



wwPDB EM Validation Summary Report ⓘ

Apr 5, 2026 – 11:20 PM UTC

PDB ID : 10FO / pdb_000010fo
EMDB ID : EMD-75138
Title : SK5B-Germline in complex with GluN1-GluN2B, full refinement
Authors : Kleeman, S.O.; Furukawa, H.F.
Deposited on : 2026-01-16
Resolution : 4.46 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:

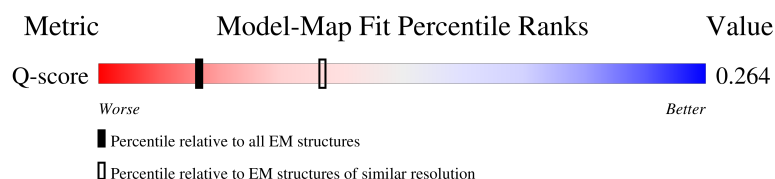
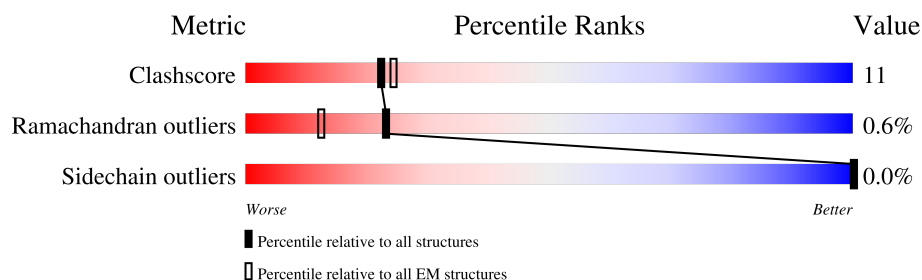
EMDB validation analysis : 0.0.1.dev132
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & 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 4.46 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	3001 (3.96 - 4.96)

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	844	
1	C	844	
2	B	826	
2	D	826	

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Mol	Chain	Length	Quality of chain
3	E	111	100%
			<div><div></div><div></div><div></div></div> 60%39%.•
4	F	121	100%
			<div><div></div><div></div><div></div></div> 59%40%.•

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 24462 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 Glutamate receptor ionotropic, NMDA 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	800	Total	C	N	O	S	0	0
			5940	3808	1025	1079	28		
1	C	800	Total	C	N	O	S	0	0
			5752	3676	1000	1048	28		

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	5	HIS	ARG	conflict	UNP Q05586
A	9	PHE	LEU	conflict	UNP Q05586
A	17	PHE	VAL	conflict	UNP Q05586
A	22	SER	CYS	conflict	UNP Q05586
A	212	ARG	LYS	conflict	UNP Q05586
A	267	ILE	LEU	conflict	UNP Q05586
A	556	ASN	GLN	conflict	UNP Q05586
A	819	ILE	LEU	conflict	UNP Q05586
A	839	SER	-	expression tag	UNP Q05586
A	840	ARG	-	expression tag	UNP Q05586
A	841	ALA	-	expression tag	UNP Q05586
C	5	HIS	ARG	conflict	UNP Q05586
C	9	PHE	LEU	conflict	UNP Q05586
C	17	PHE	VAL	conflict	UNP Q05586
C	22	SER	CYS	conflict	UNP Q05586
C	212	ARG	LYS	conflict	UNP Q05586
C	267	ILE	LEU	conflict	UNP Q05586
C	556	ASN	GLN	conflict	UNP Q05586
C	819	ILE	LEU	conflict	UNP Q05586
C	839	SER	-	expression tag	UNP Q05586
C	840	ARG	-	expression tag	UNP Q05586
C	841	ALA	-	expression tag	UNP Q05586

- Molecule 2 is a protein called Glutamate receptor ionotropic, NMDA 2B.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	752	Total 5565	C 3572	N 922	O 1037	S 34	0	0
2	D	749	Total 5428	C 3480	N 896	O 1022	S 30	0	0

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	271	SER	ALA	conflict	UNP Q13224
B	437	GLU	GLN	conflict	UNP Q13224
B	588	SER	CYS	conflict	UNP Q13224
B	838	SER	CYS	conflict	UNP Q13224
B	849	SER	CYS	conflict	UNP Q13224
D	271	SER	ALA	conflict	UNP Q13224
D	437	GLU	GLN	conflict	UNP Q13224
D	588	SER	CYS	conflict	UNP Q13224
D	838	SER	CYS	conflict	UNP Q13224
D	849	SER	CYS	conflict	UNP Q13224

- Molecule 3 is a protein called Light chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	E	111	Total 848	C 531	N 141	O 173	S 3	0	0

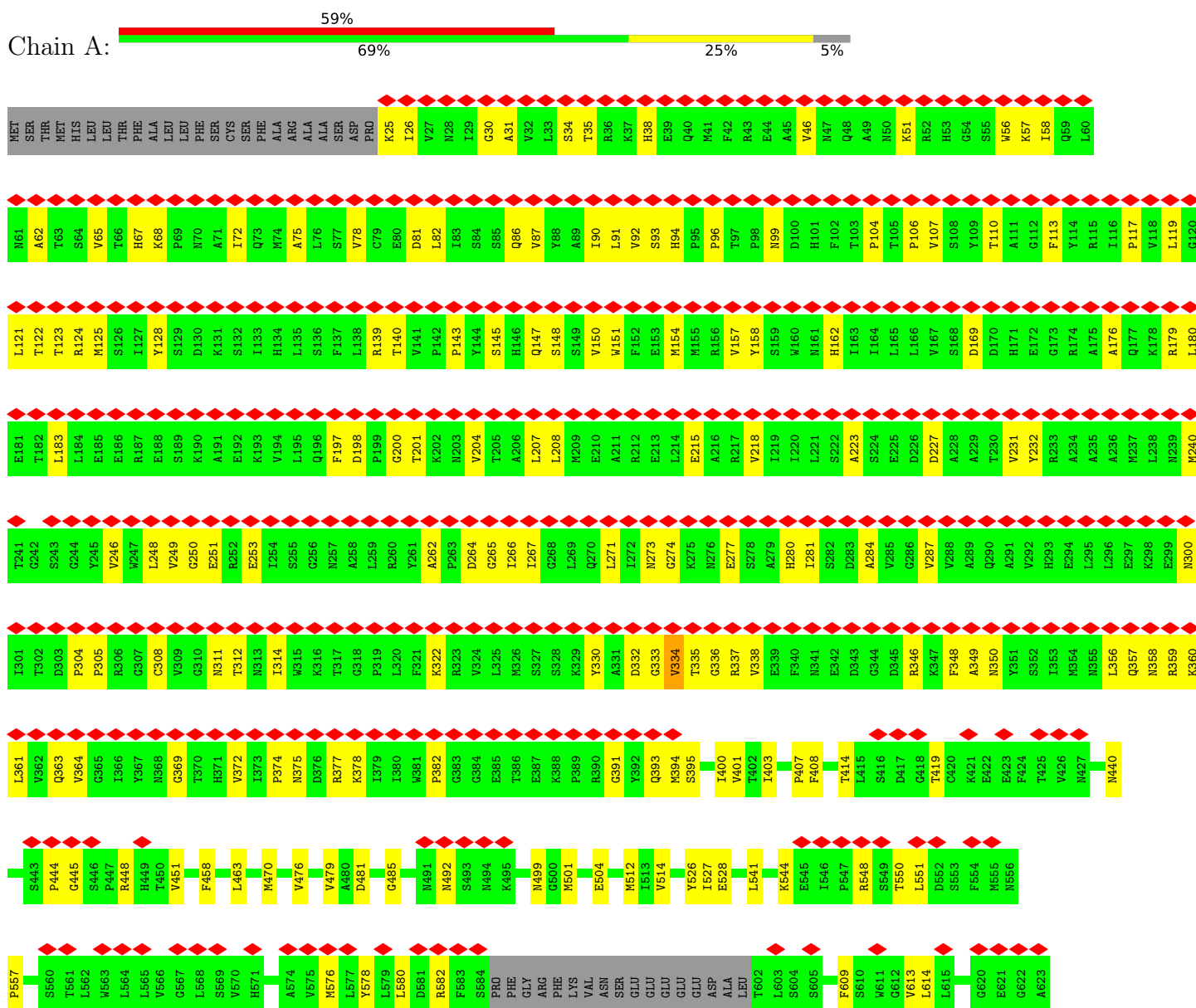
- Molecule 4 is a protein called Heavy chain.

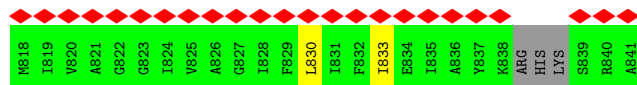
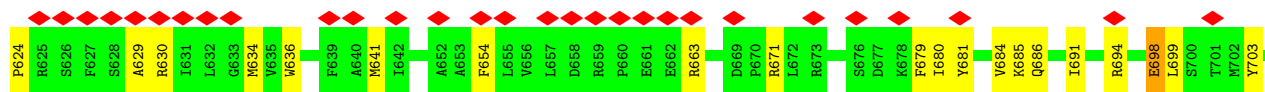
Mol	Chain	Residues	Atoms					AltConf	Trace
4	F	121	Total 929	C 583	N 152	O 190	S 4	0	0

3 Residue-property plots

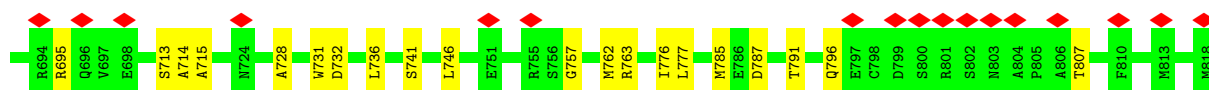
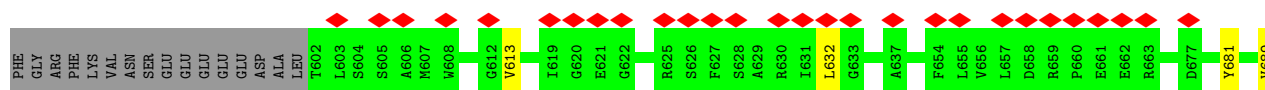
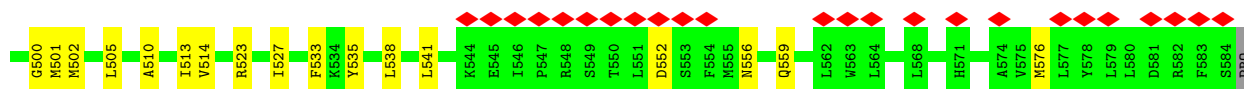
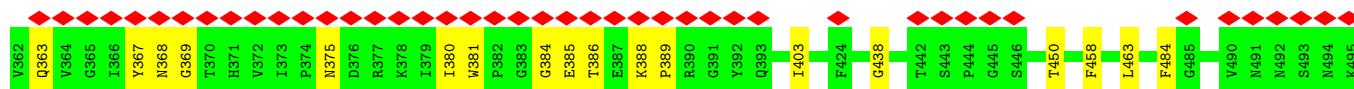
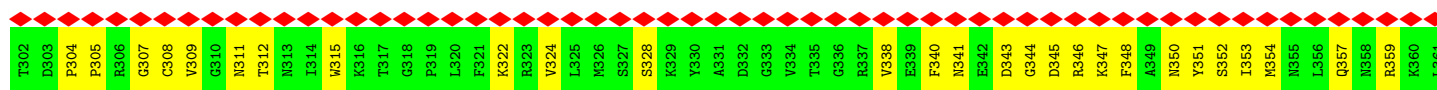
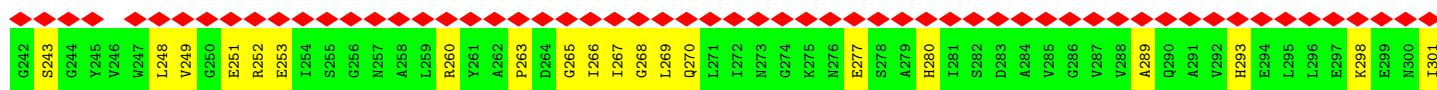
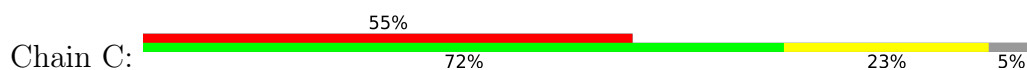
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion 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.

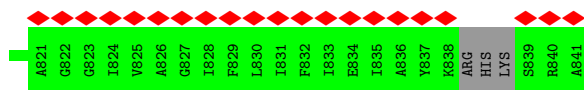
- Molecule 1: Glutamate receptor ionotropic, NMDA 1



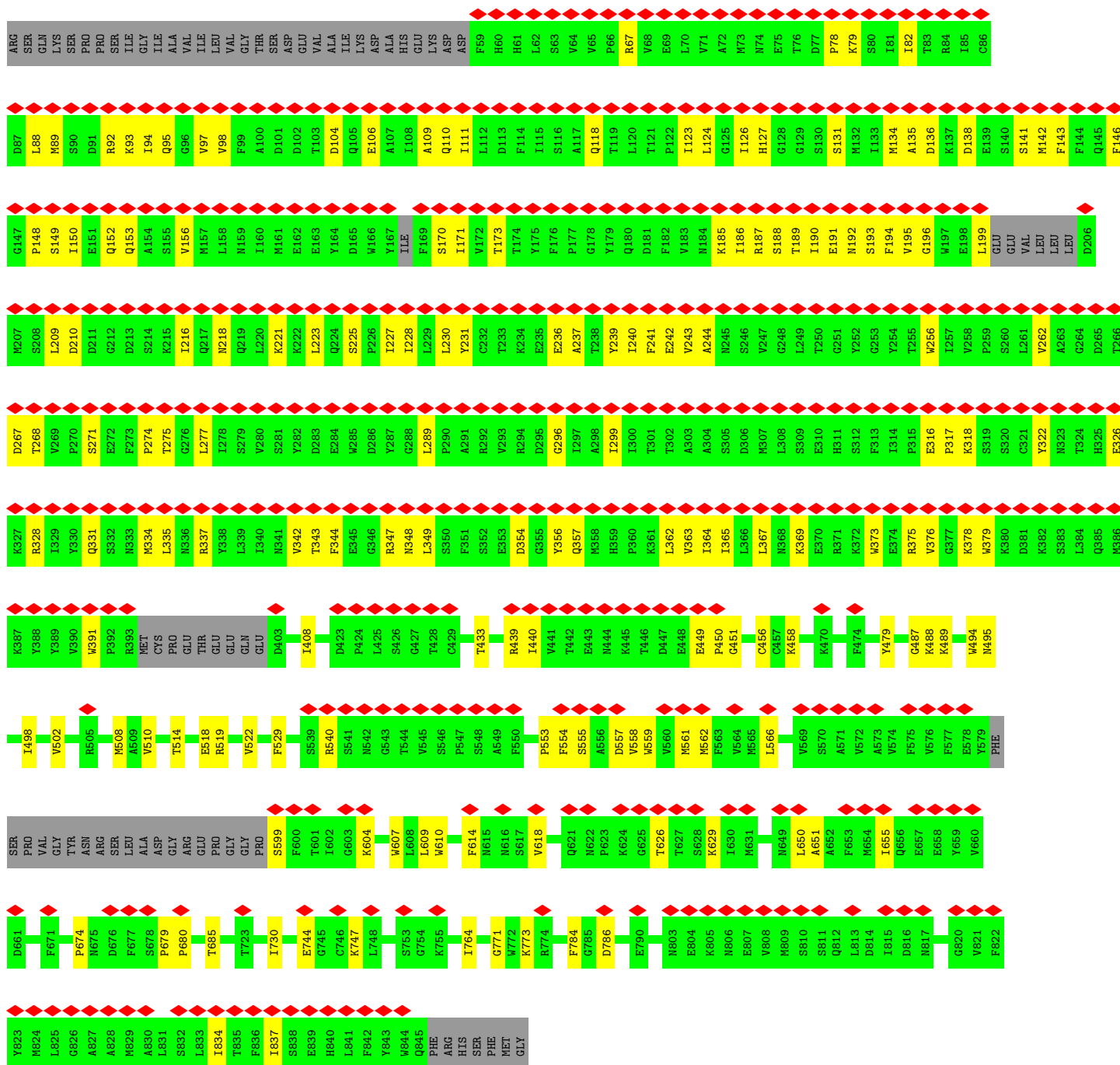


• Molecule 1: Glutamate receptor ionotropic, NMDA 1

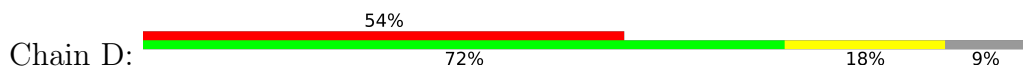


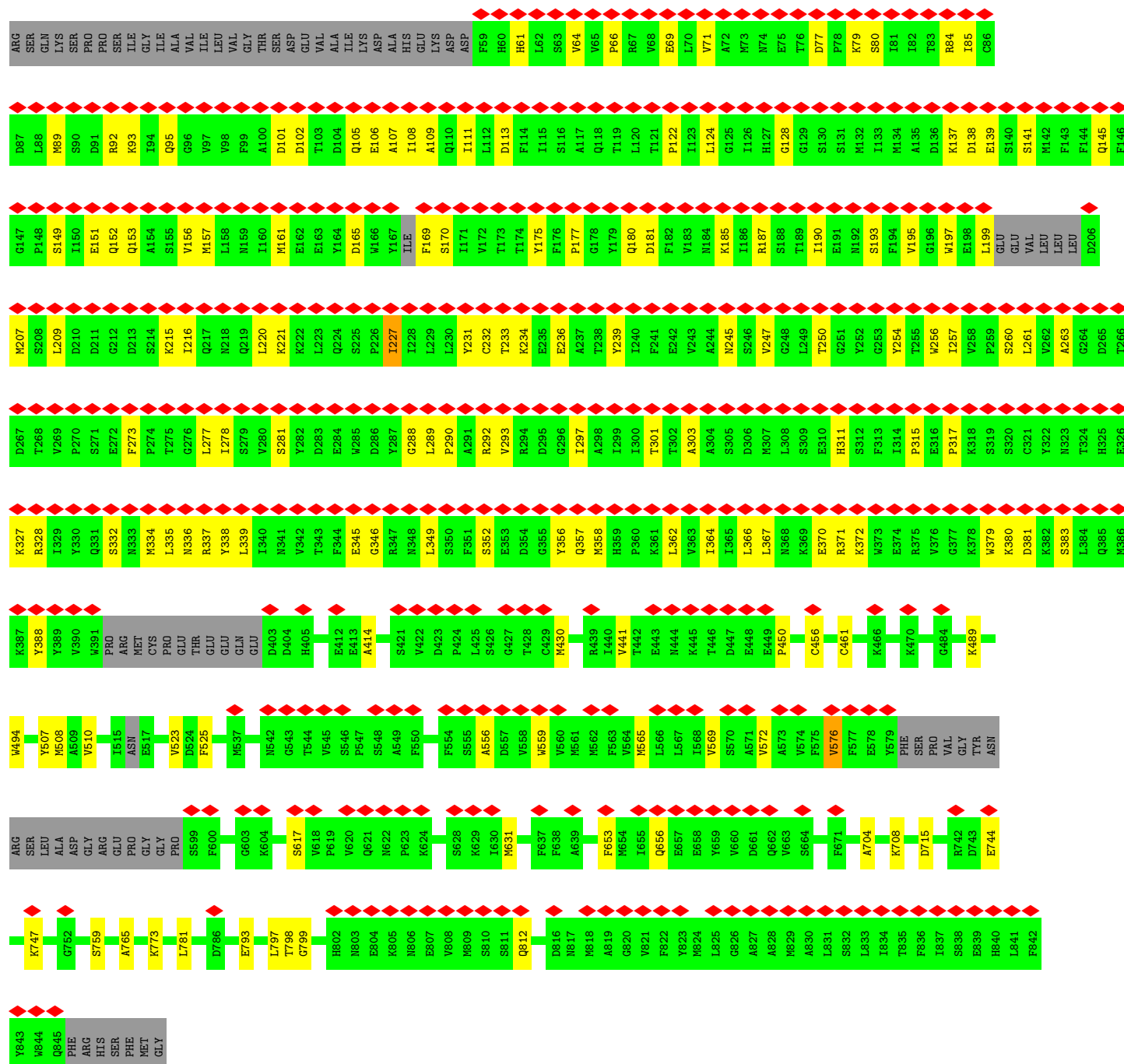


• Molecule 2: Glutamate receptor ionotropic, NMDA 2B



• Molecule 2: Glutamate receptor ionotropic, NMDA 2B





S140	D80	P61	K92	F93	Q84	G85	K86	A87	T88	I89	T90	A91	D92	T93	S94	S95	N96	T97	A98	Y99	L100	Q101	L102	S103	S104	L105	T106	S107	E108	D109	T110	A111	V112	Y113	Y114	G115	A116	L117	Y118	G119	N120	Y121	E122	G123	G124	Y125	A126	M127	D128	Y129	W130	G131	Q132	G133	T134	S135	V136	T137	V138	S139
	E20	V21	Q22	L23	Q24	Q25	S26	G27	A28	E29	L30	V31	K32	P33	G34	A35	S36	V37	K38	L39	S40	C41	T42	A43	S44	G45	F46	H47	I48	K49	D50	T51	Y52	M53	H54	V55	V56	K57	Q58	R59	P60	E61	Q62	G63	L64	E65	W66	L67	G68	R69	I70	D71	P72	A73	N74	G75	N76	T77	K78	S79

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	52452	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	71.7	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	2200	Depositor
Magnification	Not provided	
Image detector	GATAN K3 BIOCONTINUUM (6k x 4k)	Depositor
Maximum map value	0.415	Depositor
Minimum map value	-0.223	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.008	Depositor
Recommended contour level	0.1	Depositor
Map size (Å)	400.0, 400.0, 400.0	wwPDB
Map dimensions	400, 400, 400	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.0, 1.0, 1.0	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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	0.27	0/6077	0.65	0/8289
1	C	0.24	0/5883	0.62	5/8043 (0.1%)
2	B	0.26	0/5684	0.68	0/7731
2	D	0.25	0/5542	0.65	0/7546
3	E	0.28	0/867	0.72	0/1179
4	F	0.31	0/950	0.77	0/1291
All	All	0.26	0/25003	0.66	5/34079 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	C	0	1
2	D	0	1
All	All	0	2

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	96	PRO	CA-C-N	6.74	138.23	121.80
1	C	96	PRO	C-N-CA	6.74	138.23	121.80
1	C	181	GLU	N-CA-CB	5.87	119.97	110.40
1	C	104	PRO	CA-C-N	-5.62	116.55	122.28
1	C	104	PRO	C-N-CA	-5.62	116.55	122.28

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	95	PRO	Peptide
2	D	165	ASP	Peptide

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	5940	0	5660	142	0
1	C	5752	0	5295	128	0
2	B	5565	0	5200	119	0
2	D	5428	0	4955	97	0
3	E	848	0	808	30	0
4	F	929	0	878	47	0
All	All	24462	0	22796	538	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 11.

The worst 5 of 538 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:D:137:LYS:HD3	2:D:145:GLN:HE22	1.47	0.78
1:A:262:ALA:HB1	1:A:266:ILE:HG13	1.66	0.76
2:D:364:ILE:HG12	2:D:379:TRP:HB2	1.67	0.76
3:E:51:SER:HB3	3:E:56:PHE:HB3	1.68	0.76
1:A:78:VAL:HG23	1:A:82:LEU:HD12	1.68	0.75

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	796/844 (94%)	727 (91%)	65 (8%)	4 (0%)	24	63
1	C	796/844 (94%)	730 (92%)	63 (8%)	3 (0%)	30	67
2	B	742/826 (90%)	666 (90%)	68 (9%)	8 (1%)	11	45
2	D	737/826 (89%)	640 (87%)	94 (13%)	3 (0%)	30	67
3	E	109/111 (98%)	91 (84%)	17 (16%)	1 (1%)	14	49
4	F	119/121 (98%)	92 (77%)	26 (22%)	1 (1%)	16	53
All	All	3299/3572 (92%)	2946 (89%)	333 (10%)	20 (1%)	23	59

5 of 20 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	314	ILE
1	A	444	PRO
2	B	210	ASP
1	C	95	PRO
1	C	714	ALA

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	590/727 (81%)	590 (100%)	0	100	100
1	C	539/727 (74%)	539 (100%)	0	100	100
2	B	550/722 (76%)	550 (100%)	0	100	100
2	D	518/722 (72%)	517 (100%)	1 (0%)	87	85
3	E	94/94 (100%)	94 (100%)	0	100	100
4	F	99/99 (100%)	99 (100%)	0	100	100
All	All	2390/3091 (77%)	2389 (100%)	1 (0%)	100	100

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	D	656	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 28 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	28	ASN
4	F	96	ASN
1	C	280	HIS
3	E	26	GLN
1	C	257	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](#)

There are no ligands in this entry.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

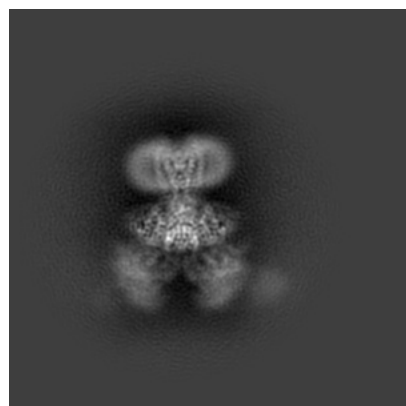
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-75138. These allow visual inspection of the internal detail of the map and identification of artifacts.

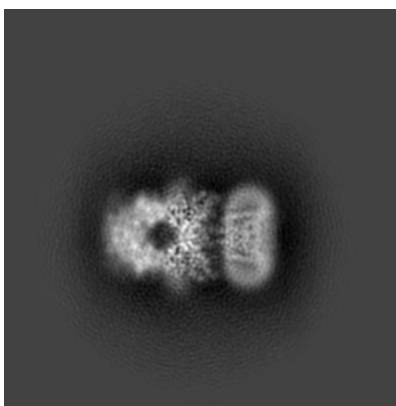
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

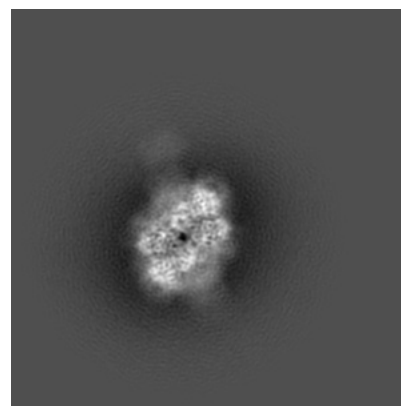
6.1.1 Primary map



X

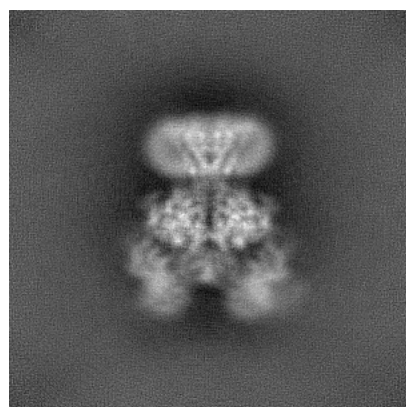


Y

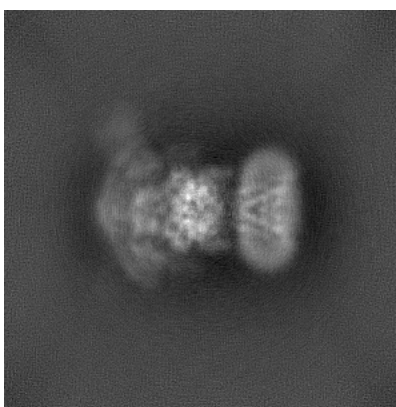


Z

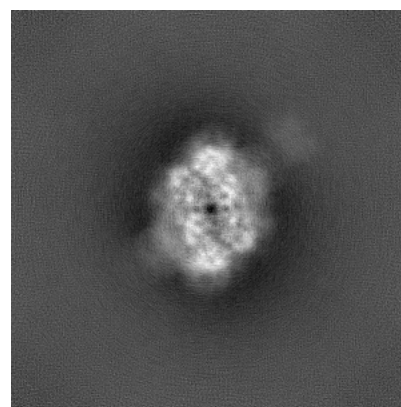
6.1.2 Raw map



X



Y

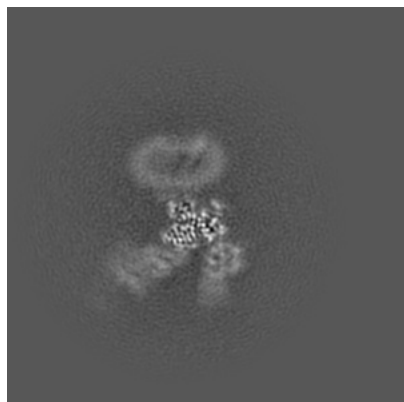


Z

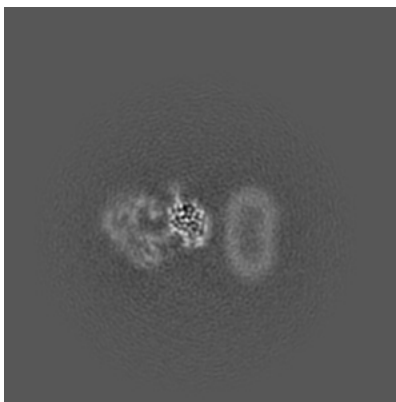
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

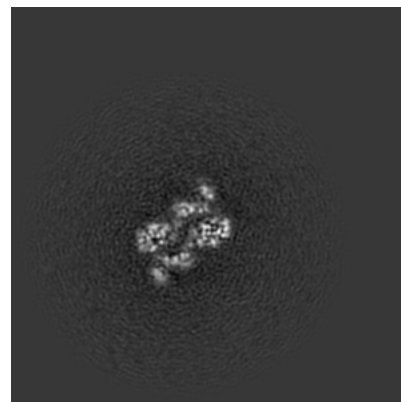
6.2.1 Primary map



X Index: 200

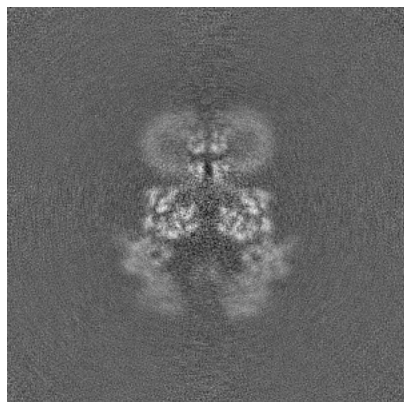


Y Index: 200

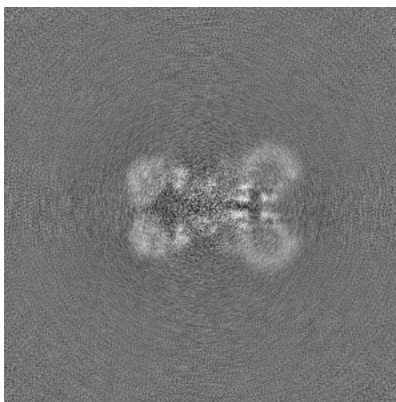


Z Index: 200

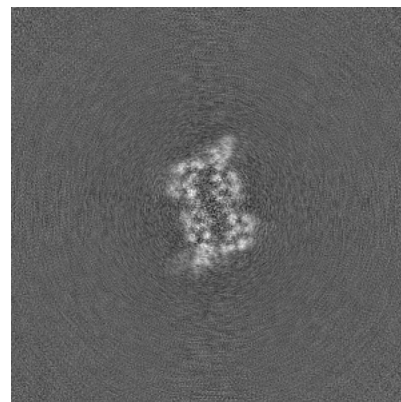
6.2.2 Raw map



X Index: 200



Y Index: 200

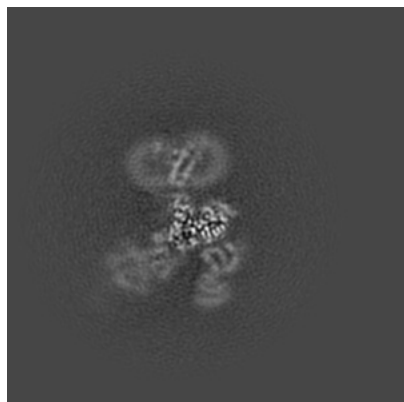


Z Index: 200

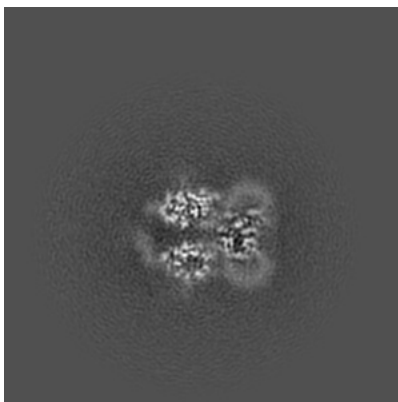
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

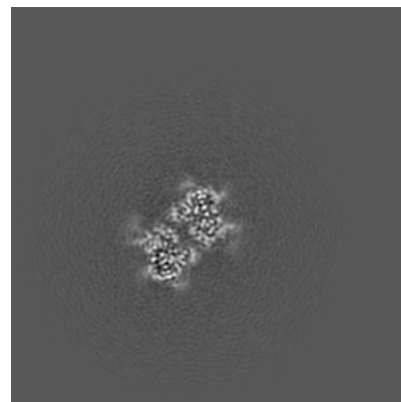
6.3.1 Primary map



X Index: 193

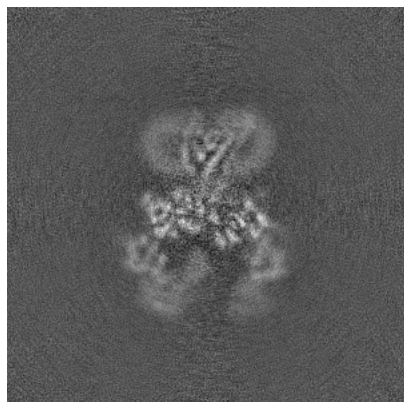


Y Index: 174

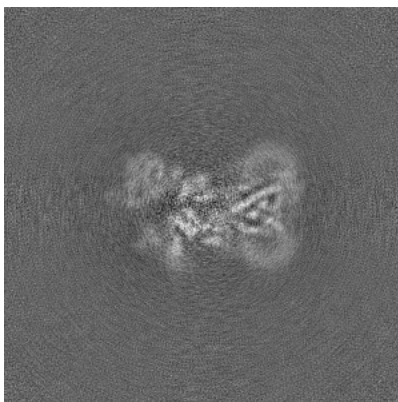


Z Index: 178

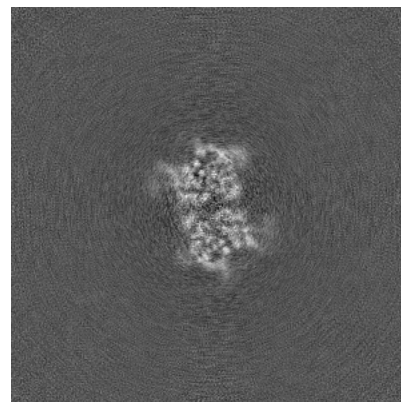
6.3.2 Raw map



X Index: 190



Y Index: 209

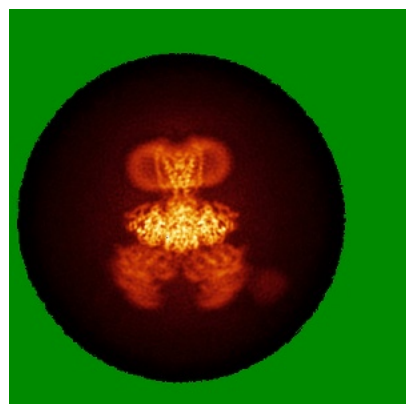


Z Index: 185

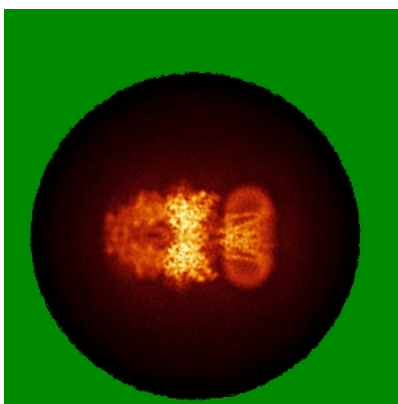
The images above show the largest variance slices of the map in three orthogonal directions.

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

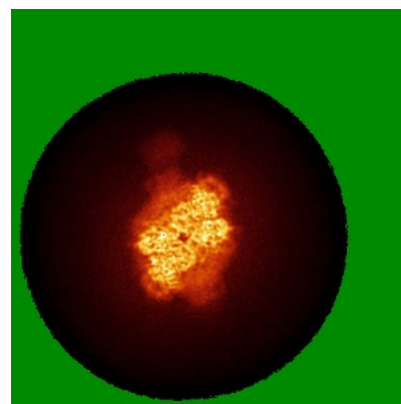
6.4.1 Primary map



X

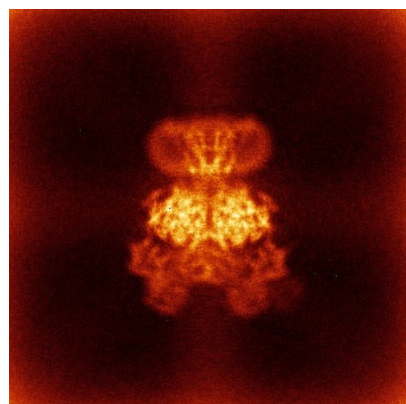


Y

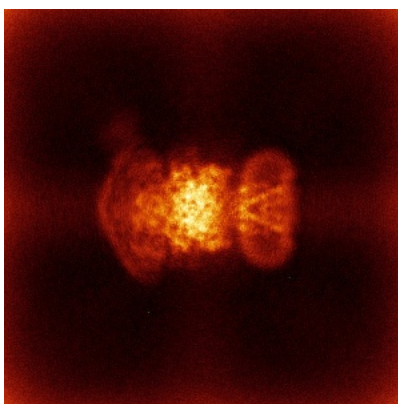


Z

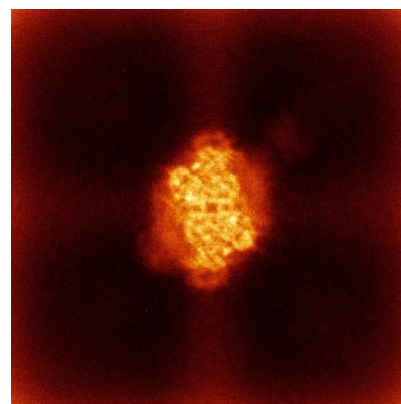
6.4.2 Raw map



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.

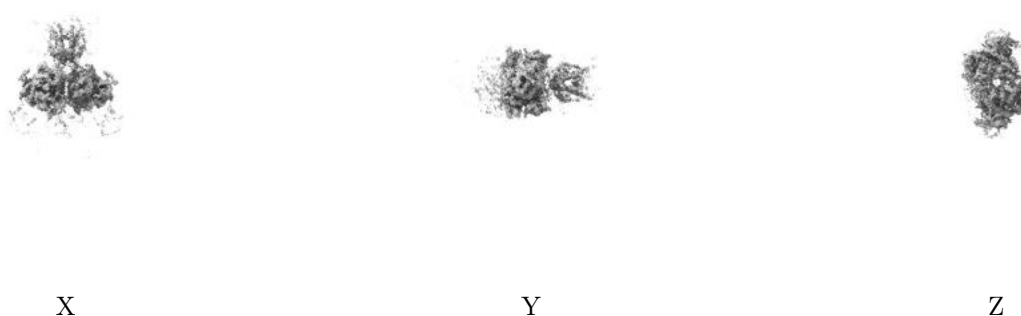
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.1. 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



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.

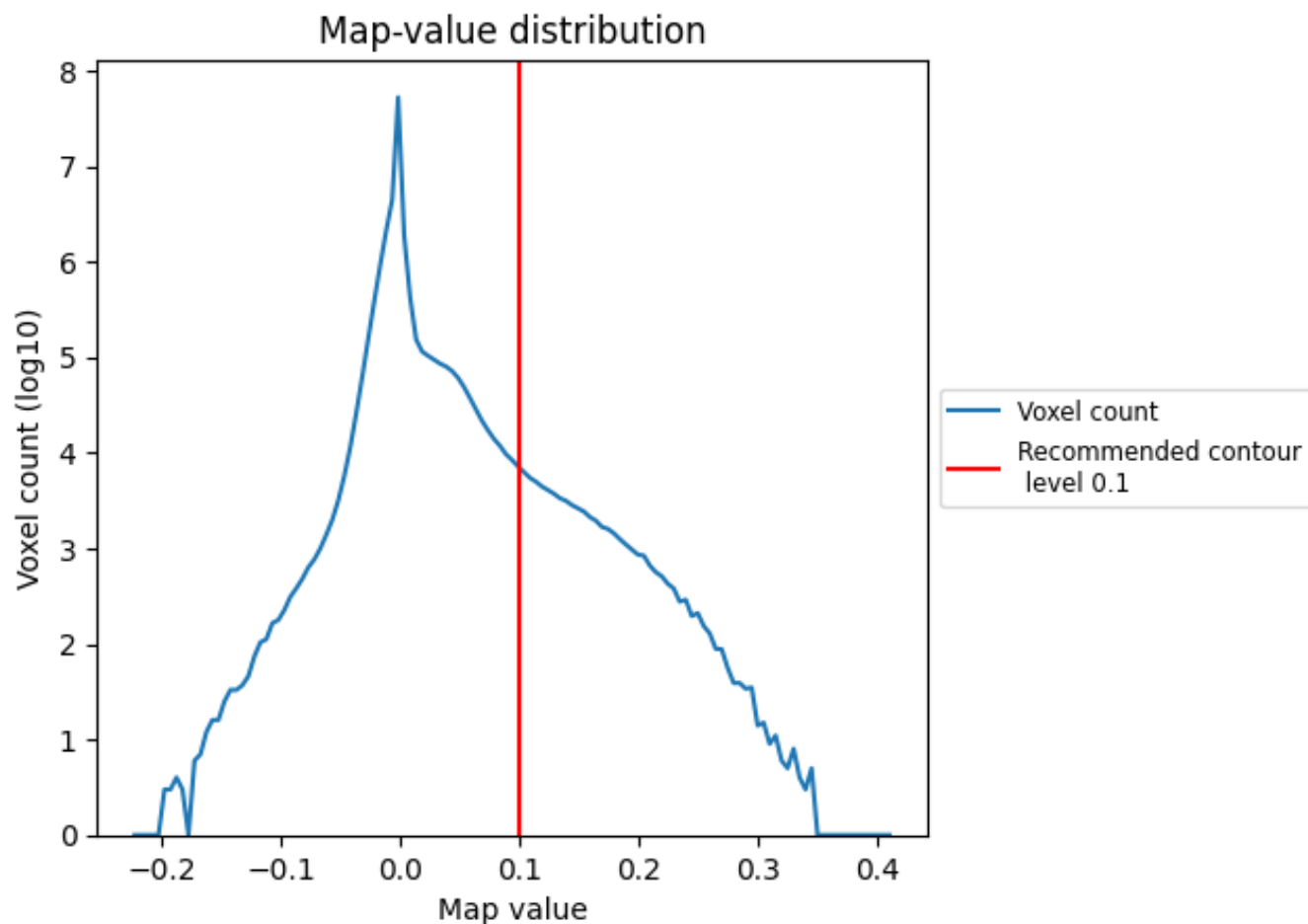
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

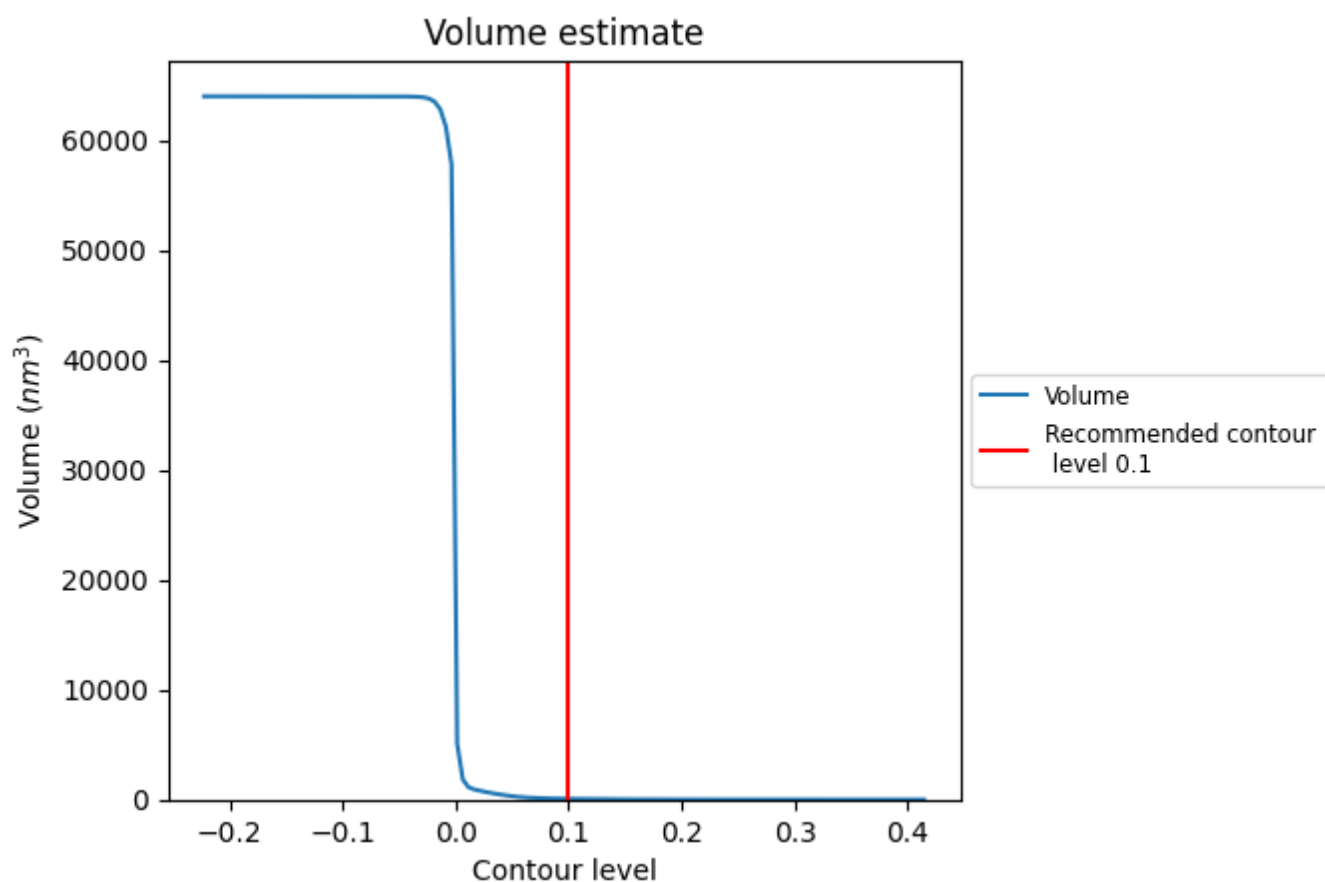
This section contains the results of statistical analysis of the map.

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.

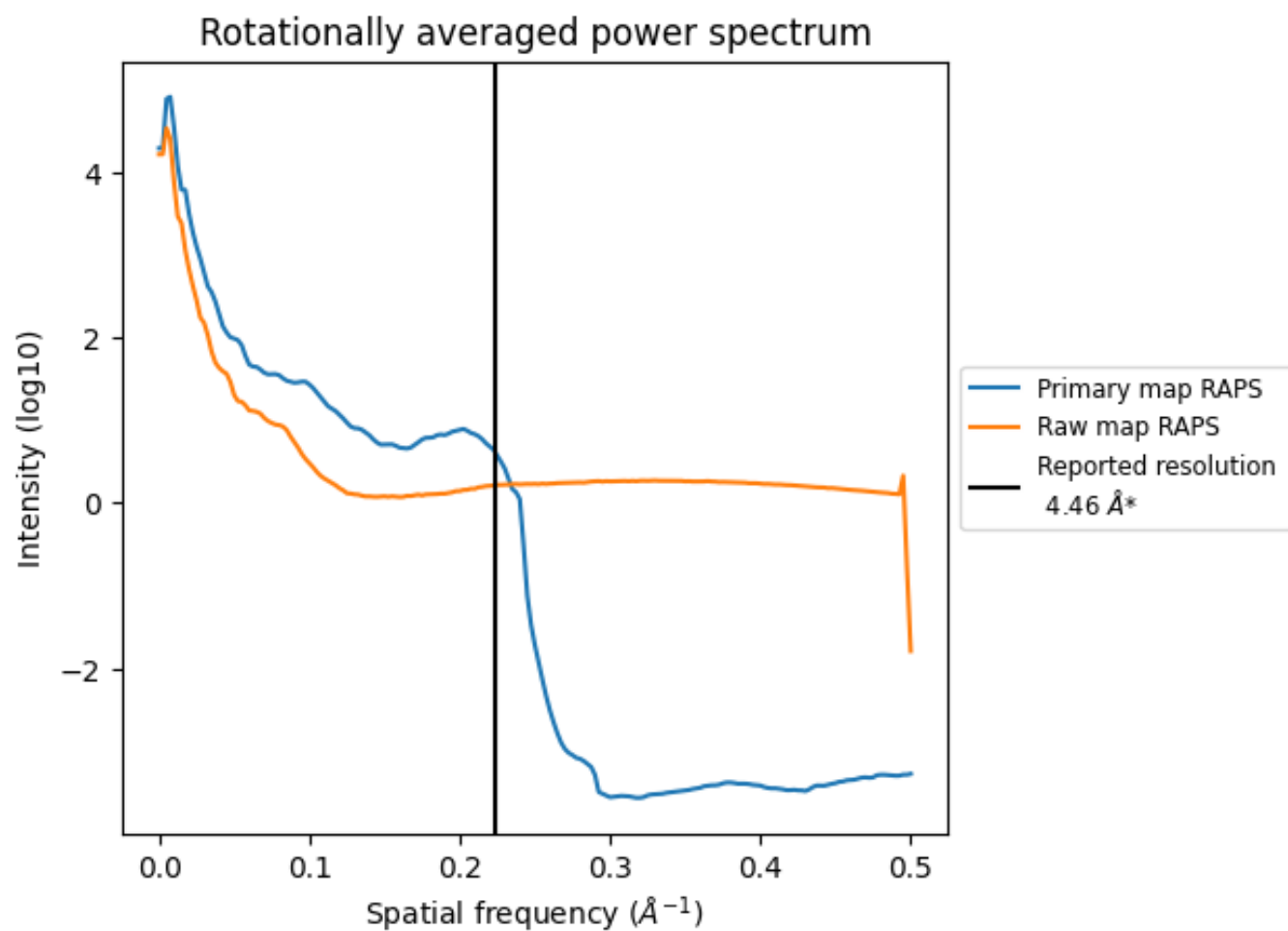
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 66 nm³; this corresponds to an approximate mass of 60 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 ⓘ

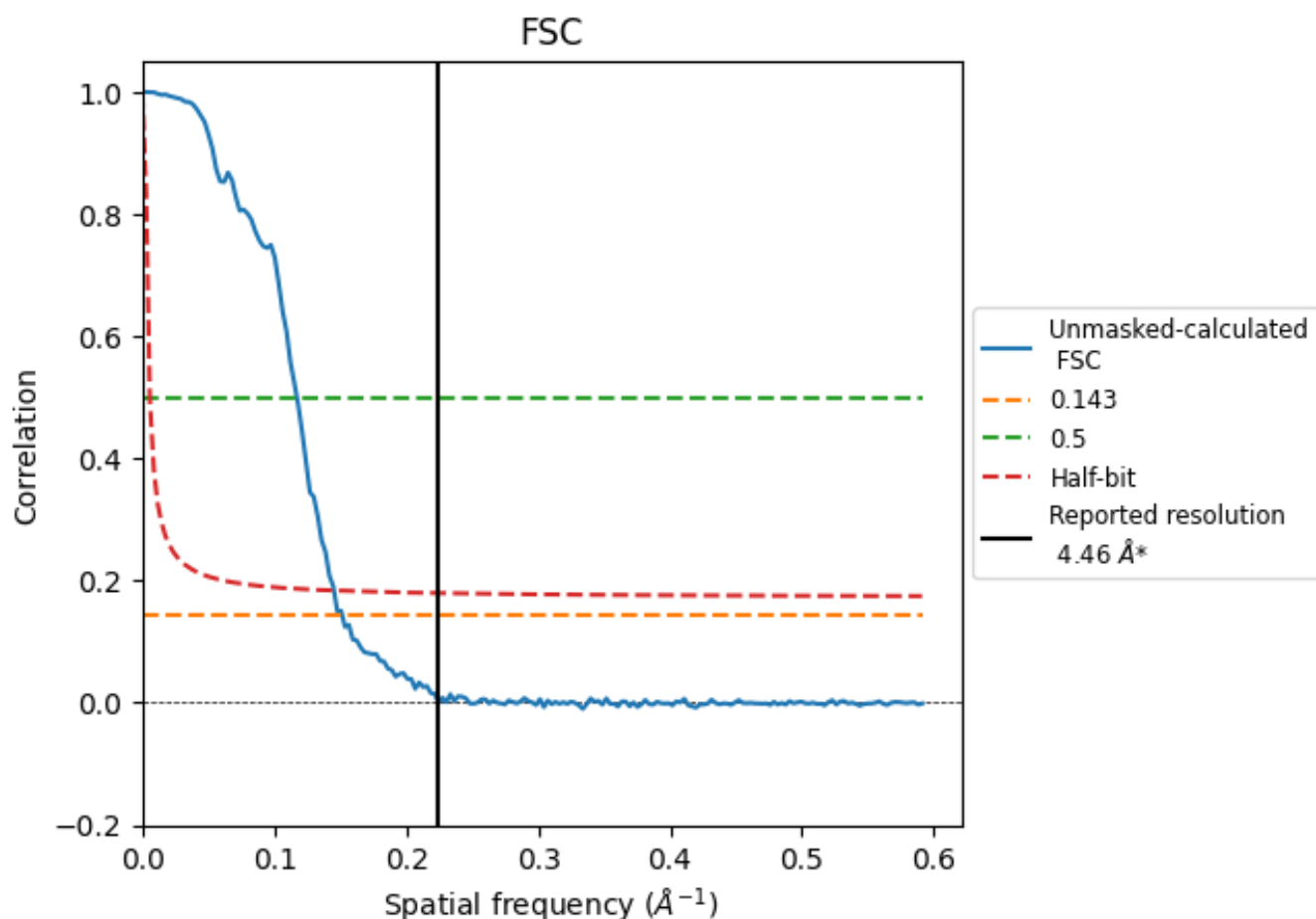


*Reported resolution corresponds to spatial frequency of 0.224 \AA^{-1}

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 0.224 Å⁻¹

8.2 Resolution estimates [i](#)

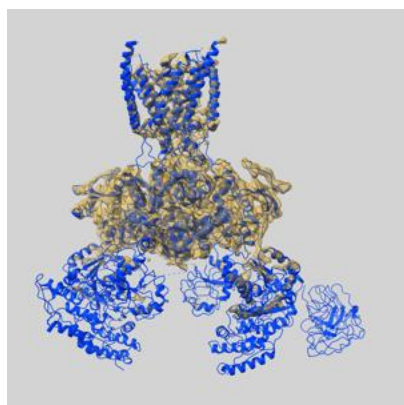
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	4.46	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	6.60	8.53	6.88

*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 6.60 differs from the reported value 4.46 by more than 10 %

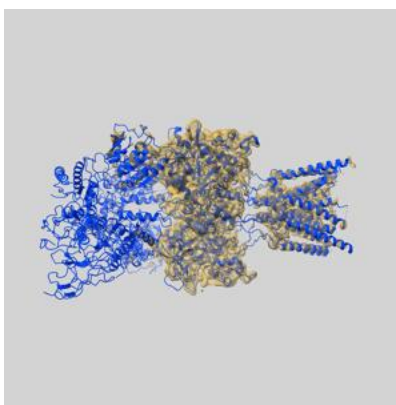
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-75138 and PDB model 10FO. Per-residue inclusion information can be found in section [3](#) on page [6](#).

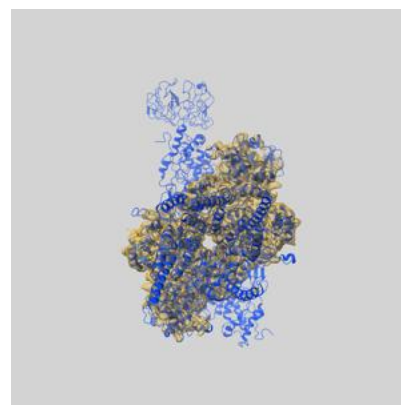
9.1 Map-model overlay [i](#)



X



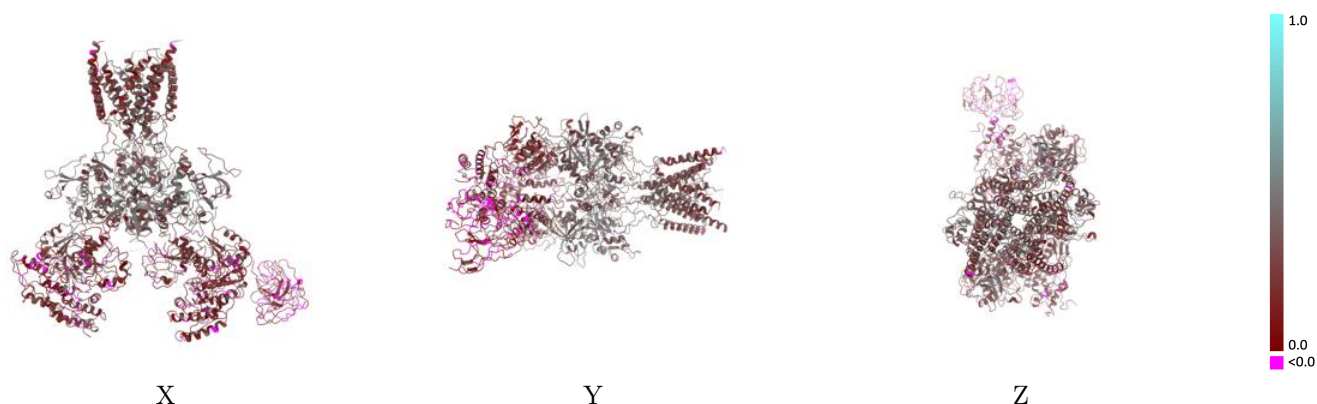
Y



Z

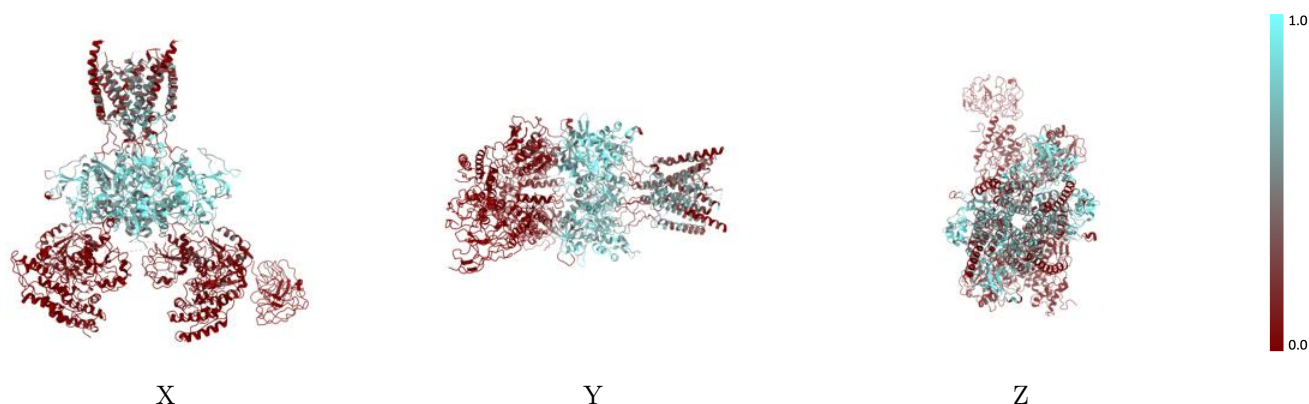
The images above show the 3D surface view of the map at the recommended contour level 0.1 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



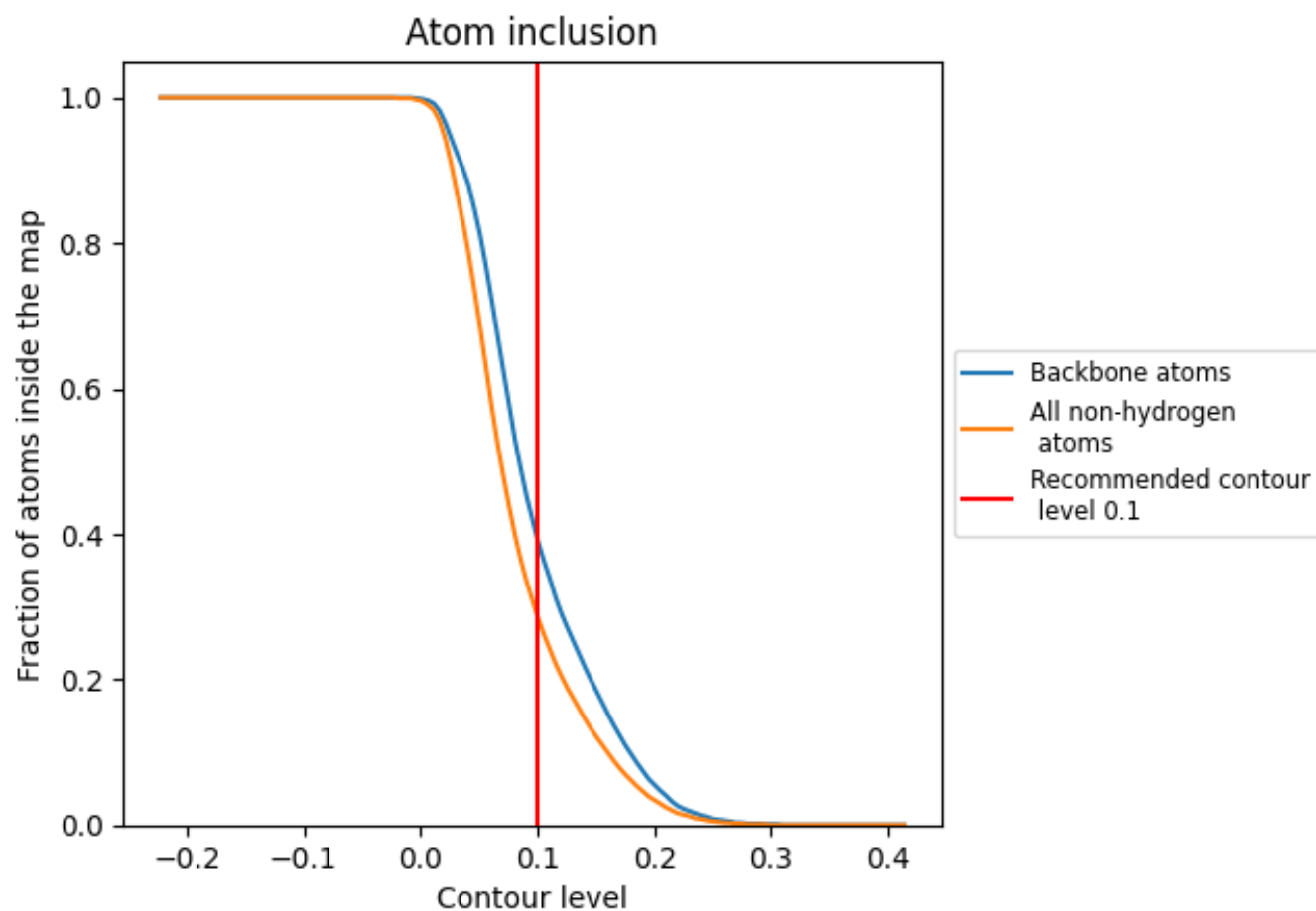
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.1).

9.4 Atom inclusion [i](#)



At the recommended contour level, 39% of all backbone atoms, 29% 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 (0.1) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div></div> 0.2870	<div></div> 0.2640
A	<div></div> 0.3010	<div></div> 0.2760
B	<div></div> 0.3000	<div></div> 0.2740
C	<div></div> 0.3460	<div></div> 0.2930
D	<div></div> 0.2920	<div></div> 0.2700
E	<div></div> 0.0000	<div></div> 0.0500
F	<div></div> 0.0000	<div></div> 0.0990

1.0

0.0

<0.0