



wwPDB EM Validation Summary Report ⓘ

Nov 23, 2022 – 08:01 AM EST

PDB ID : 7S1X
EMDB ID : EMD-24807
Title : Cryo-EM structure of human NKCC1 K289NA492EL671C bound with bumetanide
Authors : Zhao, Y.X.; Cao, E.H.
Deposited on : 2021-09-02
Resolution : 2.90 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) : 2.31.3

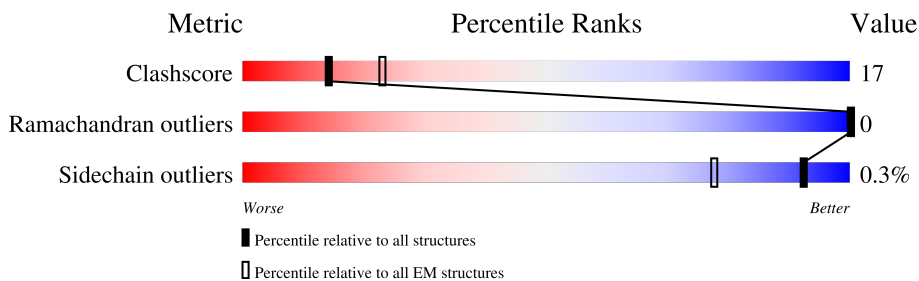
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.90 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	1216	
1	B	1216	

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
4	CL	A	1303	-	-	X	-
4	CL	B	1303	-	-	X	-

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 12658 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.

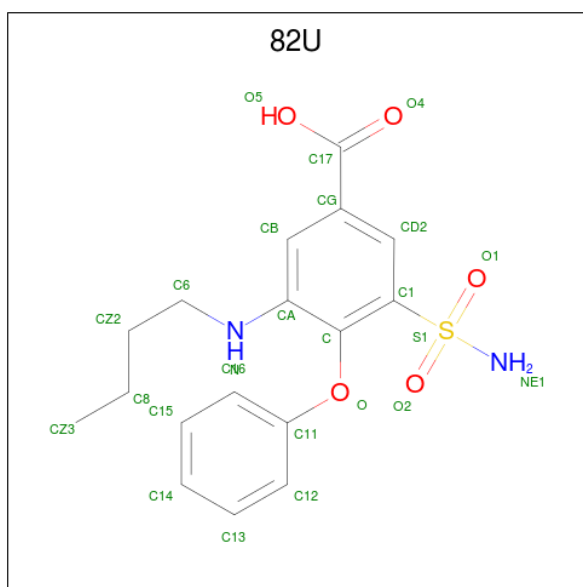
- Molecule 1 is a protein called Solute carrier family 12 member 2.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	B	871	6302	4115	1063	1088	36	0	0
1	A	871	6302	4115	1063	1088	36	0	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-3	GLY	-	expression tag	UNP P55011
B	-2	ALA	-	expression tag	UNP P55011
B	-1	MET	-	expression tag	UNP P55011
B	0	GLY	-	expression tag	UNP P55011
B	1	SER	-	expression tag	UNP P55011
B	289	ASN	LYS	engineered mutation	UNP P55011
B	492	GLU	ALA	engineered mutation	UNP P55011
B	671	CYS	LEU	engineered mutation	UNP P55011
A	-3	GLY	-	expression tag	UNP P55011
A	-2	ALA	-	expression tag	UNP P55011
A	-1	MET	-	expression tag	UNP P55011
A	0	GLY	-	expression tag	UNP P55011
A	1	SER	-	expression tag	UNP P55011
A	289	ASN	LYS	engineered mutation	UNP P55011
A	492	GLU	ALA	engineered mutation	UNP P55011
A	671	CYS	LEU	engineered mutation	UNP P55011

- Molecule 2 is 3-(butylamino)-4-phenoxy-5-sulfamoylbenzoic acid (three-letter code: 82U) (formula: C₁₇H₂₀N₂O₅S) (labeled as "Ligand of Interest" by depositor).



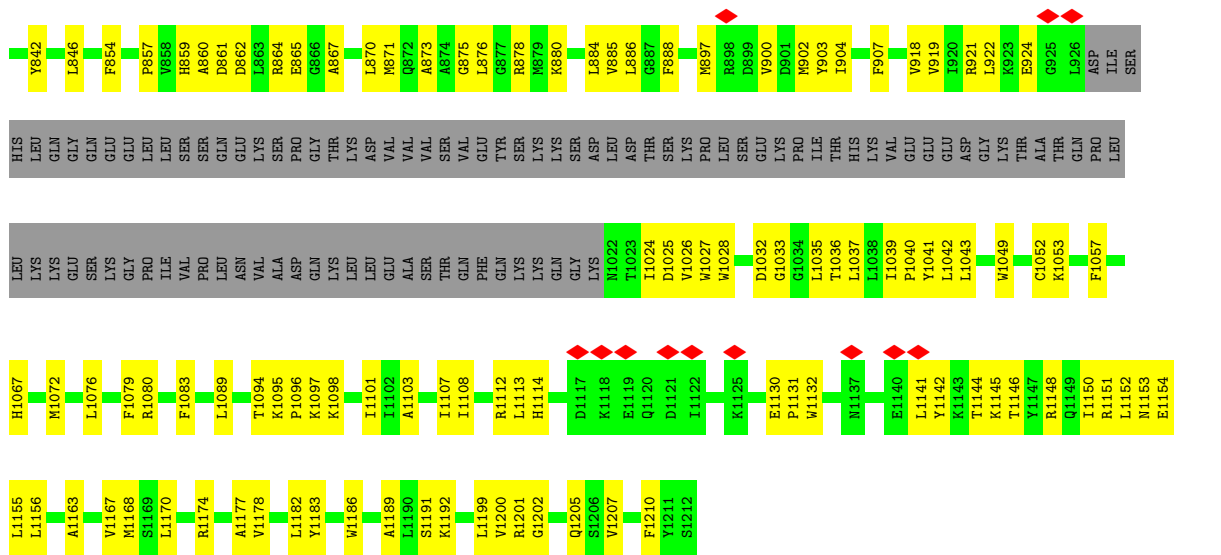
Mol	Chain	Residues	Atoms					AltConf
2	B	1	Total	C	N	O	S	0
			25	17	2	5	1	
2	A	1	Total	C	N	O	S	0
			25	17	2	5	1	

- Molecule 3 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms		AltConf
3	B	1	Total	K	0
			1	1	
3	A	1	Total	K	0
			1	1	

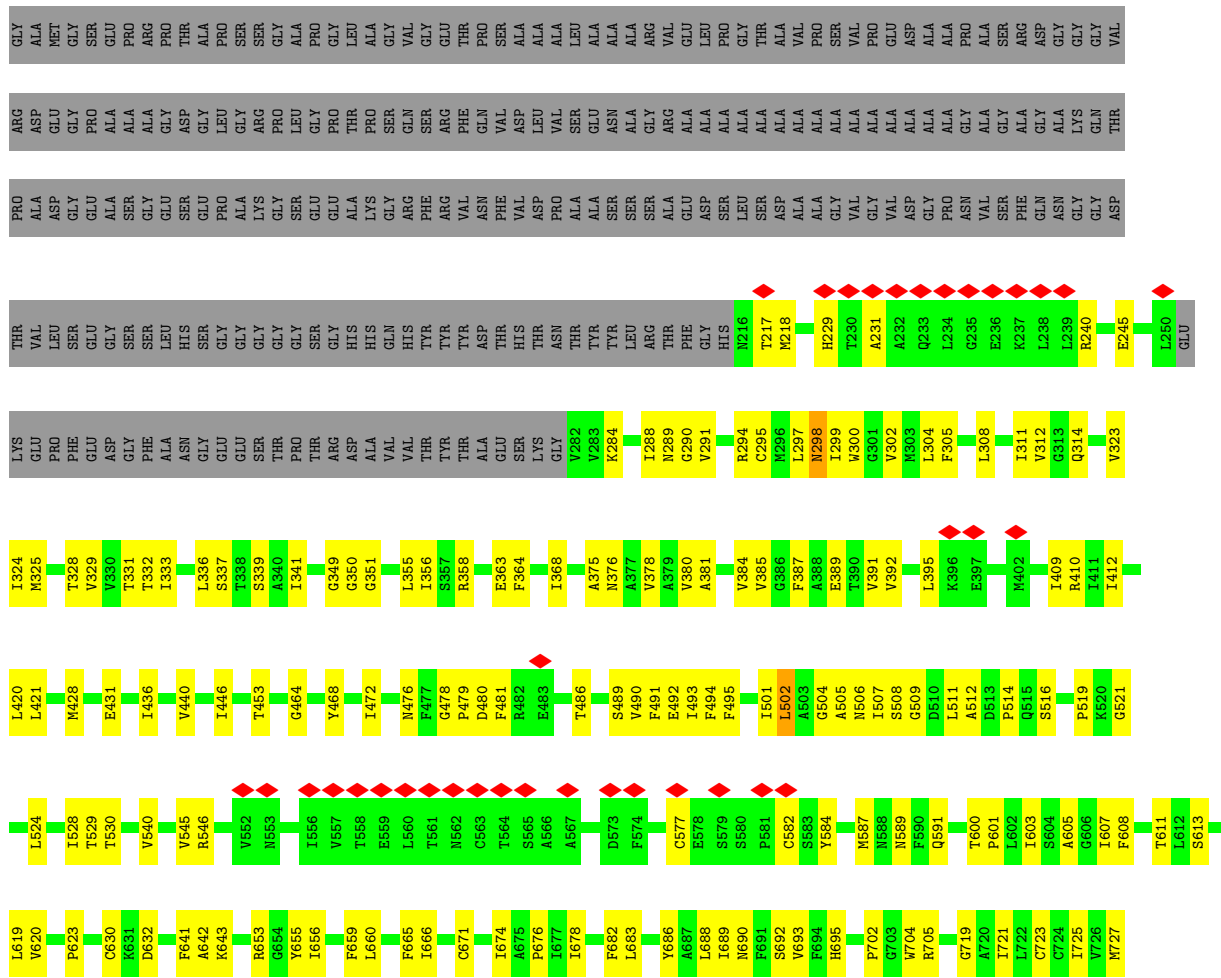
- Molecule 4 is CHLORIDE ION (three-letter code: CL) (formula: Cl) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
4	B	1	Total	Cl	0
			1	1	
4	A	1	Total	Cl	0
			1	1	



• Molecule 1: Solute carrier family 12 member 2

Chain A:



I730	M835	PRO	I1054	R1148
M731	D838	LEU	R1055	Q1149
W732	F1057	LEU	V1056	I1150
W733	F1057	LYS	F1057	R1151
A734	H1067	GLU	H1067	L1152
A735	M1072	SER	M1072	N1153
L736	L1076	LYS	L1076	E1154
L737	F1079	GLY	F1079	L1155
V740	R1080	PRO	R1080	L1156
I741	F1083	VAL	F1083	A1163
Y746	L1089	PRO	L1089	V1167
W758	G1090	LEU	G1090	M1168
G759	D1091	ASN	D1091	S1169
A764	T1094	ALA	T1094	L1170
L765	K1095	ASP	K1095	R1174
L766	P1096	GLN	P1096	A1177
L771	K1097	LYS	K1097	V1178
Q772	K1098	LEU	K1098	L1182
H773	I1101	LEU	I1101	Y1183
S774	I1102	ASP	I1102	W1186
I775	A1103	THR	A1103	A1189
S778	I1107	GLN	I1107	L1190
G779	I1108	GLN	I1108	S1191
V780	R1112	LYS	R1112	K1192
K785	L1113	GLY	L1113	D1193
M786	H1114	LYS	H1114	L1194
F787	D1117	LEU	D1117	L1199
Q790	K1118	LEU	K1118	V1200
C791	E1119	ASP	E1119	R1201
L792	Q1120	THR	Q1120	G1202
V793	D1121	SER	D1121	Q1205
M794	I1122	PRO	I1122	S1206
A797	K1125	LEU	K1125	V1207
S800	E1130	GLU	E1130	F1210
A803	P1131	LYS	P1131	Y1211
L804	W1132	PRO	W1132	S1212
V808	M1137	ILE	M1137	
F811	E1140	THR	E1140	
V918	L1141	THR	L1141	
V919	Y1142	GLU	Y1142	
L817	K1143	GLU	K1143	
L817	T1144	GLY	T1144	
C820	K1145	LYS	K1145	
R828	T1146	THR	T1146	
M832	Y1147	ALA	Y1147	
		GLN		

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	504481	Depositor
Resolution determination method	DIFFRACTION PATTERN/LAYERLINES	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	1.175	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	5.478	Depositor
Minimum map value	-3.239	Depositor
Average map value	0.009	Depositor
Map value standard deviation	0.148	Depositor
Recommended contour level	0.6	Depositor
Map size (\AA)	271.36, 271.36, 271.36	wwPDB
Map dimensions	256, 256, 256	wwPDB
Map angles ($^\circ$)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (\AA)	1.06, 1.06, 1.06	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 82U, CL, K

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	0.31	0/6451	0.51	1/8796 (0.0%)
1	B	0.31	0/6451	0.51	1/8796 (0.0%)
All	All	0.31	0/12902	0.51	2/17592 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	502	LEU	CA-CB-CG	5.12	127.08	115.30
1	A	502	LEU	CA-CB-CG	5.11	127.05	115.30

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	6302	0	6014	228	0
1	B	6302	0	6014	225	0
2	A	25	0	0	0	0
2	B	25	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	1	0	0	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	1	0	0	2	0
All	All	12658	0	12028	429	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 17.

The worst 5 of 429 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:686:TYR:OH	4:B:1303:CL:CL	2.06	1.10
1:A:686:TYR:OH	4:A:1303:CL:CL	2.06	1.07
1:B:1079:PHE:O	1:A:705:ARG:NH1	2.05	0.88
1:B:705:ARG:NH1	1:A:1079:PHE:O	2.05	0.88
1:B:476:ASN:HA	1:B:546:ARG:HH12	1.42	0.83

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	865/1216 (71%)	779 (90%)	86 (10%)	0	100	100
1	B	865/1216 (71%)	780 (90%)	85 (10%)	0	100	100
All	All	1730/2432 (71%)	1559 (90%)	171 (10%)	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	592/985 (60%)	590 (100%)	2 (0%)	92	98
1	B	592/985 (60%)	590 (100%)	2 (0%)	92	98
All	All	1184/1970 (60%)	1180 (100%)	4 (0%)	92	98

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	298	ASN
1	B	1067	HIS
1	A	298	ASN
1	A	1067	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	731	ASN
1	B	773	HIS
1	B	1153	ASN
1	A	731	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

Of 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 for Mogul analysis.

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	82U	B	1301	3	26,26,26	1.48	5 (19%)	32,36,36	1.31	1 (3%)
2	82U	A	1301	3	26,26,26	1.48	5 (19%)	32,36,36	1.31	1 (3%)

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	82U	B	1301	3	-	1/19/19/19	0/2/2/2
2	82U	A	1301	3	-	1/19/19/19	0/2/2/2

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1301	82U	S1-NE1	5.32	1.70	1.60
2	A	1301	82U	S1-NE1	5.28	1.70	1.60
2	A	1301	82U	CA-N	2.64	1.44	1.37
2	B	1301	82U	CA-N	2.61	1.44	1.37
2	B	1301	82U	O4-C17	2.39	1.29	1.22

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1301	82U	O2-S1-O1	-5.79	109.25	118.76
2	B	1301	82U	O2-S1-O1	-5.78	109.25	118.76

There are no chirality outliers.

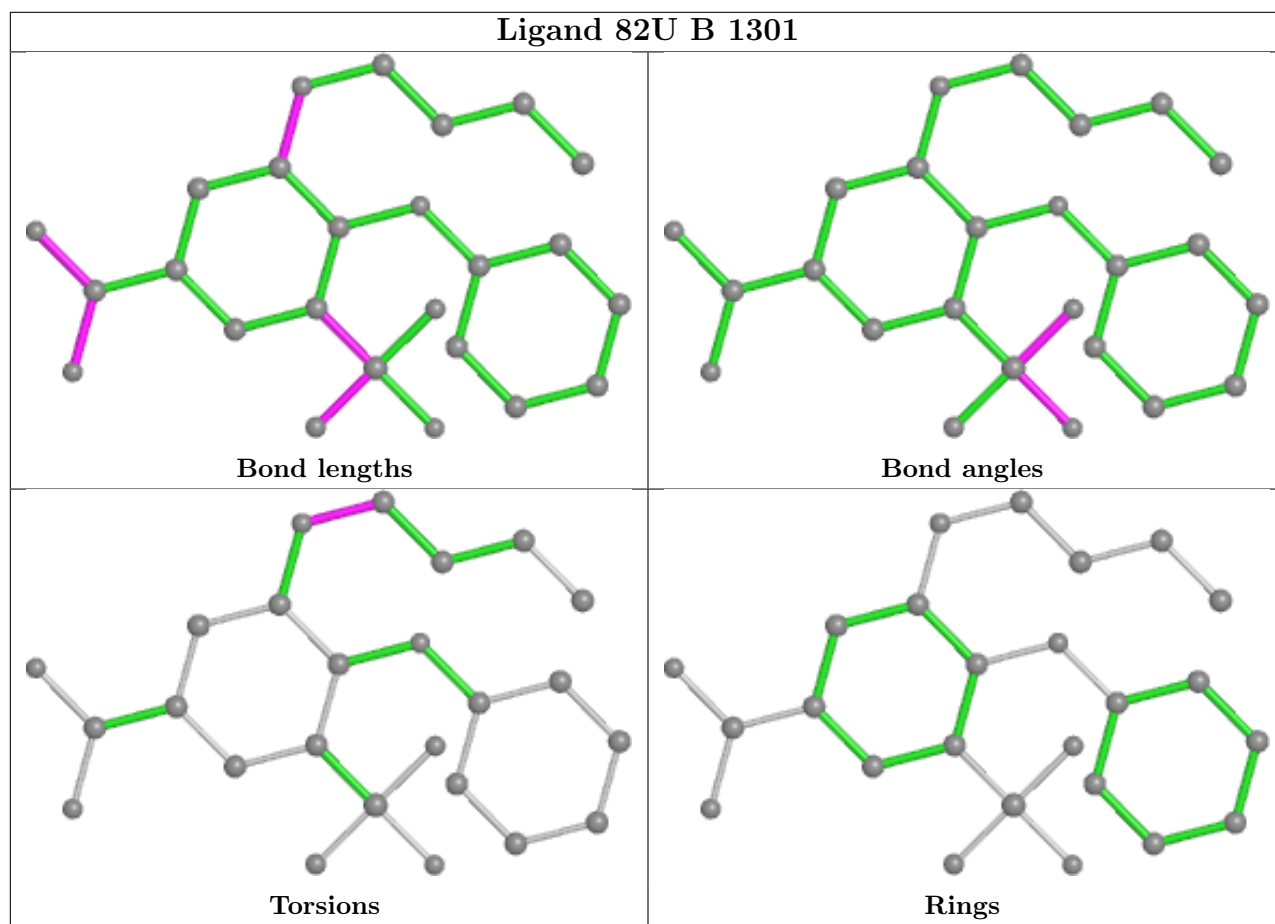
All (2) torsion outliers are listed below:

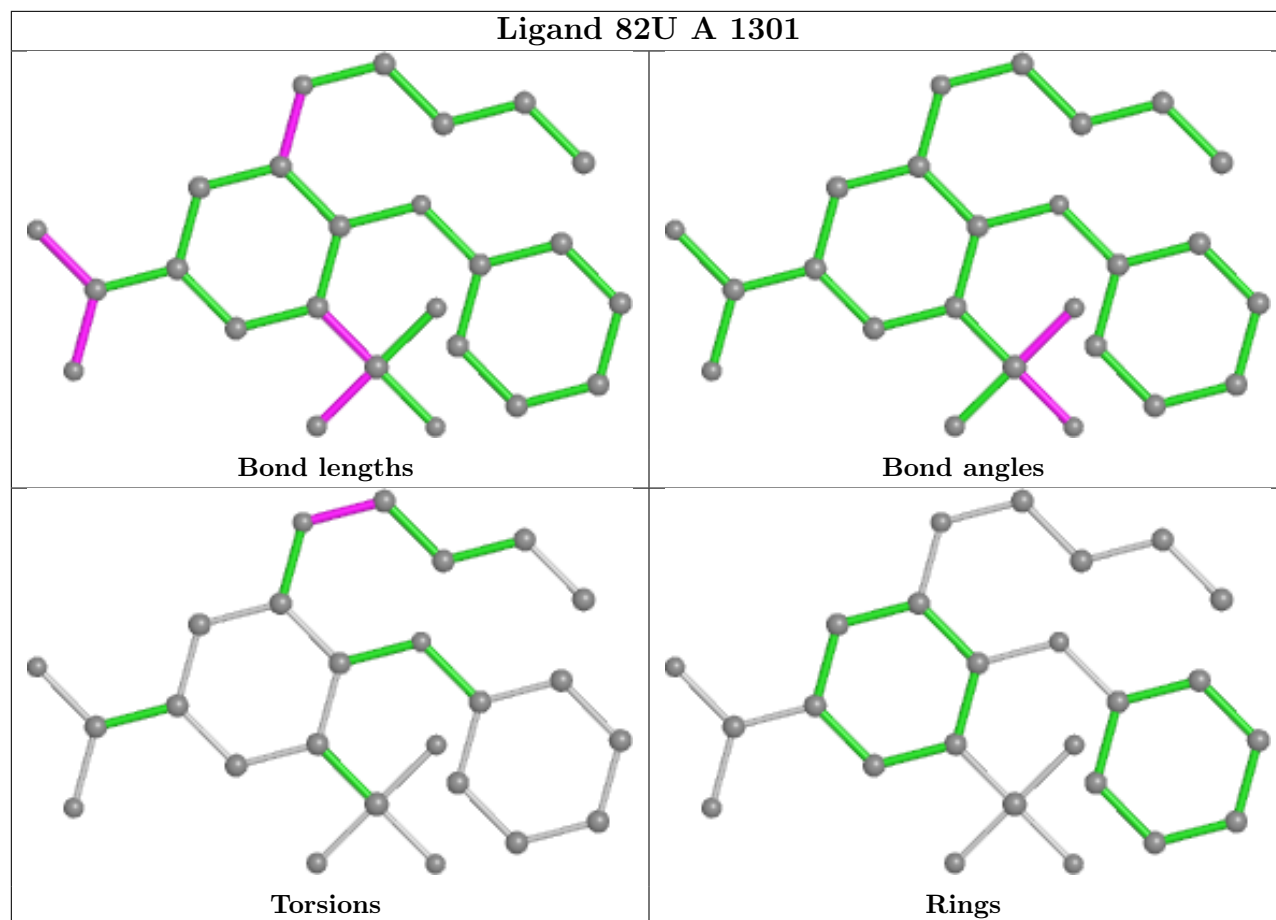
Mol	Chain	Res	Type	Atoms
2	B	1301	82U	CZ2-C6-N-CA
2	A	1301	82U	CZ2-C6-N-CA

There are no ring outliers.

No monomer is involved in short contacts.

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.

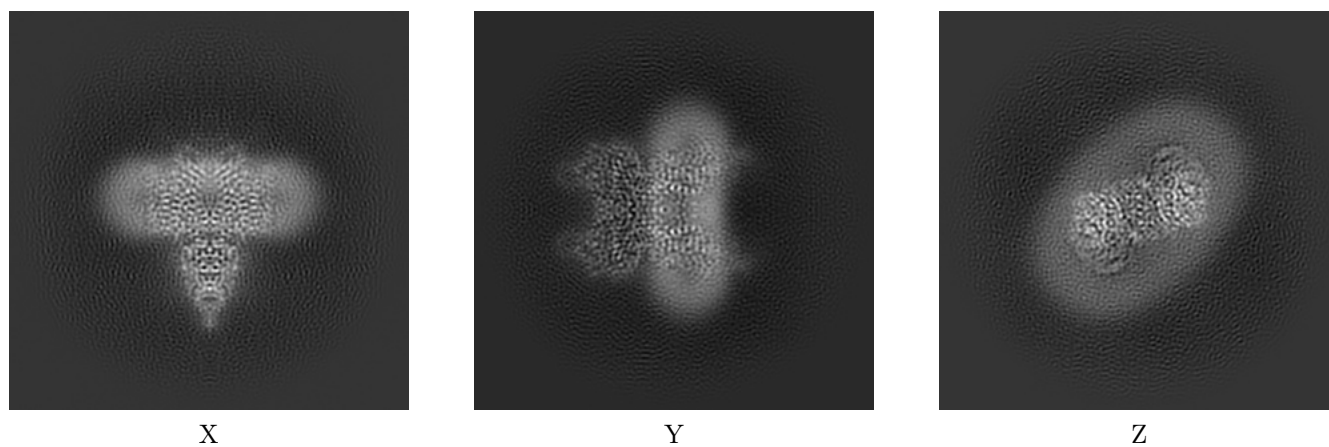
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-24807. 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](#)

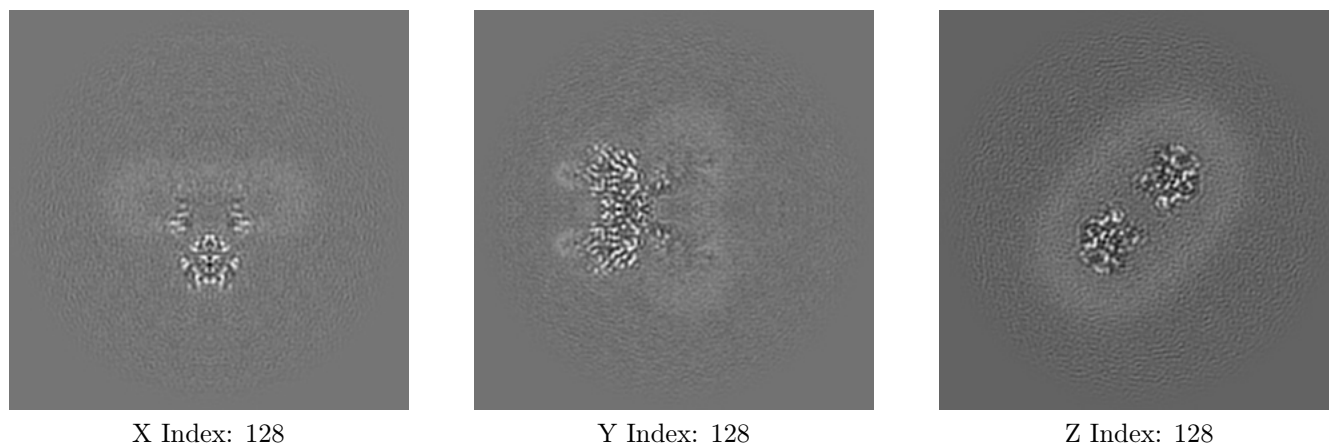
6.1.1 Primary map



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

6.2 Central slices [i](#)

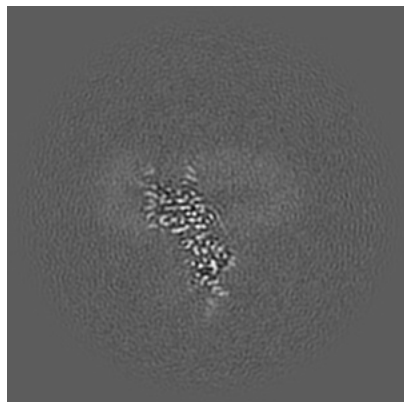
6.2.1 Primary map



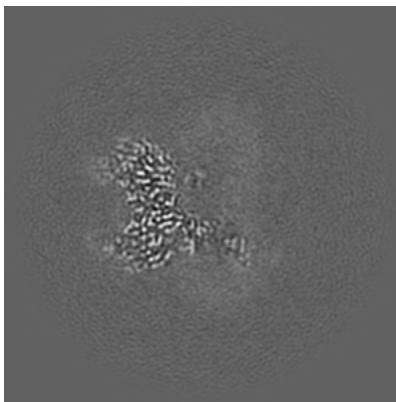
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

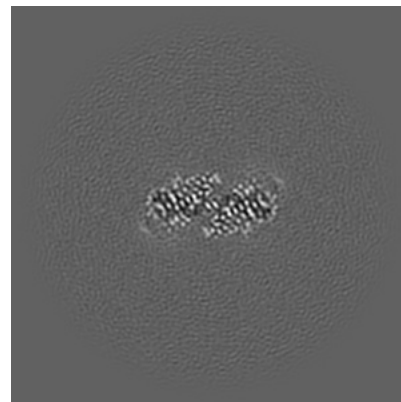
6.3.1 Primary map



X Index: 113



Y Index: 124



Z Index: 91

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

6.4 Orthogonal surface views [i](#)

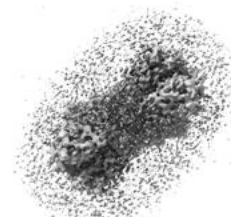
6.4.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.6. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

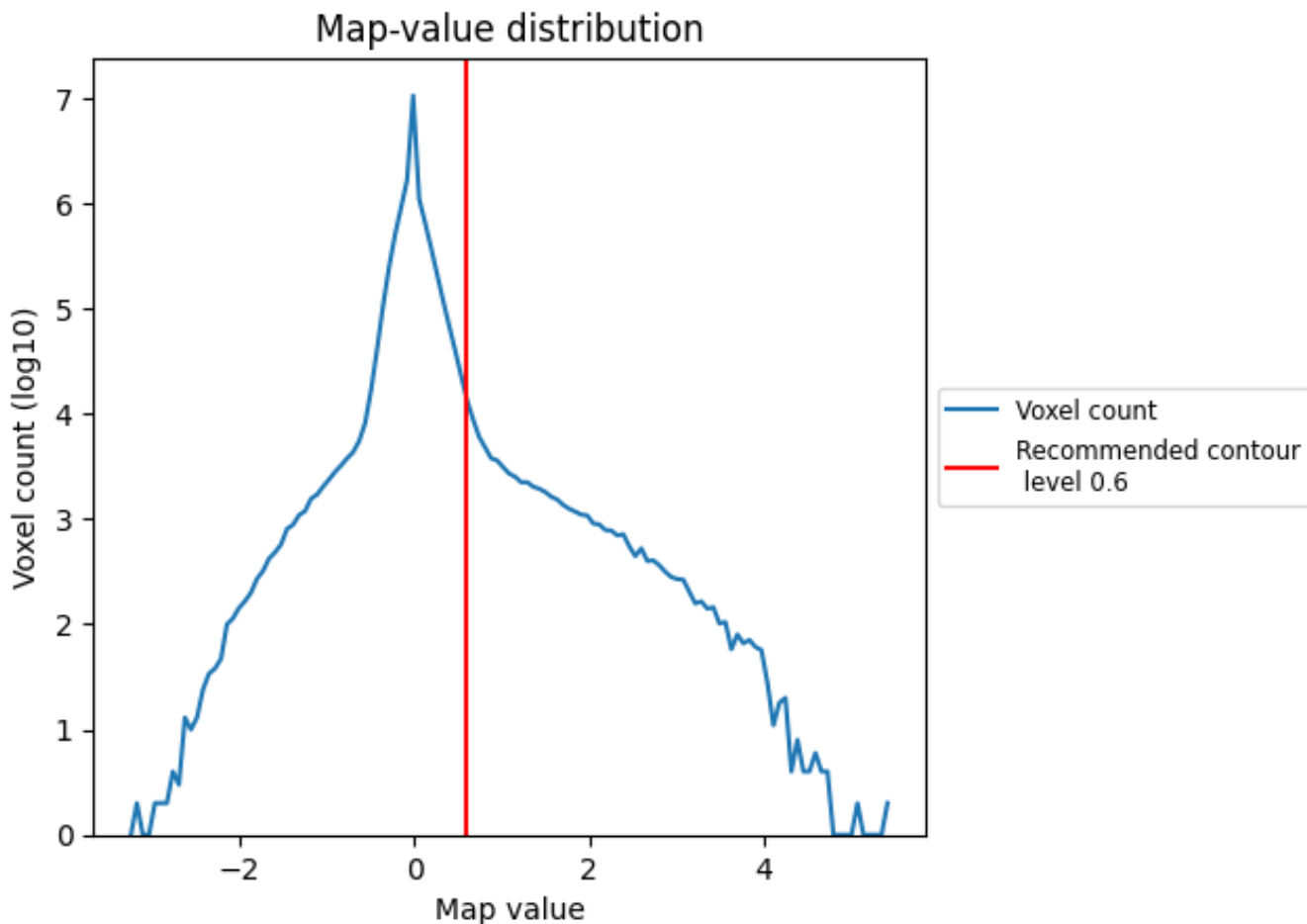
6.5 Mask visualisation

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

7 Map analysis [i](#)

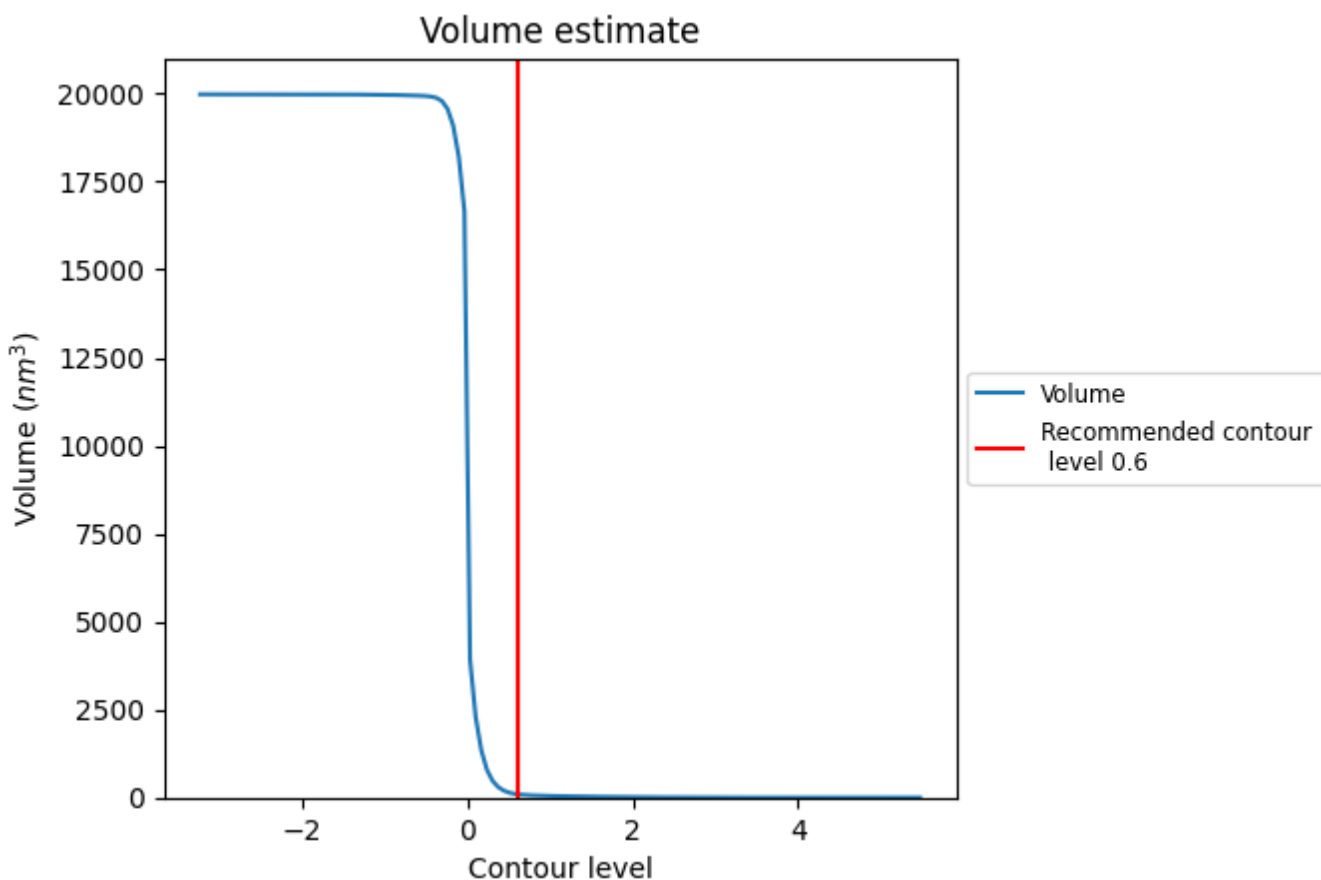
This section contains the results of statistical analysis of the map.

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.

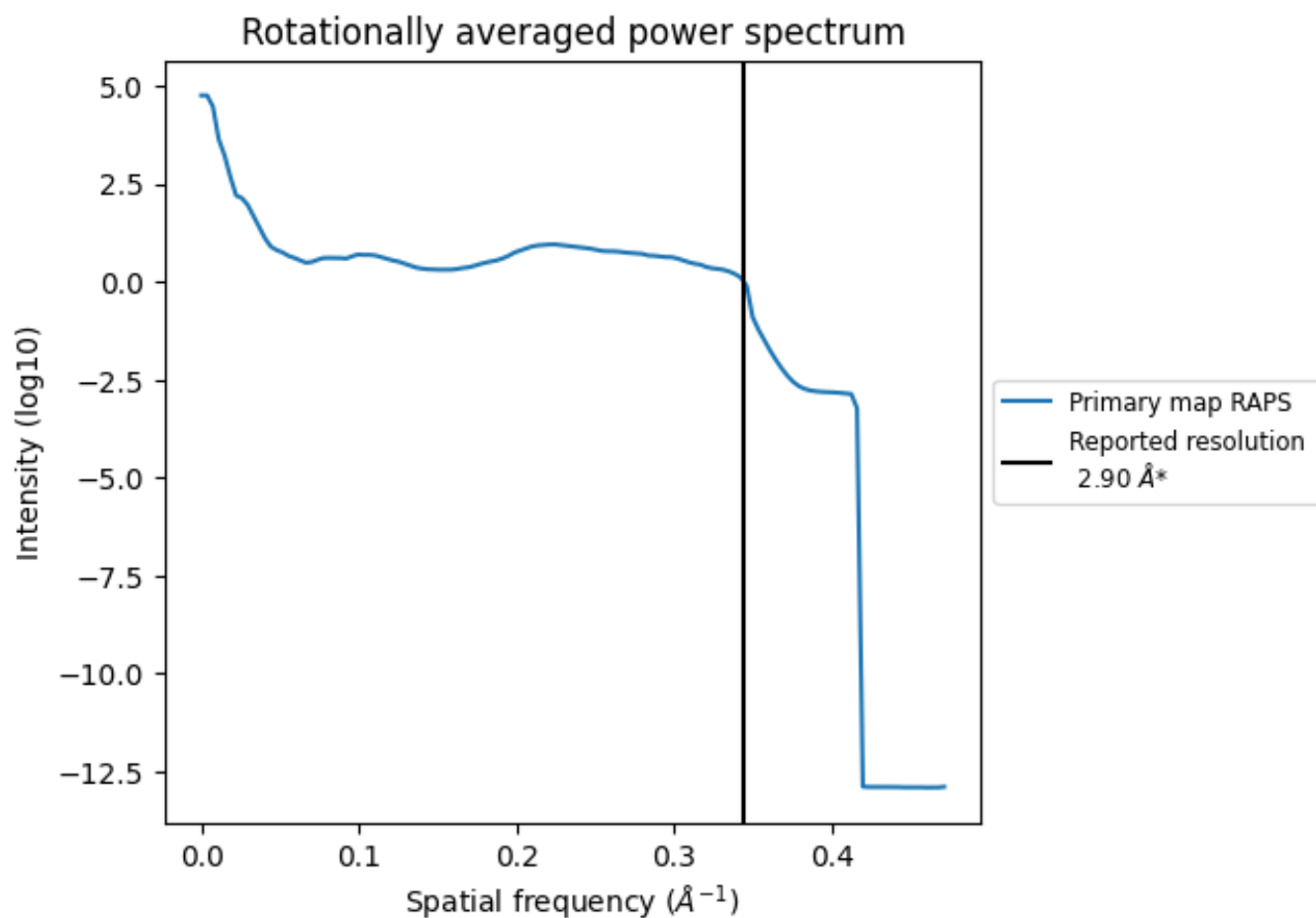
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 96 nm³; this corresponds to an approximate mass of 87 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 0.345 Å⁻¹

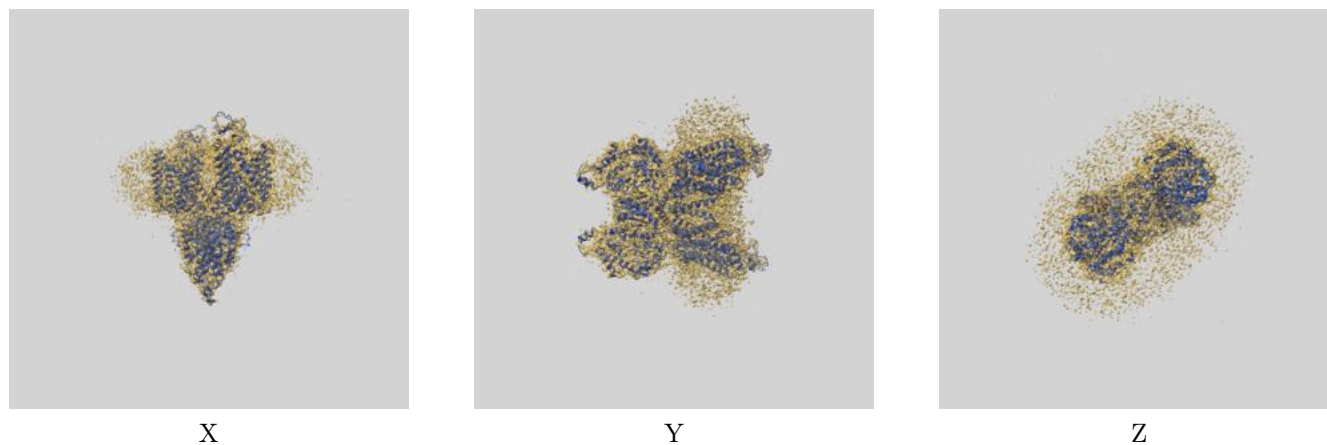
8 Fourier-Shell correlation

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

9 Map-model fit [i](#)

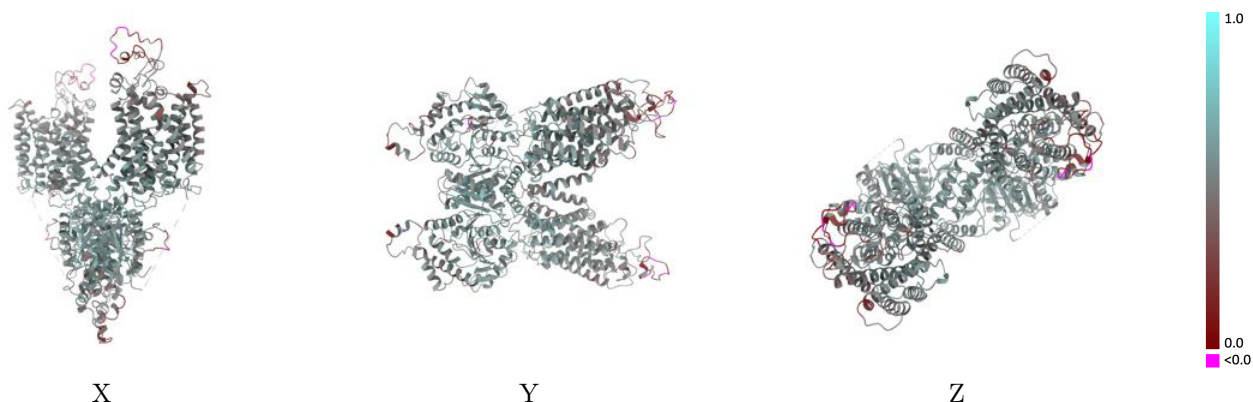
This section contains information regarding the fit between EMDB map EMD-24807 and PDB model 7S1X. Per-residue inclusion information can be found in section [3](#) on page [5](#).

9.1 Map-model overlay [i](#)



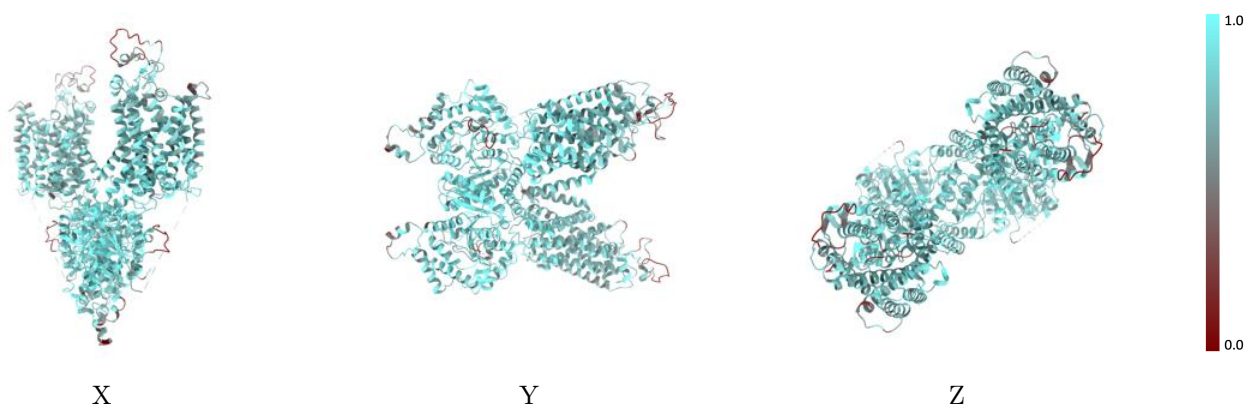
The images above show the 3D surface view of the map at the recommended contour level 0.6 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



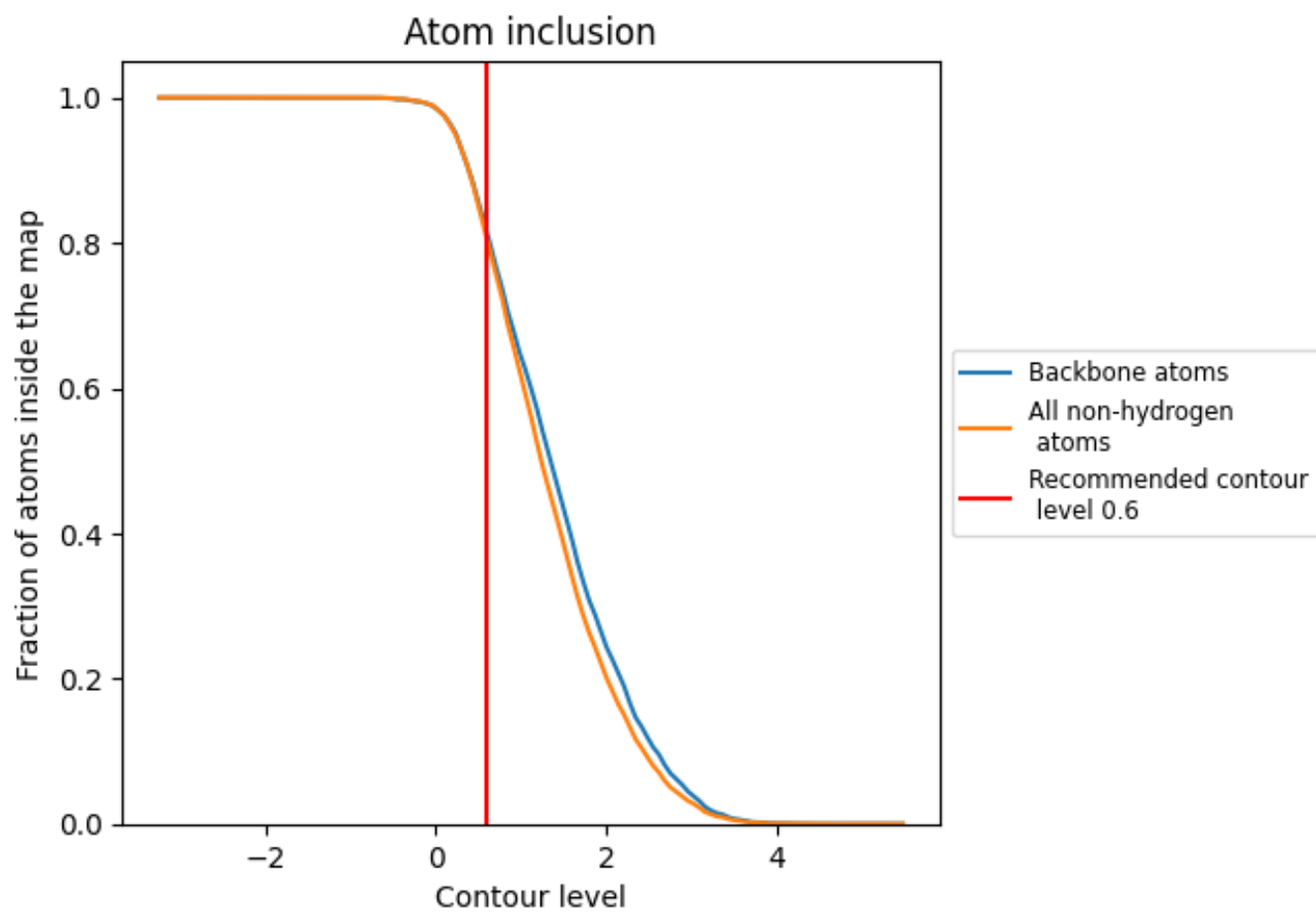
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.6).







9.4 Atom inclusion [i](#)



At the recommended contour level, 81% of all backbone atoms, 81% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary [i](#)

The table lists the average atom inclusion at the recommended contour level (0.6) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8059	 0.5150
A	 0.8061	 0.5150
B	 0.8056	 0.5150

