wwPDB EM Validation Summary Report (i)

Feb 24, 2024 – 09:18 PM EST

PDB ID	:	6XNX
EMDB ID	:	EMD-22272
Title	:	Structure of RAG1 (R848M/E649V)-RAG2-DNA Strand Transfer Complex (Dynamic-Form)
Authors	:	Zhang, Y.; Corbett, E.; Wu, S.; Schatz, D.G.
Deposited on	:	2020-07-05
Resolution	:	2.70 Å(reported)
Based on initial model	:	5ZDZ

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 (i) 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 (i)) were used in the production of this report:

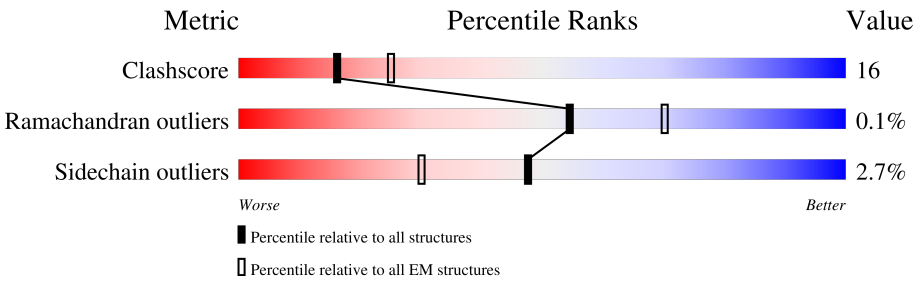
EMDB validation analysis	:	0.0.1.dev70
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ	:	1.9.13
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

The reported resolution of this entry is 2.70 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 <=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	750	• 46% 27% • 27%
1	C	750	• 46% 27% • 27%
2	B	363	8% 63% 30% • 6%
2	D	363	12% 58% 36% • 6%
3	x	55	15% 56% • 42%
4	y	66	8% 41% • 58%
5	I	16	31% 31% 56% 12%
5	J	16	31% 25% 62% 12%

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Mol	Chain	Length	Quality of chain
6	L	45	18% 9% 73%
7	M	34	26% 21% 53%

2 Entry composition (i)

There are 9 unique types of molecules in this entry. The entry contains 16540 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 V(D)J recombination-activating protein 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	549	4407	2781	770	823	33	0	0
1	C	548	4401	2778	769	821	33	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	259	GLY	-	expression tag	UNP P15919
A	260	PRO	-	expression tag	UNP P15919
A	649	VAL	GLU	engineered mutation	UNP P15919
A	848	MET	ARG	engineered mutation	UNP P15919
C	259	GLY	-	expression tag	UNP P15919
C	260	PRO	-	expression tag	UNP P15919
C	649	VAL	GLU	engineered mutation	UNP P15919
C	848	MET	ARG	engineered mutation	UNP P15919

- Molecule 2 is a protein called V(D)J recombination-activating protein 2.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	B	342	2678	1712	454	492	20	0	0
2	D	343	2688	1718	456	494	20	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-1	GLY	-	expression tag	UNP P21784
B	0	PRO	-	expression tag	UNP P21784
B	1	MET	-	expression tag	UNP P21784
B	2	ALA	-	expression tag	UNP P21784
D	-1	GLY	-	expression tag	UNP P21784

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Chain	Residue	Modelled	Actual	Comment	Reference
D	0	PRO	-	expression tag	UNP P21784
D	1	MET	-	expression tag	UNP P21784
D	2	ALA	-	expression tag	UNP P21784

- Molecule 3 is a DNA chain called 12RSS integration strand DNA (55-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
3	x	32	644	308	112	193	31	0	0

- Molecule 4 is a DNA chain called 23RSS integration strand DNA (66-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
4	y	28	564	270	99	168	27	0	0

- Molecule 5 is a DNA chain called Flanking DNA top strand DNA.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
5	I	14	288	137	58	80	13	0	0
5	J	14	288	137	58	80	13	0	0

- Molecule 6 is a DNA chain called 23RSS signal top strand DNA (45-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
6	L	12	246	118	47	70	11	0	0

- Molecule 7 is a DNA chain called 12RSS signal top strand DNA (34-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
7	M	16	330	157	65	93	15	0	0

- Molecule 8 is MAGNESIUM ION (three-letter code: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
			Total	Mg	
8	A	2	2	2	0
8	C	1	1	1	0
8	x	1	1	1	0

- Molecule 9 is ZINC ION (three-letter code: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

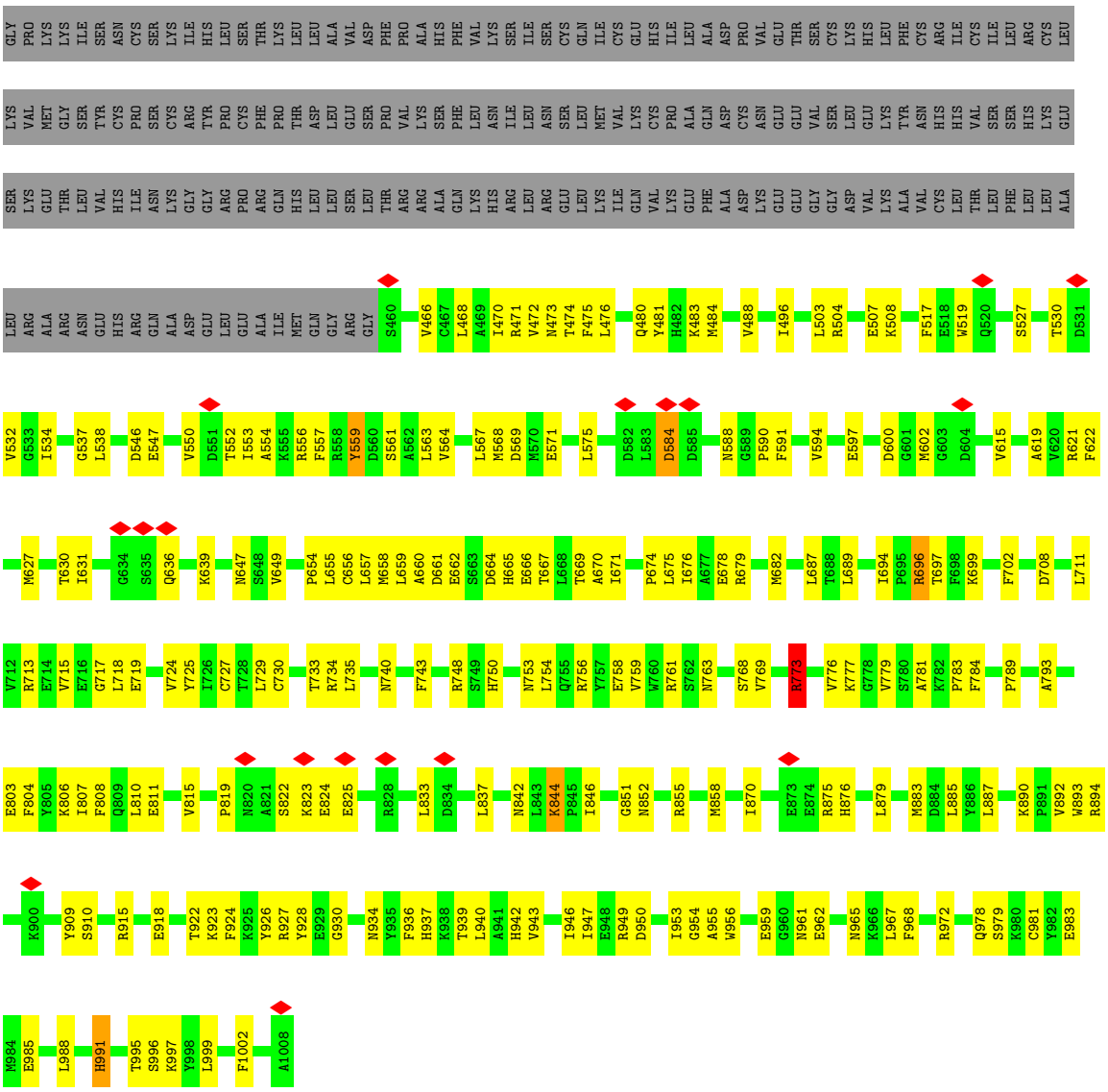
Mol	Chain	Residues	Atoms		AltConf
			Total	Zn	
9	A	1	1	1	0
9	C	1	1	1	0

3 Residue-property plots (i)

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.

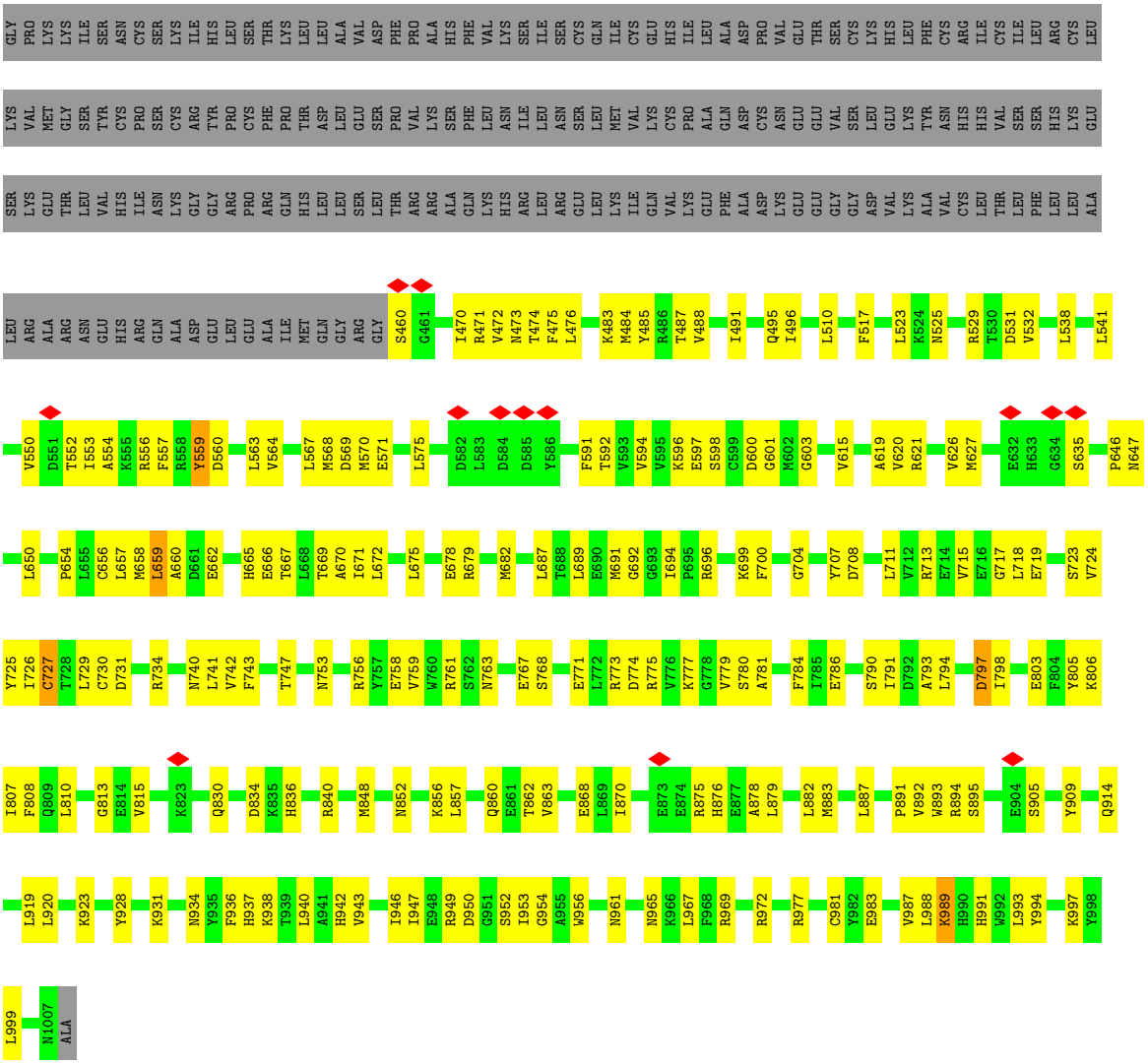
• Molecule 1: V(D)J recombination-activating protein 1

Chain A: 46% 27% 27%



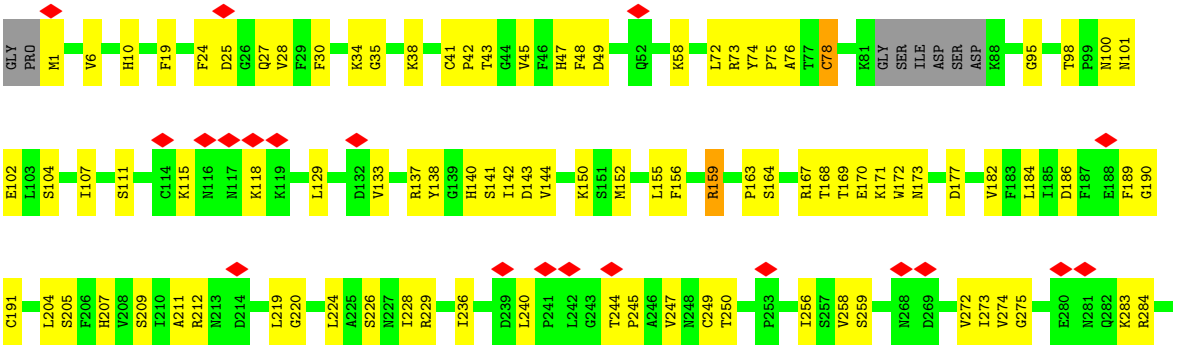
• Molecule 1: V(D)J recombination-activating protein 1

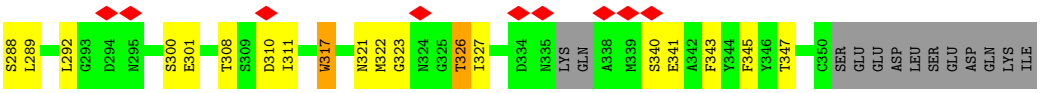
Chain C:



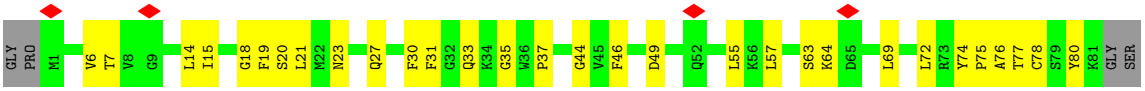
- Molecule 2: V(D)J recombination-activating protein 2

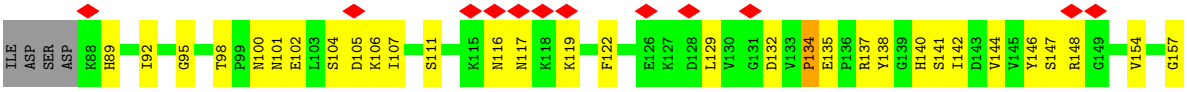
Chain B:

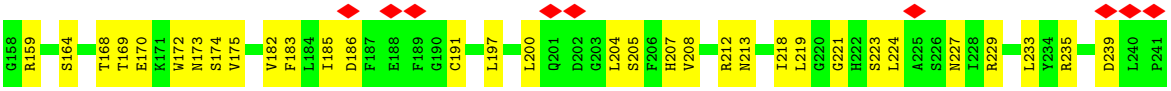


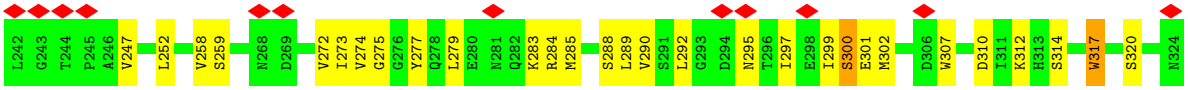


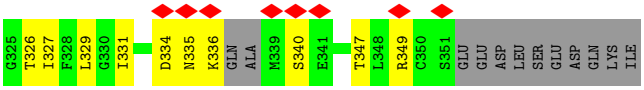
• Molecule 2: V(D)J recombination-activating protein 2



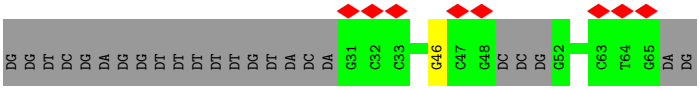




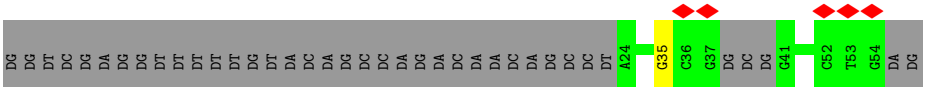




• Molecule 3: 12RSS integration strand DNA (55-MER)



• Molecule 4: 23RSS integration strand DNA (66-MER)



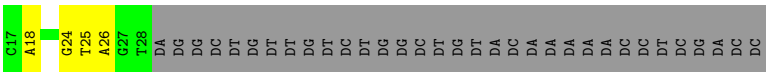
• Molecule 5: Flanking DNA top strand DNA

• Molecule 5: Flanking DNA top strand DNA

Chain J:

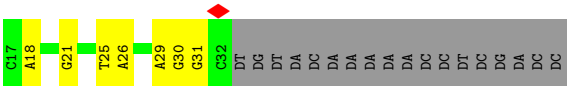
- Molecule 6: 23RSS signal top strand DNA (45-MER)

Chain L:



- Molecule 7: 12RSS signal top strand DNA (34-MER)

Chain M:



4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	106374	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 ($e^-/Å^2$)	72.8	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	2300	Depositor
Magnification	130000	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	0.200	Depositor
Minimum map value	-0.092	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.006	Depositor
Recommended contour level	0.03	Depositor
Map size (Å)	256.19998, 256.19998, 256.19998	wwPDB
Map dimensions	244, 244, 244	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.05, 1.05, 1.05	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: ZN, MG

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	0.63	0/4504	0.51	1/6074 (0.0%)
1	C	0.64	0/4498	0.51	0/6067
2	B	0.60	0/2745	0.51	0/3718
2	D	0.60	0/2755	0.53	0/3730
3	x	0.88	0/718	0.99	1/1102 (0.1%)
4	y	0.92	0/629	0.99	1/965 (0.1%)
5	I	0.77	0/324	0.80	0/499
5	J	0.77	0/324	0.80	0/499
6	L	1.22	0/276	0.95	0/425
7	M	1.19	0/371	0.92	0/572
All	All	0.68	0/17144	0.61	3/23651 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	y	35	DG	C1'-O4'-C4'	-7.00	103.10	110.10
3	x	46	DG	C1'-O4'-C4'	-6.84	103.26	110.10
1	A	773	ARG	CG-CD-NE	-5.96	99.28	111.80

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	4407	0	4363	155	0
1	C	4401	0	4358	148	0
2	B	2678	0	2643	83	0
2	D	2688	0	2656	102	0
3	x	644	0	363	0	0
4	y	564	0	318	0	0
5	I	288	0	158	7	0
5	J	288	0	157	11	0
6	L	246	0	137	4	0
7	M	330	0	181	6	0
8	A	2	0	0	0	0
8	C	1	0	0	0	0
8	x	1	0	0	0	0
9	A	1	0	0	0	0
9	C	1	0	0	0	0
All	All	16540	0	15334	473	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 16.

The worst 5 of 473 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:A:470:ILE:O	1:A:474:THR:HG23	1.70	0.90
2:B:152:MET:HG2	2:B:240:LEU:HD21	1.60	0.83
2:D:212:ARG:NH1	2:D:213:ASN:OD1	2.13	0.81
1:C:470:ILE:O	1:C:474:THR:HG23	1.83	0.77
2:D:117:ASN:O	2:D:117:ASN:OD1	2.02	0.77

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	547/750 (73%)	513 (94%)	33 (6%)	1 (0%)	47	73
1	C	546/750 (73%)	520 (95%)	26 (5%)	0	100	100
2	B	336/363 (93%)	308 (92%)	28 (8%)	0	100	100
2	D	337/363 (93%)	305 (90%)	31 (9%)	1 (0%)	41	66
All	All	1766/2226 (79%)	1646 (93%)	118 (7%)	2 (0%)	54	78

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	823	LYS
2	D	134	PRO

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	486/668 (73%)	476 (98%)	10 (2%)	53	80
1	C	486/668 (73%)	473 (97%)	13 (3%)	44	74
2	B	299/318 (94%)	289 (97%)	10 (3%)	38	67
2	D	301/318 (95%)	291 (97%)	10 (3%)	38	67
All	All	1572/1972 (80%)	1529 (97%)	43 (3%)	48	74

5 of 43 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	780	SER
2	D	147	SER
1	C	797	ASP
1	C	989	LYS
2	D	175	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	473	ASN
2	D	117	ASN
2	D	207	HIS
2	B	101	ASN
1	A	744	HIS

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)

Of 6 ligands modelled in this entry, 6 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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.

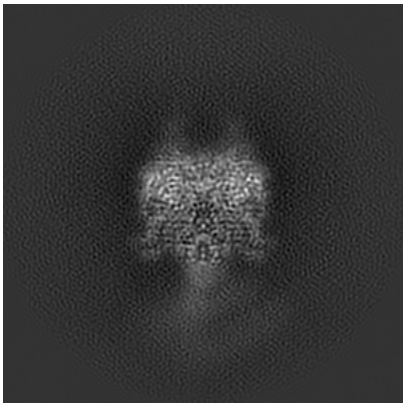
6 Map visualisation (i)

This section contains visualisations of the EMDB entry EMD-22272. These allow visual inspection of the internal detail of the map and identification of artifacts.

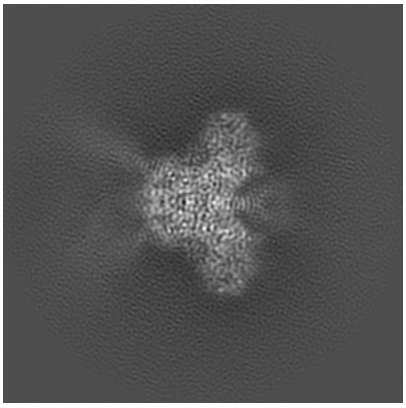
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections (i)

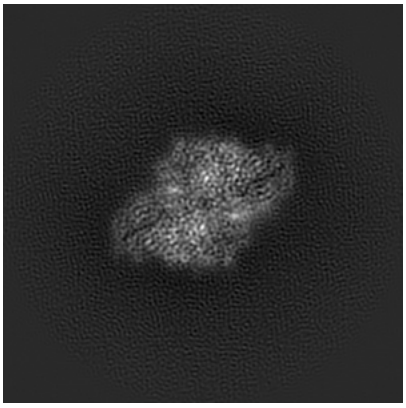
6.1.1 Primary map



X



Y

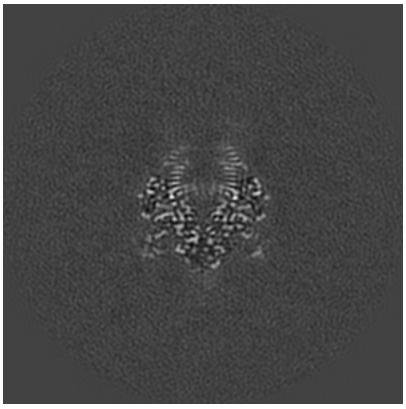


Z

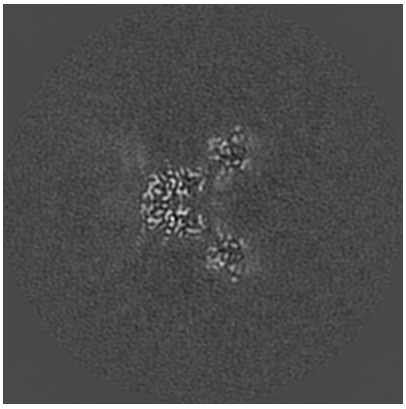
The images above show the map projected in three orthogonal directions.

6.2 Central slices (i)

6.2.1 Primary map



X Index: 122



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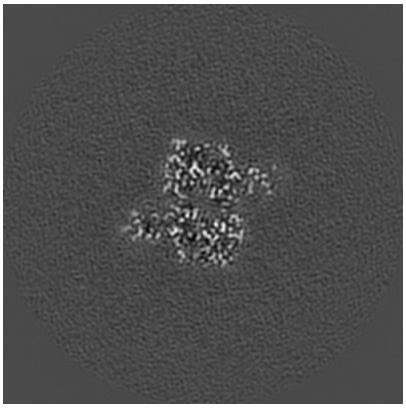
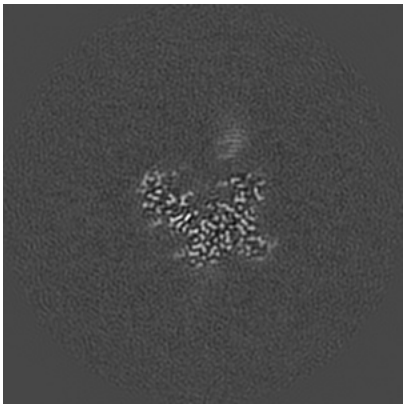


Z Index: 122

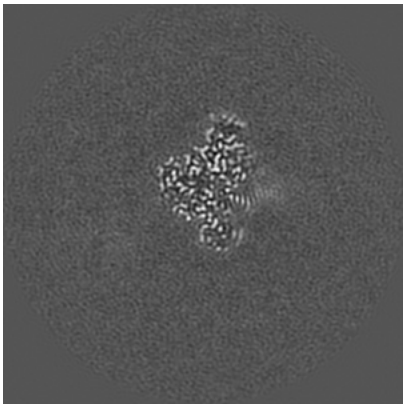
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices (i)

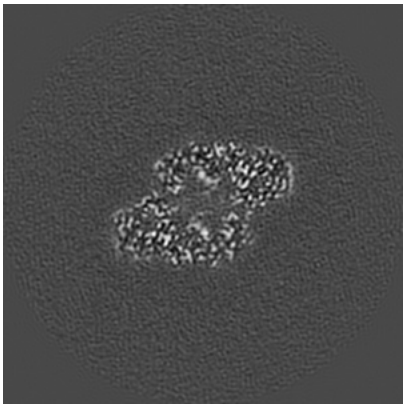
6.3.1 Primary map



X Index: 129



Y Index: 142

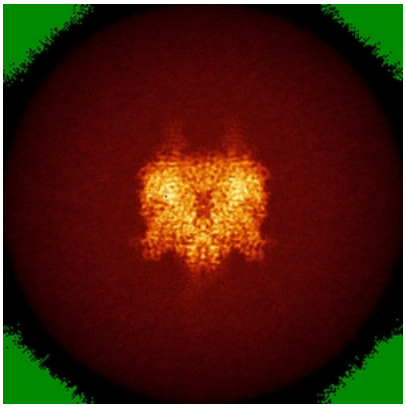


Z Index: 134

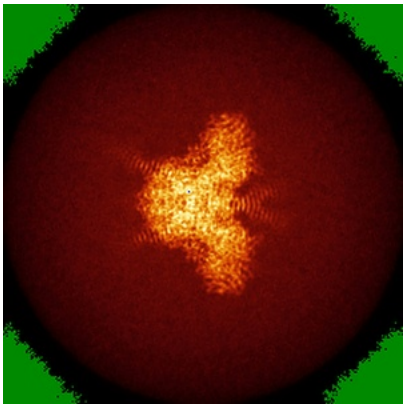
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal standard-deviation projections (False-color) (i)

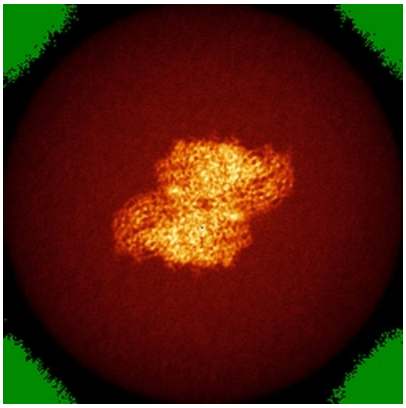
6.4.1 Primary map



X



Y



Z

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 0.03. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

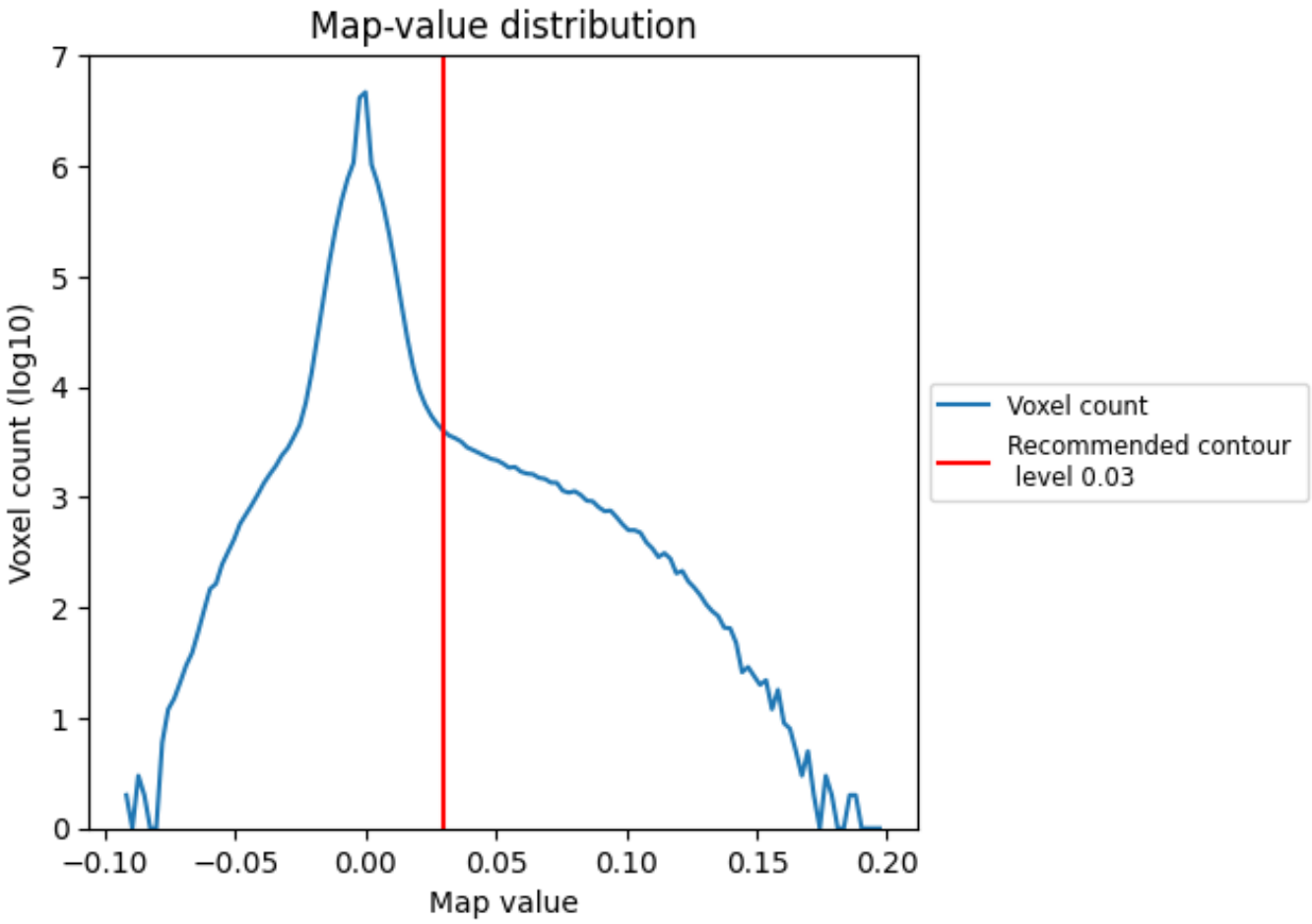
6.6 Mask visualisation (i)

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

7 Map analysis (i)

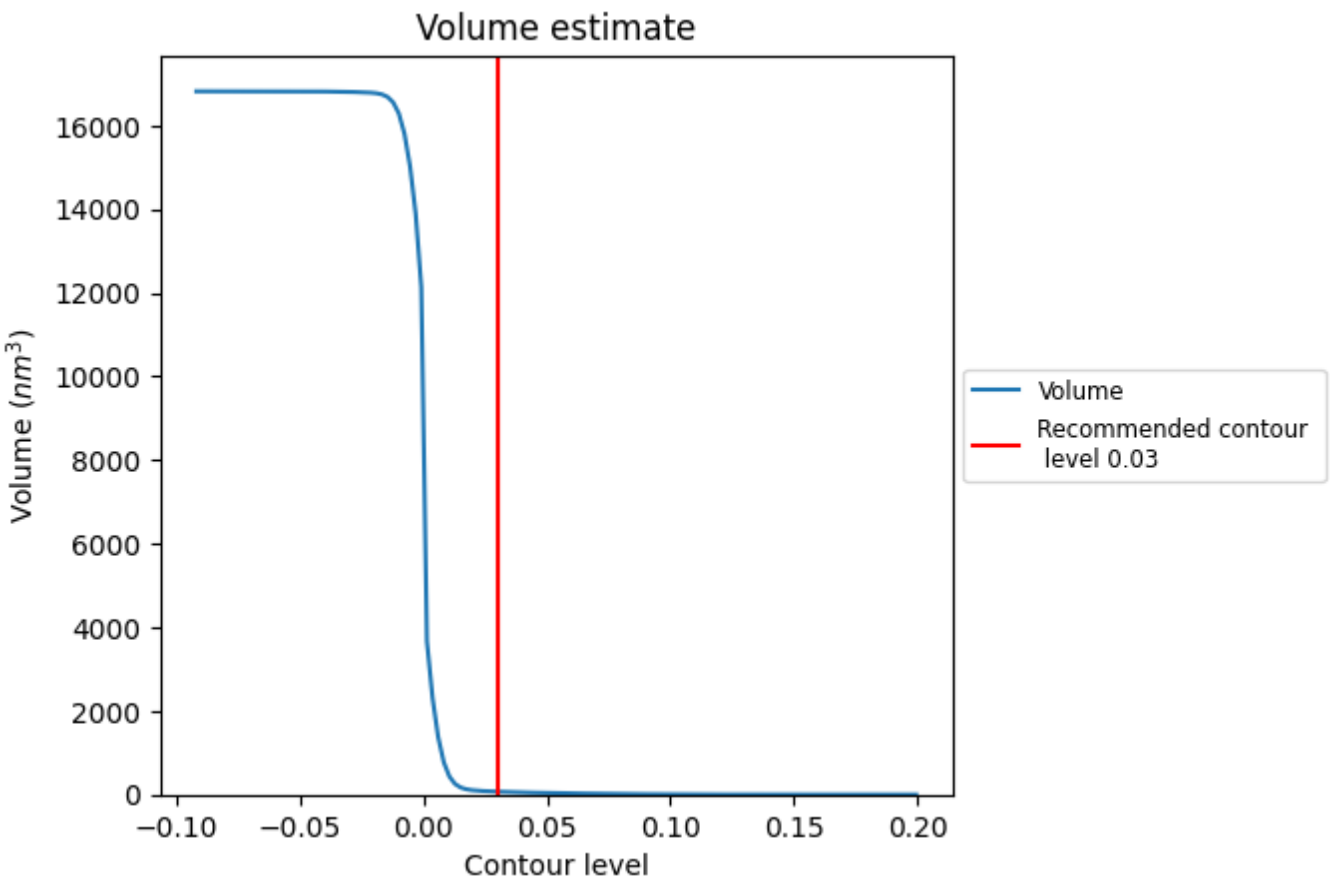
This section contains the results of statistical analysis of the map.

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.

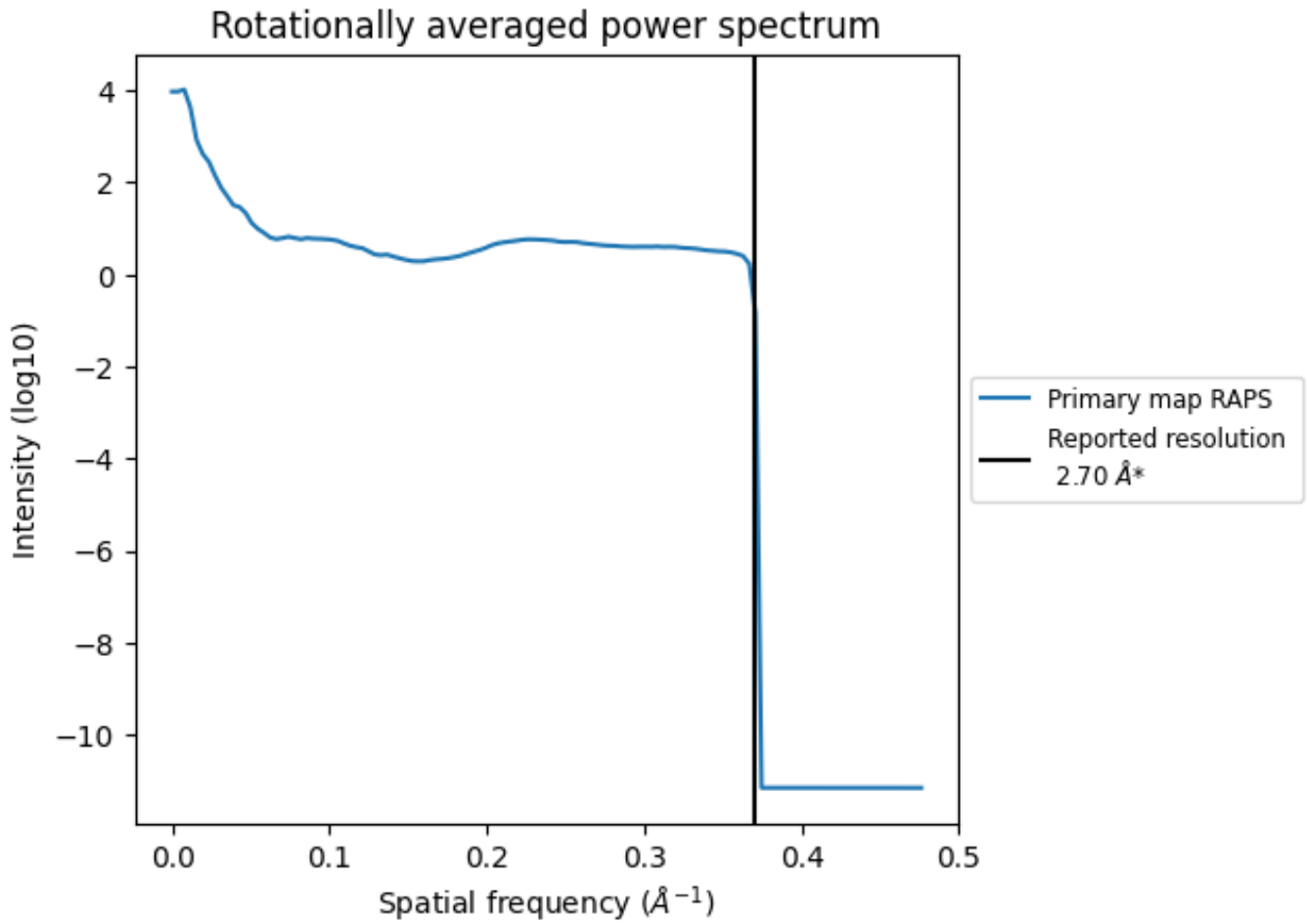
7.2 Volume estimate (i)



The volume at the recommended contour level is 69 nm^3; this corresponds to an approximate mass of 62 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 0.370 Å^{-1}

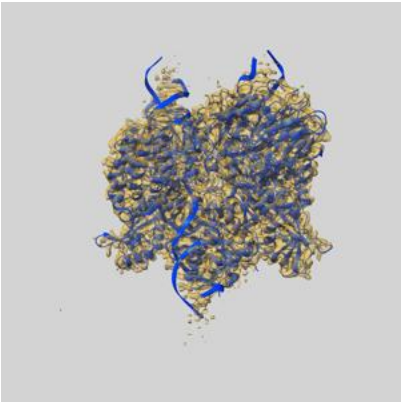
8 Fourier-Shell correlation (i)

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

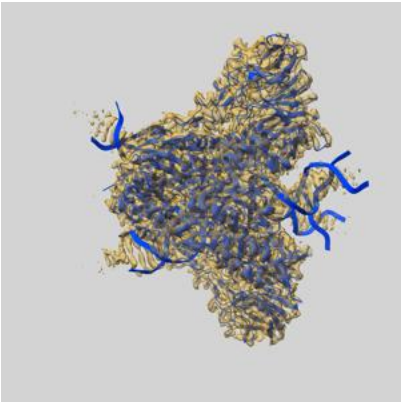
9 Map-model fit (i)

This section contains information regarding the fit between EMDB map EMD-22272 and PDB model 6XNX. Per-residue inclusion information can be found in section 3 on page 7.

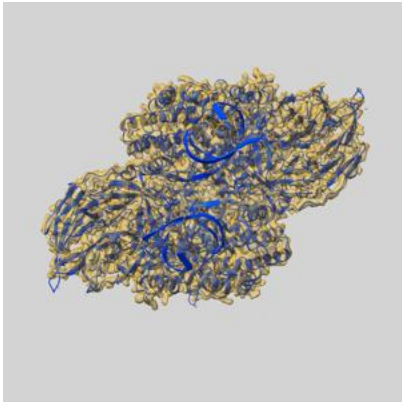
9.1 Map-model overlay (i)



X



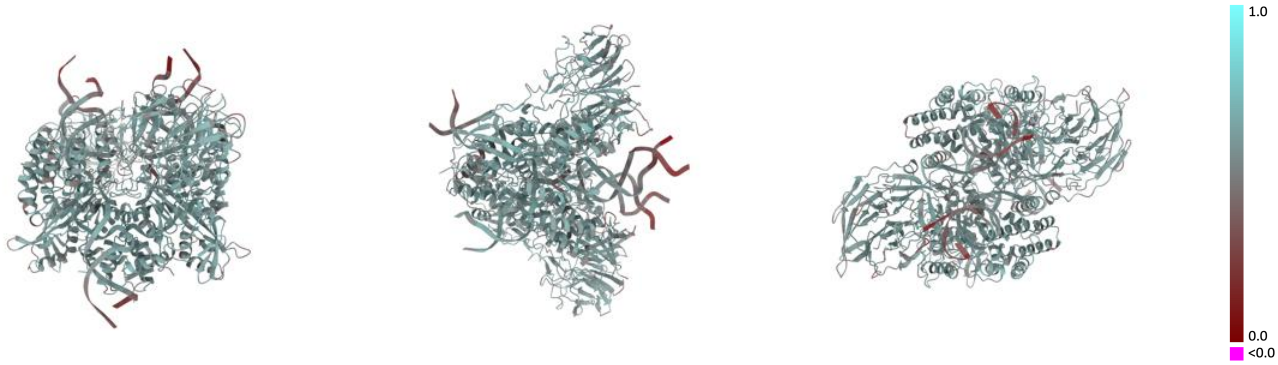
Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.03 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.

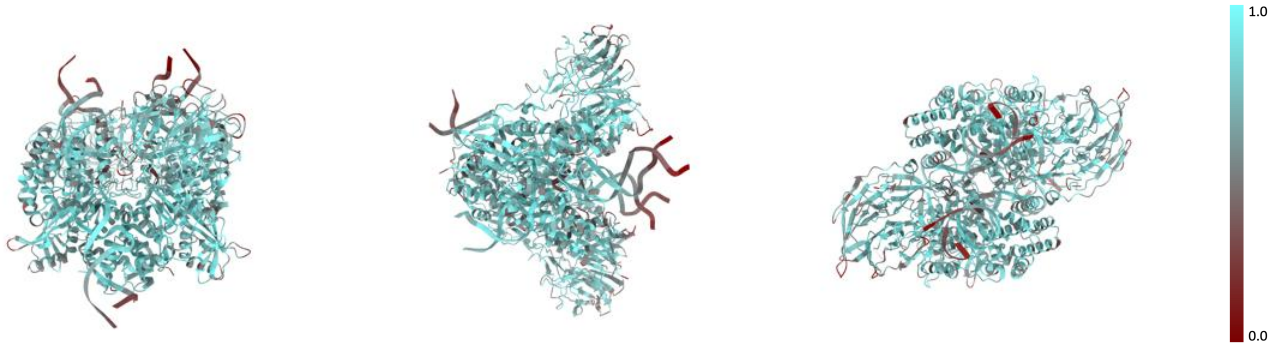
9.2 Q-score mapped to coordinate model (i)



X Y Z

The images above show the model with each residue coloured according 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.

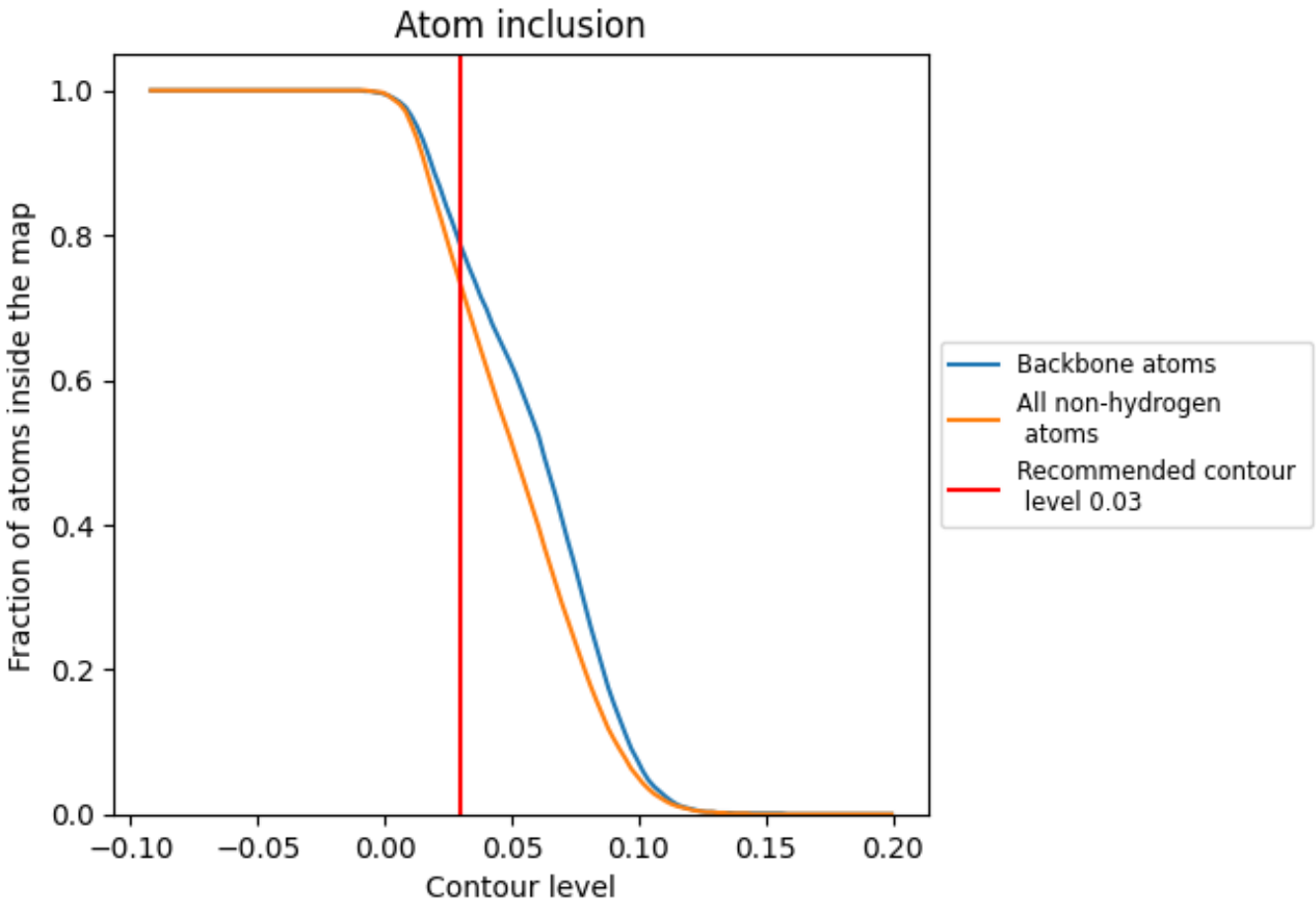
9.3 Atom inclusion mapped to coordinate model (i)



X Y Z

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 (0.03).

9.4 Atom inclusion (i)



At the recommended contour level, 78% of all backbone atoms, 73% 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 (0.03) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.7310	0.5630
A	0.7660	0.5830
B	0.7120	0.5600
C	0.7650	0.5820
D	0.7000	0.5570
I	0.5350	0.4320
J	0.5620	0.4550
L	0.8290	0.6010
M	0.7640	0.5470
x	0.6400	0.4990
y	0.6630	0.5040