



wwPDB EM Validation Summary Report ⓘ

Nov 15, 2021 – 12:17 pm GMT

PDB ID : 7PER
EMDB ID : EMD-12814
Title : Model of the inner ring of the human nuclear pore complex
Authors : Schuller, A.P.; Wojtynek, M.; Mankus, D.; Tatli, M.; Kronenberg-Tenga, R.;
Regmi, S.G.; Dasso, M.; Weis, K.; Medalia, O.; Schwartz, T.U.
Deposited on : 2021-08-11
Resolution : 35.00 Å(reported)
Based on initial model : 5IJN

This is a wwPDB EM Validation Summary Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/EMValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

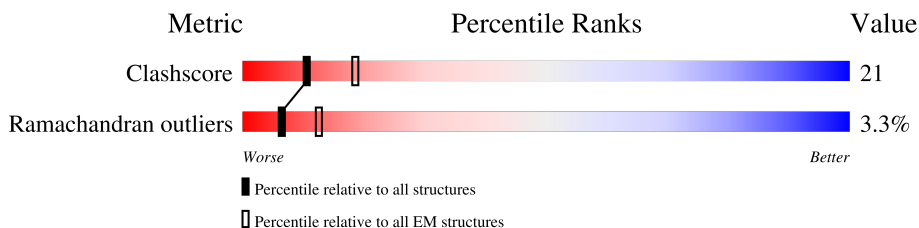
EMDB validation analysis : 0.0.0.dev97
MolProbity : 4.02b-467
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.23.2

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 35.00 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

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	F	507	 41% 13% 7% 5% 34%
1	L	507	 6% 43% 11% 7% 5% 34%
1	R	507	 40% 14% 7% 5% 34%
1	X	507	 43% 11% 7% 5% 34%
2	G	599	 17% 8% . . 71%
2	M	599	 17% 7% . . 71%
2	S	599	 17% 8% . . 71%
2	Y	599	 17% 8% . . 71%
3	H	522	 18% 10% . . 68%

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Mol	Chain	Length	Quality of chain
3	N	522	
3	T	522	
3	Z	522	
4	D	2012	
4	J	2012	
4	P	2012	
4	V	2012	
5	E	1391	
5	K	1391	
5	Q	1391	
5	W	1391	
6	C	819	
6	I	819	
6	O	819	
6	U	819	

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 67036 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 Nucleoporin p54.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
1	F	335	1658	988	335	335	0	0
1	X	335	1658	988	335	335	0	0
1	L	335	1658	988	335	335	0	0
1	R	335	1658	988	335	335	0	0

- Molecule 2 is a protein called Nucleoporin p58/p45.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
2	G	171	853	511	171	171	0	0
2	Y	171	853	511	171	171	0	0
2	M	171	853	511	171	171	0	0
2	S	171	853	511	171	171	0	0

- Molecule 3 is a protein called Nuclear pore glycoprotein p62.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
3	H	169	842	504	169	169	0	0
3	Z	169	842	504	169	169	0	0
3	N	169	842	504	169	169	0	0
3	T	169	842	504	169	169	0	0

- Molecule 4 is a protein called Nuclear pore complex protein Nup205.

Mol	Chain	Residues	Atoms				AltConf	Trace
4	P	1028	Total 5094	C 3038	N 1028	O 1028	0	0
4	V	1028	Total 5094	C 3038	N 1028	O 1028	0	0
4	D	1028	Total 5094	C 3038	N 1028	O 1028	0	0
4	J	1028	Total 5094	C 3038	N 1028	O 1028	0	0

- Molecule 5 is a protein called Nuclear pore complex protein Nup155.

Mol	Chain	Residues	Atoms				AltConf	Trace
5	W	1083	Total 5366	C 3200	N 1083	O 1083	0	0
5	K	1083	Total 5366	C 3200	N 1083	O 1083	0	0
5	E	1083	Total 5366	C 3200	N 1083	O 1083	0	0
5	Q	1083	Total 5366	C 3200	N 1083	O 1083	0	0

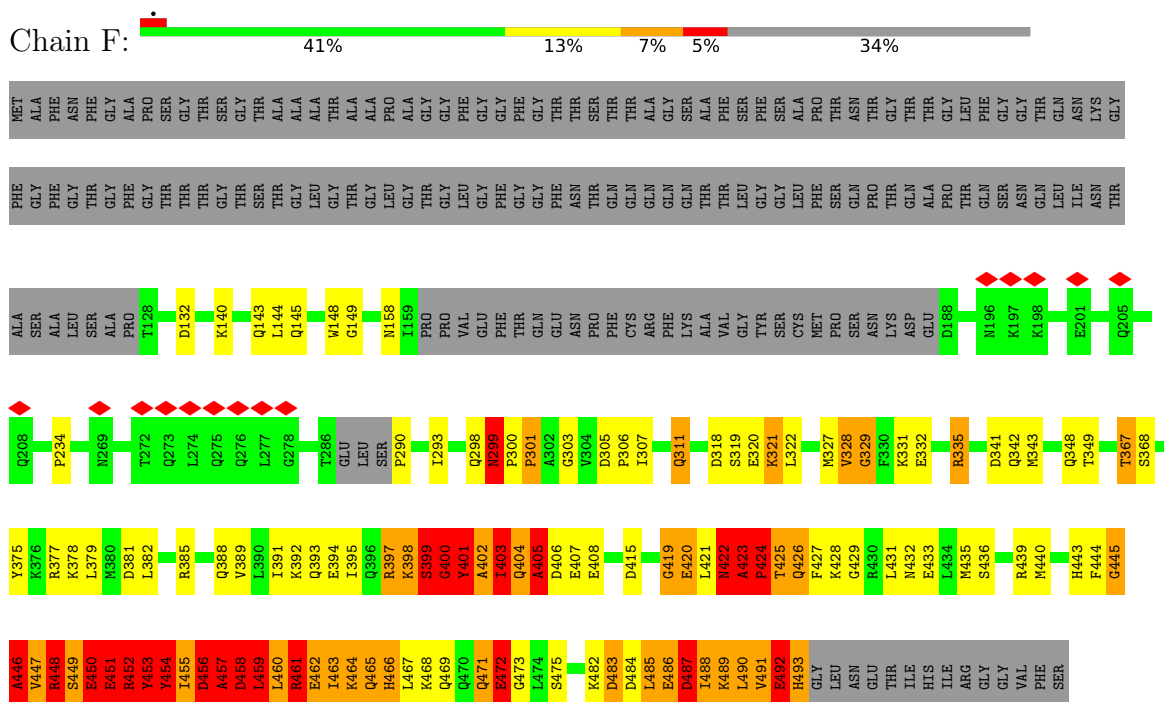
- Molecule 6 is a protein called Nuclear pore complex protein Nup93.

Mol	Chain	Residues	Atoms				AltConf	Trace
6	C	594	Total 2946	C 1758	N 594	O 594	0	0
6	I	594	Total 2946	C 1758	N 594	O 594	0	0
6	O	594	Total 2946	C 1758	N 594	O 594	0	0
6	U	594	Total 2946	C 1758	N 594	O 594	0	0

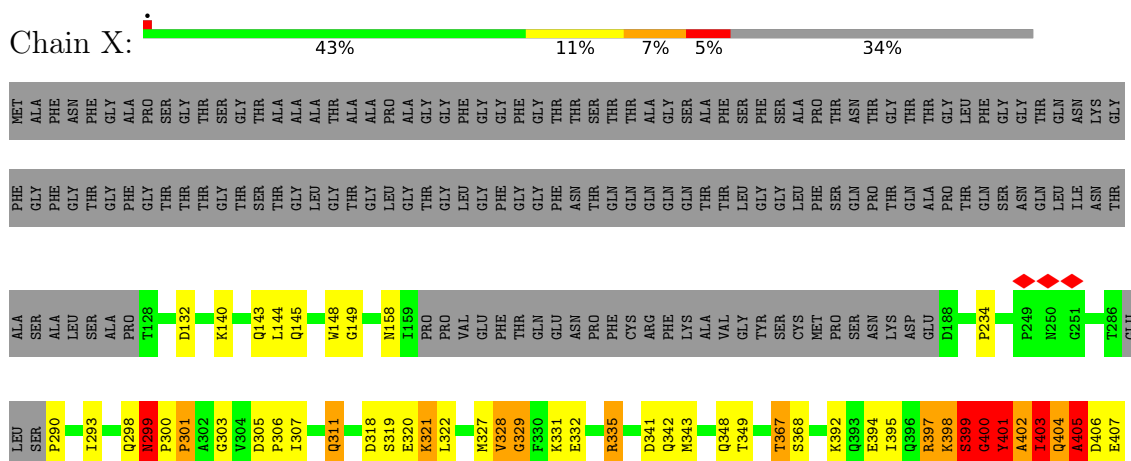
3 Residue-property plots

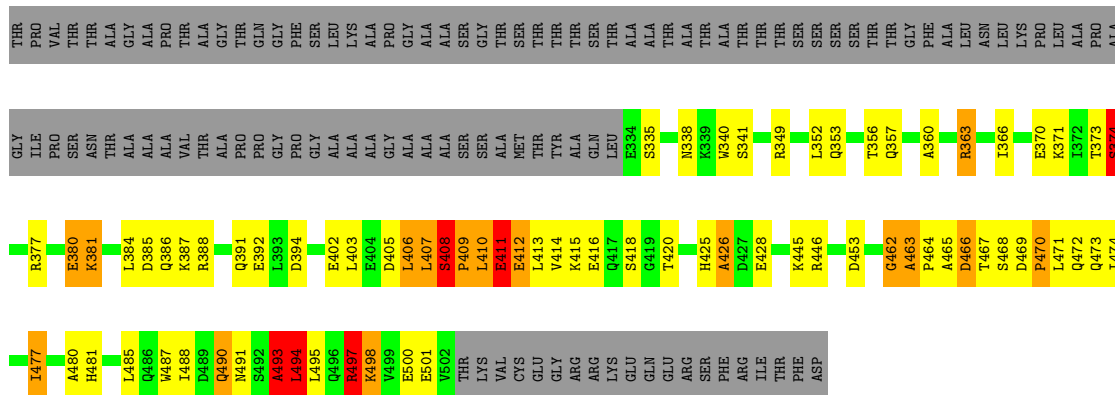
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion in map density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red diamond above a residue indicates a poor fit to the EM map for this residue (all-atom inclusion < 40%). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: Nucleoporin p54

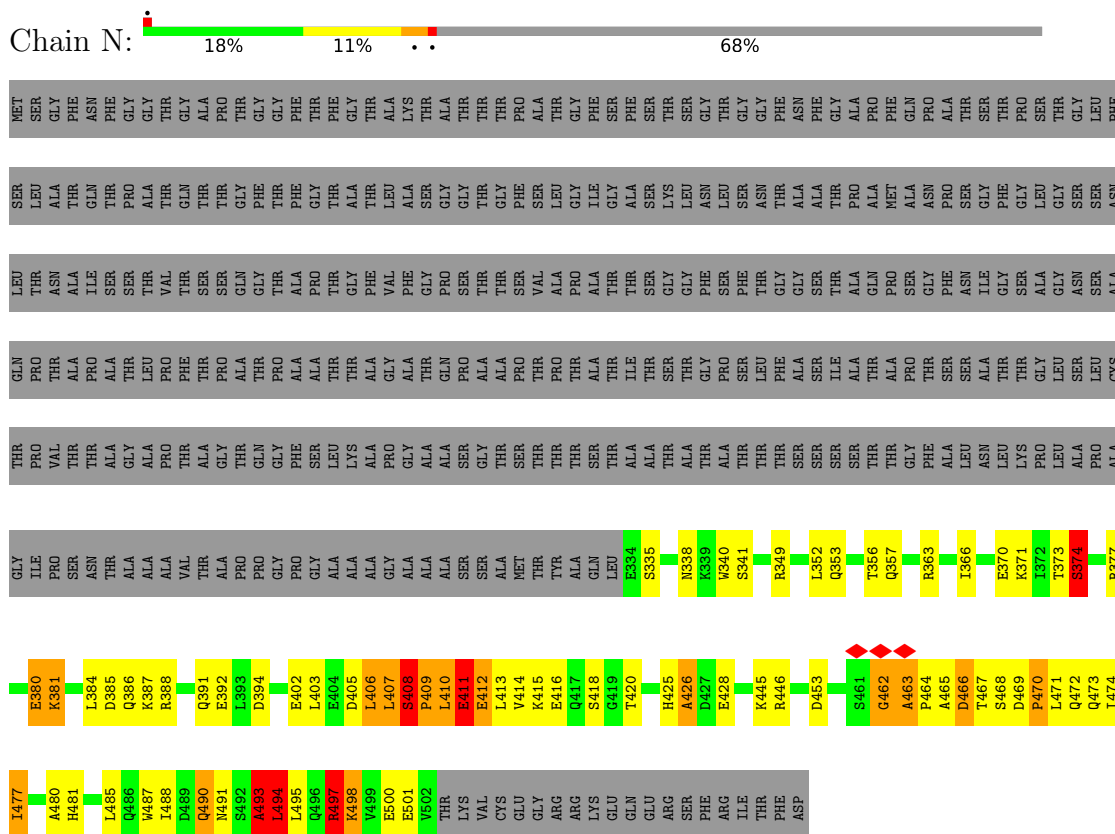


- Molecule 1: Nucleoporin p54

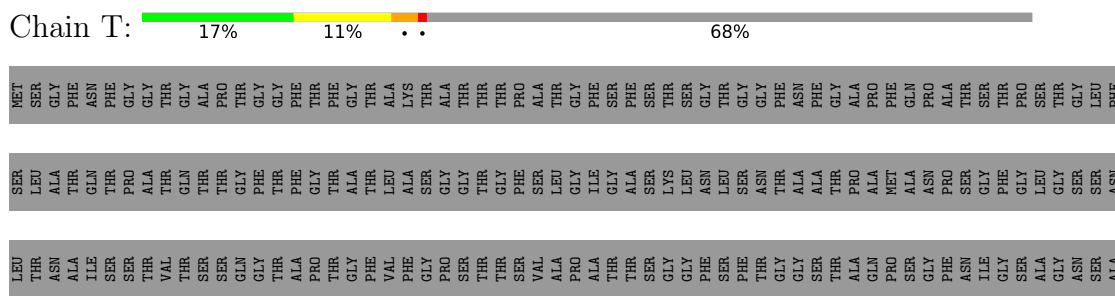


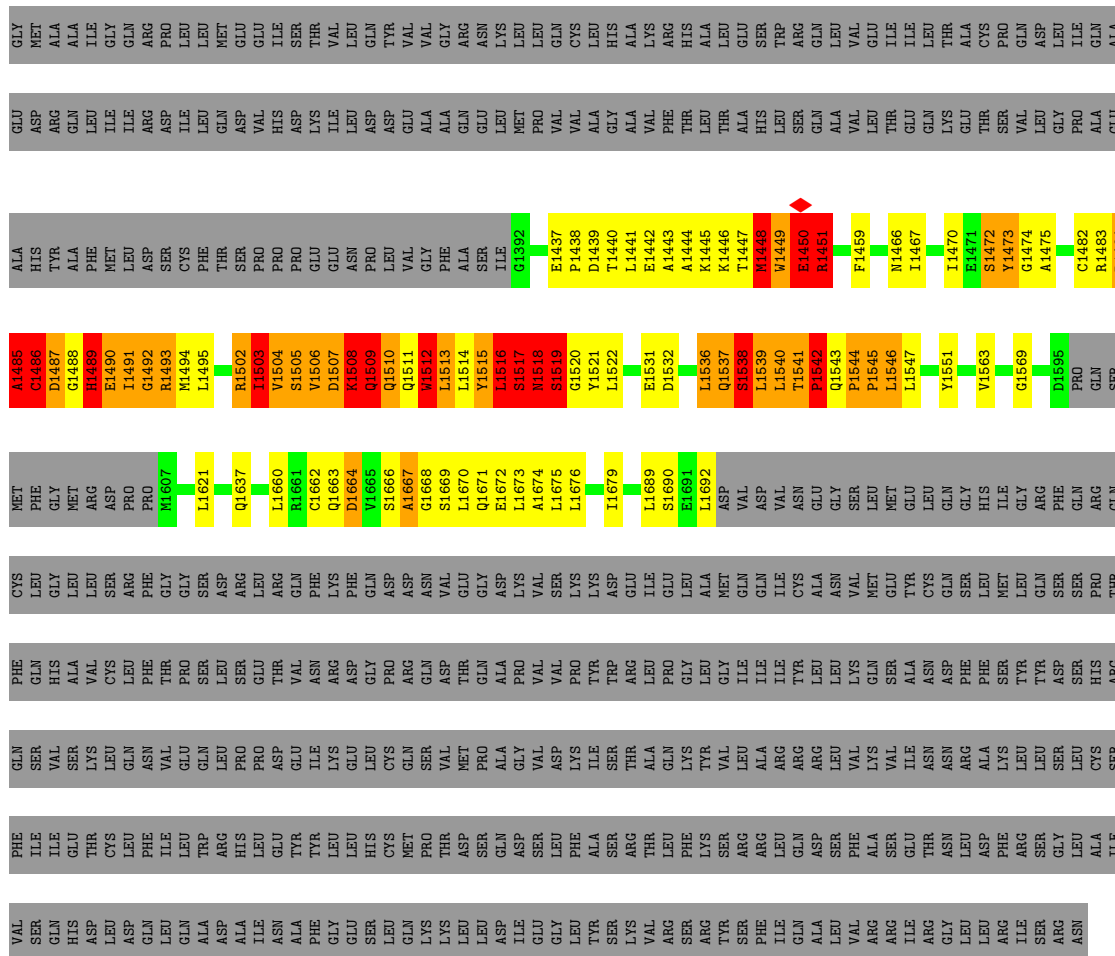


• Molecule 3: Nuclear pore glycoprotein p62

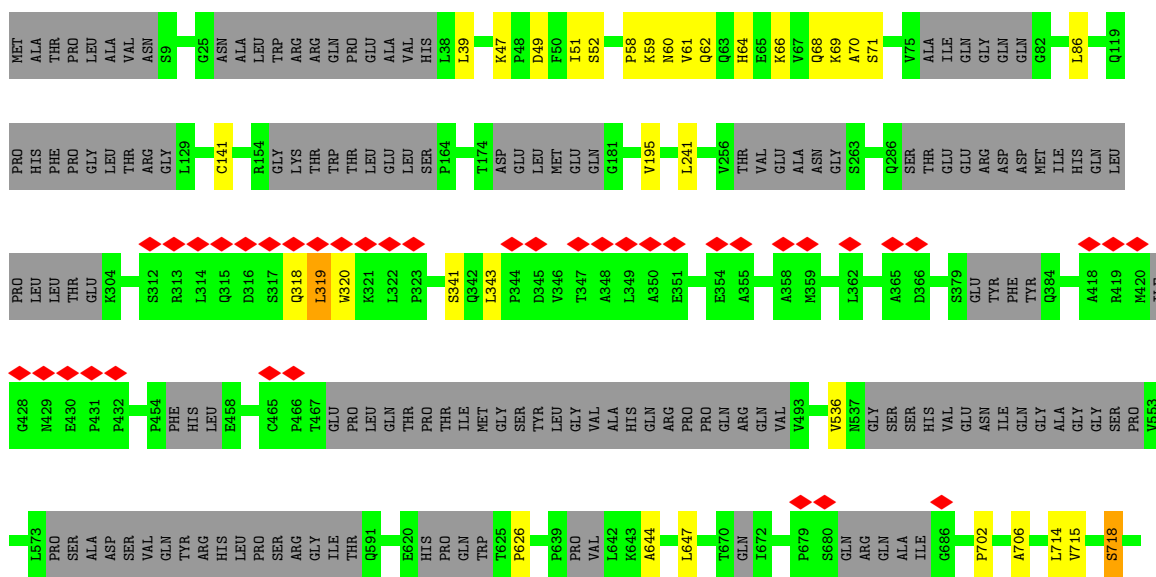


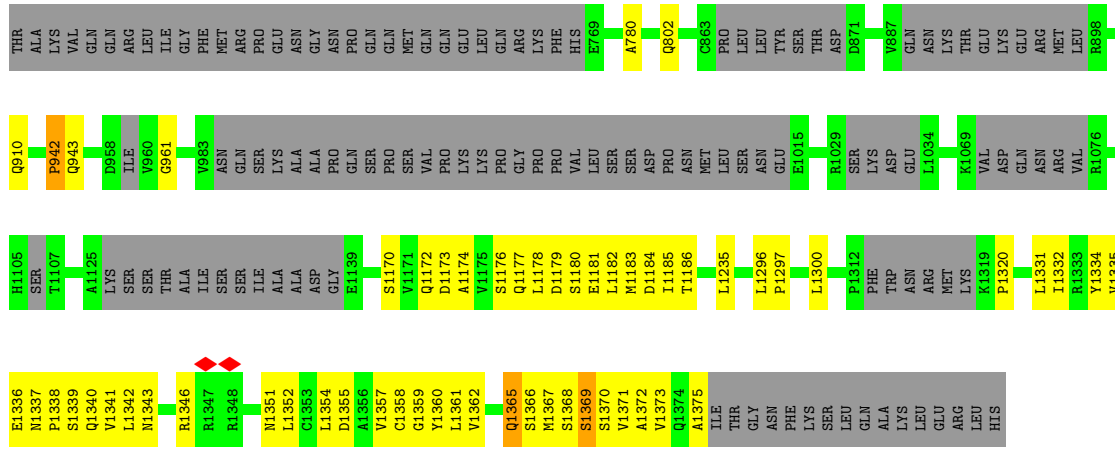
• Molecule 3: Nuclear pore glycoprotein p62



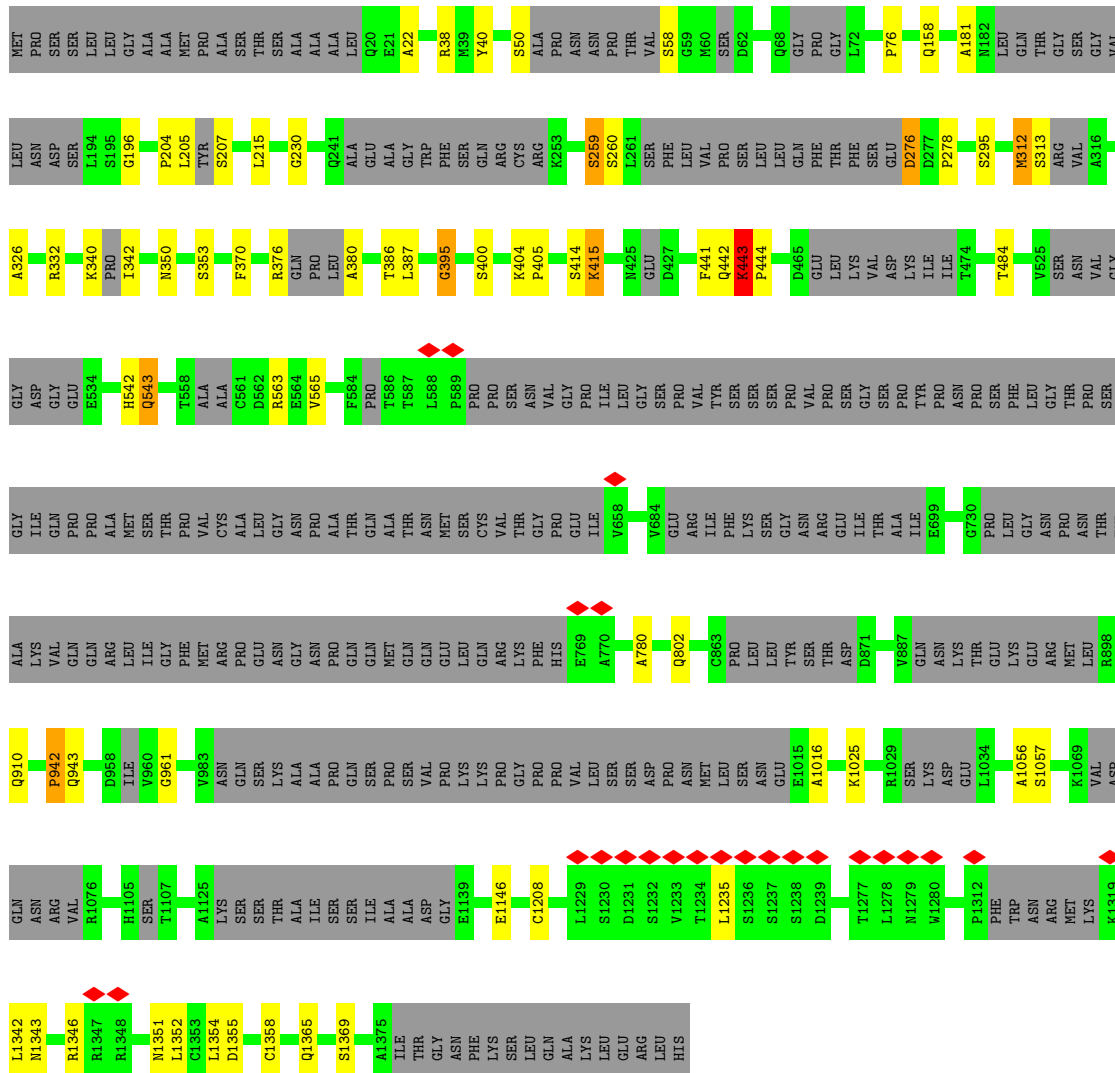


• Molecule 4: Nuclear pore complex protein Nup205



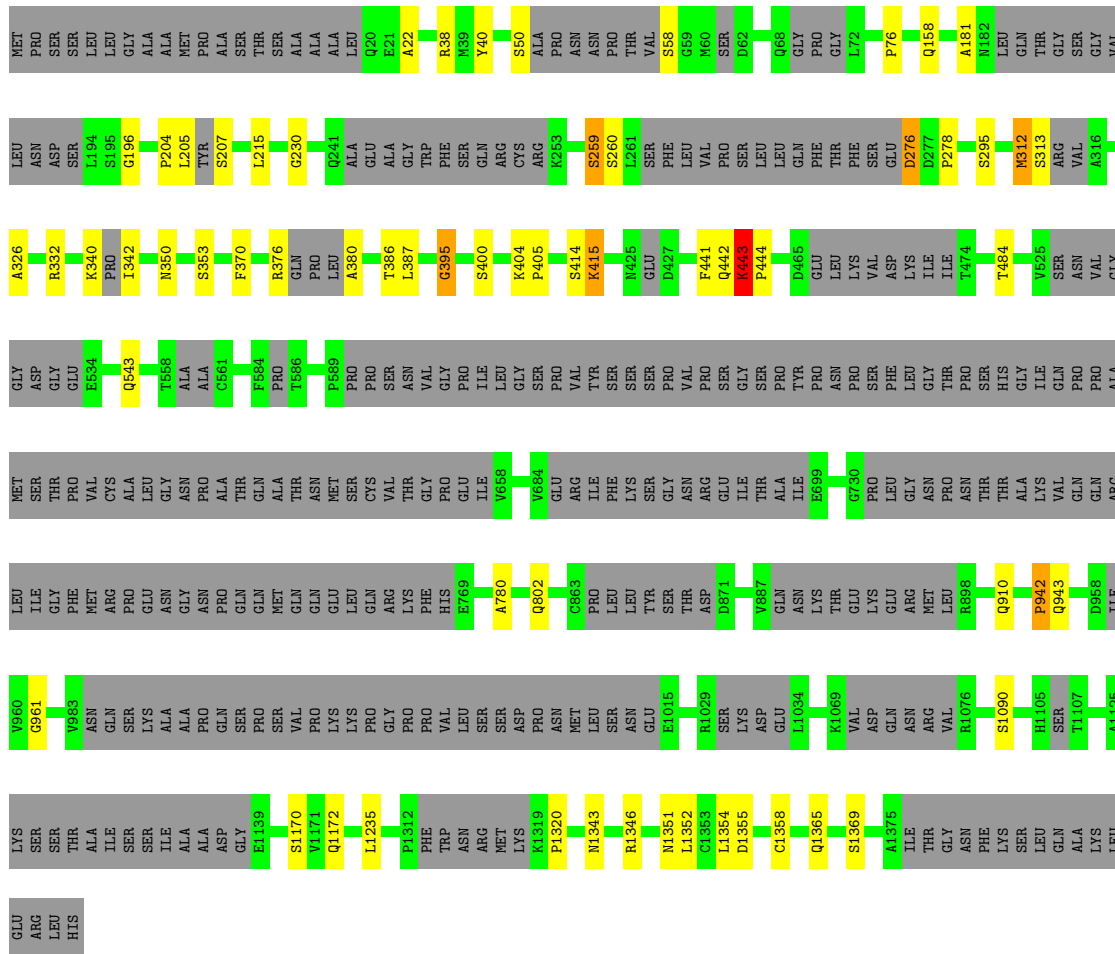


• Molecule 5: Nuclear pore complex protein Nup155



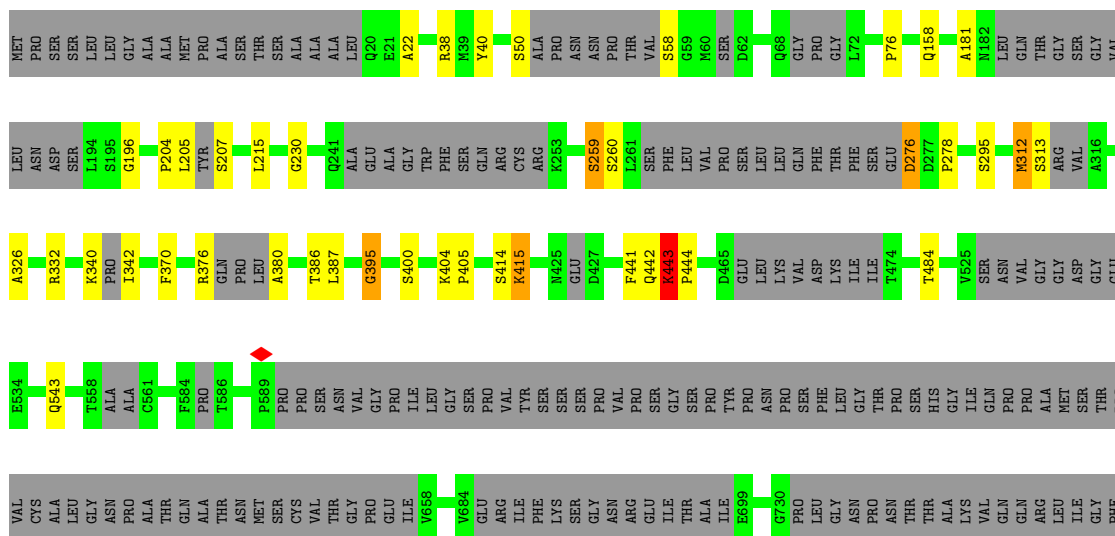
• Molecule 5: Nuclear pore complex protein Nup155

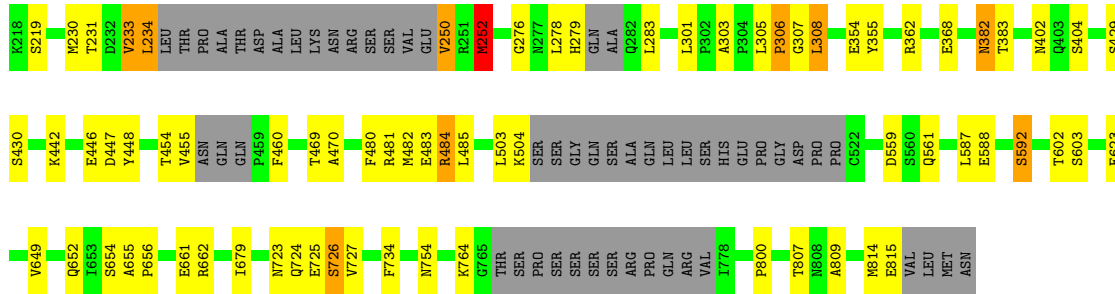
Chain E: 73% 22%



● Molecule 5: Nuclear pore complex protein Nup155

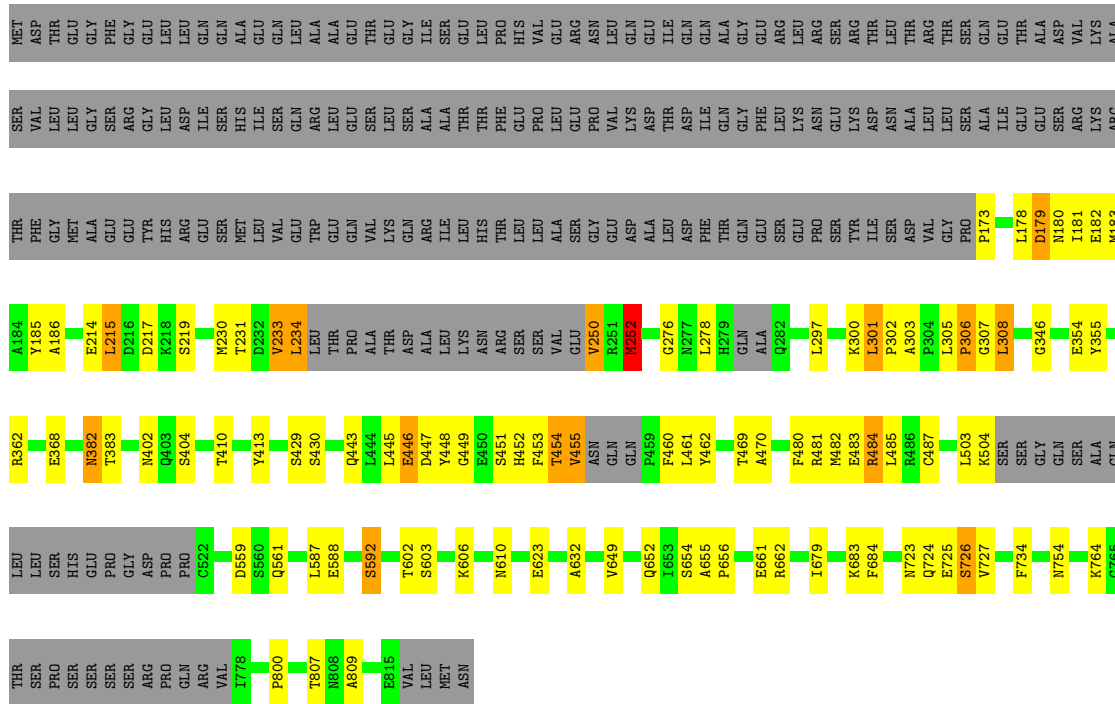
Chain Q: 73% 22%





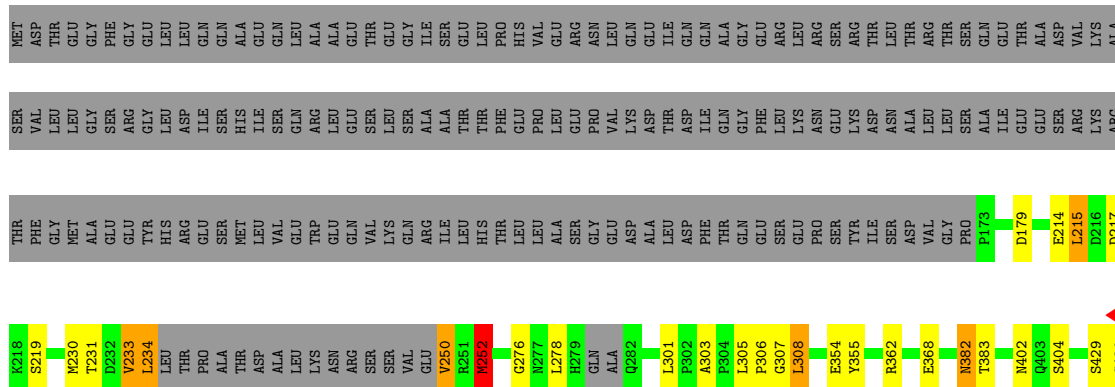
- Molecule 6: Nuclear pore complex protein Nup93

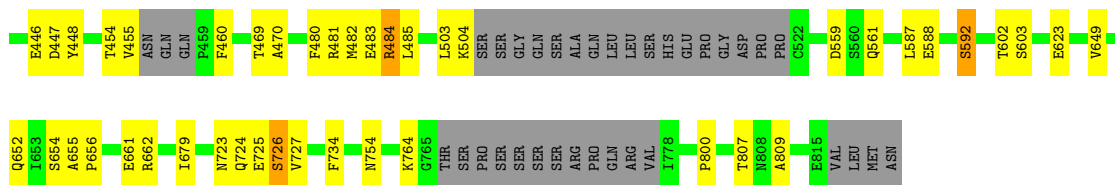
Chain O: 60% 10% 27%



- Molecule 6: Nuclear pore complex protein Nup93

Chain U: 64% 8% 27%





4 Experimental information

Property	Value	Source
EM reconstruction method	SUBTOMOGRAM AVERAGING	Depositor
Imposed symmetry	POINT, C8	Depositor
Number of subtomograms used	1252	Depositor
Resolution determination method	FSC 0.5 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING ONLY	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	2.4	Depositor
Minimum defocus (nm)	2500	Depositor
Maximum defocus (nm)	5000	Depositor
Magnification	Not provided	
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	1.000	Depositor
Minimum map value	0.000	Depositor
Average map value	0.351	Depositor
Map value standard deviation	0.050	Depositor
Recommended contour level	0.44	Depositor
Map size (\AA)	2188.8, 2188.8, 2188.8	wwPDB
Map dimensions	320, 320, 320	wwPDB
Map angles ($^\circ$)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (\AA)	6.84, 6.84, 6.84	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	F	3.74	152/1655 (9.2%)	3.77	224/2302 (9.7%)
1	L	3.74	154/1655 (9.3%)	3.77	222/2302 (9.6%)
1	R	3.74	152/1655 (9.2%)	3.77	223/2302 (9.7%)
1	X	3.74	151/1655 (9.1%)	3.77	224/2302 (9.7%)
2	G	3.95	84/852 (9.9%)	3.81	122/1190 (10.3%)
2	M	3.95	85/852 (10.0%)	3.81	122/1190 (10.3%)
2	S	3.95	83/852 (9.7%)	3.81	122/1190 (10.3%)
2	Y	3.95	84/852 (9.9%)	3.81	122/1190 (10.3%)
3	H	3.44	83/841 (9.9%)	3.09	110/1174 (9.4%)
3	N	3.44	83/841 (9.9%)	3.09	110/1174 (9.4%)
3	T	3.44	83/841 (9.9%)	3.10	109/1174 (9.3%)
3	Z	3.44	84/841 (10.0%)	3.09	109/1174 (9.3%)
4	D	1.22	38/5066 (0.8%)	1.69	118/7020 (1.7%)
4	J	1.22	39/5066 (0.8%)	1.69	119/7020 (1.7%)
4	P	1.22	38/5066 (0.8%)	1.69	116/7020 (1.7%)
4	V	1.22	39/5066 (0.8%)	1.69	118/7020 (1.7%)
5	E	0.93	0/5338	1.17	10/7399 (0.1%)
5	K	0.93	0/5338	1.17	10/7399 (0.1%)
5	Q	0.93	0/5338	1.18	10/7399 (0.1%)
5	W	0.93	0/5338	1.17	10/7399 (0.1%)
6	C	0.94	1/2938 (0.0%)	1.31	20/4086 (0.5%)
6	I	0.94	1/2938 (0.0%)	1.31	20/4086 (0.5%)
6	O	0.94	1/2938 (0.0%)	1.31	20/4086 (0.5%)
6	U	0.94	1/2938 (0.0%)	1.31	19/4086 (0.5%)
All	All	1.91	1436/66760 (2.2%)	2.06	2409/92684 (2.6%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
1	F	7	31

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Mol	Chain	#Chirality outliers	#Planarity outliers
1	L	7	31
1	R	7	31
1	X	7	30
2	G	9	10
2	M	9	10
2	S	9	10
2	Y	9	10
3	H	5	5
3	N	5	5
3	T	5	5
3	Z	5	5
4	D	0	19
4	J	0	20
4	P	0	21
4	V	0	20
5	E	0	1
5	K	0	1
5	Q	0	1
5	W	0	1
All	All	84	267

The worst 5 of 1436 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	Y	380	ILE	N-CA	38.62	2.23	1.46
2	M	380	ILE	N-CA	38.57	2.23	1.46
2	G	380	ILE	N-CA	38.49	2.23	1.46
2	S	380	ILE	N-CA	38.48	2.23	1.46
2	Y	379	HIS	CA-C	37.09	2.49	1.52

The worst 5 of 2409 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	452	ARG	CA-C-N	-39.57	30.16	117.20
1	L	452	ARG	CA-C-N	-39.56	30.17	117.20
1	R	452	ARG	CA-C-N	-39.55	30.18	117.20
1	F	452	ARG	CA-C-N	-39.55	30.19	117.20
2	Y	343	ALA	CB-CA-C	-36.26	55.71	110.10

5 of 84 chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	F	305	ASP	CA
1	F	341	ASP	CA
1	F	423	ALA	CA
1	F	454	TYR	CA
1	F	459	LEU	CA

5 of 267 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	F	393	GLN	Mainchain
1	F	397	ARG	Mainchain
1	F	398	LYS	Mainchain,Peptide
1	F	399	SER	Peptide
1	F	400	GLY	Mainchain

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	F	1658	0	715	186	0
1	L	1658	0	715	153	0
1	R	1658	0	710	232	0
1	X	1658	0	715	153	0
2	G	853	0	384	61	0
2	M	853	0	384	56	0
2	S	853	0	384	56	0
2	Y	853	0	384	57	0
3	H	842	0	365	43	0
3	N	842	0	365	37	0
3	T	842	0	365	37	0
3	Z	842	0	365	36	0
4	D	5094	0	2272	135	0
4	J	5094	0	2271	69	0
4	P	5094	0	2253	344	0
4	V	5094	0	2258	298	0
5	E	5366	0	2365	31	0
5	K	5366	0	2362	61	0
5	Q	5366	0	2365	36	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	W	5366	0	2350	236	0
6	C	2946	0	1307	78	0
6	I	2946	0	1306	35	0
6	O	2946	0	1296	189	0
6	U	2946	0	1307	21	0
All	All	67036	0	29563	2028	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 21.

The worst 5 of 2028 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:G:366:GLU:CB	2:G:366:GLU:CA	1.76	1.63
1:X:451:GLU:CA	1:X:451:GLU:CB	1.77	1.61
1:F:447:VAL:CB	1:F:447:VAL:CA	1.78	1.60
1:R:447:VAL:CA	1:R:447:VAL:CB	1.78	1.60
1:L:454:TYR:CA	1:L:454:TYR:CB	1.77	1.60

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	F	329/507 (65%)	295 (90%)	16 (5%)	18 (6%)	2	19
1	L	329/507 (65%)	295 (90%)	16 (5%)	18 (6%)	2	19
1	R	329/507 (65%)	295 (90%)	16 (5%)	18 (6%)	2	19
1	X	329/507 (65%)	295 (90%)	16 (5%)	18 (6%)	2	19
2	G	169/599 (28%)	153 (90%)	11 (6%)	5 (3%)	4	28

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	M	169/599 (28%)	153 (90%)	11 (6%)	5 (3%)	4	28
2	S	169/599 (28%)	153 (90%)	10 (6%)	6 (4%)	3	25
2	Y	169/599 (28%)	153 (90%)	10 (6%)	6 (4%)	3	25
3	H	167/522 (32%)	152 (91%)	8 (5%)	7 (4%)	3	22
3	N	167/522 (32%)	152 (91%)	8 (5%)	7 (4%)	3	22
3	T	167/522 (32%)	152 (91%)	8 (5%)	7 (4%)	3	22
3	Z	167/522 (32%)	152 (91%)	8 (5%)	7 (4%)	3	22
4	D	972/2012 (48%)	911 (94%)	46 (5%)	15 (2%)	10	46
4	J	972/2012 (48%)	911 (94%)	46 (5%)	15 (2%)	10	46
4	P	972/2012 (48%)	911 (94%)	46 (5%)	15 (2%)	10	46
4	V	972/2012 (48%)	911 (94%)	46 (5%)	15 (2%)	10	46
5	E	1027/1391 (74%)	947 (92%)	58 (6%)	22 (2%)	7	36
5	K	1027/1391 (74%)	947 (92%)	58 (6%)	22 (2%)	7	36
5	Q	1027/1391 (74%)	947 (92%)	58 (6%)	22 (2%)	7	36
5	W	1027/1391 (74%)	947 (92%)	58 (6%)	22 (2%)	7	36
6	C	578/819 (71%)	486 (84%)	53 (9%)	39 (7%)	1	15
6	I	578/819 (71%)	486 (84%)	53 (9%)	39 (7%)	1	15
6	O	578/819 (71%)	486 (84%)	52 (9%)	40 (7%)	1	15
6	U	578/819 (71%)	486 (84%)	53 (9%)	39 (7%)	1	15
All	All	12968/23400 (55%)	11776 (91%)	765 (6%)	427 (3%)	6	26

5 of 427 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	F	148	TRP
1	F	318	ASP
1	F	403	ILE
1	F	405	ALA
1	F	451	GLU

5.3.2 Protein sidechains [i](#)

There are no protein residues with a non-rotameric sidechain to report in this entry.

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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	F	5
1	X	5
1	L	5
1	R	5
2	G	3
2	S	3
2	Y	3
2	M	3
3	H	3
3	Z	3
3	N	3
3	T	3
6	C	2
6	I	2
6	O	2
6	U	2

The worst 5 of 52 chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	C	483:GLU	C	484:ARG	N	4.02
1	I	483:GLU	C	484:ARG	N	4.02
1	O	483:GLU	C	484:ARG	N	4.02
1	U	483:GLU	C	484:ARG	N	4.02
1	C	447:ASP	C	448:TYR	N	3.63

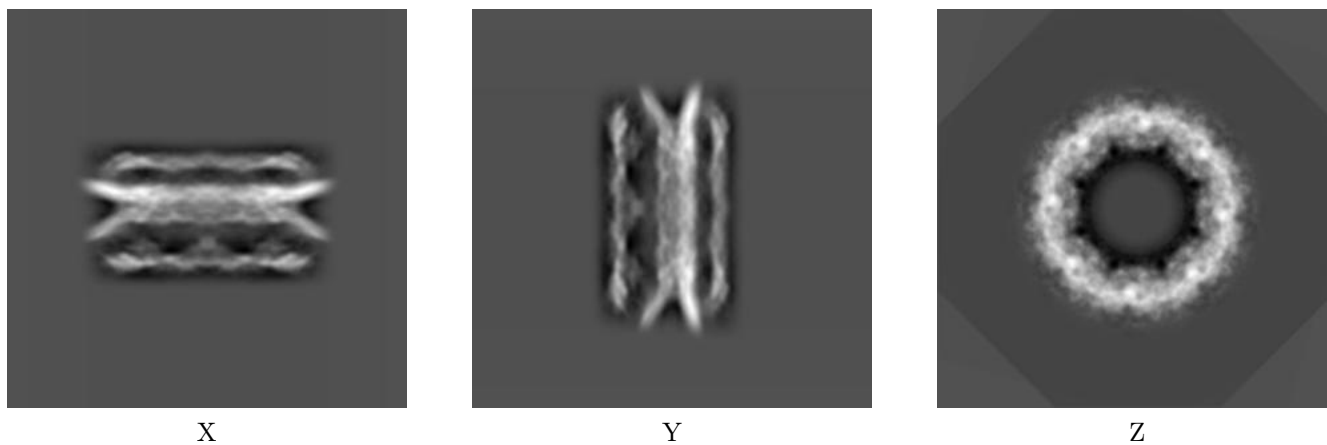
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-12814. These allow visual inspection of the internal detail of the map and identification of artifacts.

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

6.1 Orthogonal projections [i](#)

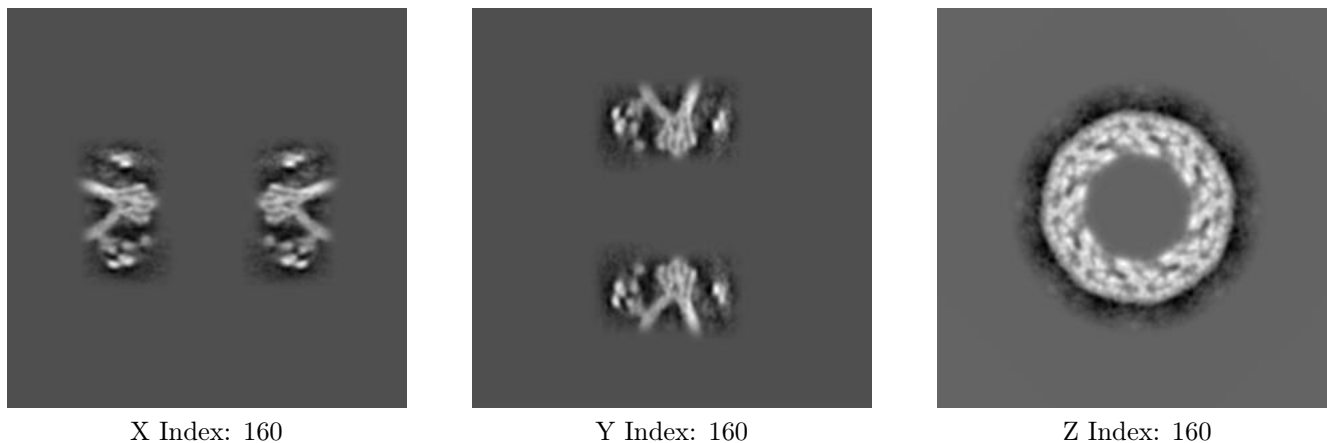
6.1.1 Primary map



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

6.2 Central slices [i](#)

6.2.1 Primary map



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

6.3 Largest variance slices [i](#)

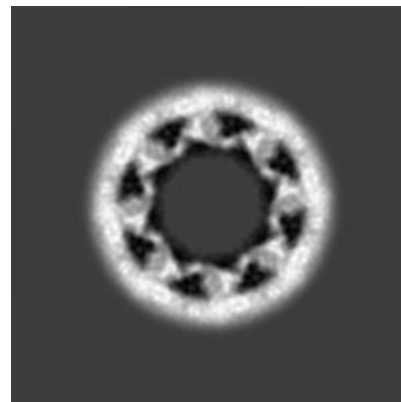
6.3.1 Primary map



X Index: 100



Y Index: 220



Z Index: 174

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

6.4 Orthogonal surface views [i](#)

6.4.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.44. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

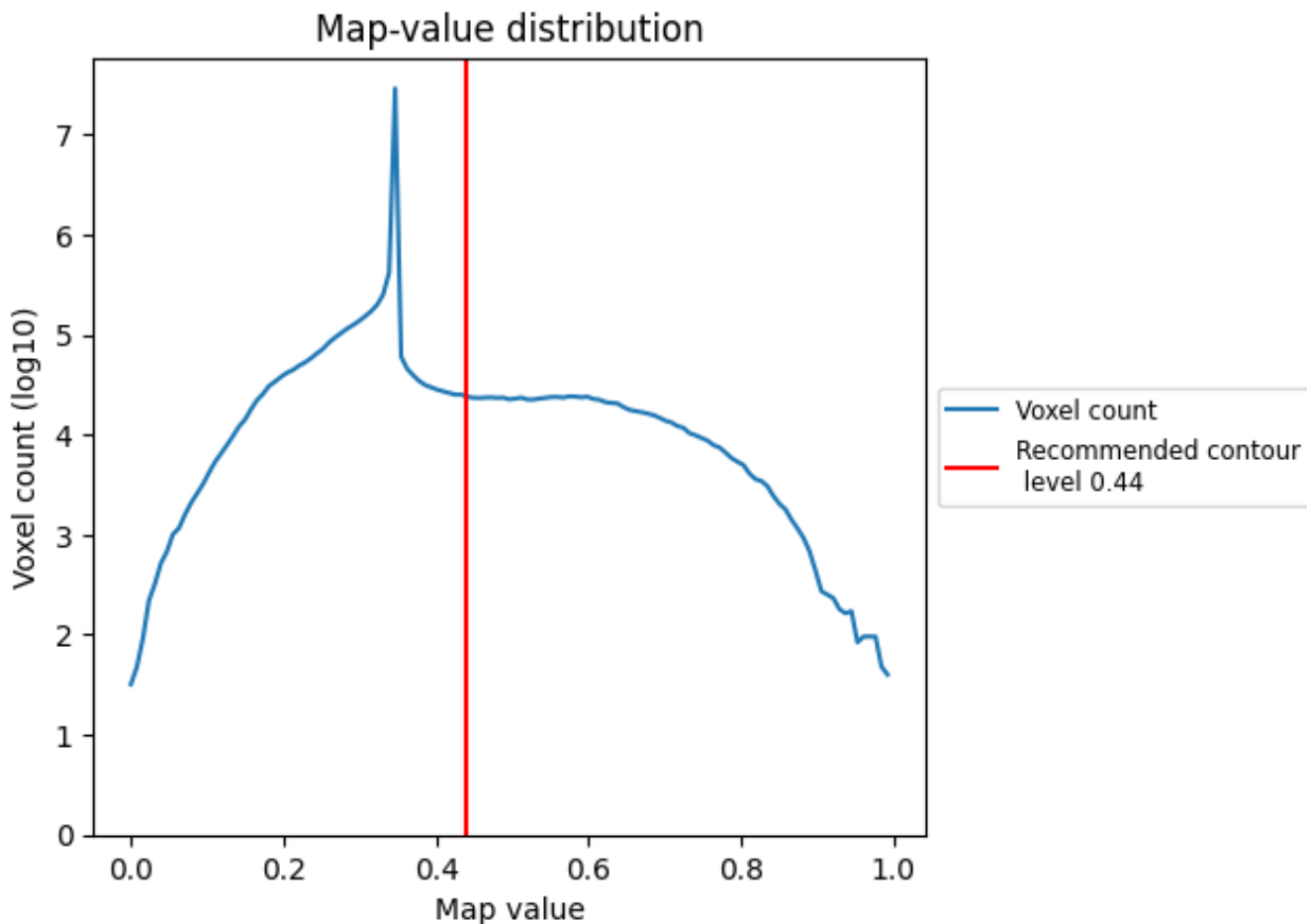
6.5 Mask visualisation

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

7 Map analysis [i](#)

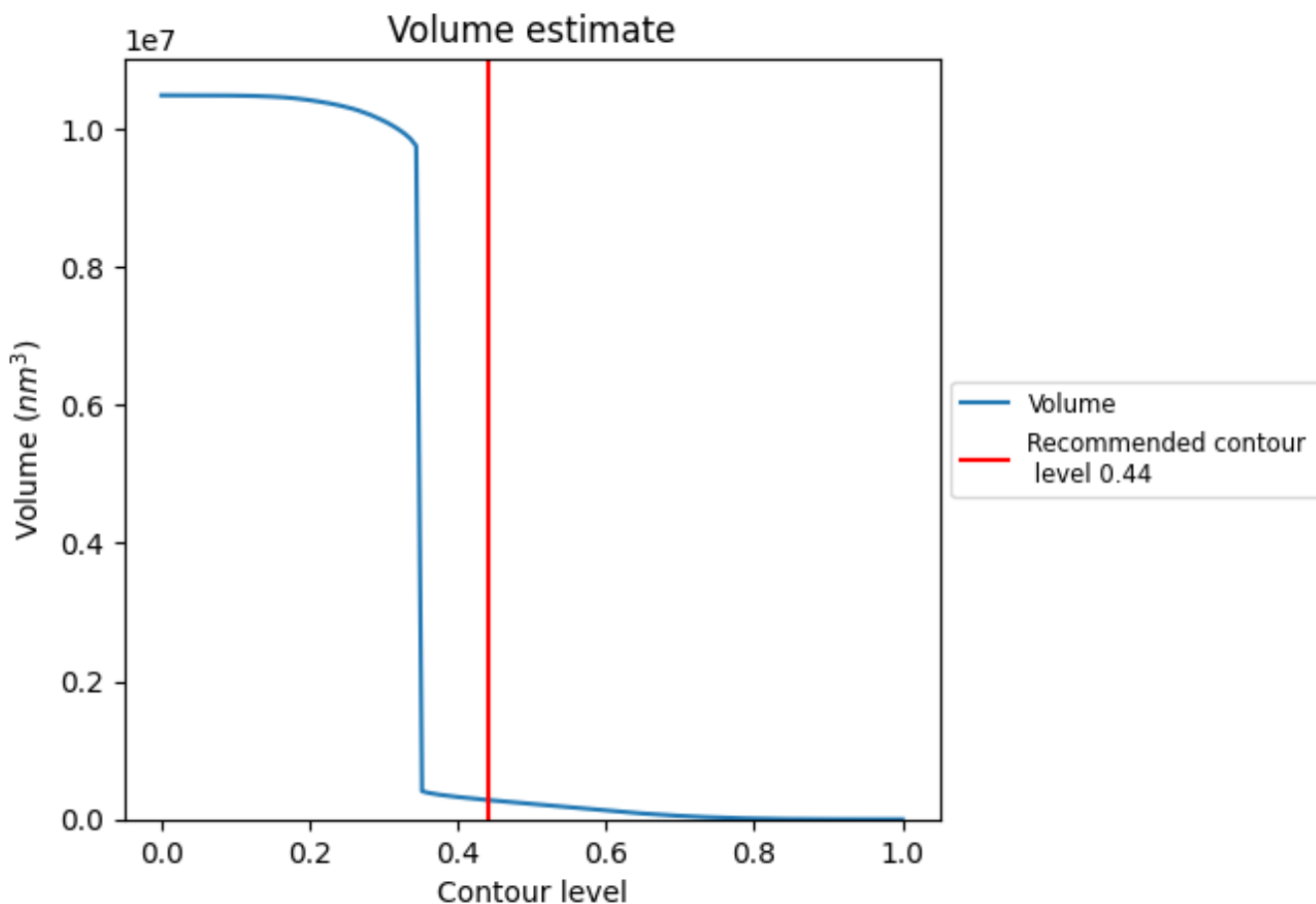
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution [i](#)



The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

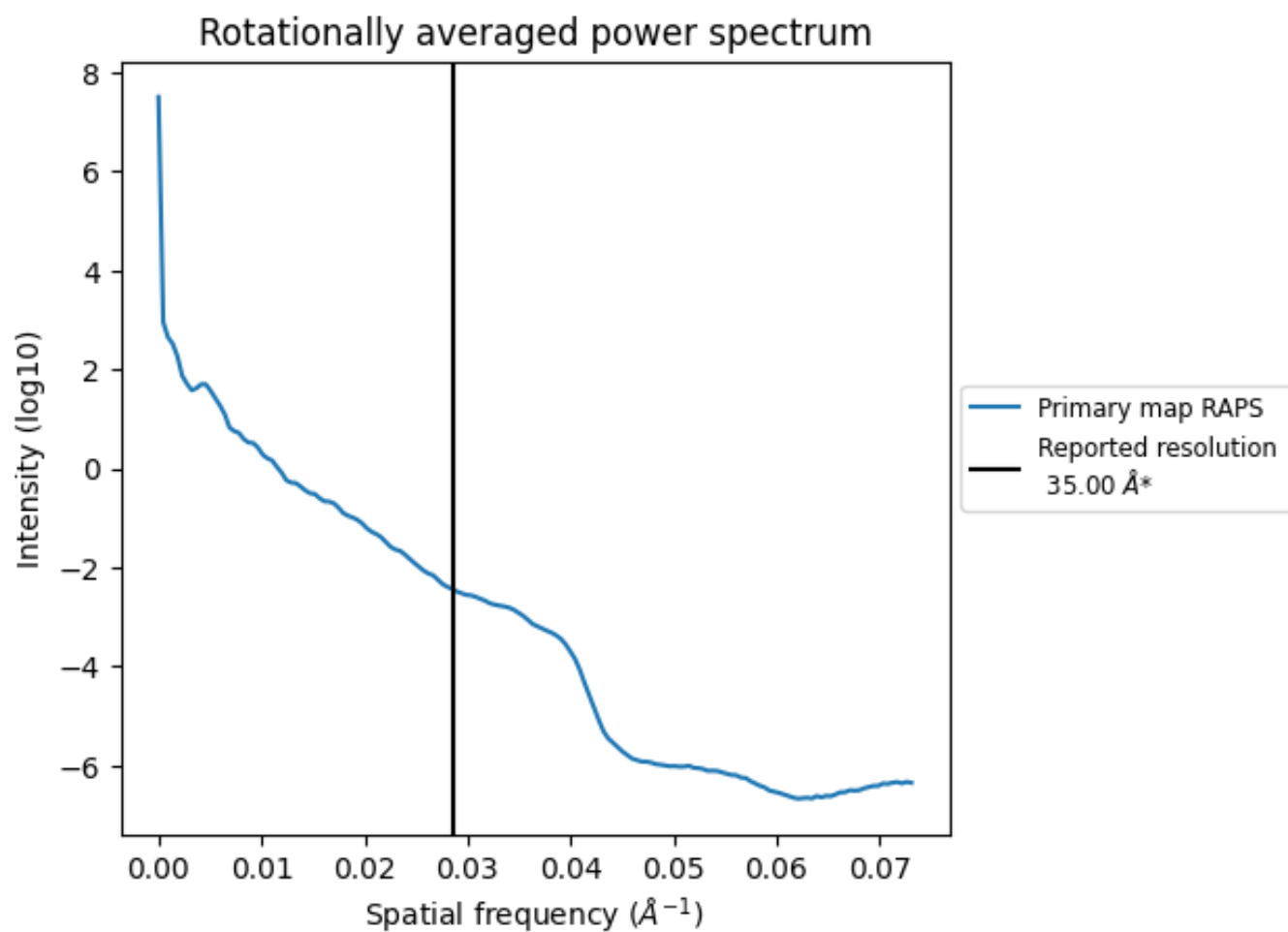
7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 280168 nm^3 ; this corresponds to an approximate mass of 253083 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 0.029 Å⁻¹

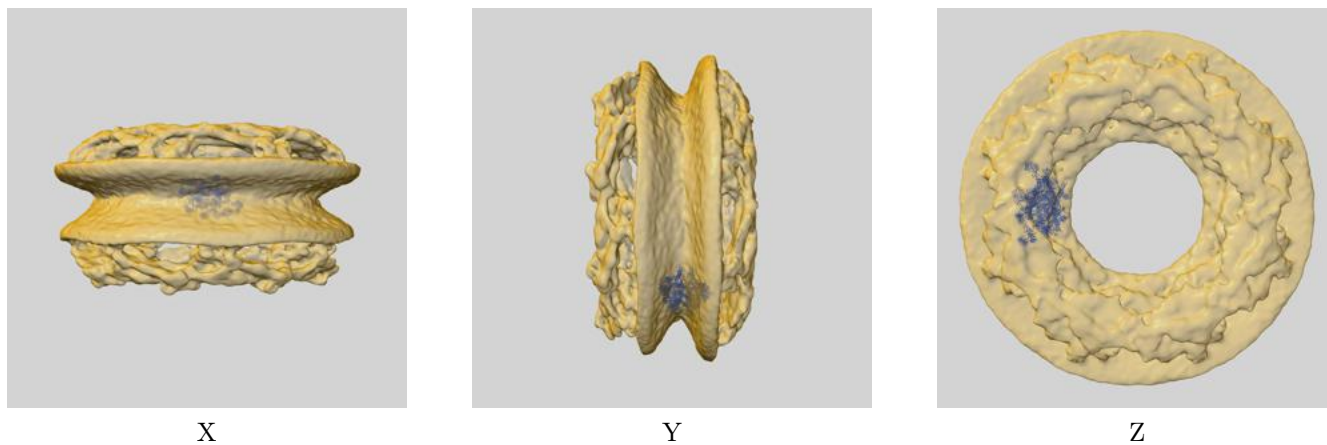
8 Fourier-Shell correlation

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

9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-12814 and PDB model 7PER. Per-residue inclusion information can be found in section 3 on page 6.

9.0.1 Map-model overlay [i](#)

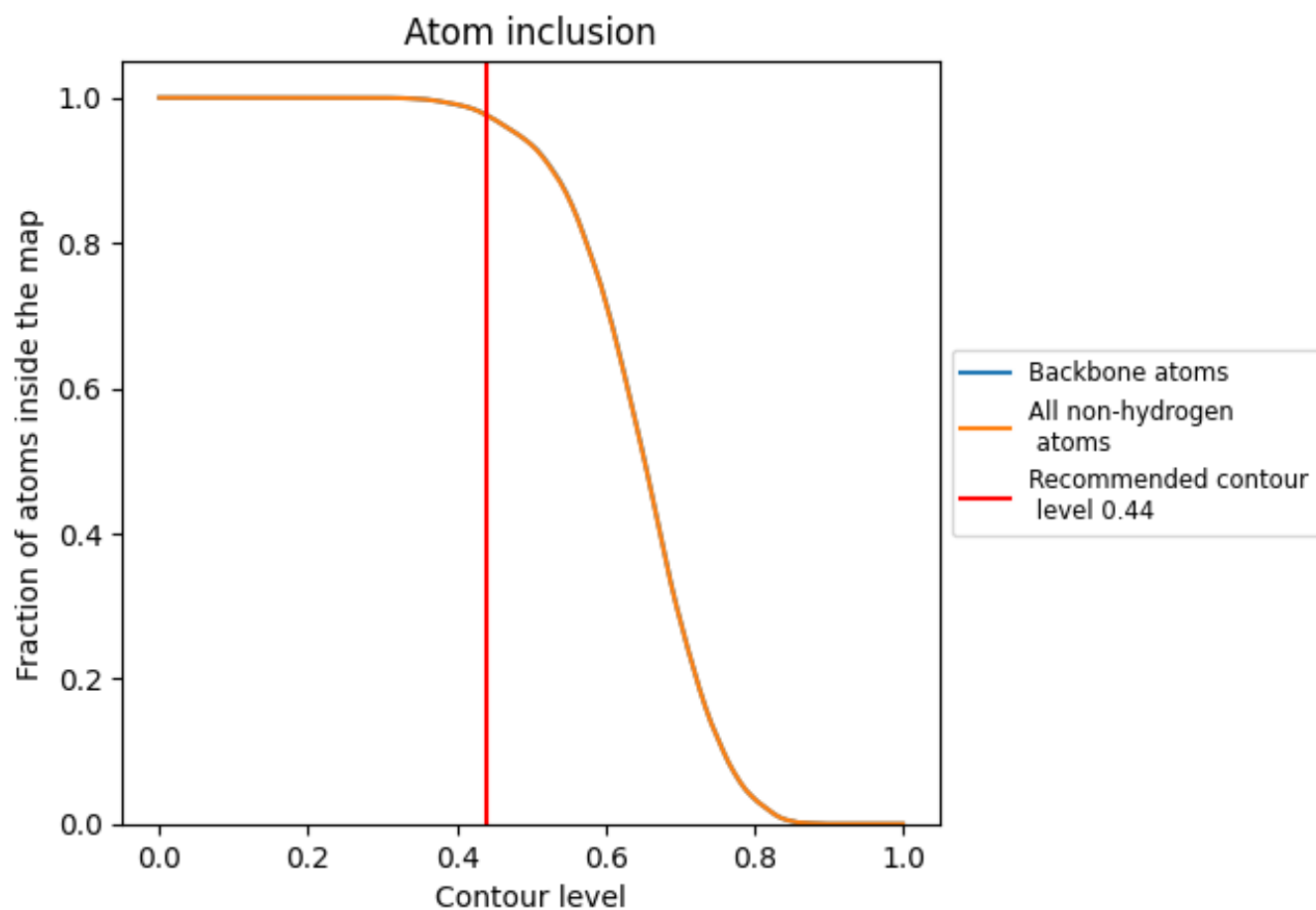


9.0.2 Map-model assembly overlay [i](#)



The images above show the 3D surface view of the map at the recommended contour level 0.44 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.

9.1 Atom inclusion [i](#)



At the recommended contour level, 98% of all backbone atoms, 98% of all non-hydrogen atoms, are inside the map.