



Full wwPDB EM Validation Report ⓘ

Sep 22, 2026 – 03:38 PM EDT

PDB ID : 38OA / pdb_000038oa
EMDB ID : EMD-78957
Title : Cryo-EM structure of wild-type Arabidopsis thaliana mechanosensitive channel of small conductance-like protein 2 (MSL2) in DOPC lipid nanodiscs.
Authors : Angiulli, G.; Dong, L.; Walz, T.
Deposited on : 2026-09-08
Resolution : 2.30 Å(reported)

This is a Full wwPDB EM Validation 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:

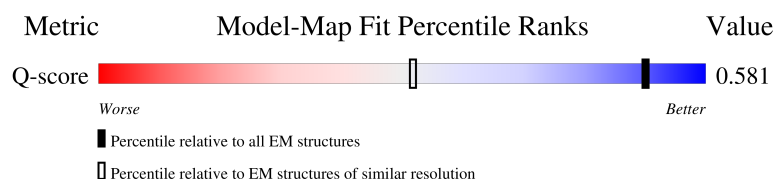
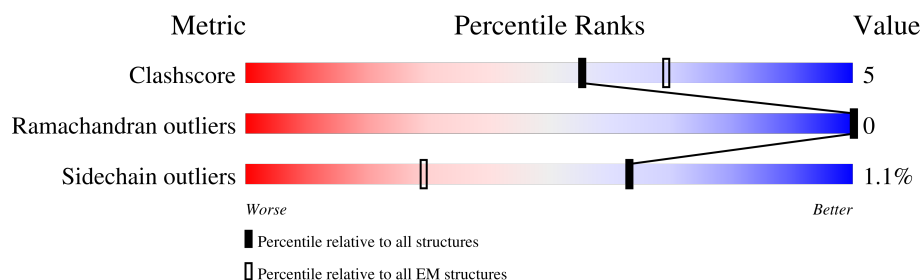
EMDB validation analysis : 0.0.1.dev133
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.50

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 2.30 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)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	4254 (1.80 - 2.80)

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	866	
1	B	866	
1	C	866	
1	D	866	

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Mol	Chain	Length	Quality of chain
1	E	866	21%78%
1	F	866	19%78%
1	G	866	19%78%

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 11025 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 Mechanosensitive ion channel protein 2, chloroplastic, Green fluorescent protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	194	Total	C	N	O	S	0	0
			1575	1006	293	271	5		
1	B	194	Total	C	N	O	S	0	0
			1575	1006	293	271	5		
1	C	194	Total	C	N	O	S	0	0
			1575	1006	293	271	5		
1	D	194	Total	C	N	O	S	0	0
			1575	1006	293	271	5		
1	E	194	Total	C	N	O	S	0	0
			1575	1006	293	271	5		
1	F	194	Total	C	N	O	S	0	0
			1575	1006	293	271	5		
1	G	194	Total	C	N	O	S	0	0
			1575	1006	293	271	5		

There are 245 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	75	MET	-	initiating methionine	UNP Q56X46
A	674	SER	-	linker	UNP Q56X46
A	675	ASN	-	linker	UNP Q56X46
A	676	SER	-	linker	UNP Q56X46
A	677	LEU	-	linker	UNP Q56X46
A	678	GLU	-	linker	UNP Q56X46
A	679	VAL	-	linker	UNP Q56X46
A	680	LEU	-	linker	UNP Q56X46
A	681	PHE	-	linker	UNP Q56X46
A	682	GLN	-	linker	UNP Q56X46
A	683	GLY	-	linker	UNP Q56X46
A	684	PRO	-	linker	UNP Q56X46
A	685	THR	-	linker	UNP Q56X46
A	686	ALA	-	linker	UNP Q56X46
A	687	ALA	-	linker	UNP Q56X46

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Chain	Residue	Modelled	Actual	Comment	Reference
A	688	ALA	-	linker	UNP Q56X46
A	689	ALA	-	linker	UNP Q56X46
A	690	VAL	-	linker	UNP Q56X46
A	753	LEU	PHE	conflict	UNP P42212
A	754	THR	SER	conflict	UNP P42212
A	895	LYS	ALA	conflict	UNP P42212
A	920	LEU	HIS	conflict	UNP P42212
A	928	SER	-	expression tag	UNP P42212
A	929	GLY	-	expression tag	UNP P42212
A	930	GLY	-	expression tag	UNP P42212
A	931	GLY	-	expression tag	UNP P42212
A	932	THR	-	expression tag	UNP P42212
A	933	GLU	-	expression tag	UNP P42212
A	934	THR	-	expression tag	UNP P42212
A	935	SER	-	expression tag	UNP P42212
A	936	GLN	-	expression tag	UNP P42212
A	937	VAL	-	expression tag	UNP P42212
A	938	ALA	-	expression tag	UNP P42212
A	939	PRO	-	expression tag	UNP P42212
A	940	ALA	-	expression tag	UNP P42212
B	75	MET	-	initiating methionine	UNP Q56X46
B	674	SER	-	linker	UNP Q56X46
B	675	ASN	-	linker	UNP Q56X46
B	676	SER	-	linker	UNP Q56X46
B	677	LEU	-	linker	UNP Q56X46
B	678	GLU	-	linker	UNP Q56X46
B	679	VAL	-	linker	UNP Q56X46
B	680	LEU	-	linker	UNP Q56X46
B	681	PHE	-	linker	UNP Q56X46
B	682	GLN	-	linker	UNP Q56X46
B	683	GLY	-	linker	UNP Q56X46
B	684	PRO	-	linker	UNP Q56X46
B	685	THR	-	linker	UNP Q56X46
B	686	ALA	-	linker	UNP Q56X46
B	687	ALA	-	linker	UNP Q56X46
B	688	ALA	-	linker	UNP Q56X46
B	689	ALA	-	linker	UNP Q56X46
B	690	VAL	-	linker	UNP Q56X46
B	753	LEU	PHE	conflict	UNP P42212
B	754	THR	SER	conflict	UNP P42212
B	895	LYS	ALA	conflict	UNP P42212
B	920	LEU	HIS	conflict	UNP P42212

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Chain	Residue	Modelled	Actual	Comment	Reference
B	928	SER	-	expression tag	UNP P42212
B	929	GLY	-	expression tag	UNP P42212
B	930	GLY	-	expression tag	UNP P42212
B	931	GLY	-	expression tag	UNP P42212
B	932	THR	-	expression tag	UNP P42212
B	933	GLU	-	expression tag	UNP P42212
B	934	THR	-	expression tag	UNP P42212
B	935	SER	-	expression tag	UNP P42212
B	936	GLN	-	expression tag	UNP P42212
B	937	VAL	-	expression tag	UNP P42212
B	938	ALA	-	expression tag	UNP P42212
B	939	PRO	-	expression tag	UNP P42212
B	940	ALA	-	expression tag	UNP P42212
C	75	MET	-	initiating methionine	UNP Q56X46
C	674	SER	-	linker	UNP Q56X46
C	675	ASN	-	linker	UNP Q56X46
C	676	SER	-	linker	UNP Q56X46
C	677	LEU	-	linker	UNP Q56X46
C	678	GLU	-	linker	UNP Q56X46
C	679	VAL	-	linker	UNP Q56X46
C	680	LEU	-	linker	UNP Q56X46
C	681	PHE	-	linker	UNP Q56X46
C	682	GLN	-	linker	UNP Q56X46
C	683	GLY	-	linker	UNP Q56X46
C	684	PRO	-	linker	UNP Q56X46
C	685	THR	-	linker	UNP Q56X46
C	686	ALA	-	linker	UNP Q56X46
C	687	ALA	-	linker	UNP Q56X46
C	688	ALA	-	linker	UNP Q56X46
C	689	ALA	-	linker	UNP Q56X46
C	690	VAL	-	linker	UNP Q56X46
C	753	LEU	PHE	conflict	UNP P42212
C	754	THR	SER	conflict	UNP P42212
C	895	LYS	ALA	conflict	UNP P42212
C	920	LEU	HIS	conflict	UNP P42212
C	928	SER	-	expression tag	UNP P42212
C	929	GLY	-	expression tag	UNP P42212
C	930	GLY	-	expression tag	UNP P42212
C	931	GLY	-	expression tag	UNP P42212
C	932	THR	-	expression tag	UNP P42212
C	933	GLU	-	expression tag	UNP P42212
C	934	THR	-	expression tag	UNP P42212

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Chain	Residue	Modelled	Actual	Comment	Reference
C	935	SER	-	expression tag	UNP P42212
C	936	GLN	-	expression tag	UNP P42212
C	937	VAL	-	expression tag	UNP P42212
C	938	ALA	-	expression tag	UNP P42212
C	939	PRO	-	expression tag	UNP P42212
C	940	ALA	-	expression tag	UNP P42212
D	75	MET	-	initiating methionine	UNP Q56X46
D	674	SER	-	linker	UNP Q56X46
D	675	ASN	-	linker	UNP Q56X46
D	676	SER	-	linker	UNP Q56X46
D	677	LEU	-	linker	UNP Q56X46
D	678	GLU	-	linker	UNP Q56X46
D	679	VAL	-	linker	UNP Q56X46
D	680	LEU	-	linker	UNP Q56X46
D	681	PHE	-	linker	UNP Q56X46
D	682	GLN	-	linker	UNP Q56X46
D	683	GLY	-	linker	UNP Q56X46
D	684	PRO	-	linker	UNP Q56X46
D	685	THR	-	linker	UNP Q56X46
D	686	ALA	-	linker	UNP Q56X46
D	687	ALA	-	linker	UNP Q56X46
D	688	ALA	-	linker	UNP Q56X46
D	689	ALA	-	linker	UNP Q56X46
D	690	VAL	-	linker	UNP Q56X46
D	753	LEU	PHE	conflict	UNP P42212
D	754	THR	SER	conflict	UNP P42212
D	895	LYS	ALA	conflict	UNP P42212
D	920	LEU	HIS	conflict	UNP P42212
D	928	SER	-	expression tag	UNP P42212
D	929	GLY	-	expression tag	UNP P42212
D	930	GLY	-	expression tag	UNP P42212
D	931	GLY	-	expression tag	UNP P42212
D	932	THR	-	expression tag	UNP P42212
D	933	GLU	-	expression tag	UNP P42212
D	934	THR	-	expression tag	UNP P42212
D	935	SER	-	expression tag	UNP P42212
D	936	GLN	-	expression tag	UNP P42212
D	937	VAL	-	expression tag	UNP P42212
D	938	ALA	-	expression tag	UNP P42212
D	939	PRO	-	expression tag	UNP P42212
D	940	ALA	-	expression tag	UNP P42212
E	75	MET	-	initiating methionine	UNP Q56X46

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Chain	Residue	Modelled	Actual	Comment	Reference
E	674	SER	-	linker	UNP Q56X46
E	675	ASN	-	linker	UNP Q56X46
E	676	SER	-	linker	UNP Q56X46
E	677	LEU	-	linker	UNP Q56X46
E	678	GLU	-	linker	UNP Q56X46
E	679	VAL	-	linker	UNP Q56X46
E	680	LEU	-	linker	UNP Q56X46
E	681	PHE	-	linker	UNP Q56X46
E	682	GLN	-	linker	UNP Q56X46
E	683	GLY	-	linker	UNP Q56X46
E	684	PRO	-	linker	UNP Q56X46
E	685	THR	-	linker	UNP Q56X46
E	686	ALA	-	linker	UNP Q56X46
E	687	ALA	-	linker	UNP Q56X46
E	688	ALA	-	linker	UNP Q56X46
E	689	ALA	-	linker	UNP Q56X46
E	690	VAL	-	linker	UNP Q56X46
E	753	LEU	PHE	conflict	UNP P42212
E	754	THR	SER	conflict	UNP P42212
E	895	LYS	ALA	conflict	UNP P42212
E	920	LEU	HIS	conflict	UNP P42212
E	928	SER	-	expression tag	UNP P42212
E	929	GLY	-	expression tag	UNP P42212
E	930	GLY	-	expression tag	UNP P42212
E	931	GLY	-	expression tag	UNP P42212
E	932	THR	-	expression tag	UNP P42212
E	933	GLU	-	expression tag	UNP P42212
E	934	THR	-	expression tag	UNP P42212
E	935	SER	-	expression tag	UNP P42212
E	936	GLN	-	expression tag	UNP P42212
E	937	VAL	-	expression tag	UNP P42212
E	938	ALA	-	expression tag	UNP P42212
E	939	PRO	-	expression tag	UNP P42212
E	940	ALA	-	expression tag	UNP P42212
F	75	MET	-	initiating methionine	UNP Q56X46
F	674	SER	-	linker	UNP Q56X46
F	675	ASN	-	linker	UNP Q56X46
F	676	SER	-	linker	UNP Q56X46
F	677	LEU	-	linker	UNP Q56X46
F	678	GLU	-	linker	UNP Q56X46
F	679	VAL	-	linker	UNP Q56X46
F	680	LEU	-	linker	UNP Q56X46

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Chain	Residue	Modelled	Actual	Comment	Reference
F	681	PHE	-	linker	UNP Q56X46
F	682	GLN	-	linker	UNP Q56X46
F	683	GLY	-	linker	UNP Q56X46
F	684	PRO	-	linker	UNP Q56X46
F	685	THR	-	linker	UNP Q56X46
F	686	ALA	-	linker	UNP Q56X46
F	687	ALA	-	linker	UNP Q56X46
F	688	ALA	-	linker	UNP Q56X46
F	689	ALA	-	linker	UNP Q56X46
F	690	VAL	-	linker	UNP Q56X46
F	753	LEU	PHE	conflict	UNP P42212
F	754	THR	SER	conflict	UNP P42212
F	895	LYS	ALA	conflict	UNP P42212
F	920	LEU	HIS	conflict	UNP P42212
F	928	SER	-	expression tag	UNP P42212
F	929	GLY	-	expression tag	UNP P42212
F	930	GLY	-	expression tag	UNP P42212
F	931	GLY	-	expression tag	UNP P42212
F	932	THR	-	expression tag	UNP P42212
F	933	GLU	-	expression tag	UNP P42212
F	934	THR	-	expression tag	UNP P42212
F	935	SER	-	expression tag	UNP P42212
F	936	GLN	-	expression tag	UNP P42212
F	937	VAL	-	expression tag	UNP P42212
F	938	ALA	-	expression tag	UNP P42212
F	939	PRO	-	expression tag	UNP P42212
F	940	ALA	-	expression tag	UNP P42212
G	75	MET	-	initiating methionine	UNP Q56X46
G	674	SER	-	linker	UNP Q56X46
G	675	ASN	-	linker	UNP Q56X46
G	676	SER	-	linker	UNP Q56X46
G	677	LEU	-	linker	UNP Q56X46
G	678	GLU	-	linker	UNP Q56X46
G	679	VAL	-	linker	UNP Q56X46
G	680	LEU	-	linker	UNP Q56X46
G	681	PHE	-	linker	UNP Q56X46
G	682	GLN	-	linker	UNP Q56X46
G	683	GLY	-	linker	UNP Q56X46
G	684	PRO	-	linker	UNP Q56X46
G	685	THR	-	linker	UNP Q56X46
G	686	ALA	-	linker	UNP Q56X46
G	687	ALA	-	linker	UNP Q56X46

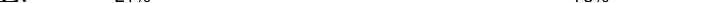
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Chain	Residue	Modelled	Actual	Comment	Reference
G	688	ALA	-	linker	UNP Q56X46
G	689	ALA	-	linker	UNP Q56X46
G	690	VAL	-	linker	UNP Q56X46
G	753	LEU	PHE	conflict	UNP P42212
G	754	THR	SER	conflict	UNP P42212
G	895	LYS	ALA	conflict	UNP P42212
G	920	LEU	HIS	conflict	UNP P42212
G	928	SER	-	expression tag	UNP P42212
G	929	GLY	-	expression tag	UNP P42212
G	930	GLY	-	expression tag	UNP P42212
G	931	GLY	-	expression tag	UNP P42212
G	932	THR	-	expression tag	UNP P42212
G	933	GLU	-	expression tag	UNP P42212
G	934	THR	-	expression tag	UNP P42212
G	935	SER	-	expression tag	UNP P42212
G	936	GLN	-	expression tag	UNP P42212
G	937	VAL	-	expression tag	UNP P42212
G	938	ALA	-	expression tag	UNP P42212
G	939	PRO	-	expression tag	UNP P42212
G	940	ALA	-	expression tag	UNP P42212

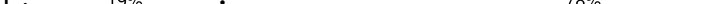
[illegible]

- Molecule 1: Mechanosensitive ion channel protein 2, chloroplastic, Green fluorescent protein

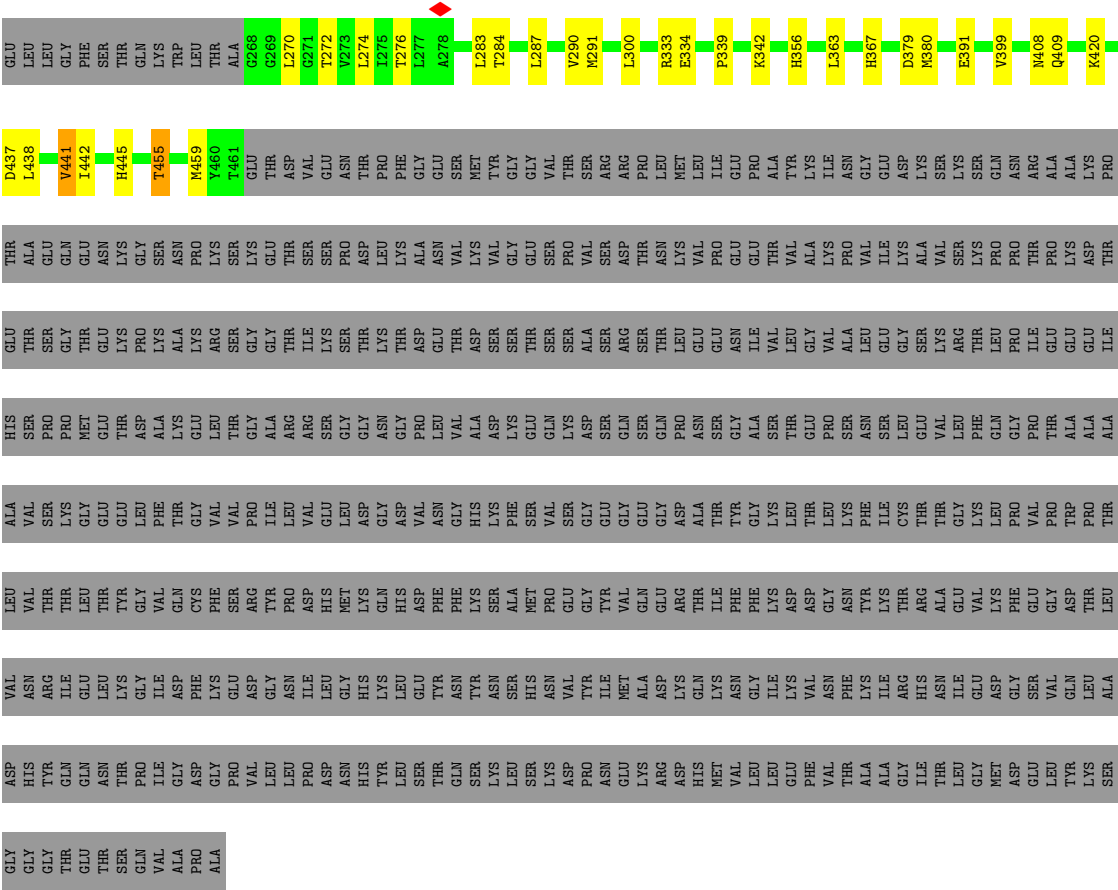
Chain E:  21% . 78%

[illegible]

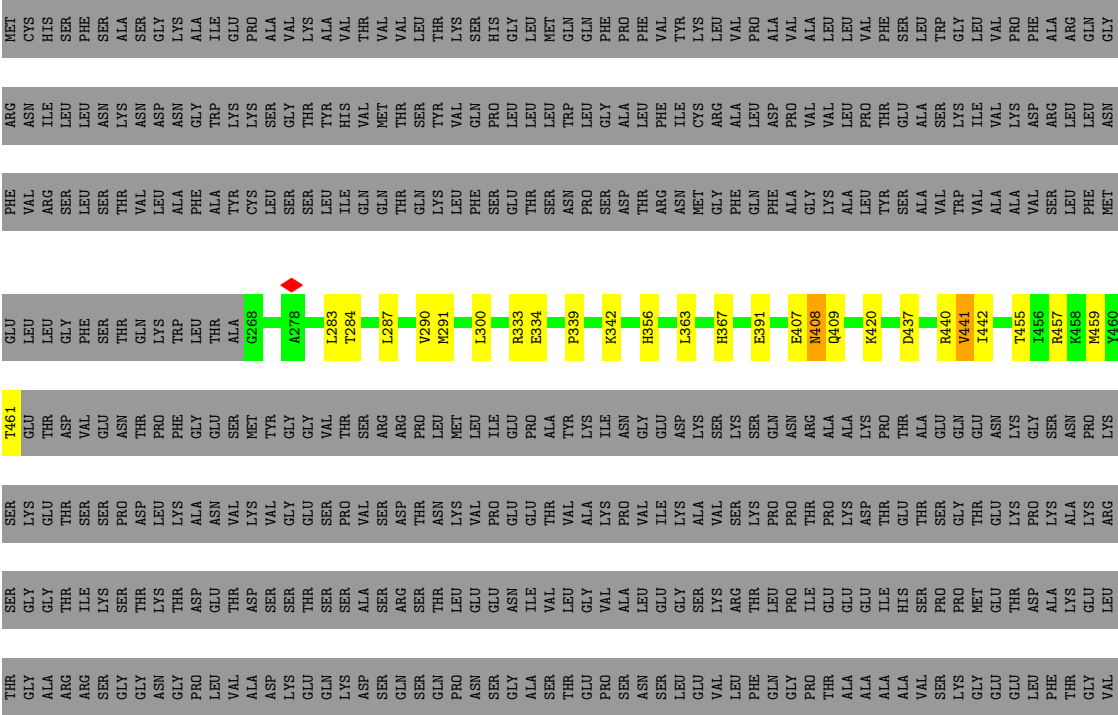
- Molecule 1: Mechanosensitive ion channel protein 2, chloroplastic, Green fluorescent protein

Chain F:  19% . 78%

PHE	VAL	ARG	ASN	ARG	ASN	MET
VAL	ARG	ILE	ILE	ILE	HIS	CYS
SER	SER	LEU	LEU	LEU	SER	HIS
SER	SER	ASN	ASN	ASN	SER	SER
THR	THR	ASN	ASN	ASN	ALA	ALA
VAL	VAL	ASN	ASN	ASN	SER	SER
LEU	LEU	ASP	ASP	ASP	GLY	GLY
ALA	ALA	ASN	ASN	ASN	LYS	LYS
PHE	PHE	GLY	GLY	GLY	ALA	ALA
ALA	ALA	TRP	TRP	TRP	ILE	ILE
TYR	TYR	LYS	LYS	LYS	GLU	GLU
CYS	CYS	LYS	LYS	LYS	PRO	PRO
LEU	LEU	SER	SER	SER	ALA	ALA
SER	SER	GLY	GLY	GLY	VAL	VAL
SER	SER	THR	THR	THR	LYS	LYS
LEU	LEU	TYR	TYR	TYR	ALA	ALA
ILE	ILE	HIS	HIS	HIS	VAL	VAL
GLN	GLN	VAL	VAL	VAL	THR	THR
GLN	GLN	MET	MET	MET	VAL	VAL
GLN	GLN	SER	SER	SER	LEU	LEU
LYS	LYS	TYR	TYR	TYR	THR	THR
LEU	LEU	VAL	VAL	VAL	LYS	LYS
PHE	PHE	GLN	GLN	GLN	SER	SER
SER	SER	PRO	PRO	PRO	HIS	HIS
GLU	GLU	LEU	LEU	LEU	GLY	GLY
THR	THR	LEU	LEU	LEU	LEU	LEU
SER	SER	LEU	LEU	LEU	MET	MET
ASN	ASN	TRP	TRP	TRP	GLN	GLN
PRO	PRO	LEU	LEU	LEU	GLN	GLN
SER	SER	GLY	GLY	GLY	PHE	PHE
ASP	ASP	ALA	ALA	ALA	PRO	PRO
THR	THR	LEU	LEU	LEU	PHE	PHE
ARG	ARG	ILE	ILE	ILE	VAL	VAL
ASN	ASN	ILE	ILE	ILE	TYR	TYR
MET	MET	CYS	CYS	CYS	LYS	LYS
GLY	GLY	ARG	ARG	ARG	LEU	LEU
PHE	PHE	ALA	ALA	ALA	VAL	VAL
GLN	GLN	LEU	LEU	LEU	PRO	PRO
PHE	PHE	ASP	ASP	ASP	ALA	ALA
ALA	ALA	PRO	PRO	PRO	VAL	VAL
GLY	GLY	VAL	VAL	VAL	ALA	ALA
LYS	LYS	VAL	VAL	VAL	LEU	LEU
ALA	ALA	LEU	LEU	LEU	LEU	LEU
LEU	LEU	PRO	PRO	PRO	VAL	VAL
TYR	TYR	THR	THR	THR	PHE	PHE
SER	SER	GLU	GLU	GLU	SER	SER
ALA	ALA	ALA	ALA	ALA	THR	THR
VAL	VAL	SER	SER	SER	GLY	GLY
VAL	VAL	ARG	ARG	ARG	LEU	LEU
SER	SER	LEU	LEU	LEU	ALA	ALA
LEU	LEU	ARG	ARG	ARG	ARG	ARG
PHE	PHE	GLY	GLY	GLY	GLN	GLN
THR	THR	ASN	ASN	ASN	VAL	VAL



● Molecule 1: Mechanosensitive ion channel protein 2, chloroplastic, Green fluorescent protein



PRO	VAL	ASP	GLU	SER	VAL
LEU	LEU	GLY	ASP	ARG	PRO
LEU	LEU	ASN	ASN	TYR	ILE
PRO	PRO	ILE	ASP	ASP	VAL
ASP	ASP	LEU	LEU	HIS	GLU
ASN	ASN	GLY	GLY	MET	LEU
HIS	HIS	HIS	TYR	LYS	ASP
TYR	TYR	LYS	LEU	HIS	GLY
LEU	LEU	LEU	LEU	HIS	ASP
SER	SER	GLU	ASP	ASP	VAL
THR	THR	TYR	TYR	PHE	ASN
GLN	GLN	ASN	ASN	PHE	GLY
SER	SER	TYR	TYR	LYS	HIS
LYS	LYS	ASN	ASN	SER	LYS
LEU	LEU	SER	SER	ALA	PHE
SER	SER	HIS	HIS	MET	SER
LYS	LYS	ASN	ASN	PRO	VAL
ASP	ASP	VAL	VAL	GLU	SER
PRO	PRO	TYR	TYR	GLY	GLY
ASN	ASN	ILE	TYR	TYR	GLU
GLU	GLU	MET	VAL	VAL	GLY
LYS	LYS	ALA	GLN	GLU	GLY
ARG	ARG	ASP	GLU	GLU	GLY
ASP	ASP	LYS	LYS	ARG	ASP
HIS	HIS	GLN	GLN	THR	ALA
MET	MET	LYS	ILE	ILE	THR
VAL	VAL	ASN	ASN	PHE	TYR
LEU	LEU	GLY	GLY	PHE	GLY
LEU	LEU	ILE	ILE	LYS	LYS
GLU	GLU	LYS	LYS	ASP	LEU
PHE	PHE	VAL	VAL	ASP	THR
THR	THR	ASN	ASN	GLY	LEU
ALA	ALA	PHE	PHE	ASN	LYS
ALA	ALA	LYS	LYS	TYR	PHE
GLY	GLY	ILE	ILE	LYS	ILE
ILE	ILE	ARG	ARG	THR	CYS
THR	THR	ASN	ASN	ALA	THR
LEU	LEU	ILE	ILE	GLU	GLY
GLY	GLY	GLU	GLU	VAL	LYS
MET	MET	ASP	ASP	LYS	LEU
ASP	ASP	GLY	GLY	PHE	PRO
GLU	GLU	SER	SER	GLU	VAL
LEU	LEU	VAL	VAL	GLY	PRO
TYR	TYR	GLN	GLN	ASP	TRP
LYS	LYS	LEU	LEU	THR	PRO
SER	SER	ALA	ALA	LEU	THR
GLY	GLY	ASP	ASP	VAL	LEU
GLY	GLY	HIS	HIS	ASN	VAL
THR	THR	TYR	TYR	ARG	THR
GLN	GLN	GLN	GLN	ILE	THR
THR	THR	ASN	ASN	LEU	LEU
SER	SER	THR	THR	LYS	THR
GLN	GLN	PRO	PRO	GLY	TYR
VAL	VAL	ILE	ILE	ILE	GLY
ALA	ALA	GLY	GLY	ASP	VAL
PRO	PRO	ASP	ASP	PHE	CYS
ALA	ALA	GLY	GLY	LYS	THR

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C7	Depositor
Number of particles used	937269	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 ($e^-/\text{\AA}^2$)	54	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	81000	Depositor
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	1.075	Depositor
Minimum map value	-0.264	Depositor
Average map value	0.002	Depositor
Map value standard deviation	0.036	Depositor
Recommended contour level	0.147	Depositor
Map size (Å)	275.2, 275.2, 275.2	wwPDB
Map dimensions	320, 320, 320	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.86, 0.86, 0.86	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	0.12	0/1608	0.27	0/2181
1	B	0.12	0/1608	0.27	0/2181
1	C	0.13	0/1608	0.28	0/2181
1	D	0.13	0/1608	0.29	0/2181
1	E	0.12	0/1608	0.26	0/2181
1	F	0.12	0/1608	0.27	0/2181
1	G	0.13	0/1608	0.30	0/2181
All	All	0.13	0/11256	0.28	0/15267

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 [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	1575	0	1632	20	0
1	B	1575	0	1632	16	0
1	C	1575	0	1632	18	0
1	D	1575	0	1632	17	0
1	E	1575	0	1632	13	0
1	F	1575	0	1632	21	0
1	G	1575	0	1632	23	0
All	All	11025	0	11424	112	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 5.

All (112) 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:C:407:GLU:N	1:C:407:GLU:OE2	2.22	0.73
1:B:334:GLU:N	1:B:334:GLU:OE1	2.23	0.72
1:D:407:GLU:N	1:D:407:GLU:OE2	2.23	0.71
1:A:407:GLU:OE2	1:A:407:GLU:N	2.22	0.70
1:G:334:GLU:OE1	1:G:334:GLU:N	2.31	0.63
1:E:407:GLU:OE2	1:E:408:ASN:HB2	1.99	0.63
1:B:272:THR:O	1:B:276:THR:HG23	2.01	0.59
1:F:272:THR:O	1:F:276:THR:HG23	2.03	0.59
1:D:334:GLU:OE1	1:D:334:GLU:N	2.38	0.57
1:G:407:GLU:OE1	1:G:408:ASN:HB2	2.04	0.57
1:B:407:GLU:N	1:B:407:GLU:OE2	2.36	0.56
1:G:287:LEU:HA	1:G:290:VAL:HG12	1.88	0.56
1:F:270:LEU:O	1:F:274:LEU:HD22	2.06	0.55
1:C:334:GLU:OE1	1:C:334:GLU:N	2.37	0.55
1:C:408:ASN:N	1:C:408:ASN:OD1	2.40	0.54
1:B:408:ASN:OD1	1:B:408:ASN:N	2.41	0.53
1:A:379:ASP:OD2	1:A:445:HIS:NE2	2.30	0.53
1:E:334:GLU:OE1	1:E:334:GLU:N	2.39	0.53
1:F:459:MET:HB2	1:G:455:THR:HG22	1.91	0.53
1:B:363:LEU:HD13	1:B:442:ILE:HD11	1.90	0.53
1:A:408:ASN:N	1:A:408:ASN:OD1	2.42	0.52
1:D:457:ARG:HG3	1:E:455:THR:HG23	1.91	0.52
1:E:283:LEU:O	1:E:287:LEU:HG	2.10	0.52
1:G:437:ASP:OD1	1:G:440:ARG:NH1	2.42	0.52
1:A:334:GLU:OE1	1:A:334:GLU:N	2.38	0.52
1:G:363:LEU:HD13	1:G:442:ILE:HD11	1.91	0.52
1:D:287:LEU:HA	1:D:290:VAL:HG12	1.92	0.51
1:C:363:LEU:HD13	1:C:442:ILE:HD11	1.91	0.51
1:G:283:LEU:O	1:G:287:LEU:HG	2.10	0.51
1:A:283:LEU:O	1:A:287:LEU:HG	2.10	0.51
1:F:334:GLU:N	1:F:334:GLU:OE1	2.37	0.51
1:C:379:ASP:OD2	1:C:445:HIS:NE2	2.32	0.51
1:C:437:ASP:O	1:C:441:VAL:HG12	2.12	0.50
1:C:283:LEU:O	1:C:287:LEU:HG	2.12	0.50
1:D:459:MET:HB2	1:E:455:THR:HG22	1.93	0.49
1:B:283:LEU:O	1:B:287:LEU:HG	2.13	0.49
1:F:408:ASN:OD1	1:F:408:ASN:N	2.39	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:F:284:THR:O	1:F:287:LEU:HD12	2.13	0.49
1:G:284:THR:O	1:G:287:LEU:HD12	2.13	0.49
1:A:437:ASP:OD1	1:A:440:ARG:NH1	2.45	0.49
1:D:284:THR:O	1:D:287:LEU:HD12	2.13	0.49
1:E:437:ASP:OD1	1:E:440:ARG:NH1	2.45	0.49
1:D:408:ASN:OD1	1:D:408:ASN:N	2.39	0.48
1:G:437:ASP:O	1:G:441:VAL:HG12	2.12	0.48
1:G:367:HIS:HB3	1:G:409:GLN:O	2.13	0.48
1:E:284:THR:O	1:E:287:LEU:HD12	2.14	0.48
1:E:457:ARG:HG3	1:F:455:THR:HG23	1.95	0.47
1:A:284:THR:O	1:A:287:LEU:HD12	2.14	0.47
1:F:363:LEU:HD13	1:F:442:ILE:HD11	1.95	0.47
1:E:291:MET:HA	1:E:291:MET:HE2	1.96	0.47
1:B:284:THR:O	1:B:287:LEU:HD12	2.14	0.47
1:B:459:MET:HB2	1:C:455:THR:HG22	1.95	0.47
1:E:367:HIS:HB3	1:E:409:GLN:O	2.15	0.47
1:F:356:HIS:HB2	1:G:333:ARG:HD3	1.97	0.47
1:A:459:MET:HB2	1:B:455:THR:HG22	1.96	0.47
1:D:342:LYS:HE3	1:D:342:LYS:HB3	1.66	0.47
1:F:437:ASP:O	1:F:441:VAL:HG12	2.14	0.47
1:C:284:THR:O	1:C:287:LEU:HD12	2.14	0.47
1:C:342:LYS:HE3	1:C:342:LYS:HB3	1.67	0.47
1:F:287:LEU:HA	1:F:290:VAL:HG12	1.95	0.47
1:C:291:MET:HA	1:C:291:MET:HE2	1.97	0.46
1:D:283:LEU:O	1:D:287:LEU:HG	2.15	0.46
1:F:379:ASP:OD2	1:F:445:HIS:NE2	2.41	0.46
1:A:356:HIS:HB2	1:B:333:ARG:HD3	1.97	0.46
1:G:408:ASN:O	1:G:408:ASN:ND2	2.26	0.46
1:A:333:ARG:HD3	1:G:356:HIS:HB2	1.97	0.46
1:A:363:LEU:HD13	1:A:442:ILE:HD11	1.96	0.46
1:B:356:HIS:HB2	1:C:333:ARG:HD3	1.98	0.46
1:F:283:LEU:O	1:F:287:LEU:HG	2.15	0.46
1:F:459:MET:HE2	1:G:457:ARG:HD2	1.98	0.46
1:C:356:HIS:HB2	1:D:333:ARG:HD3	1.98	0.45
1:D:367:HIS:HB3	1:D:409:GLN:O	2.16	0.45
1:C:367:HIS:HB3	1:C:409:GLN:O	2.16	0.45
1:A:367:HIS:HB3	1:A:409:GLN:O	2.17	0.45
1:E:356:HIS:HB2	1:F:333:ARG:HD3	1.98	0.45
1:C:380:MET:HB2	1:C:399:VAL:HG11	1.99	0.45
1:F:367:HIS:HB3	1:F:409:GLN:O	2.16	0.45
1:G:342:LYS:HE3	1:G:342:LYS:HB3	1.67	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:F:339:PRO:HD2	1:F:342:LYS:HG3	2.00	0.44
1:D:356:HIS:HB2	1:E:333:ARG:HD3	1.99	0.44
1:F:391:GLU:HA	1:F:420:LYS:HD3	1.99	0.44
1:D:380:MET:HB2	1:D:399:VAL:HG11	2.00	0.43
1:G:283:LEU:HD13	1:G:283:LEU:HA	1.89	0.43
1:A:362:HIS:NE2	1:A:402:GLU:OE2	2.50	0.43
1:B:367:HIS:HB3	1:B:409:GLN:O	2.19	0.43
1:B:380:MET:HB2	1:B:399:VAL:HG11	2.00	0.43
1:D:287:LEU:O	1:D:291:MET:HG3	2.19	0.43
1:C:437:ASP:OD1	1:C:440:ARG:NH1	2.51	0.43
1:G:408:ASN:HD22	1:G:408:ASN:C	2.15	0.43
1:A:339:PRO:HD2	1:A:342:LYS:HG3	2.01	0.42
1:A:405:ILE:HG22	1:A:407:GLU:OE2	2.19	0.42
1:G:287:LEU:O	1:G:291:MET:HG3	2.20	0.42
1:A:405:ILE:HD11	1:A:412:SER:HB2	2.01	0.42
1:B:287:LEU:O	1:B:290:VAL:HG12	2.20	0.42
1:B:300:LEU:HD23	1:B:300:LEU:HA	1.92	0.42
1:G:339:PRO:HD2	1:G:342:LYS:HG3	2.02	0.42
1:D:339:PRO:HD2	1:D:342:LYS:HG3	2.02	0.41
1:A:455:THR:HG22	1:G:459:MET:HB2	2.01	0.41
1:C:287:LEU:O	1:C:290:VAL:HG12	2.20	0.41
1:F:380:MET:SD	1:F:438:LEU:HD22	2.60	0.41
1:A:287:LEU:O	1:A:290:VAL:HG12	2.20	0.41
1:D:391:GLU:HA	1:D:420:LYS:HD3	2.02	0.41
1:F:291:MET:HE2	1:F:291:MET:HB2	1.84	0.41
1:G:391:GLU:HA	1:G:420:LYS:HD3	2.02	0.41
1:A:386:LYS:HB2	1:A:386:LYS:NZ	2.36	0.41
1:F:380:MET:HB2	1:F:399:VAL:HG11	2.04	0.41
1:B:339:PRO:HD2	1:B:342:LYS:HG3	2.04	0.40
1:E:287:LEU:O	1:E:290:VAL:HG12	2.22	0.40
1:D:363:LEU:HD13	1:D:442:ILE:HD11	2.03	0.40
1:G:300:LEU:HD23	1:G:300:LEU:HA	1.89	0.40
1:C:339:PRO:HD2	1:C:342:LYS:HG3	2.02	0.40
1:A:282:ILE:HG22	1:G:291:MET:HE1	2.04	0.40

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	192/866 (22%)	190 (99%)	2 (1%)	0	100	100
1	B	192/866 (22%)	188 (98%)	4 (2%)	0	100	100
1	C	192/866 (22%)	190 (99%)	2 (1%)	0	100	100
1	D	192/866 (22%)	189 (98%)	3 (2%)	0	100	100
1	E	192/866 (22%)	189 (98%)	3 (2%)	0	100	100
1	F	192/866 (22%)	191 (100%)	1 (0%)	0	100	100
1	G	192/866 (22%)	189 (98%)	3 (2%)	0	100	100
All	All	1344/6062 (22%)	1326 (99%)	18 (1%)	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	175/750 (23%)	175 (100%)	0	100	100
1	B	175/750 (23%)	174 (99%)	1 (1%)	78	89
1	C	175/750 (23%)	173 (99%)	2 (1%)	65	81
1	D	175/750 (23%)	174 (99%)	1 (1%)	78	89
1	E	175/750 (23%)	172 (98%)	3 (2%)	53	72
1	F	175/750 (23%)	172 (98%)	3 (2%)	53	72
1	G	175/750 (23%)	172 (98%)	3 (2%)	53	72

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	1225/5250 (23%)	1212 (99%)	13 (1%)	63 81

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	461	THR
1	C	441	VAL
1	C	461	THR
1	D	408	ASN
1	E	291	MET
1	E	408	ASN
1	E	455	THR
1	F	300	LEU
1	F	441	VAL
1	F	455	THR
1	G	408	ASN
1	G	441	VAL
1	G	461	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	319	HIS
1	B	319	HIS
1	B	424	HIS
1	C	319	HIS
1	D	319	HIS
1	E	305	GLN
1	E	319	HIS
1	E	367	HIS
1	F	367	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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.

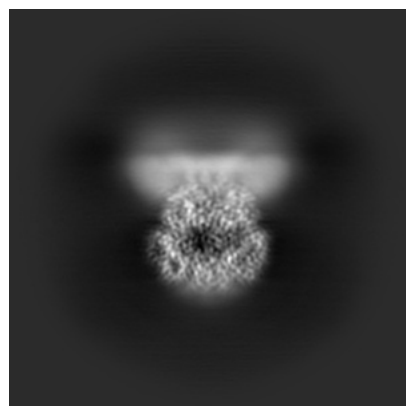
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-78957. These allow visual inspection of the internal detail of the map and identification of artifacts.

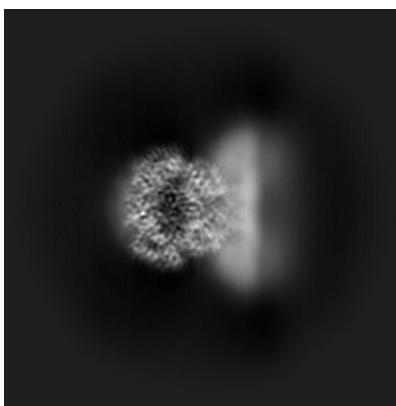
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

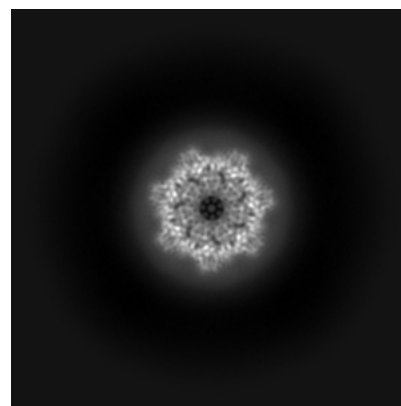
6.1.1 Primary map



X

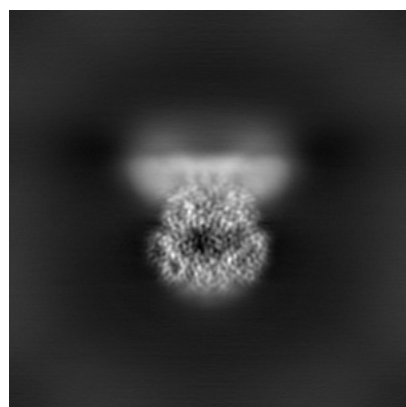


Y

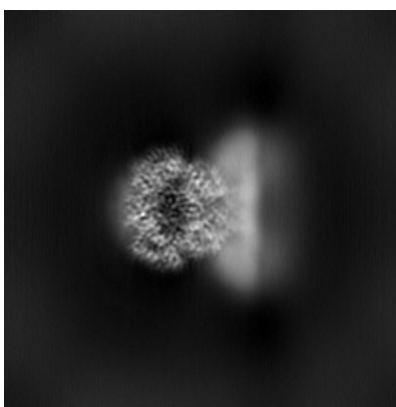


Z

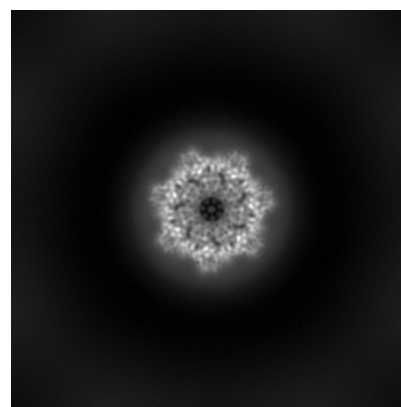
6.1.2 Raw map



X



Y

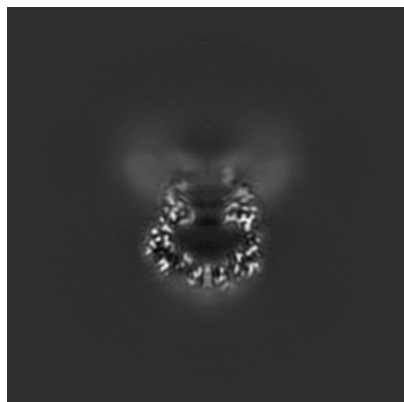


Z

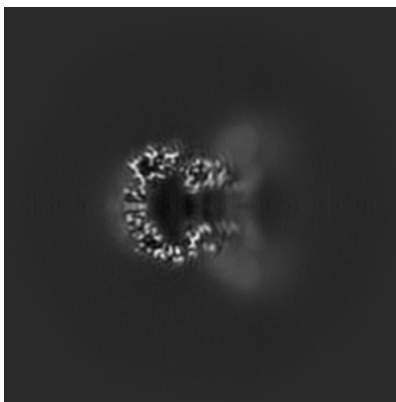
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

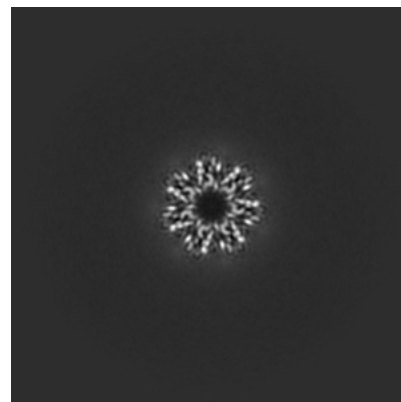
6.2.1 Primary map



X Index: 160

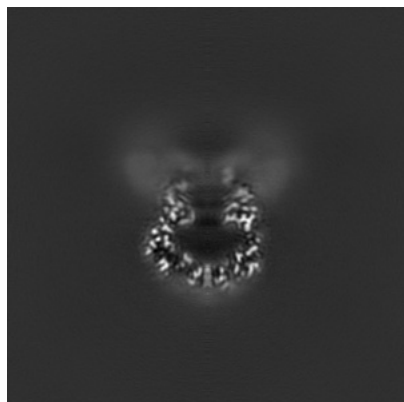


Y Index: 160

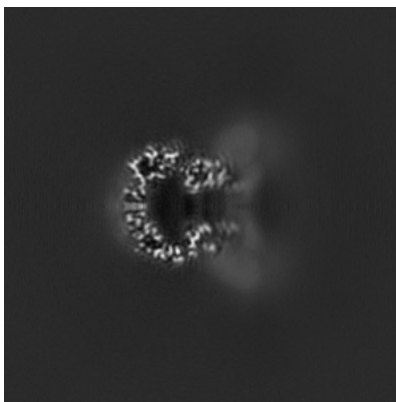


Z Index: 160

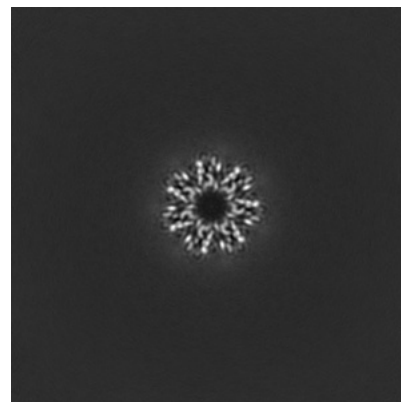
6.2.2 Raw map



X Index: 160



Y Index: 160

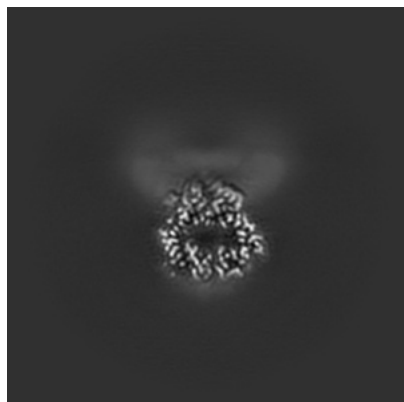


Z Index: 160

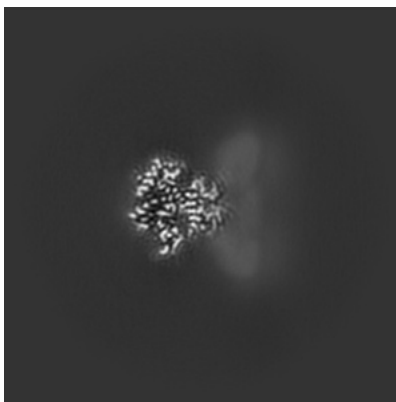
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

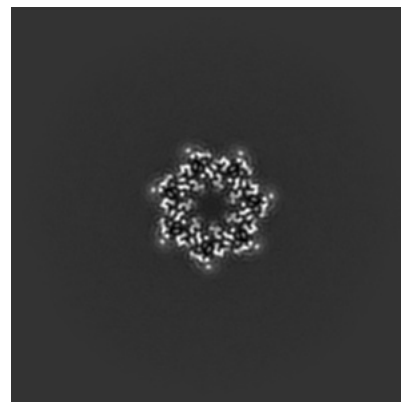
6.3.1 Primary map



X Index: 138

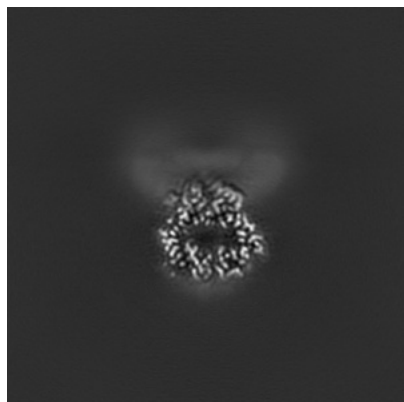


Y Index: 128

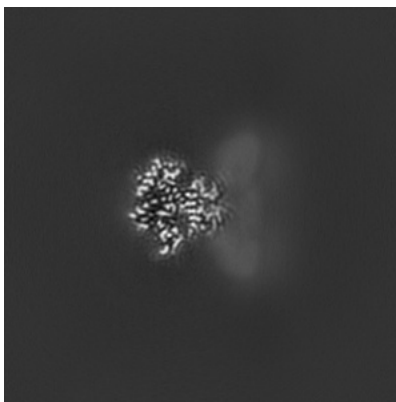


Z Index: 121

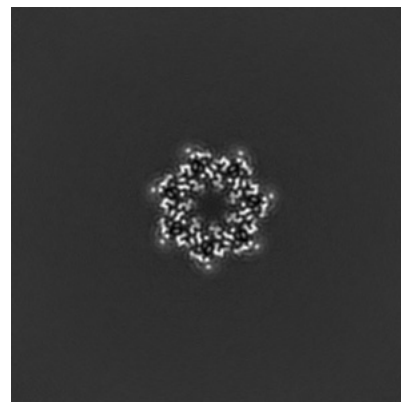
6.3.2 Raw map



X Index: 138



Y Index: 128

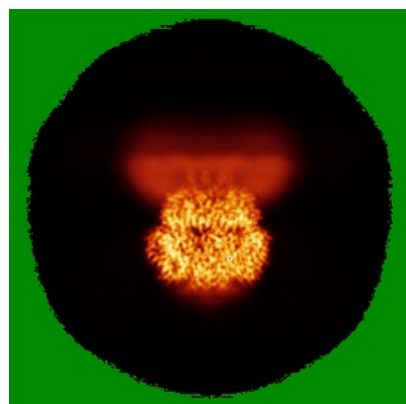


Z Index: 121

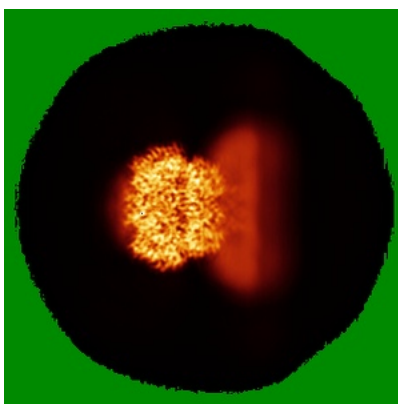
The images above show the largest variance slices of the map in three orthogonal directions.

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

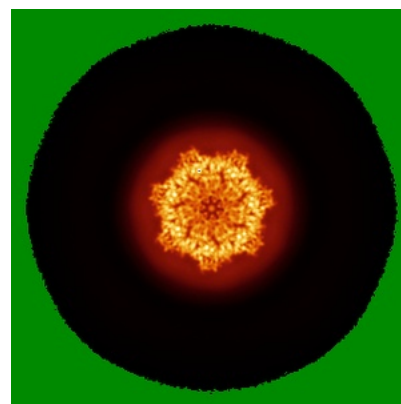
6.4.1 Primary map



X

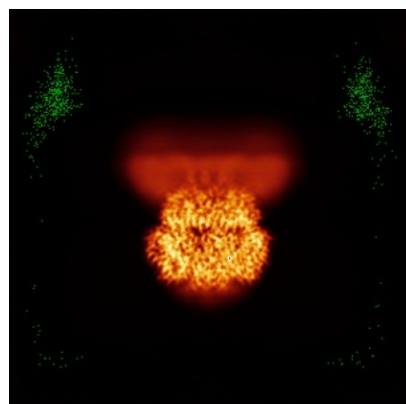


Y

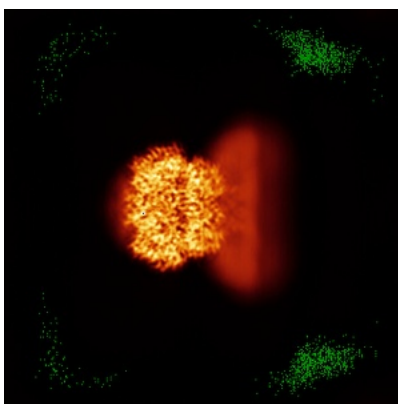


Z

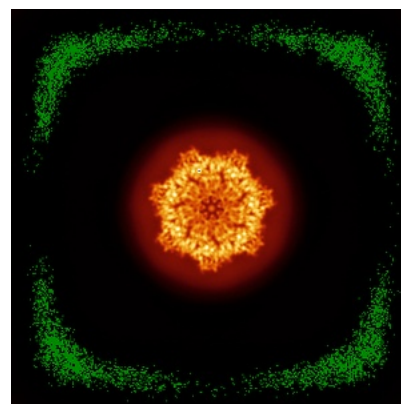
6.4.2 Raw map



X



Y

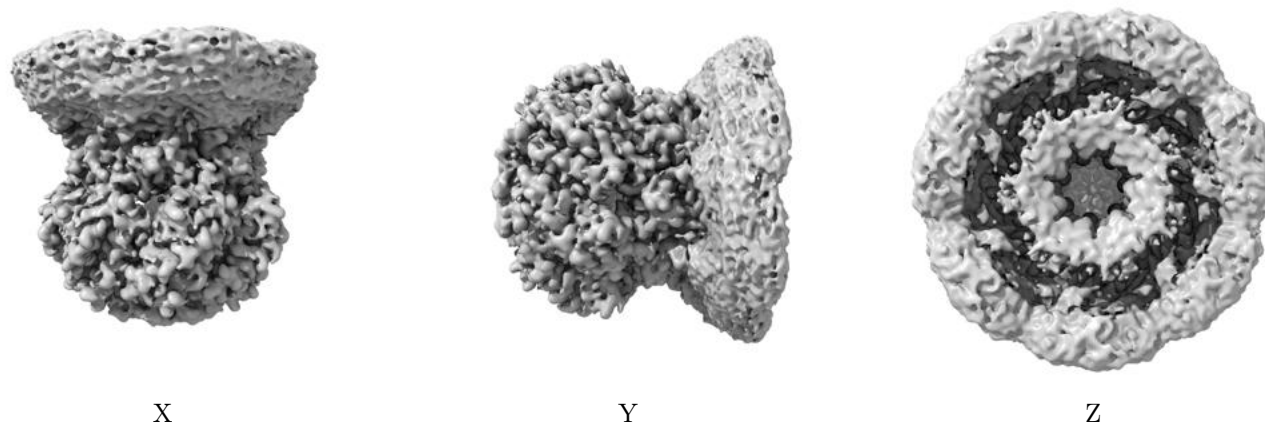


Z

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.

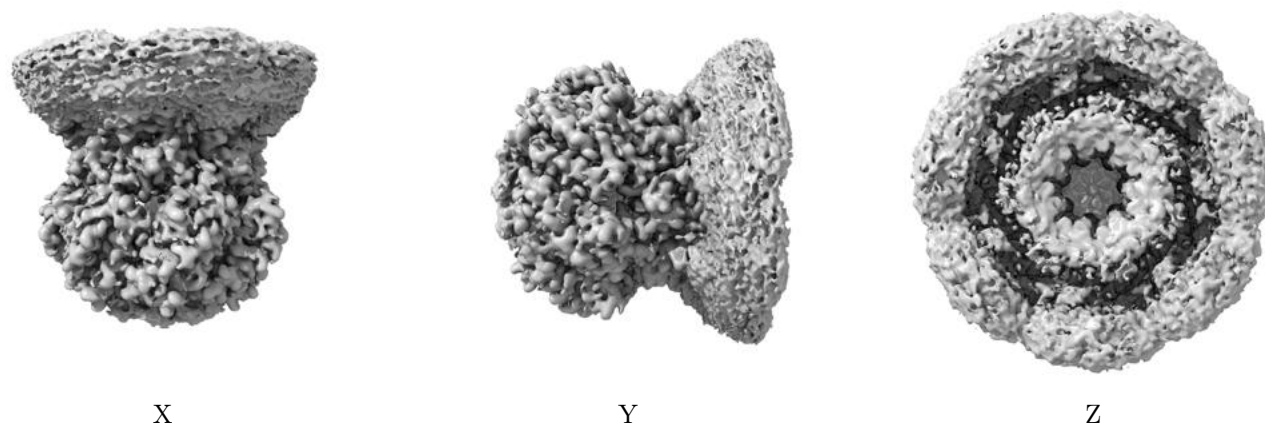
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.147. 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.

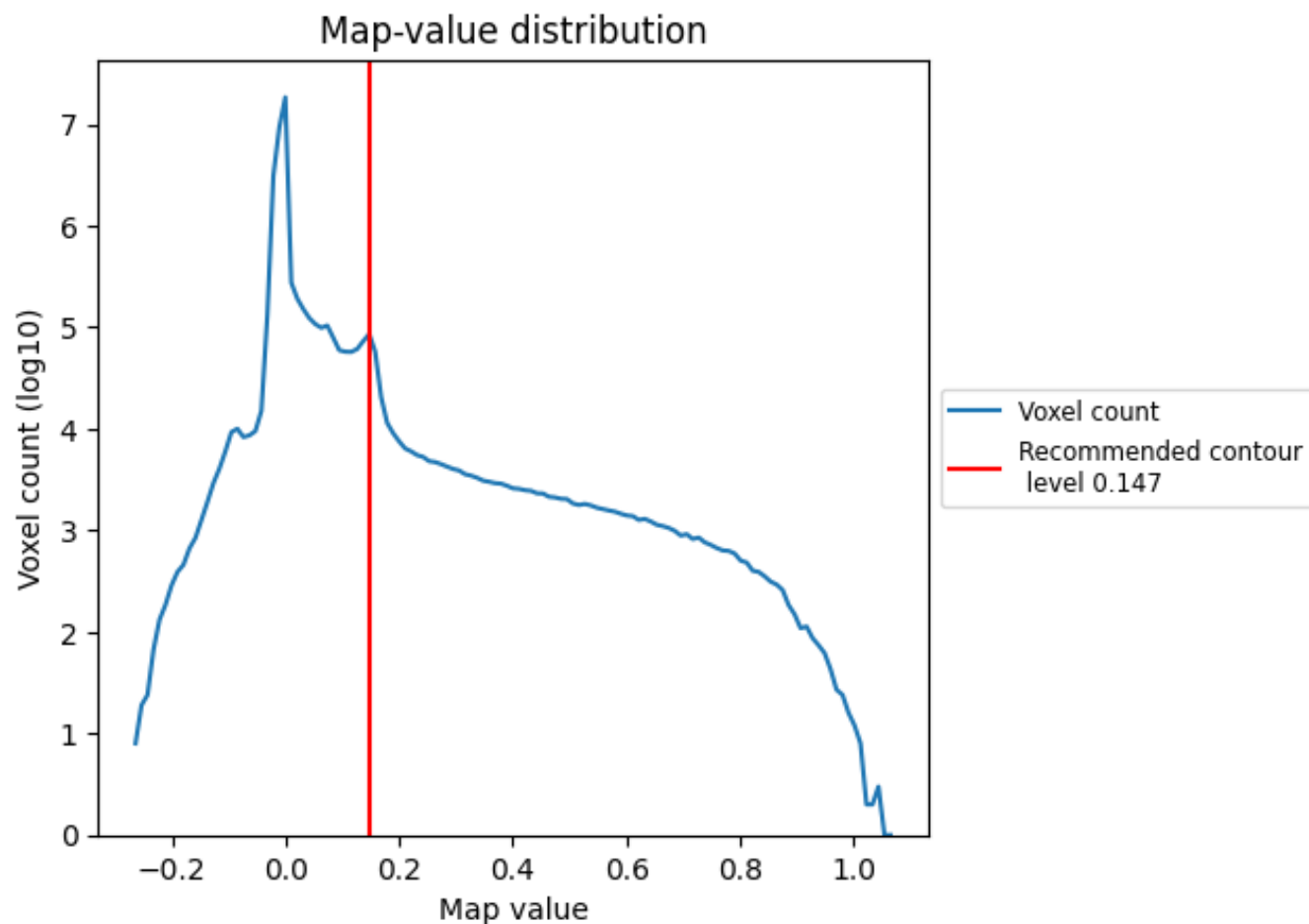
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

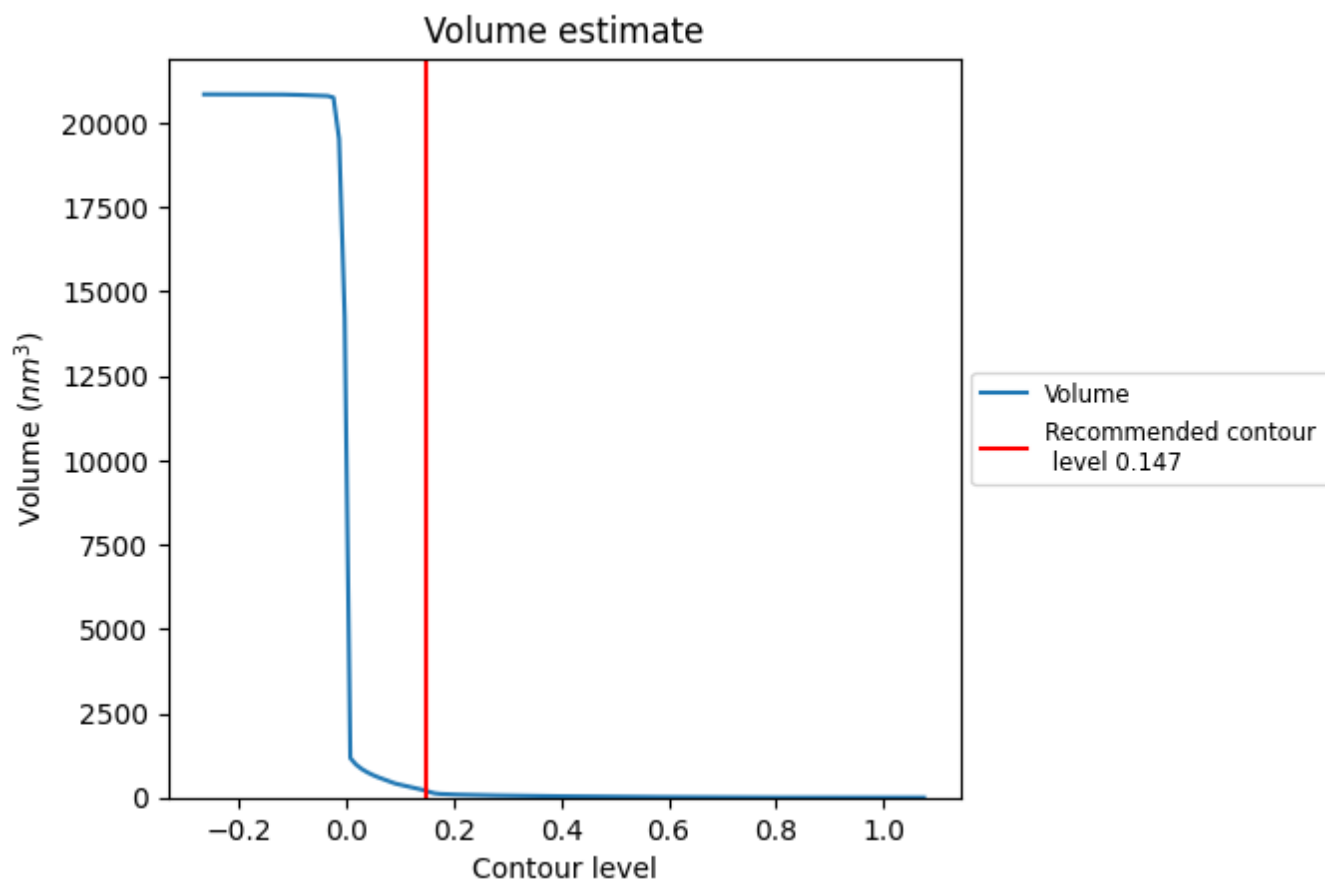
This section contains the results of statistical analysis of the map.

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.

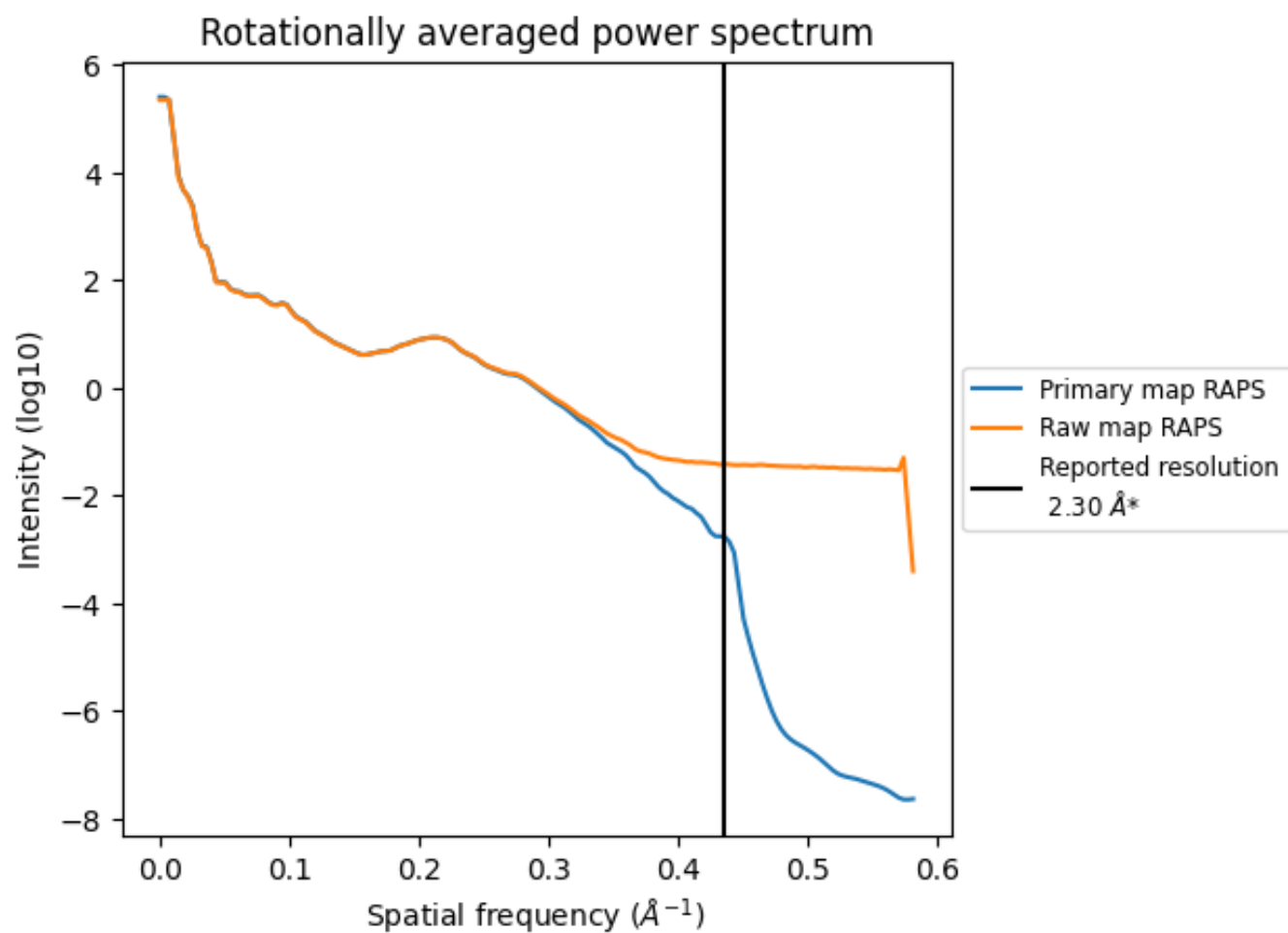
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 207 nm^3 ; this corresponds to an approximate mass of 187 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 ⓘ

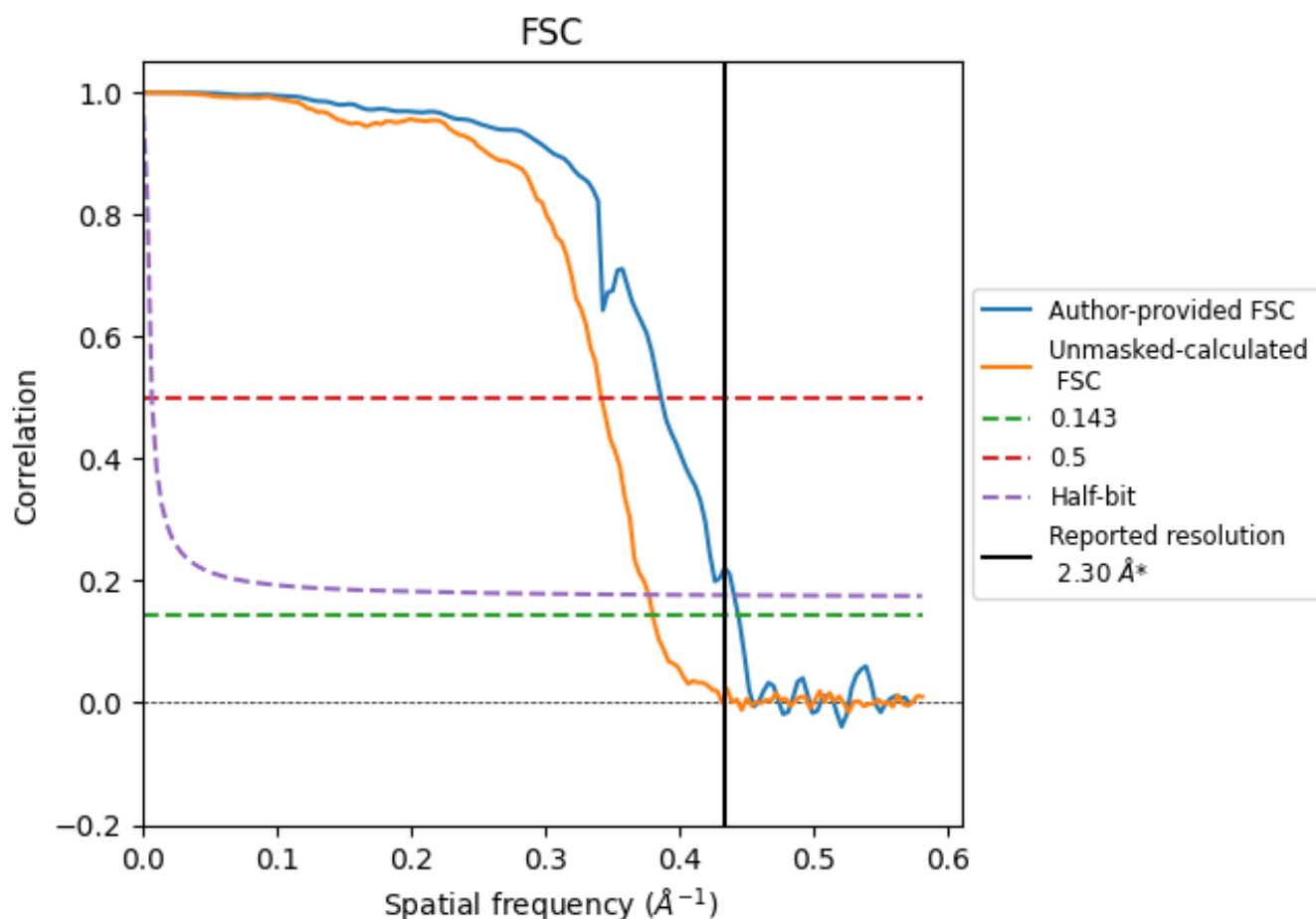


*Reported resolution corresponds to spatial frequency of 0.435 $\text{\AA}^{-1}$

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 0.435 $\text{\AA}^{-1}$

8.2 Resolution estimates [i](#)

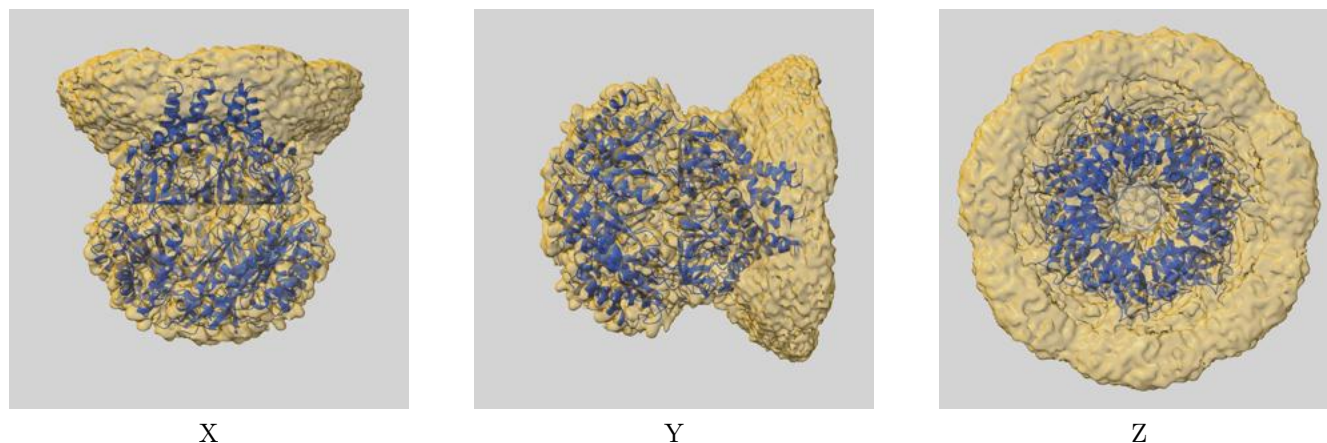
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	2.30	-	-
Author-provided FSC curve	2.25	2.59	2.27
Unmasked-calculated*	2.63	2.92	2.65

*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 2.63 differs from the reported value 2.3 by more than 10 %

9 Map-model fit [i](#)

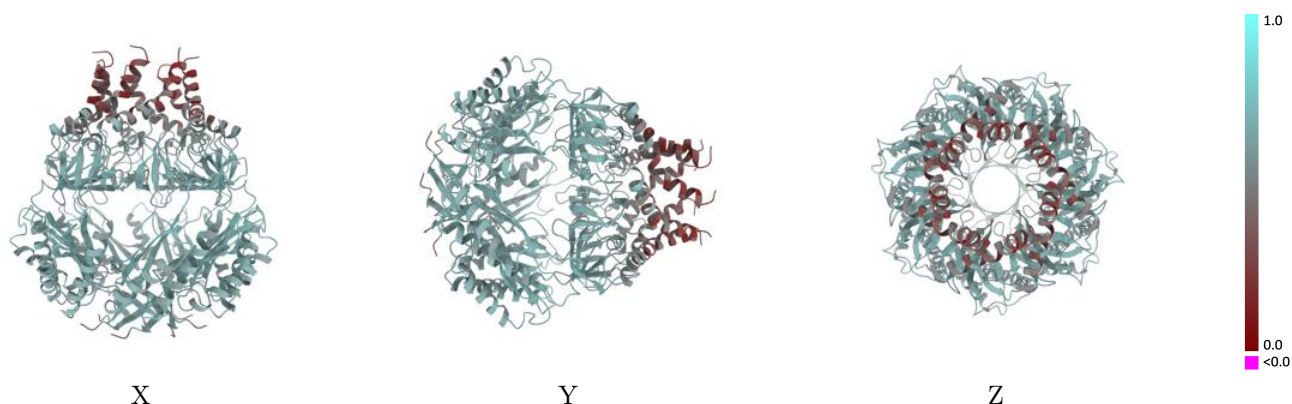
This section contains information regarding the fit between EMDB map EMD-78957 and PDB model 38OA. Per-residue inclusion information can be found in section [3](#) on page [11](#).

9.1 Map-model overlay [i](#)



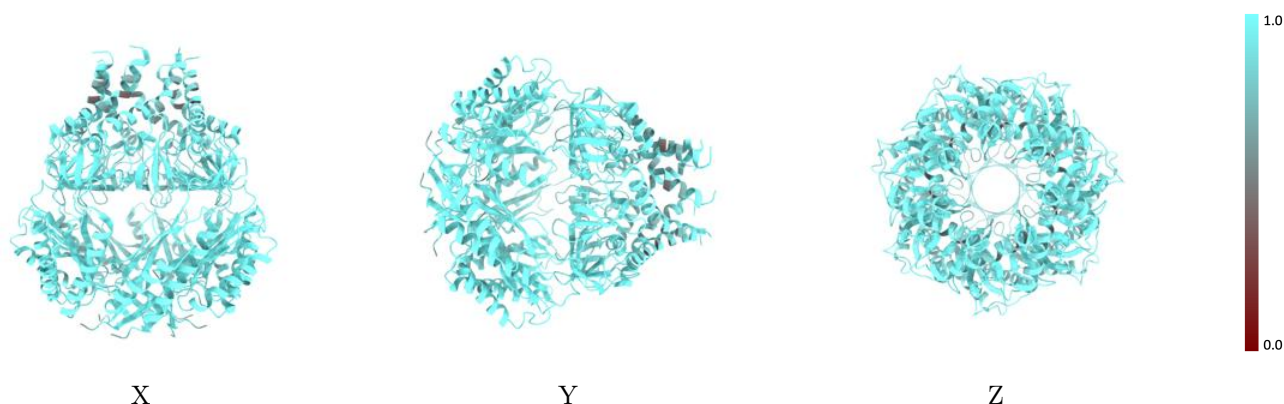
The images above show the 3D surface view of the map at the recommended contour level 0.147 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



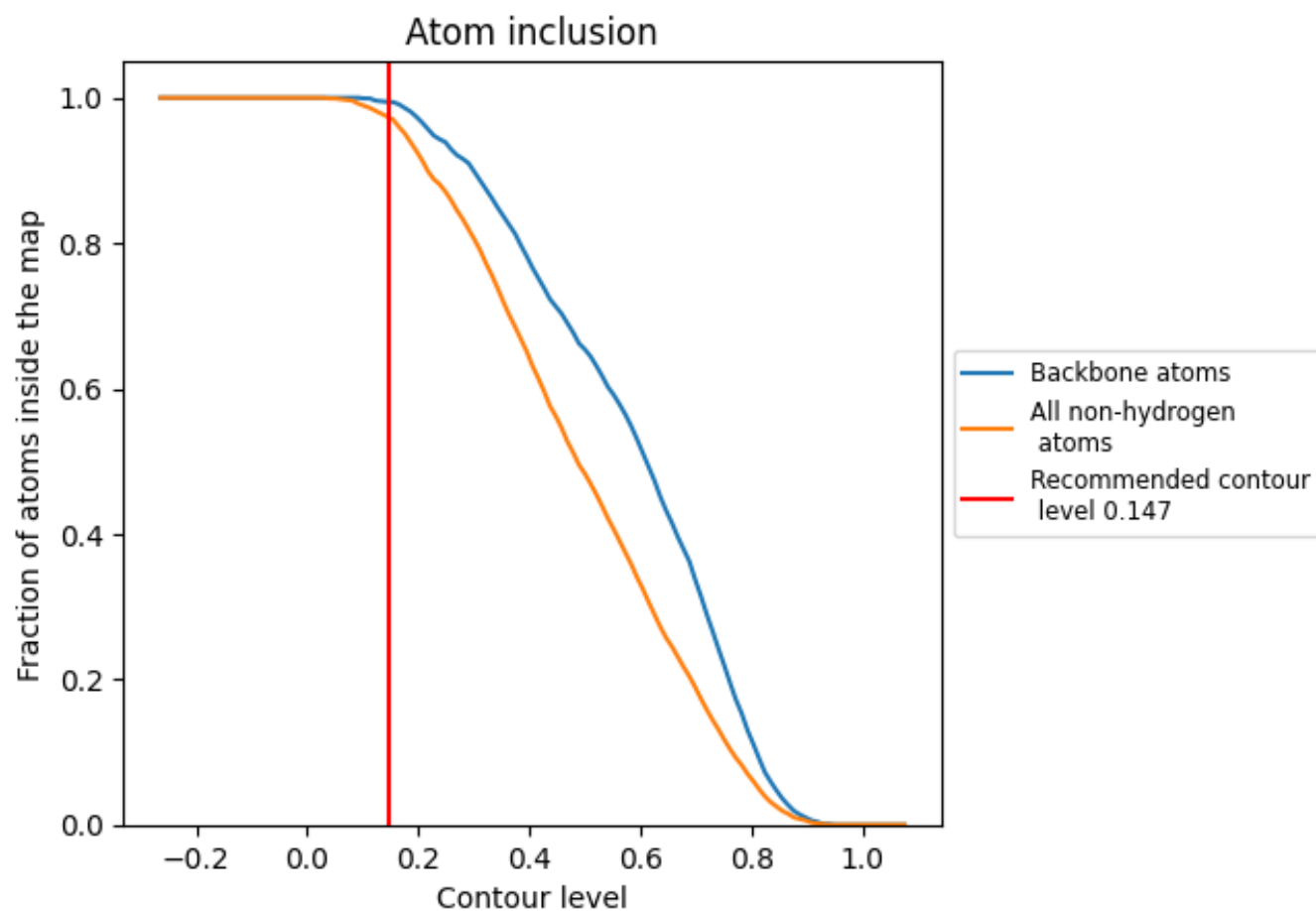
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.147).

9.4 Atom inclusion ⓘ



At the recommended contour level, 99% of all backbone atoms, 97% 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 (0.147) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.9730	0.5810
A	0.9730	0.5820
B	0.9720	0.5800
C	0.9730	0.5810
D	0.9730	0.5800
E	0.9720	0.5810
F	0.9710	0.5810
G	0.9730	0.5790

1.0

0.0

<0.0