wwPDB EM Validation Summary Report (i)

Sep 8, 2026 – 06:51 pm BST

PDB ID	:	6FO2 / pdb_00006fo2
EMDB ID	:	EMD-4288
Title	:	CryoEM structure of bovine cytochrome bc1 with no ligand bound
Authors	:	Johnson, R.M.; Amporndanai, K.; O'Neill, P.M.; Fishwick, C.W.G.; Jamson, A.H.; Rawson, S.D.; Hasnain, S.S.; Antonyuk, S.V.; Muench, S.P.
Deposited on	:	2018-02-05
Resolution	:	4.40 Å(reported)

This is a wwPDB EM Validation Summary 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 (i) 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 (i)) were used in the production of this report:

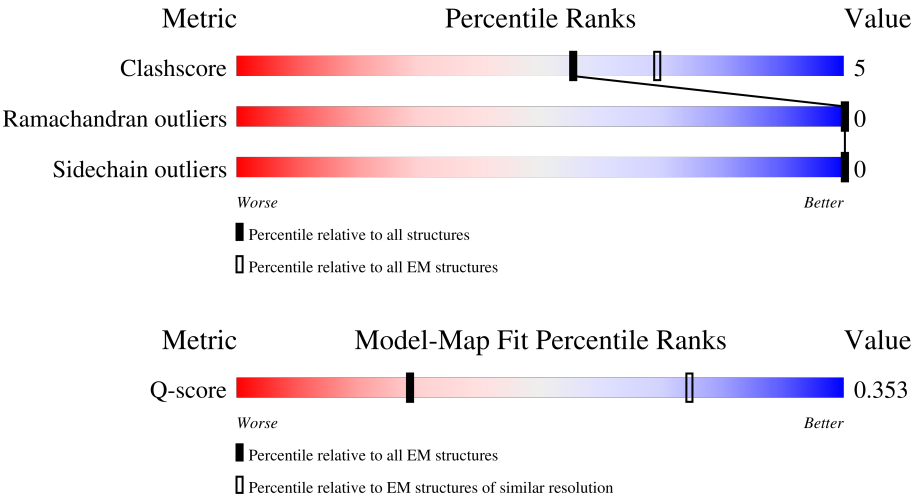
EMDB validation analysis	:	0.0.1.dev133
Mogul	:	1.8.4, CSD as541be (2020)
MolProbity	:	4-5-2 with Phenix2.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics	:	202505.v01 (Using data 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)	:	2.50

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 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	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	3132 (3.91 - 4.90)

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 <=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	480	19% 78% 14% 9%
1	N	480	20% 78% 13% 9%
2	B	453	22% 79% 12% 10%
2	O	453	23% 79% 12% 9%

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Mol	Chain	Length	Quality of chain
3	C	379	15% 84% 14%
3	P	379	15% 85% 12%
4	D	325	12% 64% 9% 27%
4	Q	325	13% 64% 9% 27%
5	E	274	34% 54% 8% 38%
5	R	274	35% 54% 7% 39%
6	F	111	9% 86% 12%
6	S	111	7% 86% 12%
7	G	82	11% 79% 11% 10%
7	T	82	17% 83% 7% 10%
8	H	91	30% 67% 29%
8	U	91	32% 67% 29%
9	I	16	50% 88% 12%
9	V	16	44% 88% 12%
10	J	64	23% 86% 12%
10	W	64	28% 77% 11% 12%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
12	HEC	D	501	X	-	-	-
12	HEC	Q	501	X	-	-	-

2 Entry composition (i)

There are 12 unique types of molecules in this entry. The entry contains 60536 atoms, of which 29987 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 Cytochrome b-c1 complex subunit 1, mitochondrial.

Mol	Chain	Residues	Atoms						AltConf	Trace
1	N	438	Total	C	H	N	O	S	0	0
			6683	2117	3297	598	651	20		
1	A	438	Total	C	H	N	O	S	0	0
			6683	2117	3297	598	651	20		

- Molecule 2 is a protein called Cytochrome b-c1 complex subunit 2, mitochondrial.

Mol	Chain	Residues	Atoms						AltConf	Trace
2	O	411	Total	C	H	N	O	S	0	0
			6156	1940	3066	546	597	7		
2	B	409	Total	C	H	N	O	S	0	0
			6127	1931	3054	543	592	7		

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
O	305	GLU	GLN	conflict	UNP P23004
B	305	GLU	GLN	conflict	UNP P23004

- Molecule 3 is a protein called Cytochrome b.

Mol	Chain	Residues	Atoms						AltConf	Trace
3	P	370	Total	C	H	N	O	S	0	0
			5933	1973	2997	456	489	18		
3	C	370	Total	C	H	N	O	S	0	0
			5933	1973	2997	456	489	18		

- Molecule 4 is a protein called Cytochrome c1, heme protein, mitochondrial.

Mol	Chain	Residues	Atoms						AltConf	Trace
4	Q	237	Total	C	H	N	O	S	0	0
			3720	1206	1833	325	341	15		

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Mol	Chain	Residues	Atoms						AltConf	Trace
4	D	237	Total	C	H	N	O	S	0	0
			3720	1206	1833	325	341	15		

- Molecule 5 is a protein called Cytochrome b-c1 complex subunit Rieske, mitochondrial.

Mol	Chain	Residues	Atoms						AltConf	Trace
5	R	168	Total	C	H	N	O	S	0	0
			2478	792	1219	219	241	7		
5	E	169	Total	C	H	N	O	S	0	0
			2477	793	1214	219	244	7		

- Molecule 6 is a protein called Cytochrome b-c1 complex subunit 7.

Mol	Chain	Residues	Atoms						AltConf	Trace
6	S	98	Total	C	H	N	O	S	0	0
			1710	547	850	154	157	2		
6	F	98	Total	C	H	N	O	S	0	0
			1710	547	850	154	157	2		

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
S	56	ASP	ASN	conflict	UNP P00129
F	56	ASP	ASN	conflict	UNP P00129

- Molecule 7 is a protein called Cytochrome b-c1 complex subunit 8.

Mol	Chain	Residues	Atoms						AltConf	Trace
7	T	74	Total	C	H	N	O	S	0	0
			1255	408	631	117	98	1		
7	G	74	Total	C	H	N	O	S	0	0
			1255	408	631	117	98	1		

- Molecule 8 is a protein called Cytochrome b-c1 complex subunit 6, mitochondrial.

Mol	Chain	Residues	Atoms						AltConf	Trace
8	U	65	Total	C	H	N	O	S	0	0
			1041	321	512	96	107	5		
8	H	65	Total	C	H	N	O	S	0	0
			1041	321	512	96	107	5		

- Molecule 9 is a protein called Cytochrome b-c1 complex subunit Rieske, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
9	V	16	Total	C	H	N	O	0	0
			242	72	127	23	20		
9	I	16	Total	C	H	N	O	0	0
			242	72	127	23	20		

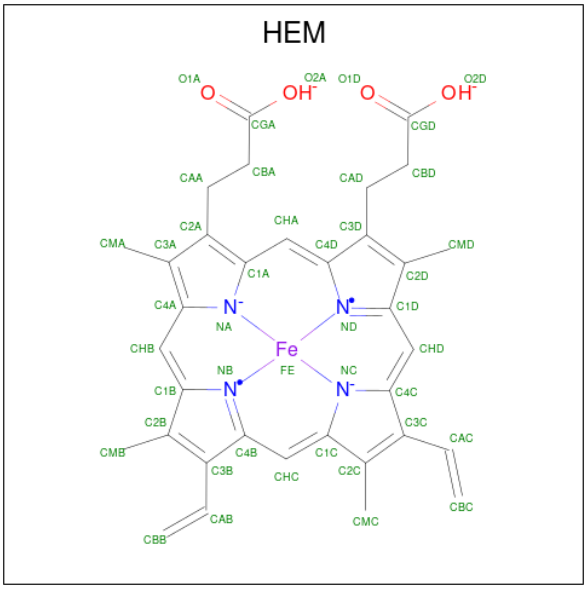
There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
V	64	VAL	LEU	conflict	UNP P13272
I	64	VAL	LEU	conflict	UNP P13272

- Molecule 10 is a protein called Cytochrome b-c1 complex subunit 9.

Mol	Chain	Residues	Atoms					AltConf	Trace
10	W	56	Total	C	H	N	O	0	0
			936	307	470	81	78		
10	J	56	Total	C	H	N	O	0	0
			936	307	470	81	78		

- Molecule 11 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



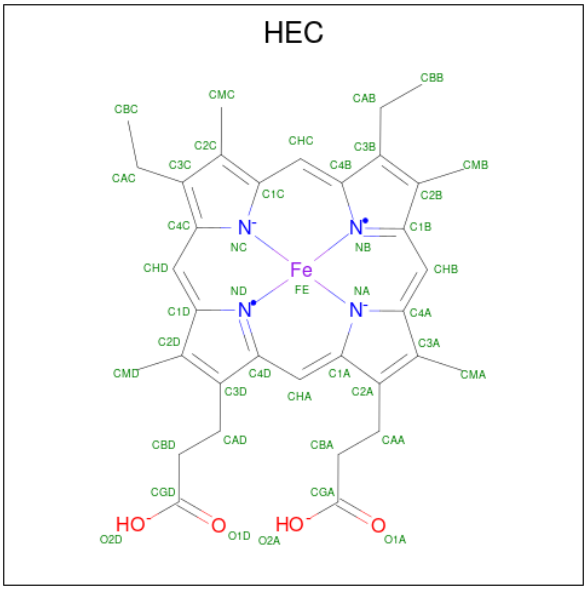
Mol	Chain	Residues	Atoms					AltConf
11	P	1	Total	C	Fe	N	O	0
			43	34	1	4	4	
11	P	1	Total	C	Fe	N	O	0
			43	34	1	4	4	

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Mol	Chain	Residues	Atoms					AltConf
11	C	1	Total	C	Fe	N	O	0
			43	34	1	4	4	
11	C	1	Total	C	Fe	N	O	0
			43	34	1	4	4	

- Molecule 12 is HEME C (CCD ID: HEC) (formula: $C_{34}H_{36}FeN_4O_4$).



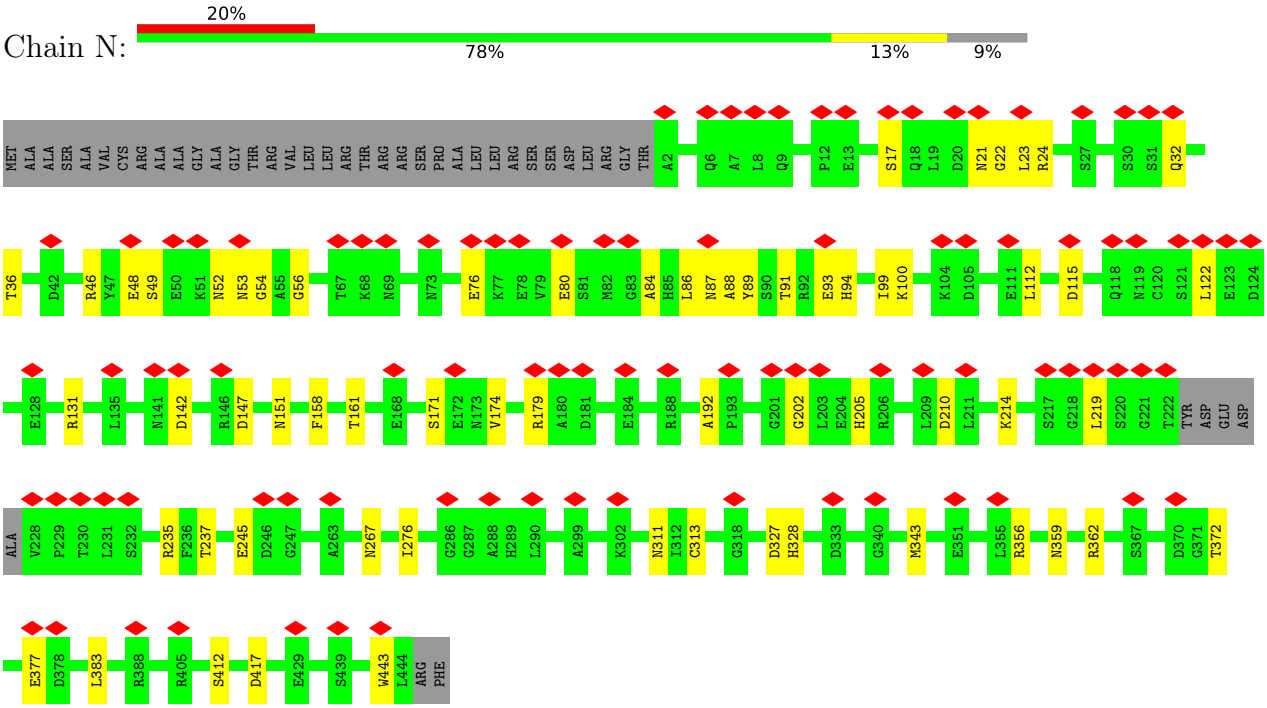
Mol	Chain	Residues	Atoms					AltConf
12	Q	1	Total	C	Fe	N	O	0
			43	34	1	4	4	
12	D	1	Total	C	Fe	N	O	0
			43	34	1	4	4	

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.

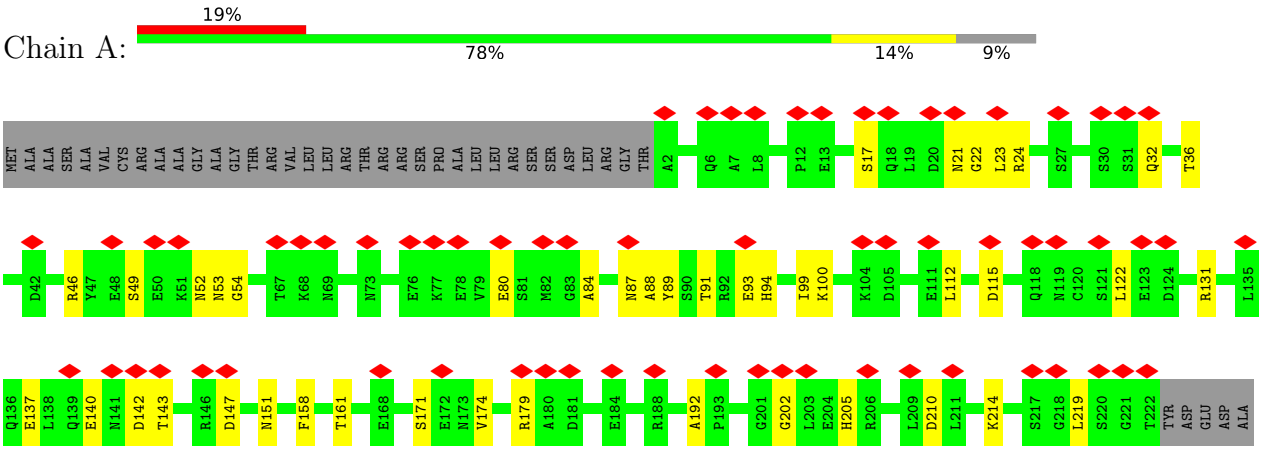
• Molecule 1: Cytochrome b-c1 complex subunit 1, mitochondrial

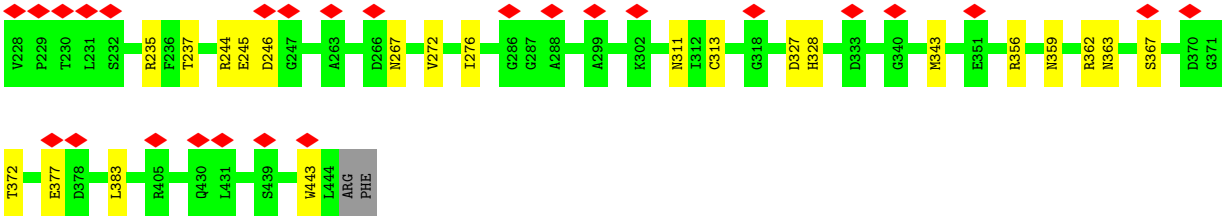
Chain N:



• Molecule 1: Cytochrome b-c1 complex subunit 1, mitochondrial

Chain A:

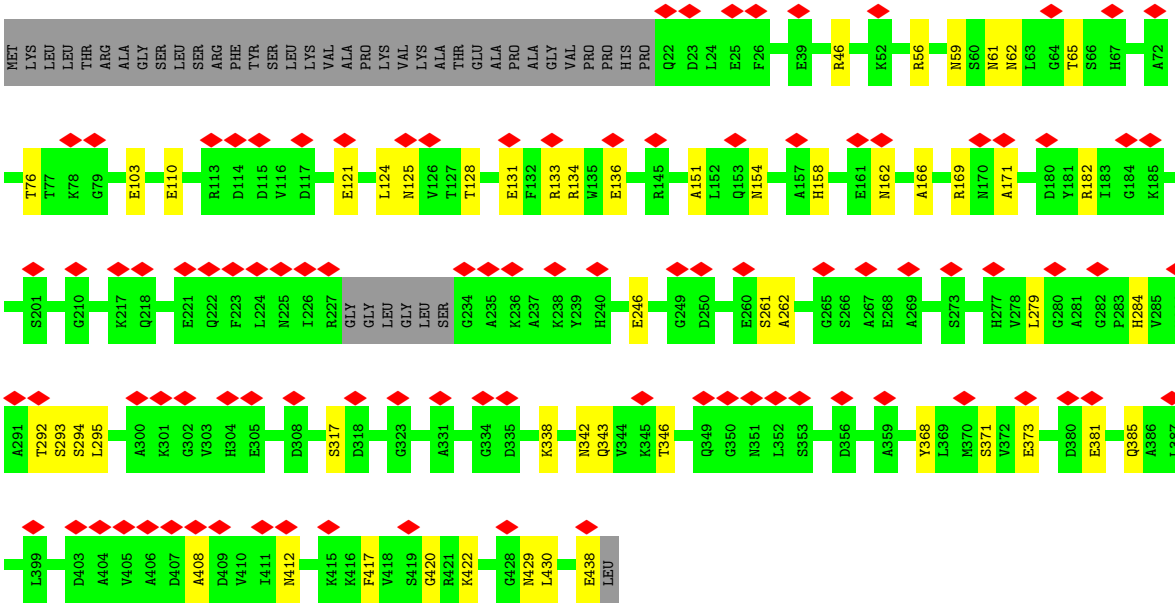




• Molecule 2: Cytochrome b-c1 complex subunit 2, mitochondrial

Chain O:

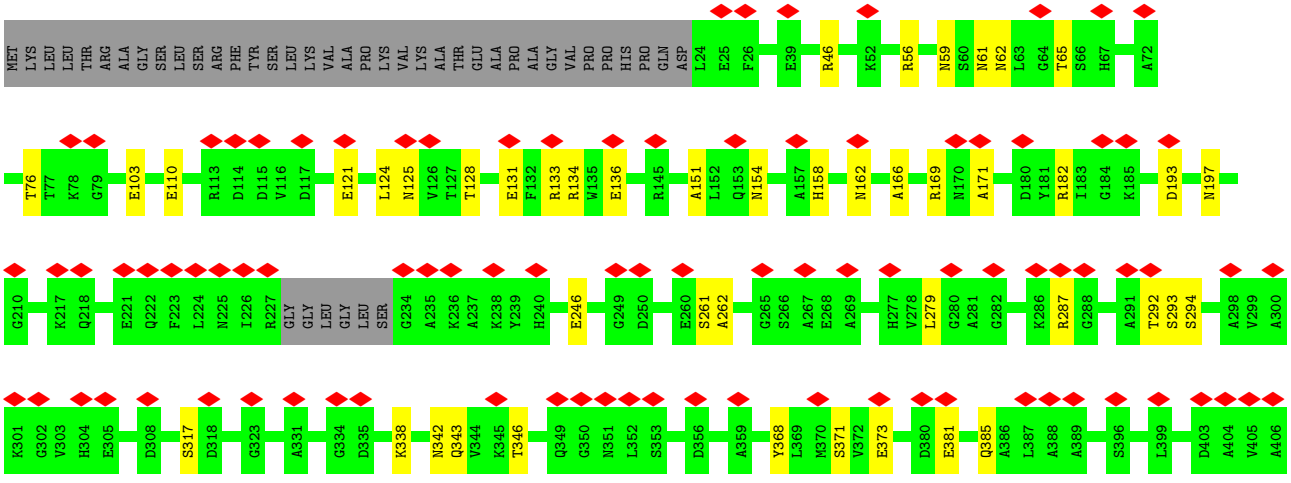


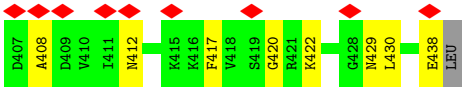


• Molecule 2: Cytochrome b-c1 complex subunit 2, mitochondrial

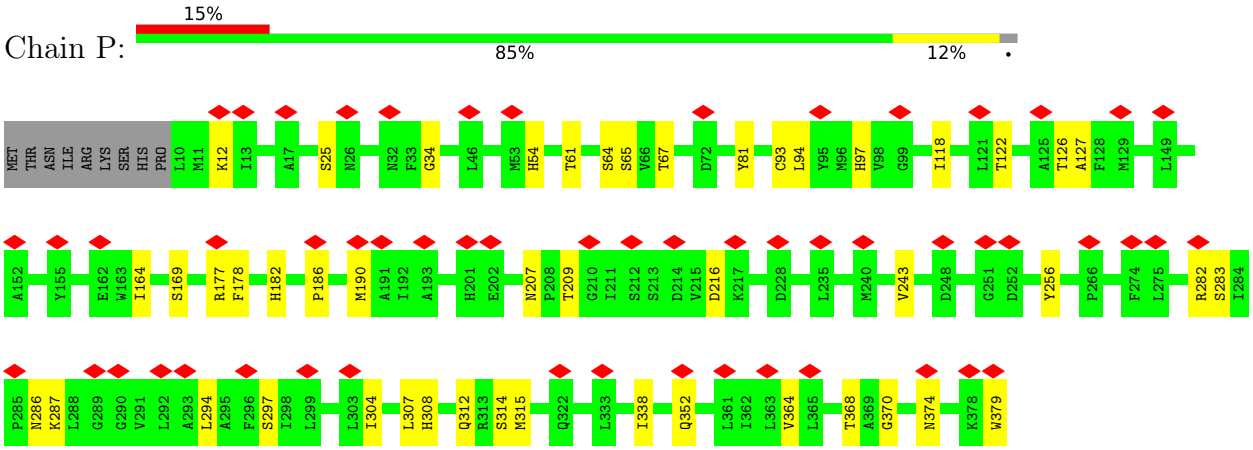
Chain B:



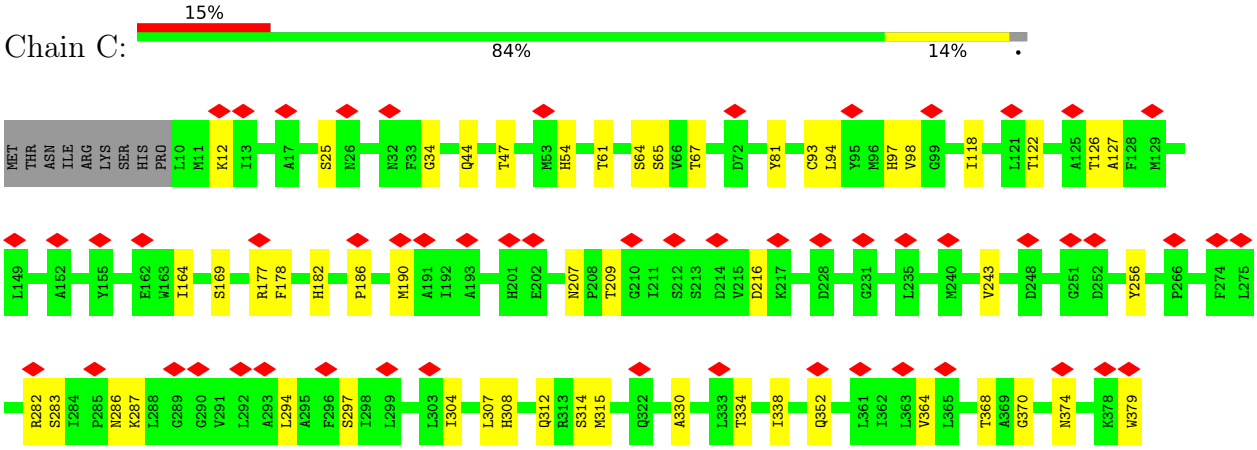




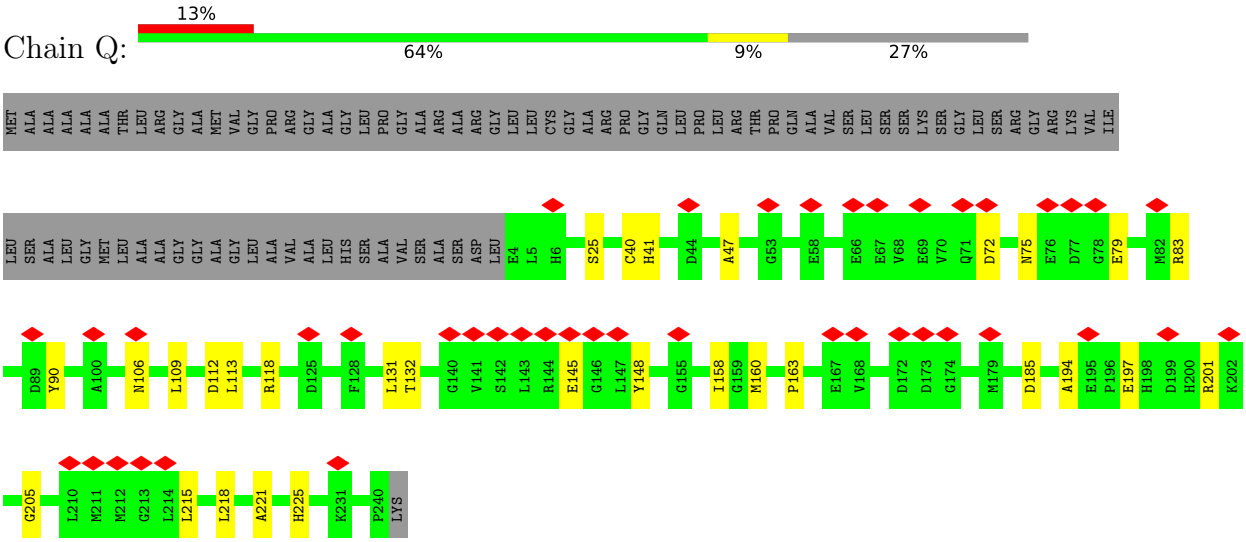
• Molecule 3: Cytochrome b



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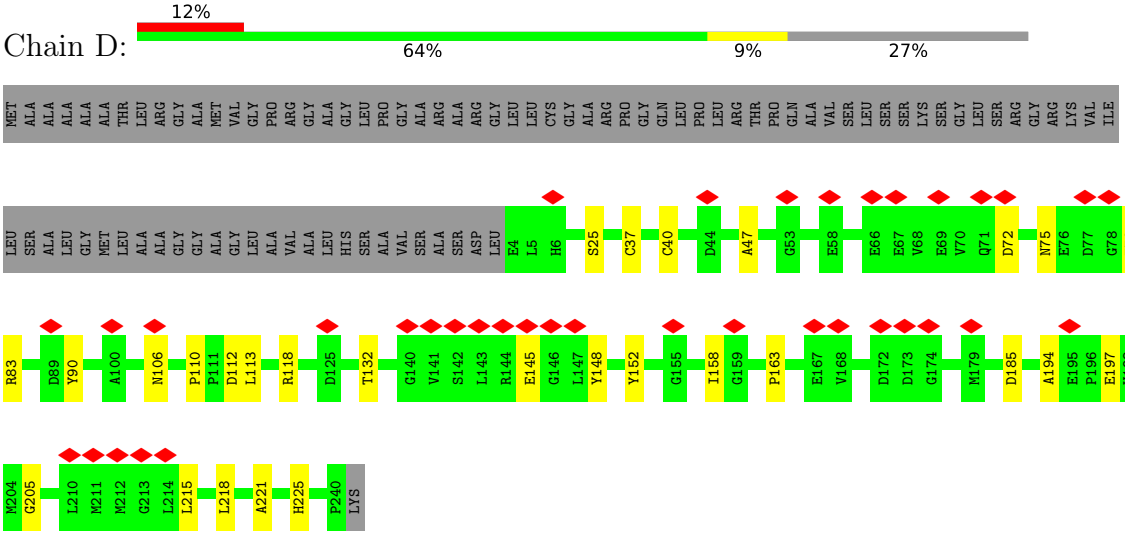


• Molecule 4: Cytochrome c1, heme protein, mitochondrial



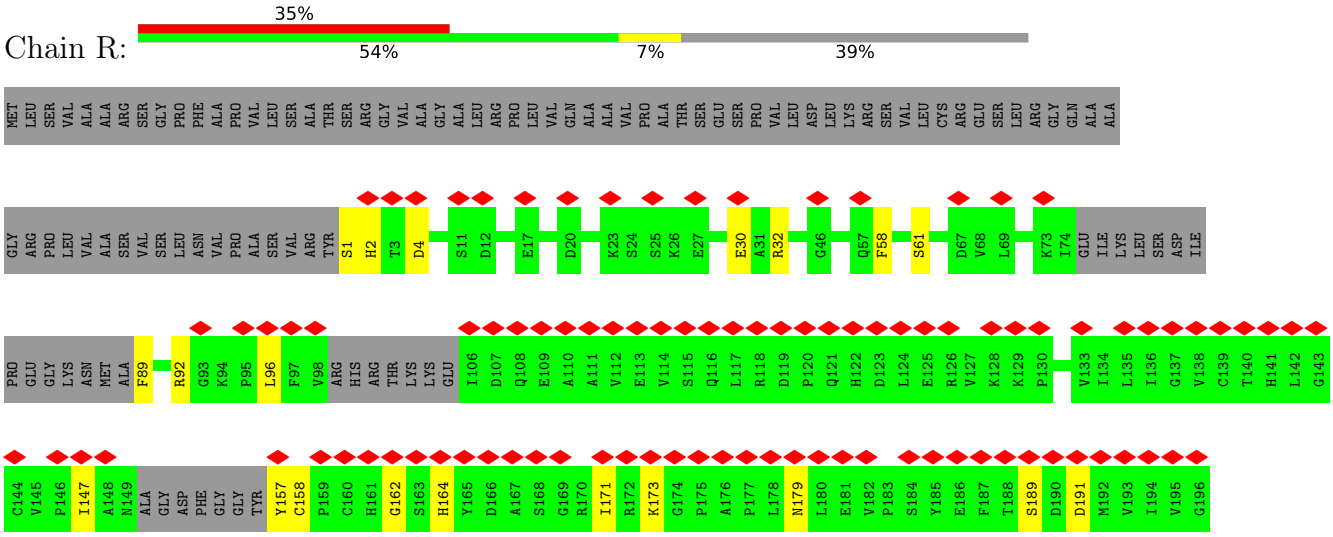
• Molecule 4: Cytochrome c1, heme protein, mitochondrial

Chain D:



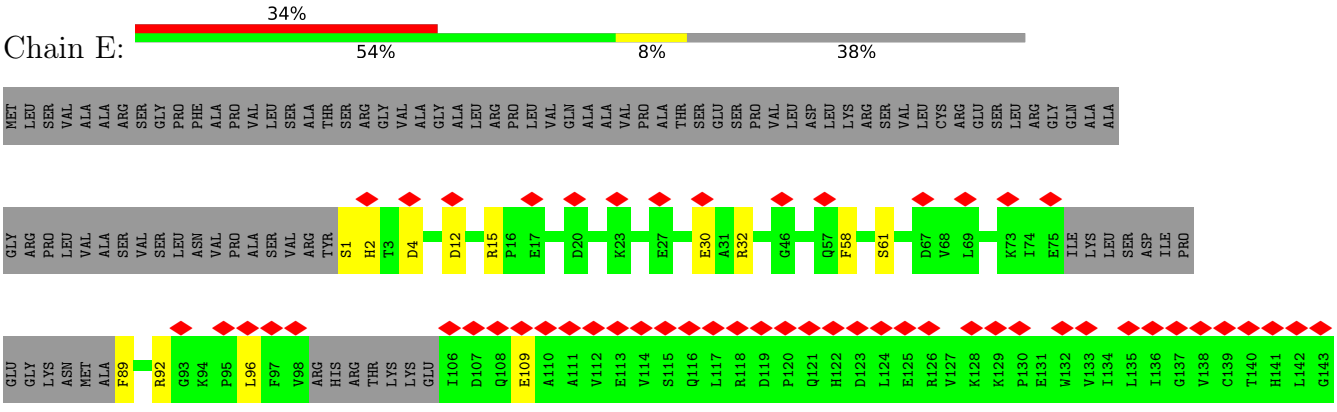
• Molecule 5: Cytochrome b-c1 complex subunit Rieske, mitochondrial

Chain R:



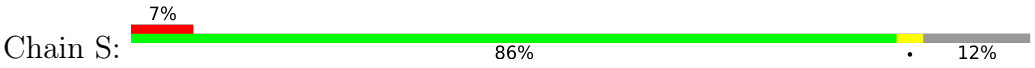
• Molecule 5: Cytochrome b-c1 complex subunit Rieske, mitochondrial

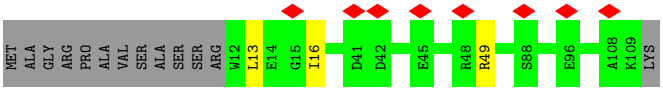
Chain E:



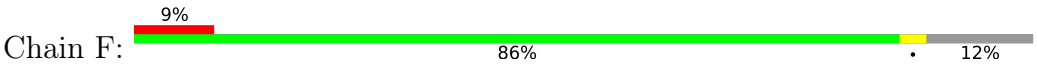


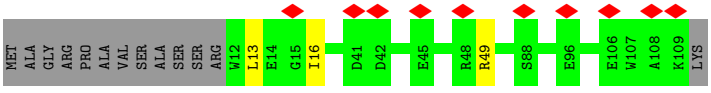
• Molecule 6: Cytochrome b-c1 complex subunit 7



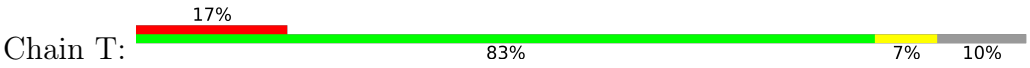


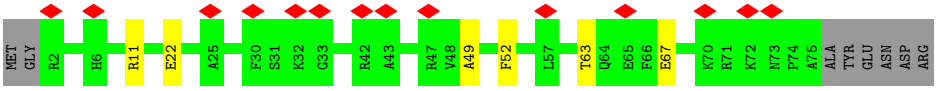
• Molecule 6: Cytochrome b-c1 complex subunit 7



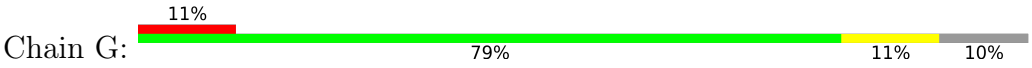


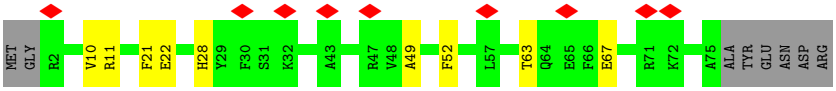
• Molecule 7: Cytochrome b-c1 complex subunit 8





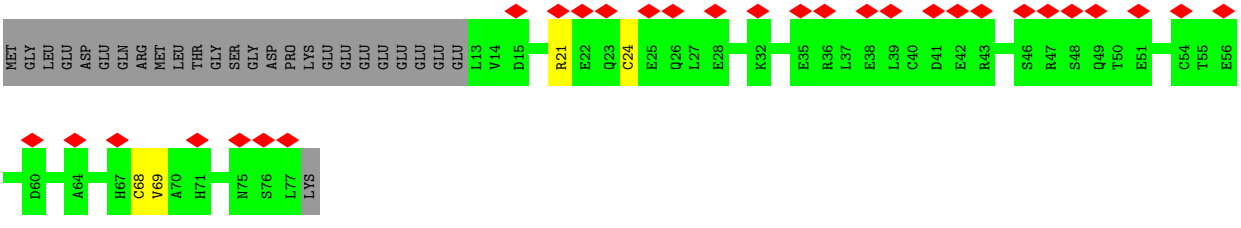
• Molecule 7: Cytochrome b-c1 complex subunit 8





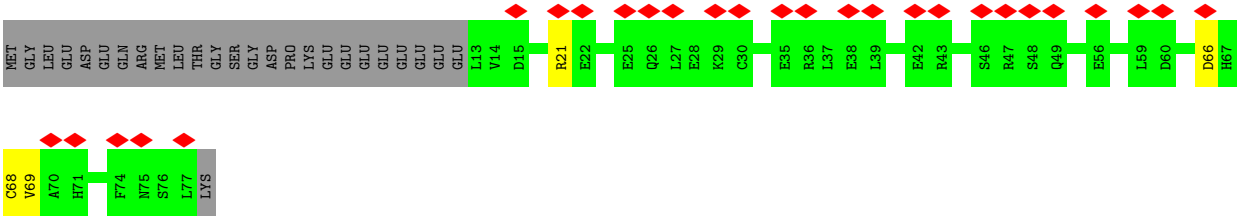
• Molecule 8: Cytochrome b-c1 complex subunit 6, mitochondrial



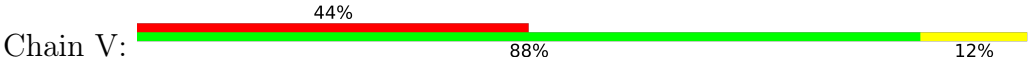


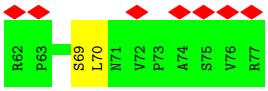
• Molecule 8: Cytochrome b-c1 complex subunit 6, mitochondrial



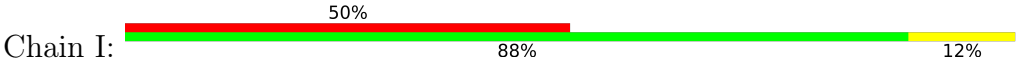


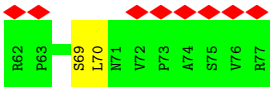
• Molecule 9: Cytochrome b-c1 complex subunit Rieske, mitochondrial



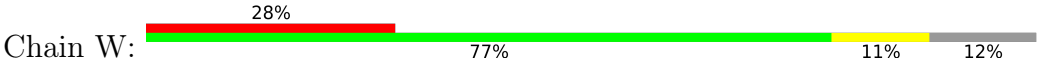


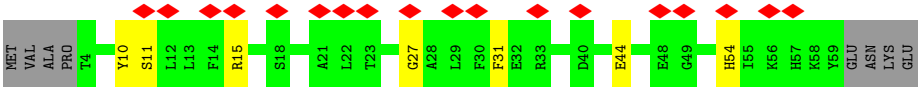
• Molecule 9: Cytochrome b-c1 complex subunit Rieske, mitochondrial



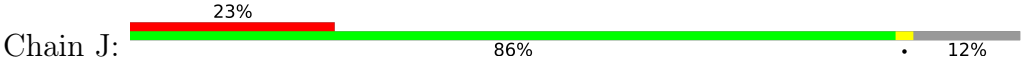


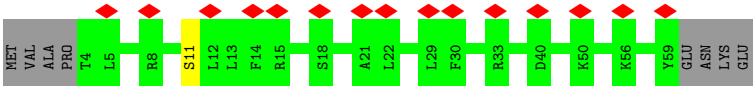
• Molecule 10: Cytochrome b-c1 complex subunit 9





• Molecule 10: Cytochrome b-c1 complex subunit 9





4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C2	Depositor
Number of particles used	57571	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 ($e^-/Å^2$)	44	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	4000	Depositor
Magnification	79000	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	0.235	Depositor
Minimum map value	-0.112	Depositor
Average map value	0.004	Depositor
Map value standard deviation	0.014	Depositor
Recommended contour level	0.0548	Depositor
Map size (Å)	209.40001, 209.40001, 209.40001	wwPDB
Map dimensions	200, 200, 200	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.047, 1.047, 1.047	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: HEC, HEM

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	0.35	0/3456	0.42	0/4690
1	N	0.35	0/3456	0.42	0/4690
2	B	0.34	0/3127	0.42	0/4238
2	O	0.34	0/3144	0.42	0/4261
3	C	0.44	0/3031	0.48	1/4150 (0.0%)
3	P	0.44	0/3031	0.48	1/4150 (0.0%)
4	D	0.38	0/1946	0.43	0/2643
4	Q	0.38	0/1946	0.43	0/2643
5	E	0.28	0/1289	0.40	0/1751
5	R	0.28	0/1285	0.40	0/1744
6	F	0.38	0/879	0.38	0/1180
6	S	0.38	0/879	0.38	0/1180
7	G	0.36	0/645	0.42	0/873
7	T	0.36	0/645	0.42	0/873
8	H	0.25	0/534	0.39	0/718
8	U	0.26	0/534	0.39	0/718
9	I	0.36	0/116	0.57	0/159
9	V	0.35	0/116	0.58	0/159
10	J	0.31	0/478	0.47	0/644
10	W	0.31	0/478	0.47	0/644
All	All	0.36	0/31015	0.43	2/42108 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	C	12	LYS	CG-CD-CE	6.20	125.56	111.30
3	P	12	LYS	CG-CD-CE	6.19	125.54	111.30

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	3386	3297	3295	41	0
1	N	3386	3297	3295	40	0
2	B	3073	3054	3051	32	0
2	O	3090	3066	3063	34	0
3	C	2936	2997	2996	33	0
3	P	2936	2997	2996	31	0
4	D	1887	1833	1834	23	0
4	Q	1887	1833	1834	22	0
5	E	1263	1214	1200	16	0
5	R	1259	1219	1207	14	0
6	F	860	850	849	2	0
6	S	860	850	849	2	0
7	G	624	631	630	8	0
7	T	624	631	630	4	0
8	H	529	512	513	3	0
8	U	529	512	513	3	0
9	I	115	127	126	1	0
9	V	115	127	126	1	0
10	J	466	470	469	1	0
10	W	466	470	469	5	0
11	C	86	0	60	13	0
11	P	86	0	60	14	0
12	D	43	0	32	9	0
12	Q	43	0	32	10	0
All	All	30549	29987	30129	303	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 5.

The worst 5 of 303 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)
4:D:37:CYS:SG	12:D:501:HEC:CAB	2.66	0.84

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:D:40:CYS:SG	12:D:501:HEC:HAC	2.18	0.83
4:D:37:CYS:SG	12:D:501:HEC:HAB	2.23	0.79
12:D:501:HEC:HBD1	12:D:501:HEC:HHA	1.64	0.79
1:A:245:GLU:OE2	7:G:11:ARG:NE	2.18	0.77

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	434/480 (90%)	407 (94%)	27 (6%)	0	100	100
1	N	434/480 (90%)	407 (94%)	27 (6%)	0	100	100
2	B	403/453 (89%)	373 (93%)	30 (7%)	0	100	100
2	O	405/453 (89%)	375 (93%)	30 (7%)	0	100	100
3	C	368/379 (97%)	332 (90%)	36 (10%)	0	100	100
3	P	368/379 (97%)	331 (90%)	37 (10%)	0	100	100
4	D	235/325 (72%)	222 (94%)	13 (6%)	0	100	100
4	Q	235/325 (72%)	222 (94%)	13 (6%)	0	100	100
5	E	161/274 (59%)	145 (90%)	16 (10%)	0	100	100
5	R	160/274 (58%)	144 (90%)	16 (10%)	0	100	100
6	F	96/111 (86%)	91 (95%)	5 (5%)	0	100	100
6	S	96/111 (86%)	91 (95%)	5 (5%)	0	100	100
7	G	72/82 (88%)	67 (93%)	5 (7%)	0	100	100
7	T	72/82 (88%)	67 (93%)	5 (7%)	0	100	100
8	H	63/91 (69%)	58 (92%)	5 (8%)	0	100	100
8	U	63/91 (69%)	58 (92%)	5 (8%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
9	I	14/16 (88%)	10 (71%)	4 (29%)	0	100	100
9	V	14/16 (88%)	10 (71%)	4 (29%)	0	100	100
10	J	54/64 (84%)	51 (94%)	3 (6%)	0	100	100
10	W	54/64 (84%)	51 (94%)	3 (6%)	0	100	100
All	All	3801/4550 (84%)	3512 (92%)	289 (8%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains (i)

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	363/394 (92%)	363 (100%)	0	100	100
1	N	363/394 (92%)	363 (100%)	0	100	100
2	B	320/355 (90%)	320 (100%)	0	100	100
2	O	322/355 (91%)	322 (100%)	0	100	100
3	C	318/327 (97%)	318 (100%)	0	100	100
3	P	318/327 (97%)	318 (100%)	0	100	100
4	D	202/257 (79%)	202 (100%)	0	100	100
4	Q	202/257 (79%)	202 (100%)	0	100	100
5	E	135/228 (59%)	135 (100%)	0	100	100
5	R	135/228 (59%)	135 (100%)	0	100	100
6	F	90/99 (91%)	90 (100%)	0	100	100
6	S	90/99 (91%)	90 (100%)	0	100	100
7	G	66/72 (92%)	66 (100%)	0	100	100
7	T	66/72 (92%)	66 (100%)	0	100	100
8	H	62/85 (73%)	62 (100%)	0	100	100
8	U	62/85 (73%)	62 (100%)	0	100	100
9	I	14/14 (100%)	14 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
9	V	14/14 (100%)	14 (100%)	0	100	100
10	J	47/54 (87%)	47 (100%)	0	100	100
10	W	47/54 (87%)	47 (100%)	0	100	100
All	All	3236/3770 (86%)	3236 (100%)	0	100	100

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

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 22 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	311	ASN
3	C	137	GLN
2	B	343	GLN
4	D	31	GLN
2	O	197	ASN

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)

6 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
11	HEM	C	502	3	50,50,50	1.64	7 (14%)	66,82,82	1.14	4 (6%)
11	HEM	P	502	3	50,50,50	1.65	7 (14%)	66,82,82	1.14	5 (7%)
12	HEC	D	501	4	50,50,50	1.74	4 (8%)	68,82,82	1.52	8 (11%)
12	HEC	Q	501	4	50,50,50	1.81	5 (10%)	68,82,82	1.35	6 (8%)
11	HEM	P	501	-	50,50,50	1.59	5 (10%)	66,82,82	1.24	4 (6%)
11	HEM	C	501	-	50,50,50	1.60	6 (12%)	66,82,82	1.22	4 (6%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
11	HEM	C	502	3	-	7/14/54/54	-
11	HEM	P	502	3	-	7/14/54/54	-
12	HEC	D	501	4	1/1/3/7	6/14/54/54	-
12	HEC	Q	501	4	1/1/3/7	8/14/54/54	-
11	HEM	P	501	-	-	3/14/54/54	-
11	HEM	C	501	-	-	3/14/54/54	-

The worst 5 of 34 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
12	D	501	HEC	C3D-C2D	7.60	1.52	1.36
12	Q	501	HEC	C3D-C2D	7.57	1.52	1.36
11	P	502	HEM	FE-ND	7.28	2.17	1.94
11	C	501	HEM	FE-NB	7.21	2.17	1.94
11	C	502	HEM	FE-ND	7.19	2.17	1.94

The worst 5 of 31 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
12	D	501	HEC	C1D-ND-C4D	6.32	111.60	105.07
12	Q	501	HEC	C1D-ND-C4D	6.18	111.45	105.07
12	D	501	HEC	CAA-CBA-CGA	-3.63	105.80	113.60
12	D	501	HEC	CAD-C3D-C4D	3.14	130.15	124.66
12	Q	501	HEC	CAD-CBD-CGD	-3.14	106.85	113.60

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
12	Q	501	HEC	NA
12	D	501	HEC	NA

5 of 34 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
11	P	501	HEM	C1A-C2A-CAA-CBA
11	C	501	HEM	C1A-C2A-CAA-CBA
11	P	501	HEM	C3A-C2A-CAA-CBA
12	Q	501	HEC	C2B-C3B-CAB-CBB
12	Q	501	HEC	C4B-C3B-CAB-CBB

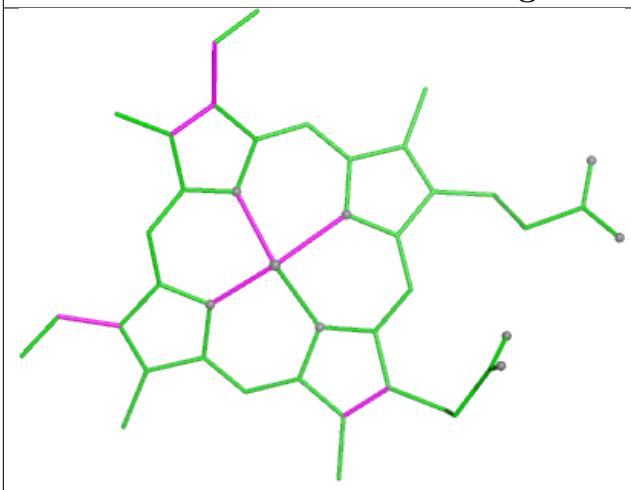
There are no ring outliers.

6 monomers are involved in 46 short contacts:

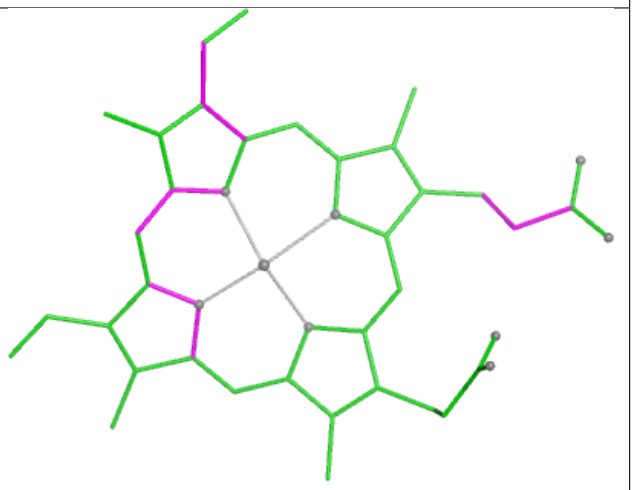
Mol	Chain	Res	Type	Clashes	Symm-Clashes
11	C	502	HEM	5	0
11	P	502	HEM	6	0
12	D	501	HEC	9	0
12	Q	501	HEC	10	0
11	P	501	HEM	8	0
11	C	501	HEM	8	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

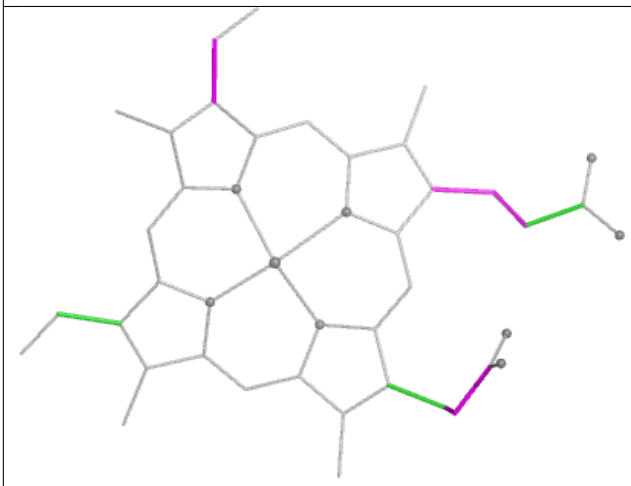
Ligand HEM C 502



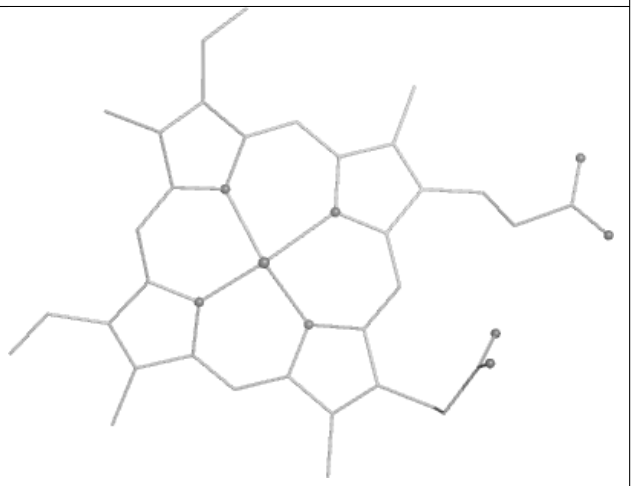
Bond lengths



Bond angles

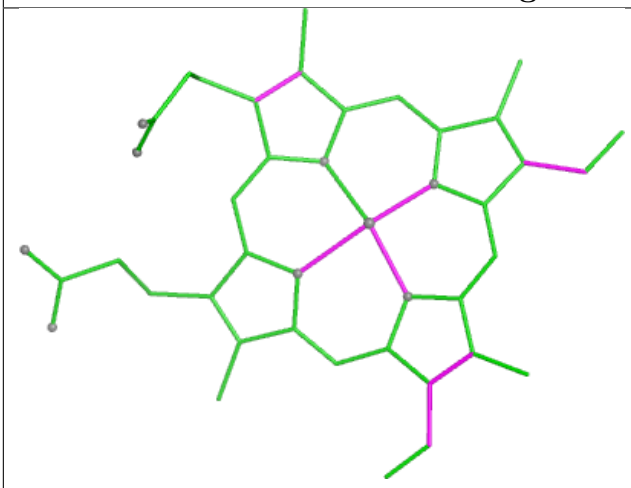


Torsions

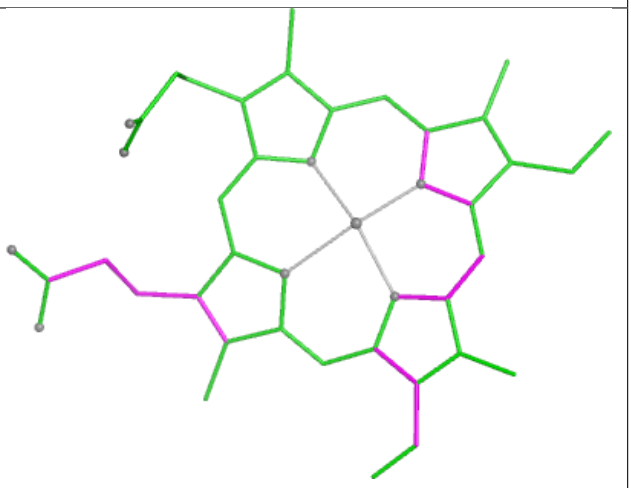


Rings

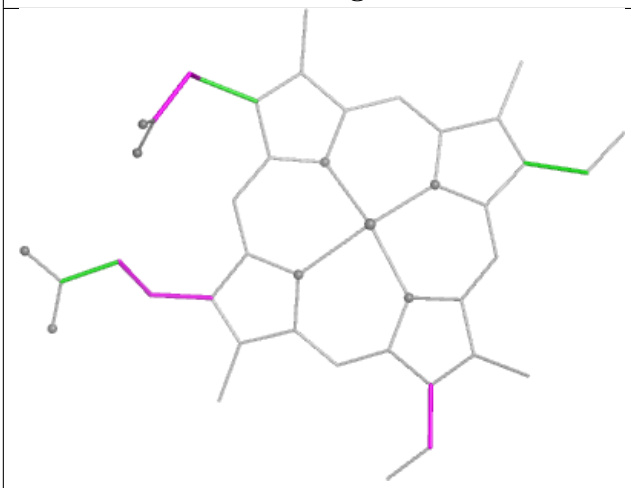
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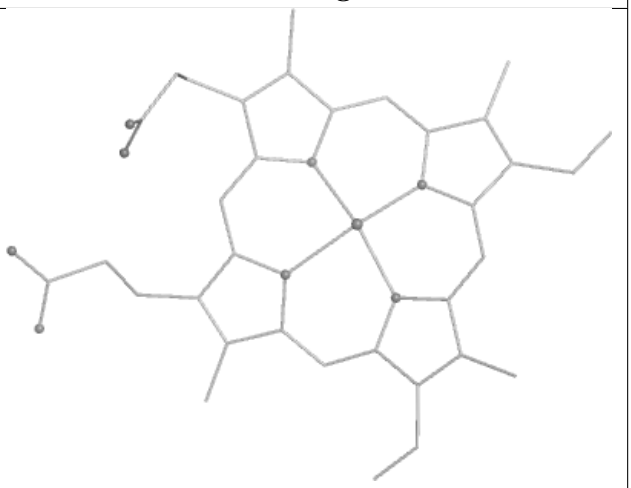
Bond lengths



Bond angles

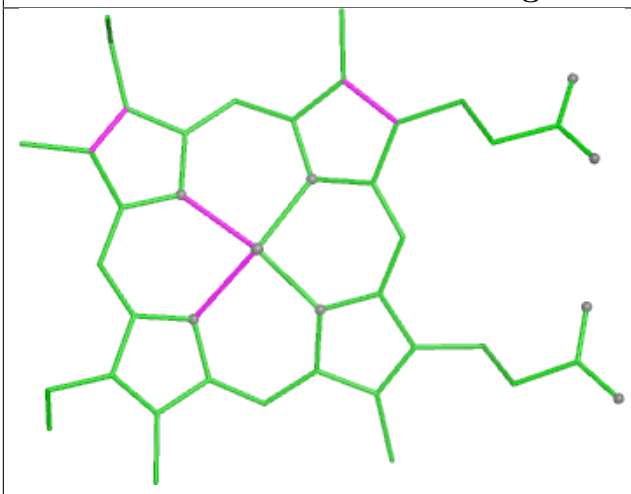


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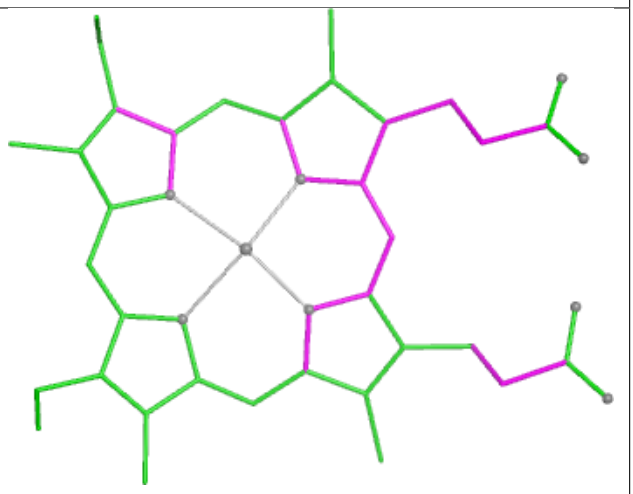


Rings

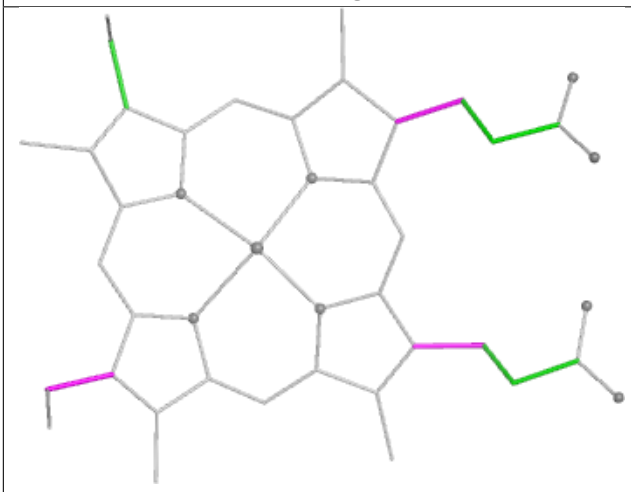
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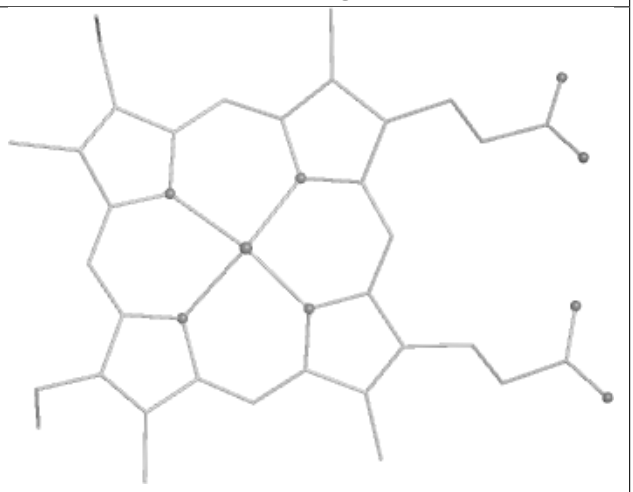
Bond lengths



Bond angles

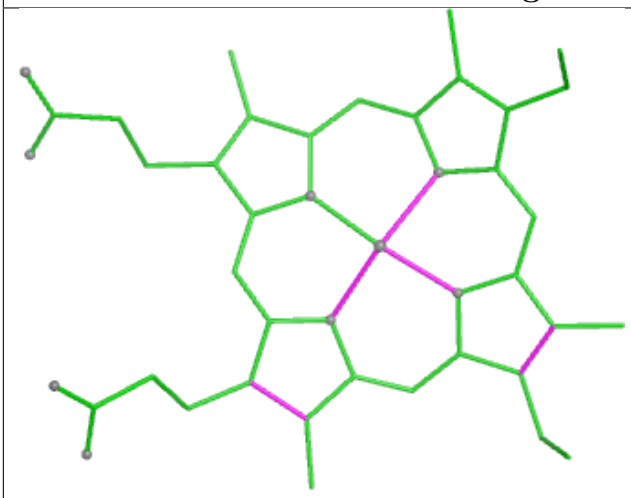


Torsions

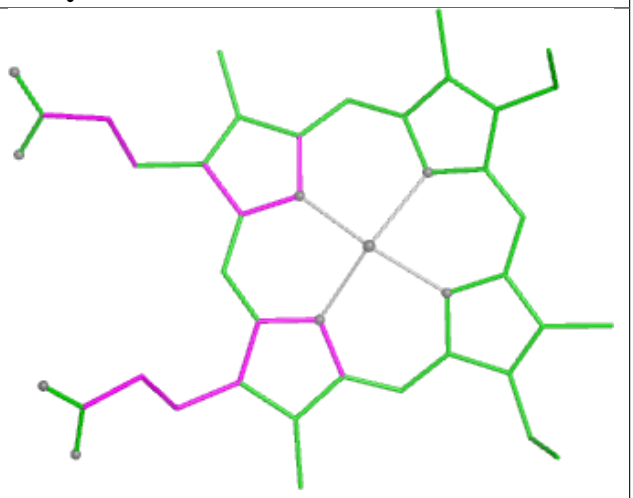


Rings

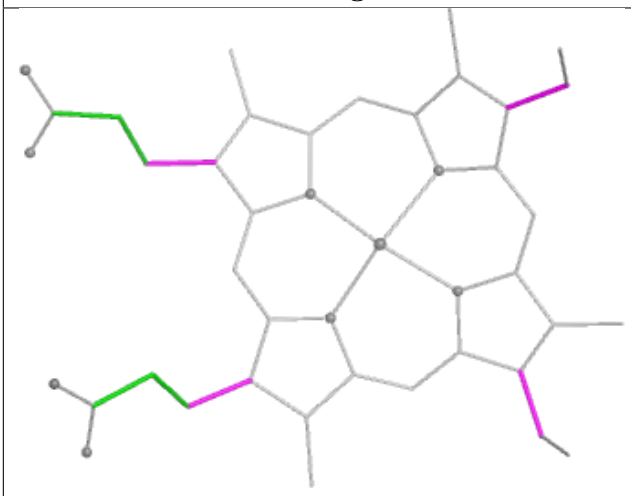
Ligand HEC Q 501



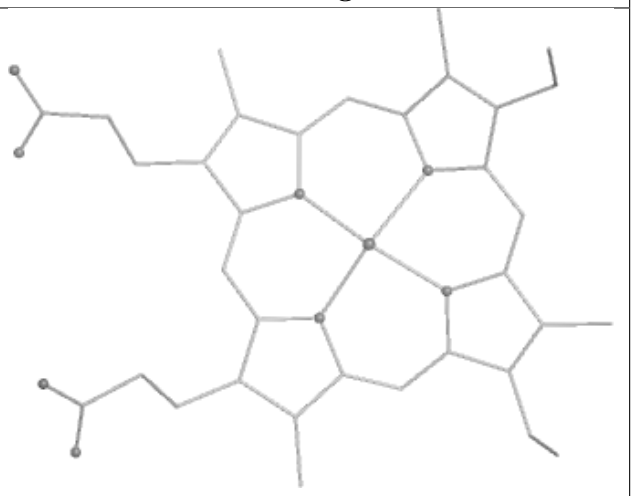
Bond lengths



Bond angles

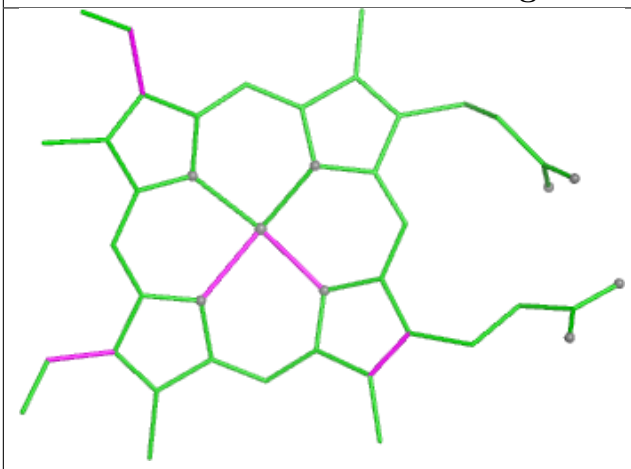


Torsions

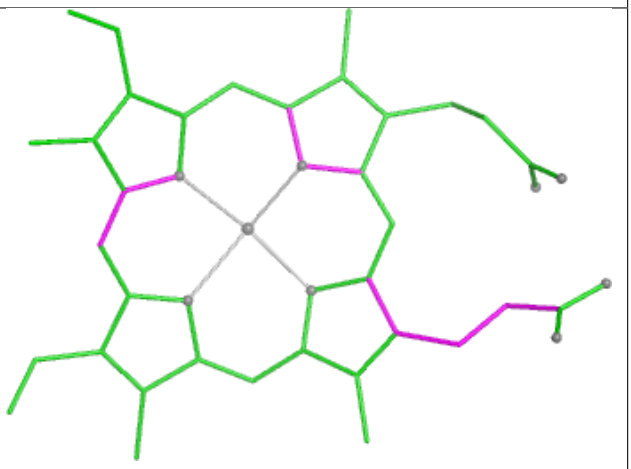


Rings

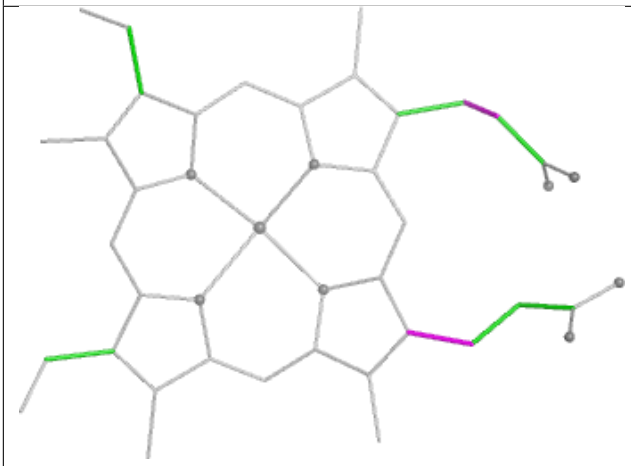
Ligand HEM P 501



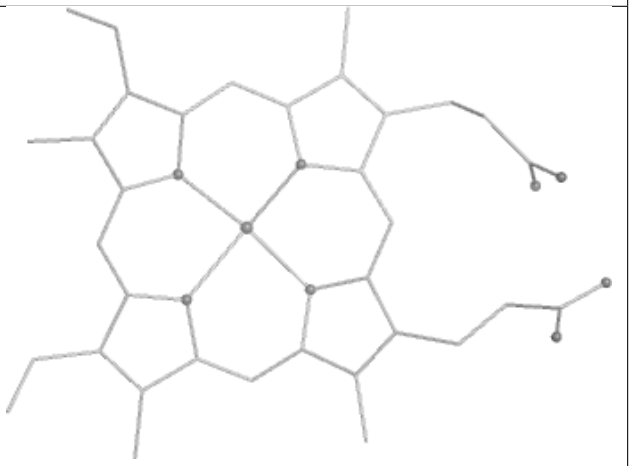
Bond lengths



Bond angles

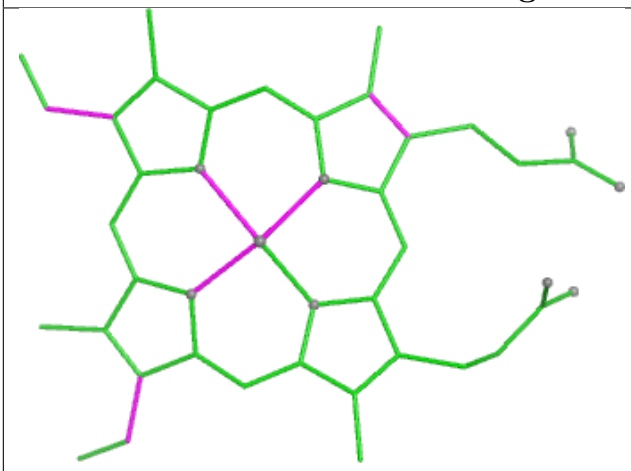


Torsions

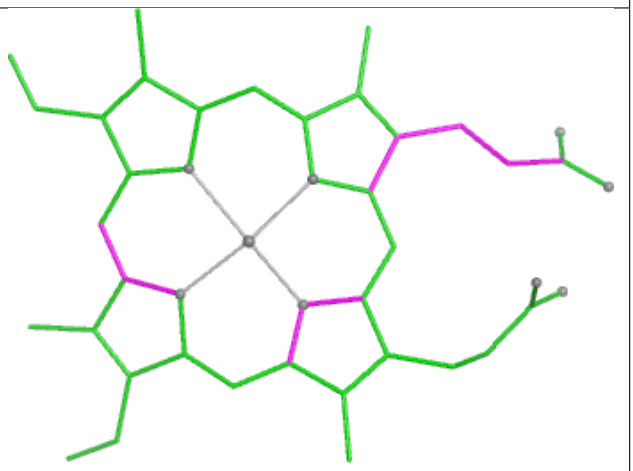


Rings

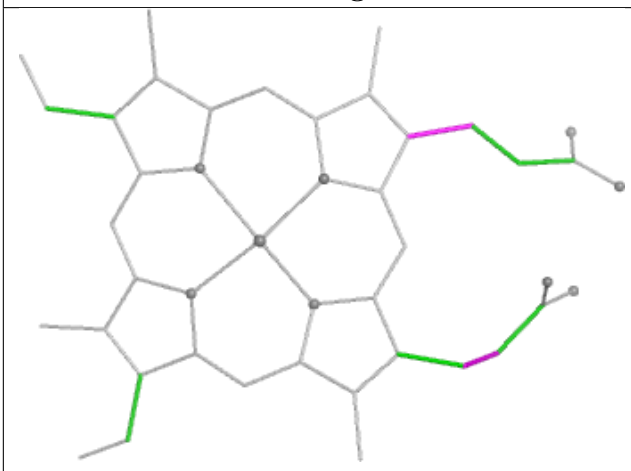
Ligand HEM C 501



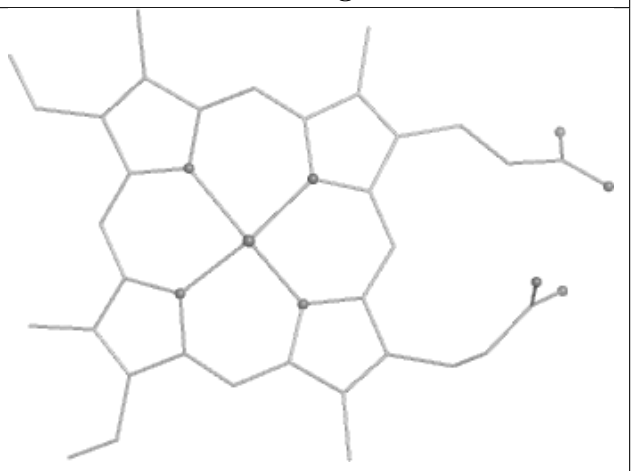
Bond lengths



Bond angles



Torsions



Rings

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.

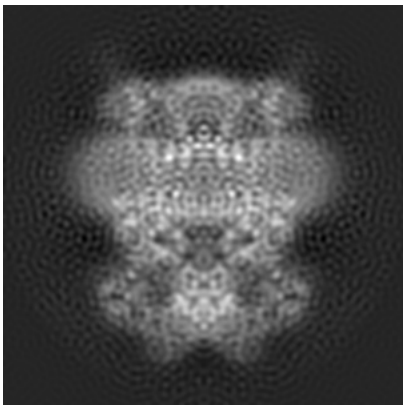
6 Map visualisation

This section contains visualisations of the EMDB entry EMD-4288. These allow visual inspection of the internal detail of the map and identification of artifacts.

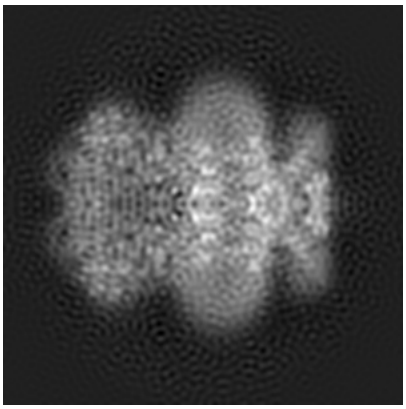
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections

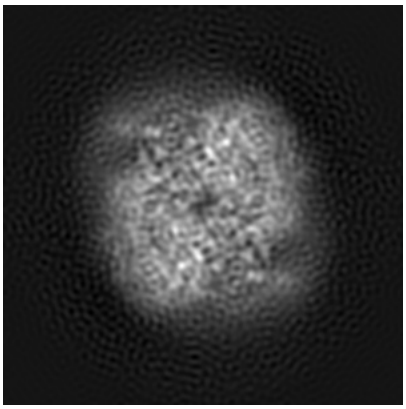
6.1.1 Primary map



X

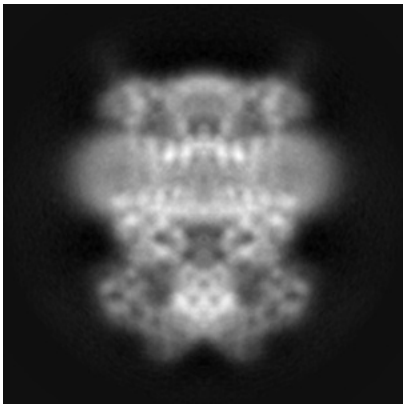


Y

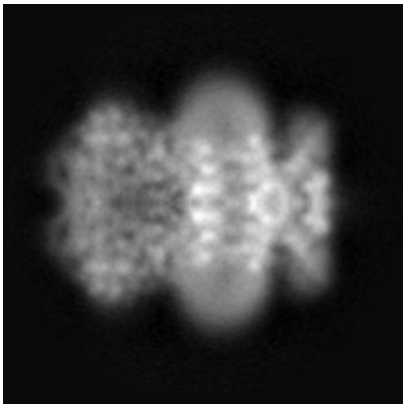


Z

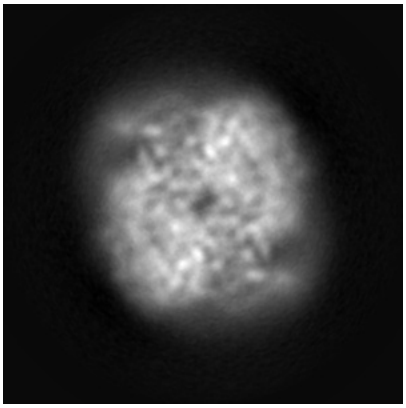
6.1.2 Raw map



X



Y

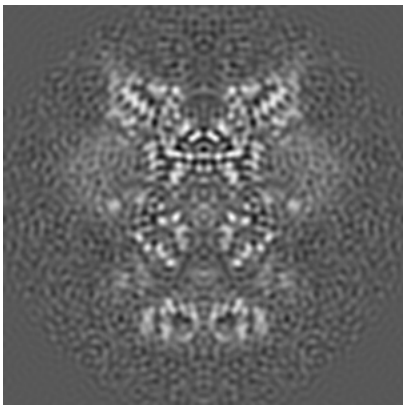


Z

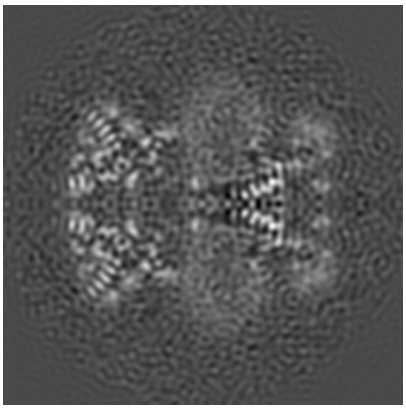
The images above show the map projected in three orthogonal directions.

6.2 Central slices (i)

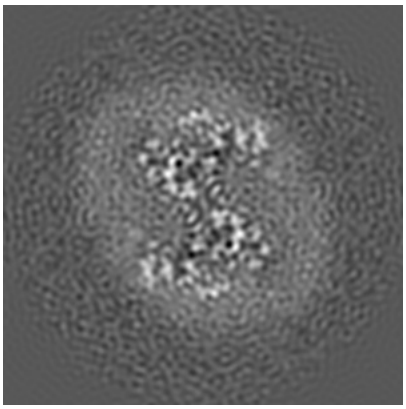
6.2.1 Primary map



X Index: 100

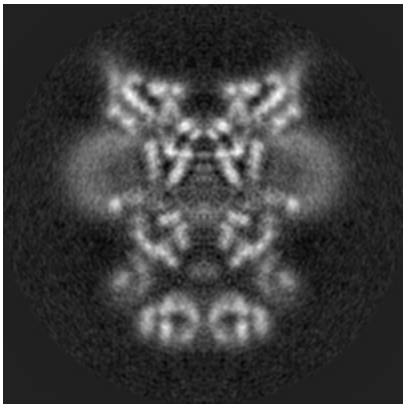


Y Index: 100

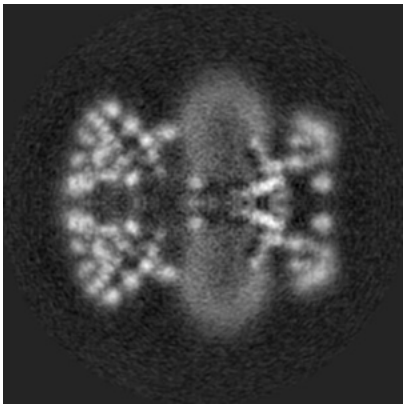


Z Index: 100

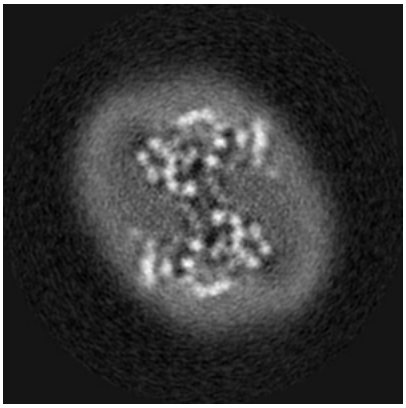
6.2.2 Raw map



X Index: 100



Y Index: 100

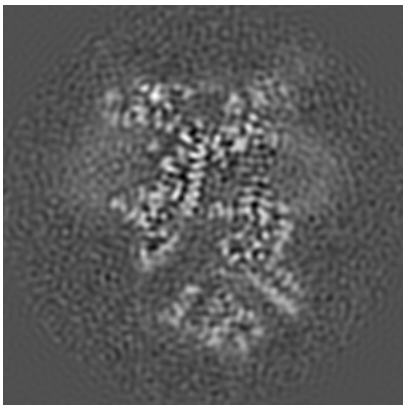


Z Index: 100

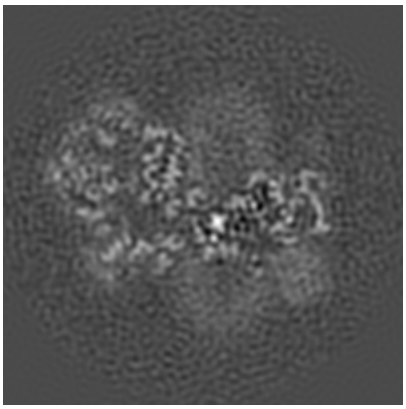
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices (i)

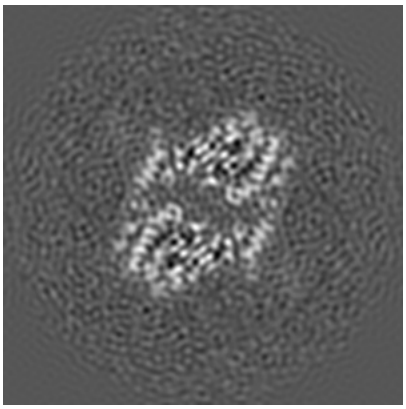
6.3.1 Primary map



X Index: 106

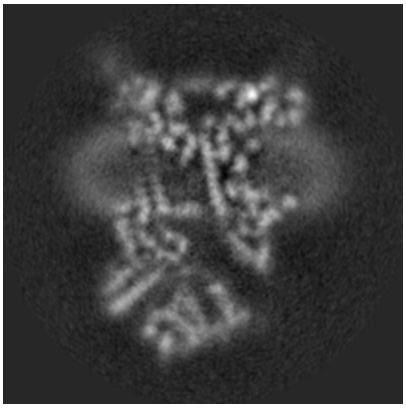


Y Index: 113

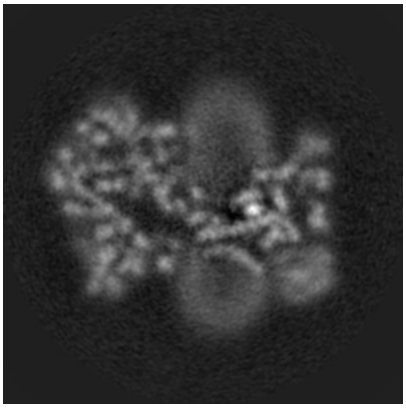


Z Index: 78

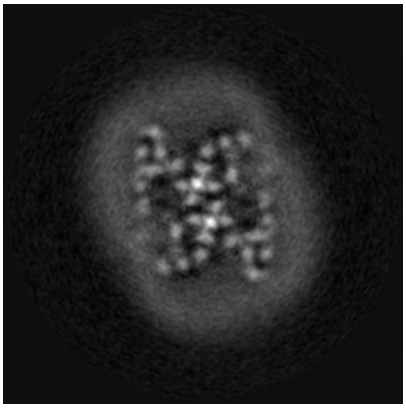
6.3.2 Raw map



X Index: 94



Y Index: 110

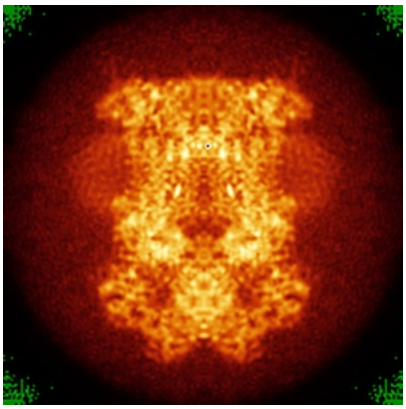


Z Index: 125

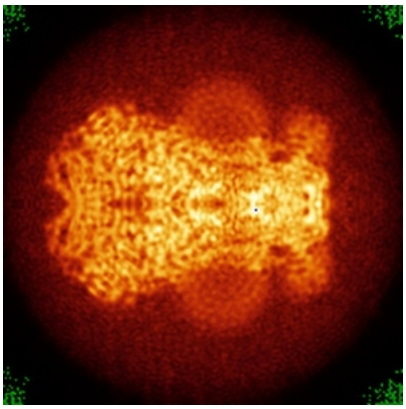
The images above show the largest variance slices of the map in three orthogonal directions.

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

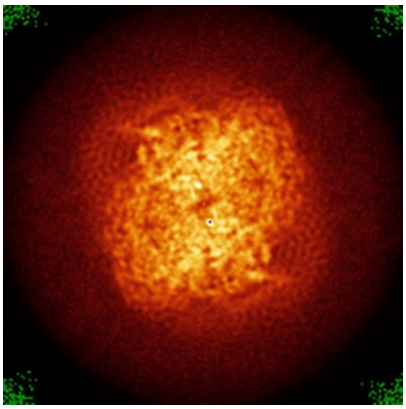
6.4.1 Primary map



X

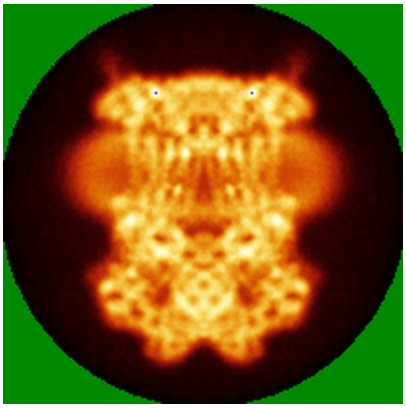


Y

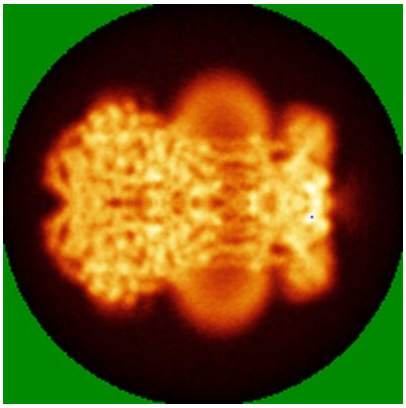


Z

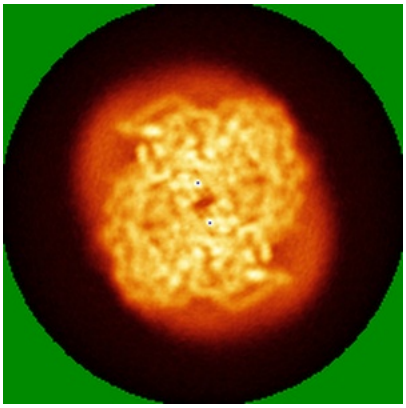
6.4.2 Raw map



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 0.0548. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

6.5.2 Raw map



X Y Z

These images show the 3D surface of the raw map. The raw map's contour level was selected so that its surface encloses the same volume as the primary map does at its recommended contour level.

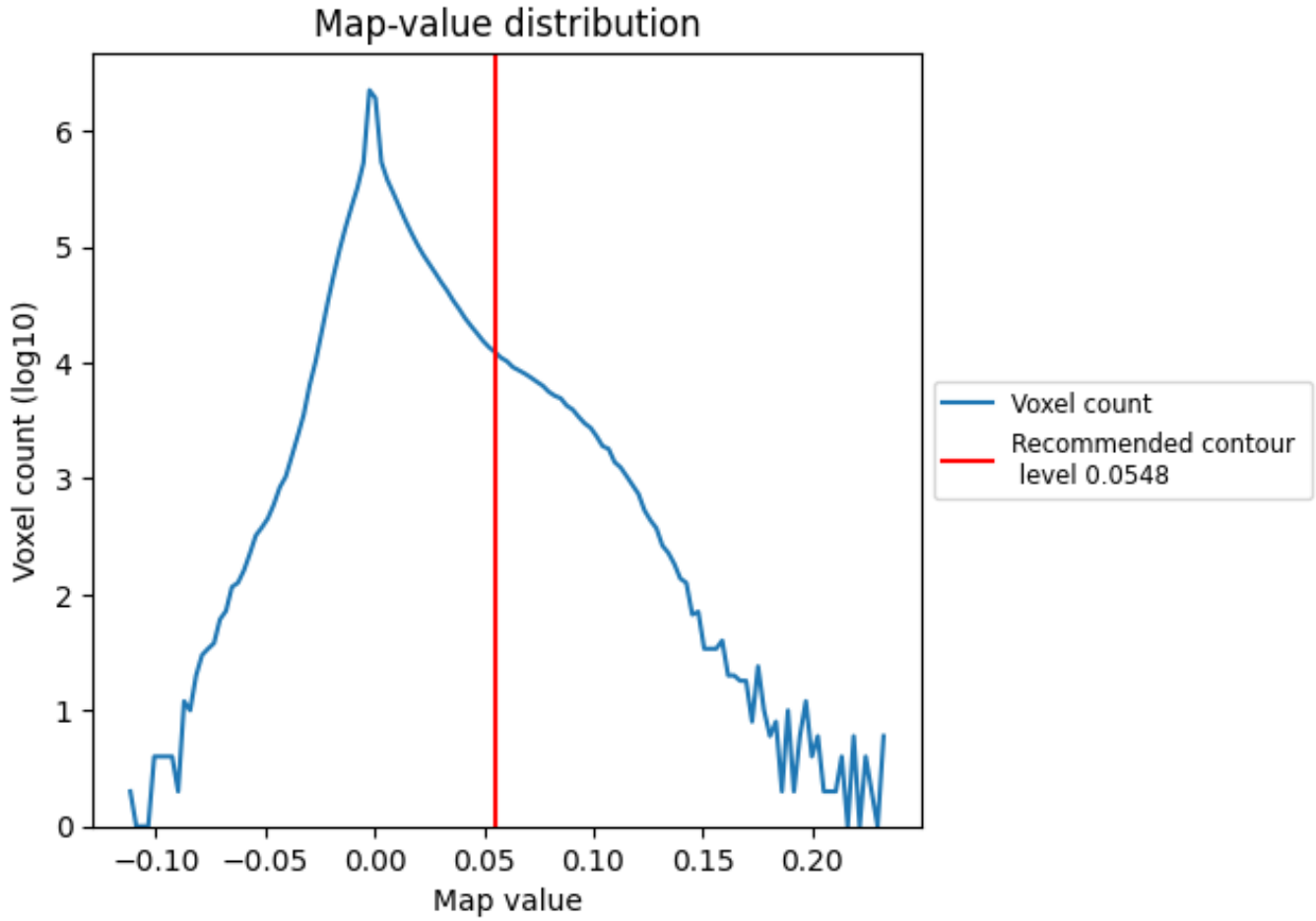
6.6 Mask visualisation (i)

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

7 Map analysis

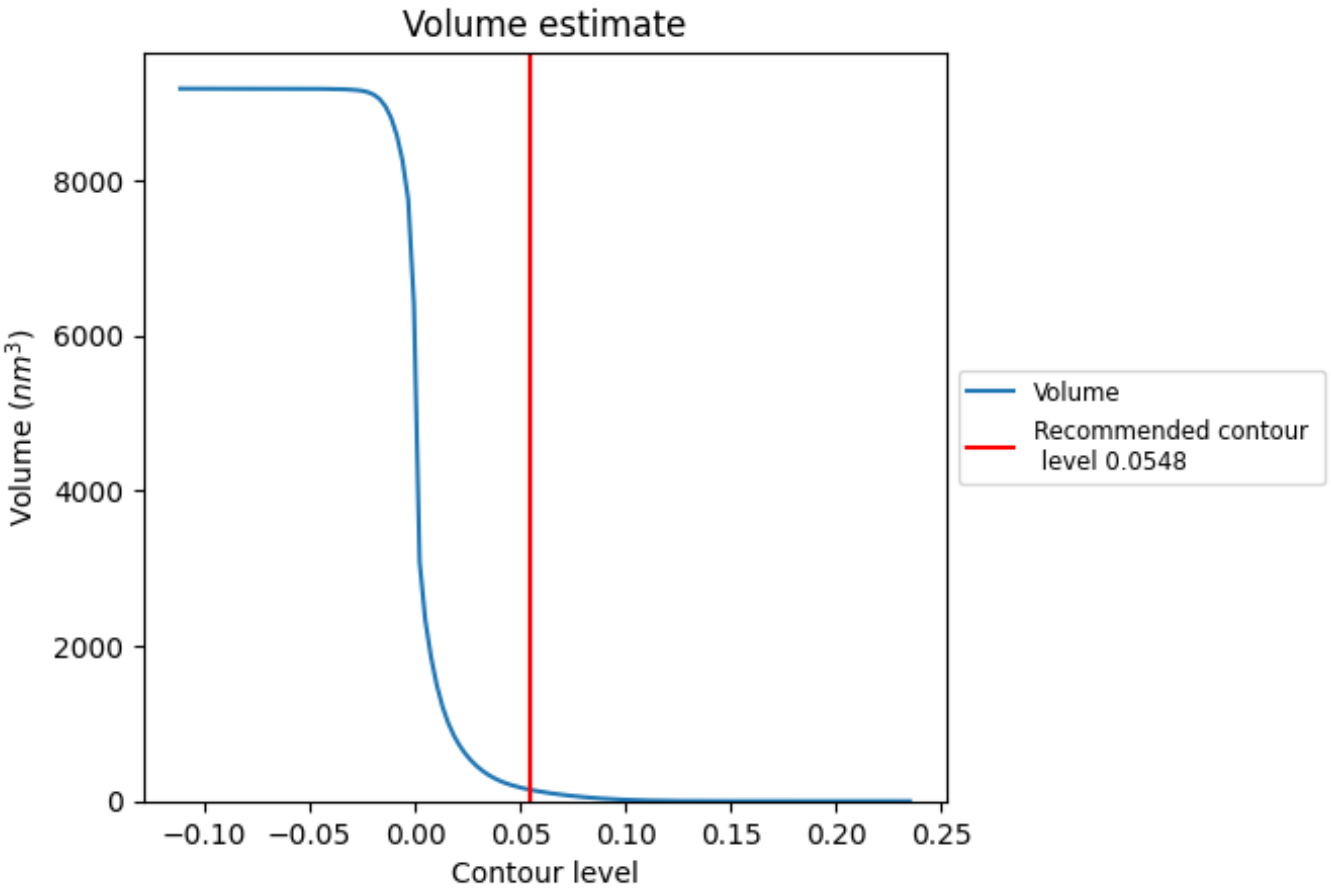
This section contains the results of statistical analysis of the map.

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.

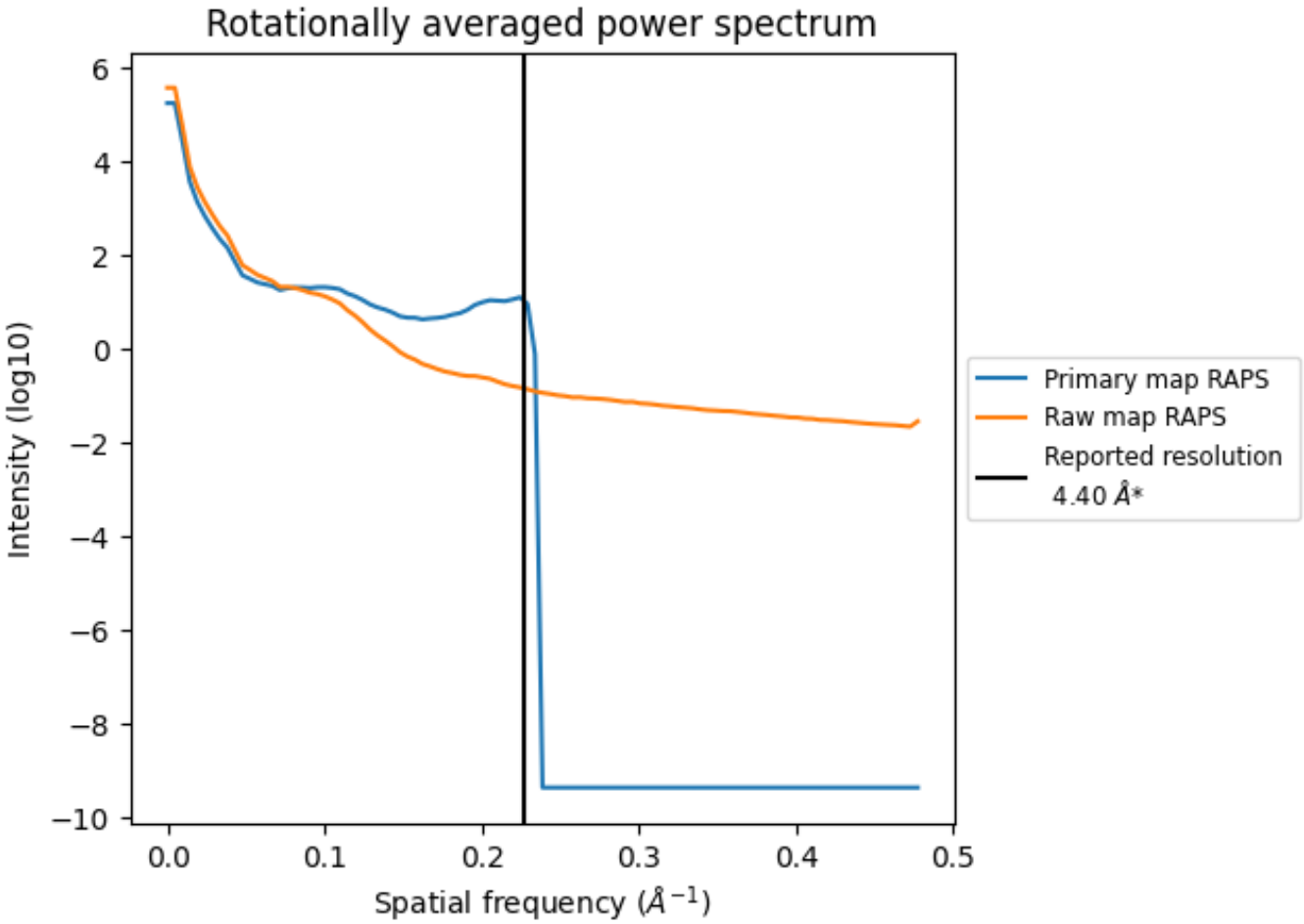
7.2 Volume estimate (i)



The volume at the recommended contour level is 147 nm^3; this corresponds to an approximate mass of 133 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)

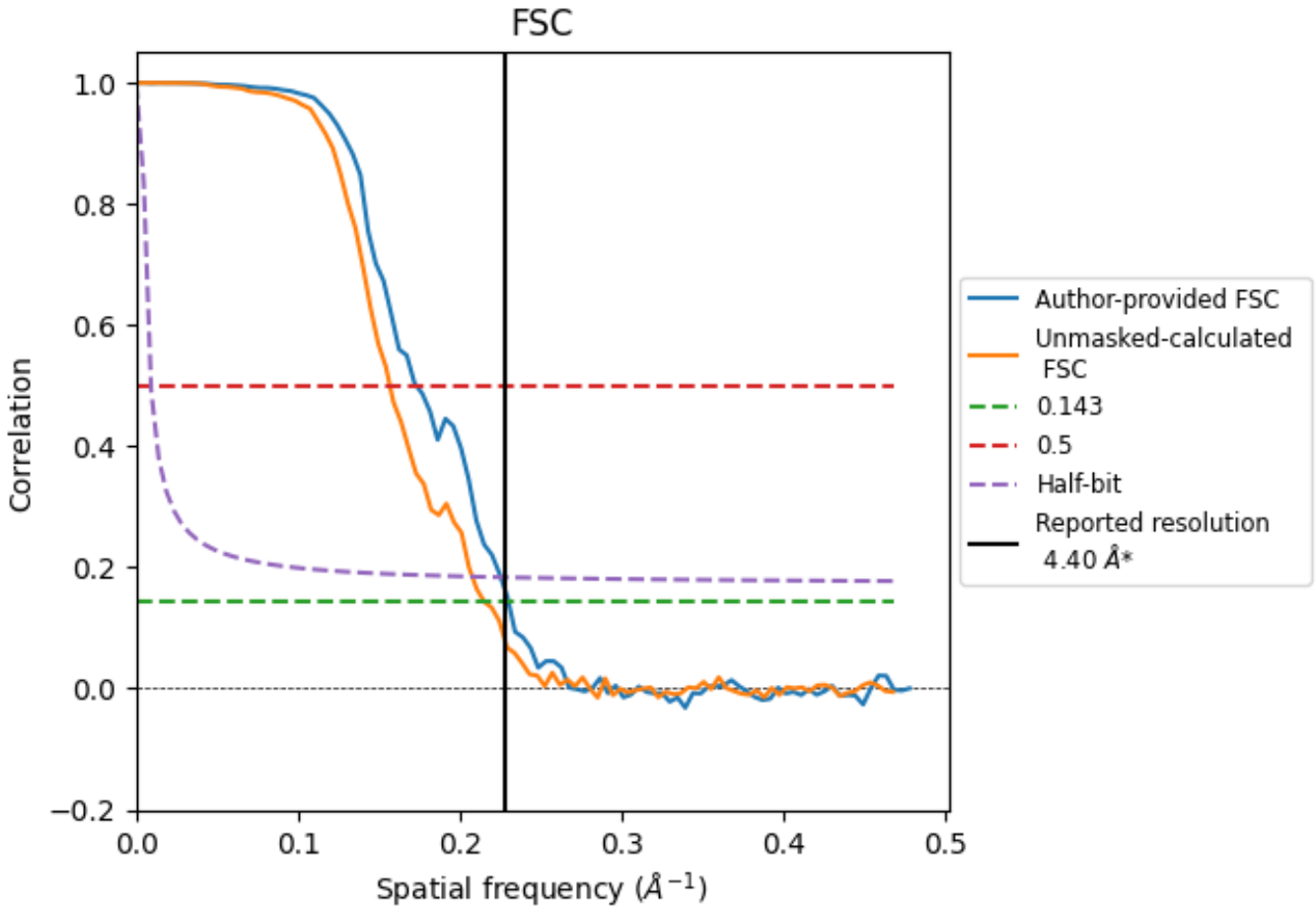


*Reported resolution corresponds to spatial frequency of 0.227 Å^{-1}

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 (i)

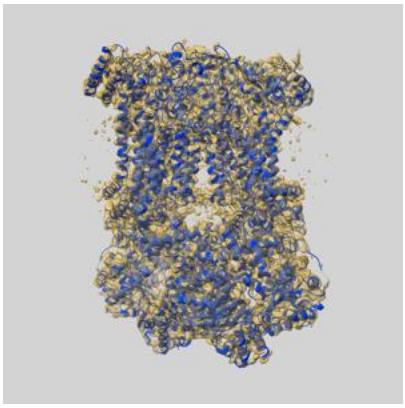
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	4.40	-	-
Author-provided FSC curve	4.35	5.78	4.44
Unmasked-calculated*	4.65	6.38	4.82

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

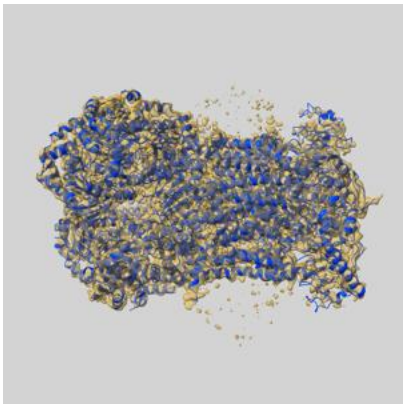
9 Map-model fit

This section contains information regarding the fit between EMDB map EMD-4288 and PDB model 6FO2. Per-residue inclusion information can be found in section 3 on page 8.

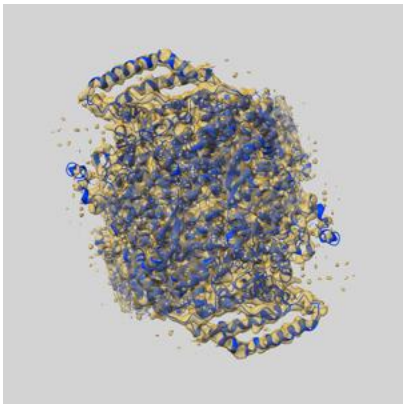
9.1 Map-model overlay



X



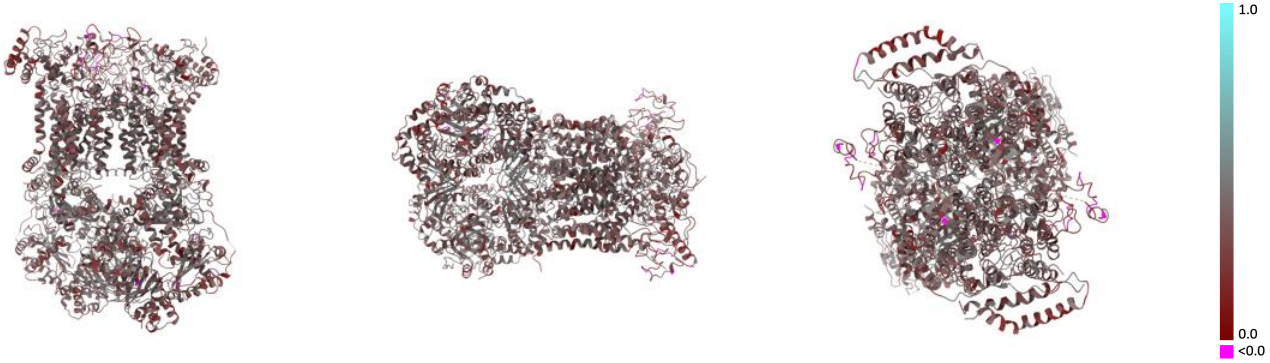
Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.0548 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.

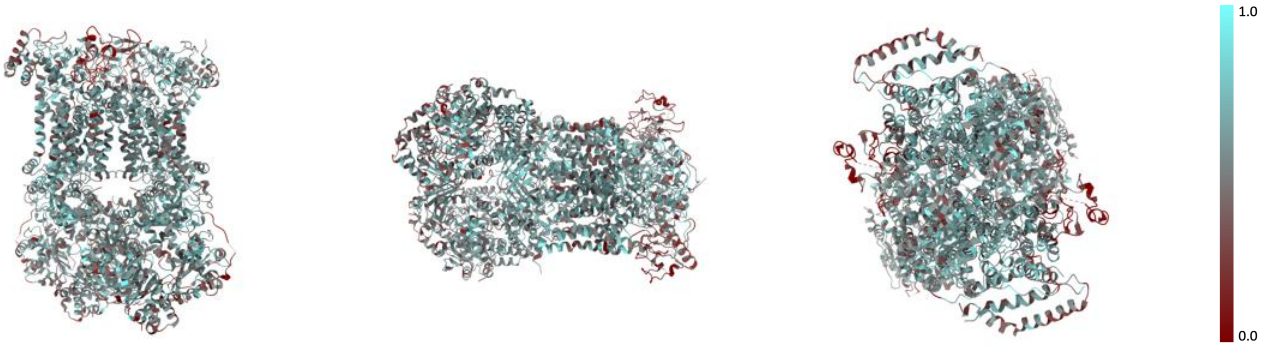
9.2 Q-score mapped to coordinate model (i)



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.

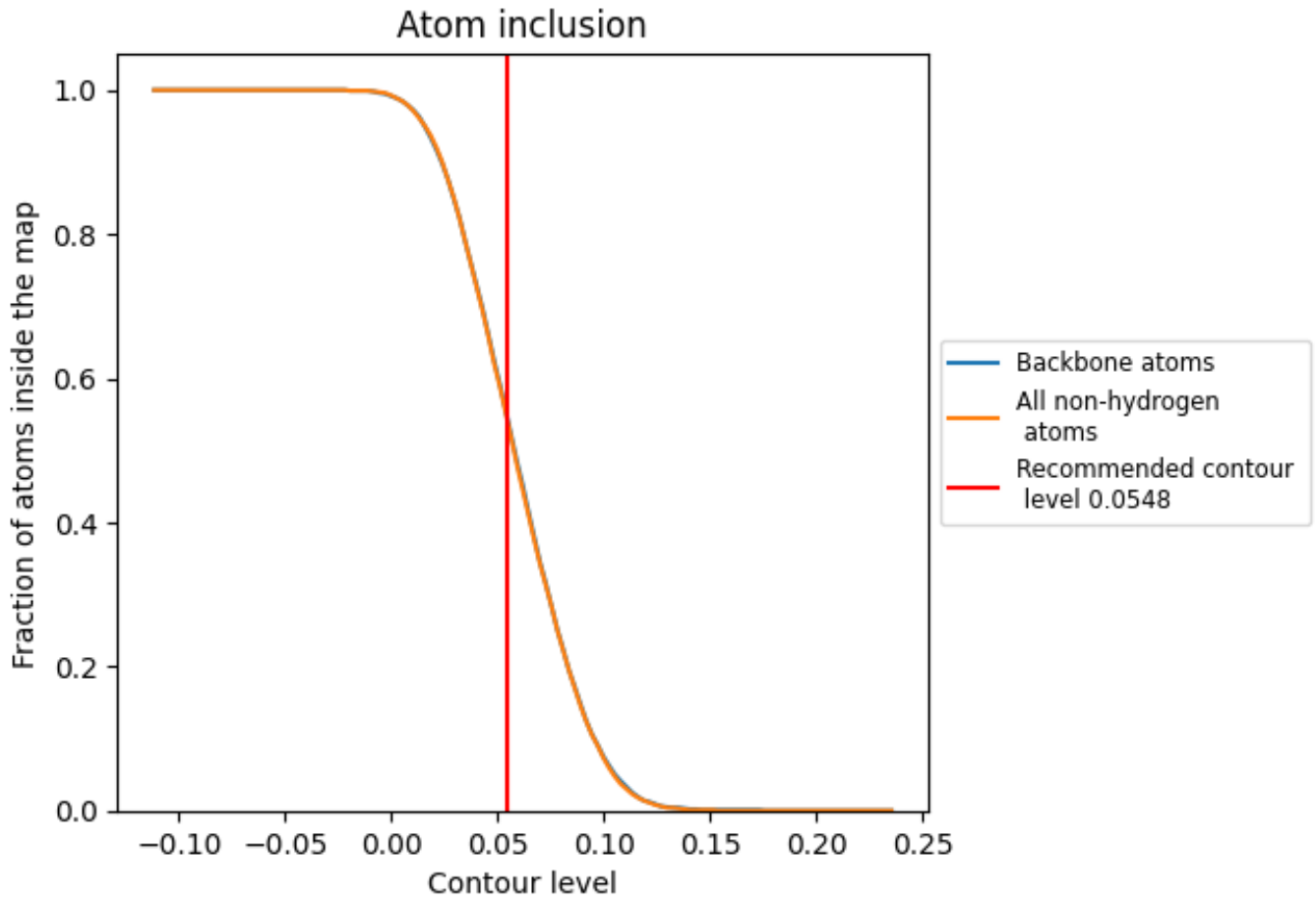
9.3 Atom inclusion mapped to coordinate model (i)



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 (0.0548).

9.4 Atom inclusion (i)



At the recommended contour level, 54% of all backbone atoms, 54% 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 (0.0548) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.5390	0.3530
A	0.5610	0.3560
B	0.5360	0.3560
C	0.5960	0.3710
D	0.6010	0.3740
E	0.3770	0.2810
F	0.6150	0.3660
G	0.5940	0.3570
H	0.4550	0.2930
I	0.3960	0.3240
J	0.5370	0.3400
N	0.5620	0.3570
O	0.5340	0.3550
P	0.5990	0.3710
Q	0.6040	0.3750
R	0.3750	0.2810
S	0.6180	0.3660
T	0.5910	0.3640
U	0.4470	0.2850
V	0.3870	0.3360
W	0.5220	0.3280

