



## wwPDB EM Validation Summary Report ⓘ

Aug 29, 2023 – 05:11 PM EDT

PDB ID : 8EAP  
EMDB ID : EMD-27790  
Title : Cryo-EM structure of the in-situ gp10-gp26 from bacteriophage P22  
Authors : Wang, C.; Liu, J.; Molineux, I.J.  
Deposited on : 2022-08-29  
Resolution : 3.30 Å (reported)

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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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

EMDB validation analysis : 0.0.1.dev50  
MolProbity : 4.02b-467  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
MapQ : 1.9.9  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.35

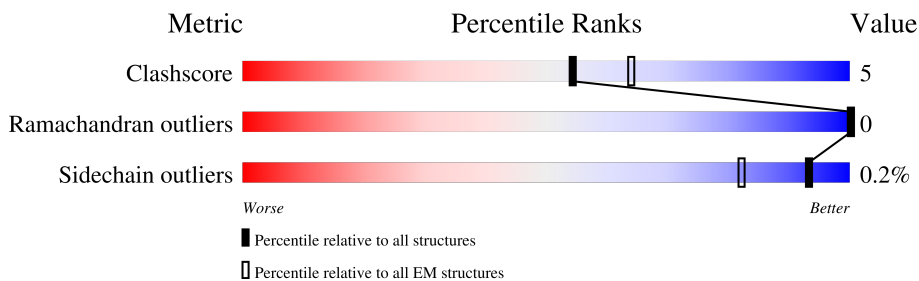
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 3.30 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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	62	
1	B	62	
1	C	62	
2	D	471	
2	E	471	
2	F	471	
2	G	471	
2	H	471	

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Mol	Chain	Length	Quality of chain
2	I	471	 <p>100% 88% 12%</p>

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 23485 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 Tail needle protein gp26.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
1	B	61	451	283	79	89	0	0
1	A	62	459	287	80	92	0	0
1	C	62	459	287	80	92	0	0

- Molecule 2 is a protein called Packaged DNA stabilization protein gp10.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	G	471	3686	2326	631	711	18	0	0
2	H	471	3686	2326	631	711	18	0	0
2	I	471	3686	2326	631	711	18	0	0
2	E	471	3686	2326	631	711	18	0	0
2	D	471	3686	2326	631	711	18	0	0
2	F	471	3686	2326	631	711	18	0	0

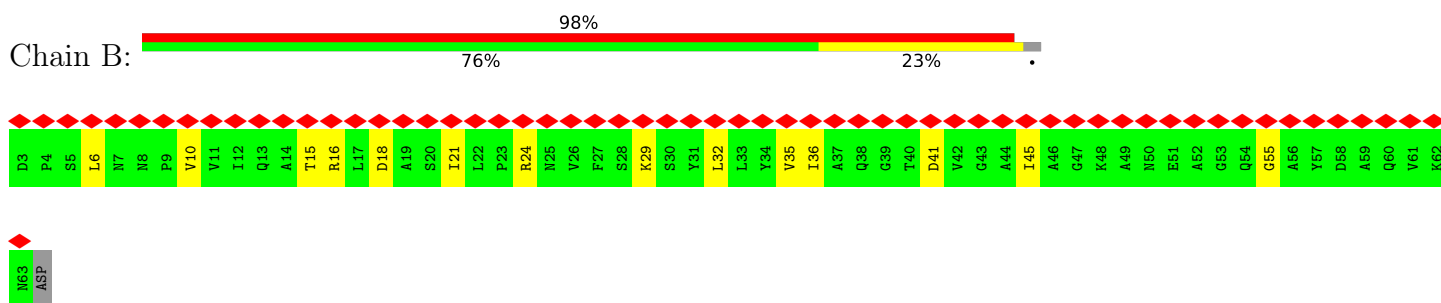
There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
G	233	SER	GLY	conflict	UNP P26749
H	233	SER	GLY	conflict	UNP P26749
I	233	SER	GLY	conflict	UNP P26749
E	233	SER	GLY	conflict	UNP P26749
D	233	SER	GLY	conflict	UNP P26749
F	233	SER	GLY	conflict	UNP P26749

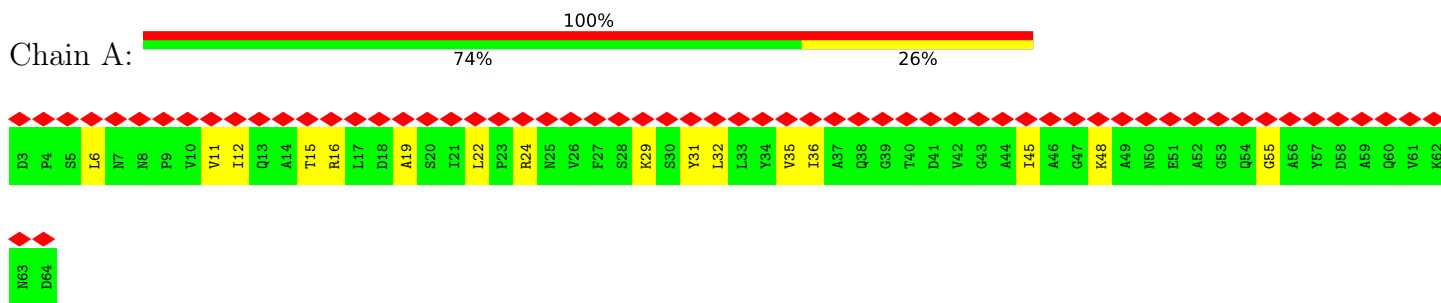
### 3 Residue-property plots [i](#)

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.

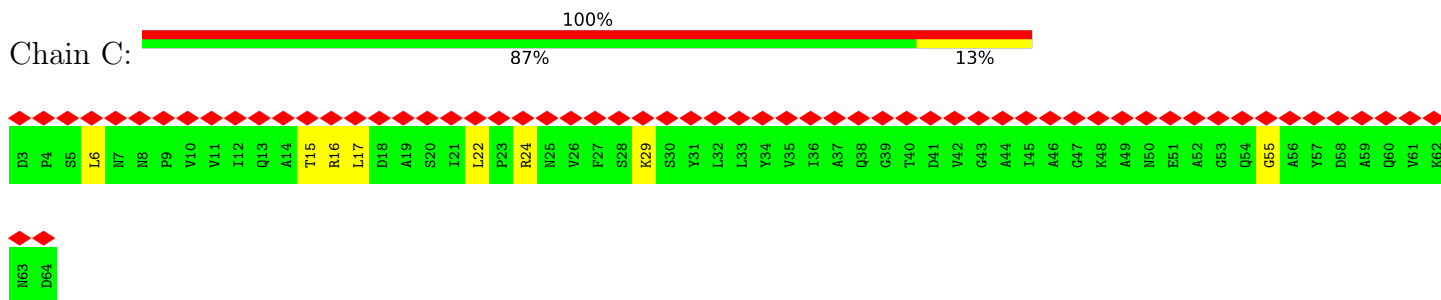
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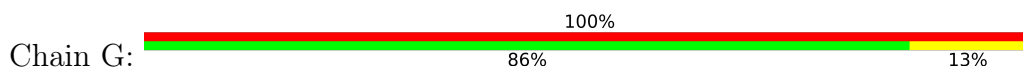
- Molecule 1: Tail needle protein gp26



- Molecule 1: Tail needle protein gp26

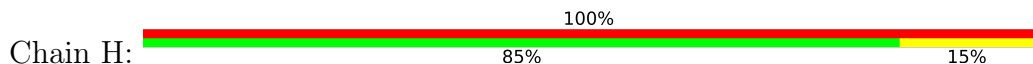


- Molecule 2: Packaged DNA stabilization protein gp10

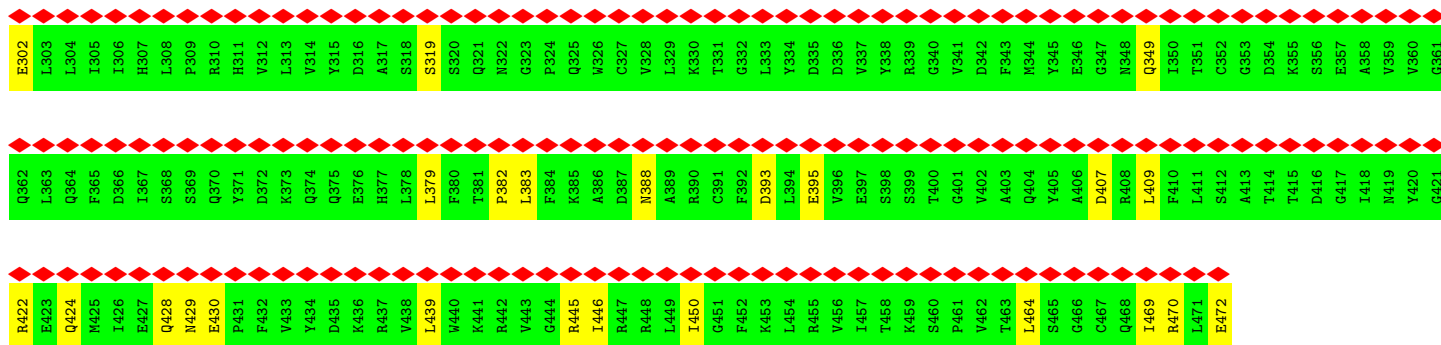


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V62	E63	Y64	N65	T66	A67	Q68	N69	A70	V71	Y72	R73	V74	C75	G76	G77	K78	L79	Y80	K81	G82	E83	S84	E85	W86	G87	D88	W89	A90	I91	S92	G93	R94	V95	S96	M97	A98	H99	G100	R101	T102	S103	Q104	A105	V106	G107	V108	N109	G110	P111	L112	V113	E114	M115	R116	Y117	D118	G119	T120	V121
K122	T123	V124	S125	N126	M127	P128	A129	D130	S131	G132	F133	V134	Q135	Y136	E137	L138	G139	S140	V141	D142	E143	I144	T145	W146	L147	R148	G149	R150	Y151	A152	V153	S154	V155	D156	G157	T158	D159	S160	W161	F162	I163	T164	D165	L166	E167	D168	N169	S170	H171	P172	D173	R174	Y175	S176	A177	Q178	G179	R180	A181
E182	S183	Q184	P185	D186	G187	I188	I189	R190	I191	G192	T193	M194	R195	D196	F197	V198	V199	C200	F201	G202	S203	S204	T205	I206	E207	Y208	F209	S210	L211	T212	G213	A214	T215	T216	A217	G218	A219	A220	L221	Y222	V223	A224	Q225	P226	S227	L228	M229	V230	Q231	K232	S233	I234	A235	G236	Y237	T238	C239	K240	T241
P242	F243	A244	D245	S246	Y247	A248	F249	I250	S251	H252	P253	A254	T255	G256	A257	P258	S259	V260	Y261	I262	L263	G264	S265	G266	Q267	A268	S269	P270	I271	A272	T273	A274	S275	L276	E277	K278	L279	I280	R281	S282	Y283	T284	A285	E286	E287	M288	A289	T290	Q291	V292	M293	E294	T295	L296	F297	D298	S300	H301	
E302	L303	L304	I305	I306	H307	L308	P309	R310	H311	V312	L313	V314	V315	D316	A317	S318	S319	S320	Q321	N322	G323	P324	Q325	W326	V328	L329	K330	T331	G332	L333	Y334	D335	D336	V337	Y338	R339	G340	V341	D342	F343	M344	Y345	E346	G347	N348	Q349	I350	T351	C352	G353	D354	K355	S356	E357	A358	V359	V360	G361	
Q362	L363	Q364	F365	D366	I367	S368	S369	Q370	P371	D372	K373	Q374	Q375	E376	H377	L378	L379	F380	T381	P382	L383	F384	K385	A386	N388	A389	R390	C391	F392	D393	L394	E395	V396	E397	S398	S399	T400	G401	V402	A403	Q404	Y405	A406	D407	R408	L409	F410	S412	A413	T414	T415	D416	G417	I418	N419	Y420	G421		
R422	E423	Q424	M425	I426	E427	Q428	N429	E430	P431	F432	V433	Y434	D435	K436	R437	V438	L439	W440	K441	R442	W443	G444	R445	I446	R447	R448	L449	I450	G451	F452	K453	L454	R455	W456	I457	T458	K459	S460	P461	V462	L463	L464	S465	G466	C467	Q468	I469	R470	L471	E472									

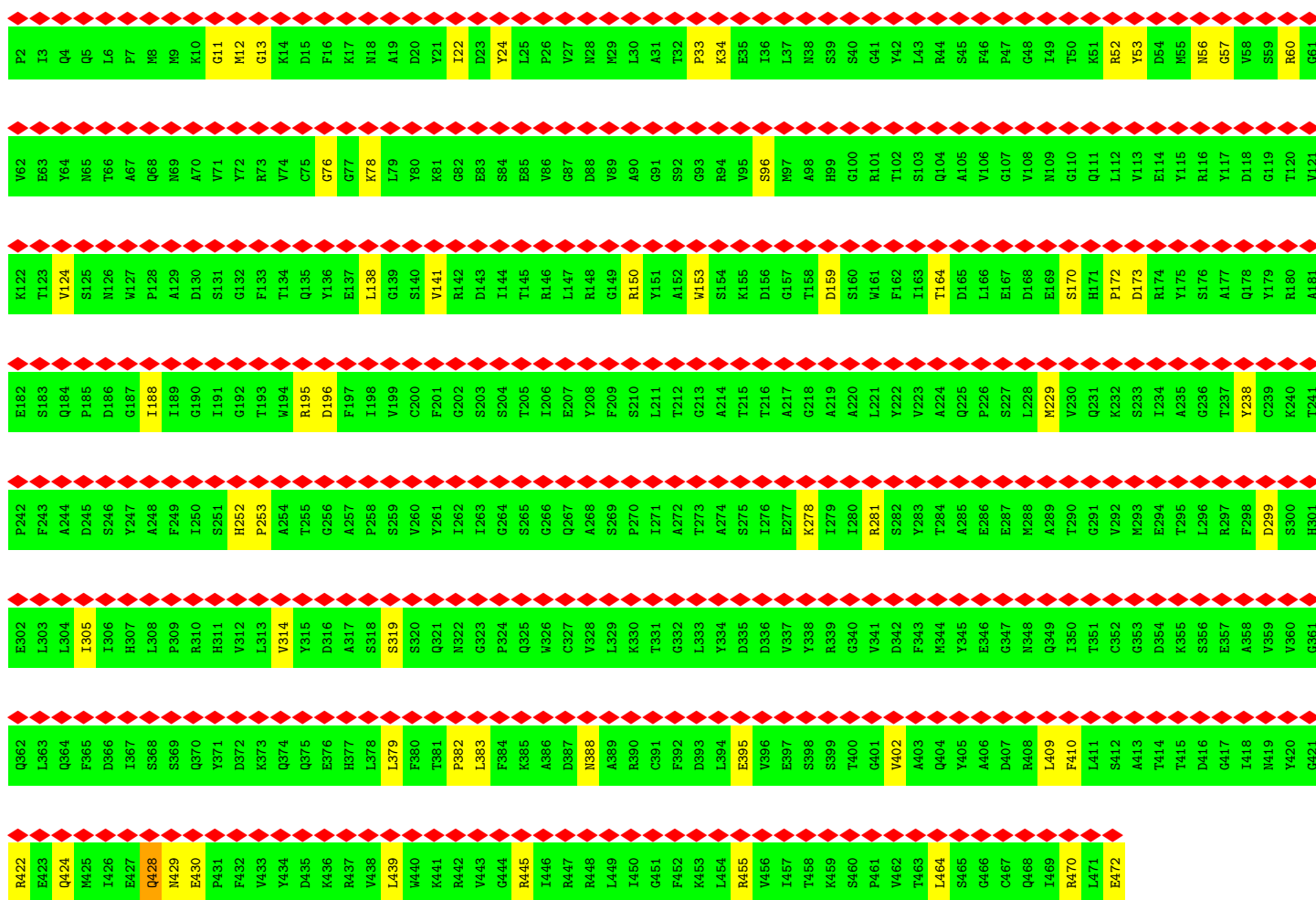
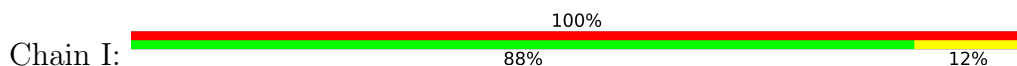
• Molecule 2: Packaged DNA stabilization protein gp10



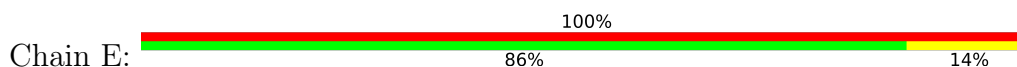
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E182	S183	Q184	P185	D186	G187	I188	I189	G190	I191	G192	T193	M194	R195	D196	F197	V198	V199	C200	F201	G202	S203	S204	T205	I206	E207	Y208	F209	S210	L211	T212	G213	A214	T215	T216	A217	G218	A219	A220	L221	Y222	V223	A224	Q225	P226	S227	L228	M229	V230	Q231	K232	S233	I234	A235	G236	Y237	T238	C239	K240	T241
P242	F243	A244	D245	S246	Y247	A248	F249	I250	S251	H252	P253	A254	T255	G256	A257	P258	S259	V260	Y261	I262	L263	G264	S265	G266	Q267	A268	S269	P270	I271	A272	T273	A274	S275	L276	E277	K278	L279	I280	R281	S282	Y283	T284	A285	E286	E287	M288	A289	T290	Q291	V292	M293	E294	T295	L296	F297	D298	S300	H301	



• Molecule 2: Packaged DNA stabilization protein gp10

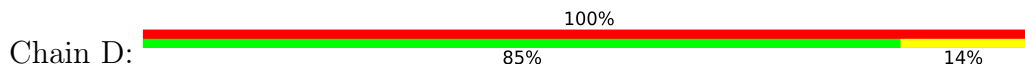


• Molecule 2: Packaged DNA stabilization protein gp10



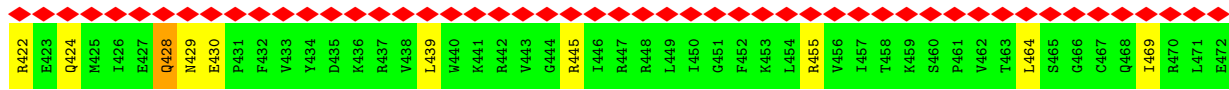
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● Molecule 2: Packaged DNA stabilization protein gp10

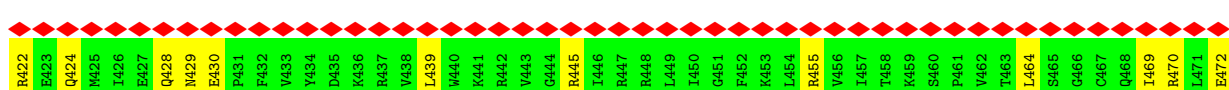
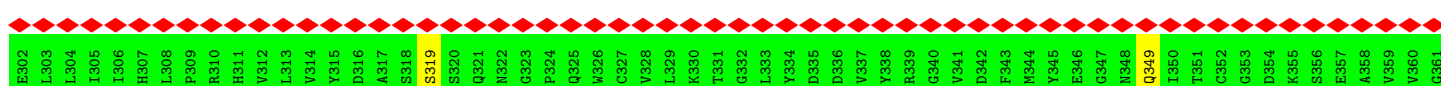
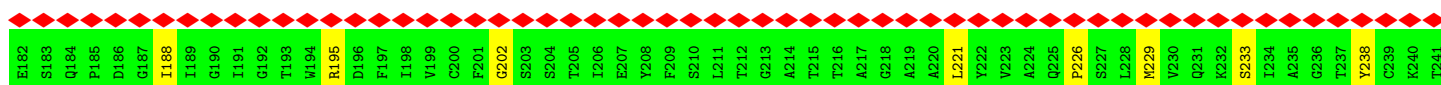
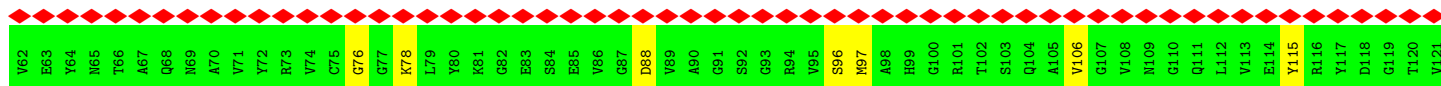
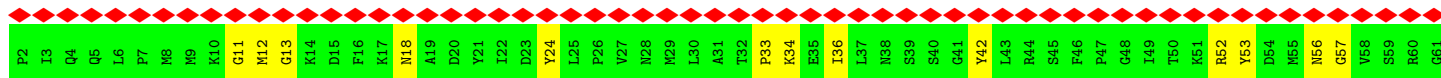
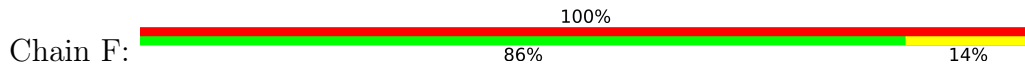


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K122	T123	V124	S125	M126	W127	P128	A129	D130	S131	G132	F133	T134	Q135	Y136	E137	L138	G139	C140	V141	R142	D143	I144	T145	R146	L147	R148	G149	R150	Y151	A152	W153	S154	K155	D156	G157	T158	D159	S160	V161	F162	I163	T164	D165	L166	E167	D168	E169	S170	Q171	P172	D173	R174	Y175	S176	A177	Q178	G179	R180	A181		
E182	S183	Q184	P185	D186	G187	I188	I189	G190	I191	G192	T193	M194	R195	D196	F197	I198	V199	C200	Y261	F201	G202	S203	S204	T205	I206	E207	Y208	F209	S210	L211	T212	G213	S275	A274	K276	L276	G277	K278	A219	A220	L221	Y222	F223	A224	Q225	P226	E227	L228	M229	V230	Q231	K232	S233	I234	A235	G236	T237	Y238	C239	K240	T241
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E302	L303	L304	I305	I306	H307	L308	P309	R310	H311	V312	L313	V314	V315	D316	A317	S318	S319	S320	Q321	N322	G323	F324	Q325	W326	C327	V328	L329	K330	T331	G332	L333	Y334	D335	D336	V337	Y338	R339	G340	V341	D342	F343	M344	Y345	E346	G347	N348	Q349	I350	T351	C352	G353	D354	K355	S356	E357	A358	V359	V360	G361		





• Molecule 2: Packaged DNA stabilization protein gp10



## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	106070	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ( $e^-/\text{\AA}^2$ )	30	Depositor
Minimum defocus (nm)	600	Depositor
Maximum defocus (nm)	1200	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	0.032	Depositor
Minimum map value	-0.010	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.001	Depositor
Recommended contour level	0.01	Depositor
Map size ( $\text{\AA}$ )	512.63995, 512.63995, 512.63995	wwPDB
Map dimensions	480, 480, 480	wwPDB
Map angles ( $^\circ$ )	90.0, 90.0, 90.0	wwPDB
Pixel spacing ( $\text{\AA}$ )	1.068, 1.068, 1.068	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	0/465	0.46	0/633
1	B	0.26	0/457	0.46	0/622
1	C	0.26	0/465	0.43	0/633
2	D	0.27	0/3767	0.50	0/5100
2	E	0.27	0/3767	0.50	0/5100
2	F	0.27	0/3767	0.50	0/5100
2	G	0.27	0/3767	0.50	0/5100
2	H	0.27	0/3767	0.50	0/5100
2	I	0.27	0/3767	0.50	0/5100
All	All	0.27	0/23989	0.49	0/32488

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	459	0	456	12	0
1	B	451	0	452	11	0
1	C	459	0	456	7	0
2	D	3686	0	3592	45	0
2	E	3686	0	3592	44	0
2	F	3686	0	3592	44	0
2	G	3686	0	3592	40	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	H	3686	0	3592	43	0
2	I	3686	0	3592	38	0
All	All	23485	0	22916	252	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.

The worst 5 of 252 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:H:12:MET:SD	2:I:34:LYS:NZ	2.53	0.82
2:D:12:MET:SD	2:F:34:LYS:NZ	2.53	0.79
1:A:15:THR:HG23	1:A:16:ARG:HG2	1.66	0.77
2:F:422:ARG:NH2	2:F:424:GLN:OE1	2.27	0.68
2:H:422:ARG:NH2	2:H:424:GLN:OE1	2.27	0.67

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	60/62 (97%)	57 (95%)	3 (5%)	0	100	100
1	B	59/62 (95%)	56 (95%)	3 (5%)	0	100	100
1	C	60/62 (97%)	57 (95%)	3 (5%)	0	100	100
2	D	469/471 (100%)	450 (96%)	19 (4%)	0	100	100
2	E	469/471 (100%)	450 (96%)	19 (4%)	0	100	100
2	F	469/471 (100%)	451 (96%)	18 (4%)	0	100	100
2	G	469/471 (100%)	448 (96%)	21 (4%)	0	100	100
2	H	469/471 (100%)	451 (96%)	18 (4%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	I	469/471 (100%)	448 (96%)	21 (4%)	0	100	100
All	All	2993/3012 (99%)	2868 (96%)	125 (4%)	0	100	100

There are no Ramachandran outliers to report.

### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	48/48 (100%)	46 (96%)	2 (4%)	30	60
1	B	47/48 (98%)	47 (100%)	0	100	100
1	C	48/48 (100%)	47 (98%)	1 (2%)	53	75
2	D	395/395 (100%)	394 (100%)	1 (0%)	92	96
2	E	395/395 (100%)	395 (100%)	0	100	100
2	F	395/395 (100%)	395 (100%)	0	100	100
2	G	395/395 (100%)	394 (100%)	1 (0%)	92	96
2	H	395/395 (100%)	395 (100%)	0	100	100
2	I	395/395 (100%)	394 (100%)	1 (0%)	92	96
All	All	2513/2514 (100%)	2507 (100%)	6 (0%)	93	97

5 of 6 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	G	428	GLN
2	I	428	GLN
2	D	428	GLN
1	A	29	LYS
1	A	24	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	63	ASN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

### 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

### 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

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.

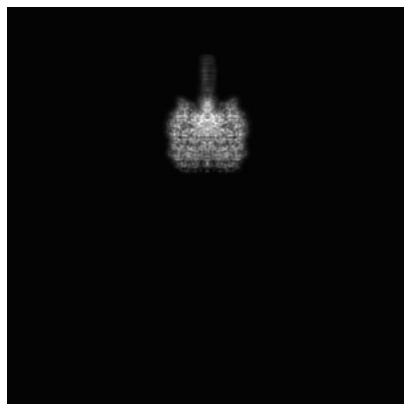
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-27790. These allow visual inspection of the internal detail of the map and identification of artifacts.

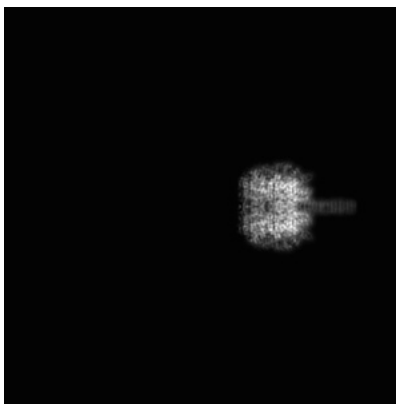
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

### 6.1 Orthogonal projections [i](#)

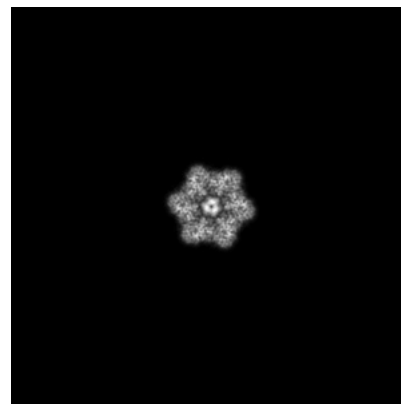
#### 6.1.1 Primary map



X

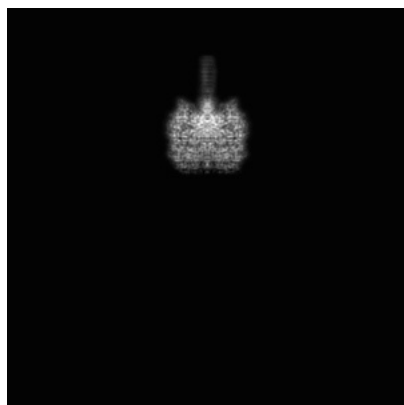


Y

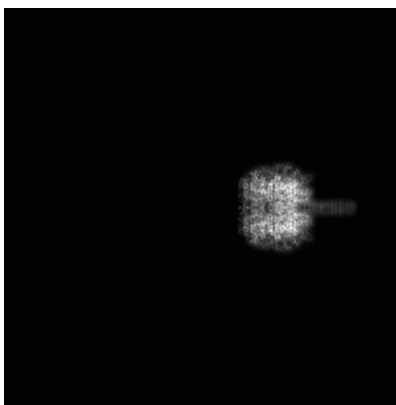


Z

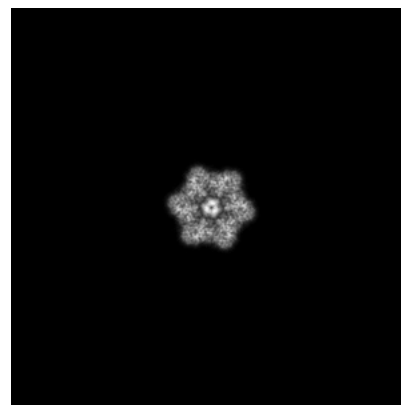
#### 6.1.2 Raw map



X



Y

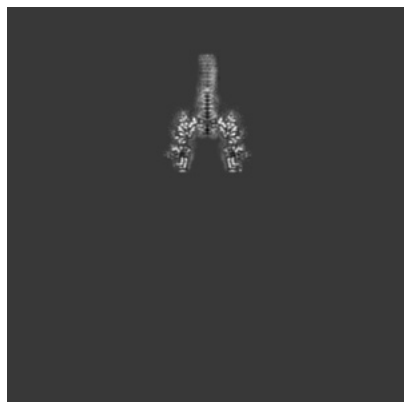


Z

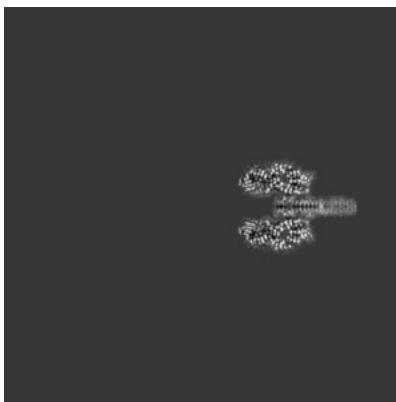
The images above show the map projected in three orthogonal directions.

## 6.2 Central slices [i](#)

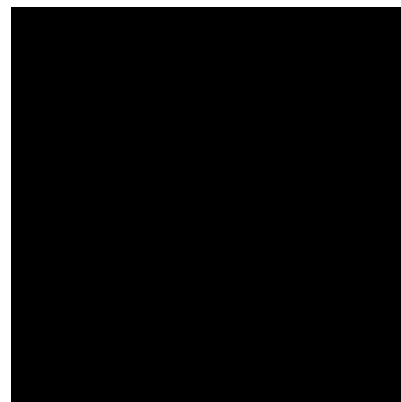
### 6.2.1 Primary map



X Index: 240

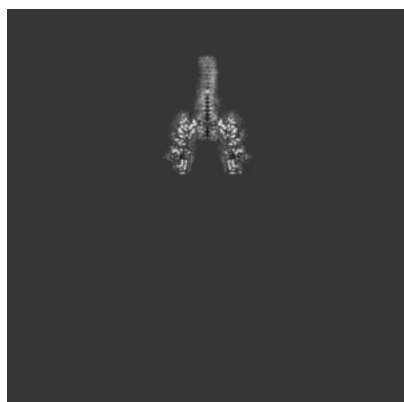


Y Index: 240

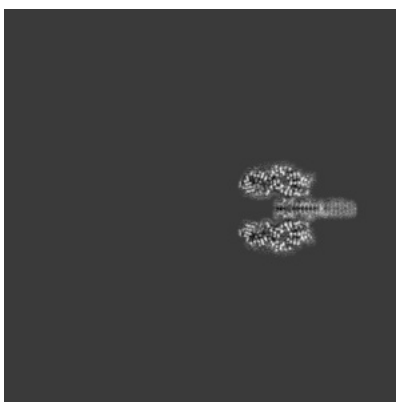


Z Index: 240

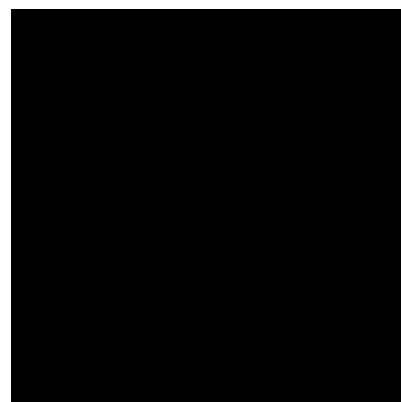
### 6.2.2 Raw map



X Index: 240



Y Index: 240



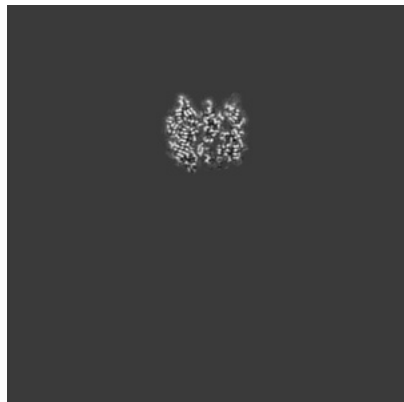
Z Index: 240

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

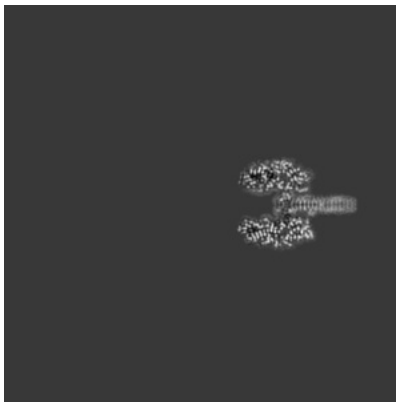


## 6.3 Largest variance slices [i](#)

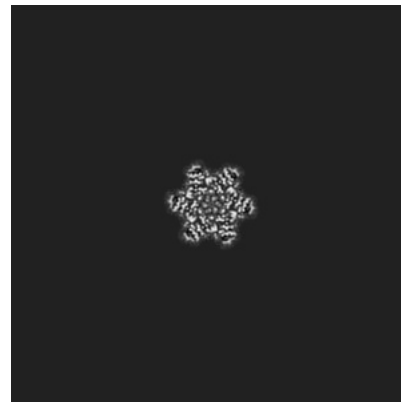
### 6.3.1 Primary map



X Index: 261

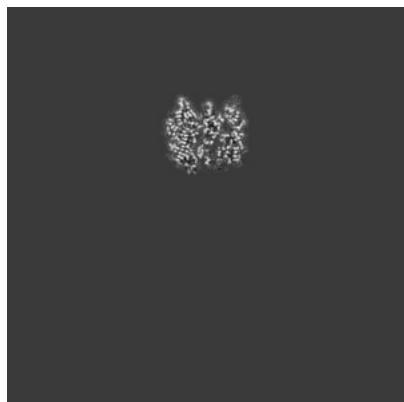


Y Index: 238

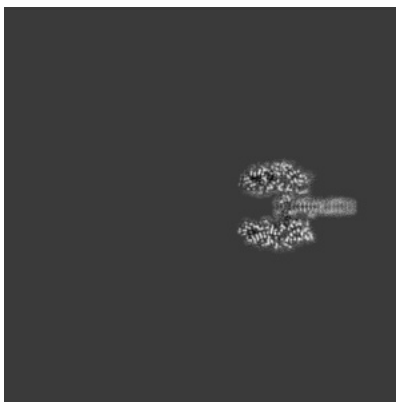


Z Index: 344

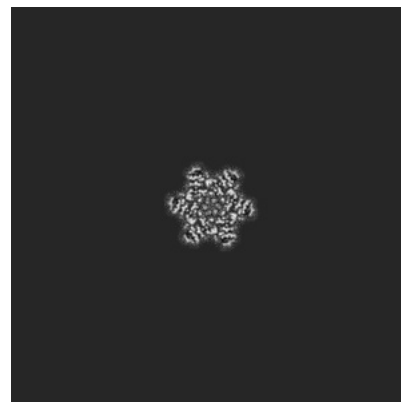
### 6.3.2 Raw map



X Index: 261



Y Index: 238

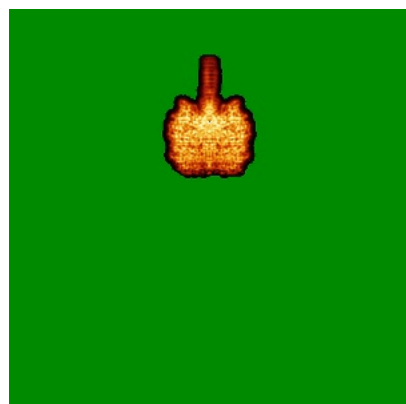


Z Index: 344

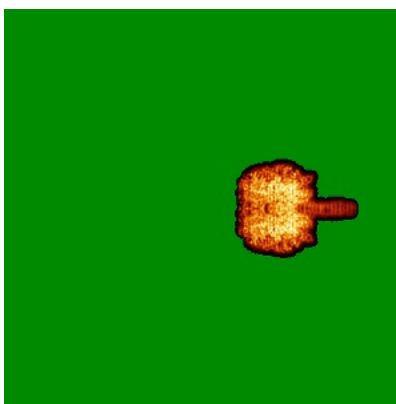
The images above show the largest variance slices of the map in three orthogonal directions.

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

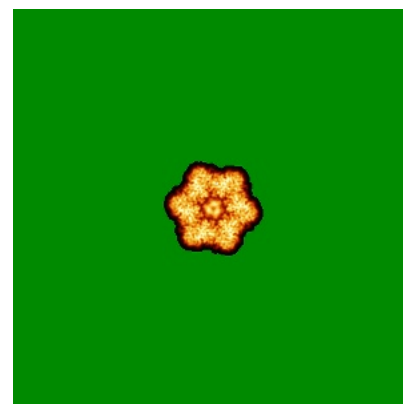
### 6.4.1 Primary map



X



Y

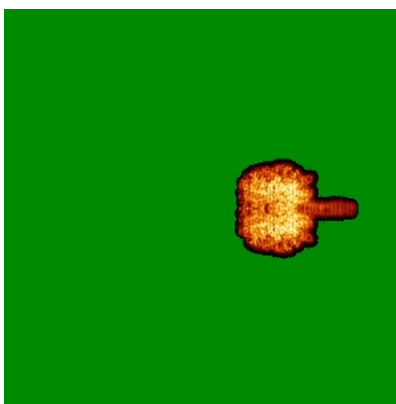


Z

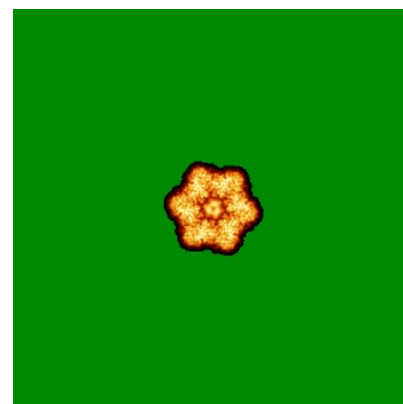
### 6.4.2 Raw map



X



Y

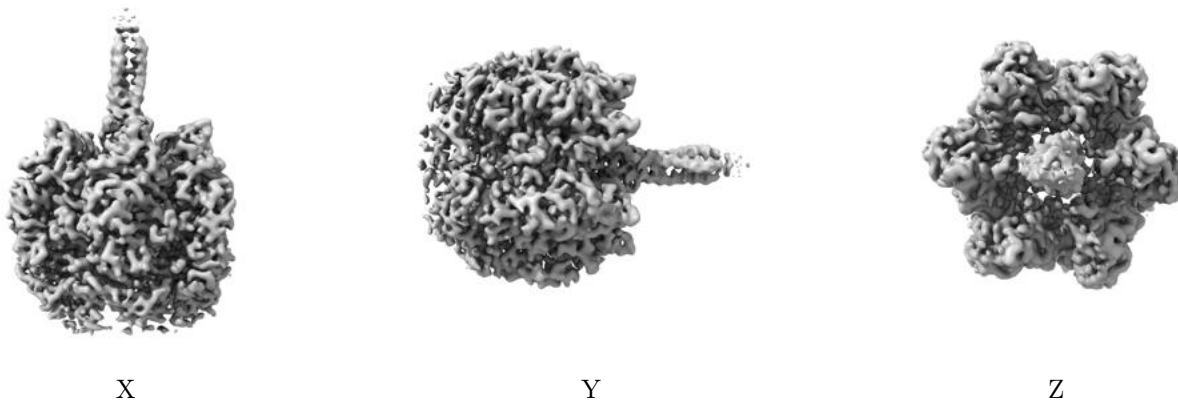


Z

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.

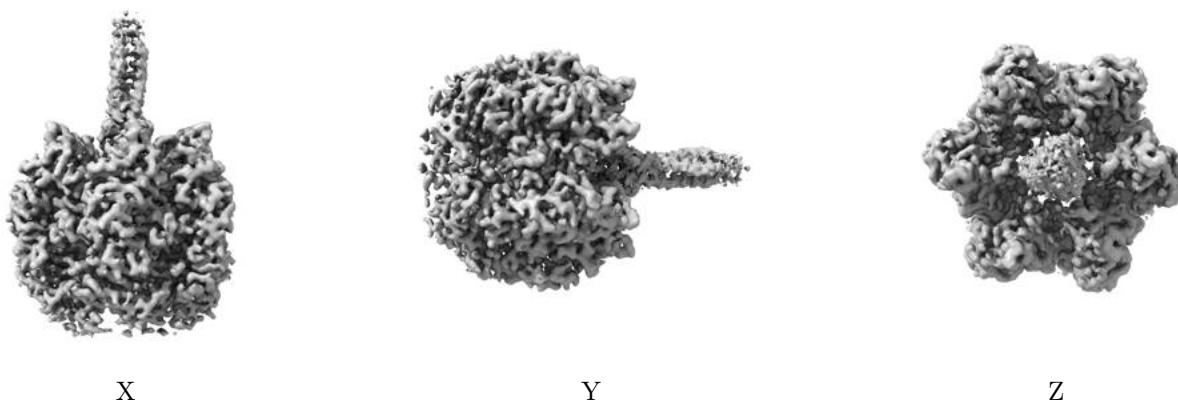
## 6.5 Orthogonal surface views [i](#)

### 6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.01. 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.

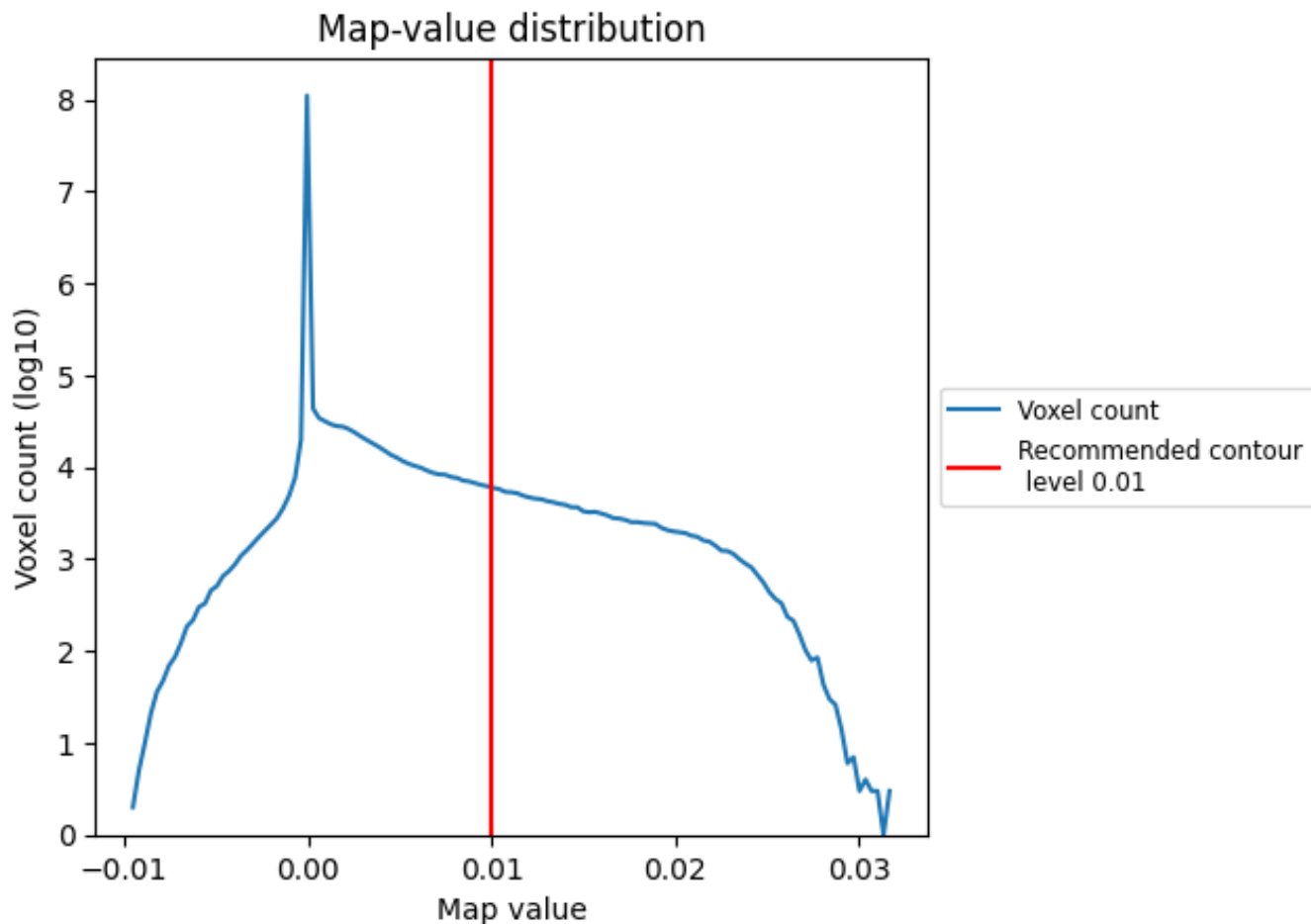
## 6.6 Mask visualisation [i](#)

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

## 7 Map analysis [i](#)

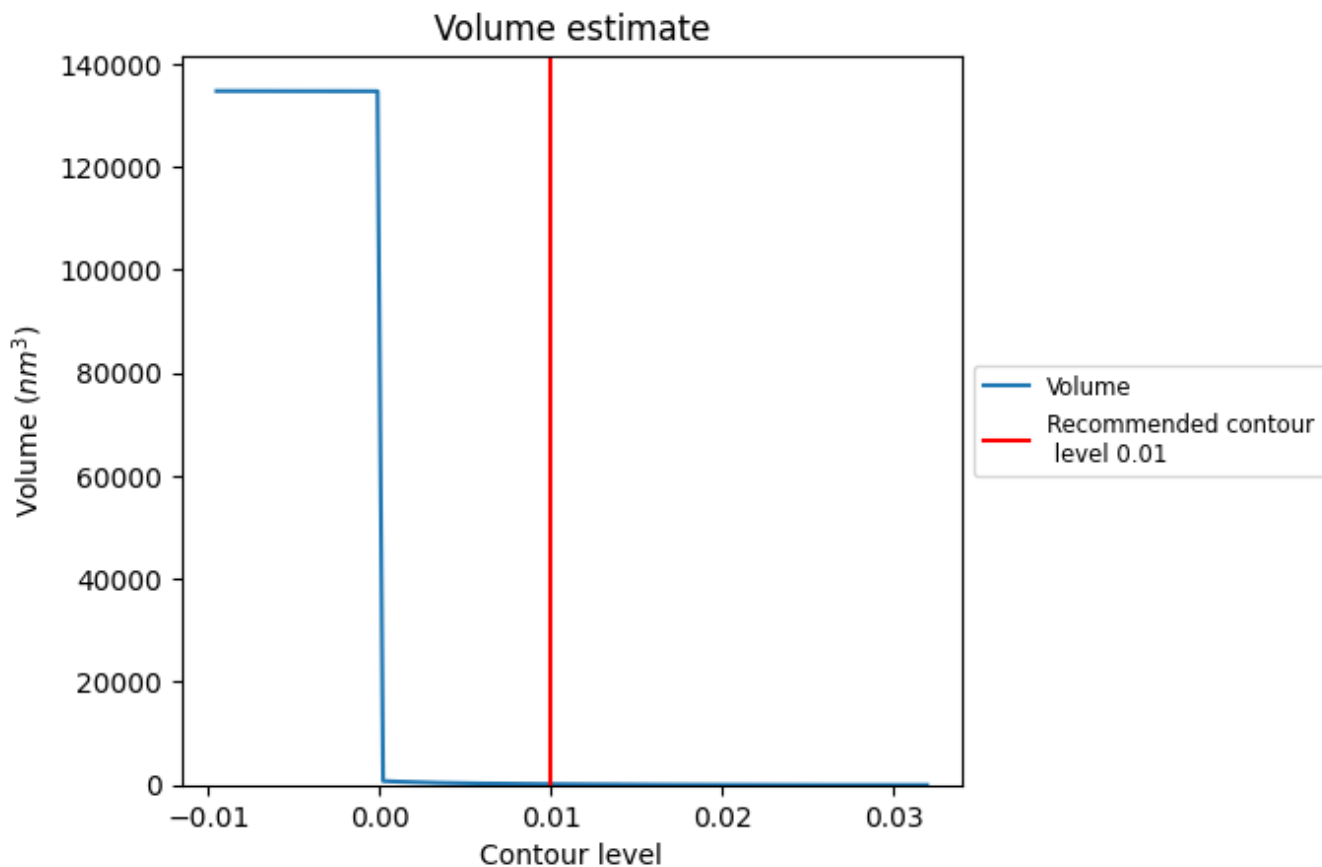
This section contains the results of statistical analysis of the map.

### 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.

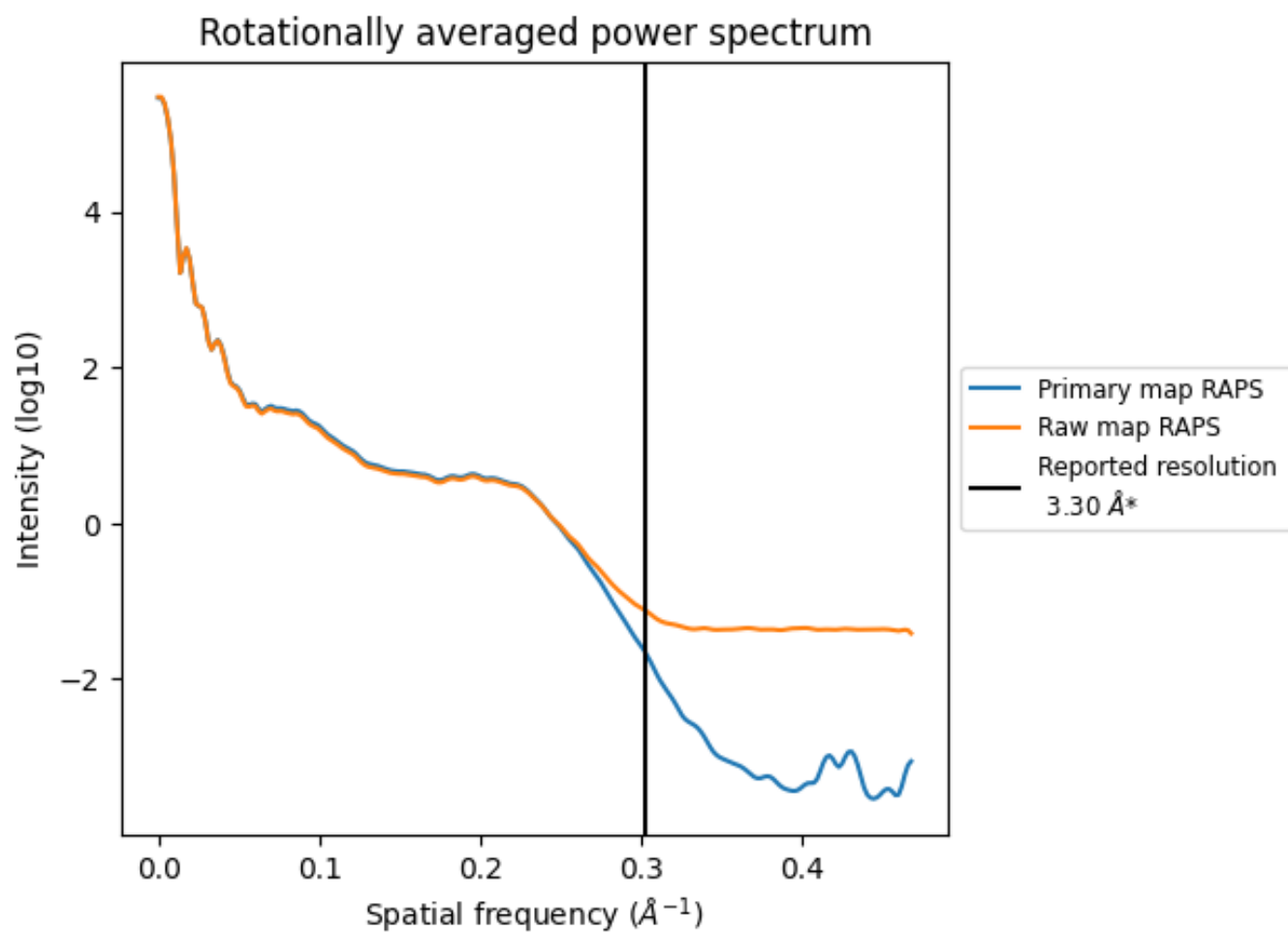
## 7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 166 nm<sup>3</sup>; this corresponds to an approximate mass of 150 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

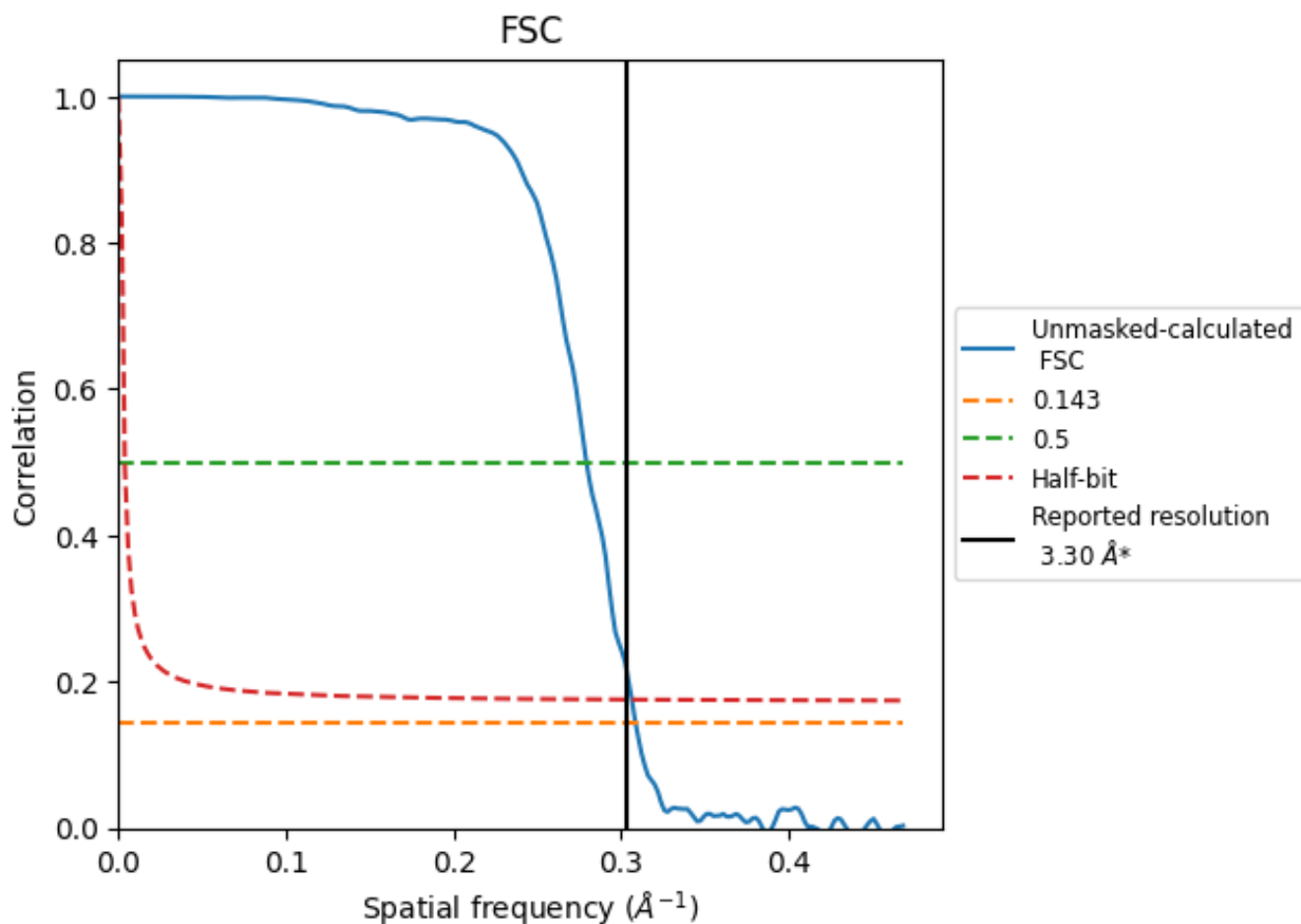


\*Reported resolution corresponds to spatial frequency of 0.303 Å<sup>-1</sup>

## 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  $0.303 \text{\AA}^{-1}$

## 8.2 Resolution estimates [i](#)

Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.30	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	3.24	3.58	3.26

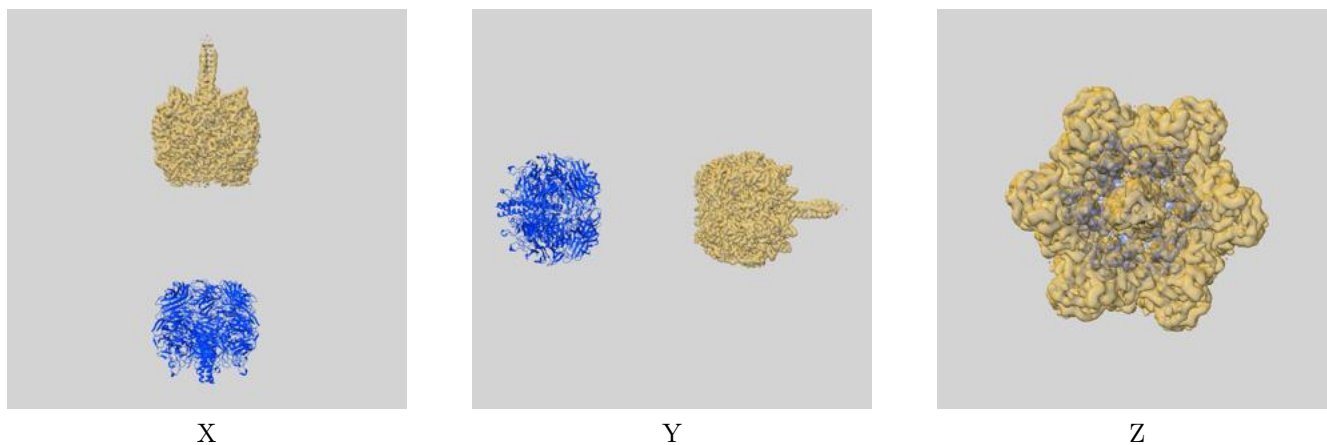
\*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps.



## 9 Map-model fit [i](#)

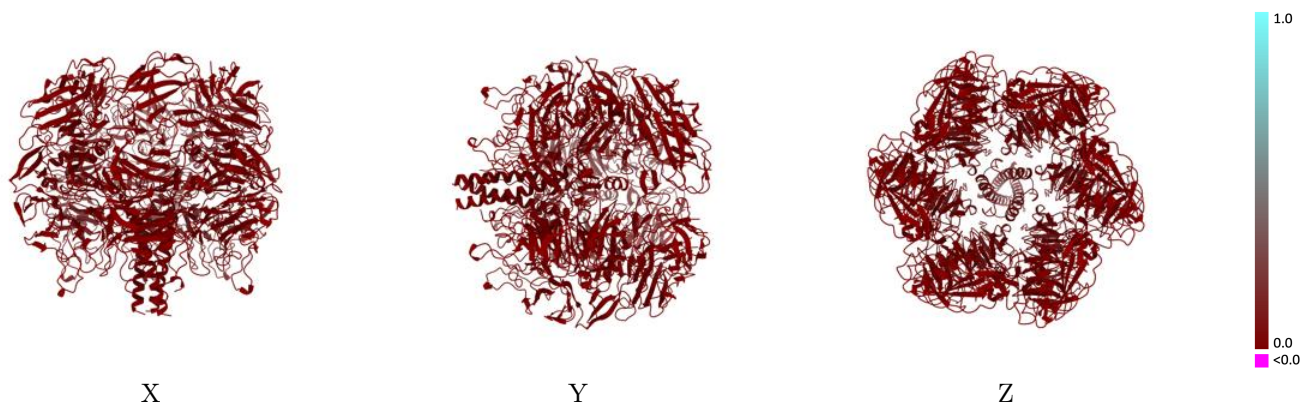
This section contains information regarding the fit between EMDB map EMD-27790 and PDB model 8EAP. Per-residue inclusion information can be found in section 3 on page 5.

### 9.1 Map-model overlay [i](#)



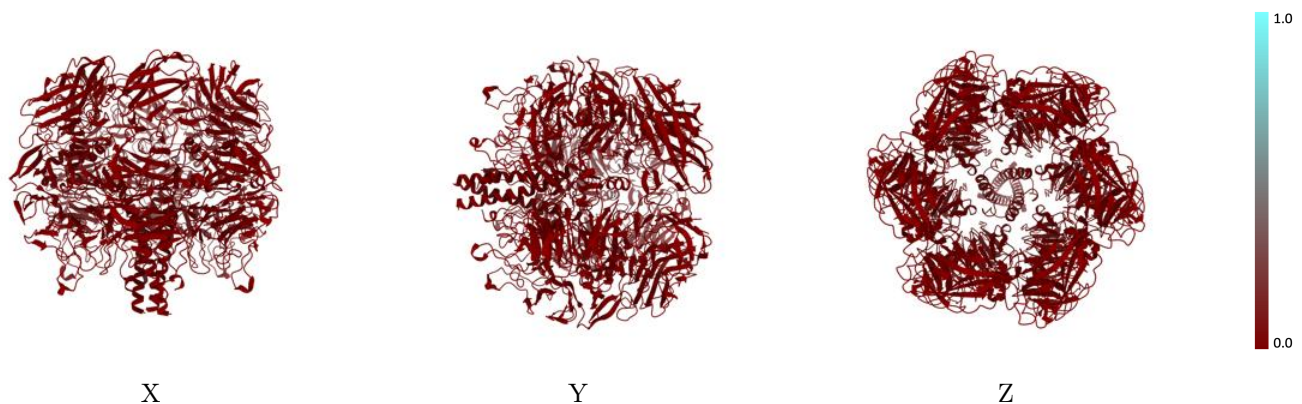
The images above show the 3D surface view of the map at the recommended contour level 0.01 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



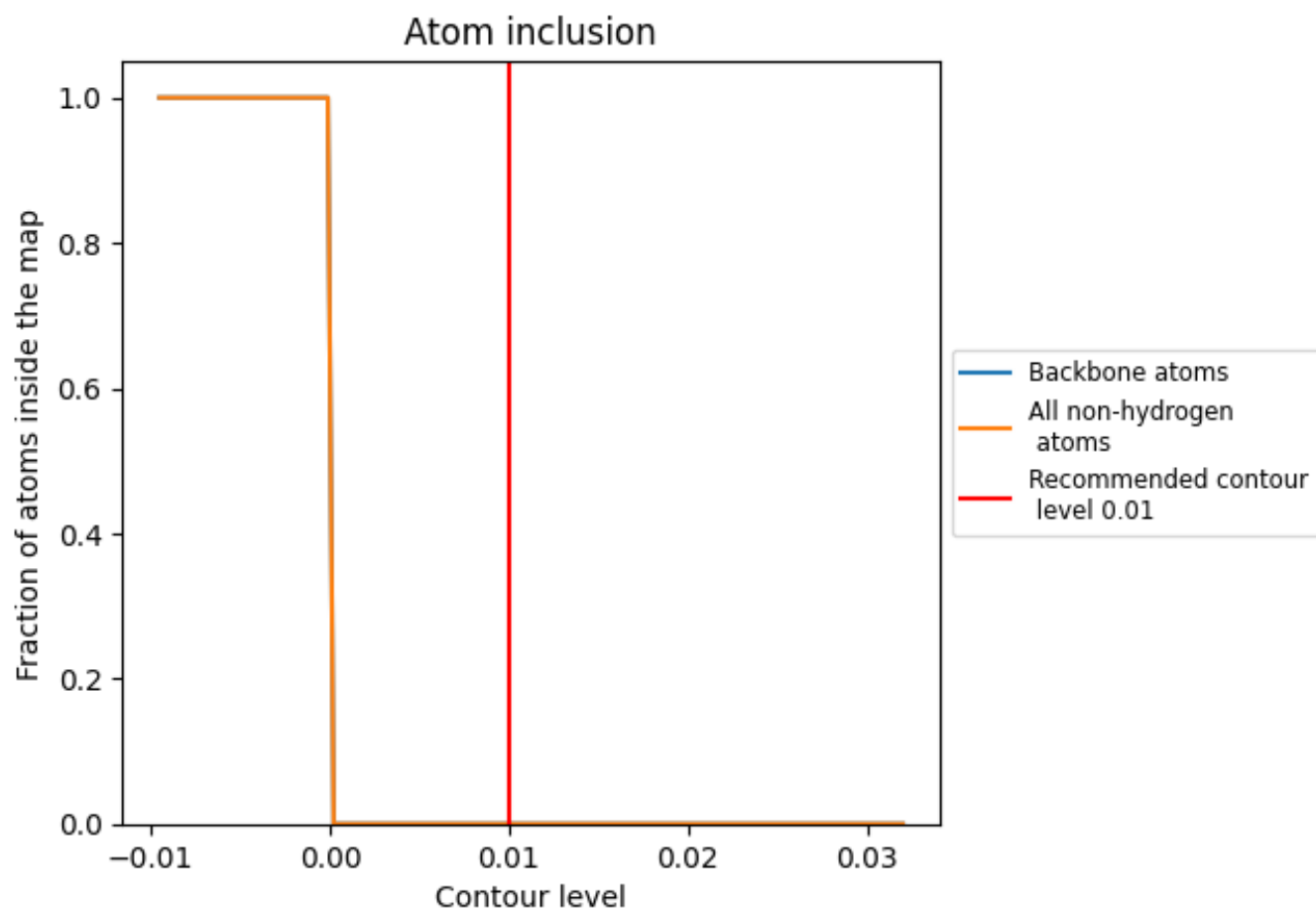
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.01).

## 9.4 Atom inclusion [i](#)



At the recommended contour level, 0% of all backbone atoms, 0% 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 (0.01) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.0000	0.0000
A	0.0000	0.0000
B	0.0000	0.0000
C	0.0000	0.0000
D	0.0000	0.0000
E	0.0000	0.0000
F	0.0000	0.0000
G	0.0000	0.0000
H	0.0000	0.0000
I	0.0000	0.0000

