



Full wwPDB EM Validation Report ⓘ

Mar 10, 2026 – 03:12 AM UTC

PDB ID : 5L9U / pdb_00005l9u
EMDB ID : EMD-3432
Title : Model of human Anaphase-promoting complex/Cyclosome (APC/C-CDH1) with a cross linked Ubiquitin variant-substrate-UBE2C (UBCH10) complex representing key features of multiubiquitination
Authors : Brown, N.G.; VanderLinden, R.; Dube, P.; Haselbach, D.; Peters, J.M.; Stark, H.; Schulman, B.A.
Deposited on : 2016-06-11
Resolution : 6.40 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

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.dev132
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

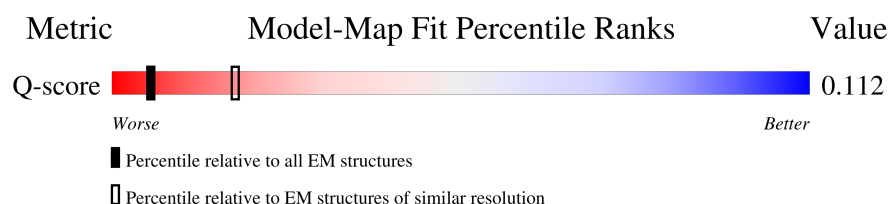
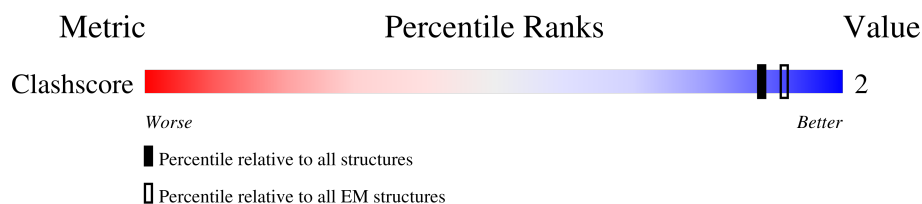
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

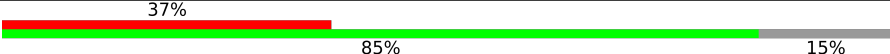
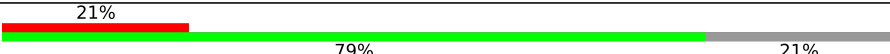
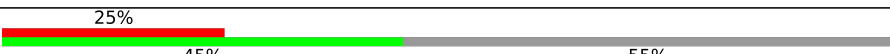
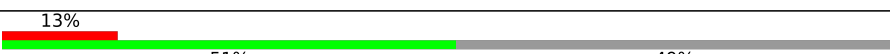
The reported resolution of this entry is 6.40 Å.

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	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Q-score	-	25397	544 (5.90 - 6.90)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the EM map (all-atom inclusion $< 40\%$). The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	1944	
2	B	84	
3	C	597	
3	P	597	
4	D	121	
5	E	110	

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
6	F	824	
6	H	824	
7	G	85	
7	W	85	
8	I	818	
9	J	620	
9	K	620	
10	L	185	
11	M	74	
12	N	822	
13	O	755	
14	R	493	
15	S	157	
16	U	188	
17	X	565	
17	Y	565	

2 Entry composition [i](#)

There are 17 unique types of molecules in this entry. The entry contains 8055 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	1342	Total	C	0	1342
			1342	1342		

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

Mol	Chain	Residues	Atoms		AltConf	Trace
2	B	71	Total	C	0	71
			71	71		

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

Mol	Chain	Residues	Atoms		AltConf	Trace
3	C	474	Total	C	0	474
			474	474		
3	P	425	Total	C	0	425
			425	425		

- Molecule 4 is a protein called Anaphase-promoting complex subunit 15.

Mol	Chain	Residues	Atoms		AltConf	Trace
4	D	55	Total	C	0	55
			55	55		

- Molecule 5 is a protein called Anaphase-promoting complex subunit 16.

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

- Molecule 6 is a protein called Cell division cycle protein 27 homolog.

Mol	Chain	Residues	Atoms		AltConf	Trace
6	F	482	Total	C	0	482
			482	482		
6	H	483	Total	C	0	483
			483	483		

- Molecule 7 is a protein called Anaphase-promoting complex subunit CDC26.

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

- Molecule 8 is a protein called Anaphase-promoting complex subunit 4.

Mol	Chain	Residues	Atoms		AltConf	Trace
8	I	719	Total	C	0	719
			719	719		

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 9 is a protein called Cell division cycle protein 16 homolog.

Mol	Chain	Residues	Atoms		AltConf	Trace
9	J	499	Total	C	0	499
			499	499		
9	K	493	Total	C	0	493
			493	493		

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

Mol	Chain	Residues	Atoms		AltConf	Trace
10	L	176	Total	C	0	176
			176	176		

- Molecule 11 is a protein called Anaphase-promoting complex subunit 13.

Mol	Chain	Residues	Atoms		AltConf	Trace
11	M	49	Total	C	0	49
			49	49		

- Molecule 12 is a protein called Anaphase-promoting complex subunit 2.

Mol	Chain	Residues	Atoms		AltConf	Trace
12	N	610	Total	C	0	610
			610	610		

- Molecule 13 is a protein called Anaphase-promoting complex subunit 5.

Mol	Chain	Residues	Atoms		AltConf	Trace
13	O	676	Total	C	0	676
			676	676		

- Molecule 14 is a protein called Fizzy-related protein homolog.

Mol	Chain	Residues	Atoms		AltConf	Trace
14	R	385	Total	C	0	385
			385	385		

- Molecule 15 is a protein called Hsl1(substrate)_peptide-Ubiquitin_variant fusion.

Mol	Chain	Residues	Atoms		AltConf	Trace
15	S	86	Total	C	0	86
			86	86		

There are 66 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
S	760	GLY	-	linker	PDB ?
S	761	SER	-	linker	PDB ?
S	762	GLY	-	linker	PDB ?
S	763	SER	-	linker	PDB ?
S	764	GLY	-	linker	PDB ?
S	765	SER	-	linker	PDB ?

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
S	766	GLY	-	linker	PDB ?
S	767	SER	-	linker	PDB ?
S	?	-	LYS	deletion	UNP P34244
S	?	-	ASN	deletion	UNP P34244
S	?	-	GLN	deletion	UNP P34244
S	?	-	PHE	deletion	UNP P34244
S	?	-	ASN	deletion	UNP P34244
S	?	-	MET	deletion	UNP P34244
S	?	-	SER	deletion	UNP P34244
S	?	-	TYR	deletion	UNP P34244
S	?	-	LYS	deletion	UNP P34244
S	?	-	PRO	deletion	UNP P34244
S	?	-	SER	deletion	UNP P34244
S	?	-	GLU	deletion	UNP P34244
S	?	-	ASN	deletion	UNP P34244
S	?	-	MET	deletion	UNP P34244
S	?	-	SER	deletion	UNP P34244
S	?	-	GLY	deletion	UNP P34244
S	?	-	LEU	deletion	UNP P34244
S	?	-	SER	deletion	UNP P34244
S	?	-	SER	deletion	UNP P34244
S	?	-	PHE	deletion	UNP P34244
S	?	-	PRO	deletion	UNP P34244
S	?	-	ILE	deletion	UNP P34244
S	?	-	PHE	deletion	UNP P34244
S	?	-	GLU	deletion	UNP P34244
S	?	-	LYS	deletion	UNP P34244
S	?	-	GLU	deletion	UNP P34244
S	?	-	ASN	deletion	UNP P34244
S	?	-	THR	deletion	UNP P34244
S	?	-	LEU	deletion	UNP P34244
S	?	-	SER	deletion	UNP P34244
S	?	-	SER	deletion	UNP P34244
S	819	CYS	SER	engineered mutation	UNP P34244
S	843	SER	-	linker	UNP P34244
S	844	GLY	-	linker	UNP P34244
S	845	SER	-	linker	UNP P34244
S	846	SER	-	linker	UNP P34244
S	847	GLY	-	linker	UNP P34244
S	848	SER	-	linker	UNP P34244
S	849	GLY	-	linker	UNP P34244
S	850	SER	-	linker	UNP P34244

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
S	851	SER	-	linker	UNP P34244
S	852	GLY	-	linker	UNP P34244
S	856	LEU	PHE	engineered mutation	UNP Q63429
S	860	PRO	LEU	engineered mutation	UNP Q63429
S	861	ARG	THR	engineered mutation	UNP Q63429
S	894	ILE	ARG	engineered mutation	UNP Q63429
S	896	PHE	ILE	engineered mutation	UNP Q63429
S	899	VAL	GLY	engineered mutation	UNP Q63429
S	901	ARG	GLN	engineered mutation	UNP Q63429
S	916	LYS	GLU	engineered mutation	UNP Q63429
S	918	SER	THR	engineered mutation	UNP Q63429
S	920	LEU	HIS	engineered mutation	UNP Q63429
S	922	ALA	VAL	engineered mutation	UNP Q63429
S	923	MET	LEU	engineered mutation	UNP Q63429
S	925	VAL	LEU	engineered mutation	UNP Q63429
S	926	PRO	ARG	engineered mutation	UNP Q63429
S	928	LYS	GLY	engineered mutation	UNP Q63429
S	930	LYS	GLN	engineered mutation	UNP Q63429

- Molecule 16 is a protein called Ubiquitin-conjugating enzyme E2 C.

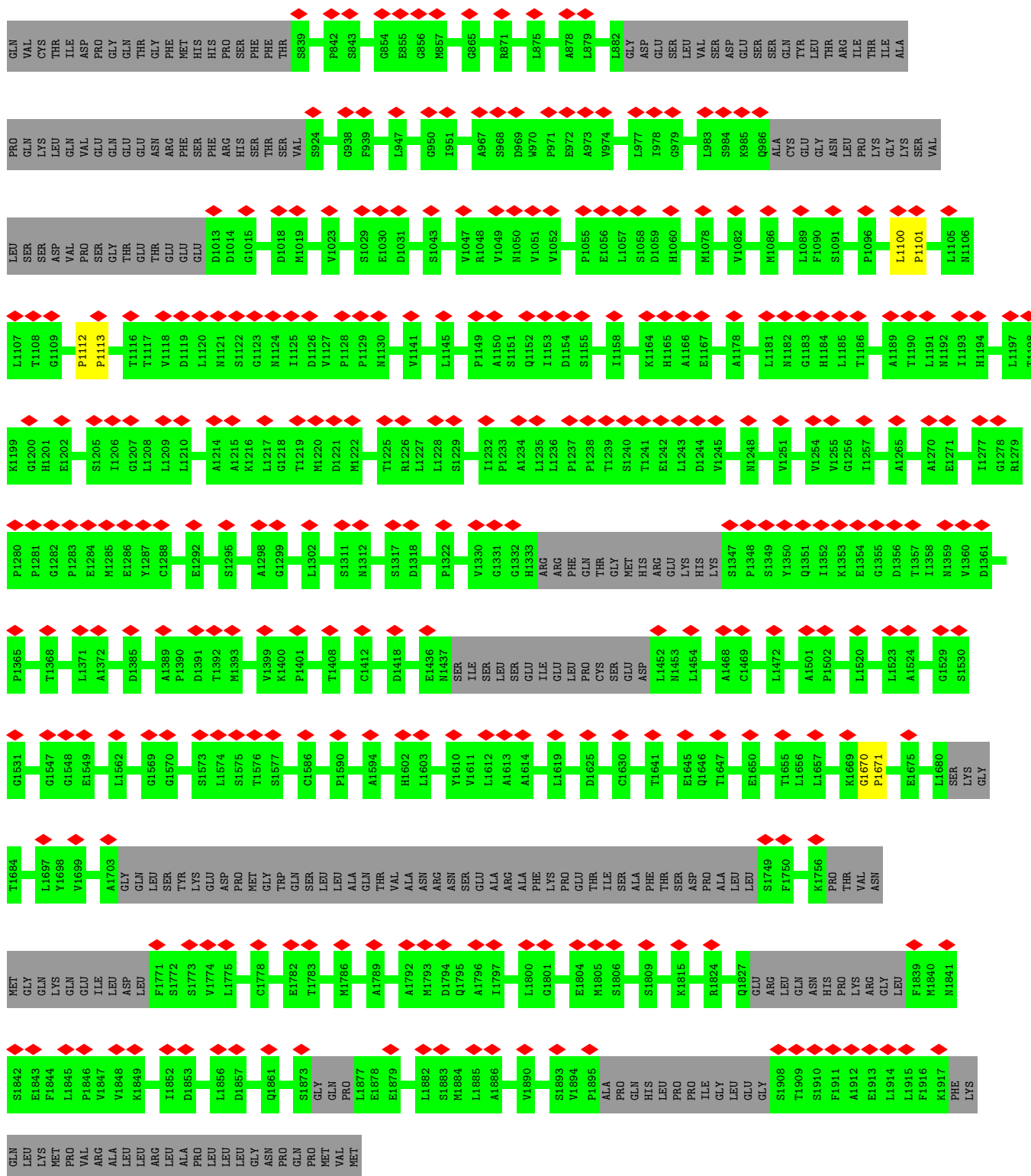
Mol	Chain	Residues	Atoms	AltConf	Trace
16	U	145	Total C 145 145	0	145

There are 10 discrepancies between the modelled and reference sequences:

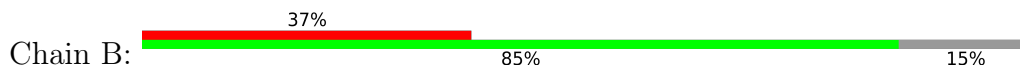
Chain	Residue	Modelled	Actual	Comment	Reference
U	-1	SEC	-	expression tag	UNP O00762
U	0	ASX	-	expression tag	UNP O00762
U	102	ALA	CYS	engineered mutation	UNP O00762
U	180	TRP	-	expression tag	UNP O00762
U	181	SER	-	expression tag	UNP O00762
U	182	HIS	-	expression tag	UNP O00762
U	183	PRO	-	expression tag	UNP O00762
U	184	GLN	-	expression tag	UNP O00762
U	185	GLU	-	expression tag	UNP O00762
U	186	LYS	-	expression tag	UNP O00762

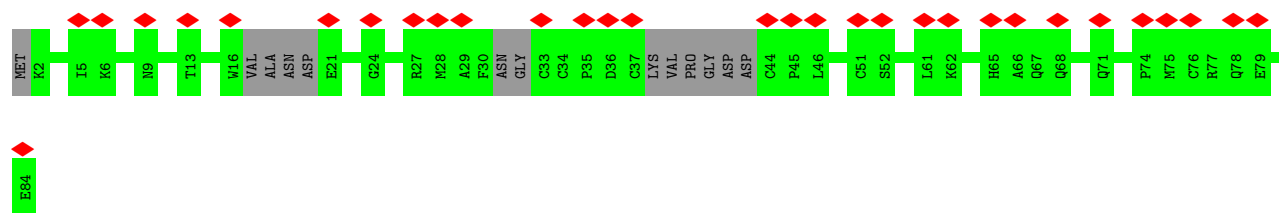
- Molecule 17 is a protein called Anaphase-promoting complex subunit 7.

Mol	Chain	Residues	Atoms		AltConf	Trace
17	X	380	Total 380	C 380	0	380
17	Y	399	Total 399	C 399	0	399

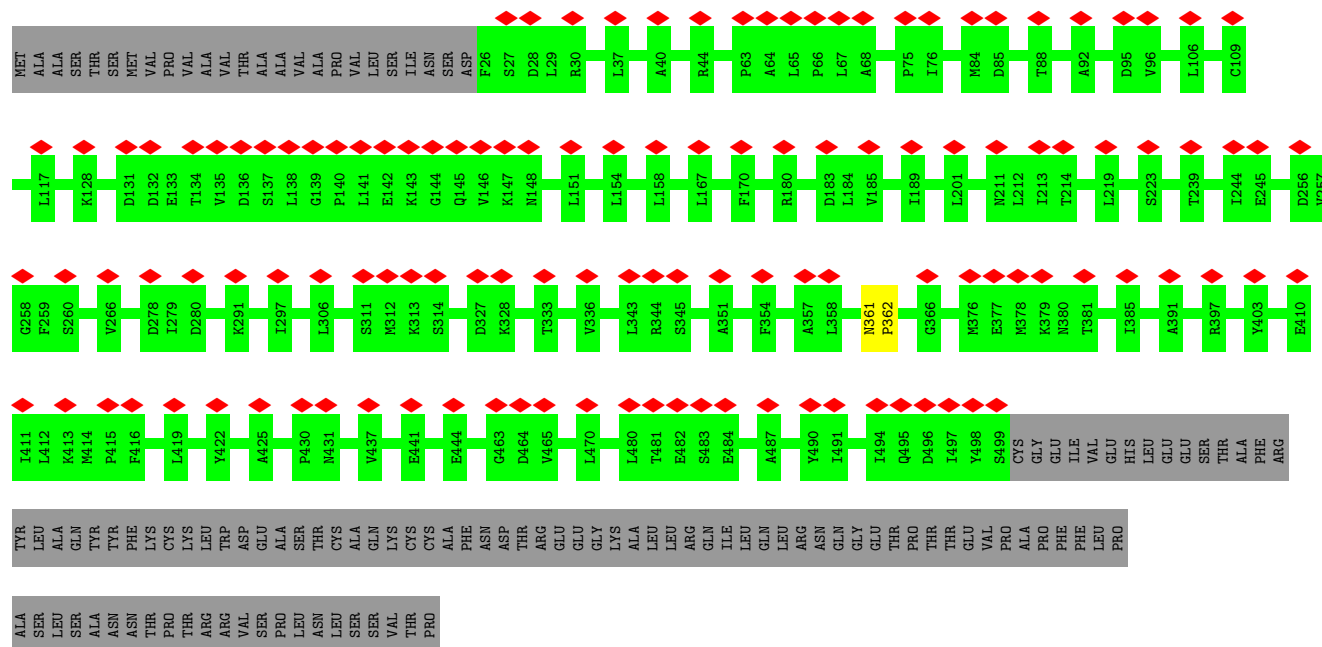
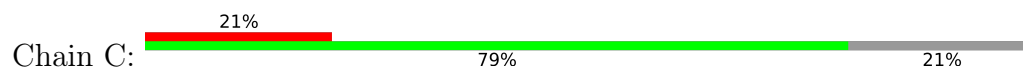


• Molecule 2: Anaphase-promoting complex subunit 11

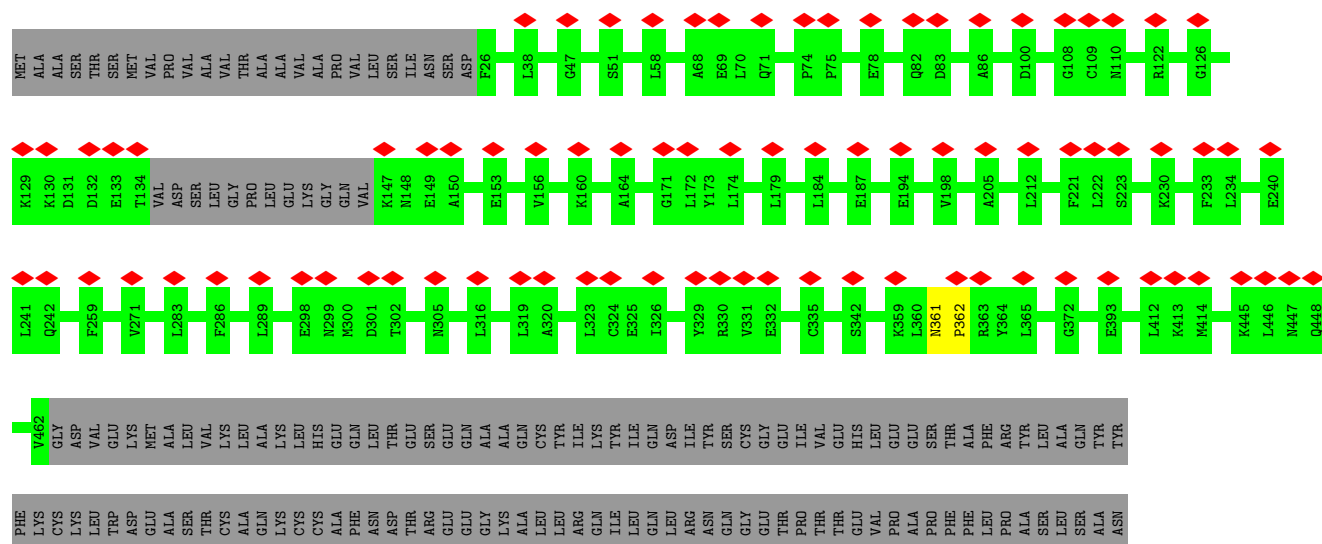


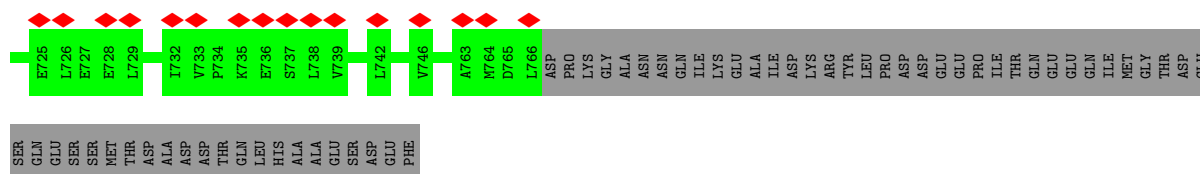


• Molecule 3: Cell division cycle protein 23 homolog

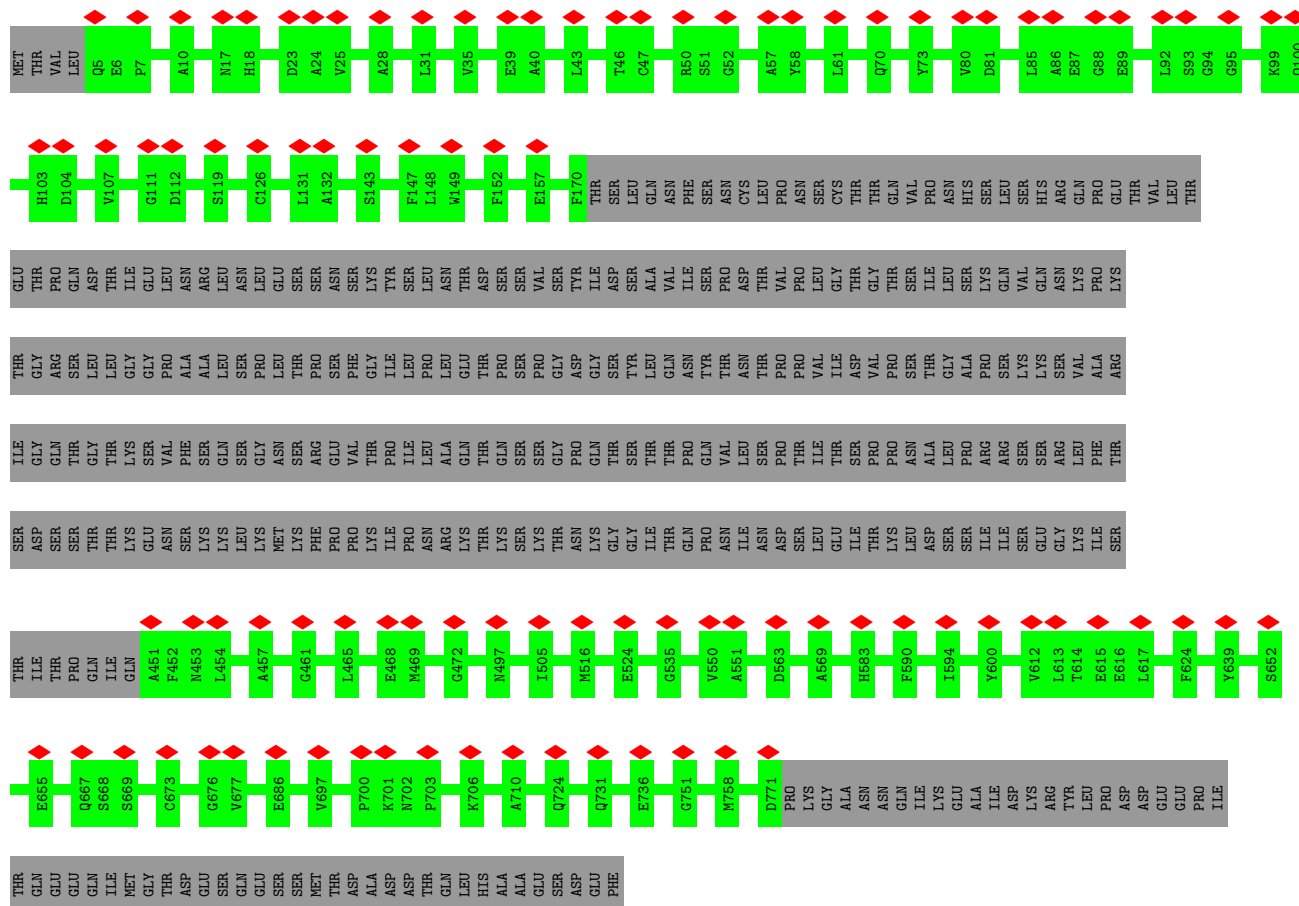


• Molecule 3: Cell division cycle protein 23 homolog

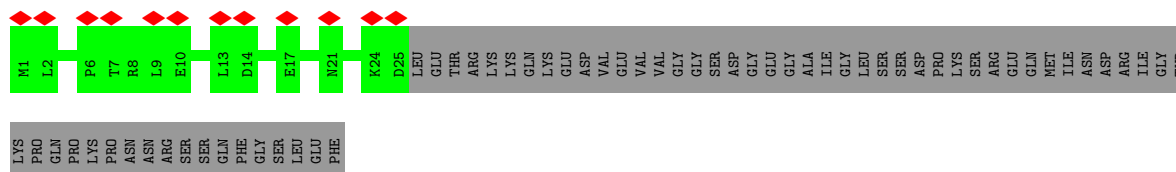




• Molecule 6: Cell division cycle protein 27 homolog

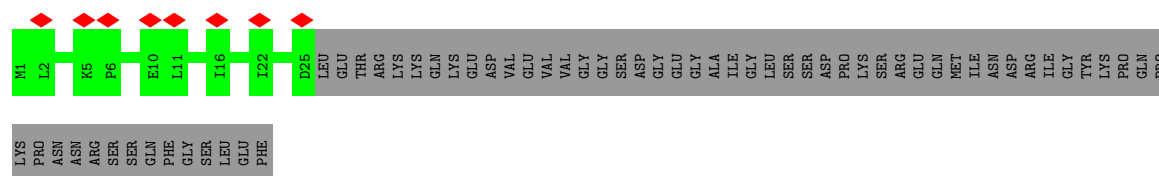


• Molecule 7: Anaphase-promoting complex subunit CDC26



• Molecule 7: Anaphase-promoting complex subunit CDC26





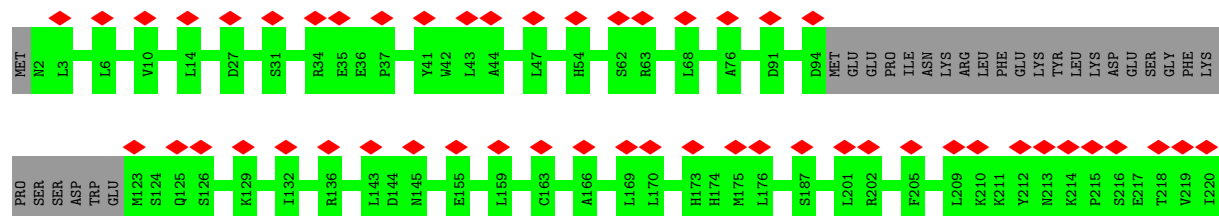
• Molecule 8: Anaphase-promoting complex subunit 4

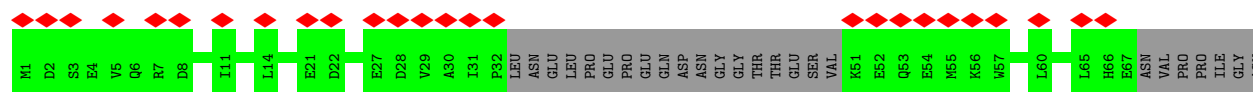
Chain I: 27% 88% 12%



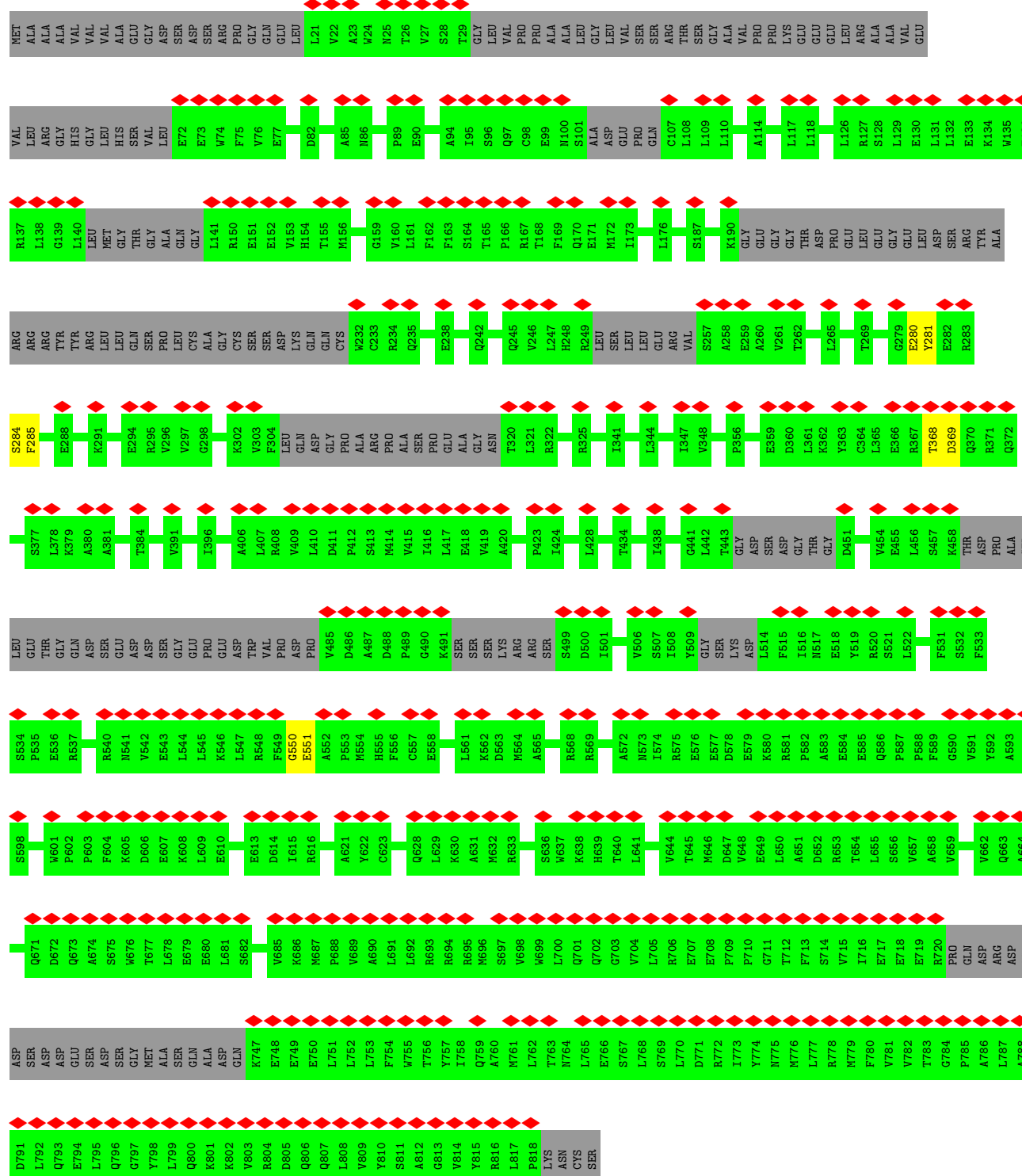
• Molecule 9: Cell division cycle protein 16 homolog

Chain J: 19% 80% 20%

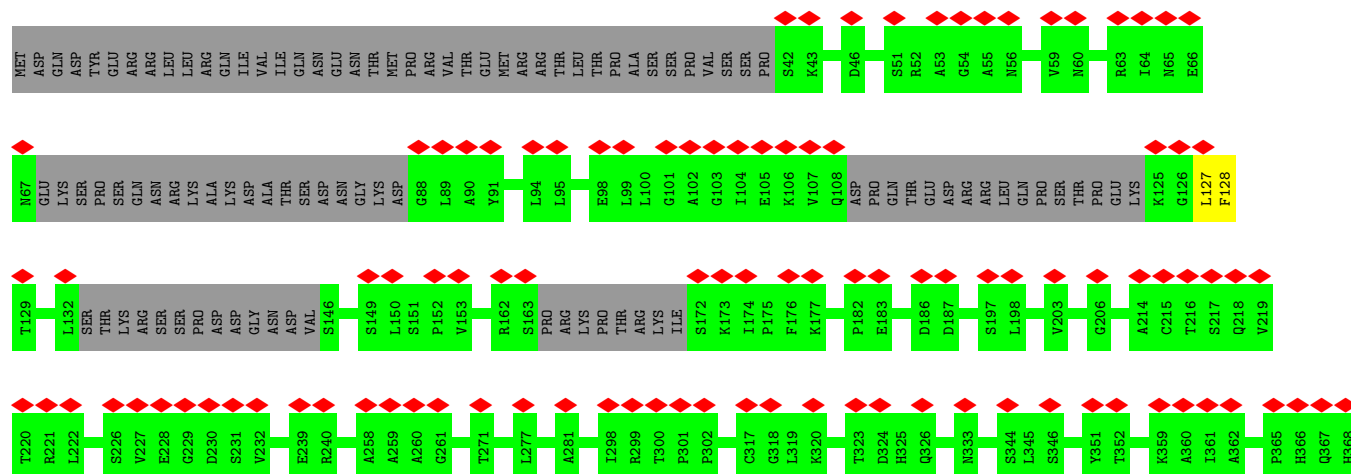
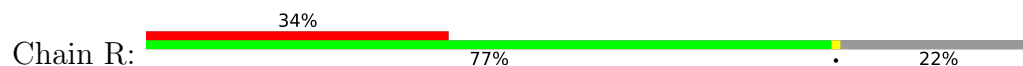


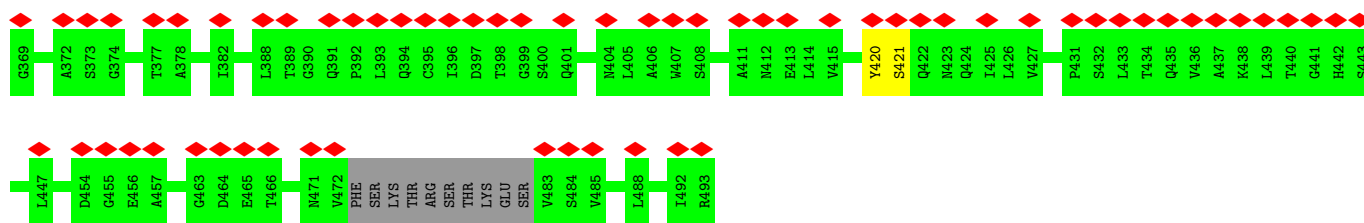


• Molecule 12: Anaphase-promoting complex subunit 2

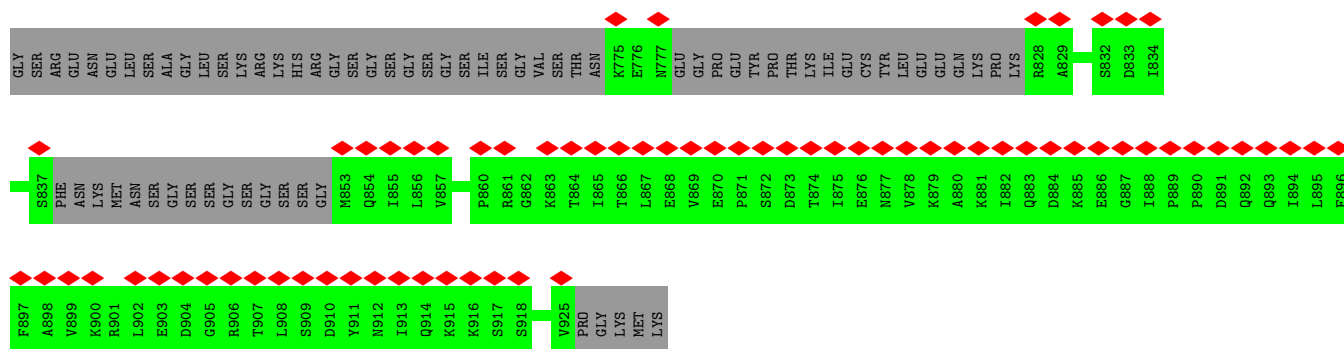
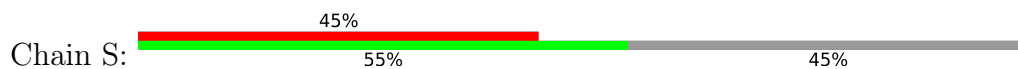


Chain O: 25% 89% 10%

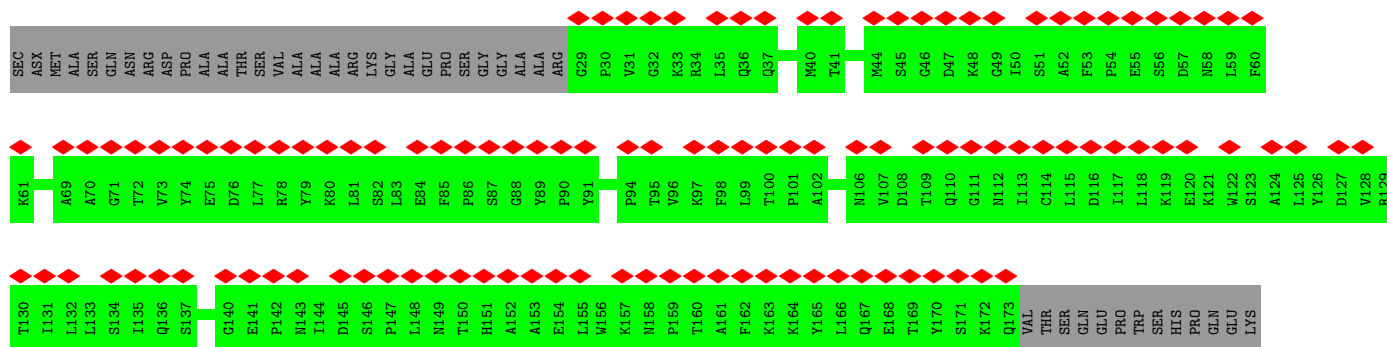
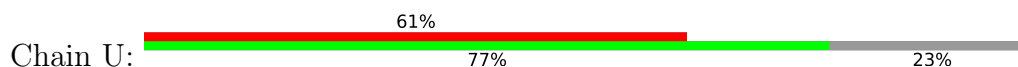




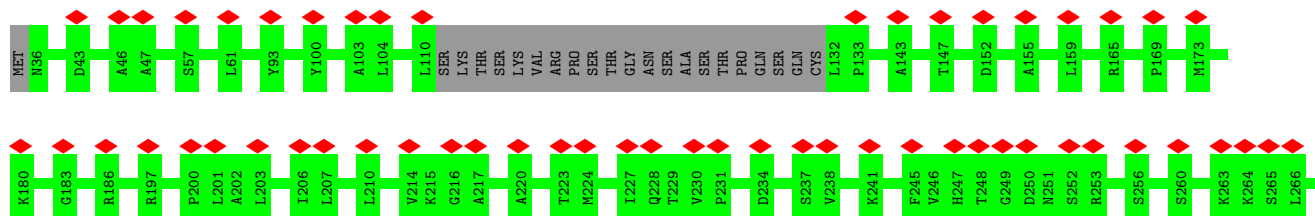
• Molecule 15: Hsl1(substrate)_peptide-Ubiquitin_variant fusion

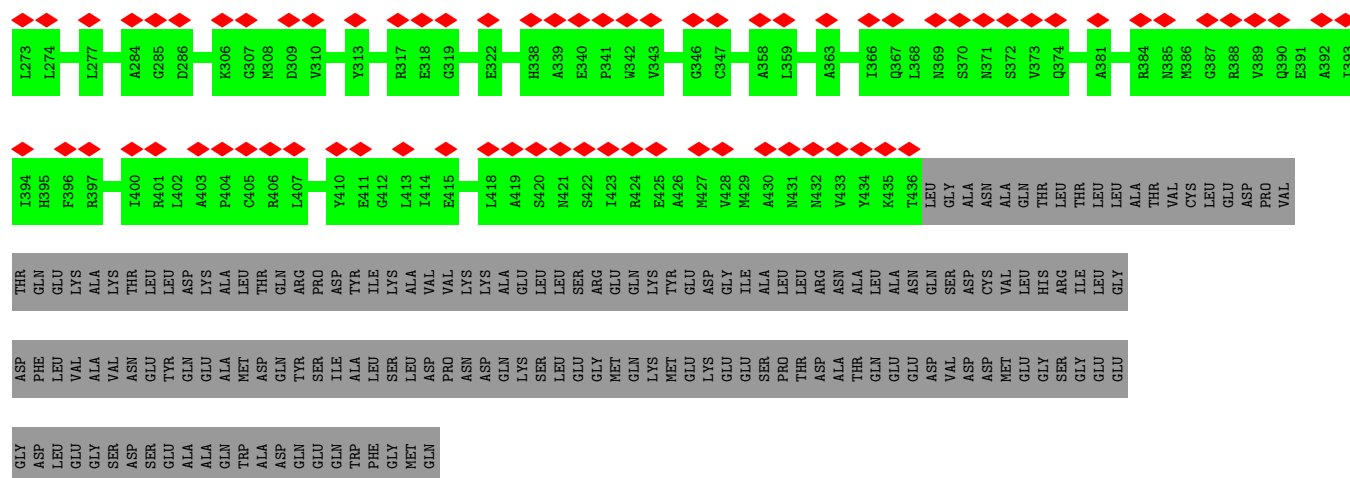


• Molecule 16: Ubiquitin-conjugating enzyme E2 C

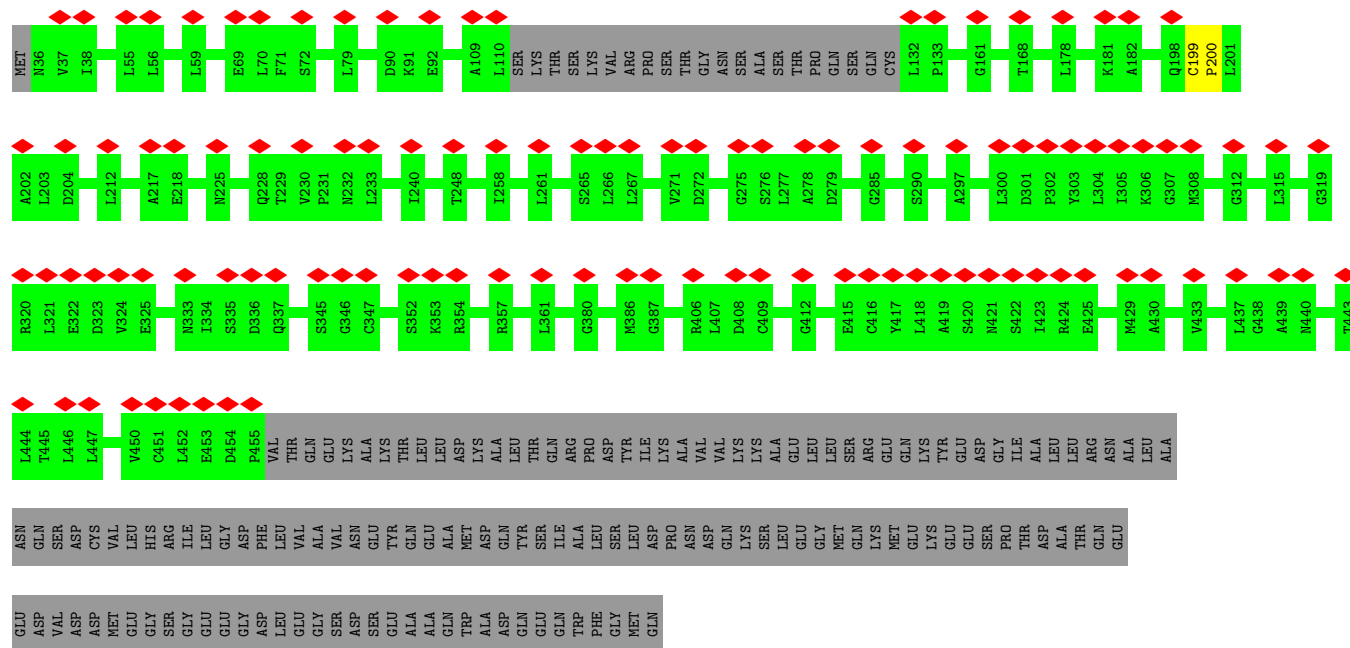


• Molecule 17: Anaphase-promoting complex subunit 7





• Molecule 17: 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	135578	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	0.190	Depositor
Minimum map value	-0.064	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.011	Depositor
Recommended contour level	0.065	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	1342	0	0	3	0
2	B	71	0	0	0	0
3	C	474	0	0	1	0
3	P	425	0	0	1	0
4	D	55	0	0	0	0
5	E	56	0	0	0	0
6	F	482	0	0	0	0
6	H	483	0	0	0	0
7	G	25	0	0	0	0
7	W	25	0	0	0	0
8	I	719	0	0	1	0
9	J	499	0	0	0	0
9	K	493	0	0	0	0
10	L	176	0	0	1	0
11	M	49	0	0	0	0
12	N	610	0	0	4	0
13	O	676	0	0	1	0
14	R	385	0	0	2	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
15	S	86	0	0	0	0
16	U	145	0	0	0	0
17	X	380	0	0	0	0
17	Y	399	0	0	1	0
All	All	8055	0	0	15	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 2.

All (15) 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)
14:R:420:TYR:CA	14:R:421:SER:CA	2.80	0.59
12:N:280:GLU:CA	12:N:281:TYR:CA	2.82	0.57
1:A:1670:GLY:CA	1:A:1671:PRO:CA	2.84	0.55
17:Y:199:CYS:CA	17:Y:200:PRO:CA	2.85	0.55
13:O:123:GLU:CA	13:O:124:PRO:CA	2.85	0.54
12:N:368:THR:CA	12:N:369:ASP:CA	2.85	0.54
12:N:550:GLY:CA	12:N:551:GLU:CA	2.89	0.50
14:R:127:LEU:CA	14:R:128:PHE:CA	2.92	0.48
3:P:361:ASN:CA	3:P:362:PRO:CA	2.92	0.47
10:L:60:GLN:CA	10:L:61:PRO:CA	2.93	0.47
1:A:1100:LEU:CA	1:A:1101:PRO:CA	2.93	0.46
3:C:361:ASN:CA	3:C:362:PRO:CA	2.96	0.43
8:I:572:PHE:CA	8:I:573:PRO:CA	2.96	0.43
1:A:1112:PRO:CA	1:A:1113:PRO:CA	2.99	0.41
12:N:284:SER:CA	12:N:285:PHE:CA	2.99	0.40

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 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.

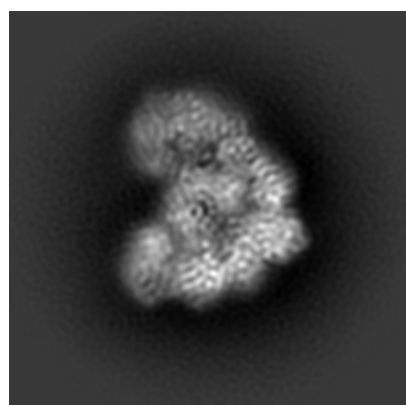
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-3432. These allow visual inspection of the internal detail of the map and identification of artifacts.

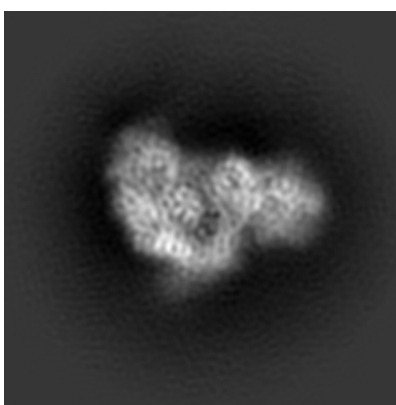
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

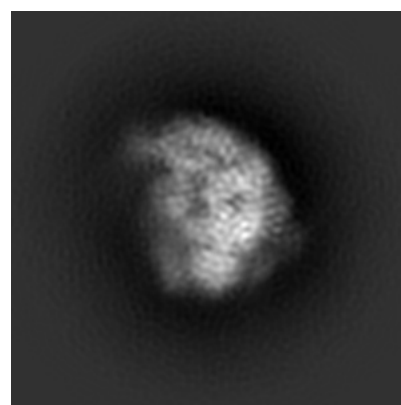
6.1.1 Primary map



X



Y

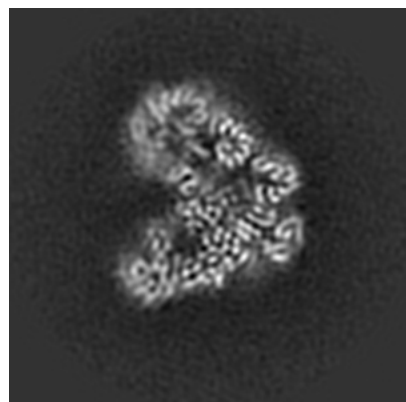


Z

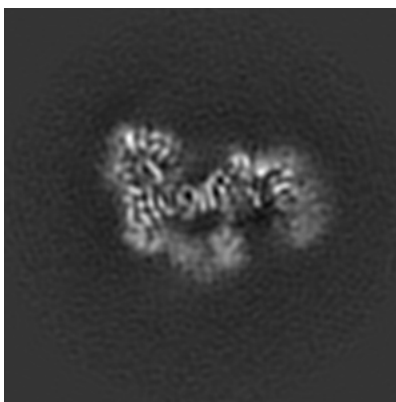
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

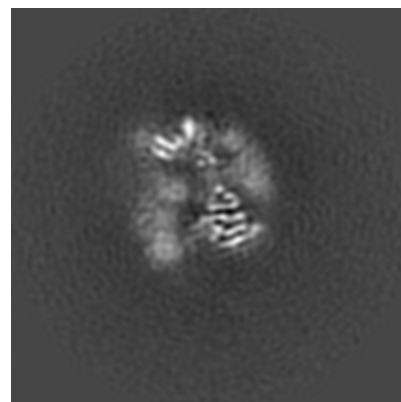
6.2.1 Primary map



X Index: 128



Y Index: 128

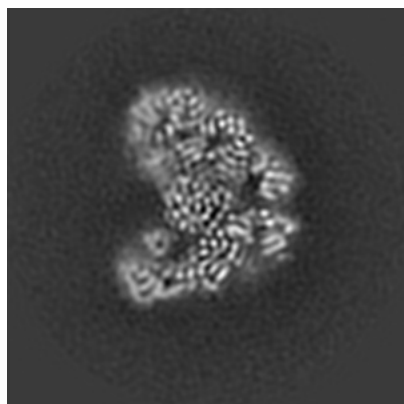


Z Index: 128

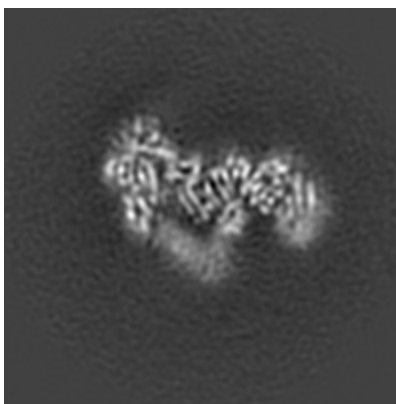
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

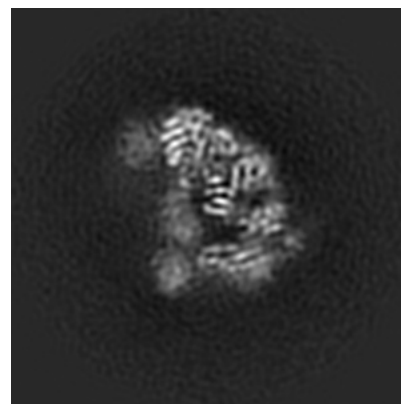
6.3.1 Primary map



X Index: 134



Y Index: 119

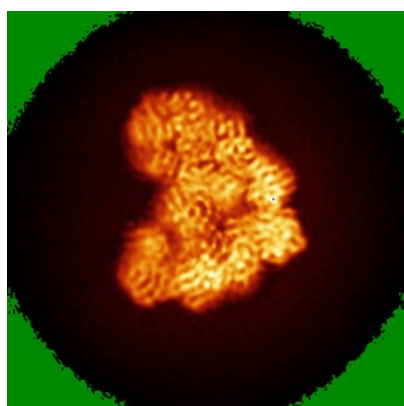


Z Index: 105

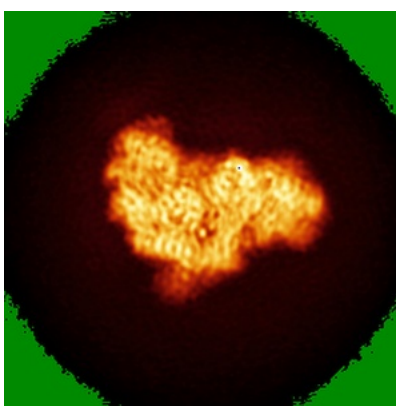
The images above show the largest variance slices of the map in three orthogonal directions.

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

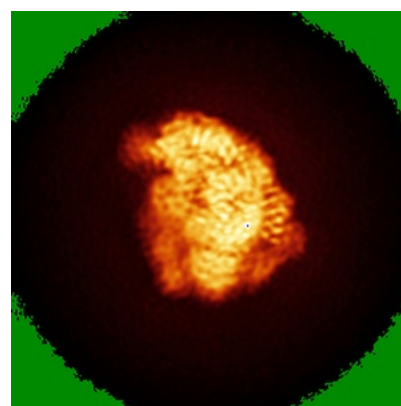
6.4.1 Primary map



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

This section was not generated.

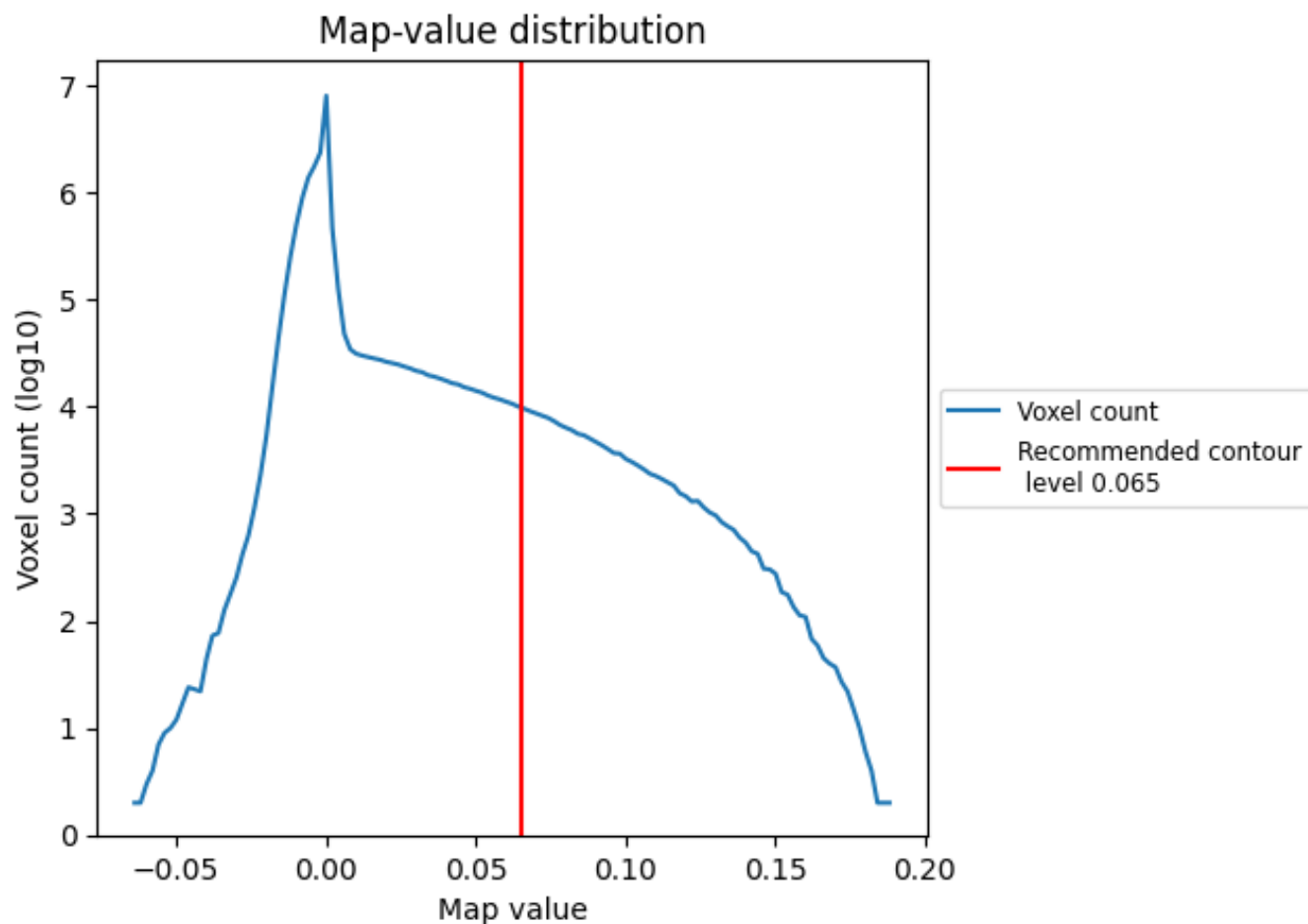
6.6 Mask visualisation

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

7 Map analysis [i](#)

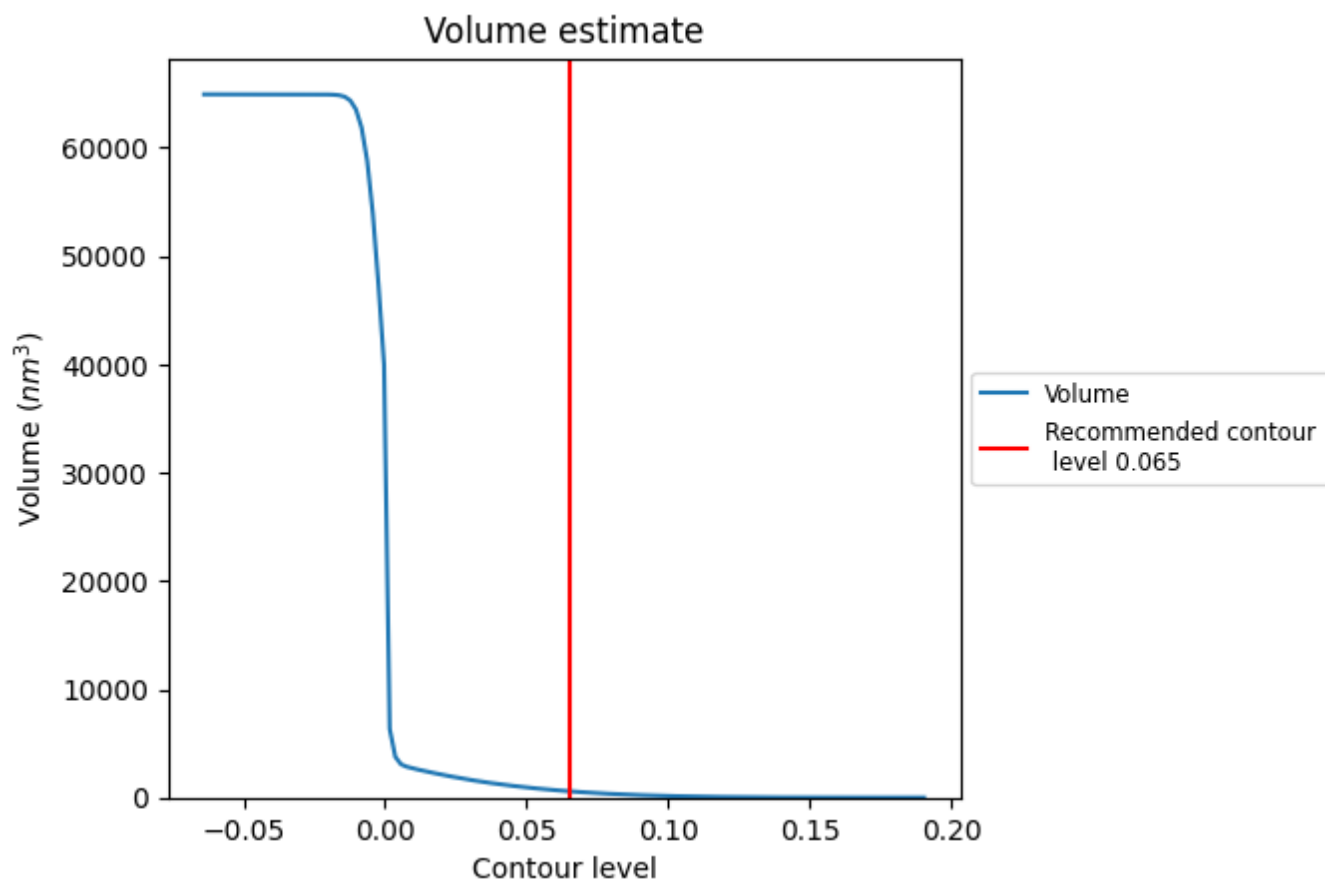
This section contains the results of statistical analysis of the map.

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.

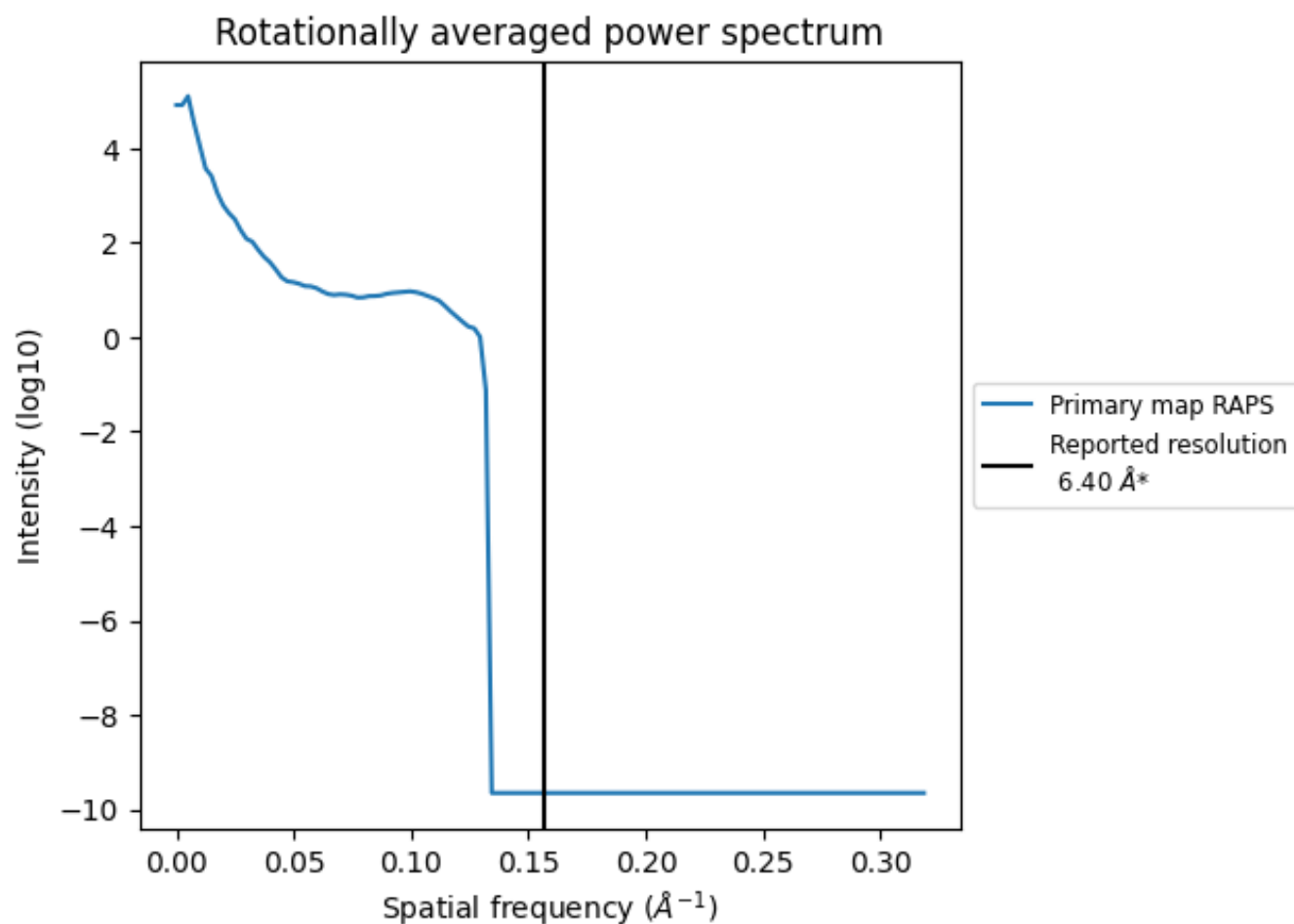
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 580 nm³; this corresponds to an approximate mass of 524 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 ⓘ



*Reported resolution corresponds to spatial frequency of 0.156 Å⁻¹

8 Fourier-Shell correlation ⓘ

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

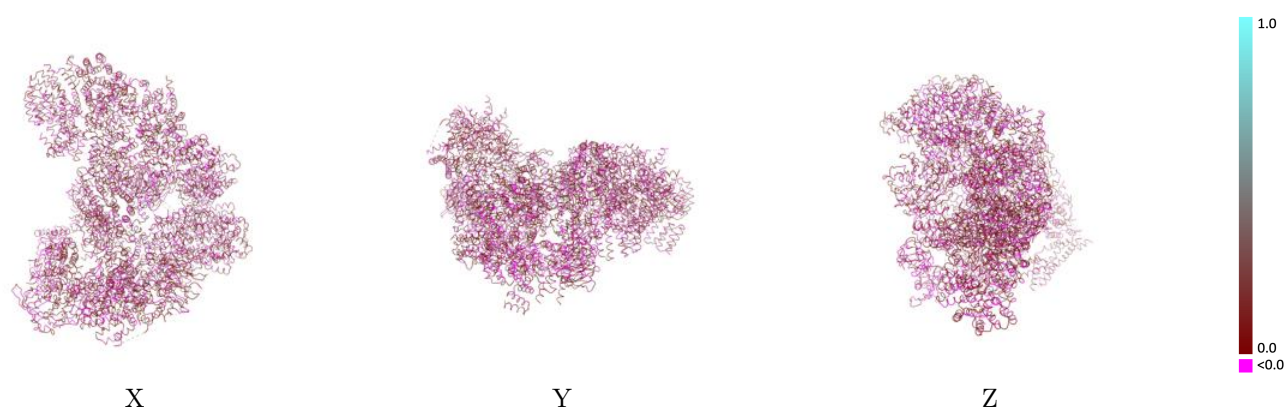
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-3432 and PDB model 5L9U. Per-residue inclusion information can be found in section 3 on page 10.

9.1 Map-model overlay [i](#)

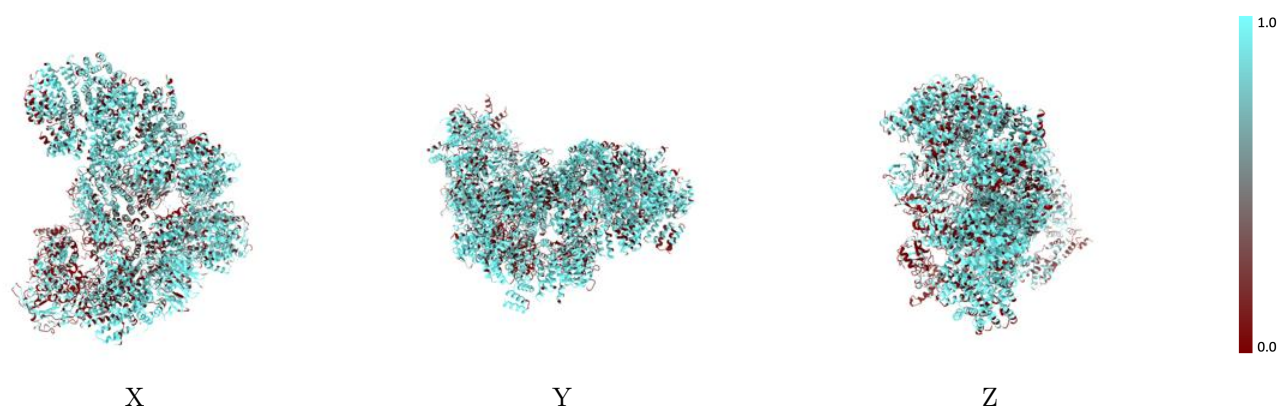
This section was not generated.

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



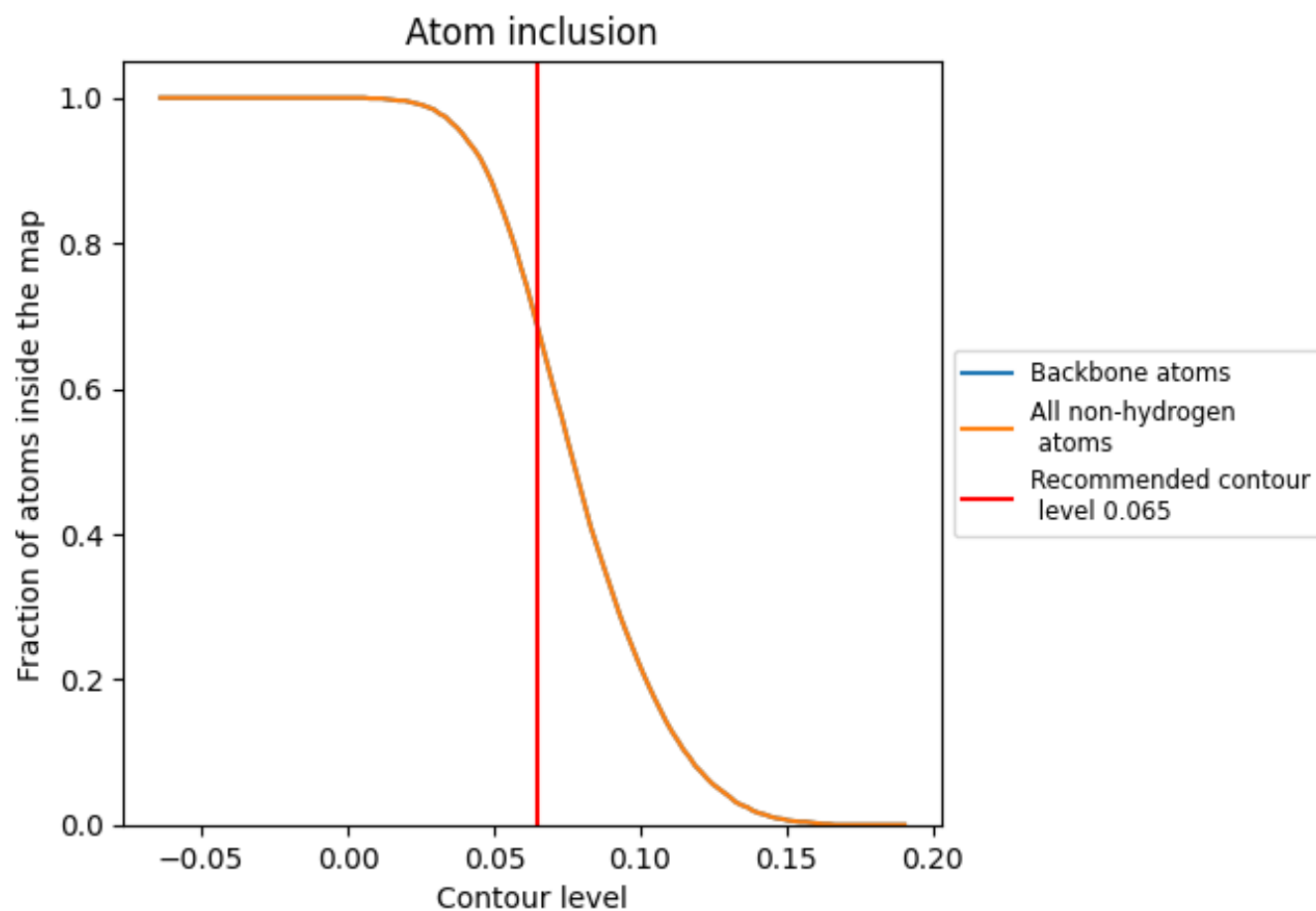
The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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

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



The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.065).

9.4 Atom inclusion [i](#)



At the recommended contour level, 68% of all backbone atoms, 68% 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 (0.065) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.6830	 0.1120
A	 0.7090	 0.1280
B	 0.5630	 0.0770
C	 0.7380	 0.1170
D	 0.4550	 0.1280
E	 0.7500	 0.1040
F	 0.7990	 0.1180
G	 0.5200	 0.1260
H	 0.8010	 0.1240
I	 0.6910	 0.1100
J	 0.7630	 0.1050
K	 0.8110	 0.1260
L	 0.7440	 0.1470
M	 0.4690	 0.1220
N	 0.3740	 0.0970
O	 0.7190	 0.1140
P	 0.8000	 0.1200
R	 0.5660	 0.0910
S	 0.1740	 0.0260
U	 0.2070	 0.0540
W	 0.6800	 0.1380
X	 0.6580	 0.0830
Y	 0.7220	 0.1190

