



## Full wwPDB EM Validation Report ⓘ

Feb 25, 2024 – 03:42 PM EST

PDB ID : 5KHR  
EMDB ID : EMD-4025  
Title : Model of human Anaphase-promoting complex/Cyclosome complex (APC15 deletion mutant) in complex with the E2 UBE2C/UBCH10 poised for ubiquitin ligation to substrate (APC/C-CDC20-substrate-UBE2C)  
Authors : VanderLinden, R.; Yamaguchi, M.; Dube, P.; Haselbach, D.; Stark, H.; Schulman, B.A.  
Deposited on : 2016-06-15  
Resolution : 6.10 Å(reported)

This is a Full wwPDB EM Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto: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>.

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

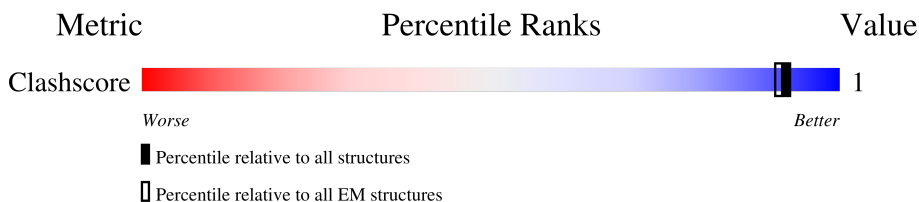
EMDB validation analysis : 0.0.1.dev70  
MolProbity : 4.02b-467  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
MapQ : 1.9.13  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36

# 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 6.10 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

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  $\geq 3$ , 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	1944	9%	71% 28%
2	B	84	18%	82% 18%
3	C	597	12%	78% 22%
3	P	597	5%	74% 26%
4	E	110	•	51% 49%
5	F	824	•	58% 42%
5	H	824	•	59% 41%
6	G	85	9%	29% 71%
6	W	85	5%	29% 71%
7	I	818	6%	84% 15%

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Mol	Chain	Length	Quality of chain
8	J	620	
8	K	620	
9	L	185	
10	M	74	
11	N	822	
12	O	755	
13	Q	190	
14	R	499	
15	S	33	
16	X	565	
16	Y	565	

## 2 Entry composition [i](#)

There are 16 unique types of molecules in this entry. The entry contains 7936 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 Anaphase-promoting complex subunit 1.

Mol	Chain	Residues	Atoms		AltConf	Trace
1	A	1391	Total	C	0	1391
			1391	1391		

- Molecule 2 is a protein called Anaphase-promoting complex subunit 11.

Mol	Chain	Residues	Atoms		AltConf	Trace
2	B	69	Total	C	1	69
			70	70		

- Molecule 3 is a protein called Cell division cycle protein 23 homolog.

Mol	Chain	Residues	Atoms		AltConf	Trace
3	C	468	Total	C	0	468
			468	468		
3	P	441	Total	C	0	441
			441	441		

- Molecule 4 is a protein called Anaphase-promoting complex subunit 16.

Mol	Chain	Residues	Atoms		AltConf	Trace
4	E	56	Total	C	0	56
			56	56		

- Molecule 5 is a protein called Cell division cycle protein 27 homolog.

Mol	Chain	Residues	Atoms		AltConf	Trace
5	F	481	Total	C	0	481
			481	481		
5	H	483	Total	C	0	483
			483	483		

- Molecule 6 is a protein called Anaphase-promoting complex subunit CDC26.

Mol	Chain	Residues	Atoms	AltConf	Trace
6	G	25	Total C 25 25	0	25
6	W	25	Total C 25 25	0	25

- Molecule 7 is a protein called Anaphase-promoting complex subunit 4.

Mol	Chain	Residues	Atoms	AltConf	Trace
7	I	693	Total C 693 693	0	693

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
I	809	GLY	-	expression tag	UNP Q9UJX5
I	810	GLY	-	expression tag	UNP Q9UJX5
I	811	SER	-	expression tag	UNP Q9UJX5
I	812	LEU	-	expression tag	UNP Q9UJX5
I	813	GLU	-	expression tag	UNP Q9UJX5
I	814	VAL	-	expression tag	UNP Q9UJX5
I	815	LEU	-	expression tag	UNP Q9UJX5
I	816	PHE	-	expression tag	UNP Q9UJX5
I	817	GLN	-	expression tag	UNP Q9UJX5
I	818	GLY	-	expression tag	UNP Q9UJX5

- Molecule 8 is a protein called Cell division cycle protein 16 homolog.

Mol	Chain	Residues	Atoms	AltConf	Trace
8	J	504	Total C 504 504	0	504
8	K	493	Total C 493 493	0	493

- Molecule 9 is a protein called Anaphase-promoting complex subunit 10.

Mol	Chain	Residues	Atoms	AltConf	Trace
9	L	174	Total C 174 174	0	174

- Molecule 10 is a protein called Anaphase-promoting complex subunit 13.

Mol	Chain	Residues	Atoms	AltConf	Trace
10	M	47	Total C 47 47	0	47

- Molecule 11 is a protein called Anaphase-promoting complex subunit 2.

Mol	Chain	Residues	Atoms	AltConf	Trace
11	N	645	Total C 645 645	0	645

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
N	534	GLU	SER	engineered mutation	UNP Q9UJX6
N	811	GLU	SER	engineered mutation	UNP Q9UJX6

- Molecule 12 is a protein called Anaphase-promoting complex subunit 5.

Mol	Chain	Residues	Atoms	AltConf	Trace
12	O	603	Total C 603 603	0	603

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
O	221	GLU	SER	engineered mutation	UNP Q9UJX4
O	232	GLU	THR	engineered mutation	UNP Q9UJX4

- Molecule 13 is a protein called Ubiquitin-conjugating enzyme E2 C.

Mol	Chain	Residues	Atoms	AltConf	Trace
13	Q	145	Total C 146 146	1	145

There are 11 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
Q	180	GLY	-	expression tag	UNP O00762
Q	181	GLY	-	expression tag	UNP O00762
Q	182	SER	-	expression tag	UNP O00762
Q	183	GLY	-	expression tag	UNP O00762
Q	184	SER	-	expression tag	UNP O00762
Q	185	LEU	-	expression tag	UNP O00762

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Chain	Residue	Modelled	Actual	Comment	Reference
Q	186	GLU	-	expression tag	UNP O00762
Q	187	VAL	-	expression tag	UNP O00762
Q	188	LEU	-	expression tag	UNP O00762
Q	189	PHE	-	expression tag	UNP O00762
Q	190	GLN	-	expression tag	UNP O00762

- Molecule 14 is a protein called Cell division cycle protein 20 homolog.

Mol	Chain	Residues	Atoms	AltConf	Trace
14	R	368	Total C 370 370	2	368

- Molecule 15 is a protein called HSL1 peptide.

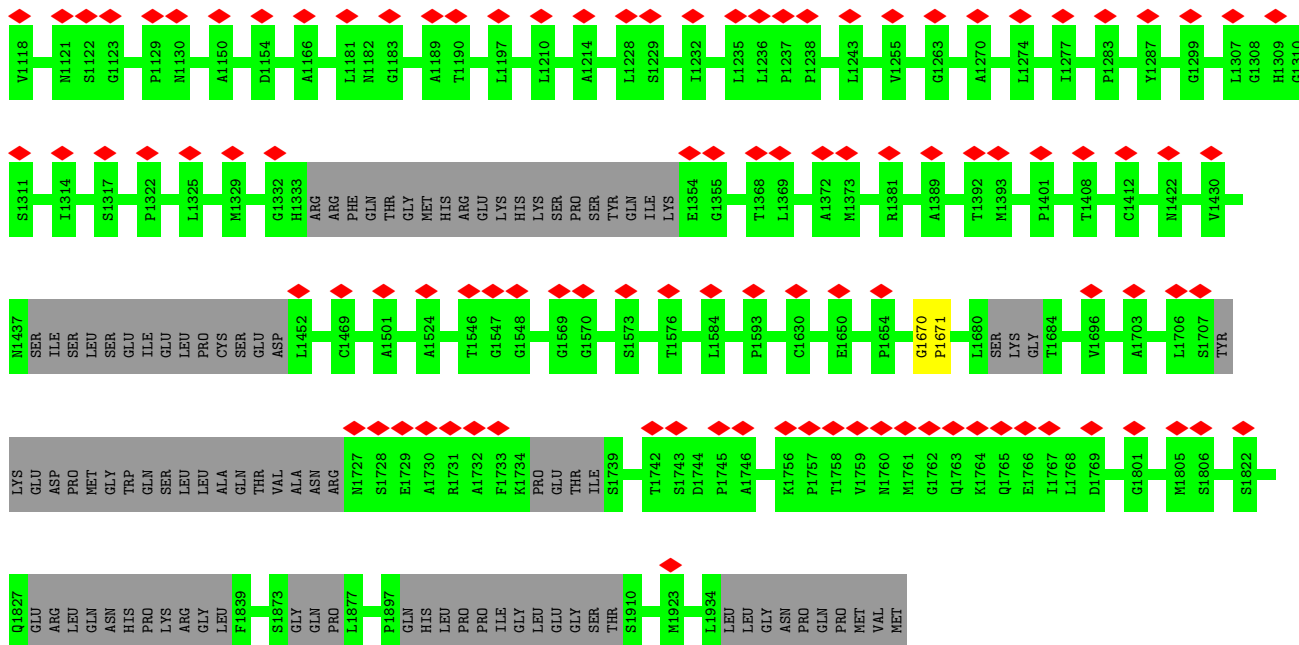
Mol	Chain	Residues	Atoms	AltConf	Trace
15	S	10	Total C 10 10	0	10

- Molecule 16 is a protein called Anaphase-promoting complex subunit 7.

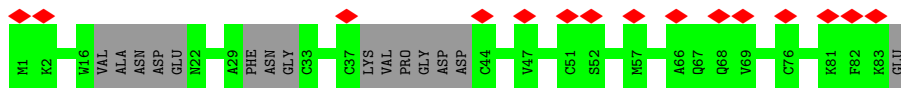
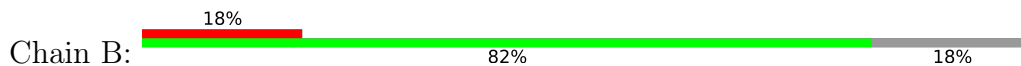
Mol	Chain	Residues	Atoms	AltConf	Trace
16	X	396	Total C 396 396	0	396
16	Y	415	Total C 415 415	0	415



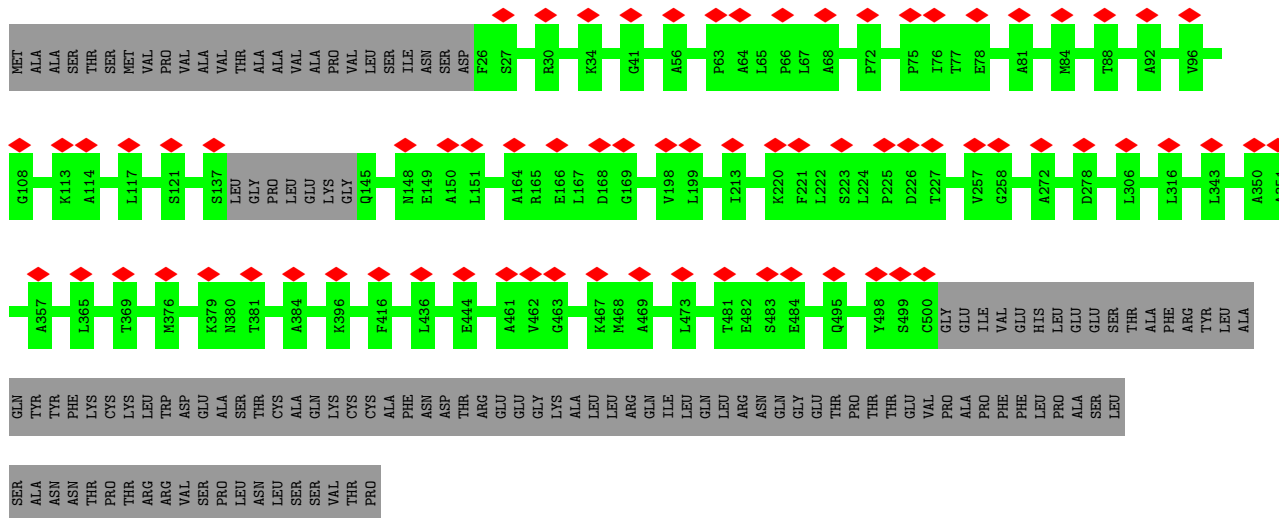
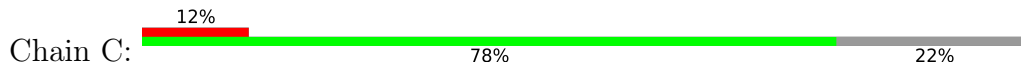




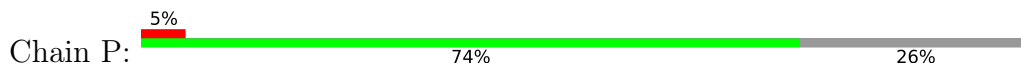
• Molecule 2: Anaphase-promoting complex subunit 11

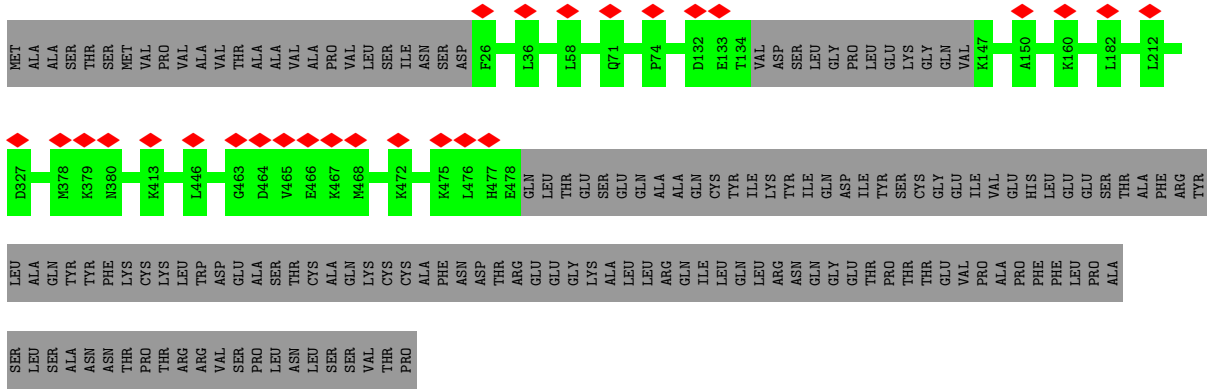


• Molecule 3: Cell division cycle protein 23 homolog

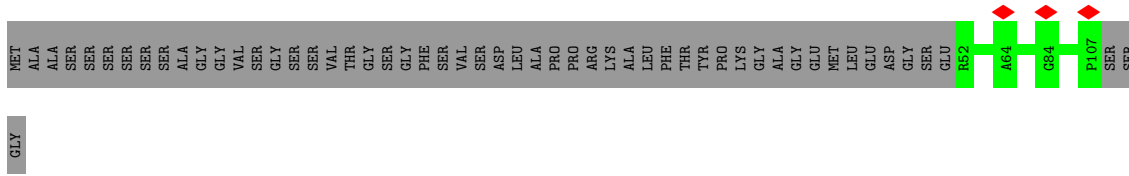


• Molecule 3: Cell division cycle protein 23 homolog

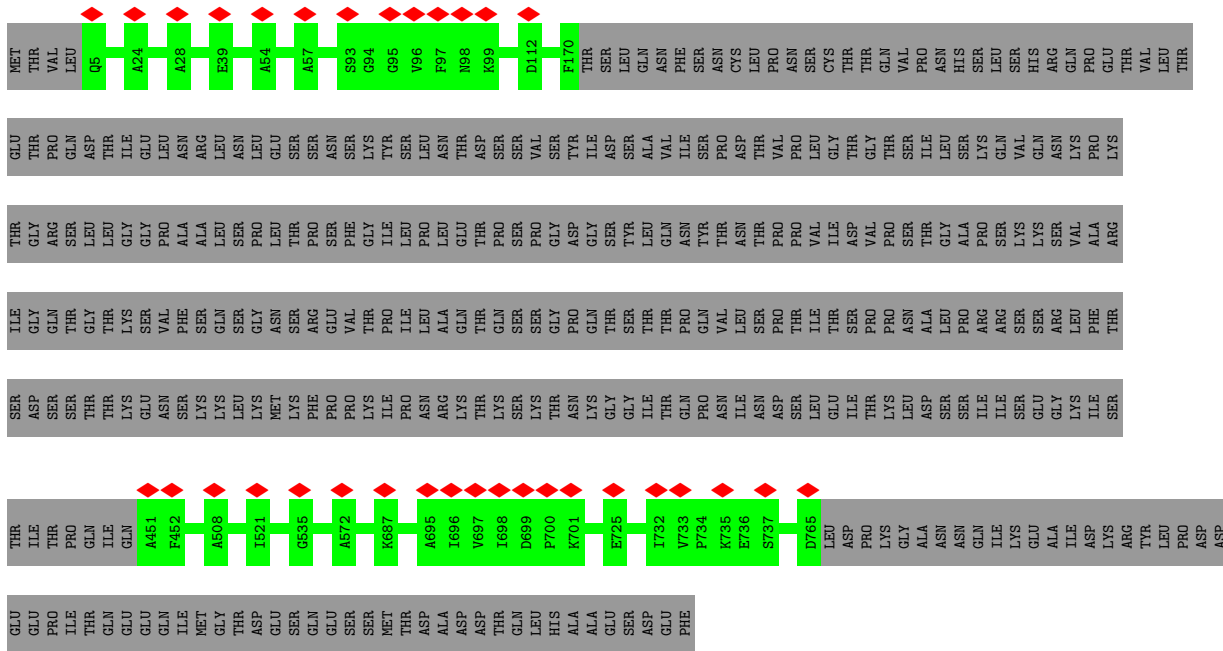




● Molecule 4: Anaphase-promoting complex subunit 16

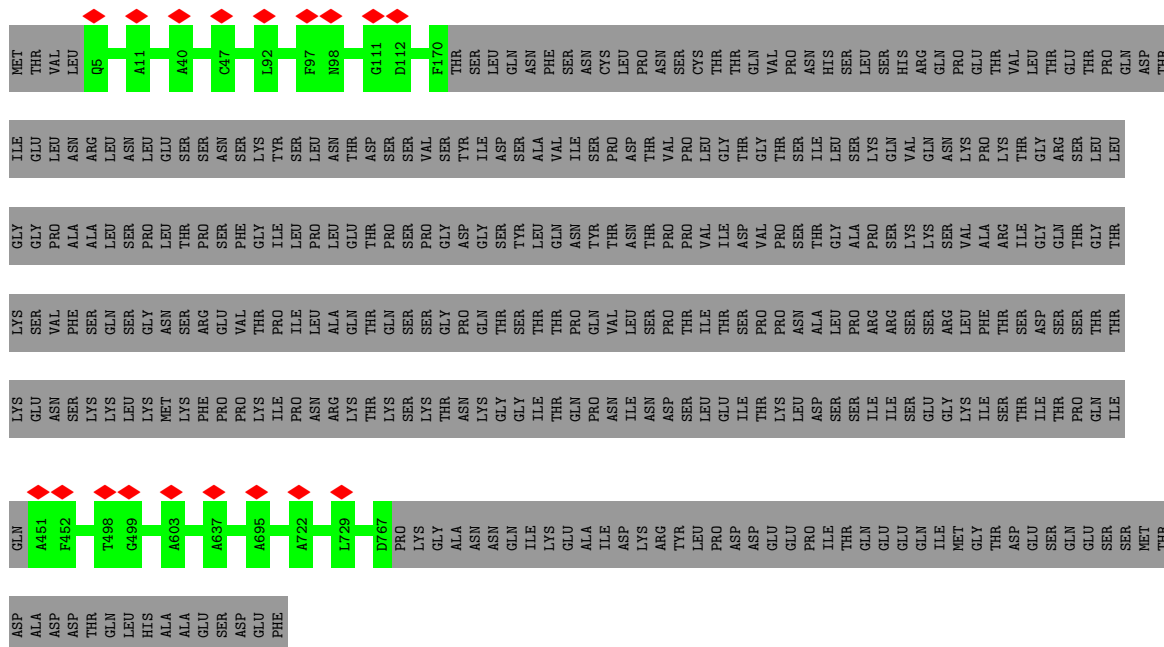


● Molecule 5: Cell division cycle protein 27 homolog



● Molecule 5: Cell division cycle protein 27 homolog





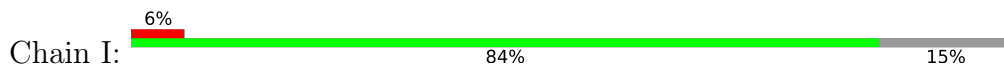
- Molecule 6: Anaphase-promoting complex subunit CDC26



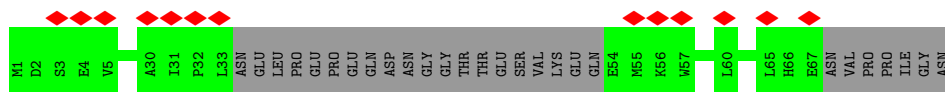
- Molecule 6: Anaphase-promoting complex subunit CDC26



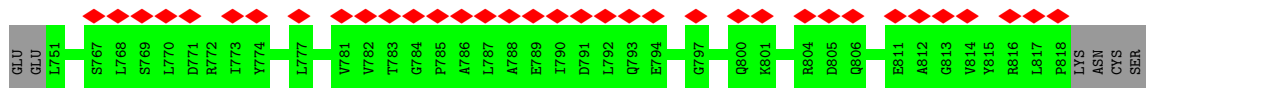
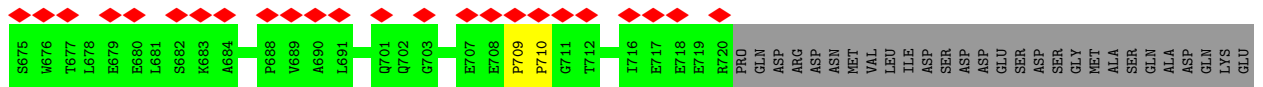
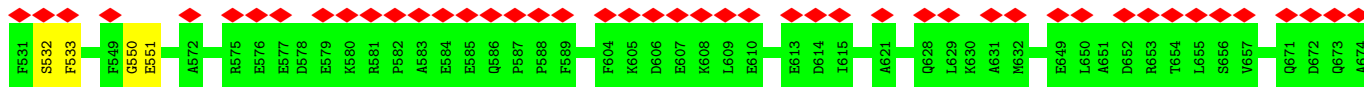
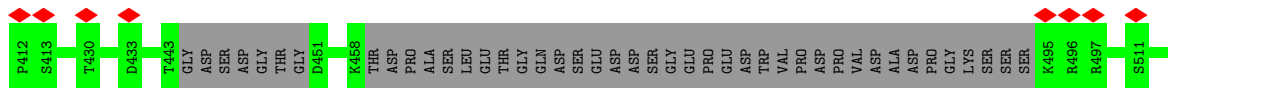
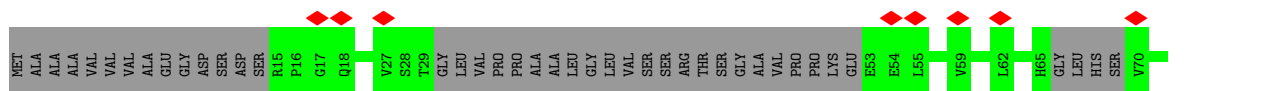
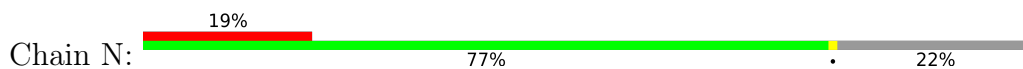
- Molecule 7: Anaphase-promoting complex subunit 4



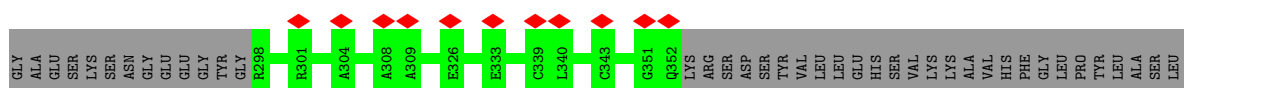
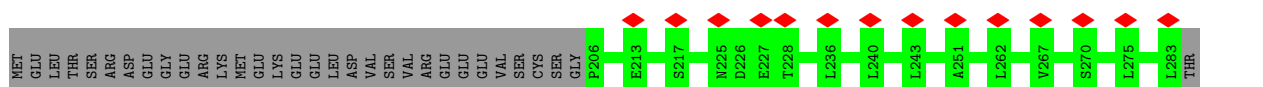
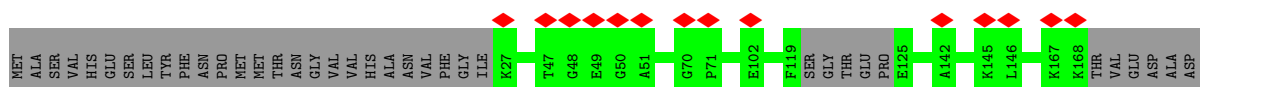
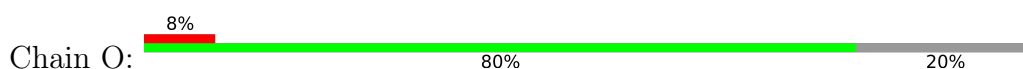


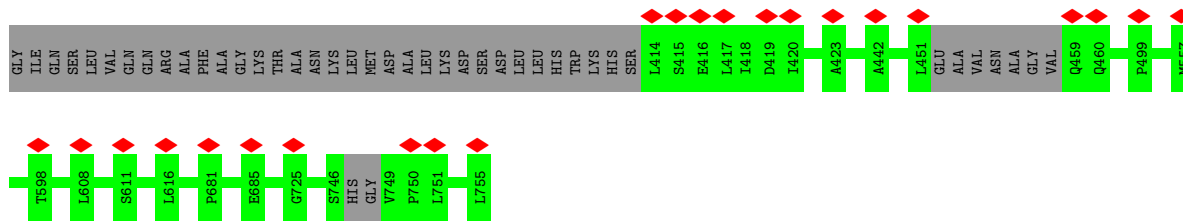


• Molecule 11: Anaphase-promoting complex subunit 2

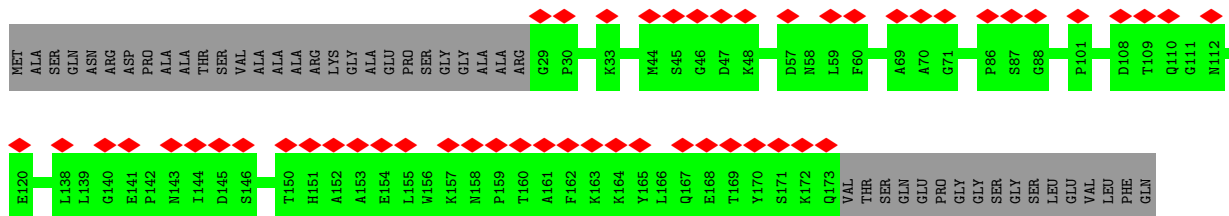
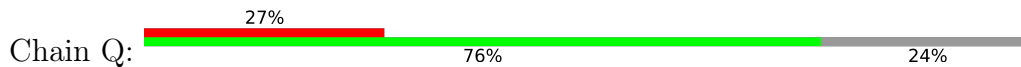


• Molecule 12: Anaphase-promoting complex subunit 5

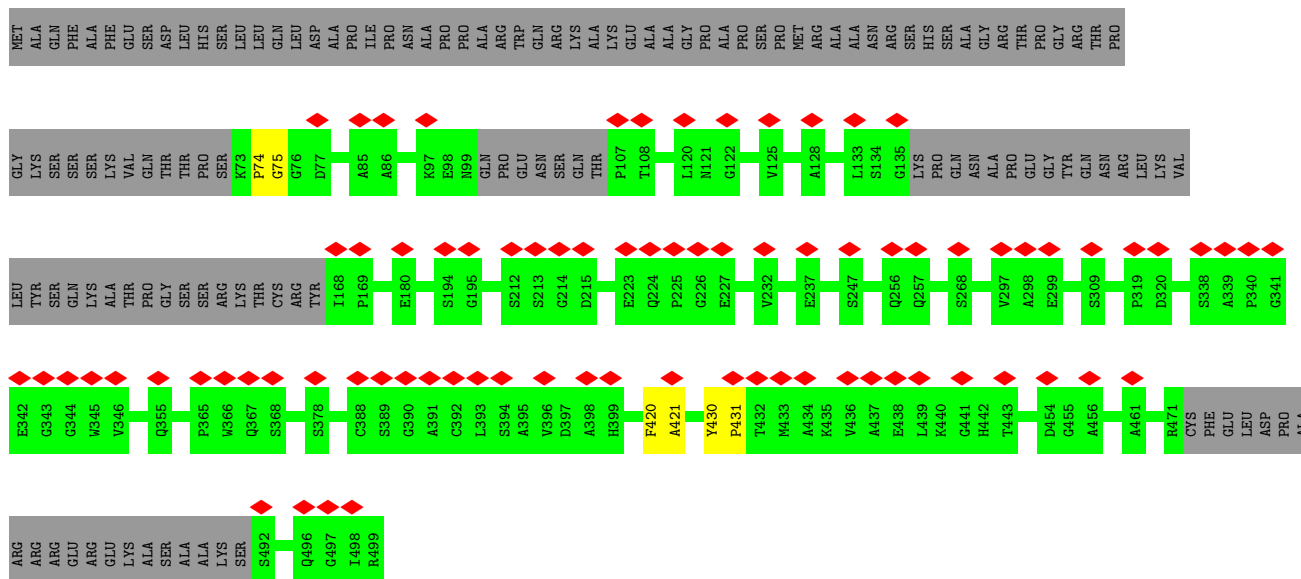
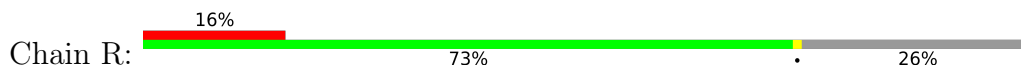




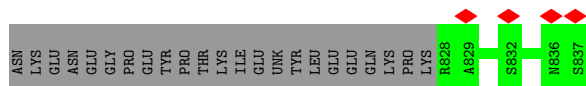
• Molecule 13: Ubiquitin-conjugating enzyme E2 C



• Molecule 14: Cell division cycle protein 20 homolog

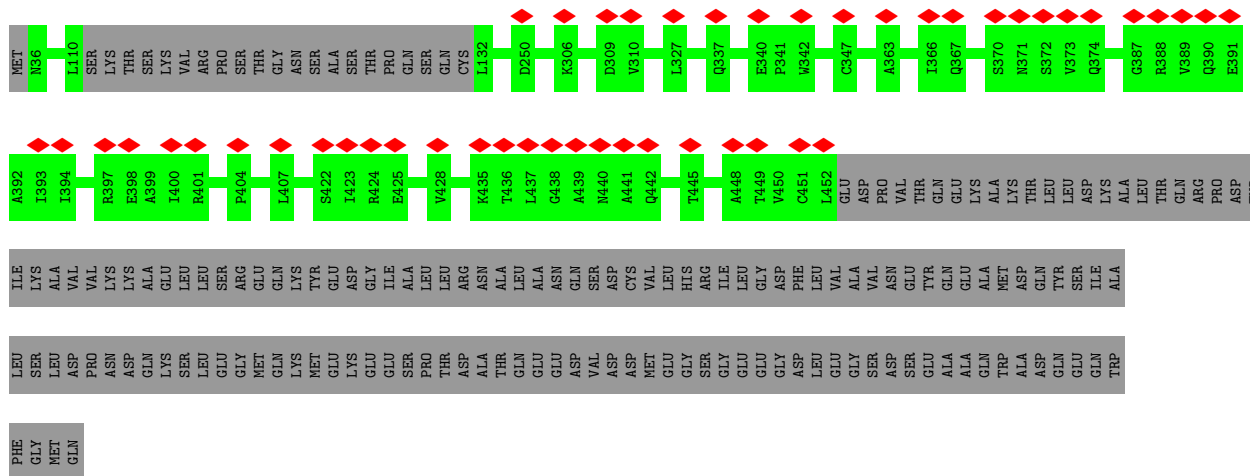


• Molecule 15: HSL1 peptide

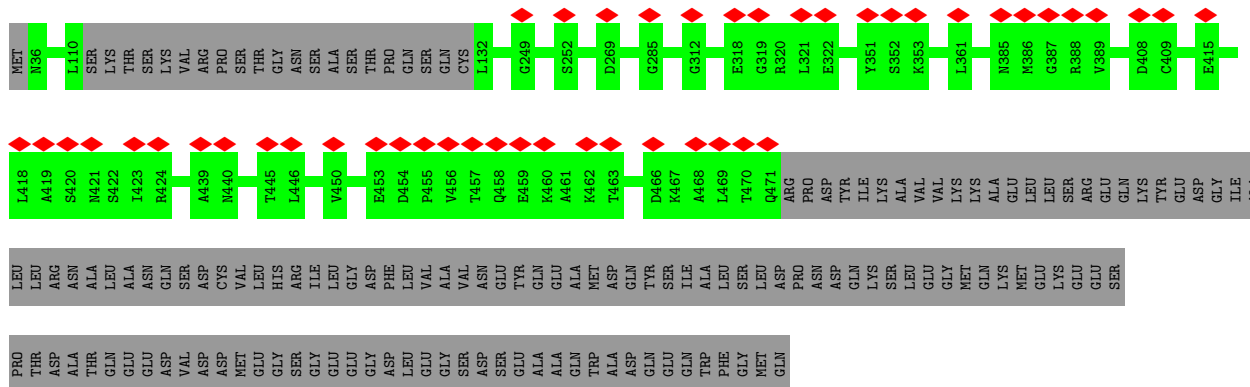
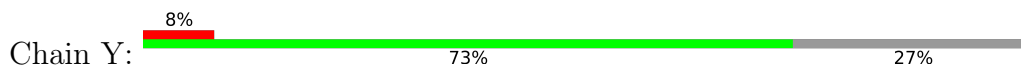


• Molecule 16: Anaphase-promoting complex subunit 7





• Molecule 16: Anaphase-promoting complex subunit 7



## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	222697	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 ( $e^-/\text{\AA}^2$ )	40	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	FEI FALCON II (4k x 4k)	Depositor
Maximum map value	0.317	Depositor
Minimum map value	-0.138	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.017	Depositor
Recommended contour level	0.081	Depositor
Map size (Å)	401.92, 401.92, 401.92	wwPDB
Map dimensions	256, 256, 256	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.57, 1.57, 1.57	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).

There are no protein, RNA or DNA chains available to summarize Z scores of covalent bonds and angles.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	1391	0	0	2	0
2	B	70	0	0	0	0
3	C	468	0	0	0	0
3	P	441	0	0	0	0
4	E	56	0	0	0	0
5	F	481	0	0	0	0
5	H	483	0	0	0	0
6	G	25	0	0	0	0
6	W	25	0	0	0	0
7	I	693	0	0	1	0
8	J	504	0	0	0	0
8	K	493	0	0	0	0
9	L	174	0	0	1	0
10	M	47	0	0	0	0
11	N	645	0	0	4	0
12	O	603	0	0	0	0
13	Q	146	0	0	0	0
14	R	370	0	0	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
15	S	10	0	0	0	0
16	X	396	0	0	0	0
16	Y	415	0	0	0	0
All	All	7936	0	0	11	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 1.

All (11) 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)
11:N:532:SER:CA	11:N:533:PHE:CA	2.83	0.56
1:A:1670:GLY:CA	1:A:1671:PRO:CA	2.84	0.55
11:N:550:GLY:CA	11:N:551:GLU:CA	2.85	0.55
11:N:368:THR:CA	11:N:369:ASP:CA	2.90	0.49
14:R:420:PHE:CA	14:R:421:ALA:CA	2.92	0.48
9:L:60:GLN:CA	9:L:61:PRO:CA	2.92	0.48
14:R:430:TYR:CA	14:R:431:PRO:CA	2.92	0.48
1:A:1112:PRO:CA	1:A:1113:PRO:CA	2.94	0.45
11:N:709:PRO:CA	11:N:710:PRO:CA	2.96	0.44
14:R:74:PRO:CA	14:R:75:GLY:CA	2.98	0.41
7:I:572:PHE:CA	7:I:573:PRO:CA	2.98	0.41

There are no symmetry-related clashes.

### 5.3 Torsion angles [\(i\)](#)

#### 5.3.1 Protein backbone [\(i\)](#)

There are no protein backbone outliers to report in this entry.

#### 5.3.2 Protein sidechains [\(i\)](#)

There are no protein residues with a non-rotameric sidechain to report in this entry.

#### 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.

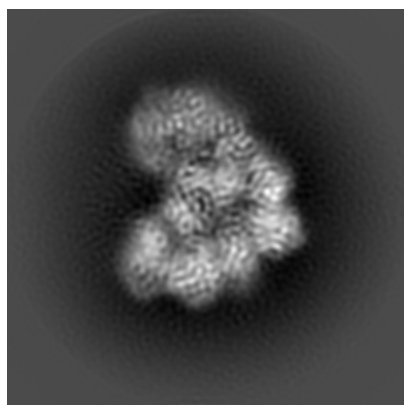
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-4025. These allow visual inspection of the internal detail of the map and identification of artifacts.

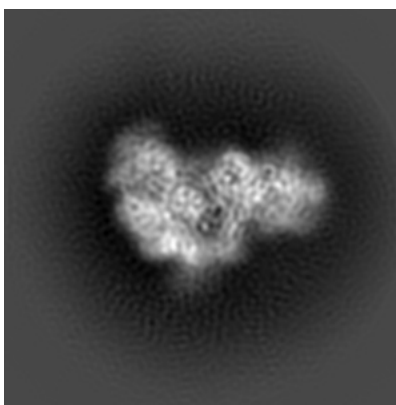
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

### 6.1 Orthogonal projections [i](#)

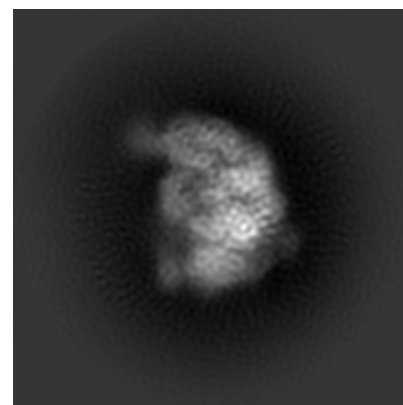
#### 6.1.1 Primary map



X



Y

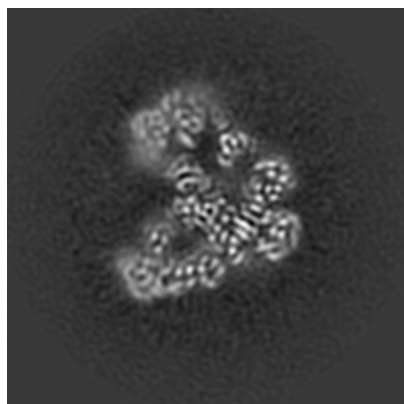


Z

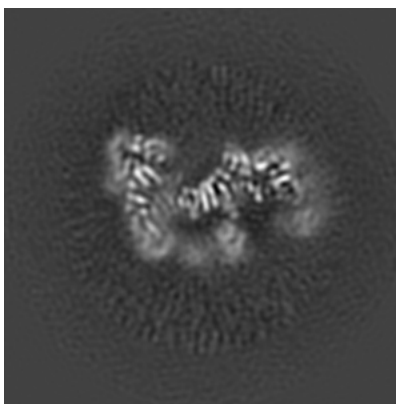
The images above show the map projected in three orthogonal directions.

### 6.2 Central slices [i](#)

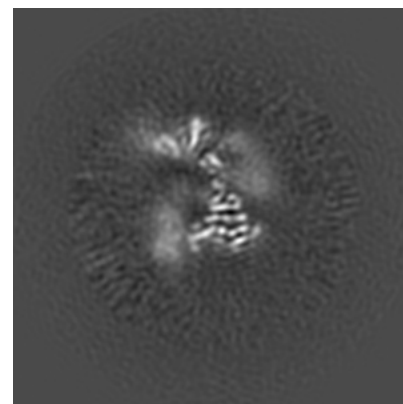
#### 6.2.1 Primary map



X Index: 128



Y Index: 128

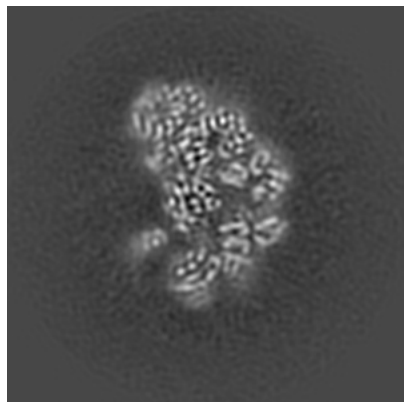


Z Index: 128

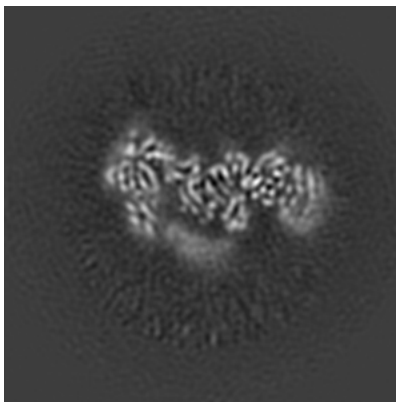
The images above show central slices of the map in three orthogonal directions.

## 6.3 Largest variance slices [i](#)

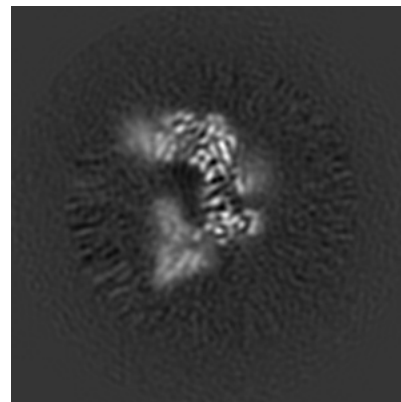
### 6.3.1 Primary map



X Index: 141



Y Index: 118

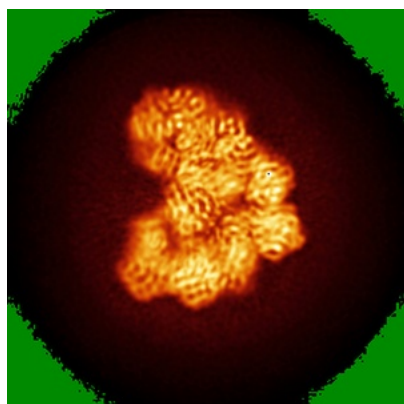


Z Index: 119

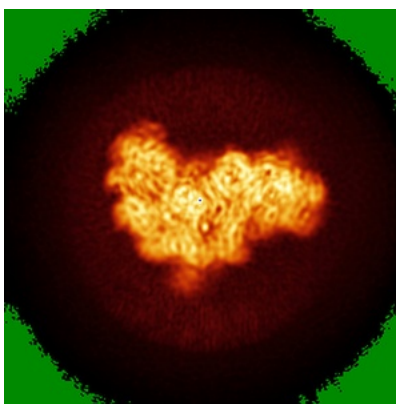
The images above show the largest variance slices of the map in three orthogonal directions.

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

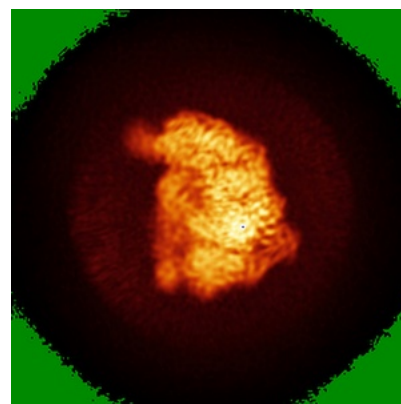
### 6.4.1 Primary map



X



Y

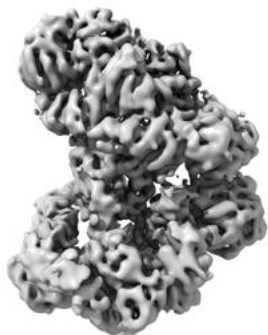


Z

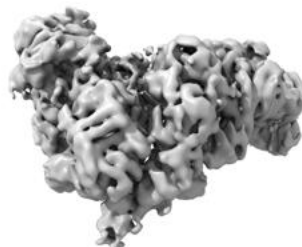
The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

## 6.5 Orthogonal surface views [i](#)

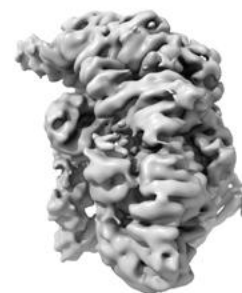
### 6.5.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.081. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

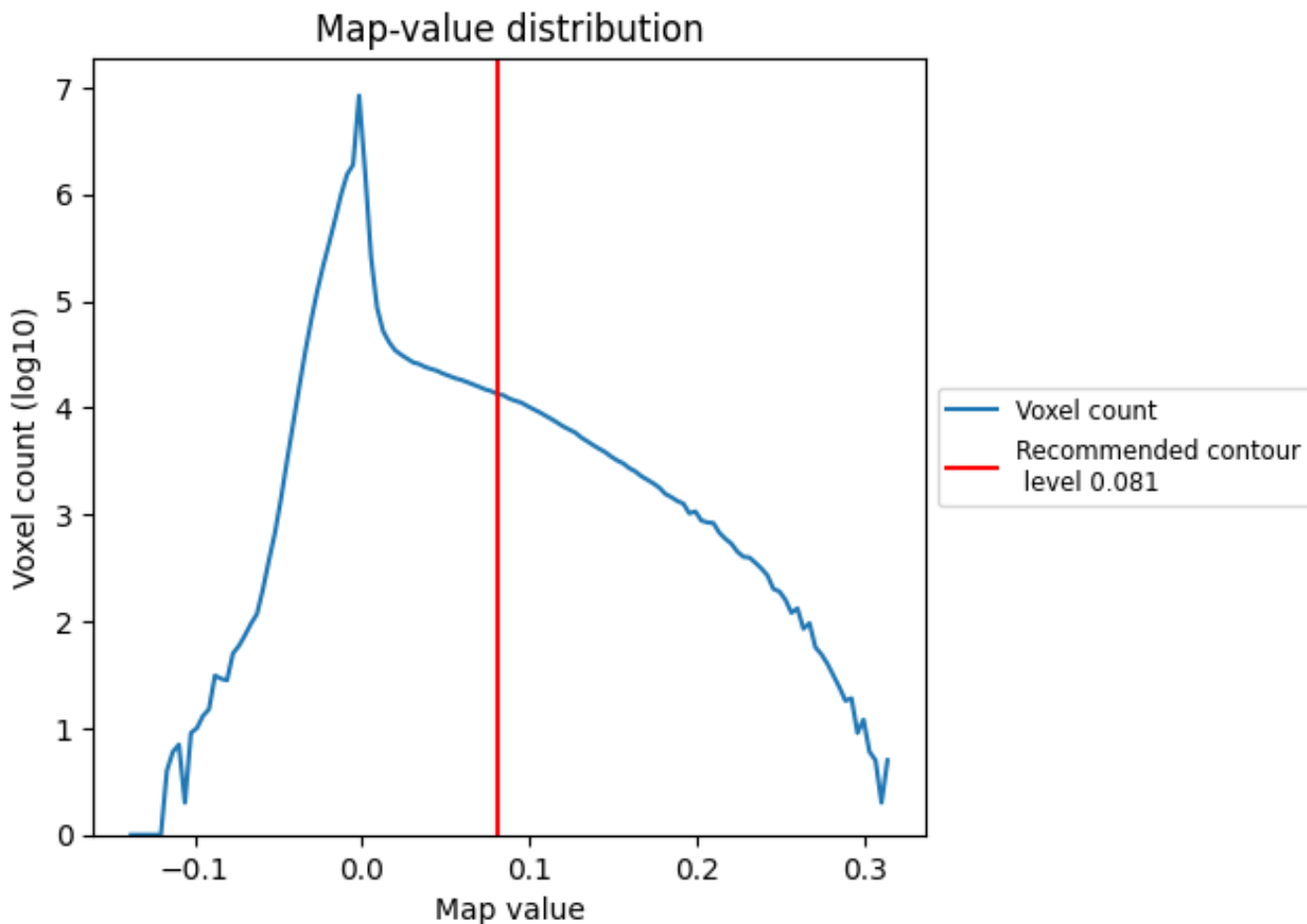
## 6.6 Mask visualisation [i](#)

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

## 7 Map analysis [i](#)

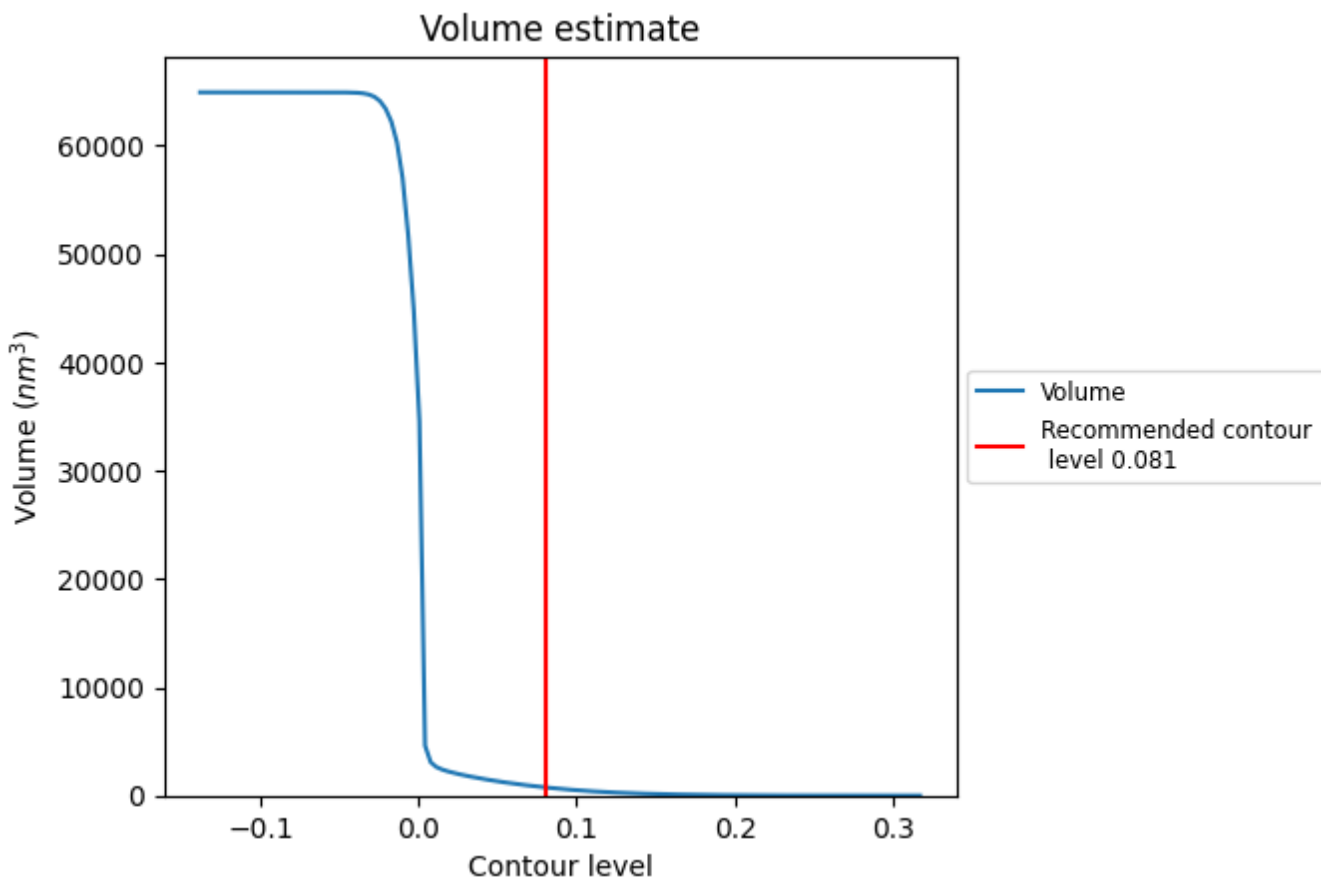
This section contains the results of statistical analysis of the map.

### 7.1 Map-value distribution [i](#)



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

## 7.2 Volume estimate [i](#)

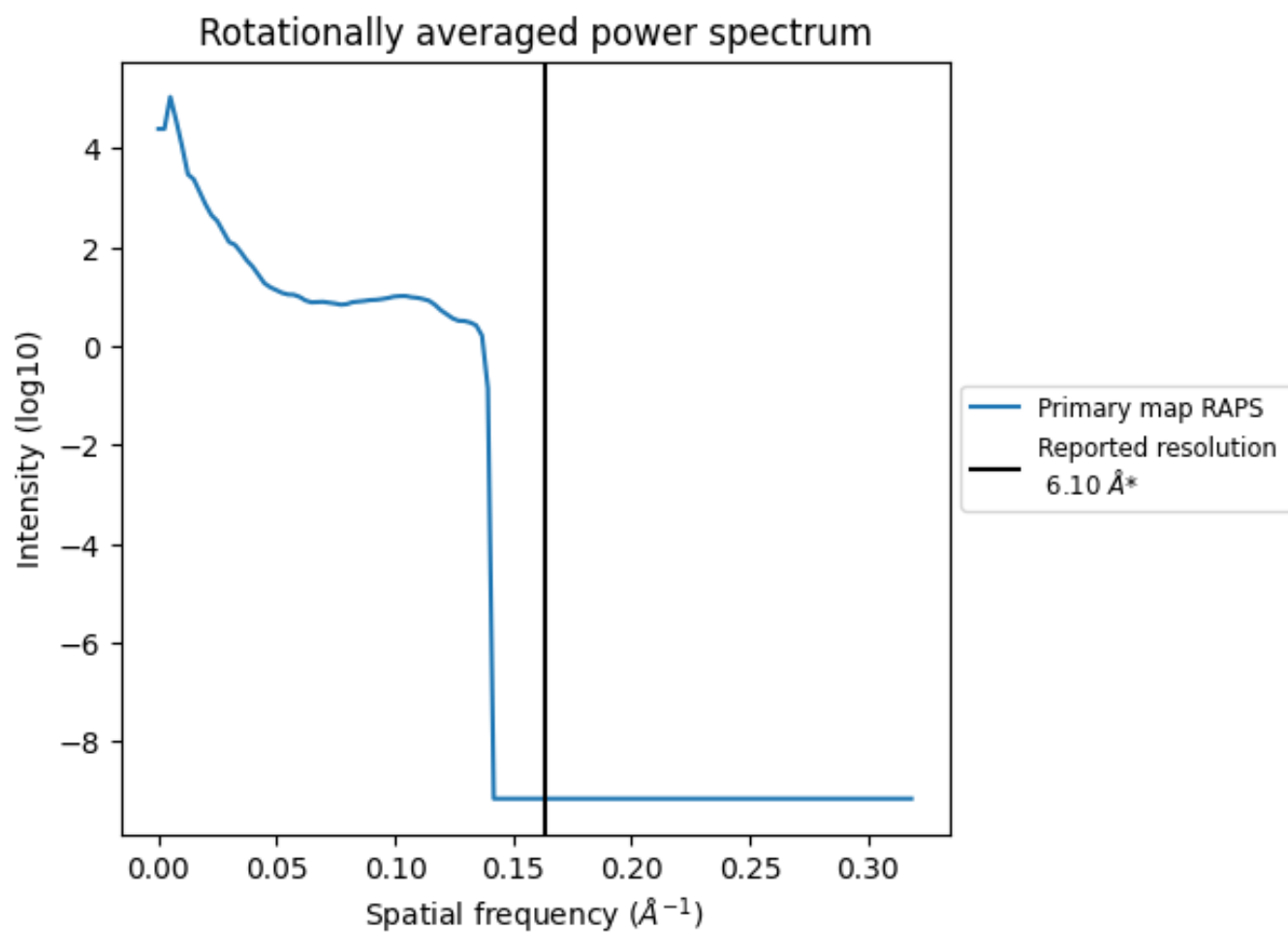


The volume at the recommended contour level is 746 nm<sup>3</sup>; this corresponds to an approximate mass of 674 kDa.

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 0.164 Å<sup>-1</sup>

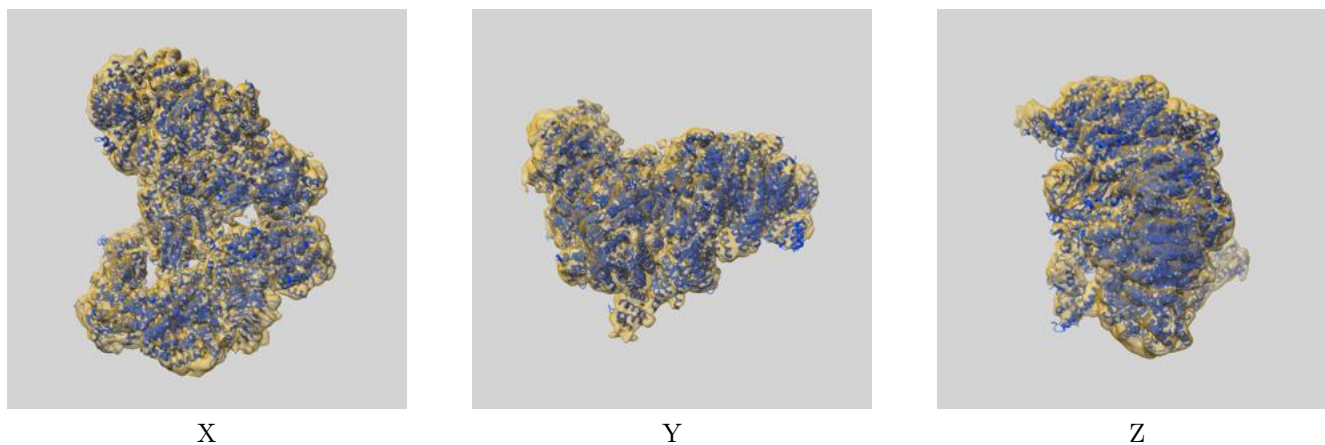
## 8 Fourier-Shell correlation

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

## 9 Map-model fit [i](#)

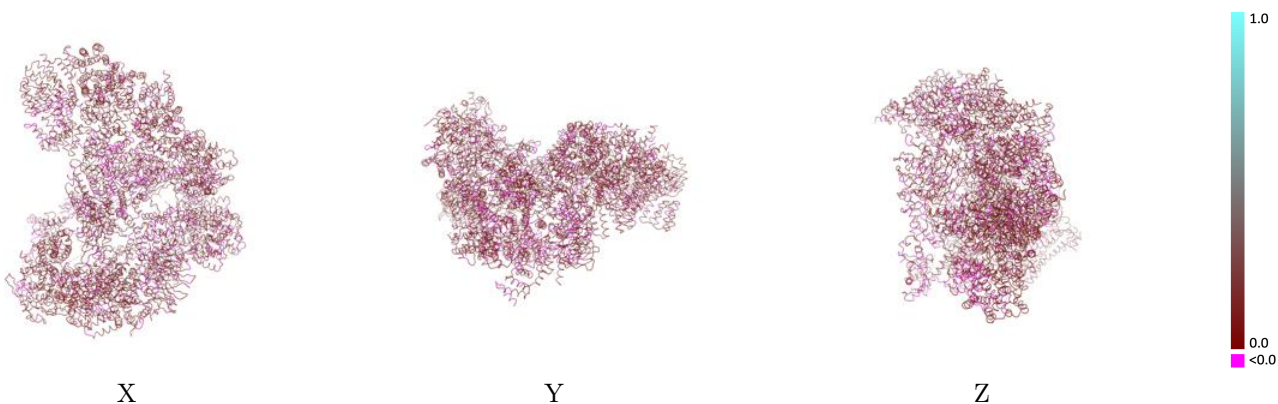
This section contains information regarding the fit between EMDB map EMD-4025 and PDB model 5KHR. Per-residue inclusion information can be found in section [3](#) on page [8](#).

### 9.1 Map-model overlay [i](#)



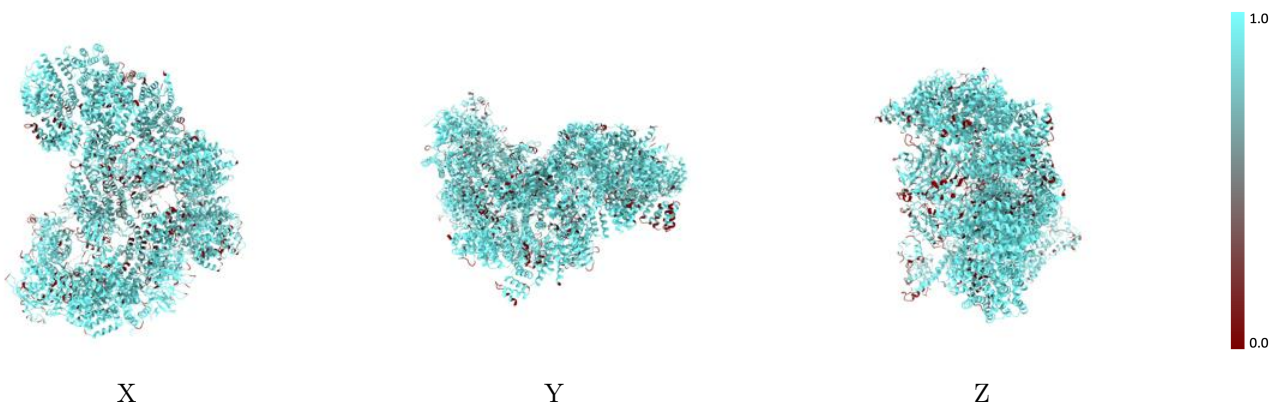
The images above show the 3D surface view of the map at the recommended contour level 0.081 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



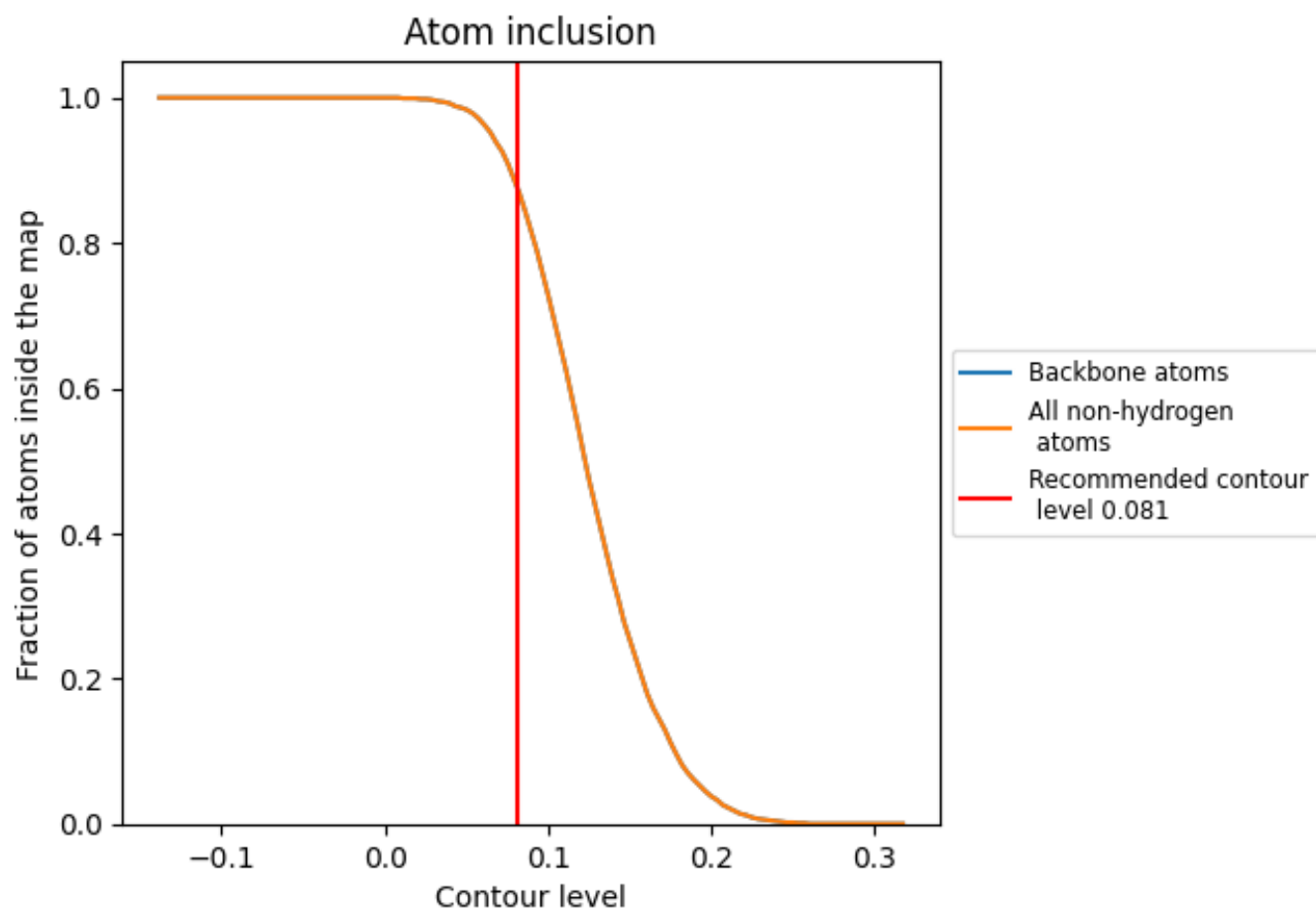
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions at which atoms can be resolved. Low Q-score values may therefore be expected for many entries.

## 9.3 Atom inclusion mapped to coordinate model [i](#)



The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.081).













































## 9.4 Atom inclusion [i](#)



At the recommended contour level, 88% of all backbone atoms, 88% 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 (0.081) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8770	 0.1330
A	 0.8750	 0.1430
B	 0.7830	 0.0960
C	 0.8440	 0.1250
E	 0.9460	 0.1450
F	 0.9310	 0.1370
G	 0.6800	 0.1580
H	 0.9630	 0.1380
I	 0.9310	 0.1470
J	 0.9150	 0.1240
K	 0.9230	 0.1390
L	 0.8620	 0.1580
M	 0.7230	 0.1640
N	 0.7570	 0.1260
O	 0.8970	 0.1320
P	 0.9390	 0.1370
Q	 0.6410	 0.0790
R	 0.7800	 0.1190
S	 0.6000	 0.1080
W	 0.8400	 0.1380
X	 0.8790	 0.0910
Y	 0.8870	 0.1390

