



wwPDB EM Validation Summary Report ⓘ

Nov 16, 2022 – 01:34 PM EST

PDB ID : 6WG3
EMDB ID : EMD-21658
Title : Cryo-EM structure of human Cohesin-NIPBL-DNA complex
Authors : Shi, Z.B.; Gao, H.; Bai, X.C.; Yu, H.
Deposited on : 2020-04-04
Resolution : 5.30 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.dev43
Mogul : 1.8.5 (274361), CSD as541be (2020)
MolProbity : 4.02b-467
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ : 1.9.9
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.31.2

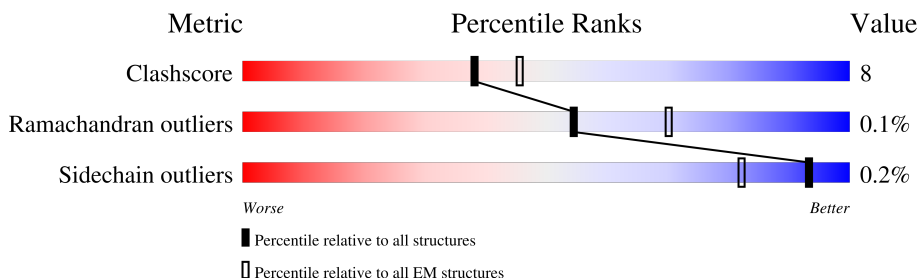
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 5.30 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
Sidechain outliers	154315	3826

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	1233	
2	B	1217	
3	C	631	
4	D	1272	
5	E	1652	
6	F	51	
7	G	51	

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 31683 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 Structural maintenance of chromosomes protein 1A.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	561	Total	C	N	O	S	0	0
			4458	2820	779	844	15		

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1157	GLN	GLU	engineered mutation	UNP Q14683

- Molecule 2 is a protein called Structural maintenance of chromosomes protein 3.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	693	Total	C	N	O	S	0	0
			5636	3568	989	1050	29		

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	1144	GLN	GLU	engineered mutation	UNP Q9UQE7

- Molecule 3 is a protein called Double-strand-break repair protein rad21 homolog.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	C	248	Total	C	N	O	S	0	0
			1991	1278	352	350	11		

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	172	ALA	ARG	engineered mutation	UNP O60216
C	279	ALA	ASP	engineered mutation	UNP O60216
C	450	ALA	ARG	engineered mutation	UNP O60216

- Molecule 4 is a protein called Cohesin subunit SA-1.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	D	932	Total	C	N	O	S	0	0
			7580	4817	1291	1425	47		

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	1259	GLY	-	expression tag	UNP Q8WVM7
D	1260	ALA	-	expression tag	UNP Q8WVM7
D	1261	PRO	-	expression tag	UNP Q8WVM7
D	1262	MET	-	expression tag	UNP Q8WVM7
D	1263	ARG	-	expression tag	UNP Q8WVM7
D	1264	SER	-	expression tag	UNP Q8WVM7
D	1265	GLY	-	expression tag	UNP Q8WVM7
D	1266	ALA	-	expression tag	UNP Q8WVM7
D	1267	LEU	-	expression tag	UNP Q8WVM7
D	1268	GLU	-	expression tag	UNP Q8WVM7
D	1269	VAL	-	expression tag	UNP Q8WVM7
D	1270	LEU	-	expression tag	UNP Q8WVM7
D	1271	PHE	-	expression tag	UNP Q8WVM7
D	1272	GLN	-	expression tag	UNP Q8WVM7

- Molecule 5 is a protein called Nipped-B-like protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	E	1226	Total	C	N	O	S	0	0
			9865	6290	1675	1829	71		

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	1153	MET	-	expression tag	UNP Q6KC79
E	1154	SER	-	expression tag	UNP Q6KC79
E	1155	TYR	-	expression tag	UNP Q6KC79
E	1156	TYR	-	expression tag	UNP Q6KC79
E	1157	HIS	-	expression tag	UNP Q6KC79
E	1158	HIS	-	expression tag	UNP Q6KC79
E	1159	HIS	-	expression tag	UNP Q6KC79
E	1160	HIS	-	expression tag	UNP Q6KC79
E	1161	HIS	-	expression tag	UNP Q6KC79
E	1162	HIS	-	expression tag	UNP Q6KC79

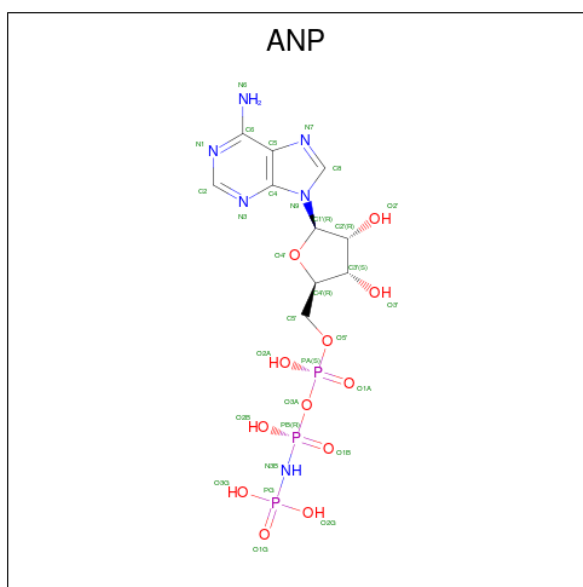
- Molecule 6 is a DNA chain called DNA (51-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
6	F	51	Total	C	N	O	P	0	0
			1071	510	255	255	51		

- Molecule 7 is a DNA chain called DNA (51-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
7	G	51	Total	C	N	O	P	0	0
			1020	510	102	357	51		

- Molecule 8 is PHOSPHOAMINOPHOSPHONIC ACID-ADENYLATE ESTER (three-letter code: ANP) (formula: $C_{10}H_{17}N_6O_{12}P_3$) (labeled as "Ligand of Interest" by depositor).

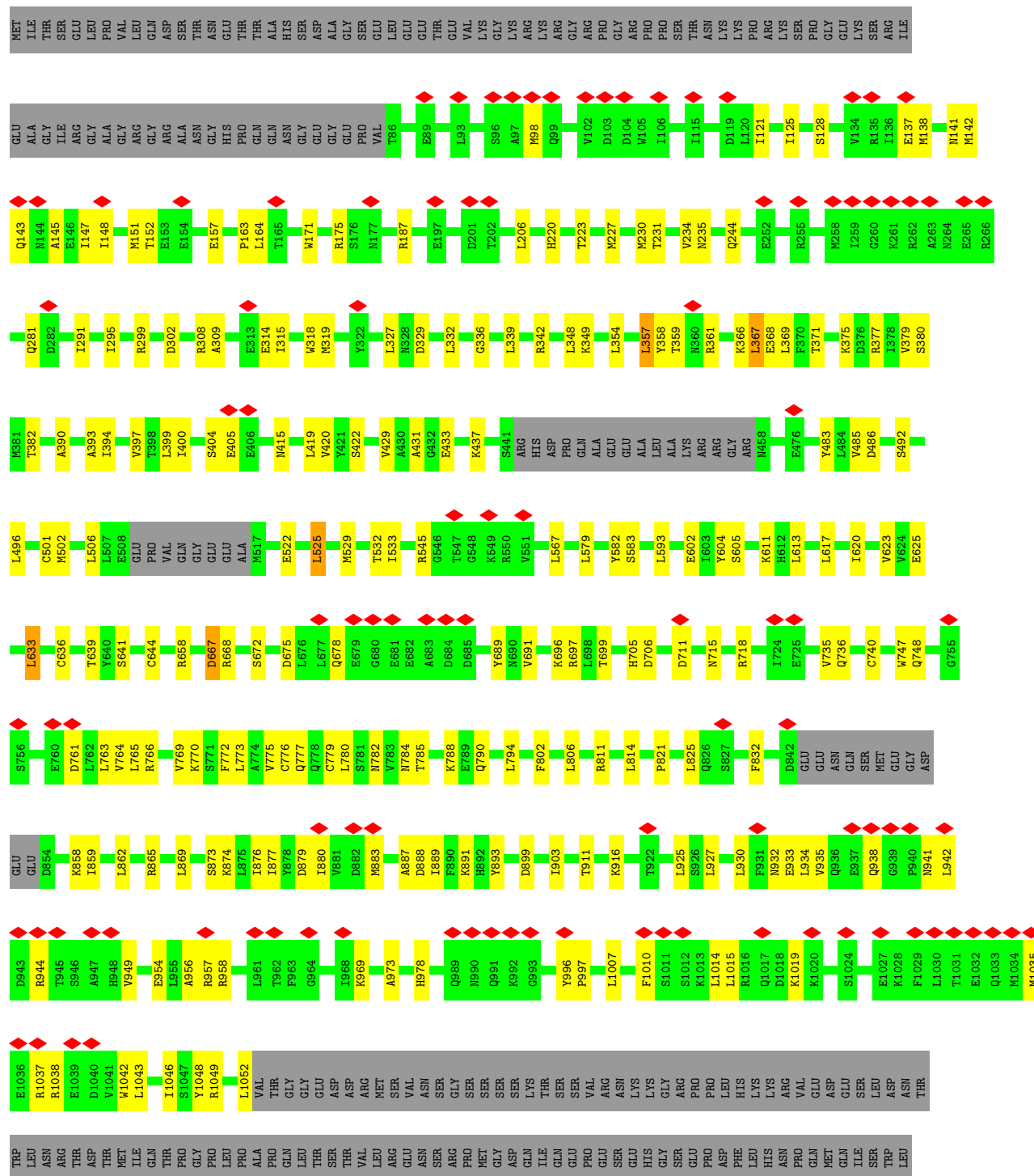


Mol	Chain	Residues	Atoms					AltConf
8	A	1	Total	C	N	O	P	0
			31	10	6	12	3	
8	B	1	Total	C	N	O	P	0
			31	10	6	12	3	

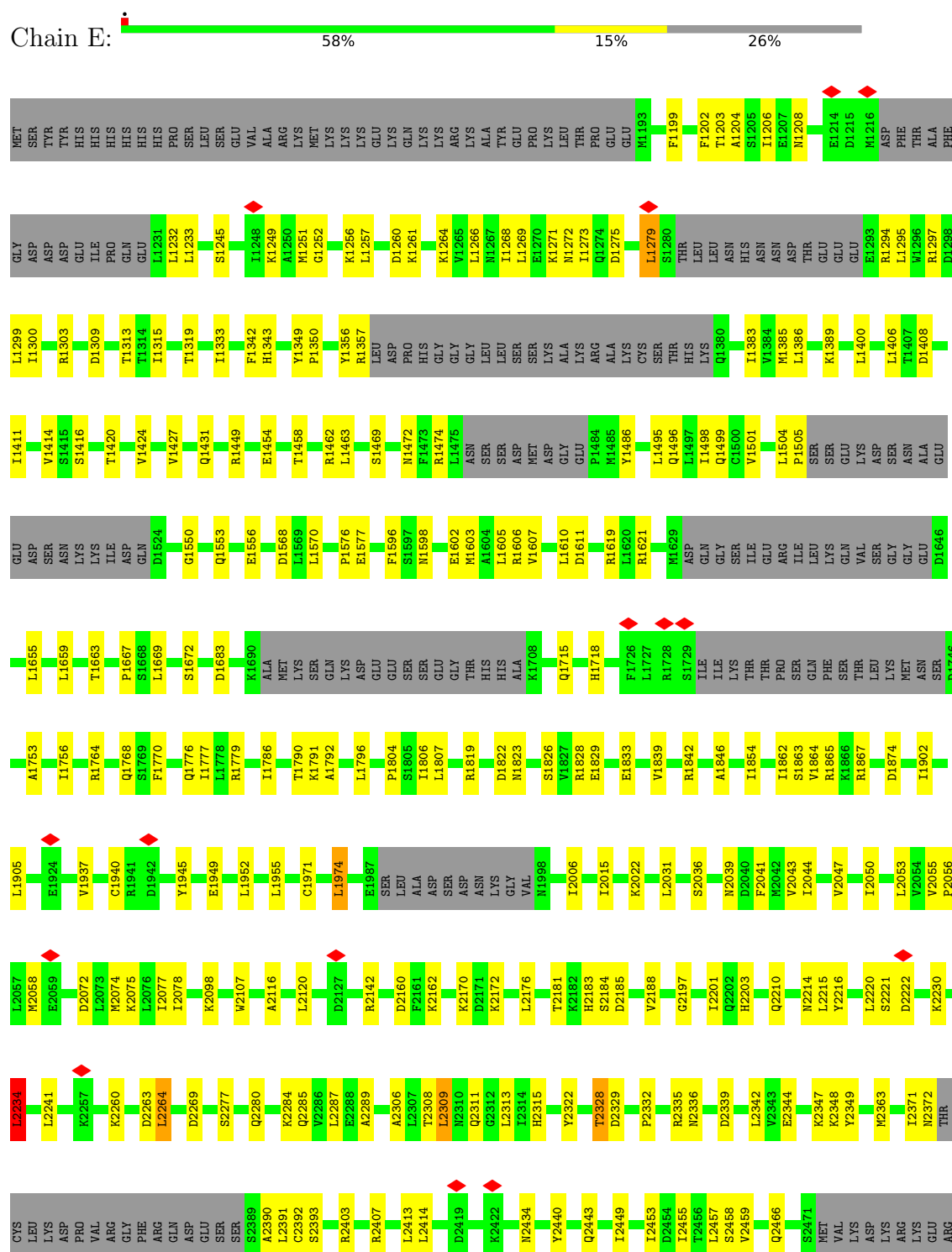


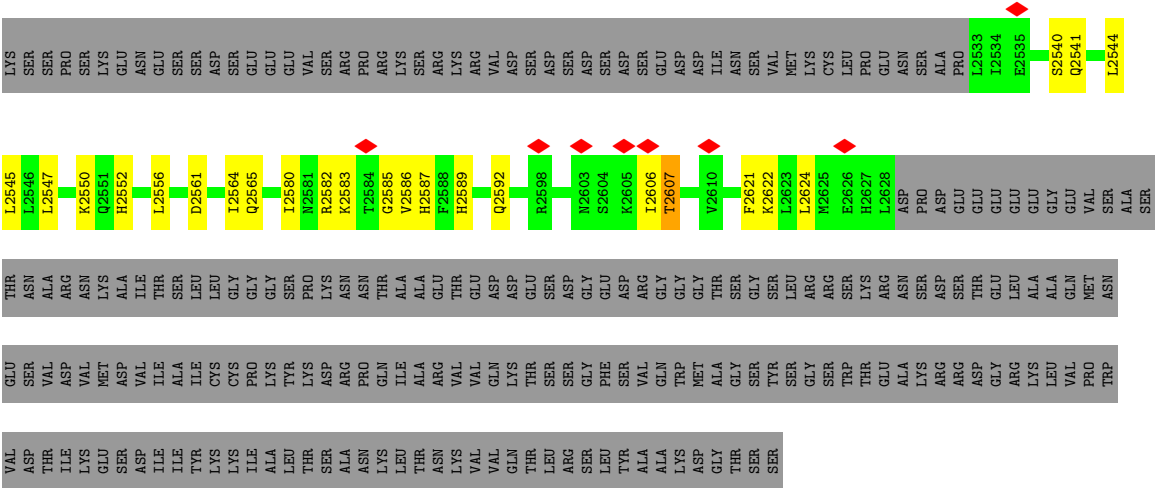


• Molecule 4: Cohesin subunit SA-1

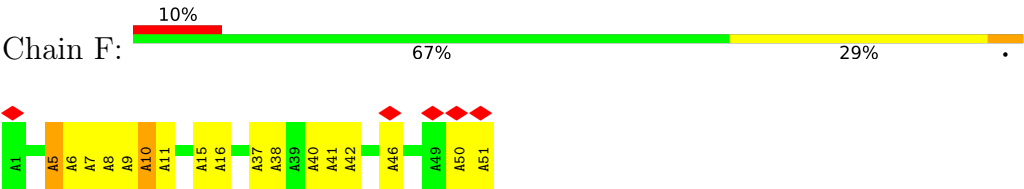


- Molecule 5: Nipped-B-like protein

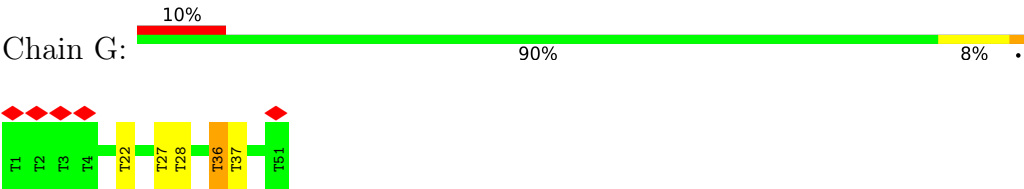




• Molecule 6: DNA (51-MER)



• Molecule 7: DNA (51-MER)



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	6857	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	60	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	0.073	Depositor
Minimum map value	-0.022	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.004	Depositor
Recommended contour level	0.02	Depositor
Map size (Å)	321.6, 321.6, 321.6	wwPDB
Map dimensions	240, 240, 240	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.34, 1.34, 1.34	Depositor

5 Model quality

5.1 Standard geometry

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

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	0.34	0/4532	0.64	4/6086 (0.1%)
2	B	0.32	0/5727	0.63	1/7675 (0.0%)
3	C	0.31	0/2026	0.65	2/2721 (0.1%)
4	D	0.33	0/7715	0.64	7/10403 (0.1%)
5	E	0.36	0/10021	0.67	12/13509 (0.1%)
6	F	0.82	0/1223	0.94	4/1883 (0.2%)
7	G	0.83	1/1121 (0.1%)	1.31	4/1730 (0.2%)
All	All	0.39	1/32365 (0.0%)	0.70	34/44007 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	G	27	DT	C3'-O3'	8.70	1.55	1.44

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	E	1974	LEU	CA-CB-CG	10.21	138.78	115.30
5	E	1279	LEU	CA-CB-CG	7.68	132.97	115.30
6	F	10	DA	OP2-P-O3'	7.24	121.14	105.20
4	D	367	LEU	CA-CB-CG	7.18	131.81	115.30
4	D	667	ASP	CB-CG-OD1	7.06	124.65	118.30

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	4458	0	4500	81	0
2	B	5636	0	5709	99	0
3	C	1991	0	2083	47	0
4	D	7580	0	7582	134	0
5	E	9865	0	10100	168	0
6	F	1071	0	562	11	0
7	G	1020	0	613	2	0
8	A	31	0	13	2	0
8	B	31	0	13	2	0
All	All	31683	0	31175	502	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 8.

The worst 5 of 502 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:187:ARG:HE	4:D:235:ASN:HD22	1.30	0.80
5:E:1303:ARG:HG2	5:E:1343:HIS:HE1	1.52	0.73
2:B:962:LEU:H	2:B:965:LEU:HD23	1.53	0.73
1:A:1091:ASN:ND2	5:E:2269:ASP:OD2	2.23	0.71
5:E:2392:CYS:SG	5:E:2434:ASN:ND2	2.63	0.71

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	555/1233 (45%)	516 (93%)	39 (7%)	0	100	100
2	B	685/1217 (56%)	648 (95%)	37 (5%)	0	100	100
3	C	240/631 (38%)	221 (92%)	19 (8%)	0	100	100
4	D	924/1272 (73%)	897 (97%)	26 (3%)	1 (0%)	51	85
5	E	1202/1652 (73%)	1113 (93%)	88 (7%)	1 (0%)	51	85
All	All	3606/6005 (60%)	3395 (94%)	209 (6%)	2 (0%)	54	85

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
4	D	366	LYS
5	E	2607	THR

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	477/1094 (44%)	476 (100%)	1 (0%)	93	96
2	B	618/1092 (57%)	616 (100%)	2 (0%)	92	95
3	C	217/563 (38%)	216 (100%)	1 (0%)	88	93
4	D	842/1135 (74%)	840 (100%)	2 (0%)	93	96
5	E	1121/1497 (75%)	1119 (100%)	2 (0%)	93	96
All	All	3275/5381 (61%)	3267 (100%)	8 (0%)	93	96

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
5	E	2234	LEU
5	E	1251	MET
4	D	361	ARG
3	C	165	MET
4	D	369	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 55 such sidechains are listed below:

Mol	Chain	Res	Type
4	D	790	GLN
5	E	1567	GLN
5	E	2592	GLN
5	E	2315	HIS
4	D	820	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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

2 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	$\# Z > 2$
8	ANP	B	2000	-	29,33,33	1.18	5 (17%)	31,52,52	1.16	2 (6%)
8	ANP	A	2000	-	29,33,33	1.17	5 (17%)	31,52,52	1.17	3 (9%)

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
8	ANP	B	2000	-	-	3/14/38/38	0/3/3/3
8	ANP	A	2000	-	-	4/14/38/38	0/3/3/3

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
8	A	2000	ANP	PG-O1G	3.16	1.51	1.46
8	B	2000	ANP	PG-O1G	2.83	1.50	1.46
8	B	2000	ANP	PB-O1B	2.75	1.50	1.46
8	A	2000	ANP	PB-O1B	2.55	1.50	1.46
8	A	2000	ANP	PB-O2B	-2.29	1.50	1.56

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	A	2000	ANP	O2B-PB-O1B	4.08	118.48	109.92
8	B	2000	ANP	O2B-PB-O1B	3.88	118.06	109.92
8	A	2000	ANP	O2G-PG-O1G	-2.40	107.42	113.45
8	A	2000	ANP	C5-C6-N6	2.31	123.86	120.35
8	B	2000	ANP	C5-C6-N6	2.29	123.83	120.35

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
8	A	2000	ANP	PG-N3B-PB-O1B
8	A	2000	ANP	PG-N3B-PB-O3A
8	B	2000	ANP	PG-N3B-PB-O1B
8	B	2000	ANP	PG-N3B-PB-O3A
8	A	2000	ANP	O4'-C4'-C5'-O5'

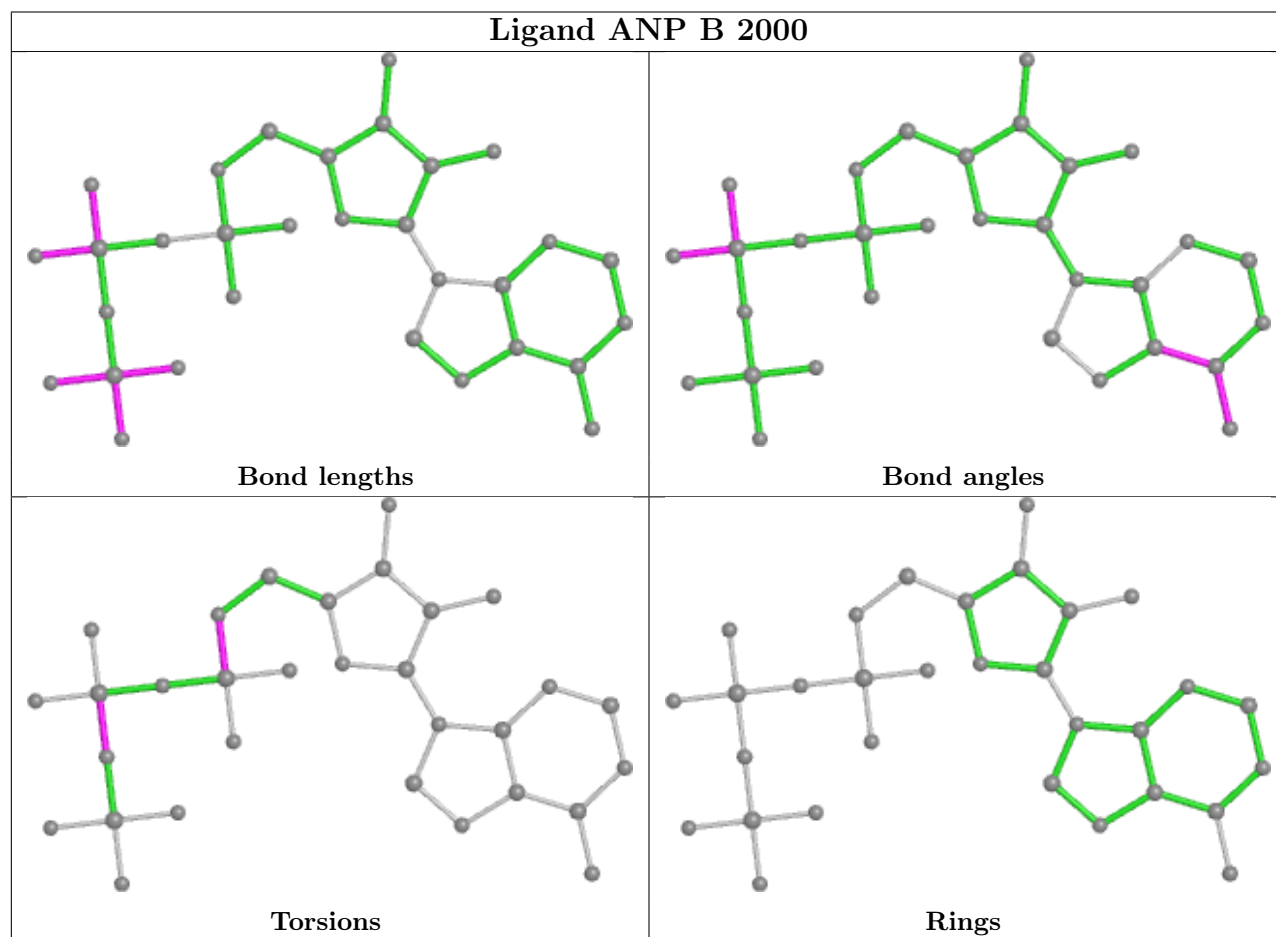
There are no ring outliers.

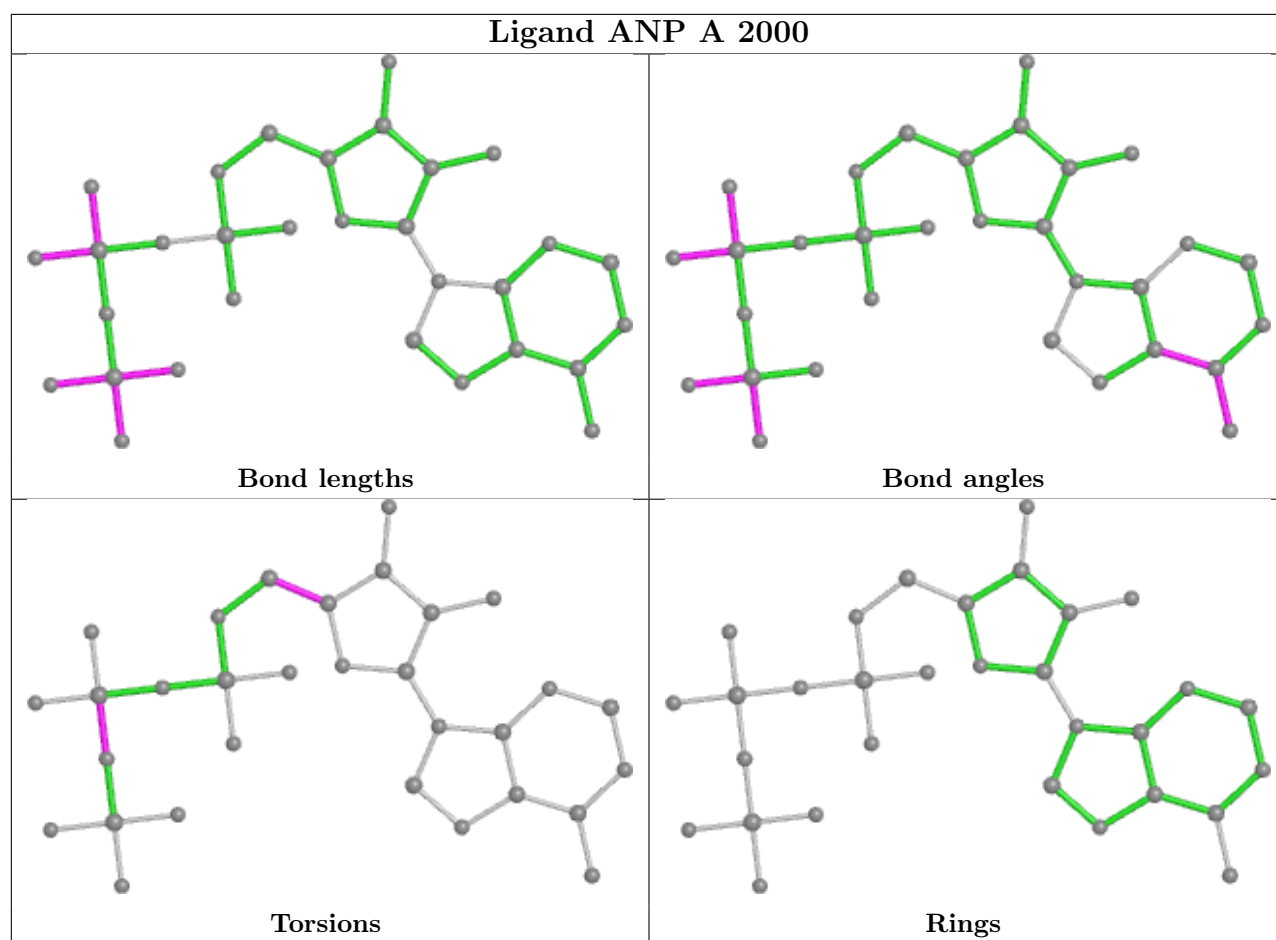
2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
8	B	2000	ANP	2	0
8	A	2000	ANP	2	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.

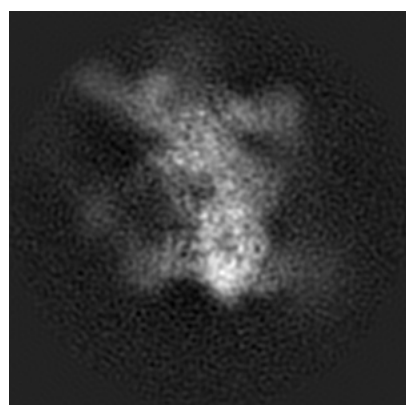
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-21658. These allow visual inspection of the internal detail of the map and identification of artifacts.

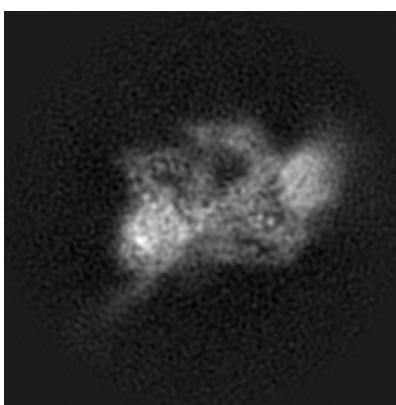
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

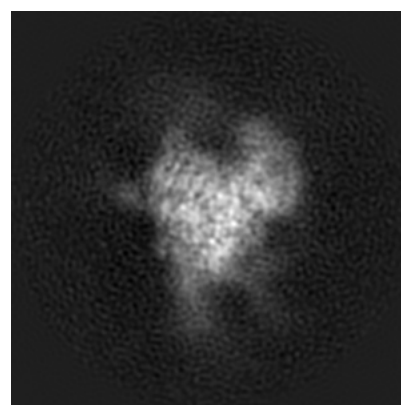
6.1.1 Primary map



X



Y

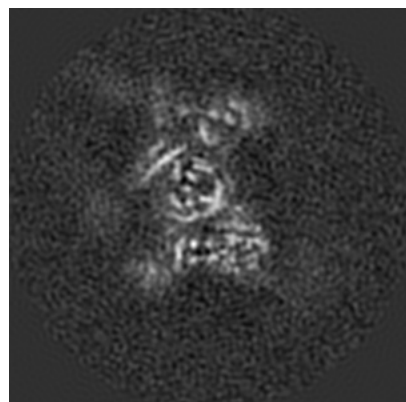


Z

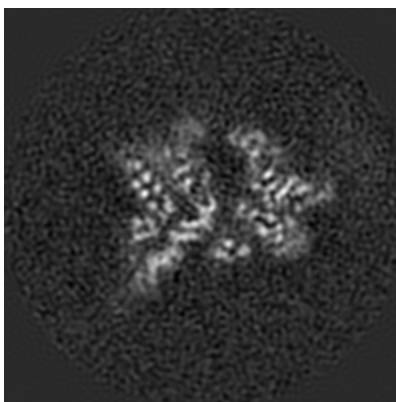
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

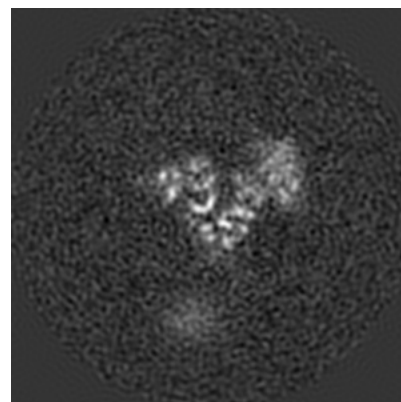
6.2.1 Primary map



X Index: 120



Y Index: 120

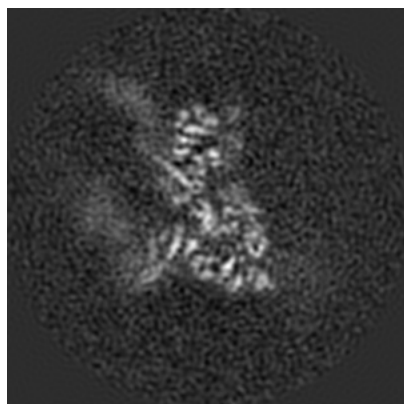


Z Index: 120

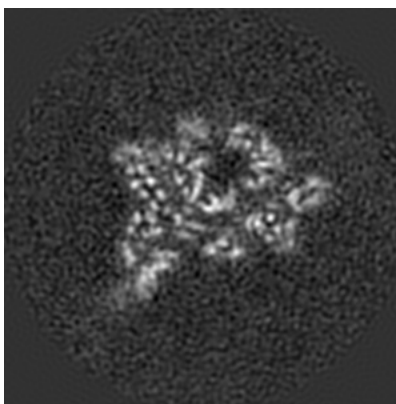
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

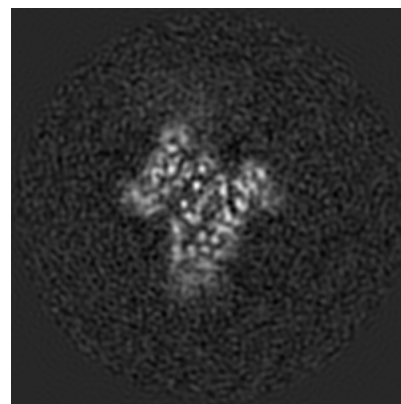
6.3.1 Primary map



X Index: 110



Y Index: 124

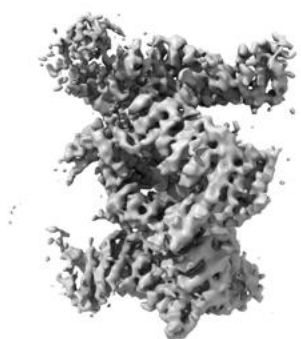


Z Index: 86

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

6.4 Orthogonal surface views [i](#)

6.4.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.02. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

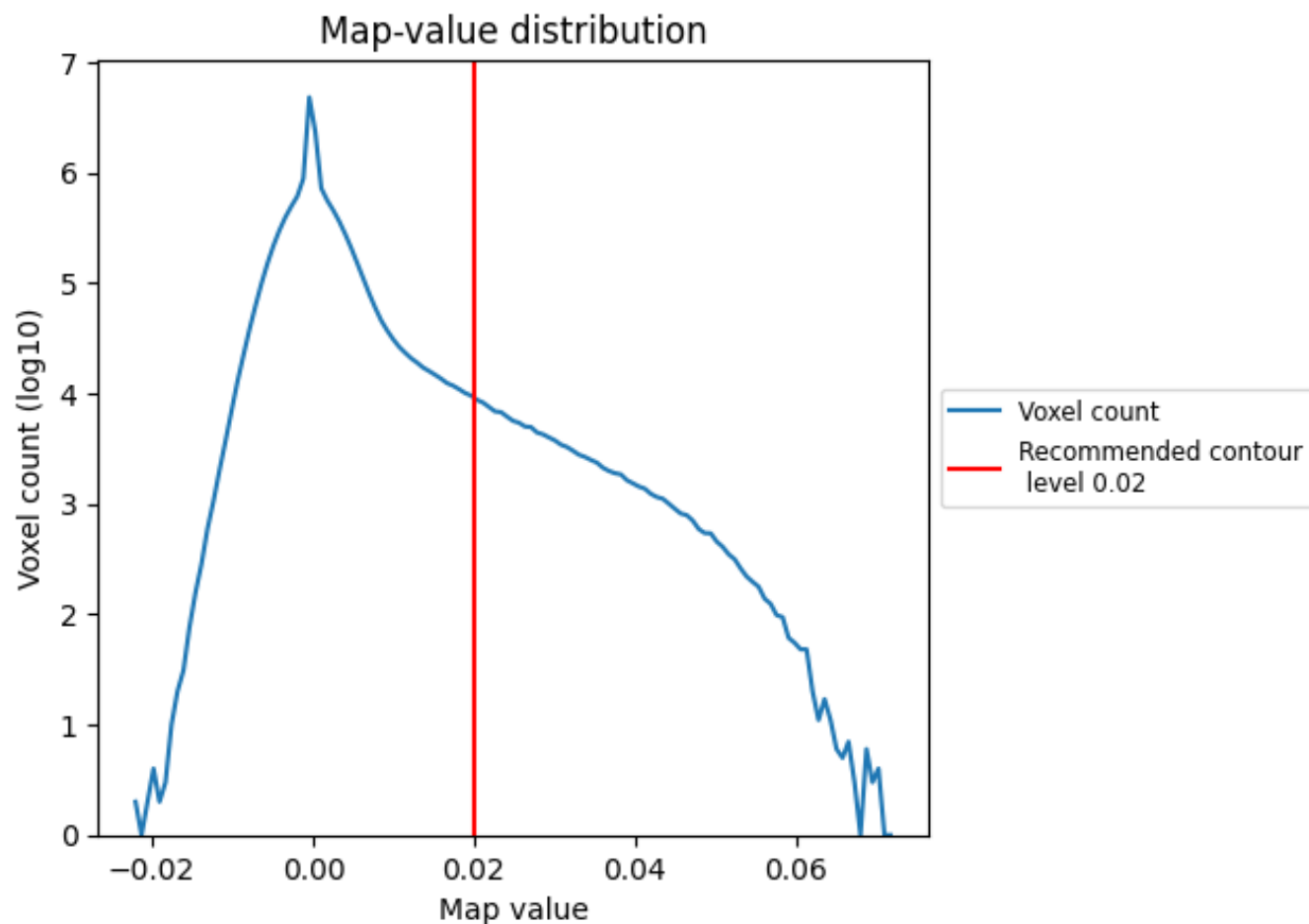
6.5 Mask visualisation

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

7 Map analysis [i](#)

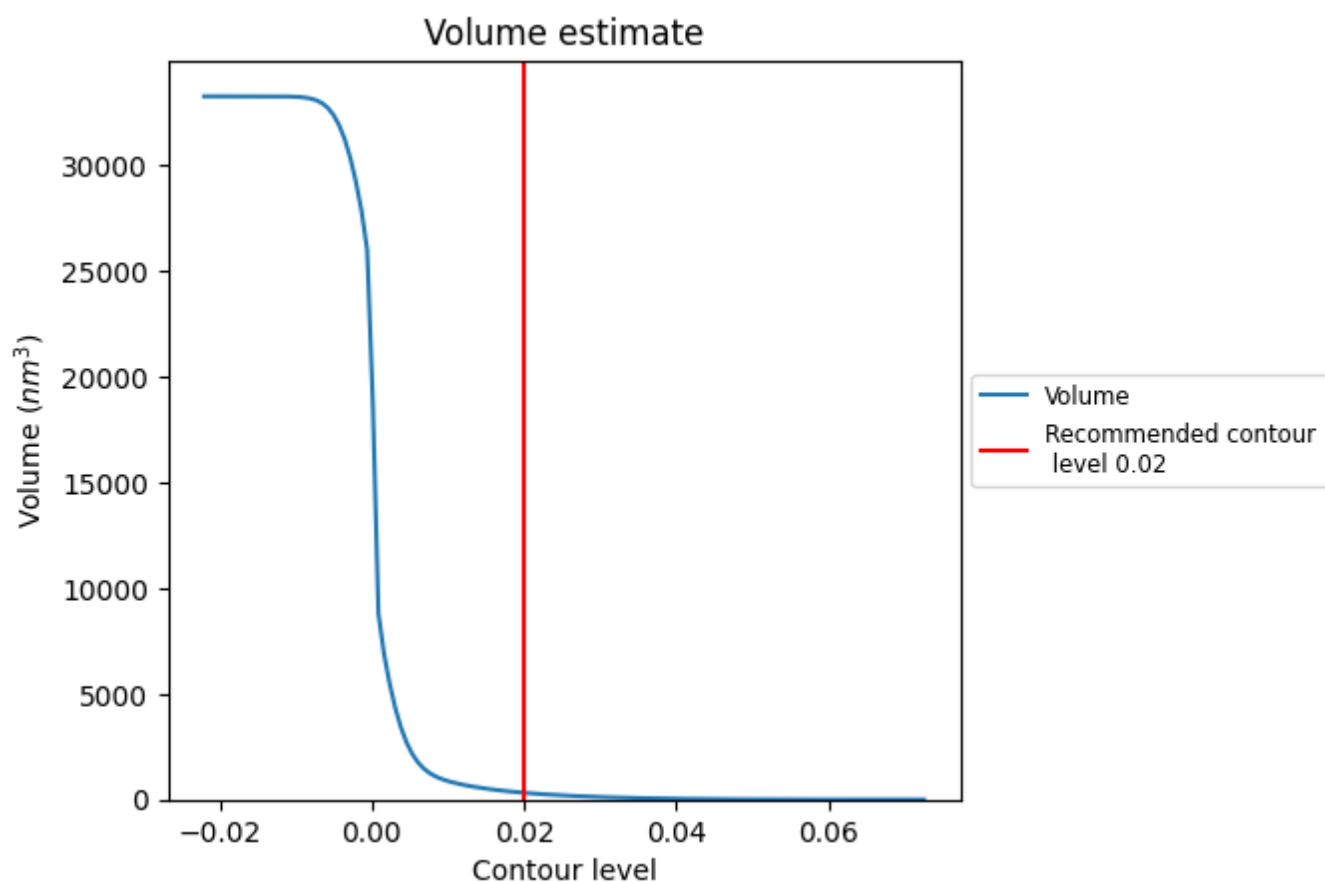
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution [i](#)



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

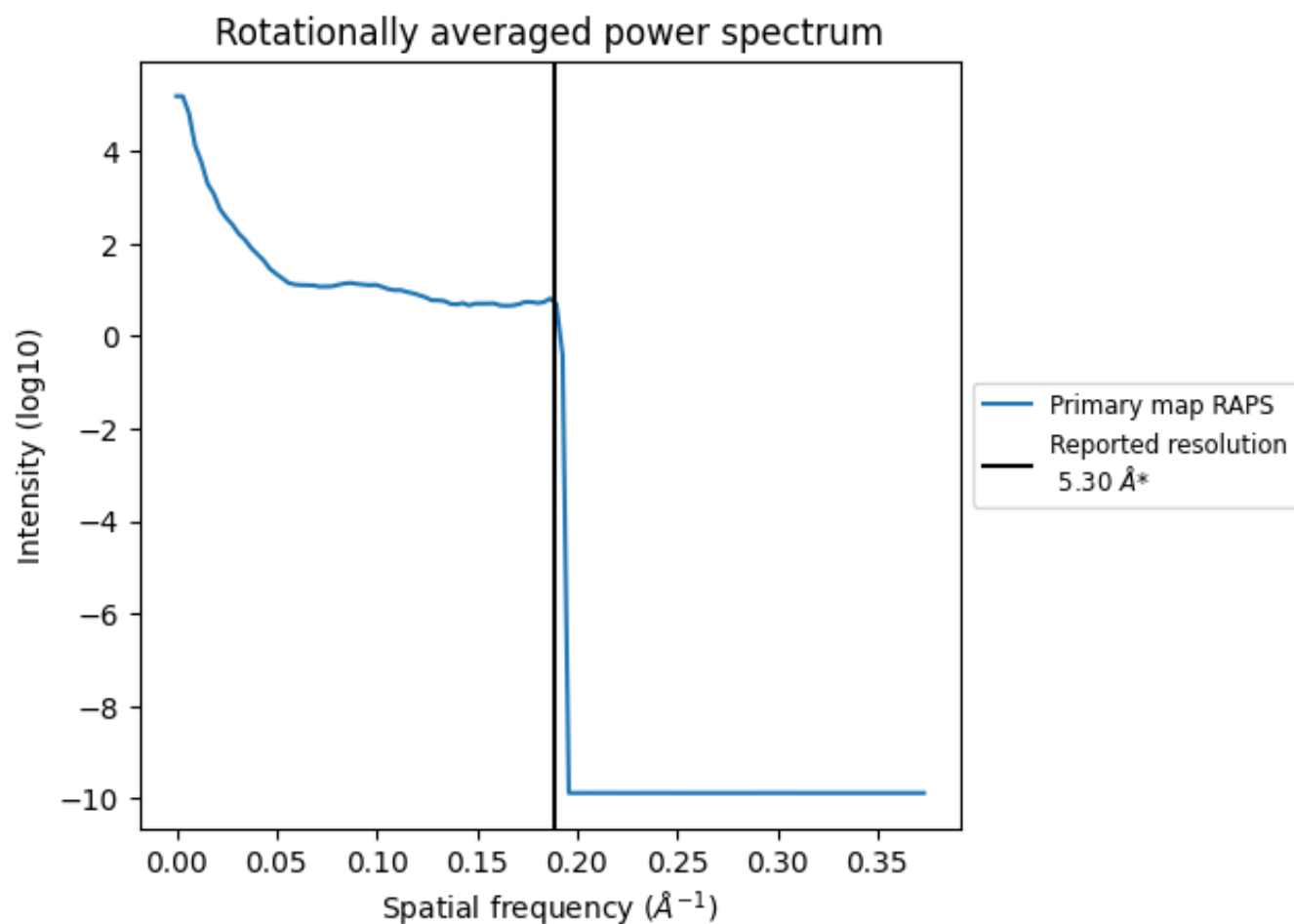
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 320 nm³; this corresponds to an approximate mass of 289 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 ⓘ

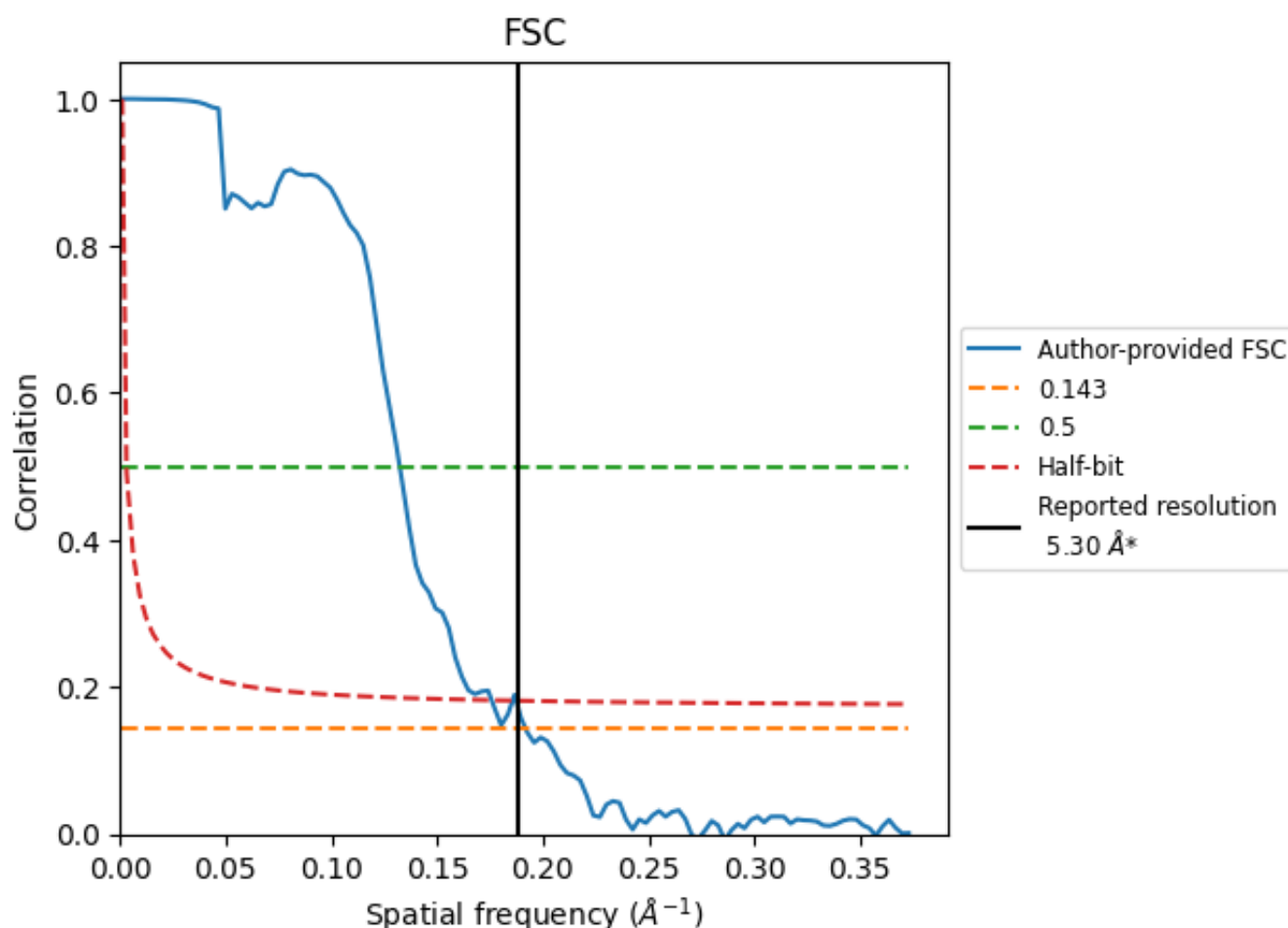


*Reported resolution corresponds to spatial frequency of 0.189 Å⁻¹

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 0.189 Å⁻¹

8.2 Resolution estimates [i](#)

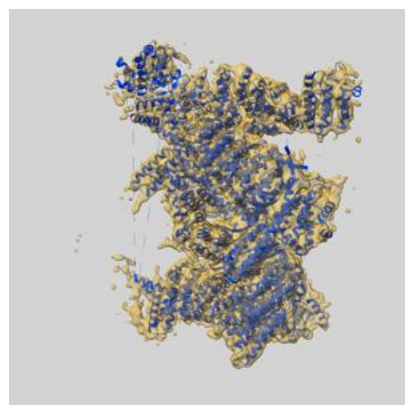
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	5.30	-	-
Author-provided FSC curve	5.21	7.56	5.69
Unmasked-calculated*	-	-	-

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

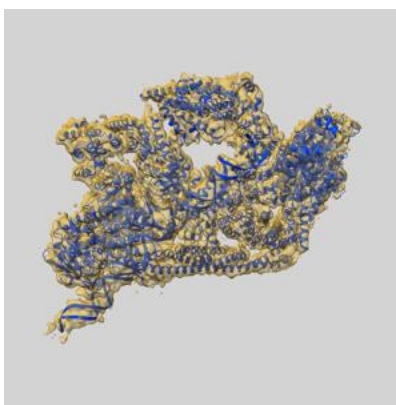
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-21658 and PDB model 6WG3. Per-residue inclusion information can be found in [section 3](#) on [page 6](#).

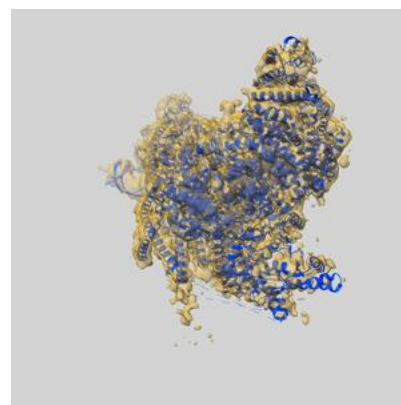
9.1 Map-model overlay [i](#)



X



Y



Z

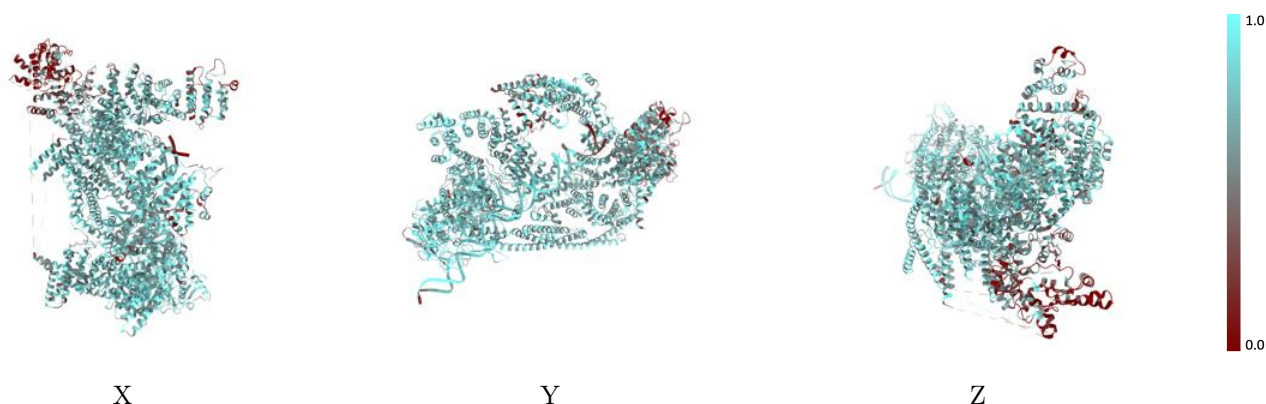
The images above show the 3D surface view of the map at the recommended contour level 0.02 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



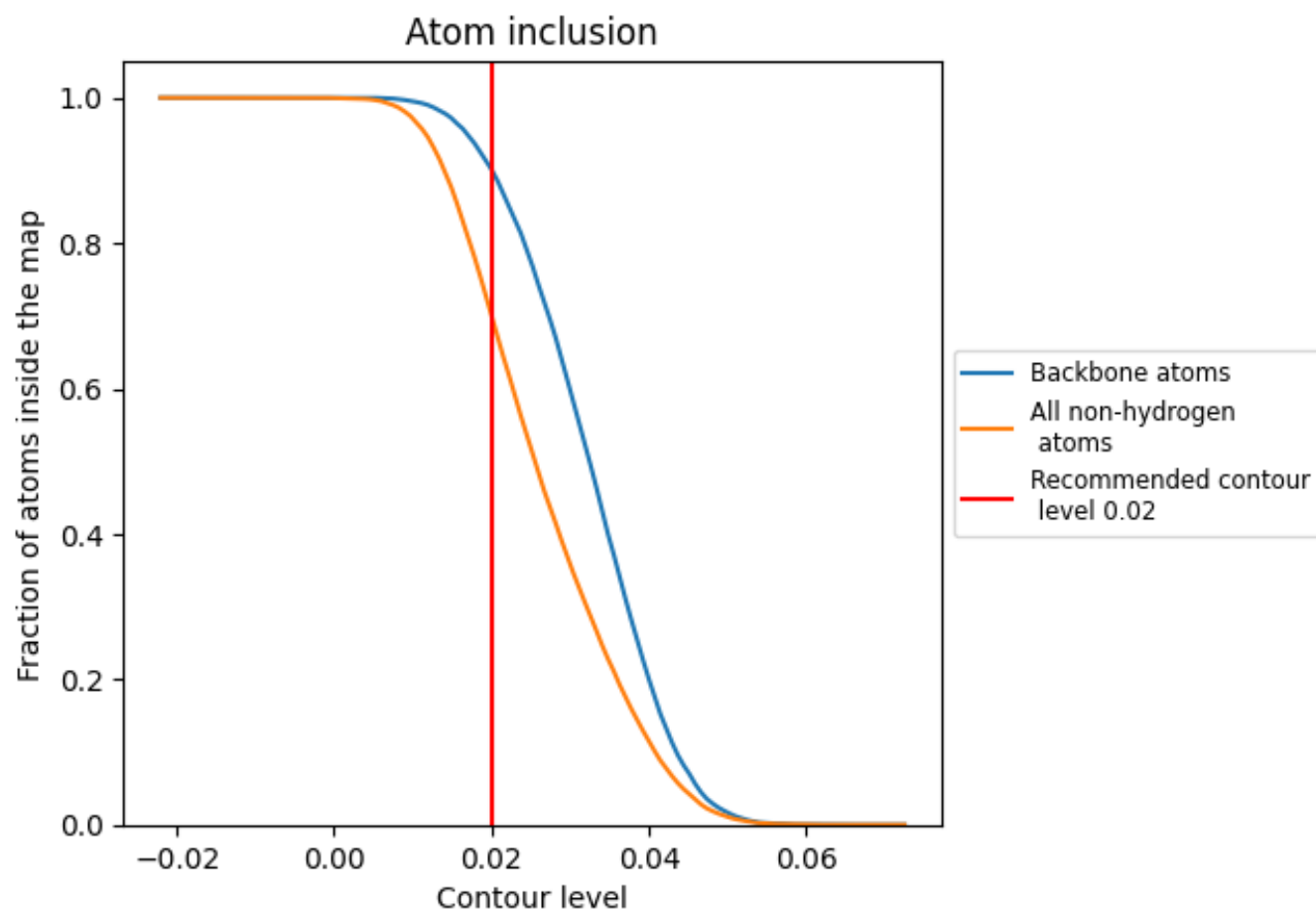
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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

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



The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.02).

9.4 Atom inclusion [i](#)



At the recommended contour level, 90% of all backbone atoms, 70% 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 (0.02) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div><div></div></div> 0.7010	<div><div></div></div> 0.2390
A	<div><div></div></div> 0.6674	<div><div></div></div> 0.2470
B	<div><div></div></div> 0.6107	<div><div></div></div> 0.2320
C	<div><div></div></div> 0.7193	<div><div></div></div> 0.2550
D	<div><div></div></div> 0.6860	<div><div></div></div> 0.2150
E	<div><div></div></div> 0.7484	<div><div></div></div> 0.2510
F	<div><div></div></div> 0.8338	<div><div></div></div> 0.2520
G	<div><div></div></div> 0.8216	<div><div></div></div> 0.2520

1.0

0.0

<0.0