Full wwPDB EM Validation Report ⓘ

Mar 19, 2024 – 03:38 PM JST

PDB ID	:	5ZRV
EMDB ID	:	EMD-6944
Title	:	Structure of human mitochondrial trifunctional protein, octamer
Authors	:	Liang, K.; Li, N.; Dai, J.; Wang, X.; Liu, P.; Chen, X.; Wang, C.; Gao, N.; Xiao, J.
Deposited on	:	2018-04-25
Resolution	:	7.70 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:

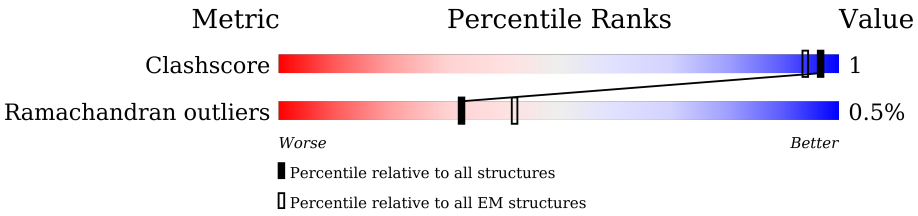
EMDB validation analysis	:	0.0.1.dev70
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ	:	1.9.13
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 7.70 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

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	763	93% 91% · 7%
1	C	763	93% 92% · 7%
1	E	763	87% 92% · 7%
1	G	763	93% 92% · 7%
2	B	474	89% 87% · 11%
2	D	474	89% 87% · 11%
2	F	474	72% 87% · 11%
2	H	474	84% 87% · 11%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 18096 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 Trifunctional enzyme subunit alpha, mitochondrial.

Mol	Chain	Residues	Atoms				AltConf	Trace
1	A	711	Total	C	N	O	0	0
			2844	1422	711	711		
1	C	711	Total	C	N	O	0	0
			2844	1422	711	711		
1	E	711	Total	C	N	O	0	0
			2844	1422	711	711		
1	G	711	Total	C	N	O	0	0
			2844	1422	711	711		

- Molecule 2 is a protein called Trifunctional enzyme subunit beta, mitochondrial.

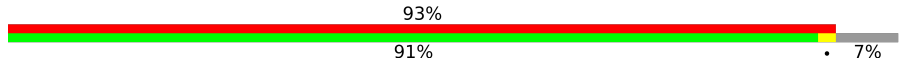
Mol	Chain	Residues	Atoms				AltConf	Trace
2	B	420	Total	C	N	O	0	0
			1680	840	420	420		
2	D	420	Total	C	N	O	0	0
			1680	840	420	420		
2	F	420	Total	C	N	O	0	0
			1680	840	420	420		
2	H	420	Total	C	N	O	0	0
			1680	840	420	420		

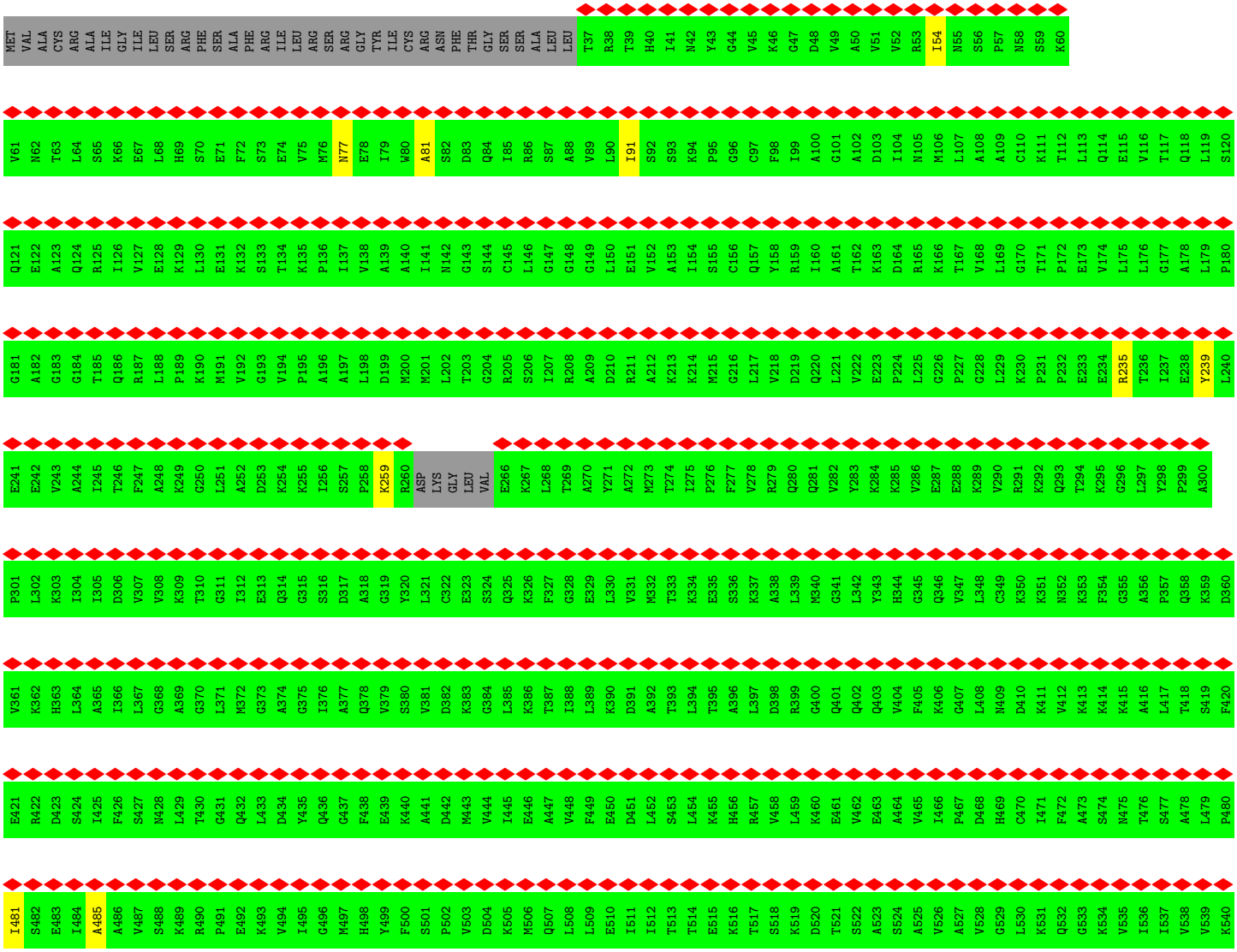
3 Residue-property plots (i)

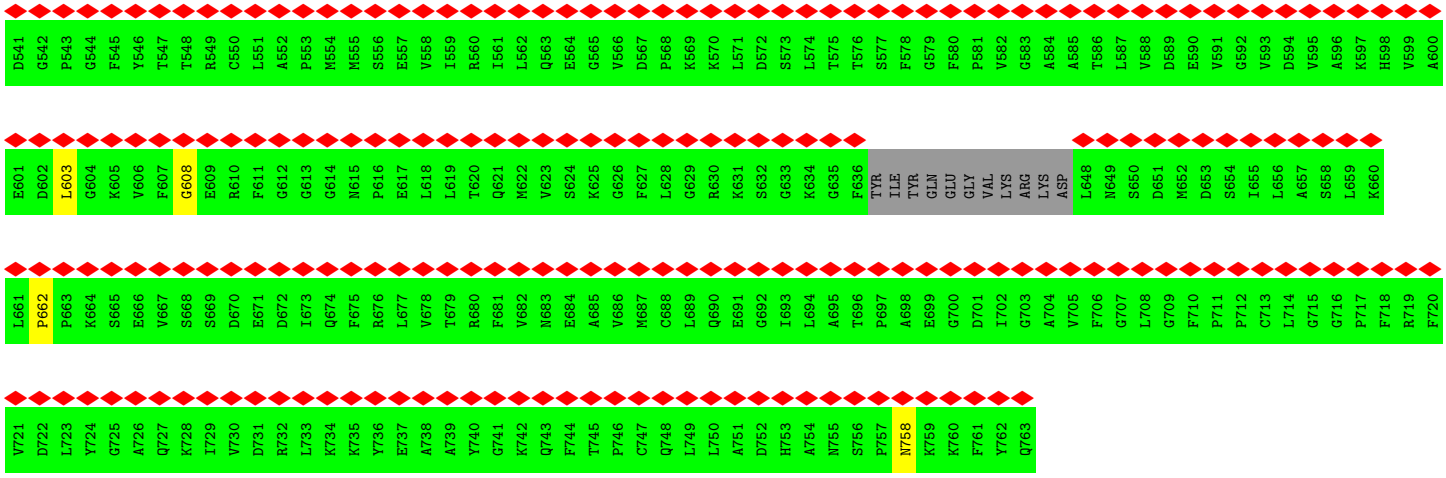
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion in map density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red diamond above a residue indicates a poor fit to the EM map for this residue (all-atom inclusion < 40%). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: Trifunctional enzyme subunit alpha, mitochondrial

Chain A:

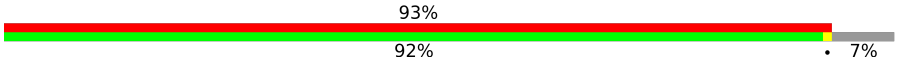


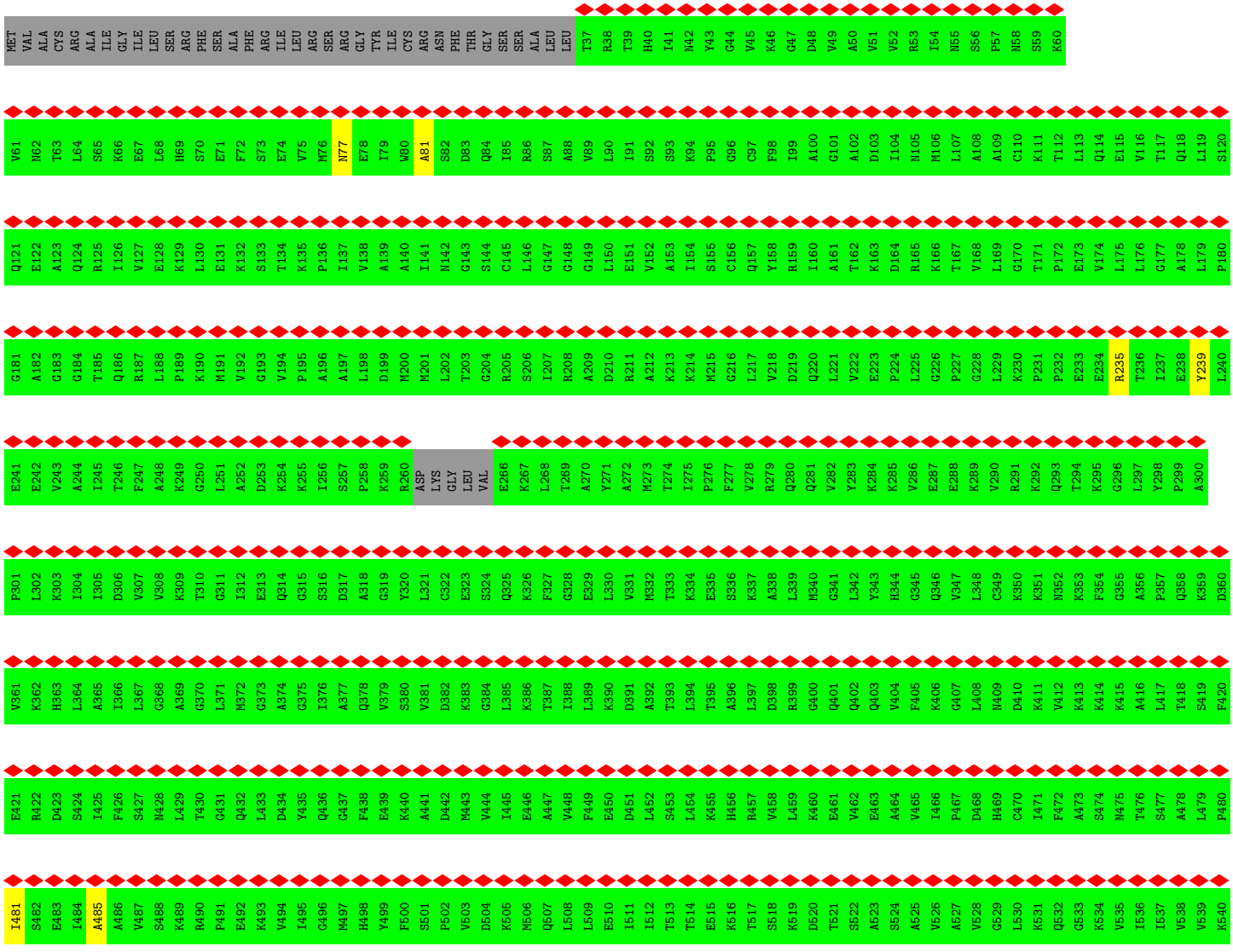


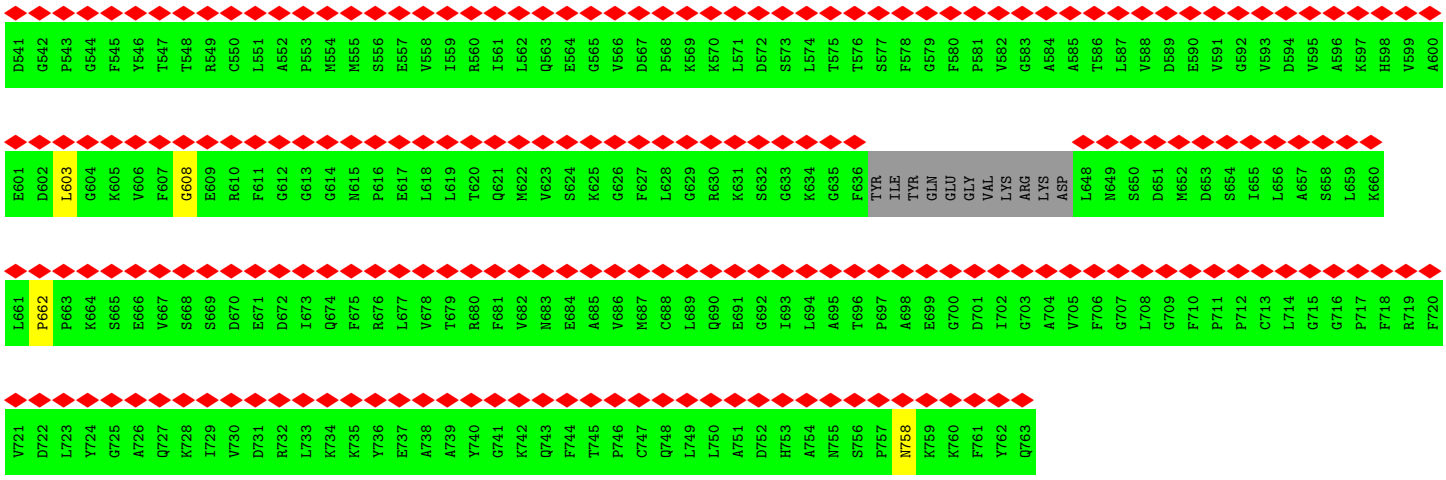


• Molecule 1: Trifunctional enzyme subunit alpha, mitochondrial

Chain C:

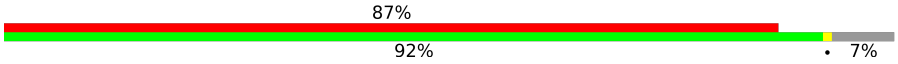


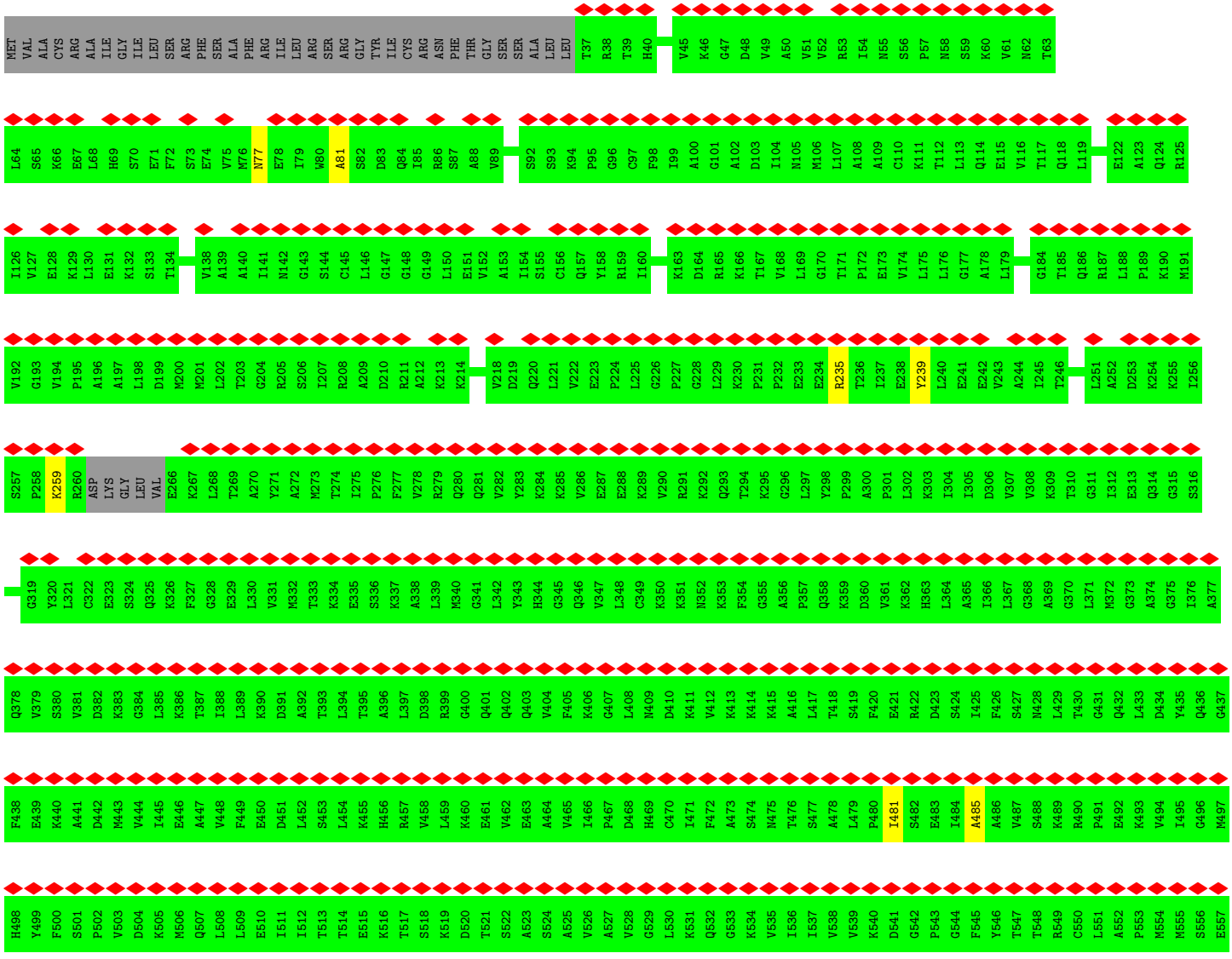


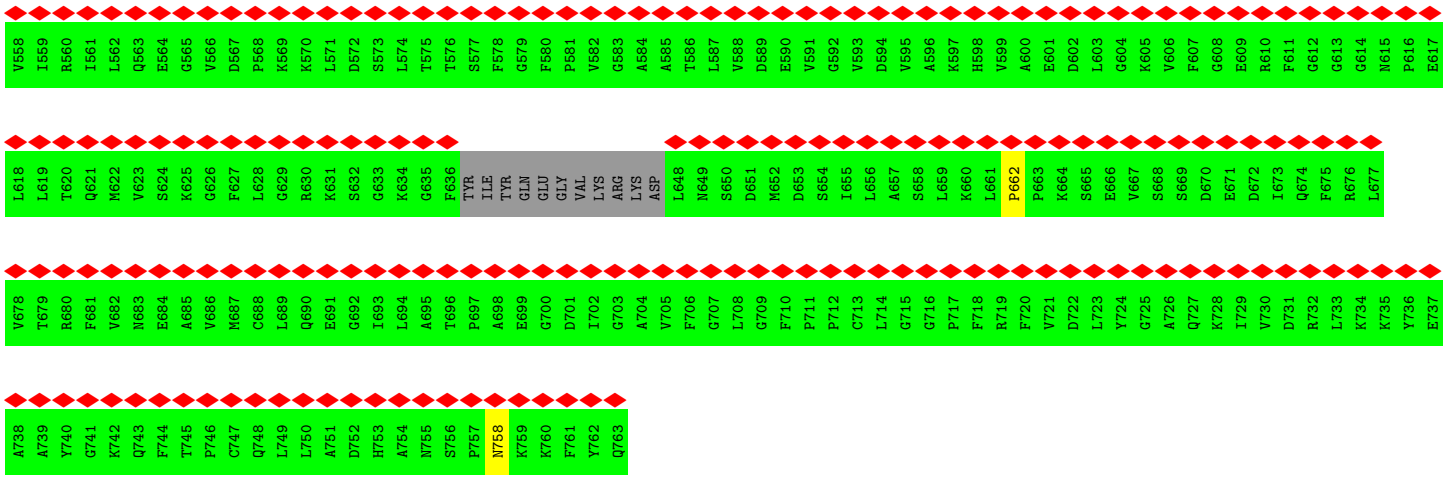


• Molecule 1: Trifunctional enzyme subunit alpha, mitochondrial

Chain E:

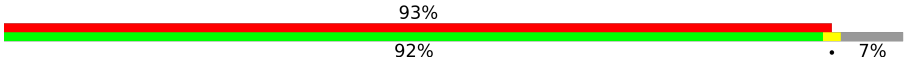


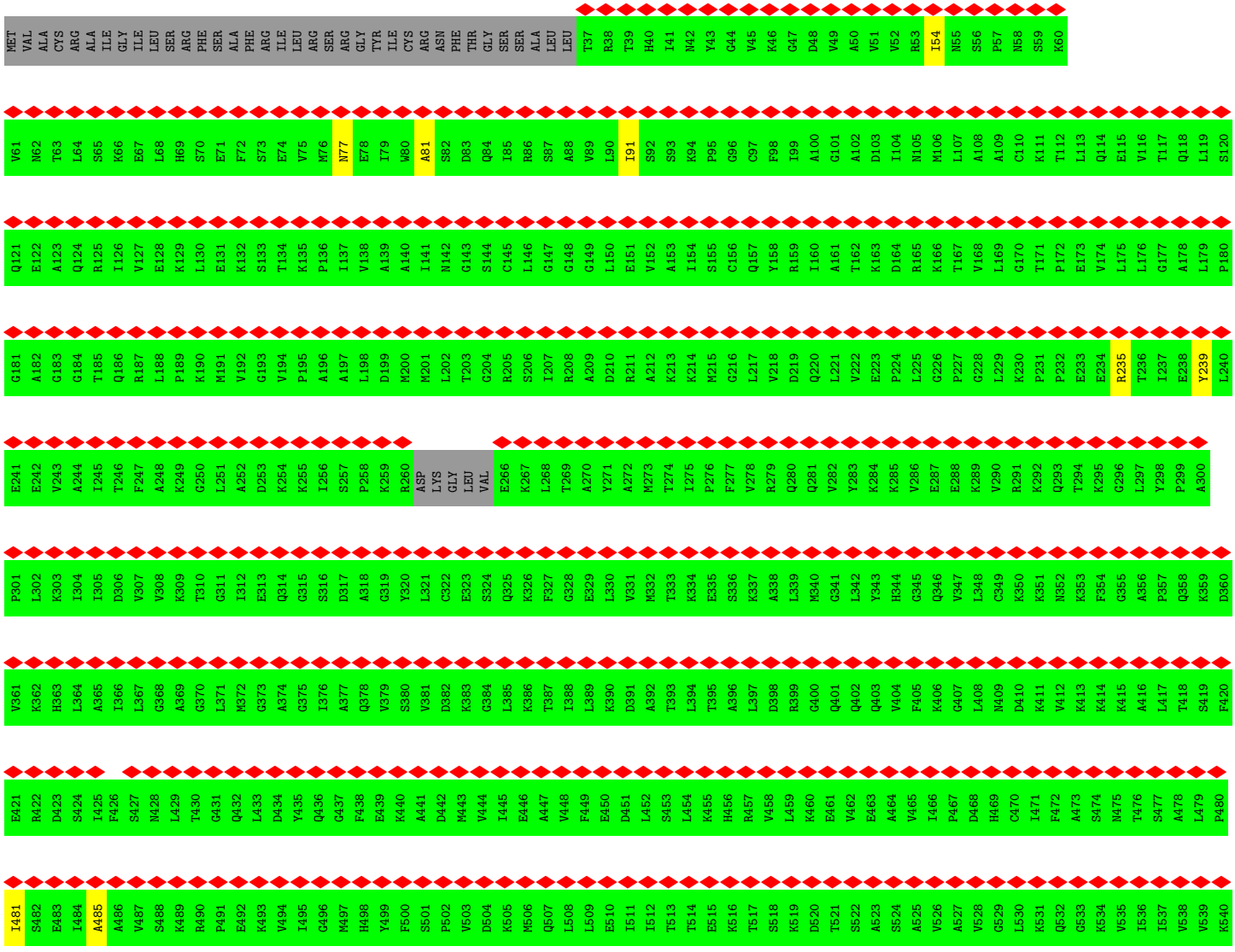




• Molecule 1: Trifunctional enzyme subunit alpha, mitochondrial

Chain G:





D541 G542 P543 G544 F545 Y546 T547 T548 R549 C550 L551 A552 P553 M554 M555 S556 E557 V558 I559 R560 I561 L562 Q563 E564 G565 V566 D567 P568 K569 K570 L571 D572 S573 L574 T575 T576 S577 F578 G579 F580 P581 V582 G583 A584 A585 T586 L587 V588 D589 E590 V591 G592 V593 D594 V595 A596 K597 H598 V599 A600

E601 D602 L603 G604 K605 V606 F607 G608 E609 R610 F611 G612 G613 G614 N615 P616 E617 L618 L619 T620 Q621 M622 V623 S624 K625 G626 F627 L628 G629 R630 K631 S632 G633 K634 G635 F636 TYR ILE TYR GLN GLU GLY VAL LYS ARG LYS ASP L648 N649 S650 D651 M652 D653 S654 I655 L656 A657 S658 L659 K660

L661 P662 P663 K664 S665 E666 V667 S668 S669 D670 E671 D672 I673 Q674 F675 R676 L677 V678 T679 R680 F681 V682 N683 E684 A685 V686 M687 C688 L689 Q690 E691 G692 I693 L694 A695 T696 P697 A698 E699 G700 D701 I702 G703 A704 V705 F706 G707 L708 G709 F710 P711 P712 C713 L714 G715 G716 P717 F718 R719 F720

V721 D722 L723 Y724 G725 A726 Q727 K728 I729 V730 D731 R732 L733 K734 K735 Y736 E737 A738 A739 Y740 G741 K742 Q743 F744 T745 P746 C747 Q748 L749 L750 A751 D752 H753 A754 N755 S756 P757 N758 K759 K760 F761 Y762 Q763

• Molecule 2: Trifunctional enzyme subunit beta, mitochondrial

Chain B:

MET THR ILE LEU THR TYR PRO PHE LYS ASN LEU PRO THR ALA SER LYS TRP ALA LEU ARG PHE SER ILE ARG PRO LEU SER CYS SER SER GLN LEU ARG ALA ALA PRO ALA VAL GLN THR LYS LYS THR LYS LYS THR LEU ALA LYS P49 N50 I51 R52 N53 V54 V55 V56 V57 D58 G59 V60

R61 T62 P63 F64 L65 L66 S67 G68 T69 S70 Y71 K72 D73 L74 M75 P76 H77 D78 L79 A80 R81 A82 A83 L84 T85 G86 L87 L88 H89 R90 T91 S92 V93 P94 K95 E96 V97 V98 D99 Y100 I101 I102 F103 G104 T105 V106 I107 Q108 E109 V110 K111 T112 S113 N114 V115 A116 R117 E118 A119 A120

L121 G122 A123 G124 F125 S126 D127 K128 T129 P130 A131 H132 T133 V134 T135 M136 A137 C138 I139 S140 A141 N142 Q143 A144 M145 T146 T147 G148 V149 G150 L151 I152 A153 S154 G155 Q156 C157 D158 V159 I160 V161 A162 G163 G164 V165 E166 L167 M168 S169 D170 V171 P172 I173 R174 H175 S176 R177 K178 M179 R180

K181 L182 M183 L184 D185 L186 ASN LYS ALA LYS SER MET G193 Q194 R195 L196 S197 L198 I199 S200 K201 F202 R203 F204 N205 F206 L207 A208 P209 E210 L211 P212 A213 V214 S215 E216 F217 S218 T219 S220 E221 T222 M223 G224 H225 S226 A227 D228 R229 L230 A231 A232 A233 F234 A235 V236 S237 R238 L239 E240

Q241 D242 E243 Y244 A245 L246 R247 S248 H249 S250 L251 A252 K253 K254 A255 Q256 D257 E258 G259 L260 L261 S262 D263 V264 V265 P266 F267 K268 V269 P270 G271 K272 D273 T274 V275 T276 K277 D278 N279 G280 I281 R282 P283 S284 S285 L286 E287 Q288 M289 A290 K291 L292 K293 P294 A295 F296 I297 K298 P299 Y300

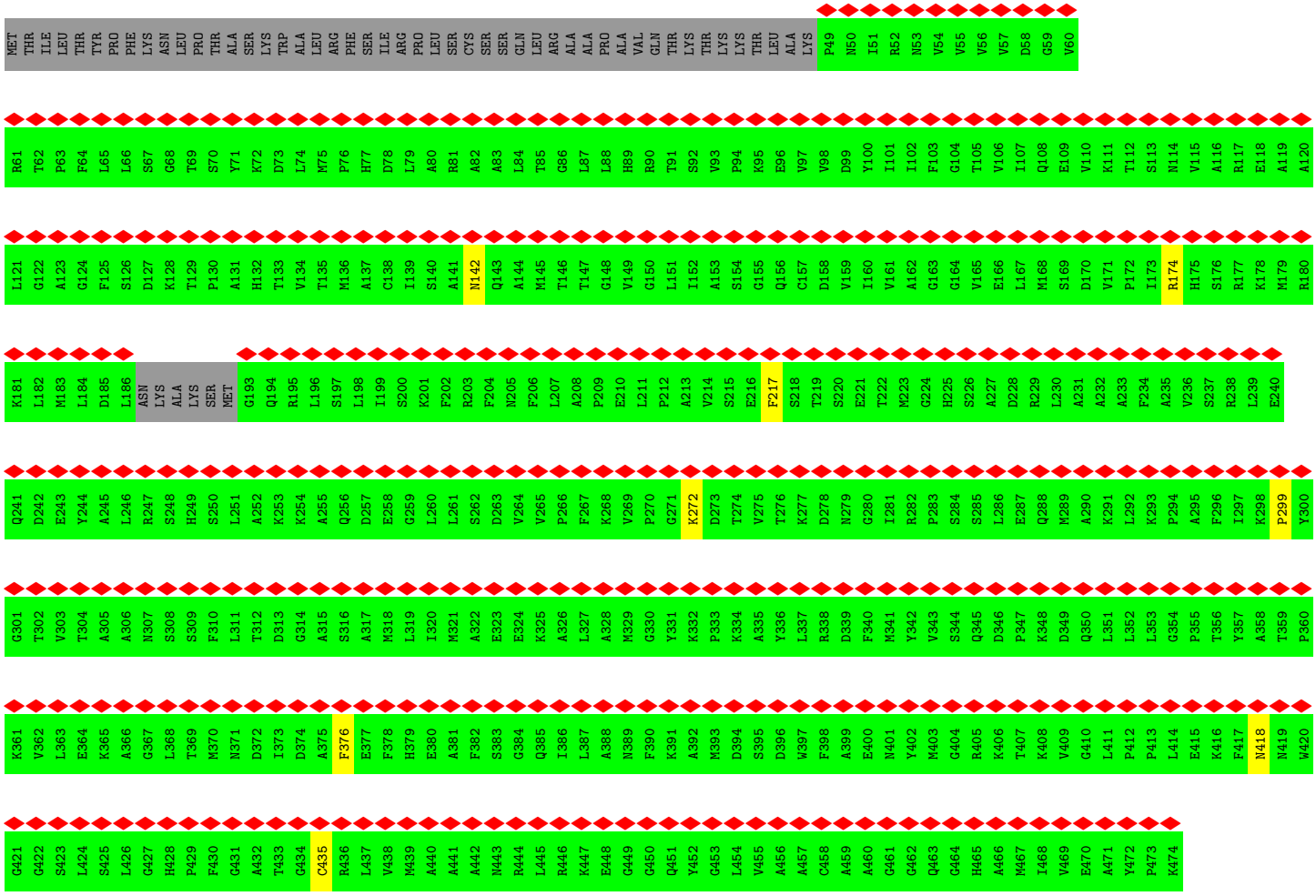
G301 T302 V303 T304 A305 A306 N307 S308 S309 F310 L311 T312 D313 G314 A315 S316 A317 M318 L319 I320 M321 A322 E323 E324 K325 A326 L327 A328 M329 G330 Y331 K332 P333 K334 A335 Y336 L337 R338 D339 F340 M341 Y342 V343 S344 Q345 D346 P347 K348 D349 Q350 L351 L352 L353 G354 P355 T356 Y357 A358 T359 P360

K361 V362 L363 E364 K365 A366 G367 L368 T369 M370 N371 D372 I373 D374 A375 F376 E377 F378 H379 E380 A381 F382 S383 G384 Q385 I386 L387 A388 N389 F390 K391 A392 M393 D394 S395 D396 W397 F398 A399 E400 N401 Y402 M403 G404 R405 K406 T407 K408 V409 G410 L411 P412 P413 L414 E415 K416 F417 N418 M419 W420

G421 G422 S423 L424 S425 L426 G427 H428 P429 F430 G431 A432 T433 G434 C435 R436 L437 V438 M439 A440 A441 A442 N443 R444 L445 R446 K447 E448 G449 G450 Q451 Y452 G453 L454 V455 A456 A457 C458 A459 A460 G461 G462 Q463 G464 H465 A466 M467 I468 V469 E470 A471 Y472 P473 K474

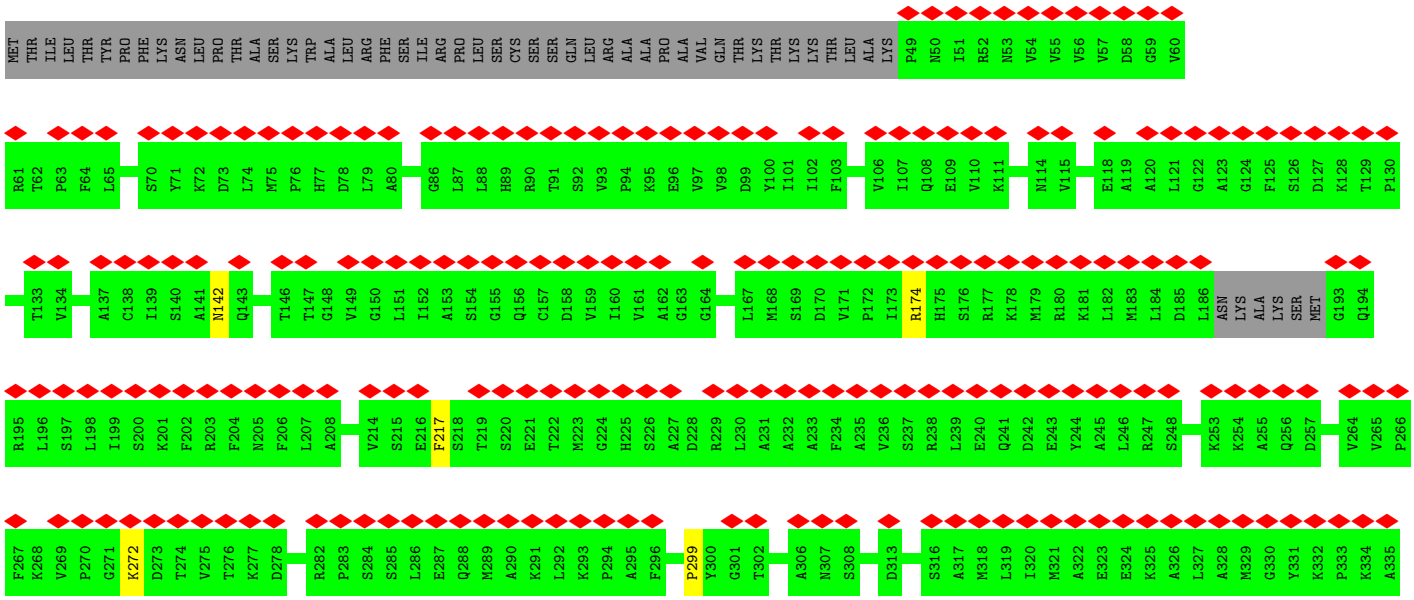
• Molecule 2: Trifunctional enzyme subunit beta, mitochondrial

Chain D:



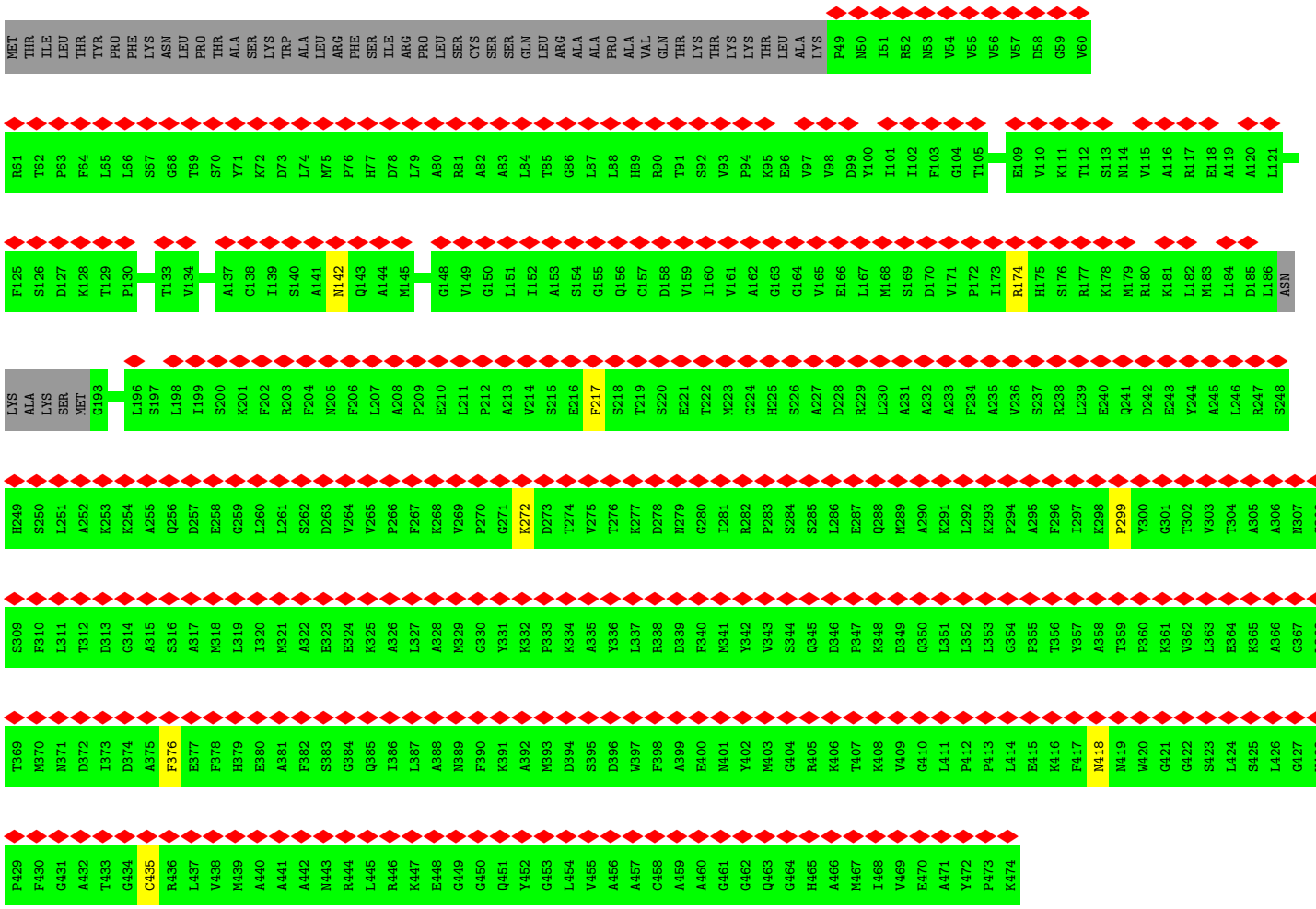
• Molecule 2: Trifunctional enzyme subunit beta, mitochondrial

Chain F:



• Molecule 2: Trifunctional enzyme subunit beta, mitochondrial

Chain H:



4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	48564	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 ($e^-/Å^2$)	50	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	0.793	Depositor
Minimum map value	-0.659	Depositor
Average map value	0.002	Depositor
Map value standard deviation	0.029	Depositor
Recommended contour level	0.15	Depositor
Map size (Å)	337.92, 337.92, 337.92	wwPDB
Map dimensions	128, 128, 128	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	2.64, 2.64, 2.64	Depositor

5 Model quality

5.1 Standard geometry

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\#\|Z\| > 5$	RMSZ	$\#\|Z\| > 5$
1	A	0.33	0/2841	0.61	0/3546
1	C	0.33	0/2841	0.61	0/3546
1	E	0.33	0/2841	0.61	0/3546
1	G	0.33	0/2841	0.61	0/3546
2	B	0.36	0/1678	0.67	0/2094
2	D	0.36	0/1678	0.68	0/2094
2	F	0.36	0/1678	0.68	0/2094
2	H	0.36	0/1678	0.68	0/2094
All	All	0.34	0/18076	0.64	0/22560

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
2	B	0	5
2	D	0	5
2	F	0	5
2	H	0	5
All	All	0	20

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (20) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	B	142	ASN	Peptide
2	B	174	ARG	Peptide
2	B	272	LYS	Peptide

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Mol	Chain	Res	Type	Group
2	B	376	PHE	Peptide
2	B	435	CYS	Peptide
2	D	142	ASN	Peptide
2	D	174	ARG	Peptide
2	D	272	LYS	Peptide
2	D	376	PHE	Peptide
2	D	435	CYS	Peptide
2	F	142	ASN	Peptide
2	F	174	ARG	Peptide
2	F	272	LYS	Peptide
2	F	376	PHE	Peptide
2	F	435	CYS	Peptide
2	H	142	ASN	Peptide
2	H	174	ARG	Peptide
2	H	272	LYS	Peptide
2	H	376	PHE	Peptide
2	H	435	CYS	Peptide

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	2844	0	801	5	0
1	C	2844	0	801	4	0
1	E	2844	0	801	3	0
1	G	2844	0	801	5	0
2	B	1680	0	468	0	0
2	D	1680	0	468	0	0
2	F	1680	0	468	0	0
2	H	1680	0	468	0	0
All	All	18096	0	5076	17	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 (17) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:235:ARG:O	1:A:239:TYR:N	2.49	0.46
1:C:235:ARG:O	1:C:239:TYR:N	2.49	0.46
1:G:235:ARG:O	1:G:239:TYR:N	2.49	0.45
1:E:235:ARG:O	1:E:239:TYR:N	2.49	0.45
1:C:77:ASN:O	1:C:81:ALA:N	2.50	0.45
1:A:77:ASN:O	1:A:81:ALA:N	2.50	0.45
1:E:77:ASN:O	1:E:81:ALA:N	2.50	0.45
1:G:77:ASN:O	1:G:81:ALA:N	2.50	0.44
1:A:603:LEU:O	1:A:608:GLY:N	2.47	0.44
1:G:603:LEU:O	1:G:608:GLY:N	2.47	0.44
1:A:54:ILE:N	1:A:91:ILE:O	2.53	0.42
1:G:54:ILE:N	1:G:91:ILE:O	2.53	0.42
1:E:481:ILE:O	1:E:485:ALA:N	2.54	0.41
1:C:603:LEU:O	1:C:608:GLY:N	2.47	0.41
1:G:481:ILE:O	1:G:485:ALA:N	2.54	0.41
1:C:481:ILE:O	1:C:485:ALA:N	2.53	0.41
1:A:481:ILE:O	1:A:485:ALA:N	2.54	0.41

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	705/763 (92%)	626 (89%)	76 (11%)	3 (0%)	34	72
1	C	705/763 (92%)	626 (89%)	77 (11%)	2 (0%)	41	77
1	E	705/763 (92%)	626 (89%)	76 (11%)	3 (0%)	34	72
1	G	705/763 (92%)	626 (89%)	77 (11%)	2 (0%)	41	77
2	B	416/474 (88%)	354 (85%)	59 (14%)	3 (1%)	22	63
2	D	416/474 (88%)	352 (85%)	61 (15%)	3 (1%)	22	63
2	F	416/474 (88%)	353 (85%)	60 (14%)	3 (1%)	22	63

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
2	H	416/474 (88%)	352 (85%)	61 (15%)	3 (1%)	22 63
All	All	4484/4948 (91%)	3915 (87%)	547 (12%)	22 (0%)	32 69

All (22) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	758	ASN
1	C	758	ASN
1	E	758	ASN
1	G	758	ASN
1	A	259	LYS
1	E	259	LYS
1	A	662	PRO
2	B	217	PHE
2	B	299	PRO
2	B	418	ASN
1	C	662	PRO
2	D	217	PHE
2	D	299	PRO
2	D	418	ASN
1	E	662	PRO
2	F	217	PHE
2	F	299	PRO
2	F	418	ASN
1	G	662	PRO
2	H	217	PHE
2	H	299	PRO
2	H	418	ASN

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

This section contains visualisations of the EMDB entry EMD-6944. 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: 64

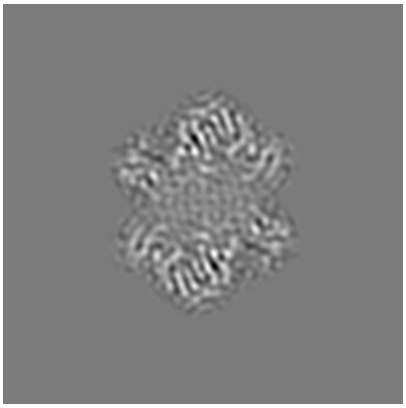
Y Index: 64

Z Index: 64

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: 68

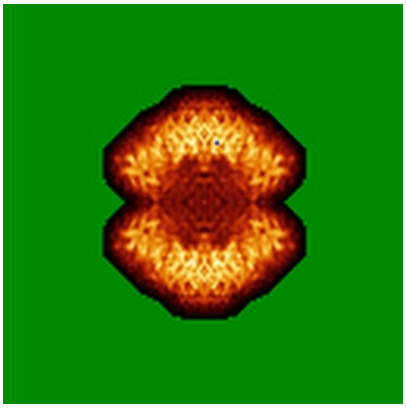
Y Index: 68

Z Index: 47

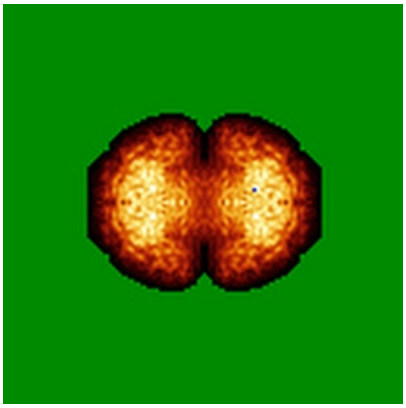
The images above show the largest variance slices of the map in three orthogonal directions.

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

6.4.1 Primary map



X



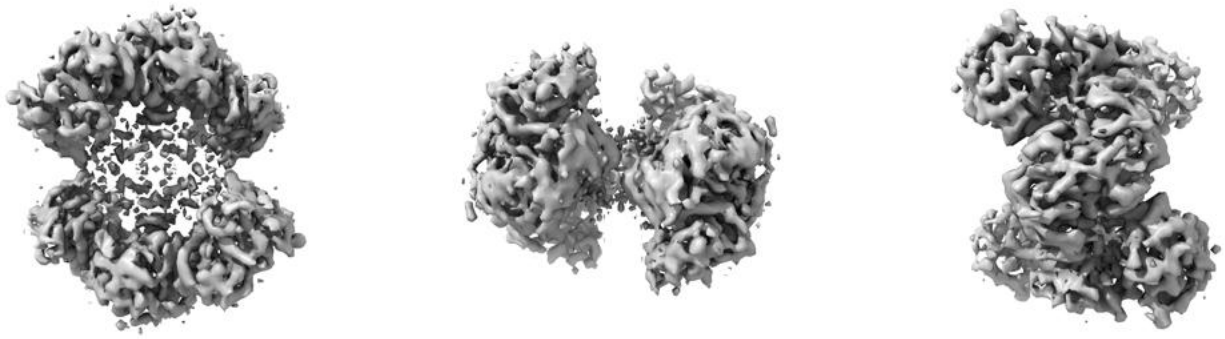
Y

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 0.15. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

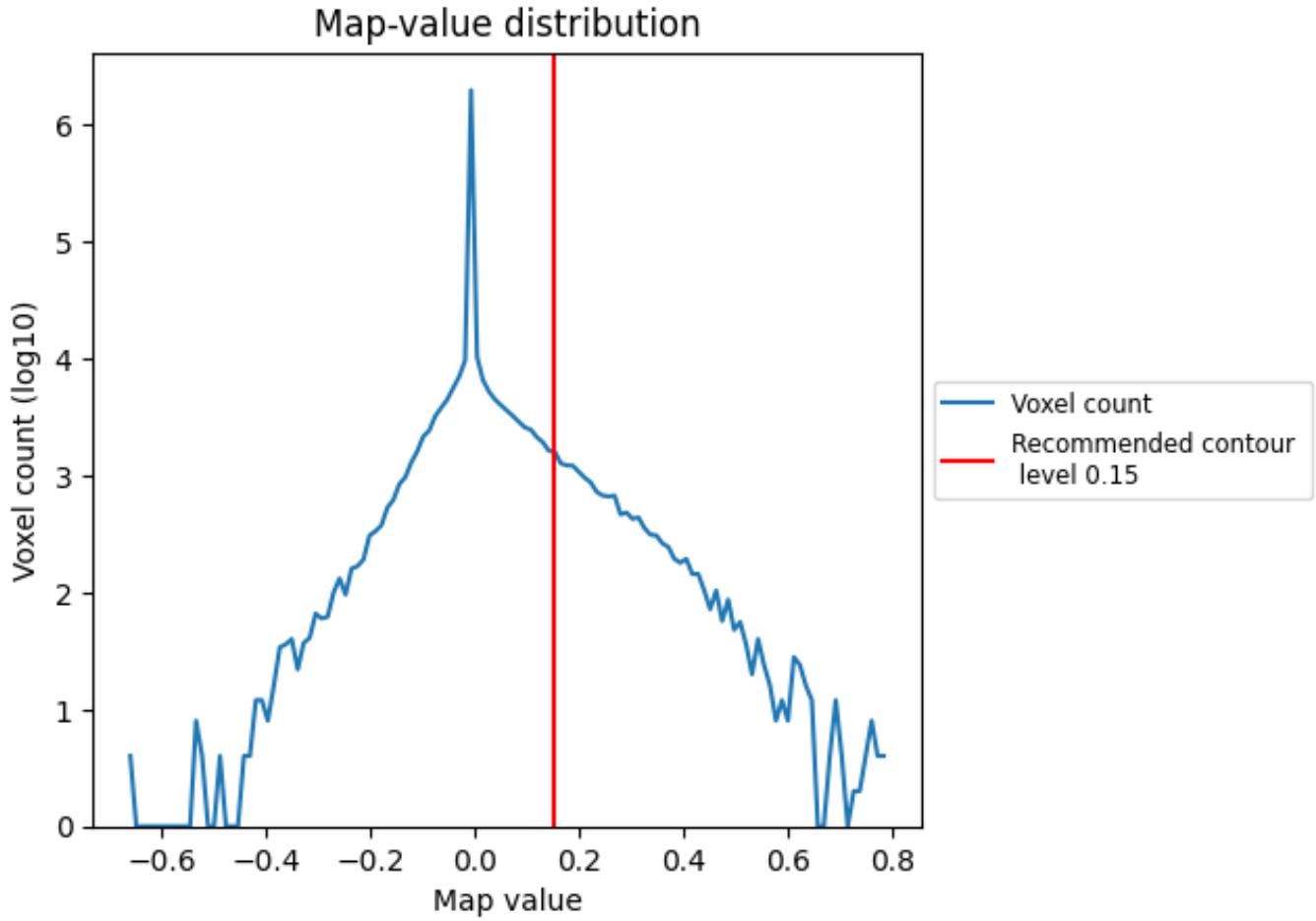
6.6 Mask visualisation (i)

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

7 Map analysis

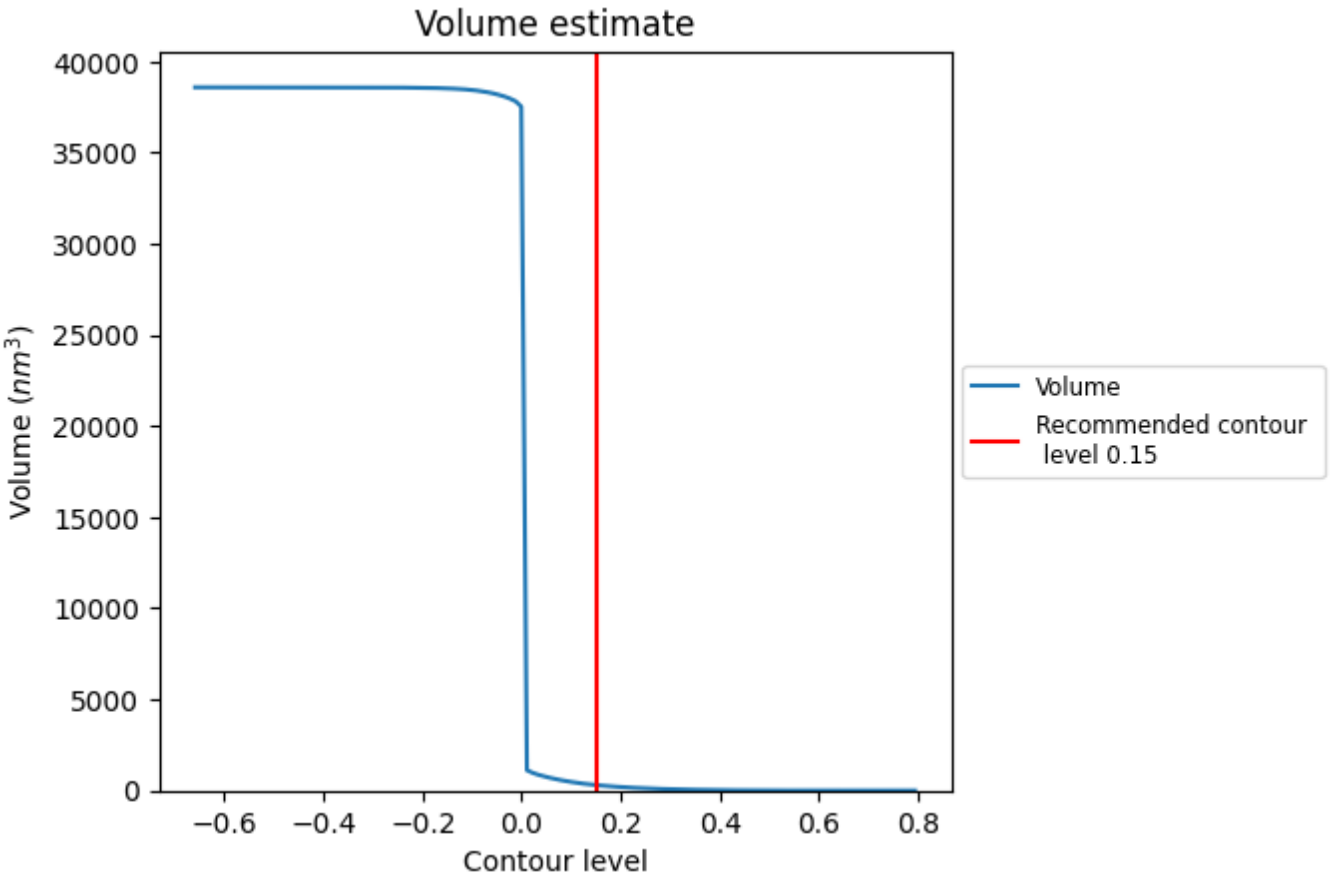
This section contains the results of statistical analysis of the map.

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.

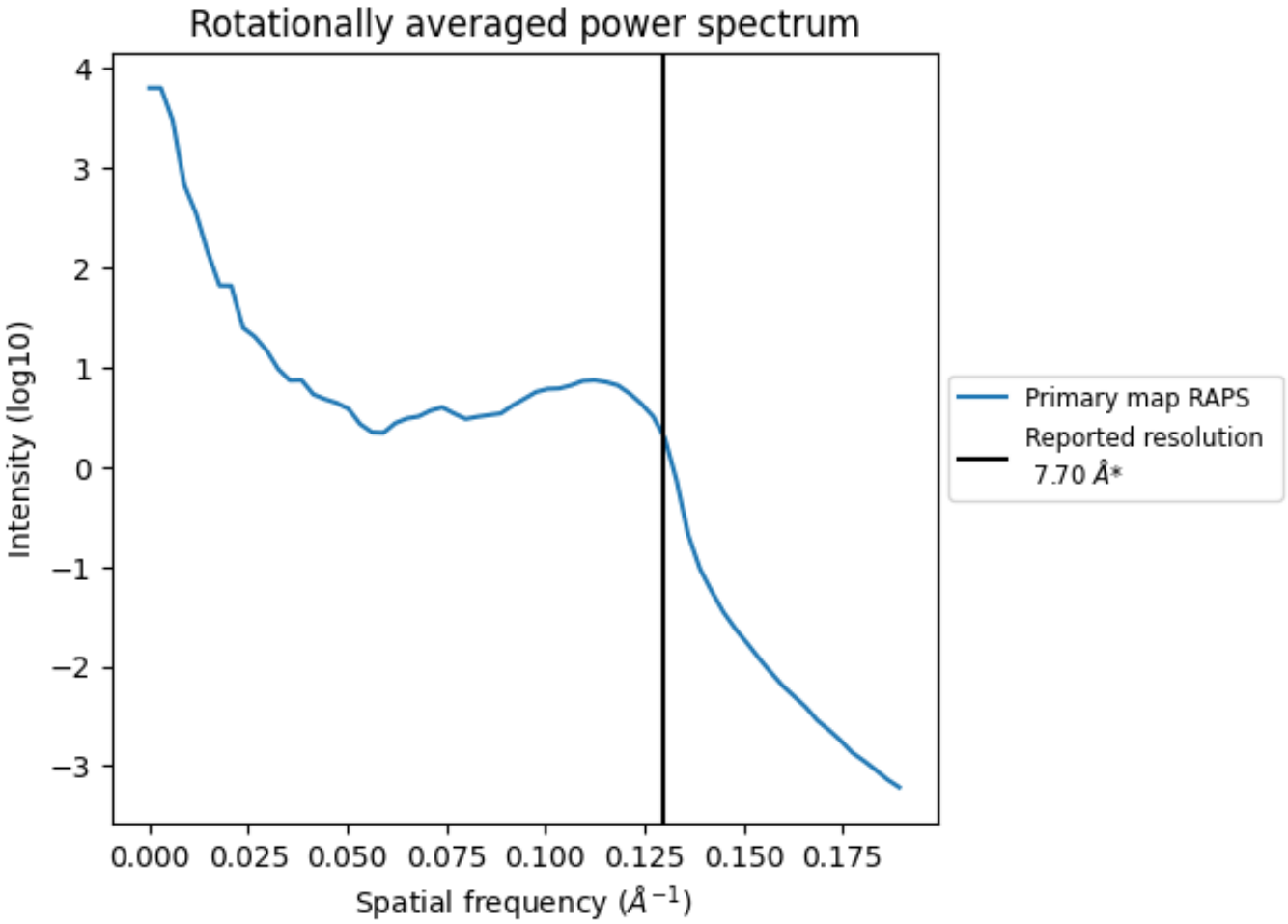
7.2 Volume estimate



The volume at the recommended contour level is 301 nm^3; this corresponds to an approximate mass of 272 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 0.130 Å^{-1}

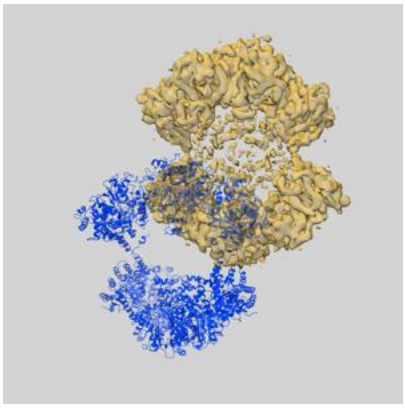
8 Fourier-Shell correlation (i)

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

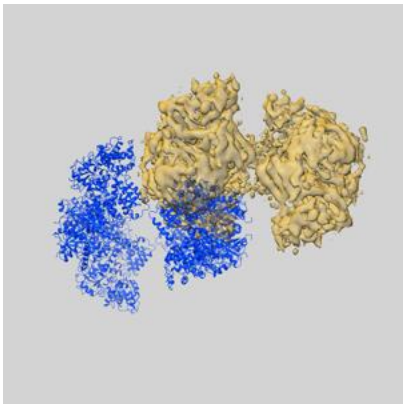
9 Map-model fit

This section contains information regarding the fit between EMDB map EMD-6944 and PDB model 5ZRV. Per-residue inclusion information can be found in section 3 on page 4.

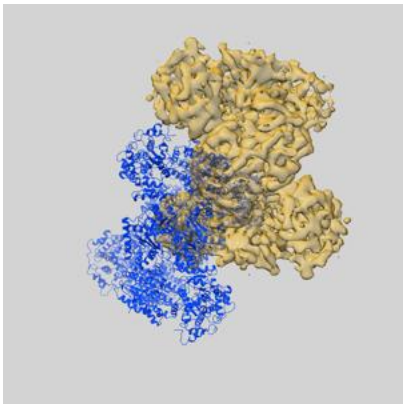
9.1 Map-model overlay



X



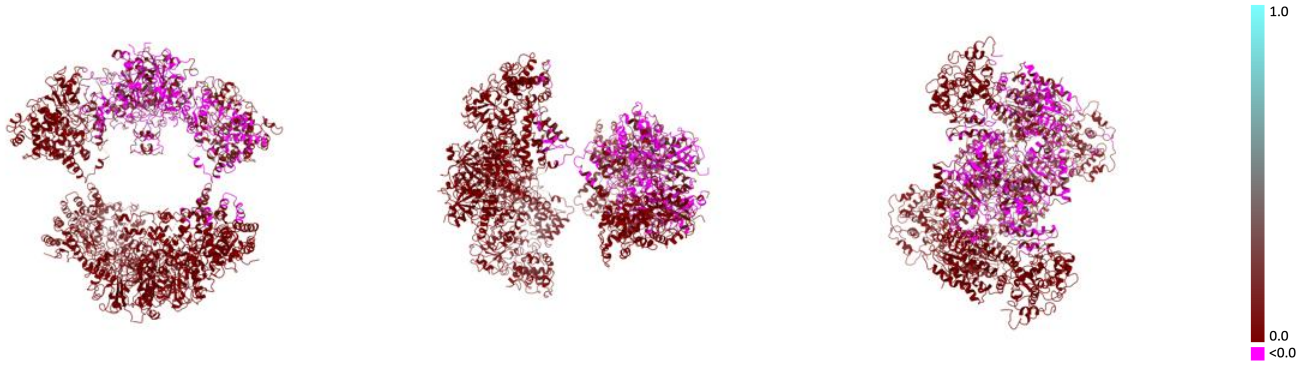
Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.15 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

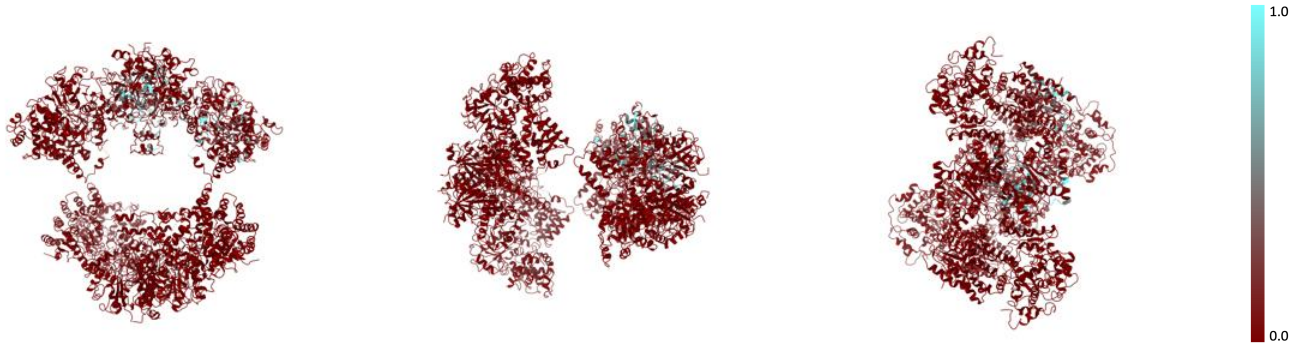
9.2 Q-score mapped to coordinate model (i)



X Y Z

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

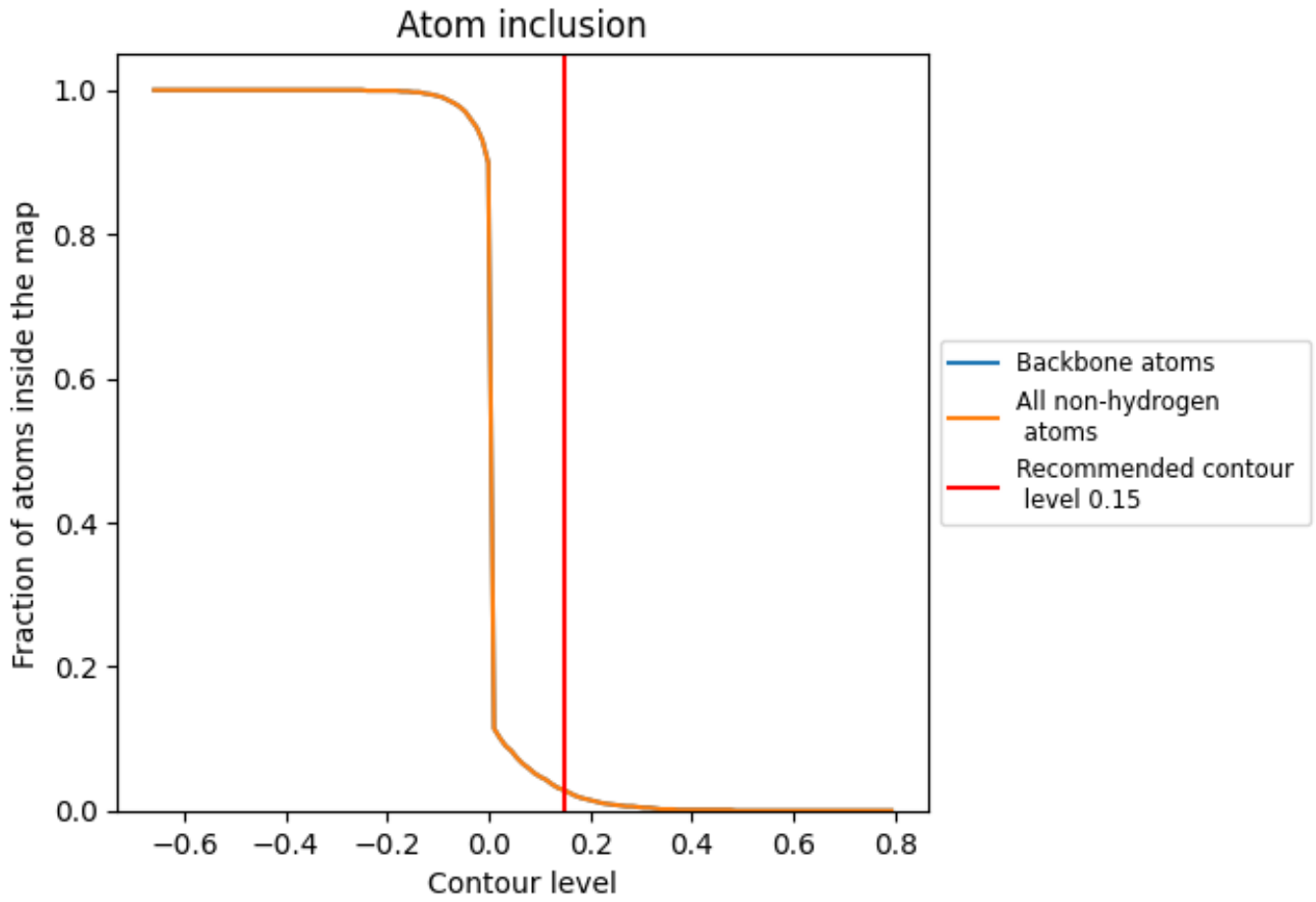
9.3 Atom inclusion mapped to coordinate model (i)



X Y Z

The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.15).

9.4 Atom inclusion (i)



At the recommended contour level, 3% of all backbone atoms, 3% 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 (0.15) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.0280	0.0020
A	0.0000	0.0050
B	0.0000	0.0000
C	0.0000	0.0000
D	0.0000	0.0000
E	0.0550	0.0040
F	0.1590	-0.0000
G	0.0010	0.0050
H	0.0430	0.0010