



wwPDB EM Validation Summary Report ⓘ

Mar 8, 2026 – 05:50 AM UTC

PDB ID : 9KRE / pdb_00009kre
EMDB ID : EMD-62307
Title : Alpha-hemolysin heptameric POPC bound pore state derived from egg
PC/Cholesterol (3:1 molar ratio) liposomes
Authors : Chatterjee, A.; Roy, A.; Dutta, S.
Deposited on : 2024-11-27
Resolution : 3.00 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 ⓘ 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
Mogul : 2022.3.0, CSD as543be (2022)
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) : 2.49

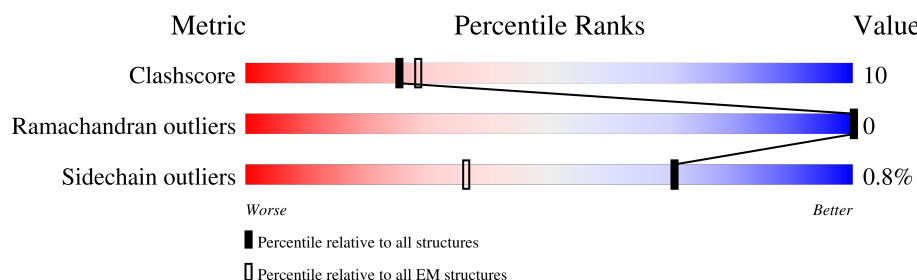
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.00 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	229148	23984
Ramachandran outliers	224038	23583
Sidechain outliers	223484	23102

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	293	88% 83%17%
1	B	293	89% 83%17%
1	C	293	88% 83%17%
1	D	293	89% 83%16%
1	E	293	89% 83%17%
1	F	293	89% 84%16%
1	G	293	89% 83%17%

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
2	POV	A	301	-	-	X	-
2	POV	A	302	-	-	X	-
2	POV	B	301	-	-	X	-
2	POV	B	302	-	-	X	-
2	POV	C	301	-	-	X	-
2	POV	D	301	-	-	X	-
2	POV	E	301	-	-	X	-

2 Entry composition [i](#)

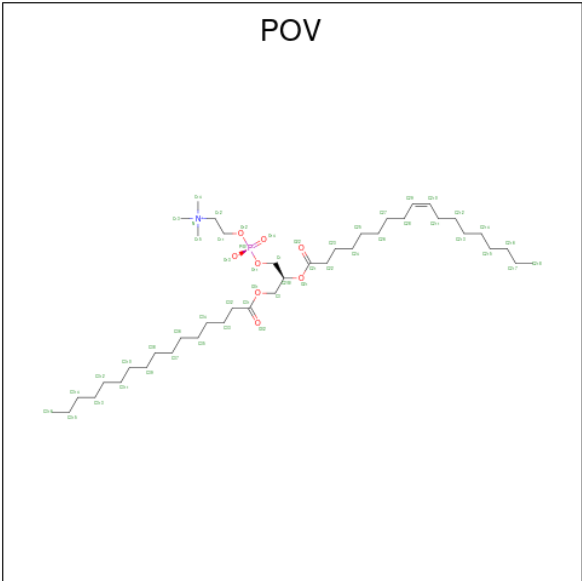
There are 2 unique types of molecules in this entry. The entry contains 16842 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Alpha-hemolysin.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	G	293	Total	C	N	O	S	1	0
			2354	1478	403	466	7		
1	A	293	Total	C	N	O	S	1	0
			2354	1478	403	466	7		
1	B	293	Total	C	N	O	S	1	0
			2354	1478	403	466	7		
1	C	293	Total	C	N	O	S	1	0
			2354	1478	403	466	7		
1	F	293	Total	C	N	O	S	1	0
			2354	1478	403	466	7		
1	D	293	Total	C	N	O	S	1	0
			2354	1478	403	466	7		
1	E	293	Total	C	N	O	S	1	0
			2354	1478	403	466	7		

- Molecule 2 is (2S)-3-(hexadecanoyloxy)-2-[(9Z)-octadec-9-enoyloxy]propyl 2-(trimethylammonio)ethyl phosphate (CCD ID: POV) (formula: C₄₂H₈₂NO₈P) (labeled as "Ligand of Interest" by depositor).

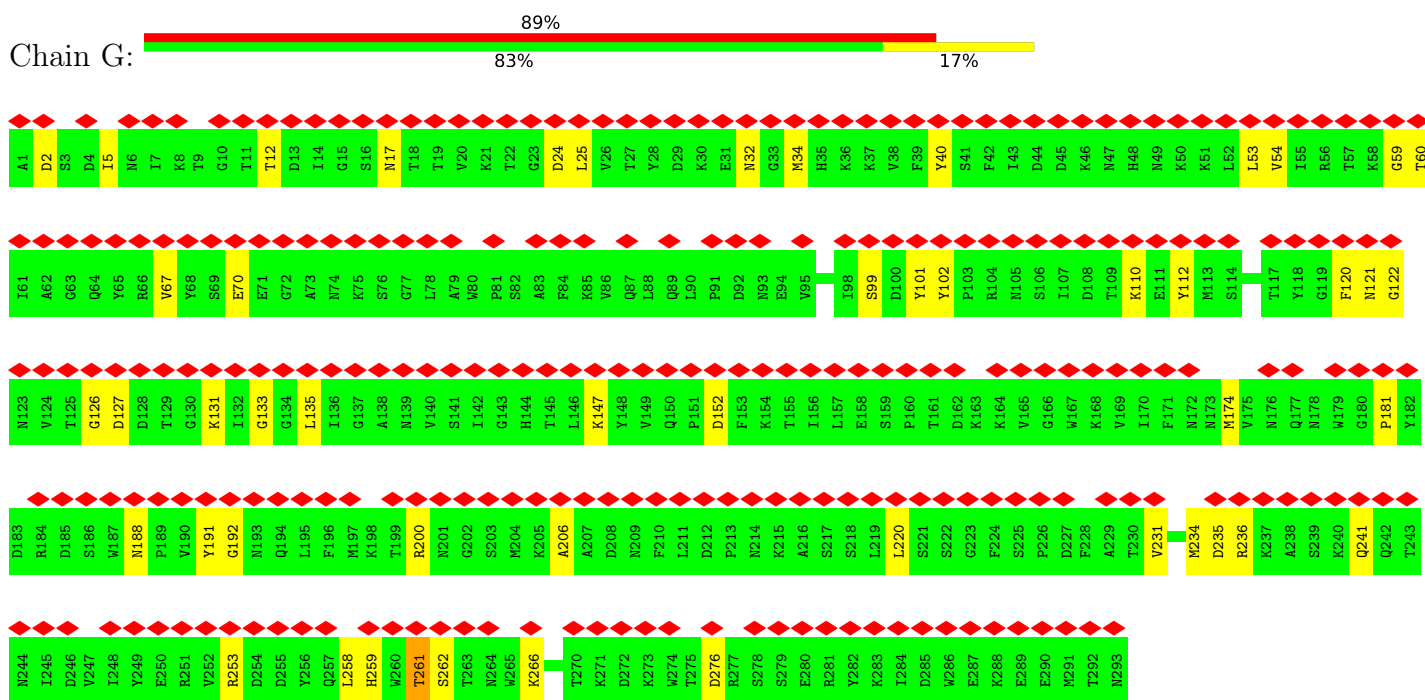


Mol	Chain	Residues	Atoms					AltConf
2	A	1	Total 52	C 42	N 1	O 8	P 1	0
2	A	1	Total 52	C 42	N 1	O 8	P 1	0
2	B	1	Total 52	C 42	N 1	O 8	P 1	0
2	B	1	Total 52	C 42	N 1	O 8	P 1	0
2	C	1	Total 52	C 42	N 1	O 8	P 1	0
2	D	1	Total 52	C 42	N 1	O 8	P 1	0
2	E	1	Total 52	C 42	N 1	O 8	P 1	0

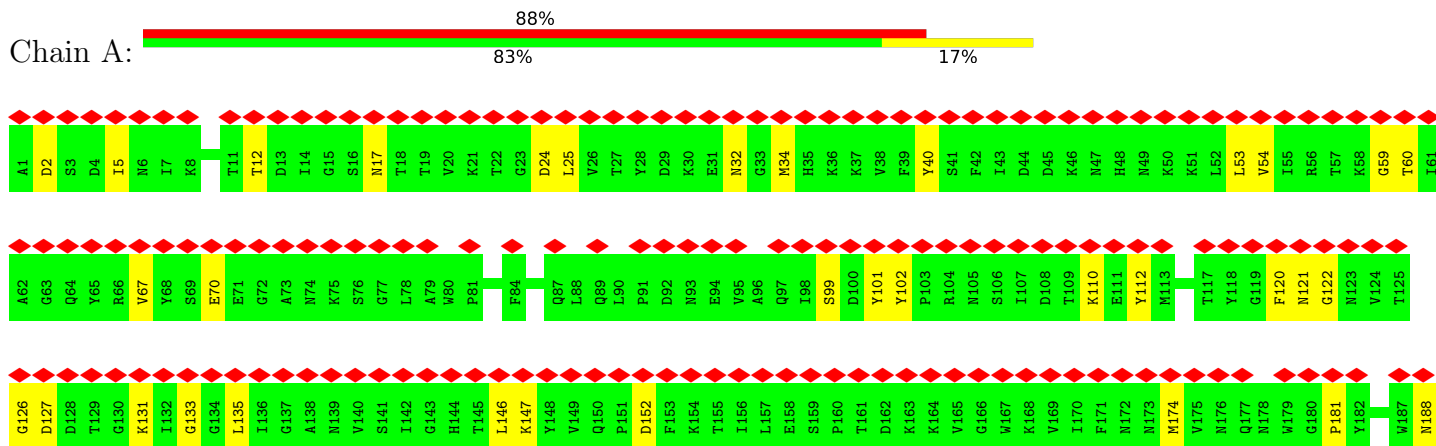
3 Residue-property plots

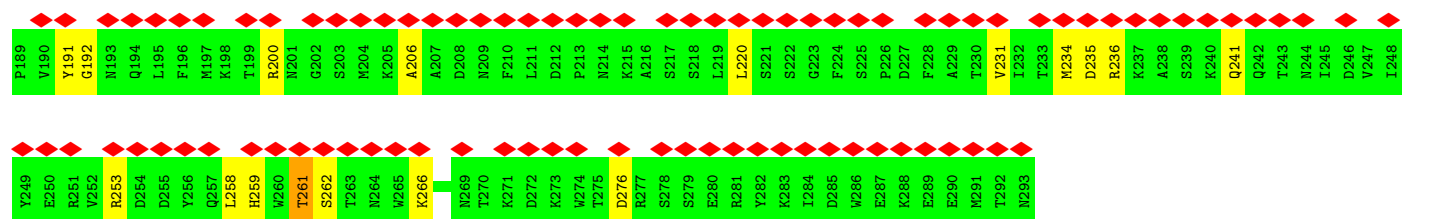
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion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

• Molecule 1: Alpha-hemolysin

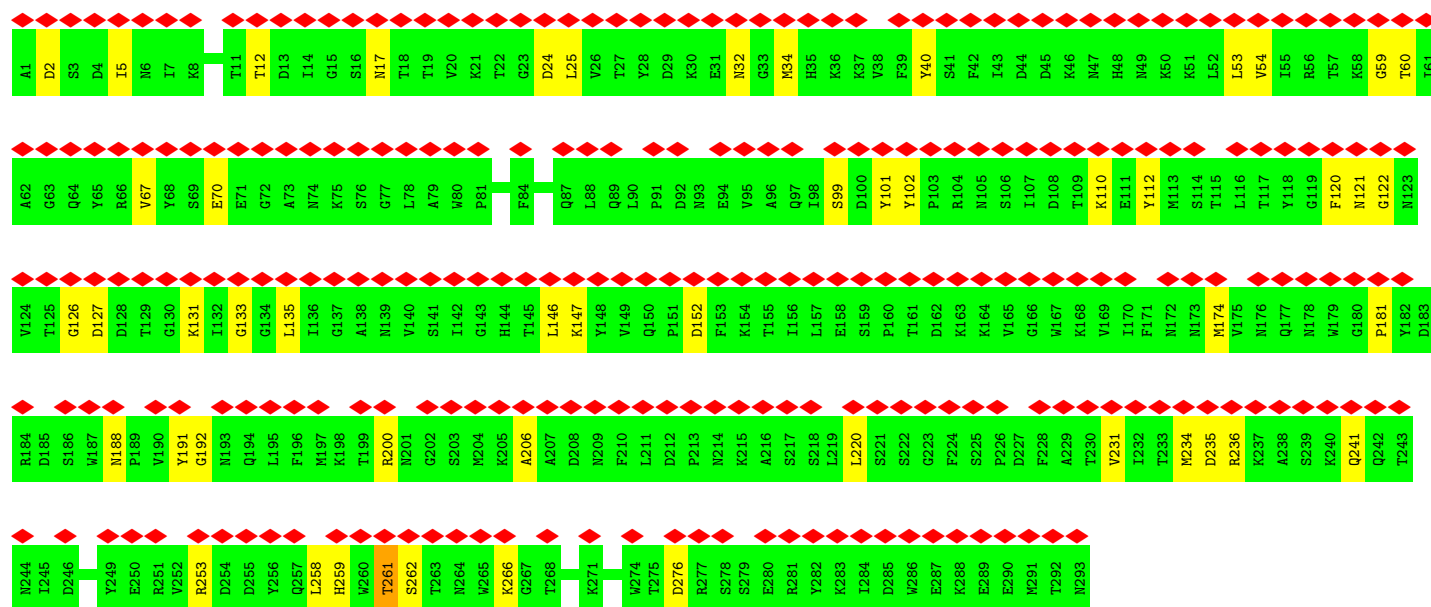
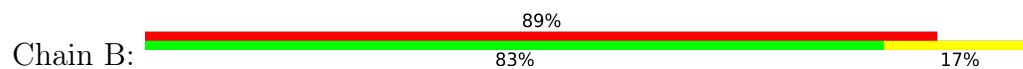


• Molecule 1: Alpha-hemolysin

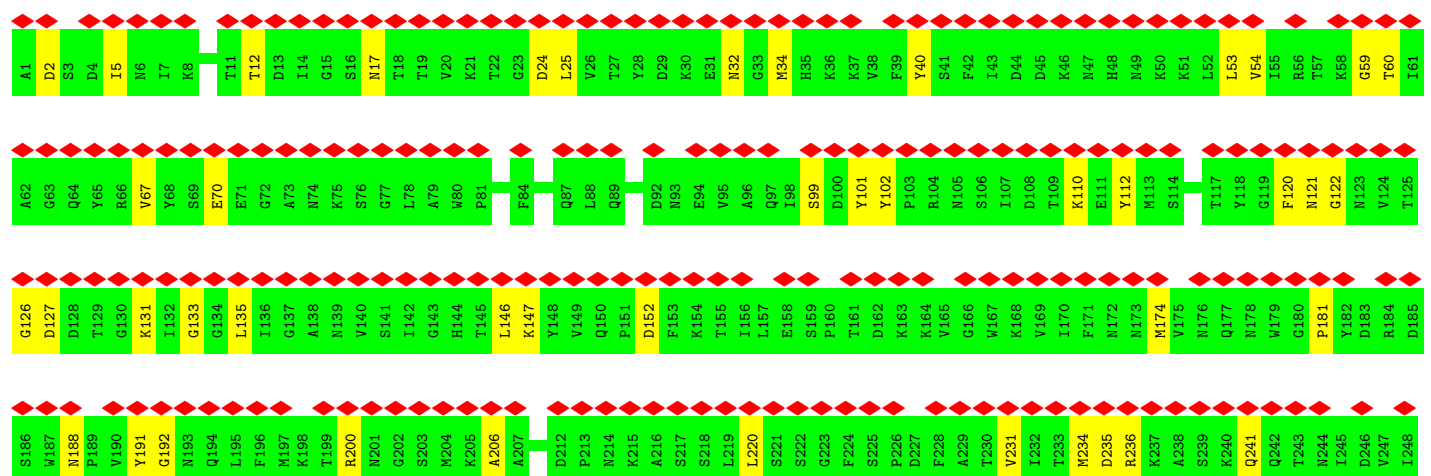
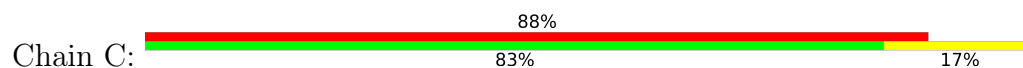




• Molecule 1: Alpha-hemolysin

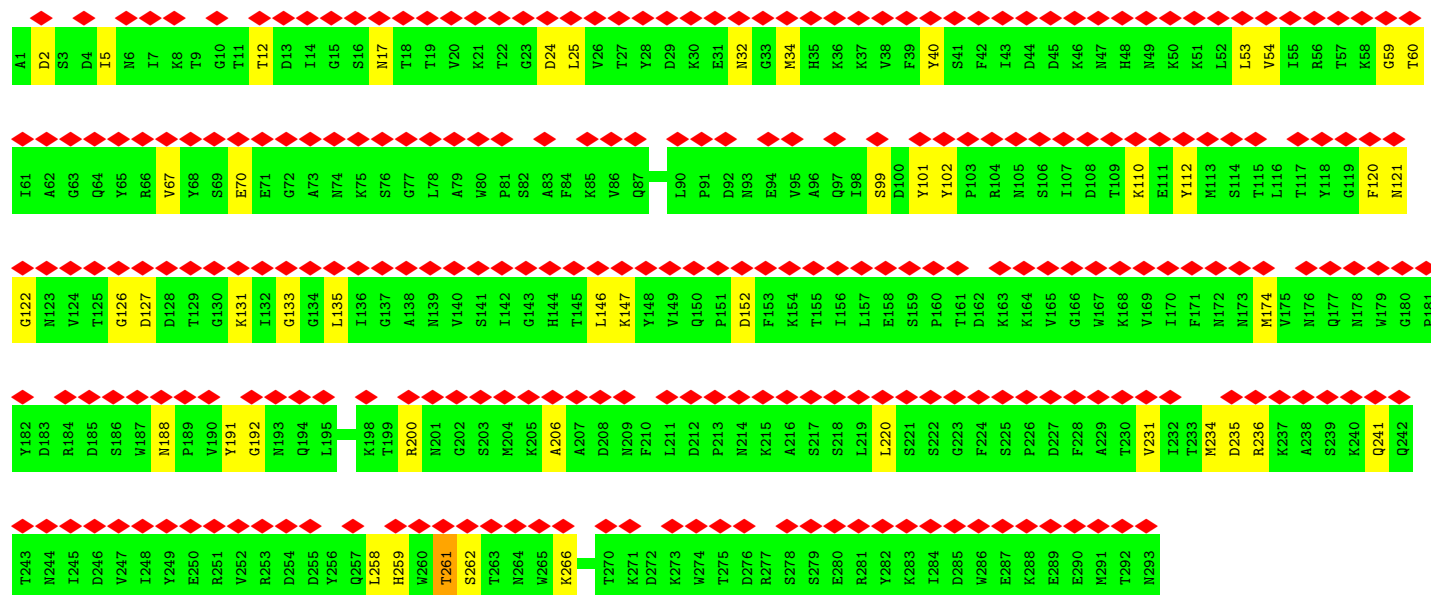
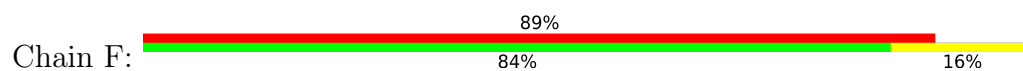


• Molecule 1: Alpha-hemolysin

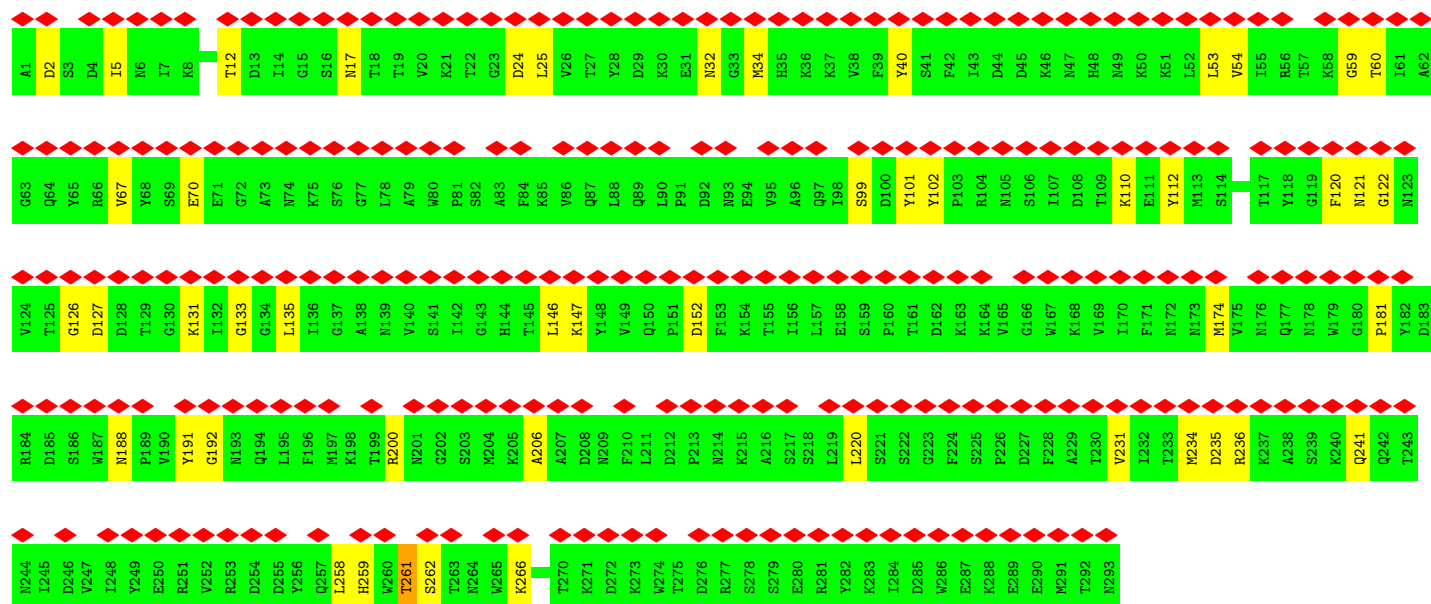
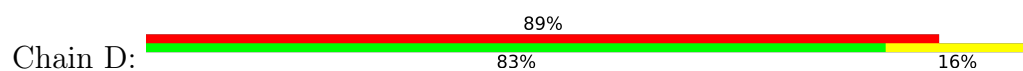




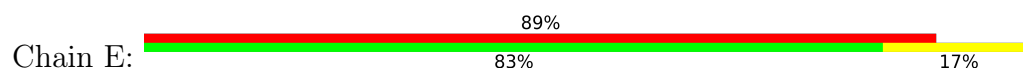
• Molecule 1: Alpha-hemolysin



• Molecule 1: Alpha-hemolysin



• Molecule 1: Alpha-hemolysin



N244	T248	Y249	E250	R251	V252	R253	D254	D255	Y256	Q257	L258	H259	W260	T261	S262	T263	N264	W265	K266	T270	K271	D272	K273	W274	T275	D276	R277	S278	S279	E280	R281	Y282	K283	L284	D285	W286	E287	K288	E289	E290	M291	T292	N293	I61	A62	G63	Q64	Y65	R66	V67	Y68	S69	E70	E71	G72	A73	N74	K75	S76	G77	L78	A79	W80	P81	S82	A83	F84	K85	V86	Q87	L88	Q89	L90	K90	P91	D92	N93	E94	V95	A96	Q97	I98	S99	D100	Y101	Y102	P103	R104	N105	S106	I107	D108	T109	K110	E111	Y112	M113	S114	T115	L116	T117	Y118	W119	G119	F120
D183	R184	D185	S186	W187	N188	P189	Y190	Y191	G192	N193	Q194	L195	F196	M197	K198	T199	R200	N201	G202	S203	M204	K205	A206	A207	D208	N209	D212	P213	N214	K215	A216	S217	S218	L219	L220	S221	S222	G223	F224	S225	P226	D227	F228	A229	T230	V231	I232	T233	M234	D235	R236	K237	A238	S239	K240	Q241	Q242	T243																																															
N121	G122	N123	V124	T125	G126	D127	D128	T129	G130	K131	I132	G133	G134	L135	I136	G137	A138	N139	V140	S141	I142	G143	H144	T145	L146	K147	Y148	V149	Q150	P151	D152	F153	K154	T155	I156	L157	E158	S159	P160	T161	D162	K163	G166	W167	K168	V169	I170	F171	N172	N173	M174	Q177	N178	W179	G180	P181	Y182																																																

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	52942	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TALOS ARCTICA	Depositor
Voltage (kV)	200	Depositor
Electron dose ($e^-/\text{\AA}^2$)	40	Depositor
Minimum defocus (nm)	750	Depositor
Maximum defocus (nm)	3500	Depositor
Magnification	Not provided	
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	1.697	Depositor
Minimum map value	-1.182	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.062	Depositor
Recommended contour level	0.244	Depositor
Map size (Å)	257.6, 257.6, 257.6	wwPDB
Map dimensions	280, 280, 280	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.92, 0.92, 0.92	Depositor

5 Model quality

5.1 Standard geometry

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

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	0.13	0/2406	0.23	0/3254
1	B	0.13	0/2406	0.23	0/3254
1	C	0.13	0/2406	0.23	0/3254
1	D	0.13	0/2406	0.23	0/3254
1	E	0.13	0/2406	0.23	0/3254
1	F	0.13	0/2406	0.23	0/3254
1	G	0.13	0/2406	0.23	0/3254
All	All	0.13	0/16842	0.23	0/22778

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

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	2354	0	2282	37	0
1	B	2354	0	2282	37	0
1	C	2354	0	2282	37	0
1	D	2354	0	2282	36	0
1	E	2354	0	2282	37	0
1	F	2354	0	2282	35	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	G	2354	0	2282	37	0
2	A	104	0	164	63	0
2	B	104	0	164	65	0
2	C	52	0	82	33	0
2	D	52	0	82	29	0
2	E	52	0	82	31	0
All	All	16842	0	16548	347	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 10.

The worst 5 of 347 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)
2:A:301:POV:H31C	2:B:301:POV:C11	1.75	1.17
2:C:301:POV:C11	2:D:301:POV:H31C	1.77	1.15
2:A:302:POV:H31C	2:E:301:POV:C11	1.77	1.14
2:D:301:POV:C11	2:E:301:POV:H31C	1.77	1.14
2:B:302:POV:C11	2:C:301:POV:H31C	1.76	1.14

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	292/293 (100%)	277 (95%)	15 (5%)	0	100	100
1	B	292/293 (100%)	277 (95%)	15 (5%)	0	100	100
1	C	292/293 (100%)	277 (95%)	15 (5%)	0	100	100
1	D	292/293 (100%)	277 (95%)	15 (5%)	0	100	100
1	E	292/293 (100%)	277 (95%)	15 (5%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	F	292/293 (100%)	277 (95%)	15 (5%)	0	100	100
1	G	292/293 (100%)	277 (95%)	15 (5%)	0	100	100
All	All	2044/2051 (100%)	1939 (95%)	105 (5%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains ⓘ

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	260/259 (100%)	258 (99%)	2 (1%)	73	86
1	B	260/259 (100%)	258 (99%)	2 (1%)	73	86
1	C	260/259 (100%)	258 (99%)	2 (1%)	73	86
1	D	260/259 (100%)	258 (99%)	2 (1%)	73	86
1	E	260/259 (100%)	258 (99%)	2 (1%)	73	86
1	F	260/259 (100%)	258 (99%)	2 (1%)	73	86
1	G	260/259 (100%)	258 (99%)	2 (1%)	73	86
All	All	1820/1813 (100%)	1806 (99%)	14 (1%)	70	86

5 of 14 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	261	THR
1	F	101	TYR
1	E	261	THR
1	D	261	THR
1	E	101	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	G	257	GLN
1	A	6	ASN
1	A	257	GLN
1	C	257	GLN
1	E	257	GLN

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](#)

7 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	$\# Z > 2$
2	POV	C	301	-	51,51,51	0.29	0	57,59,59	0.33	0
2	POV	B	301	-	51,51,51	0.29	0	57,59,59	0.33	0
2	POV	D	301	-	51,51,51	0.29	0	57,59,59	0.33	0
2	POV	B	302	-	51,51,51	0.29	0	57,59,59	0.33	0
2	POV	E	301	-	51,51,51	0.29	0	57,59,59	0.33	0
2	POV	A	302	-	51,51,51	0.29	0	57,59,59	0.33	0
2	POV	A	301	-	51,51,51	0.29	0	57,59,59	0.33	0

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
2	POV	C	301	-	-	38/55/55/55	-
2	POV	B	301	-	-	38/55/55/55	-
2	POV	D	301	-	-	38/55/55/55	-
2	POV	B	302	-	-	38/55/55/55	-
2	POV	E	301	-	-	38/55/55/55	-
2	POV	A	302	-	-	38/55/55/55	-
2	POV	A	301	-	-	38/55/55/55	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 266 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	301	POV	C1-O11-P-O14
2	A	301	POV	C11-O12-P-O11
2	A	301	POV	C22-C21-O21-C2
2	A	301	POV	O22-C21-O21-C2
2	A	302	POV	C1-O11-P-O14

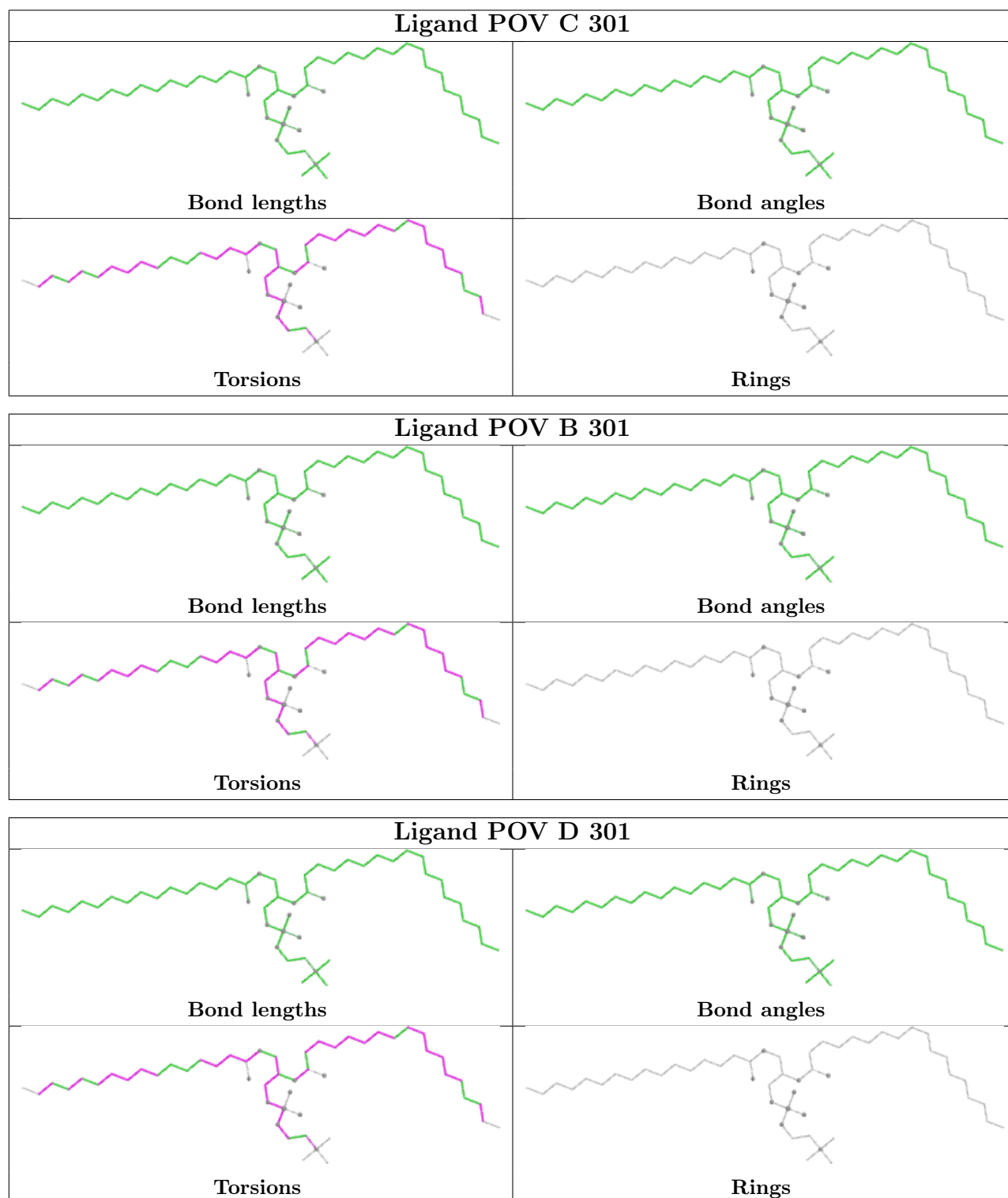
There are no ring outliers.

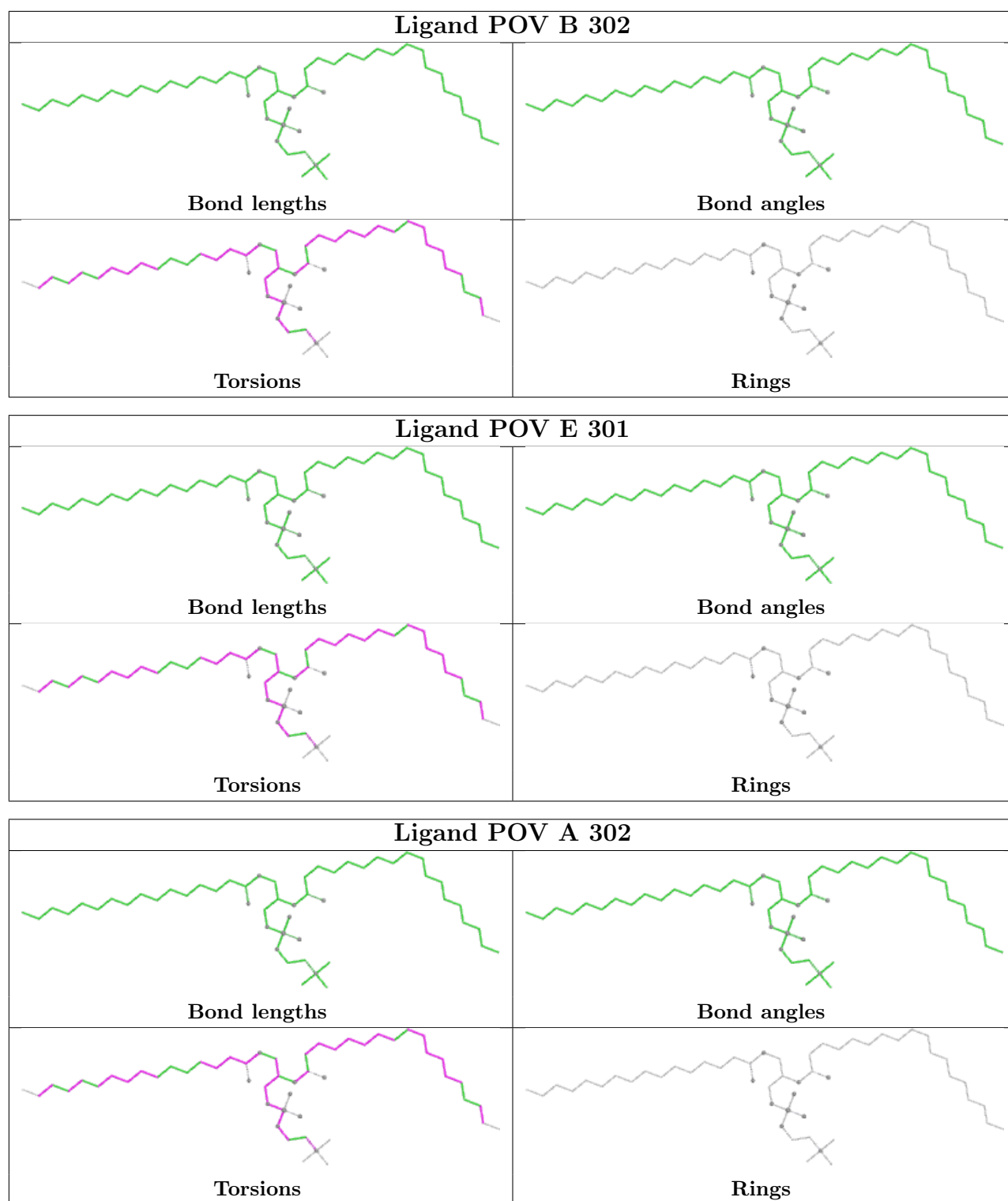
7 monomers are involved in 132 short contacts:

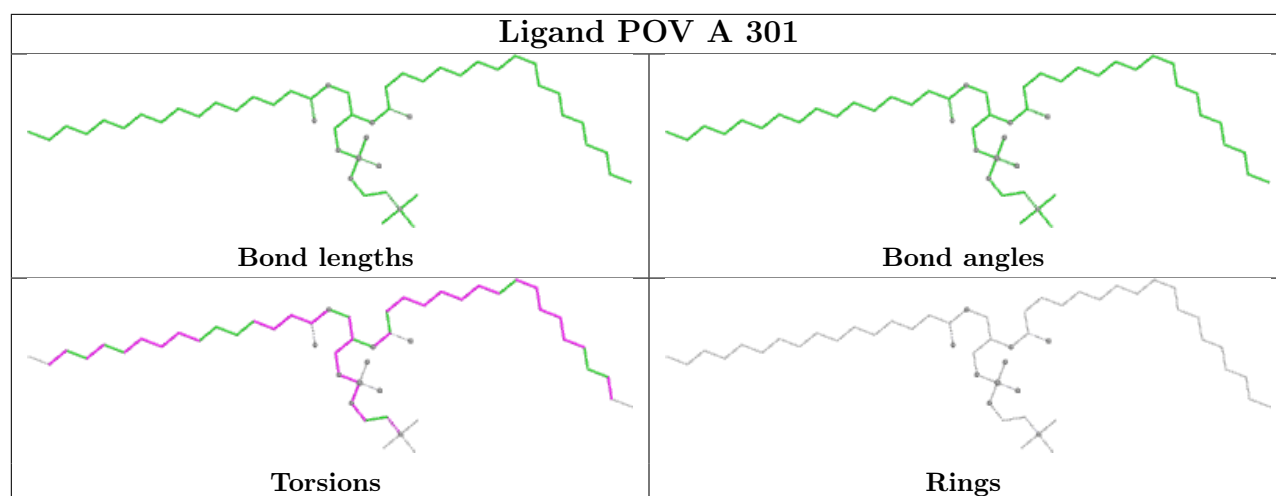
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	301	POV	33	0
2	B	301	POV	33	0
2	D	301	POV	29	0
2	B	302	POV	32	0
2	E	301	POV	31	0
2	A	302	POV	31	0
2	A	301	POV	32	0

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 than 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.







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.

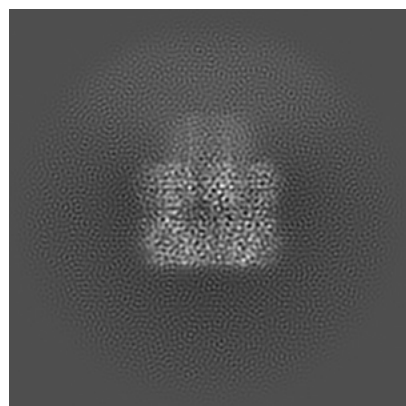
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-62307. These allow visual inspection of the internal detail of the map and identification of artifacts.

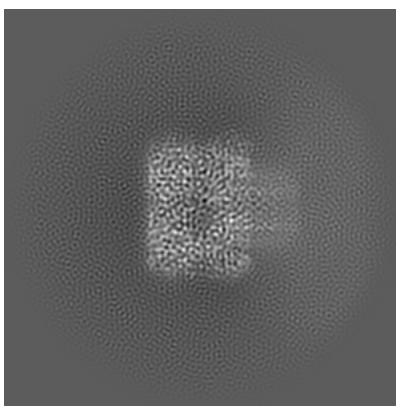
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

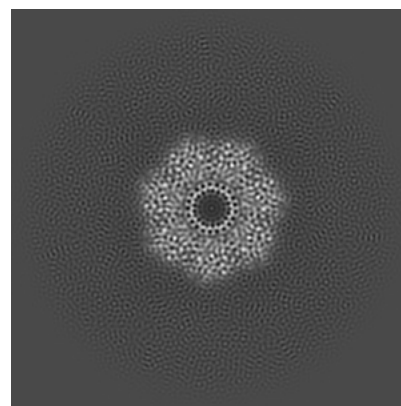
6.1.1 Primary map



X

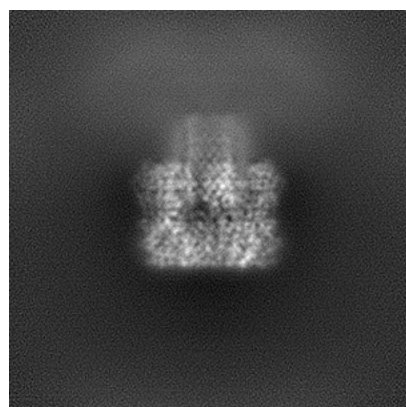


Y

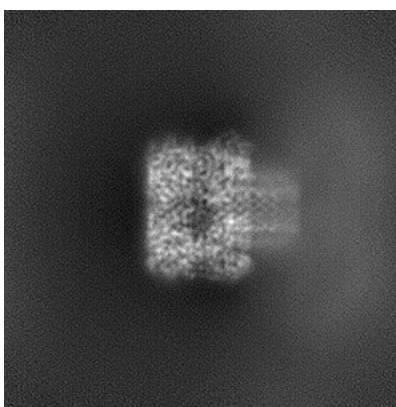


Z

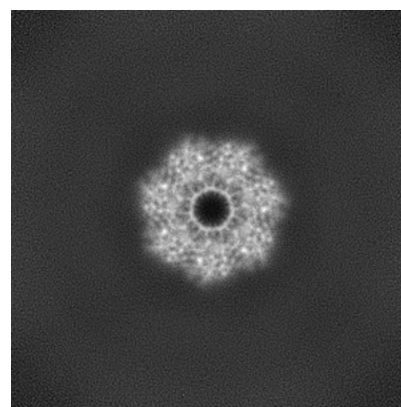
6.1.2 Raw map



X



Y

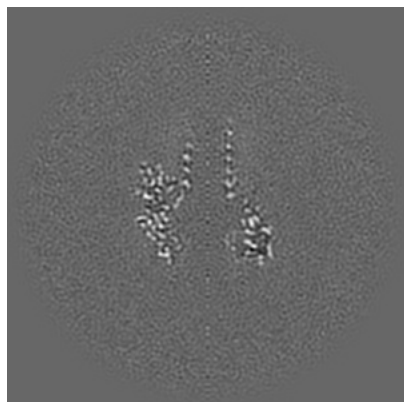


Z

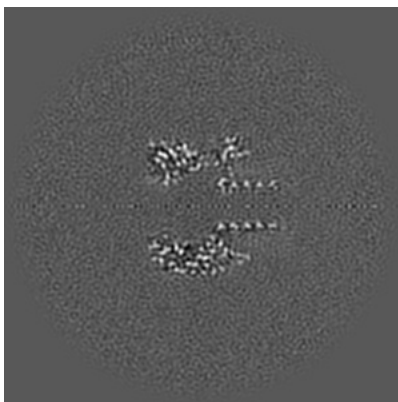
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

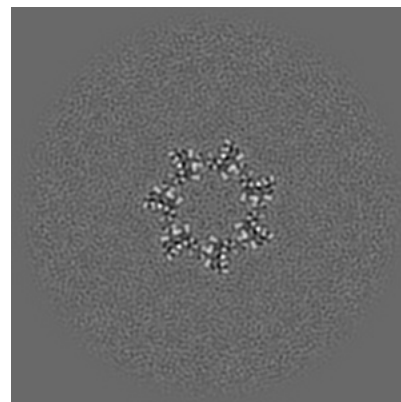
6.2.1 Primary map



X Index: 140

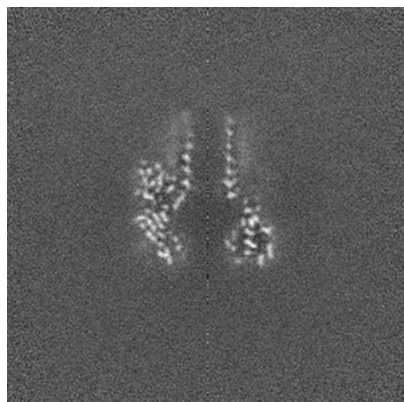


Y Index: 140

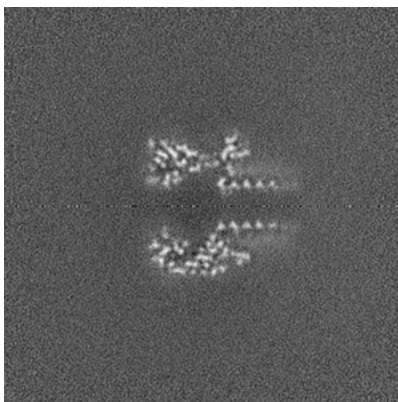


Z Index: 140

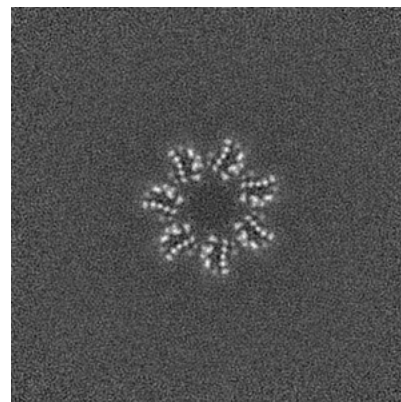
6.2.2 Raw map



X Index: 140



Y Index: 140

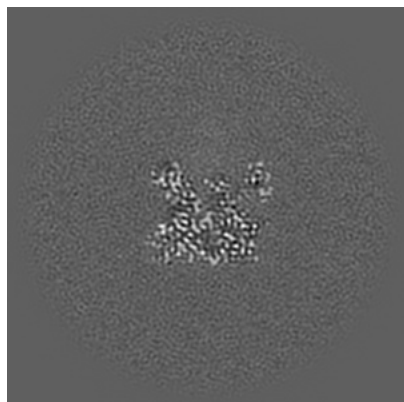


Z Index: 140

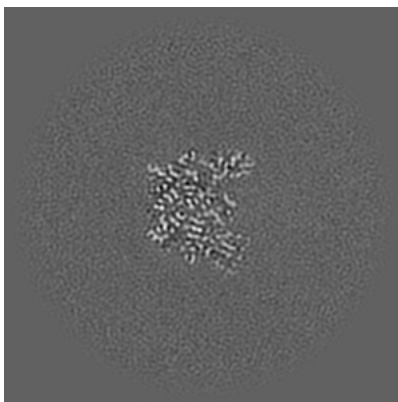
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

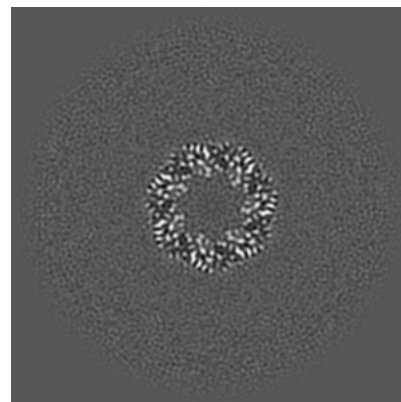
6.3.1 Primary map



X Index: 166

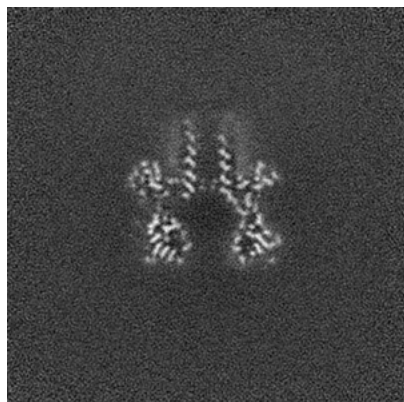


Y Index: 111

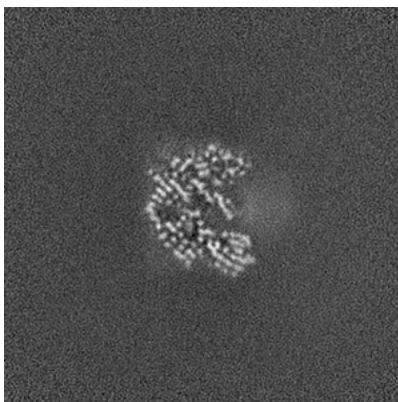


Z Index: 126

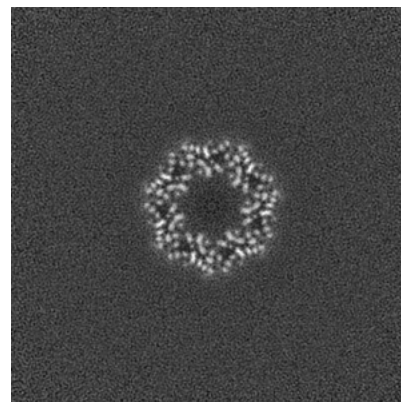
6.3.2 Raw map



X Index: 132



Y Index: 114

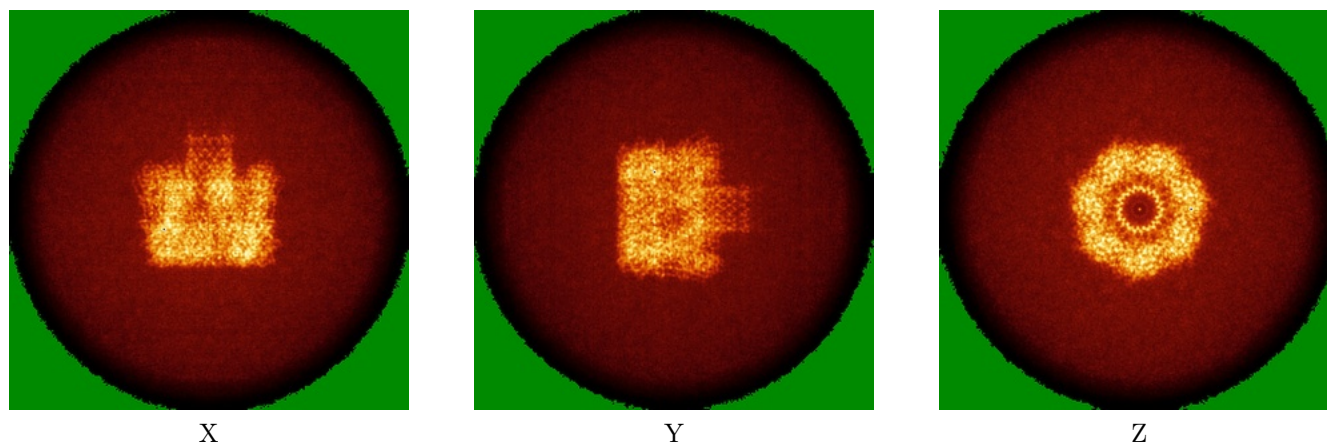


Z Index: 126

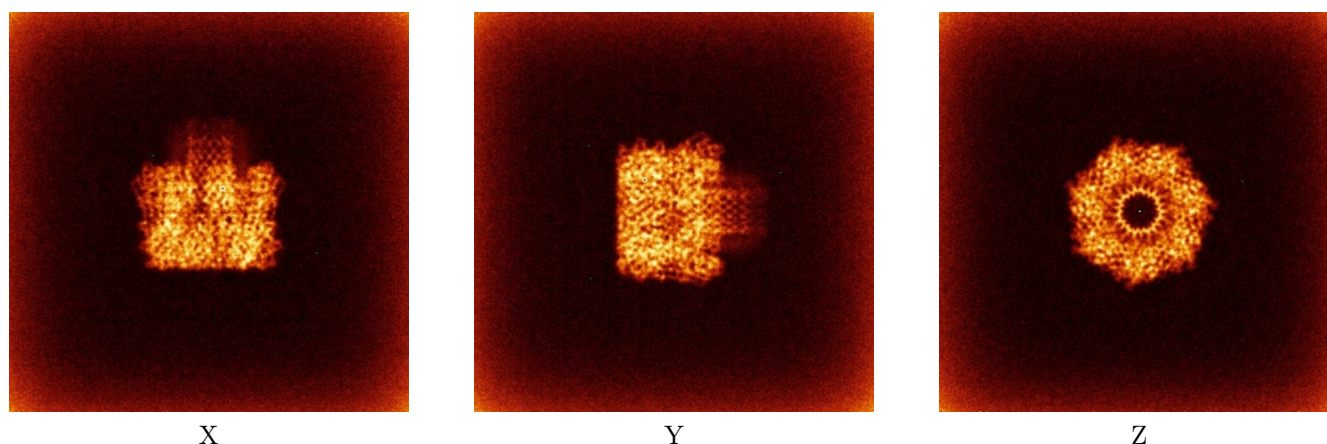
The images above show the largest variance slices of the map in three orthogonal directions.

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

6.4.1 Primary map



6.4.2 Raw map



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](#)

This section was not generated.

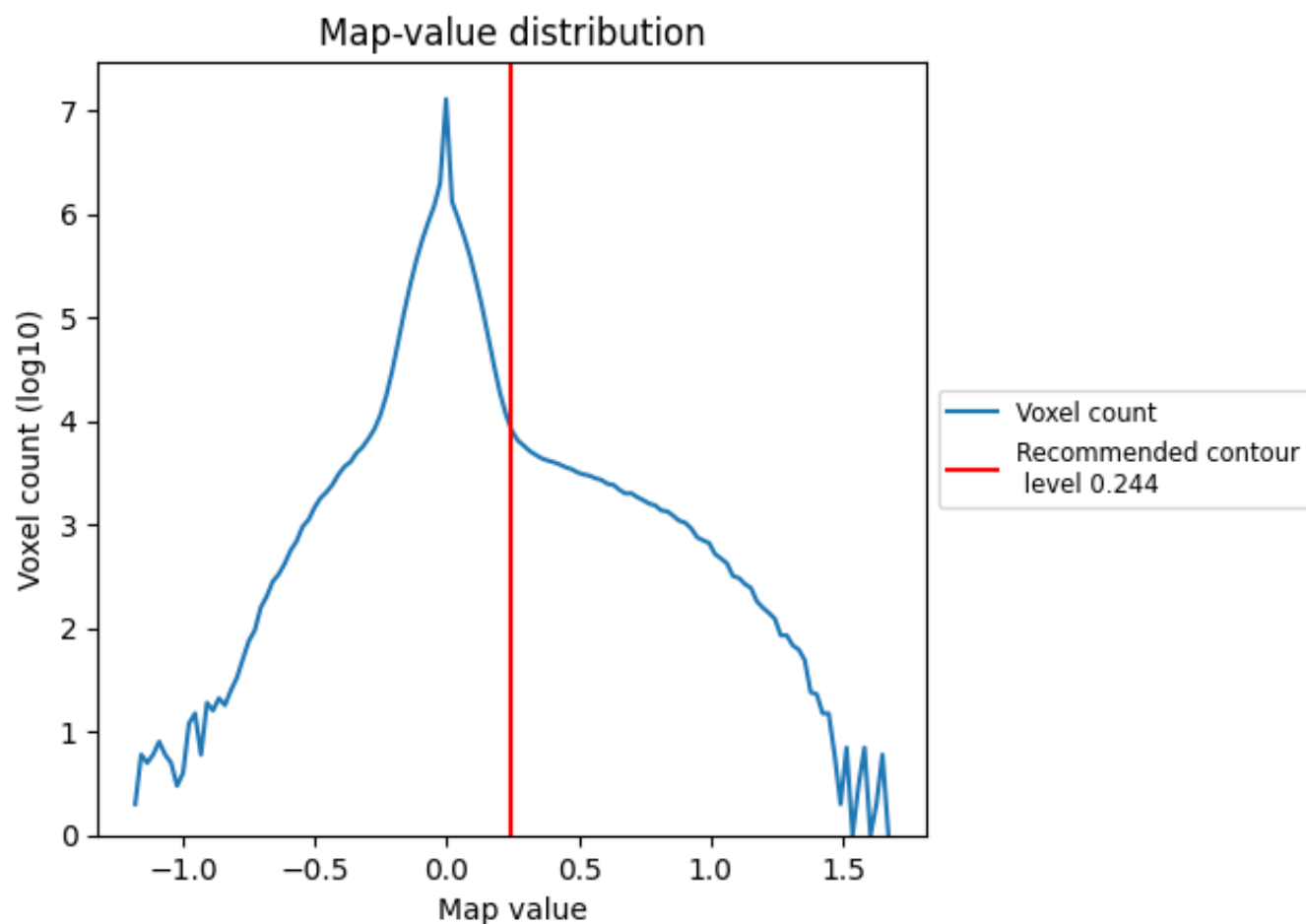
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

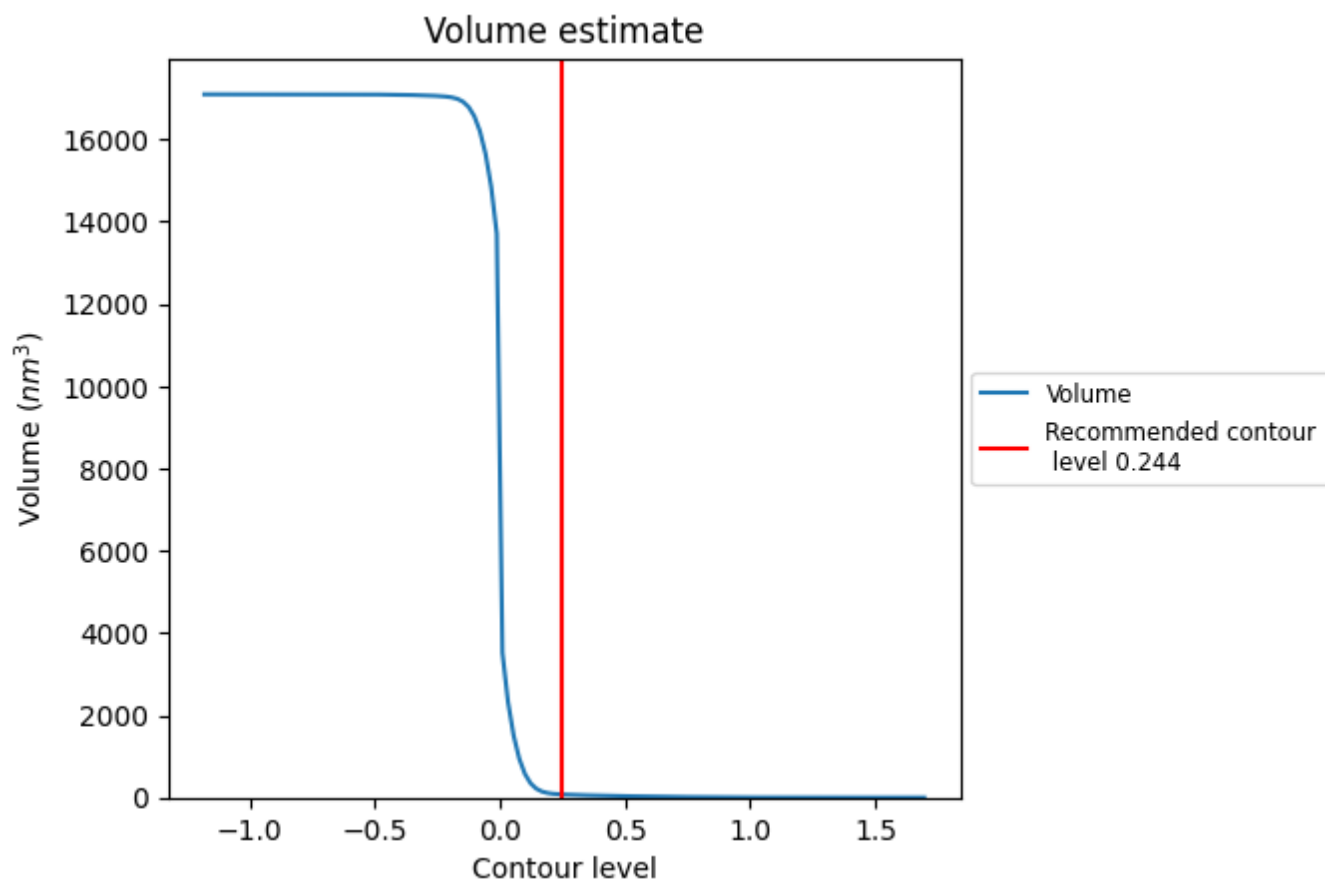
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution [i](#)



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

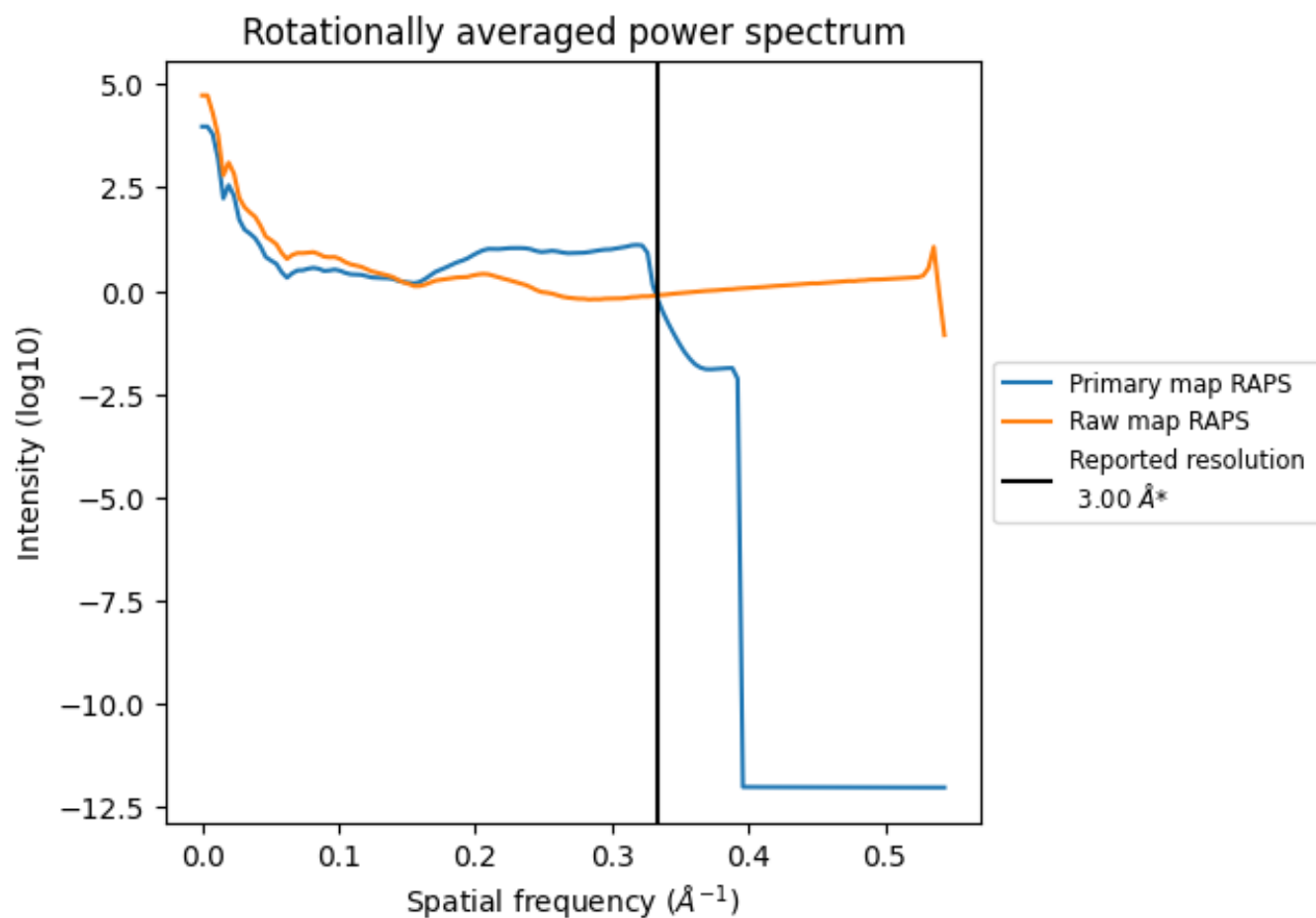
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 78 nm^3 ; this corresponds to an approximate mass of 70 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 ⓘ

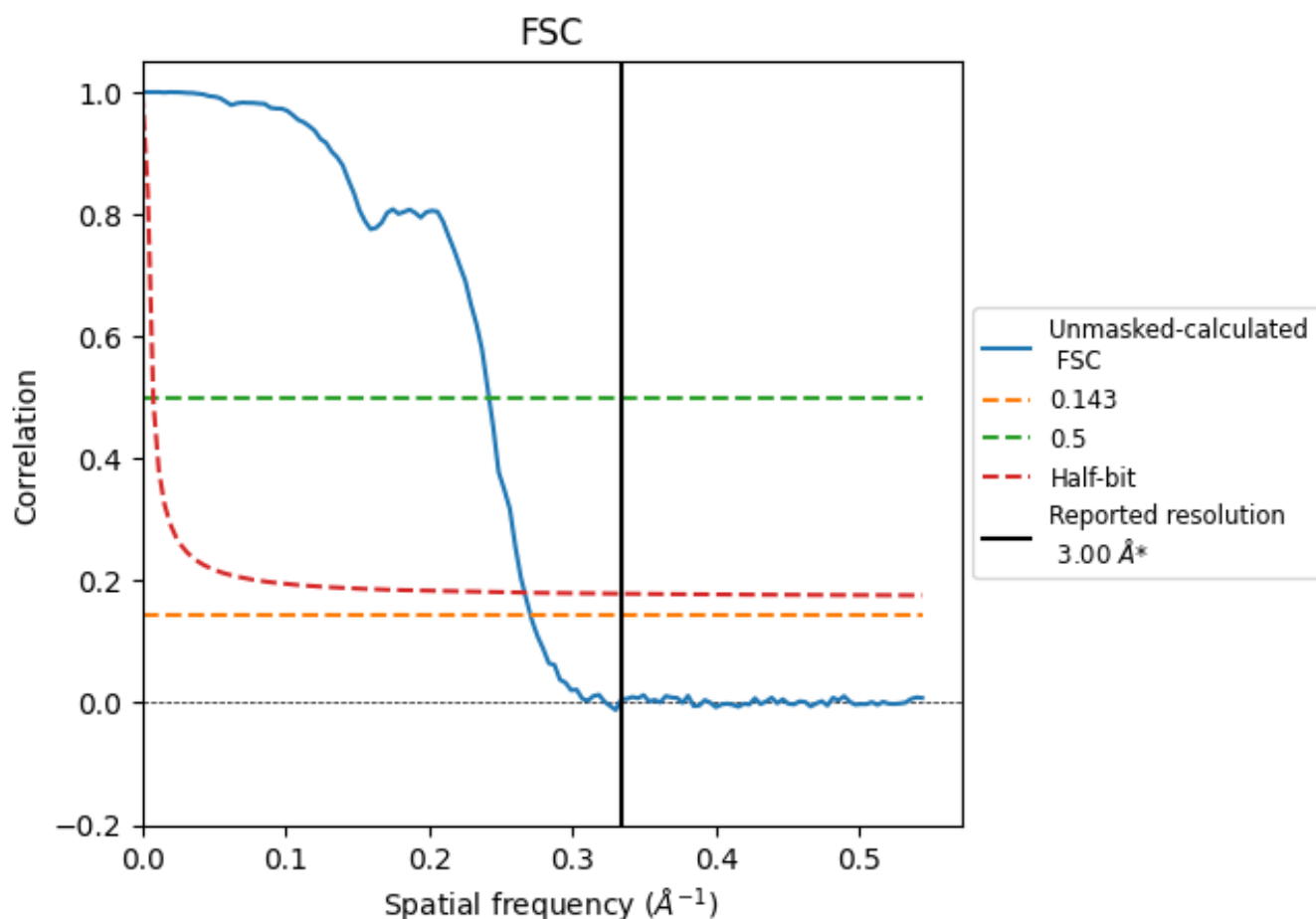


*Reported resolution corresponds to spatial frequency of 0.333 Å⁻¹

8 Fourier-Shell correlation [i](#)

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 [i](#)



*Reported resolution corresponds to spatial frequency of 0.333 Å⁻¹

8.2 Resolution estimates [i](#)

Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.00	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	3.69	4.14	3.75

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from deposited half-maps intersecting FSC 0.143 CUT-OFF 3.69 differs from the reported value 3.0 by more than 10 %

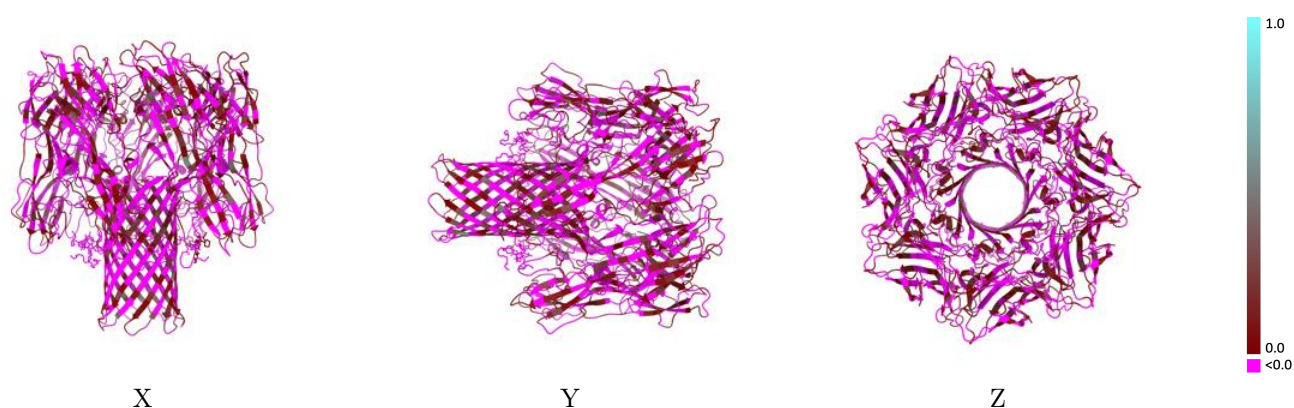
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-62307 and PDB model 9KRE. Per-residue inclusion information can be found in section 3 on page 6.

9.1 Map-model overlay [i](#)

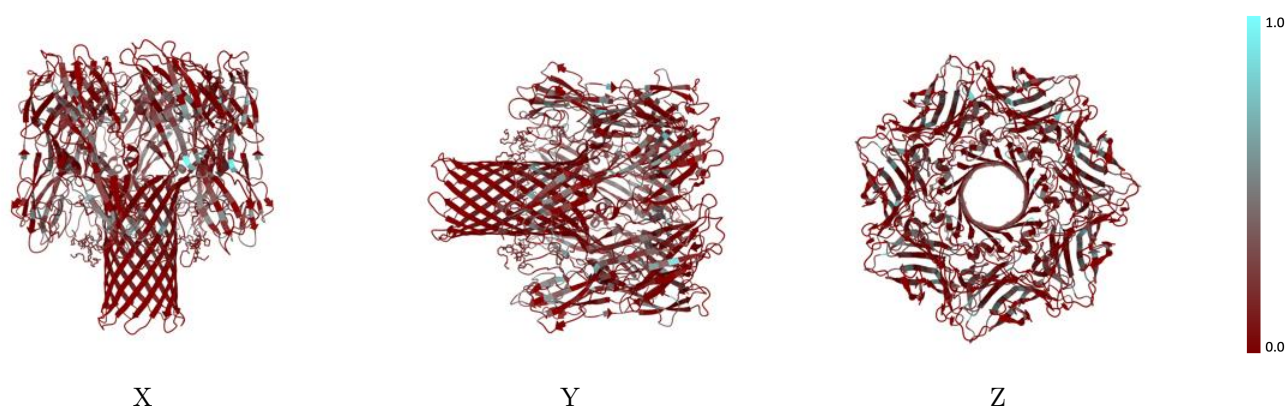
This section was not generated.

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



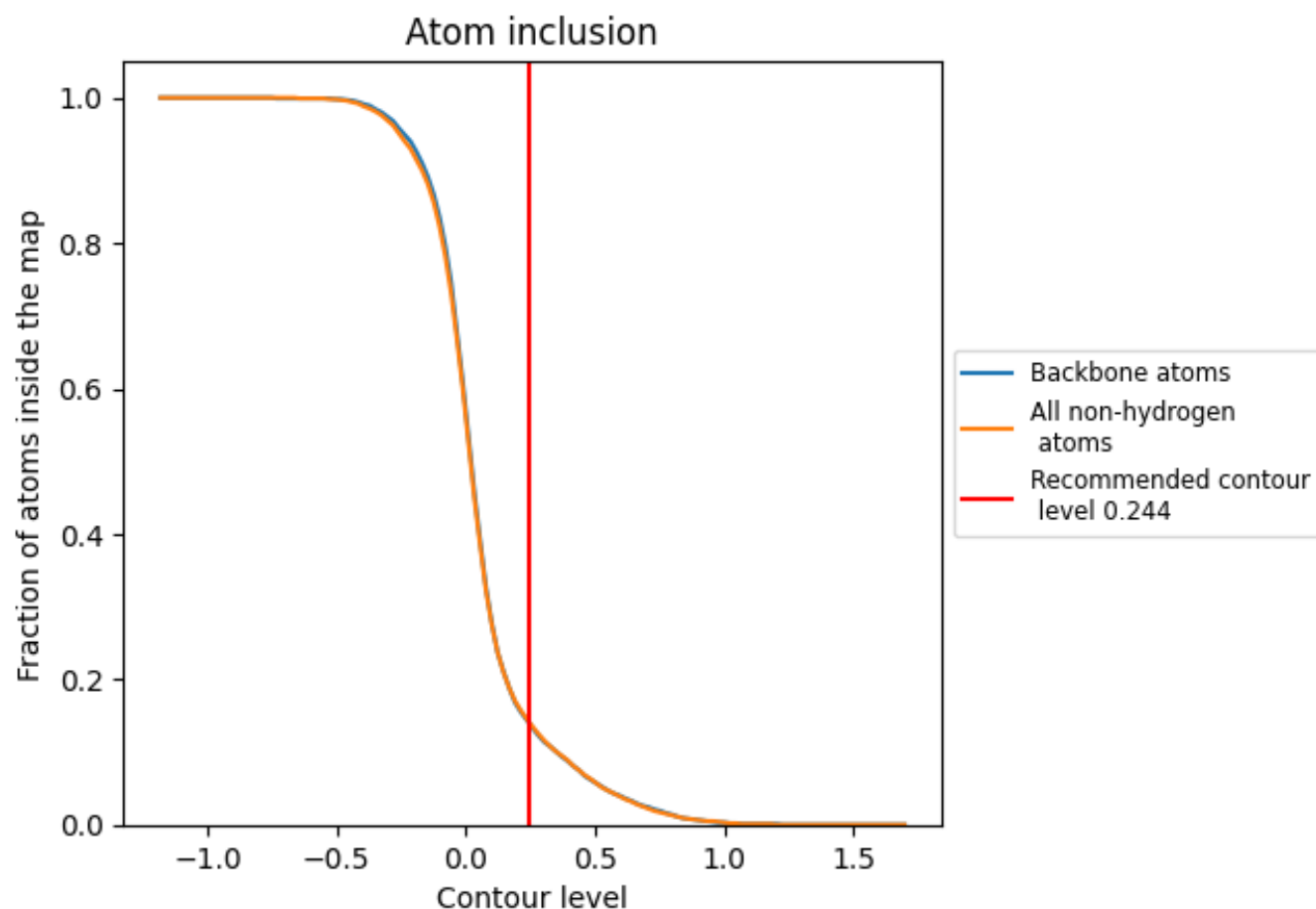
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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

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



The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.244).

9.4 Atom inclusion [i](#)



At the recommended contour level, 14% of all backbone atoms, 14% 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 (0.244) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.1410	-0.0080
A	0.1430	-0.0080
B	0.1460	-0.0040
C	0.1480	-0.0090
D	0.1400	-0.0130
E	0.1360	-0.0120
F	0.1390	-0.0070
G	0.1380	-0.0050

1.0
0.0
-0.0