


*Reported resolution corresponds to spatial frequency of 0.111 Å⁻¹

8 Fourier-Shell correlation [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 0.111 Å⁻¹

8.2 Resolution estimates [i](#)

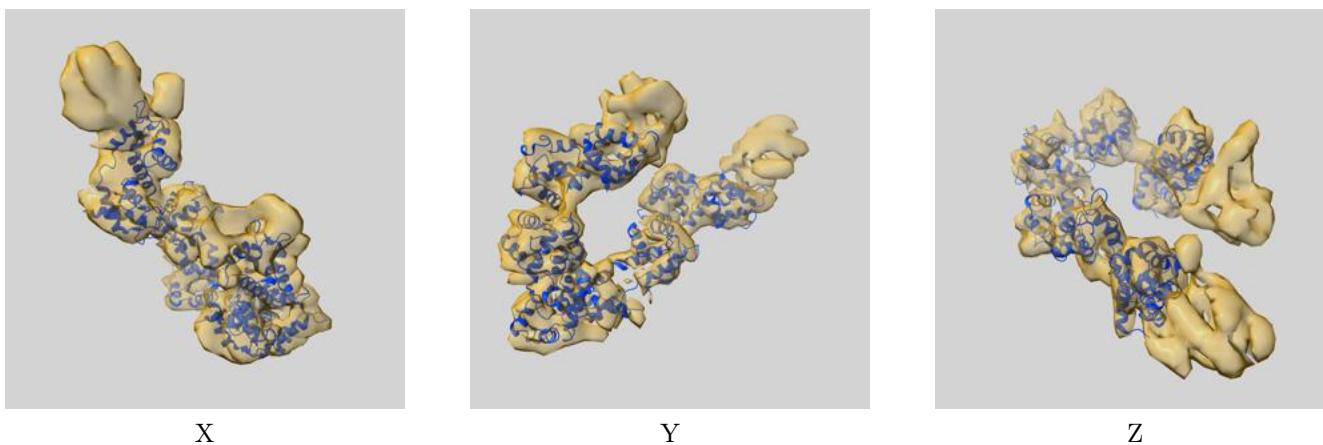
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	9.00	-	-
Author-provided FSC curve	8.95	11.03	9.19
Unmasked-calculated*	9.95	12.99	10.16

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

9 Map-model fit [i](#)

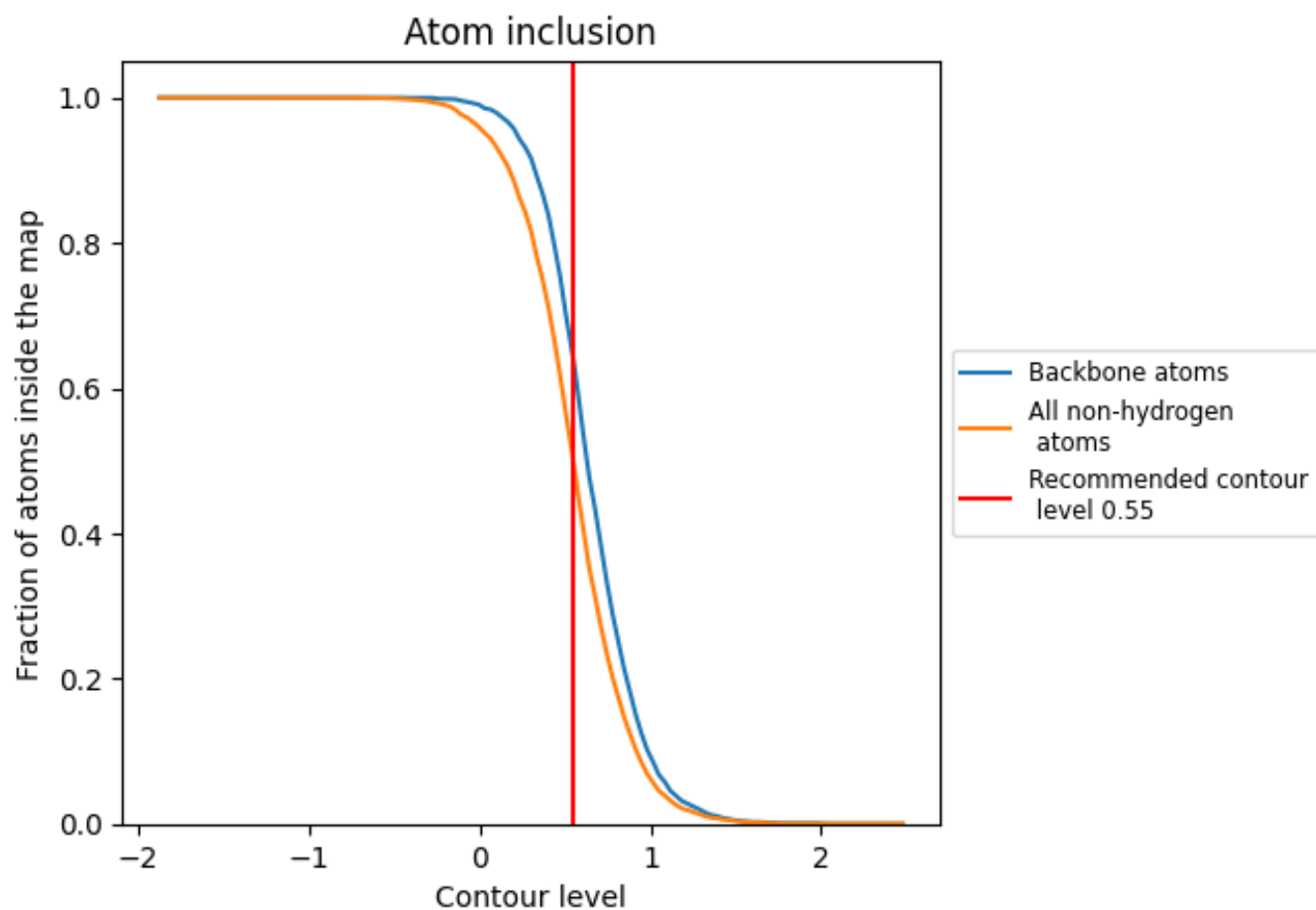
This section contains information regarding the fit between EMDB map EMD-13993 and PDB model 7QIO. Per-residue inclusion information can be found in section 3 on page 4.

9.1 Map-model overlay [i](#)



The images above show the 3D surface view of the map at the recommended contour level 0.55 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 Atom inclusion [i](#)



At the recommended contour level, 64% of all backbone atoms, 50% of all non-hydrogen atoms, are inside the map.