WORLDWIDE wwPDB PROTEIN DATA BANK

wwPDB EM Validation Summary Report ⓘ

Feb 27, 2023 – 06:16 PM JST

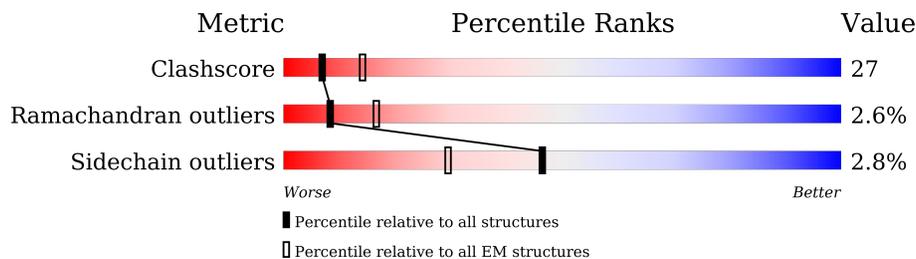|		
PDB ID	:	7W68
EMDB ID	:	EMD-32326
Title	:	human single hexameric Mcm2-7 complex
Authors	:	Xu, N.N.; Lin, Q.P.; Liu, C.D.; Tian, H.L.; Xiang, Y.; Zhu, G.
Deposited on	:	2021-12-01
Resolution	:	4.40 Å(reported)

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 4.40 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	Percentile Ranks	Value
Clashscore		27
Ramachandran outliers		2.6%
Sidechain outliers		2.8%

Worse   *Better*

▊ Percentile relative to all structures
▊ Percentile relative to all EM structures

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 <=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	904	18% / 33% 26% · 38%
2	B	808	14% / 30% 27% · · 38%
3	C	863	14% / 30% 28% · · 39%
4	D	734	15% / 29% 27% · 42%
5	E	821	24% / 40% 35% · · 19%
6	F	719	22% / 42% 36% · 20%

2 Entry composition ⓘ

There are 6 unique types of molecules in this entry. The entry contains 25833 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 DNA replication licensing factor MCM2.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	560	Total 4443	C 2800	N 797	O 823	S 23	0	0

- Molecule 2 is a protein called DNA replication licensing factor MCM3.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	498	Total 3912	C 2456	N 700	O 733	S 23	0	0

- Molecule 3 is a protein called DNA replication licensing factor MCM4.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	C	529	Total 4227	C 2670	N 745	O 788	S 24	0	0

- Molecule 4 is a protein called DNA replication licensing factor MCM5.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	D	426	Total 3349	C 2106	N 591	O 627	S 25	0	0

- Molecule 5 is a protein called DNA replication licensing factor MCM6.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	E	661	Total 5335	C 3355	N 946	O 1007	S 27	0	0

- Molecule 6 is a protein called DNA replication licensing factor MCM7.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	F	575	Total 4567	C 2866	N 815	O 861	S 25	0	0

3 Residue-property plots ⓘ

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: DNA replication licensing factor MCM2

• Molecule 2: DNA replication licensing factor MCM3

THR ALA ARG THR SER P579 V580 T581 A582 R583 T584 L585 E586 T587 L588 I589 R590 L591 A594 K597 A598 R599 M600 S601 K602 T603 V604 D605 L606 A609 E610 E611 A612 V613 E614 L615 V616 Q617 Y618 F621 LYS LYS VAL LEU GLU GLU LYS LYS ARG LYS ARG SER GLU ASP

GLU SER GLU THR GLU ASP GLU GLU LYS SER GLU GLU ASP GLN GLU GLN LYS ARG LYS THR ARG GLN PRO ASP ALA LYS ASP GLY ASP SER TYR ASP PRO TYR ASP PHE SER ASP THR GLU GLU GLU MET PRO GLN VAL HIS THR PRO LYS THR ALA ASP SER GLN GLU

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

LYS MET GLN ASP ASN VAL GLN MET VAL SER GLU GLY ILE ILE PHE LEU ILE

• Molecule 3: DNA replication licensing factor MCM4

Chain C:

MET SER SER PRO ALA SER THR SER PRO SER ARG ARG GLY SER ARG ARG GLY ARG ALA THR PRO ALA GLN THR PRO ARG ARG SER GLU ALA ARG SER SER PRO SER GLN ARG ARG GLY LEU ASP ASP SER SER THR SER THR GLY LEU GLN PRO MET PRO THR SER PRO GLY VAL ASP LEU GLN

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

ALA GLN LYS LEU LEU GLN VAL ASP LEU GLN SER ASP ALA ALA ALA GLU ASP ILE VAL ALA SER GLU GLN SER LEU GLY LYS L1 V2 I3 W4 G5 T6 D7 V10 A11 A12 C13 K14 E15 N16 F17 Q18 R19 F20 L21 Q22 R23 F24 I25 D26 PRO LEU ALA LYS GLU GLU

GLU ASN VAL GLY ILE ASP ILE THR GLU PRO LEU Y44 M45 Q46 R47 L48 G49 E50 I51 N52 V53 I54 G55 E56 P57 F58 L59 N60 V61 N62 C63 E64 H65 I66 K67 S68 F69 D70 K71 N72 L73 Y74 R75 Q76 L77 I78 S79 Q82 E83 V84 T87 F88 D89 M90 A91 V92 N93 E94

F97 D98 R99 D102 S103 I104 L105 E106 H107 Q108 V111 R112 P113 F114 N115 A116 L117 K118 T119 K120 N121 M122 R123 N124 L125 N126 P127 E128 D129 I130 D131 Q132 L133 I134 T135 I136 S137 G138 M139 V140 T143 S144 Q145 L146 I147 P148 E149 M150 Q151 E152 A153 F154 F155 Q156 C157 Q158

V159 C160 A161 H162 T163 T164 R165 V166 E167 M168 D169 R170 G171 R172 I173 A174 C179 G180 R181 C182 H183 T184 T185 H186 S187 M188 A189 L190 I191 H192 N193 R194 S195 L196 F197 S198 D199 Q201 M202 I203 K204 L205 Q206 E210 D211 M212 P213 A214 G215 Q216 T217 V221 I222 L223 F224 A225

H226 N227 D228 L229 V230 D231 K232 V233 Q234 D237 N240 V241 T242 G243 I244 V245 R246 A247 V248 R251 V252 N253 P264 R255 S261 V262 Y263 K264 T265 H266 I267 D268 V269 I270 H271 Y272 ARG LYS THR ASP ALA LYS ARG LEU HIS GLY LEU ASP GLU GLU ALA GLU GLN LYS LEU F292

S293 E294 V297 L300 K301 E302 L303 S304 R305 K306 P307 D308 I309 Y310 E311 R312 L313 A314 S315 A316 L317 A318 I321 Y322 E323 H324 E325 D326 I327 K328 K329 G330 I331 L332 L333 Q334 L335 F336 GLY GLY THR ARG LYS ASP PHE SER HIS THR GLY ARG GLY LYS PHE ARG ALA GLU ILE

ASN ILE LEU LEU CYS GLY D363 P363 G364 T365 S366 K367 S368 Q369 Q372 Y373 N376 L377 P379 R380 G381 S390 A391 V392 T395 A396 Y397 V398 M399 K400 D401 P402 E403 T404 R405 Q406 L407 V408 L409 Q410 A413 S417 D418 N419 G420 I421 C422 F427 D428 T434 R435

S436 V437 L438 H439 E440 V441 I449 A450 K451 A452 G453 I454 I455 C456 Q457 L458 N459 A460 R461 T462 S463 V464 L465 N469 PRO ILE GLU SER GLN TRP ASN PRO LYS LYS THR ILE GLU ASN ILE GLN LEU PRO H489 T490 L491 R494 F495 D496 L497 I498 F499 L500 L501 L502 D503 P504

• Molecule 4: DNA replication licensing factor MCM5

Chain D:

15%

29%   27%   42%

• Molecule 5: DNA replication licensing factor MCM6

Chain E:

• Molecule 6: DNA replication licensing factor MCM7

Chain F:

4 Experimental information ⓘ

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	186918	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 $(e^-/\text{Å}^2)$	50	Depositor
Minimum defocus (nm)	1500	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	2.293	Depositor
Minimum map value	-0.002	Depositor
Average map value	0.005	Depositor
Map value standard deviation	0.050	Depositor
Recommended contour level	0.14	Depositor
Map size (Å)	254.4, 254.4, 254.4	wwPDB
Map dimensions	240, 240, 240	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.06, 1.06, 1.06	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	0.53	0/4518	0.80	16/6093 (0.3%)
2	B	0.70	8/3965 (0.2%)	0.96	29/5341 (0.5%)
3	C	0.60	1/4299 (0.0%)	0.95	35/5809 (0.6%)
4	D	0.52	0/3390	0.74	4/4541 (0.1%)
5	E	0.67	7/5420 (0.1%)	0.97	24/7302 (0.3%)
6	F	0.56	1/4637 (0.0%)	0.77	8/6257 (0.1%)
All	All	0.60	17/26229 (0.1%)	0.88	116/35343 (0.3%)

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	14
2	B	0	8
3	C	0	17
4	D	0	9
5	E	0	13
6	F	0	7
All	All	0	68

The worst 5 of 17 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	E	153	GLN	N-CA	9.22	1.64	1.46
5	E	203	ILE	C-N	8.46	1.50	1.34
5	E	153	GLN	CB-CG	8.16	1.74	1.52
2	B	433	MET	N-CA	-8.14	1.30	1.46
2	B	433	MET	CA-CB	7.39	1.70	1.53

The worst 5 of 116 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	E	380	ASP	C-N-CD	-16.07	85.25	120.60
5	E	153	GLN	CA-CB-CG	13.68	143.50	113.40
5	E	384	ALA	N-CA-C	-11.85	79.00	111.00
3	C	151	GLN	N-CA-CB	11.20	130.76	110.60
2	B	436	ILE	CB-CA-C	11.08	133.76	111.60

There are no chirality outliers.

5 of 68 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	102	GLU	Peptide
1	A	190	GLU	Peptide
1	A	243	PRO	Peptide
1	A	289	ALA	Peptide
1	A	32	MET	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	4443	0	4482	208	0
2	B	3912	0	3993	258	0
3	C	4227	0	4258	245	0
4	D	3349	0	3429	199	0
5	E	5335	0	5359	377	0
6	F	4567	0	4622	209	0
All	All	25833	0	26143	1411	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 27.

The worst 5 of 1411 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)
3:C:552:ARG:CG	5:E:542:ILE:HG13	1.22	1.62
5:E:153:GLN:CB	5:E:153:GLN:CG	1.74	1.59

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:E:594:LYS:HE3	5:E:597:TRP:CD1	1.37	1.59
2:B:436:ILE:CD1	2:B:436:ILE:CG1	1.82	1.54
2:B:386:ARG:NE	2:B:438:LEU:CD2	1.68	1.53

There are no symmetry-related clashes.

5.3　Torsion angles　ⓘ

5.3.1　Protein backbone　ⓘ

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	546/904 (60%)	454 (83%)	79 (14%)	13 (2%)	6	36
2	B	484/808 (60%)	402 (83%)	67 (14%)	15 (3%)	4	31
3	C	515/863 (60%)	400 (78%)	100 (19%)	15 (3%)	4	32
4	D	410/734 (56%)	355 (87%)	50 (12%)	5 (1%)	13	50
5	E	653/821 (80%)	517 (79%)	109 (17%)	27 (4%)	3	25
6	F	567/719 (79%)	484 (85%)	74 (13%)	9 (2%)	9	45
All	All	3175/4849 (66%)	2612 (82%)	479 (15%)	84 (3%)	8	35

5 of 84 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	99	PRO
1	A	374	PRO
1	A	424	ALA
2	B	229	ALA
2	B	230	CYS

5.3.2   Protein sidechains   ⓘ

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	488/781 (62%)	476 (98%)	12 (2%)	47	68
2	B	429/707 (61%)	416 (97%)	13 (3%)	41	63
3	C	470/753 (62%)	461 (98%)	9 (2%)	57	75
4	D	364/625 (58%)	357 (98%)	7 (2%)	57	75
5	E	595/724 (82%)	566 (95%)	29 (5%)	25	51
6	F	494/619 (80%)	484 (98%)	10 (2%)	55	73
All	All	2840/4209 (68%)	2760 (97%)	80 (3%)	46	65

5 of 80 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
5	E	175	LEU
6	F	317	ARG
5	E	202	SER
5	E	571	LYS
6	F	405	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 31 such sidechains are listed below:

Mol	Chain	Res	Type
3	C	206	GLN
6	F	18	GLN
3	C	469	ASN
6	F	460	GLN
5	E	423	HIS

5.3.3   RNA   ⓘ

There are no RNA molecules in this entry.

5.4　Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5　Carbohydrates ⓘ

There are no monosaccharides in this entry.

5.6　Ligand geometry ⓘ

There are no ligands in this entry.

5.7　Other polymers ⓘ

There are no such residues in this entry.

5.8　Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6 Map visualisation ⓘ

This section contains visualisations of the EMDB entry EMD-32326. 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 ⓘ

6.1.1 Primary map

X

Y

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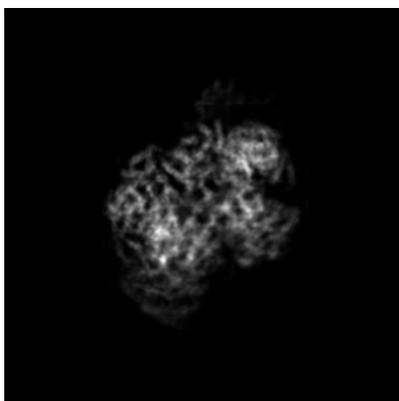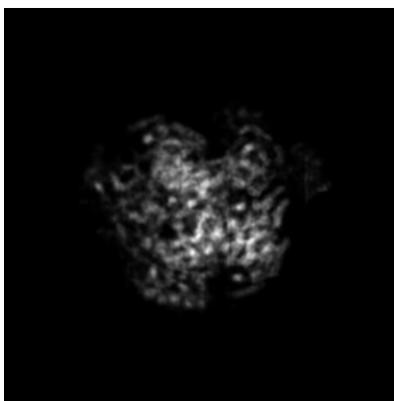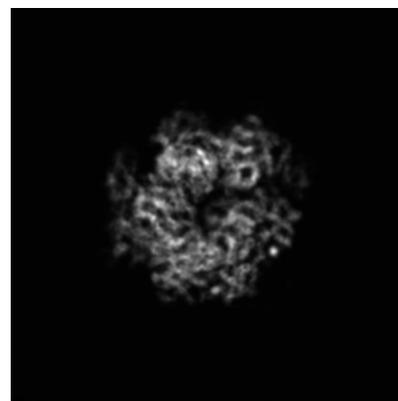
The images above show the map projected in three orthogonal directions.

6.2 Central slices ⓘ
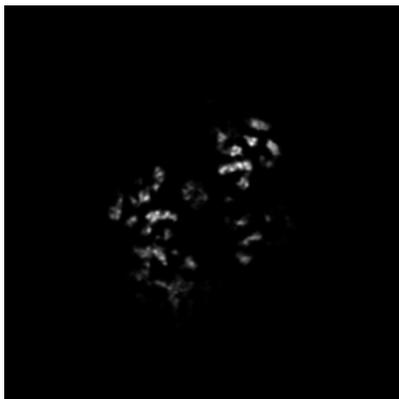
6.2.1 Primary map

X Index: 120
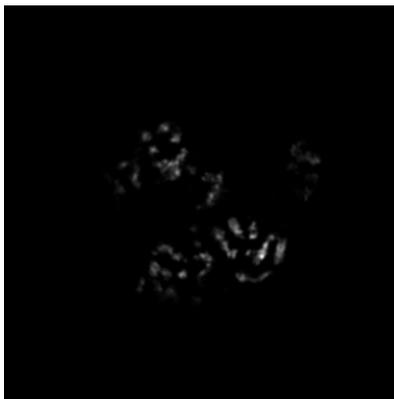
Y Index: 120
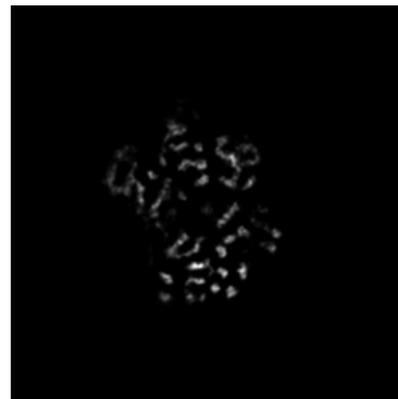
Z Index: 120

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

6.3 Largest variance slices ⓘ
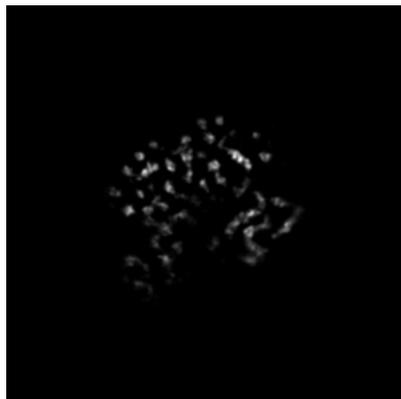
6.3.1 Primary map
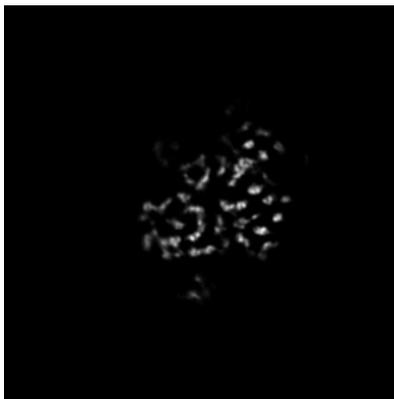
| X Index: 98 | Y Index: 146 | Z Index: 119 |
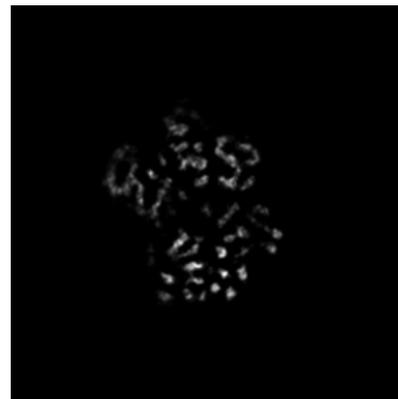
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal surface views ⓘ

6.4.1 Primary map

| X | Y | Z |
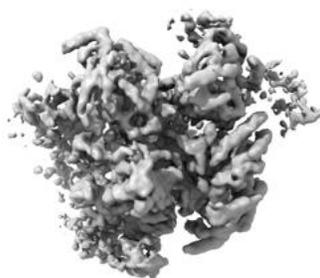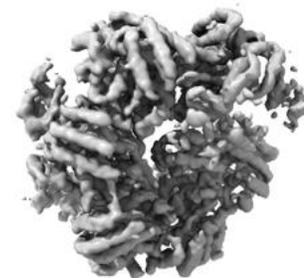
The images above show the 3D surface view of the map at the recommended contour level 0.14. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

6.5   Mask visualisation ⓘ

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

7   Map analysis ⓘ

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

7.1   Map-value distribution ⓘ
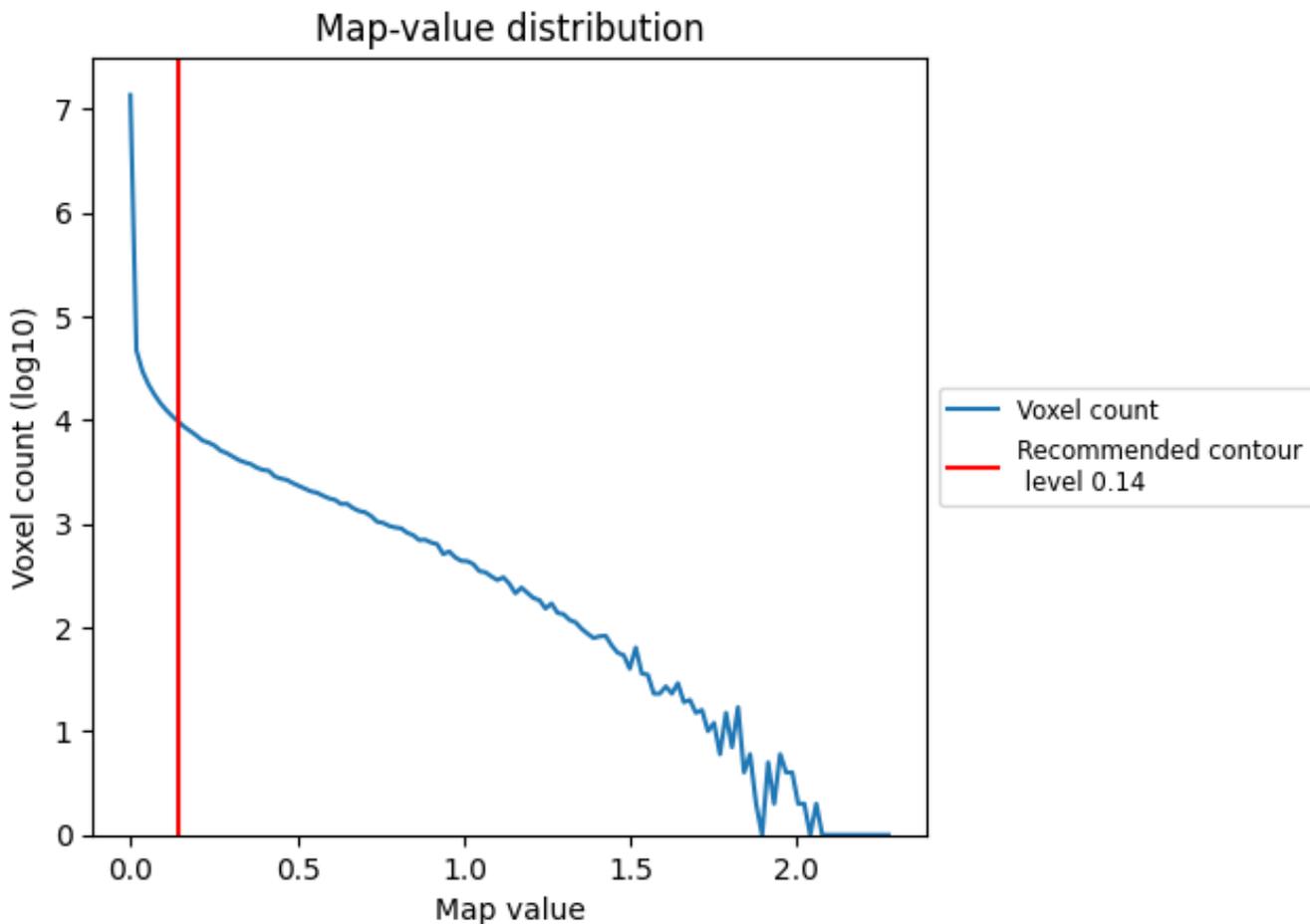
The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

7.2 Volume estimate ⓘ
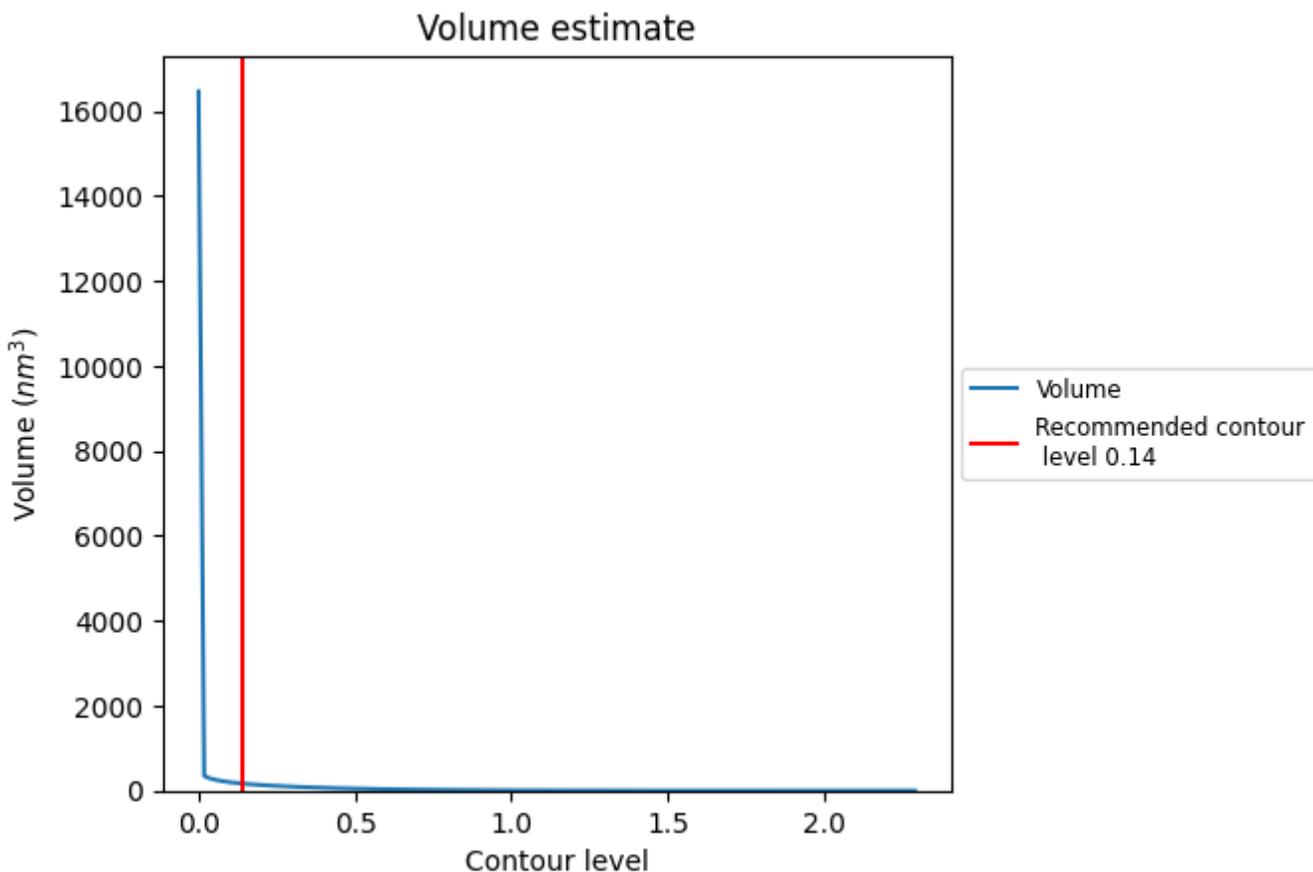
The volume at the recommended contour level is 165 nm^3; this corresponds to an approximate mass of 149 kDa.

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)
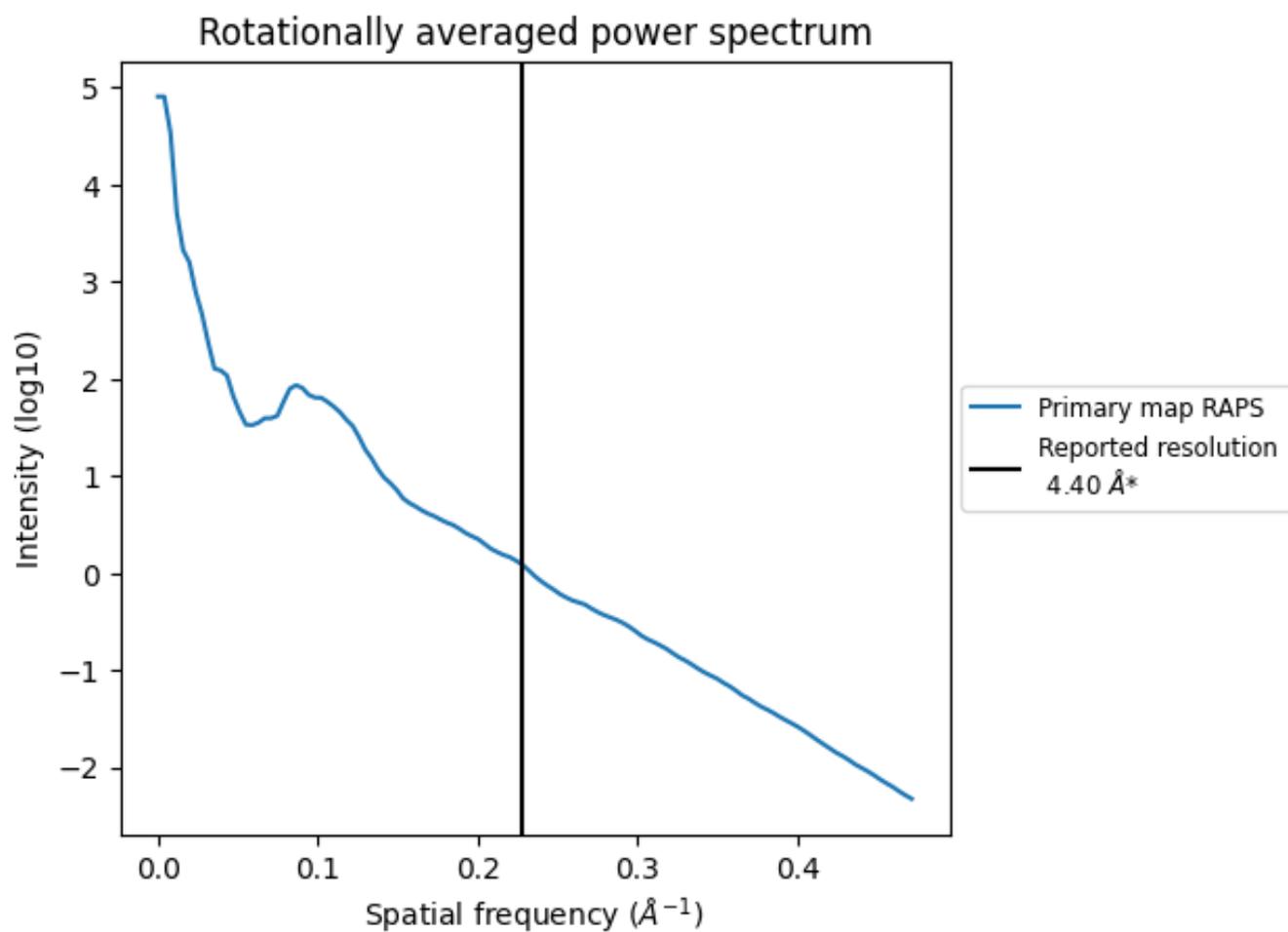
*Reported resolution corresponds to spatial frequency of 0.227 Å^{-1}

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 ⓘ
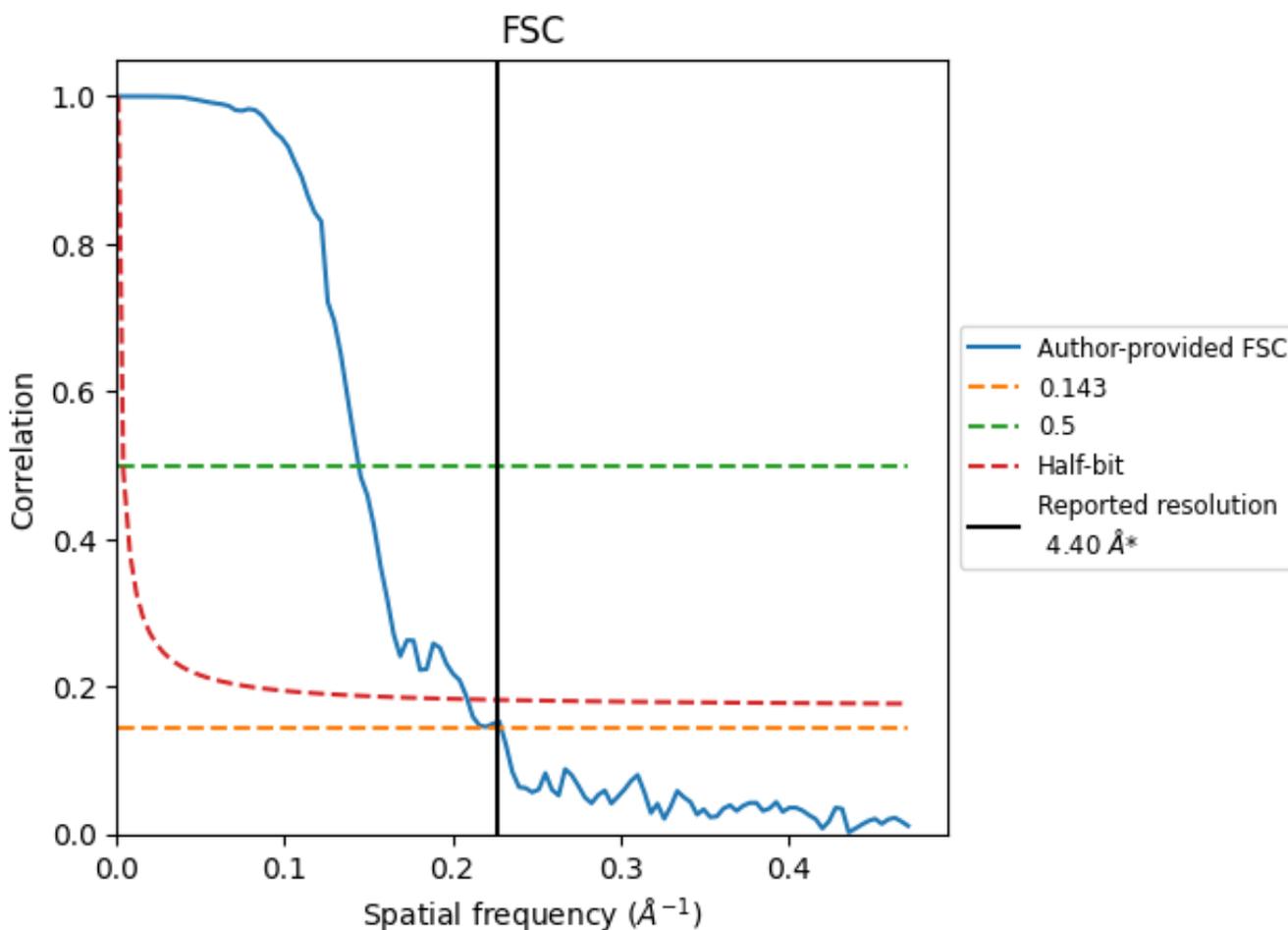
*Reported resolution corresponds to spatial frequency of 0.227 Å^{-1}

8.2 Resolution estimates ⓘ

Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	4.40	-	-
Author-provided FSC curve	4.36	6.93	4.79
Unmasked-calculated*	-	-	-

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps.

9 Map-model fit ⓘ

This section contains information regarding the fit between EMDB map EMD-32326 and PDB model 7W68. Per-residue inclusion information can be found in section 3 on page 4.

## 9.1 Map-model overlay ⓘ

| X | Y | Z |
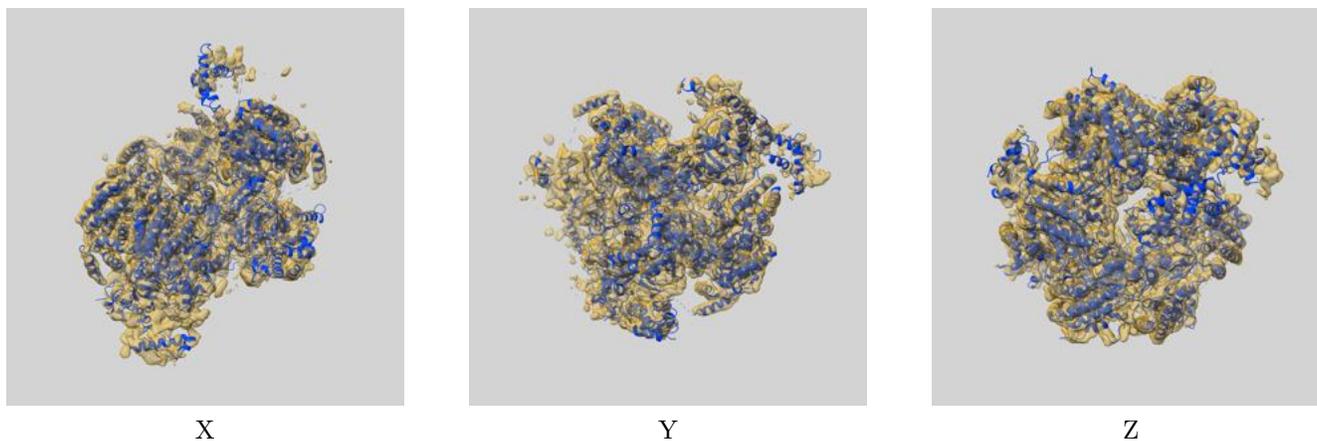
The images above show the 3D surface view of the map at the recommended contour level 0.14 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

9.2   Q-score mapped to coordinate model ⓘ


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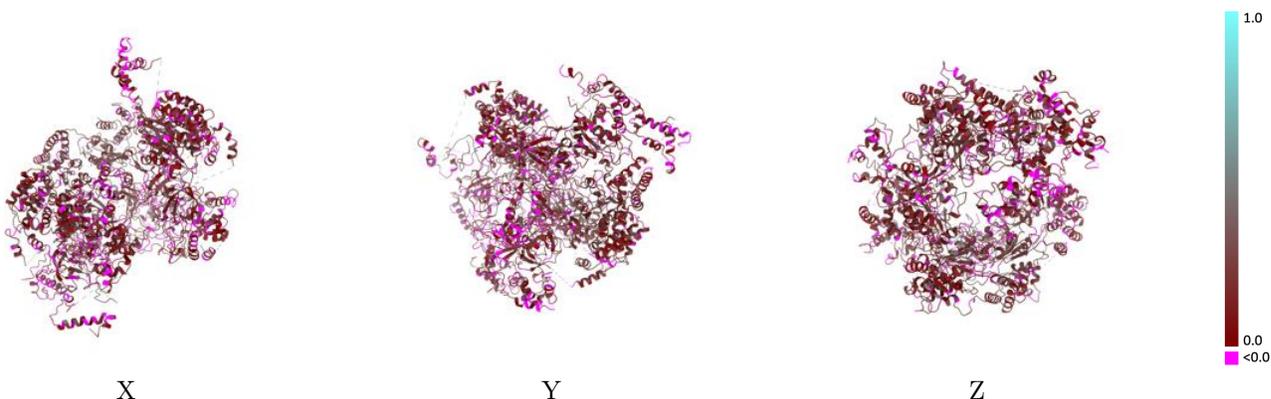
The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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

X   Y   Z
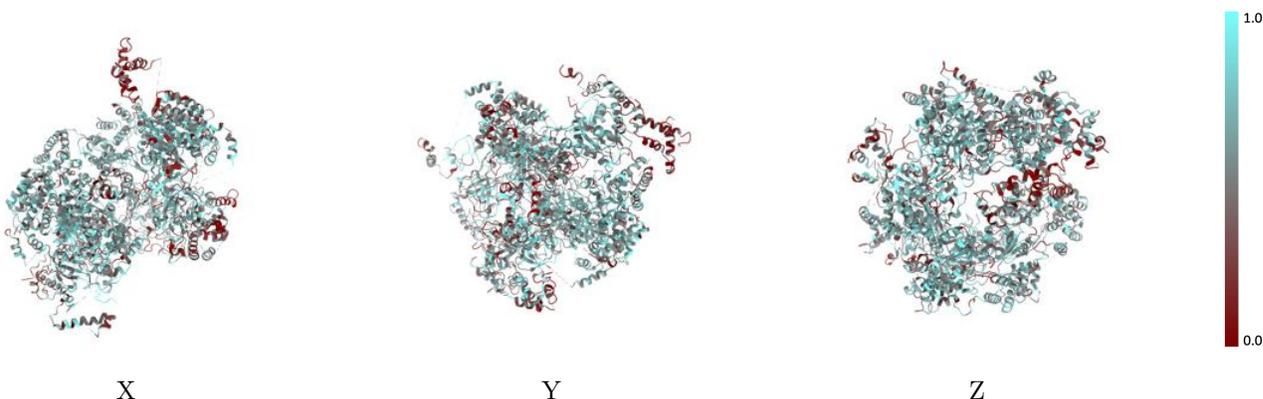
The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.14).

9.4   Atom inclusion ⓘ
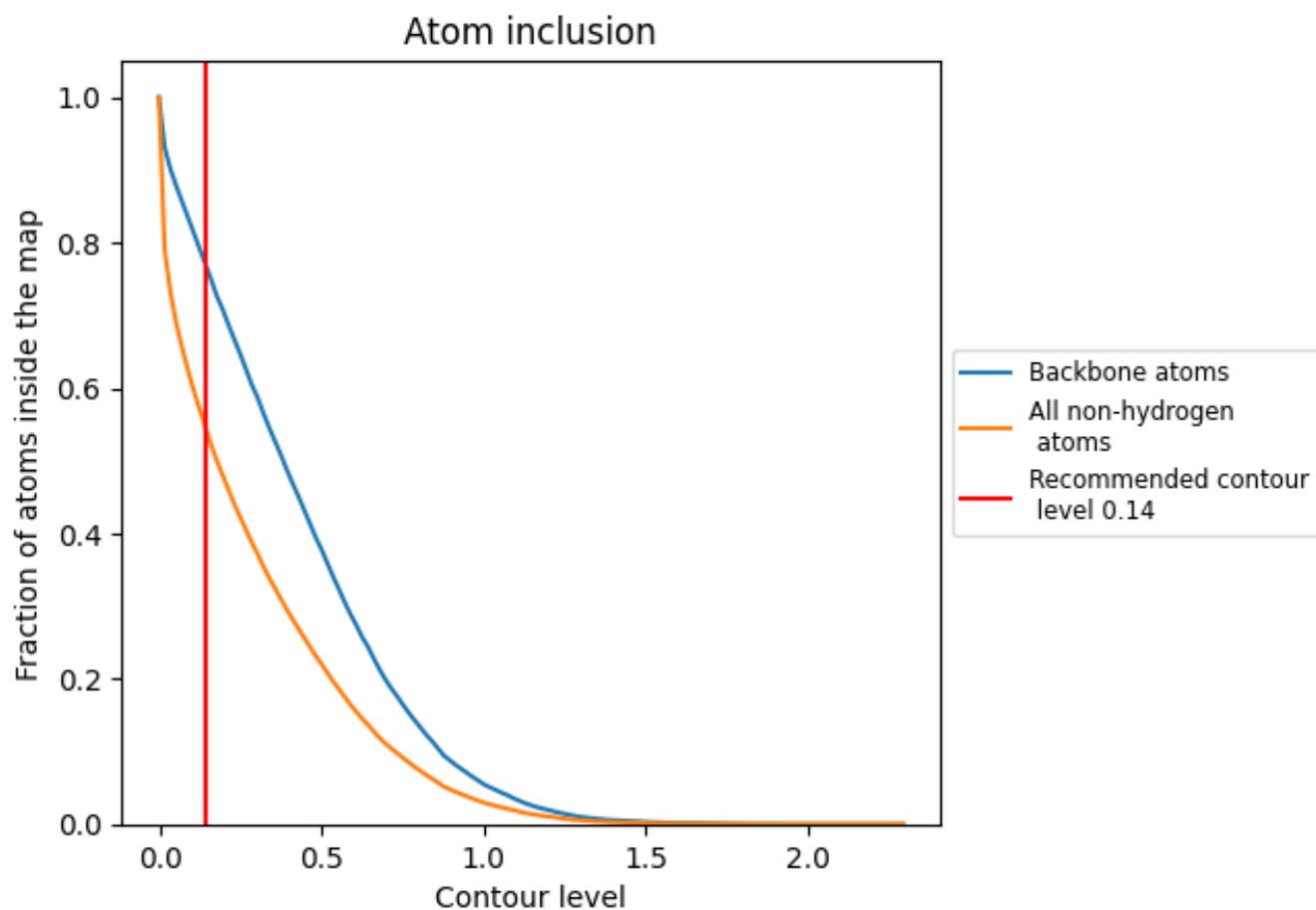
At the recommended contour level, 77% of all backbone atoms, 55% of all non-hydrogen atoms, are inside the map.

9.5   Map-model fit summary ⓘ

The table lists the average atom inclusion at the recommended contour level (0.14) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.5476	0.1490
A	0.5305	0.1370
B	0.5781	0.1690
C	0.5757	0.1560
D	0.5565	0.1460
E	0.5205	0.1450
F	0.5373	0.1440

1.0

0.0
<0.0