



wwPDB EM Validation Summary Report ⓘ

Jun 7, 2023 – 03:21 PM EDT

PDB ID : 8EZ9
EMDB ID : EMD-28731
Title : Dimeric complex of DNA-PKcs
Authors : Chen, S.; He, Y.
Deposited on : 2022-10-31
Resolution : 5.67 Å(reported)

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

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

A user guide is available at

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

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

EMDB validation analysis : 0.0.1.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) : 2.33

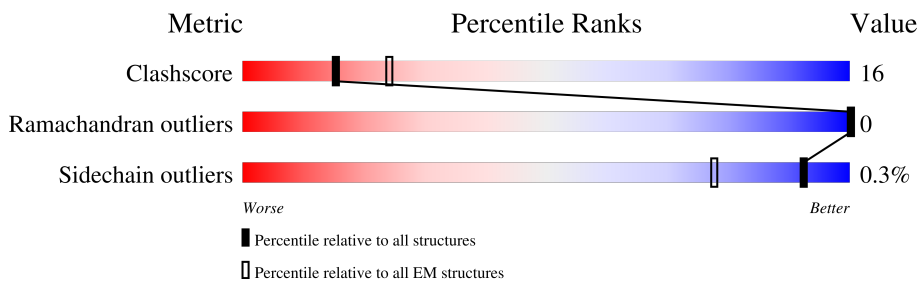
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 5.67 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 $\leq 5\%$. 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	Q	20	
1	R	20	
2	C	4128	
2	L	4128	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 58770 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 unknown region of DNA-PKcs.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
1	R	20	101	60	20	21	0	0
1	Q	20	101	60	20	21	0	0

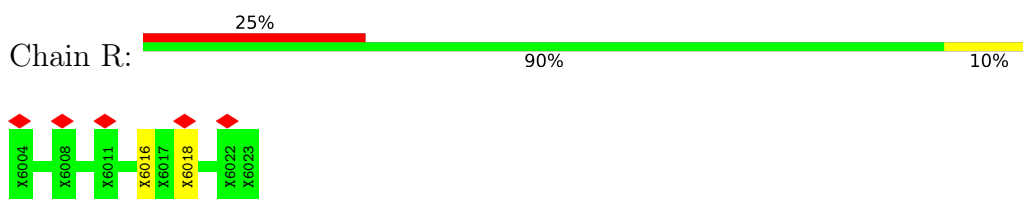
- Molecule 2 is a protein called DNA-dependent protein kinase catalytic subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	L	3662	29284	18776	4946	5370	192	0	0
2	C	3662	29284	18776	4946	5370	192	0	0

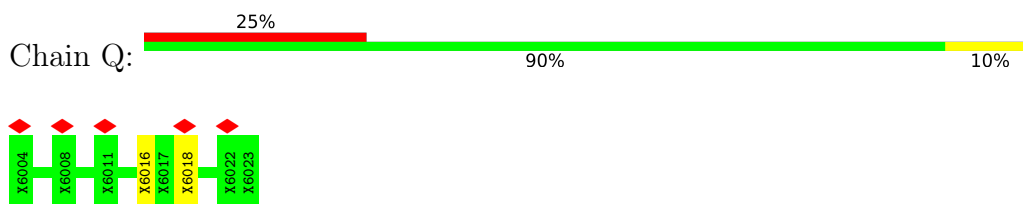
3 Residue-property plots

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.

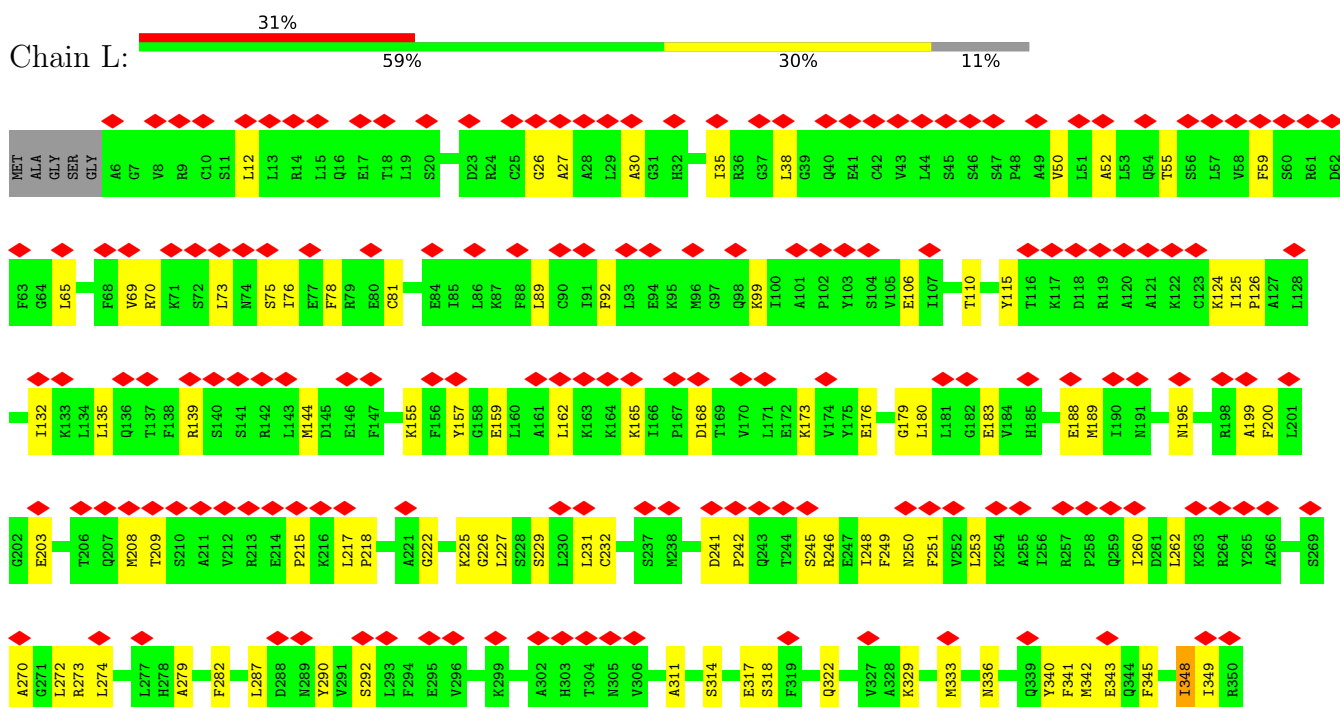
- Molecule 1: unknown region of DNA-PKcs

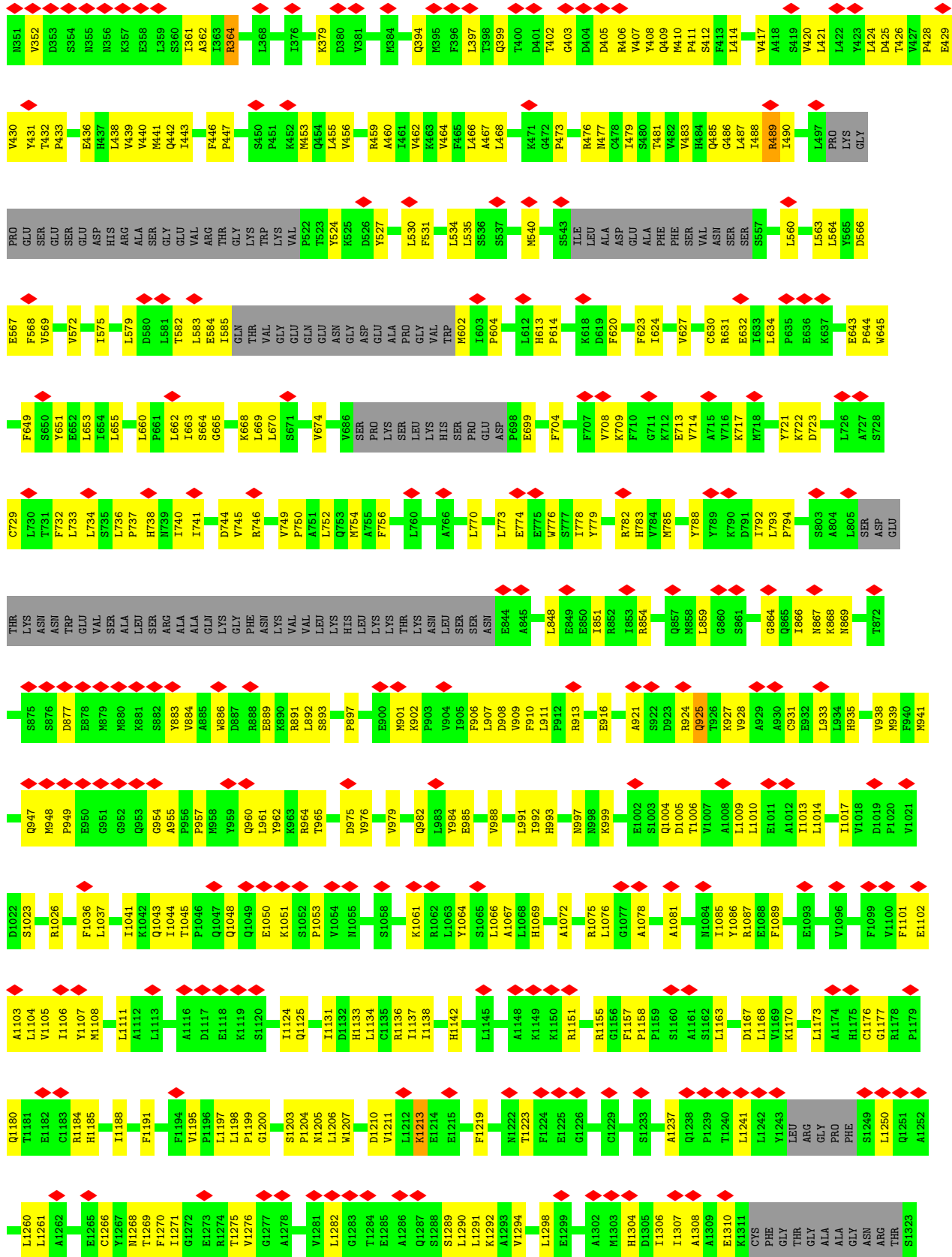


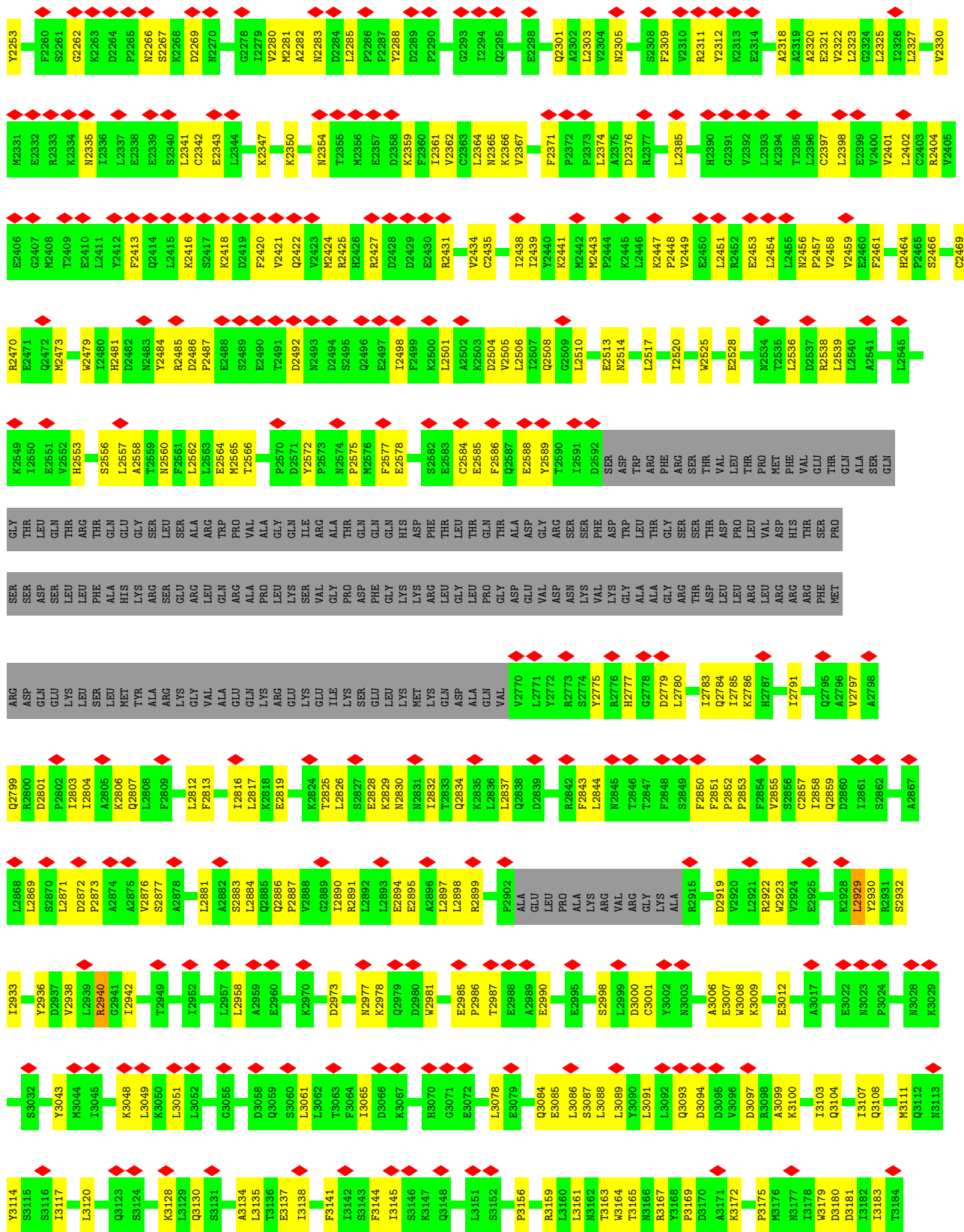
- Molecule 1: unknown region of DNA-PKcs



- Molecule 2: DNA-dependent protein kinase catalytic subunit

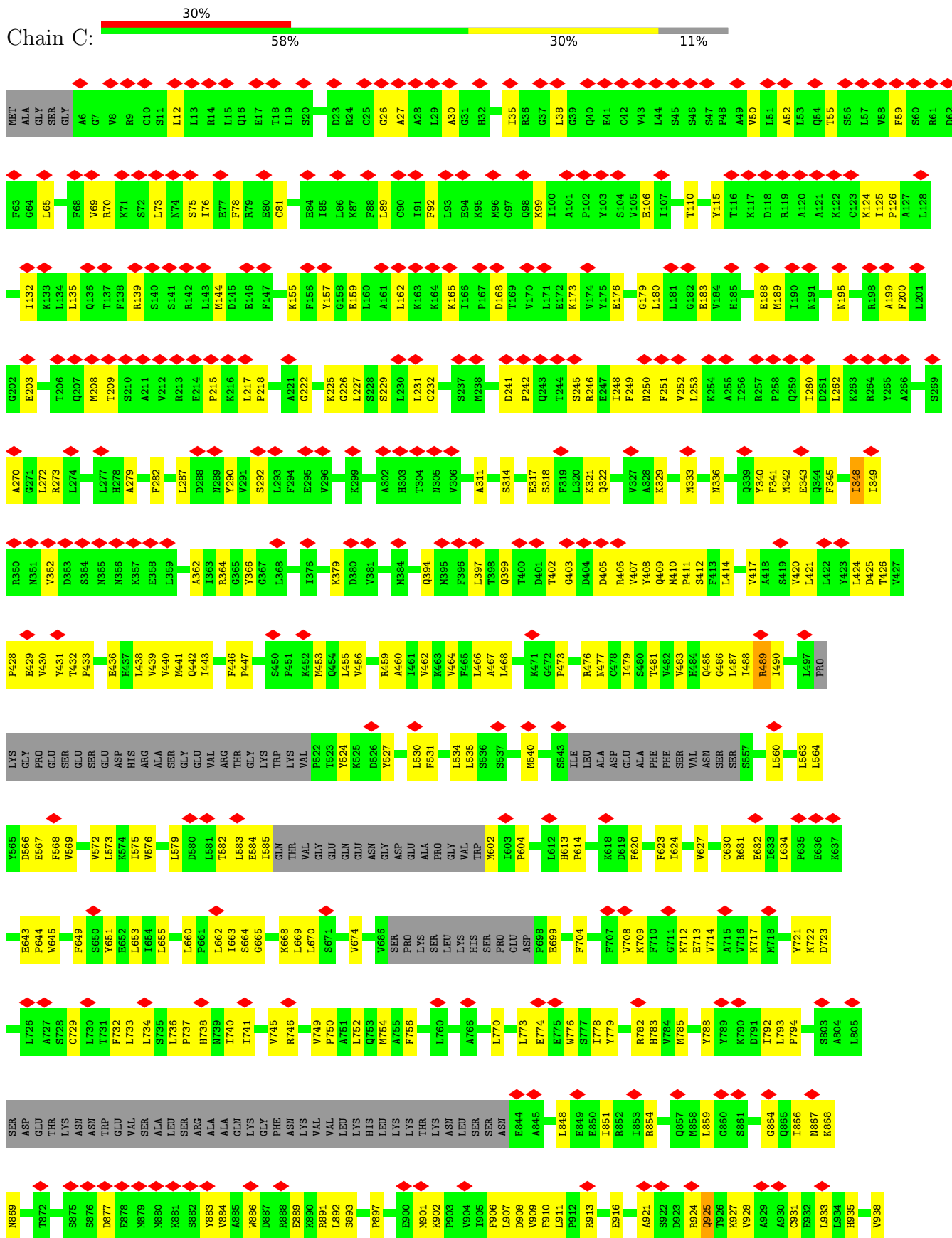


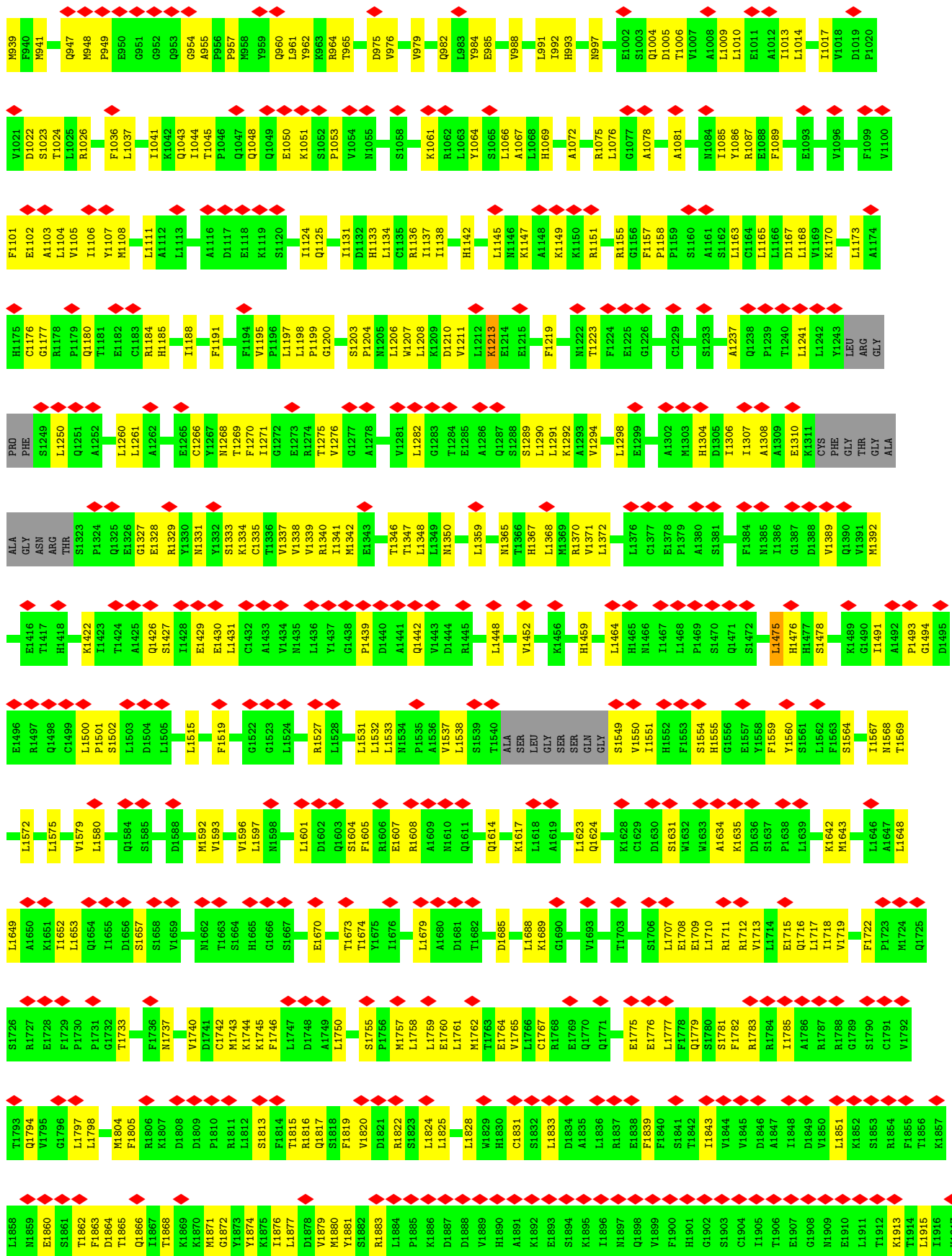




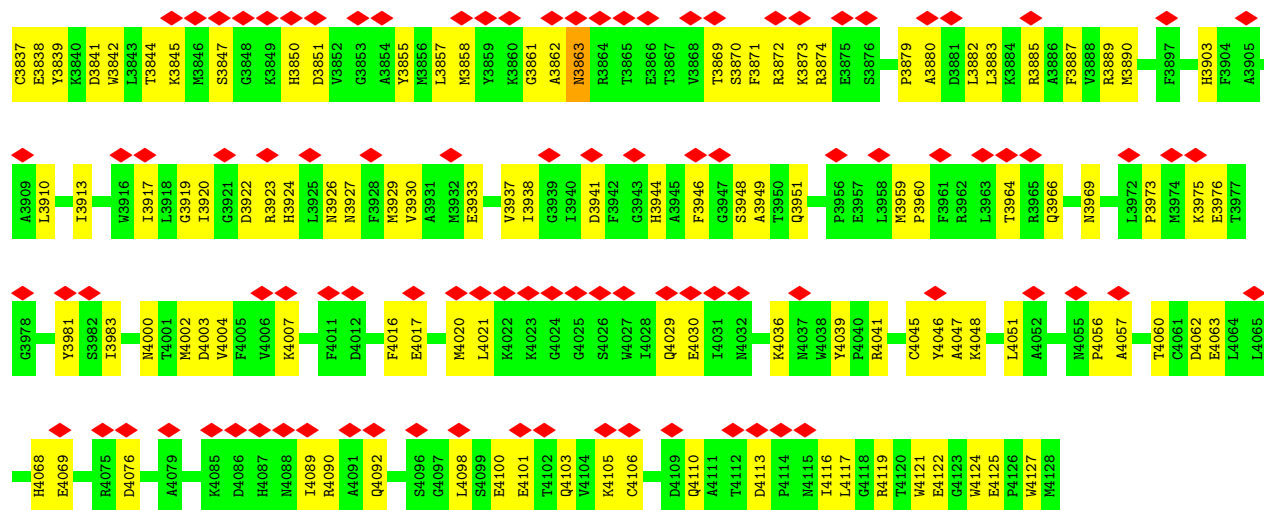
H4068	E4069	R4075	D4076	A4079	K4085	D4086	H4087	H4088	T4089	R4090	A4091	Q4092	S4096	G4097	L4098	E4100	E4101	F4102	Q4103	V4104	S4105	W4107	I4108	C4106	B4109	Q4110	A4111	T4112	D4113	P4114	N4115	I4116	L4117	G4118	R4119	T4120	E4122	G4123	W4124	E4125	F4126	W4127	M4128	H3185	R3186	C3187	F3188	F3189	L3190	S3191	K3192	L3193	E3194	E3195	K3196	L3197	T3198	F3199	LEU	PRO	GLU	ASP	ASN	SER	NET	ASN	VAL	ASP	GLN	ASP	GLY	ASP	PRO	SER	ASP	ARG	GLU	VAL	GLN	GLU	GLU	GLU	ASP	I3227	I3231	R3232	S3233	C3234	K3235	F3236	S3237	R3238	K3239	M3240	K3242	I3243	K3246	R3247	K3248	Q3249	F3252	S3253	K3257	L3258	L3259	K3260	E3261	L3262	H3263	K3264	K3267	T3268	D3271	W3272	S3275	Q3278	C3281	R3282	H3285	C3286	R3287	S3288	Q3291	G3292	E3295	Q3296	V3297	L3298	T3299	K3302	T3303	V3304	S3305	L3306	L3307	D3308	V3312	S3313	S3314	Y3315	K3318	N3319	A3322	F3323	R3324	D3325	Q3326	N3327	L3328	L3329	L3330	G3331	T3332	T3333	Y3334	Y3335	I3336	I3337	L3341	E3344	F3345	A3346	C3347	L3348	A3349	E3350	I3351	E3352	E3353	K3355	A3356	R3357	R3358	L3359	L3360	E3361	G3364	S3365	S3366	S3367	E3368	D3369	K3372	V3373	L3374	A3375	G3376	L3377	Y3378	Q3379	R3380	A3381	F3382	Q3383	L3385	V3389	Q3390	A3391	A3392	E3393	E3394	E3395	ALA	GLN	PRO	PRO	SER	TRP	SER	CYS	PRO	A3406	A3407	G3408	D3411	A3412	T3415	L3416	F3419	Q3422	Q3423	L3424	R3425	K3426	E3427	N3430	A3431	S3432	V3433	T3434	D3435	S3436	A3437	E3438	L3439	Q3440	A3441	Y3442	V3446	T3447	E3448	K3449	M3450	L3451	K3452	A3453	L3454	K3455	R3462	L3463	K3464	F3465	P3466	R3467	Q3470	I3471	I3472	E3473	R3474	Y3475	P3476	T3479	L3482	K3485	S3489	W3493	Q3494	F3495	W3498	H3501	M3502	V3503	A3504	L3505	D3507	K3508	L3509	Q3510	A3513	V3514	Q3515	H3516	S3517	V3518	E3519	E3520	I3521	T3522	A3528	I3529	V3530	Y3531	P3532	I3535	K3536	S3537	E3538	S3539	Y3540	S3541	F3542	K3543	D3544	T3545	S3546	E3547	G3548	H3549	K3550	Y3555	L3558	K3559	S3560	K3561	L3562	D3563	Q3564	K3565	I3568	Q3569	D3570	F3571	L3572	N3573	L3574	L3575	G3576	Q3577	L3578	L3583	L3584	F3585	W3588	R3593	A3594	E3595	S3596	D3597	K3598	T3599	F3600	V3601	N3602	K3603	K3604	N3605	L3606	F3607	K3608	K3609	Y3610	E3611	R3612	Y3613	Y3614	A3615	G3616	L3617	G3618	P3619	P3620	A3621	A3622	P3623	G3624	L3625	G3626	A3627	F3628	R3629	R3630	K3631	F3632	I3633	Q3634	T3635	G3637	K3638	E3639	F3640	H3643	F3644	G3645	K3646	G3647	G3648	S3649	K3650	L3651	L3652	R3653	M3654	K3655	L3656	S3657	D3658	F3659	N3660	D3661	T3662	T3663	N3664	L3665	L3666	L3667	L3668	K3669	M3670	M3671	S3674	K3675	P3676	F3677	G3678	N3679	L3680	K3681	E3682	C3683	S3684	M3687	F3690	K3691	Y3692	E3693	F3694	N3697	E3700	I3701	F3702	G3703	Q3704	R3708	R3709	L3800	G3801	L3802	L3803	E3804	W3805	L3806	E3807	N3808	D3814	L3815	L3816	L3817	N3818	T3819	M3820	S3821	R3734	P3735	K3736	I3739	L3740	R3741	G3742	H3743	D3744	E3745	R3746	F3750	L3751	V3752	K3753	G3754	G3755	E3756	D3757	L3758	R3759	Q3760	D3761	V3764	L3767	I3774	A3780	A3931	N3932	E3933	V3937	L3938	G3939	L3940	D3941	F3942	G3943	H3944	A3945	F3946	G3947	S3948	A3949	T3950	Q3951	P3956	E3957	L3958	M3959	P3960	F3961	R3962	L3963	T3964	R3965	Q3966	N3969	L3972	P3973	W3974	K3975	R3833	C3837	E3838	Y3839	K3840	D3841	W3842	L3843	T3844	K3845	M3846	S3847	G3848	K3849	H3850	D3851	Y3852	G3853	A3854	Y3855	M3856	L3857	M3858	Y3859	K3860	G3861	A3862	N3863	R3864	T3865	E3866	T3867	F3868	S3870	F3871	R3872	K3873	R3874	E3875	S3876	P3879	A3880	D3881	L3882	L3883	K3884	R3885	A3886	F3887	V3888	K3889	M3890	F3897	H3903	F3904	A3905	L3906	A3907	A3908	A3909	A3910	A3911	A3912	A3913	A3914	A3915	A3916	A3917	A3918	A3919	A3920	D3921	R3922	R3923	H3924	L3925	N3926	N3927	F3928	K3929	V3930	A3931	N3932	E3933	V3937	L3938	G3939	L3940	D3941	F3942	G3943	H3944	A3945	F3946	G3947	S3948	A3949	T3950	Q3951	P3956	E3957	L3958	M3959	P3960	F3961	R3962	L3963	T3964	R3965	Q3966	N3969	L3972	P3973	W3974	K3975
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• Molecule 2: DNA-dependent protein kinase catalytic subunit









4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C2	Depositor
Number of particles used	64775	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 ($e^-/\text{\AA}^2$)	65	Depositor
Minimum defocus (nm)	2000	Depositor
Maximum defocus (nm)	4000	Depositor
Magnification	105000	Depositor
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	0.031	Depositor
Minimum map value	-0.017	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.002	Depositor
Recommended contour level	0.006	Depositor
Map size (Å)	356.6592, 356.6592, 356.6592	wwPDB
Map dimensions	432, 432, 432	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.8256, 0.8256, 0.8256	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
2	C	0.30	0/29884	0.61	9/40387 (0.0%)
2	L	0.30	0/29884	0.61	8/40387 (0.0%)
All	All	0.30	0/59768	0.61	17/80774 (0.0%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
2	C	0	3
2	L	0	2
All	All	0	5

There are no bond length outliers.

The worst 5 of 17 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	2929	LEU	CB-CG-CD2	-7.05	99.01	111.00
2	L	139	ARG	NE-CZ-NH2	7.04	123.82	120.30
2	L	2929	LEU	CB-CG-CD2	-7.04	99.03	111.00
2	C	139	ARG	NE-CZ-NH2	7.02	123.81	120.30
2	C	746	ARG	CA-CB-CG	5.94	126.47	113.40

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	C	364	ARG	Sidechain
2	C	366	TYR	Sidechain
2	C	489	ARG	Sidechain
2	L	364	ARG	Sidechain

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Mol	Chain	Res	Type	Group
2	L	489	ARG	Sidechain

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	Q	101	0	25	3	0
1	R	101	0	25	3	0
2	C	29284	0	29680	975	0
2	L	29284	0	29680	981	0
All	All	58770	0	59410	1928	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 1928 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:L:3606:ILE:O	2:L:3610:TYR:HB2	1.53	1.08
2:C:3606:ILE:O	2:C:3610:TYR:HB2	1.53	1.07
2:L:26:GLY:C	2:C:76:ILE:HD12	1.84	0.97
2:L:76:ILE:HD12	2:C:26:GLY:C	1.86	0.96
2:C:2890:ILE:HG12	2:C:2929:LEU:HD21	1.47	0.95

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	
2	C	3632/4128 (88%)	3344 (92%)	288 (8%)	0	100	100
2	L	3632/4128 (88%)	3343 (92%)	289 (8%)	0	100	100
All	All	7264/8256 (88%)	6687 (92%)	577 (8%)	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	
2	C	3266/3671 (89%)	3255 (100%)	11 (0%)	92	94
2	L	3266/3671 (89%)	3255 (100%)	11 (0%)	92	94
All	All	6532/7342 (89%)	6510 (100%)	22 (0%)	92	94

5 of 22 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	C	1527	ARG
2	C	2485	ARG
2	C	2158	ARG
2	C	2940	ARG
2	L	2485	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 41 such sidechains are listed below:

Mol	Chain	Res	Type
2	C	2301	GLN
2	C	3249	GLN
2	C	2305	ASN
2	C	3104	GLN
2	C	3634	GLN

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.

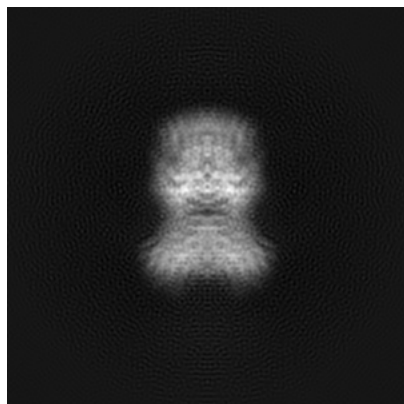
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-28731. These allow visual inspection of the internal detail of the map and identification of artifacts.

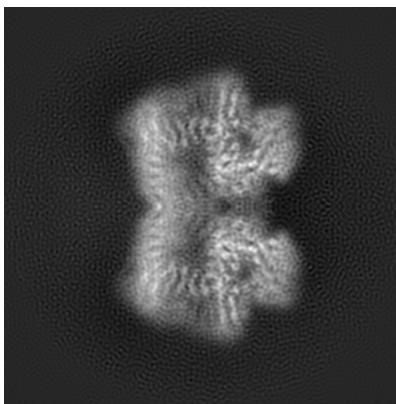
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

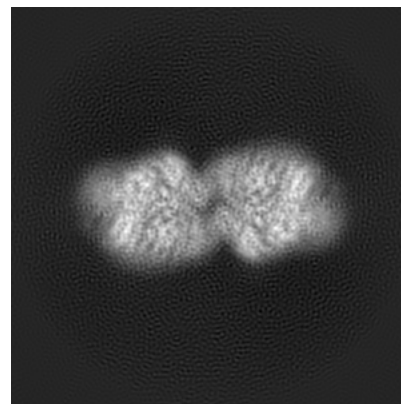
6.1.1 Primary map



X

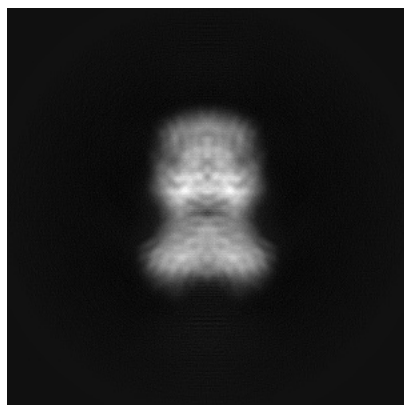


Y

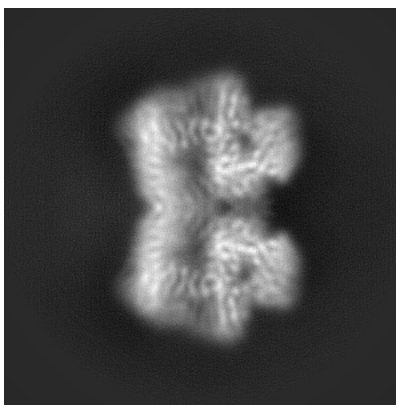


Z

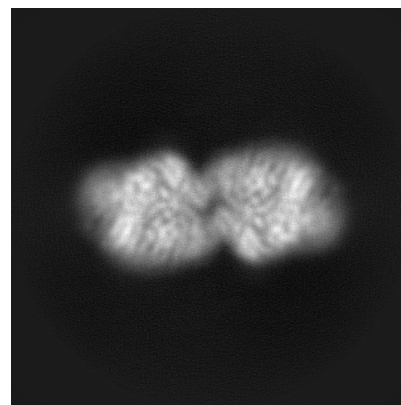
6.1.2 Raw map



X



Y

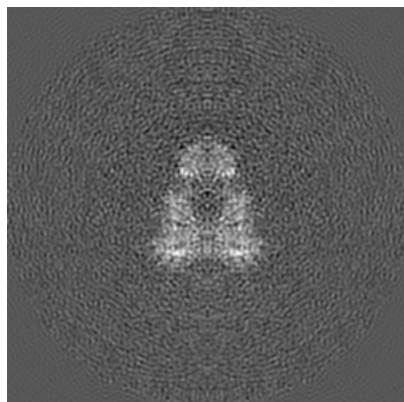


Z

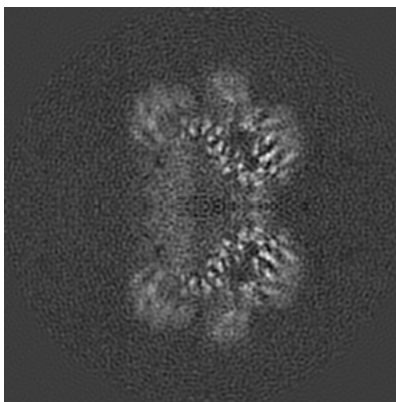
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

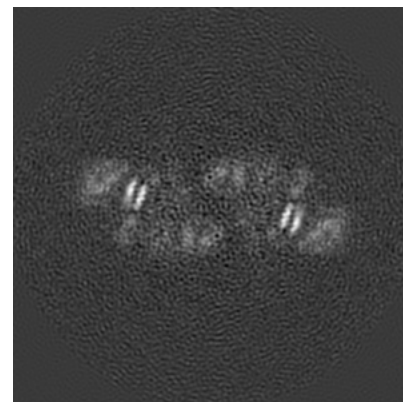
6.2.1 Primary map



X Index: 216

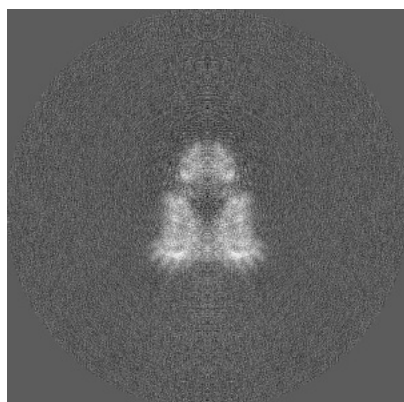


Y Index: 216

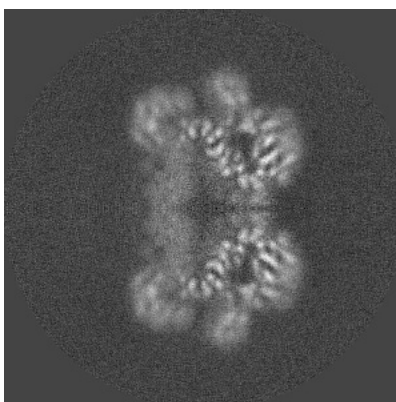


Z Index: 216

6.2.2 Raw map



X Index: 216



Y Index: 216

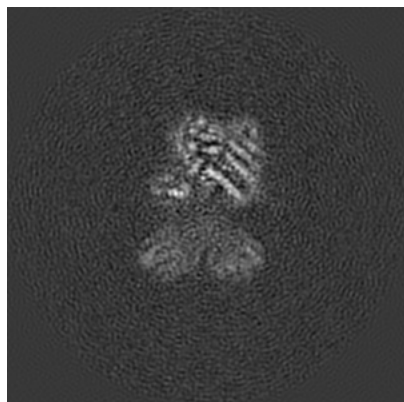


Z Index: 216

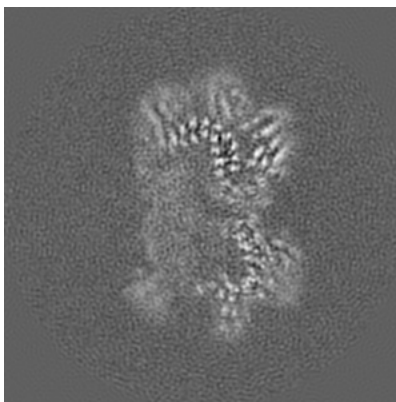
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

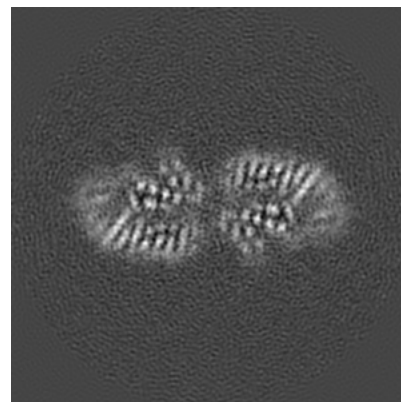
6.3.1 Primary map



X Index: 174

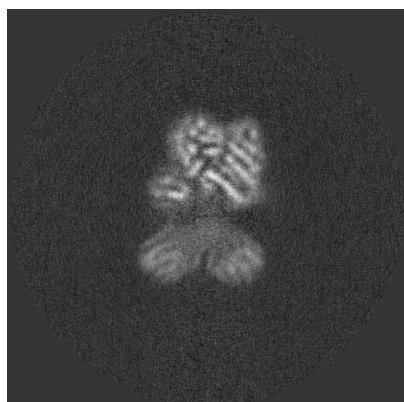


Y Index: 204

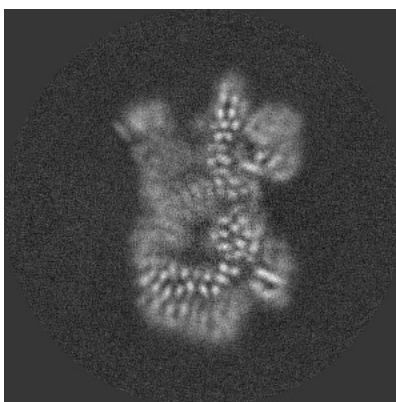


Z Index: 234

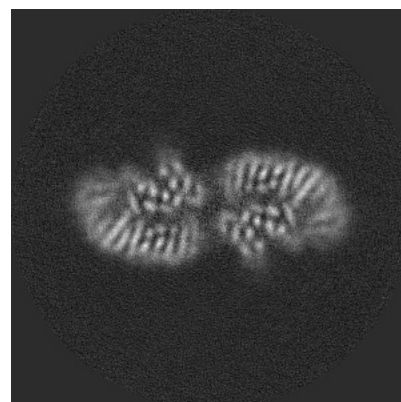
6.3.2 Raw map



X Index: 174



Y Index: 239

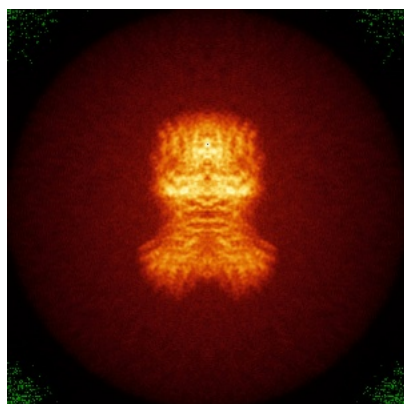


Z Index: 234

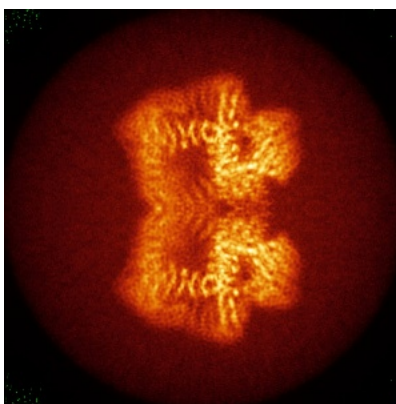
The images above show the largest variance slices of the map in three orthogonal directions.

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

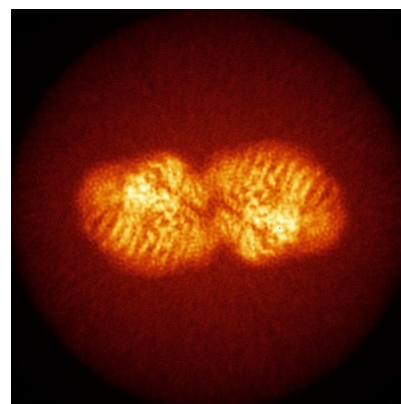
6.4.1 Primary map



X

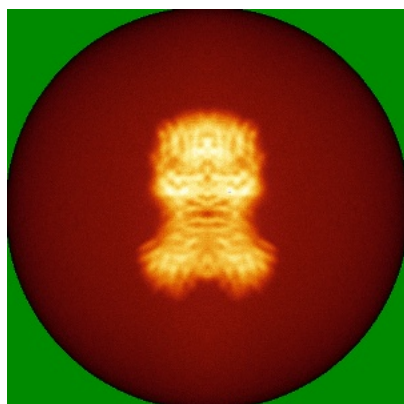


Y

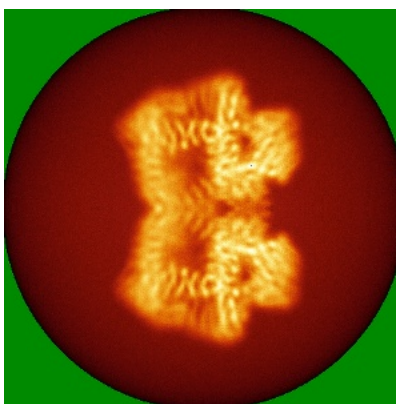


Z

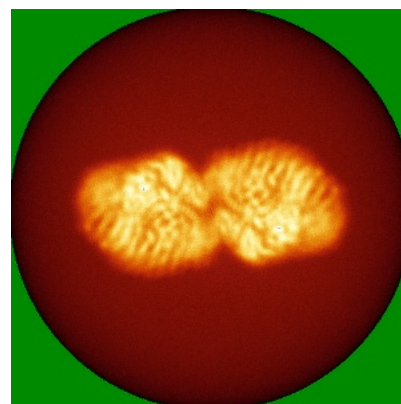
6.4.2 Raw map



X



Y

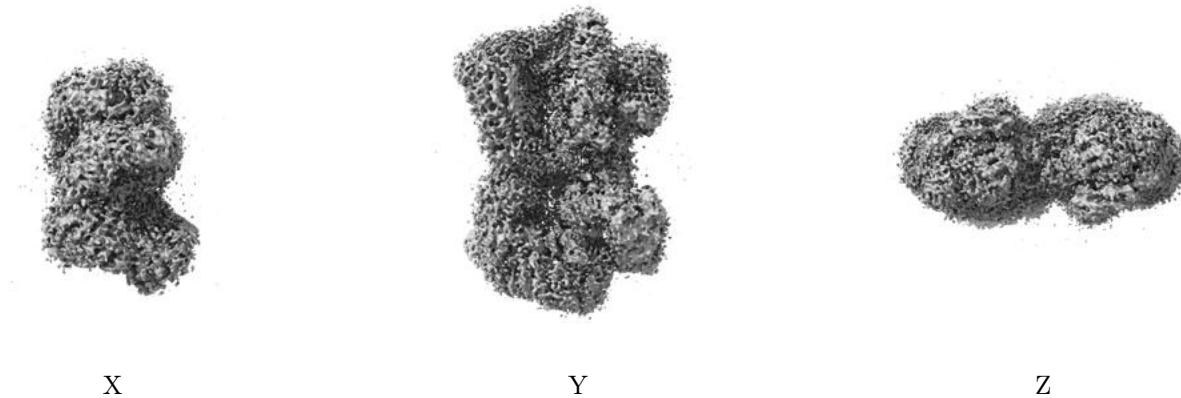


Z

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.

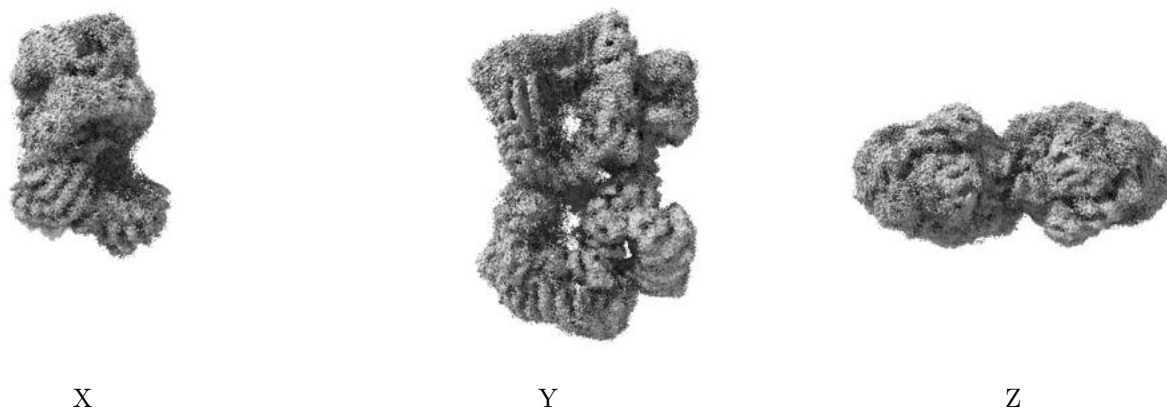
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.006. 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.

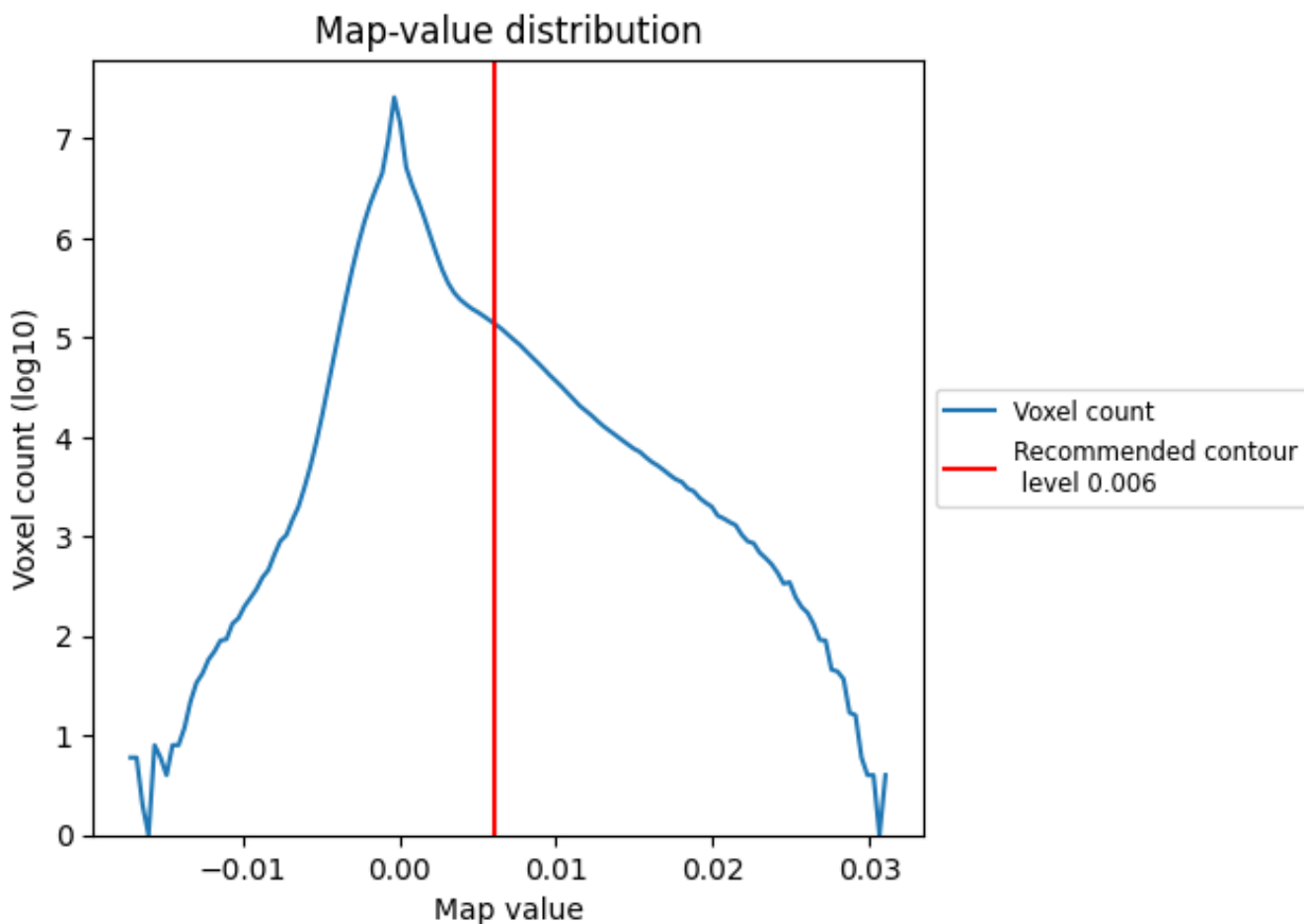
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

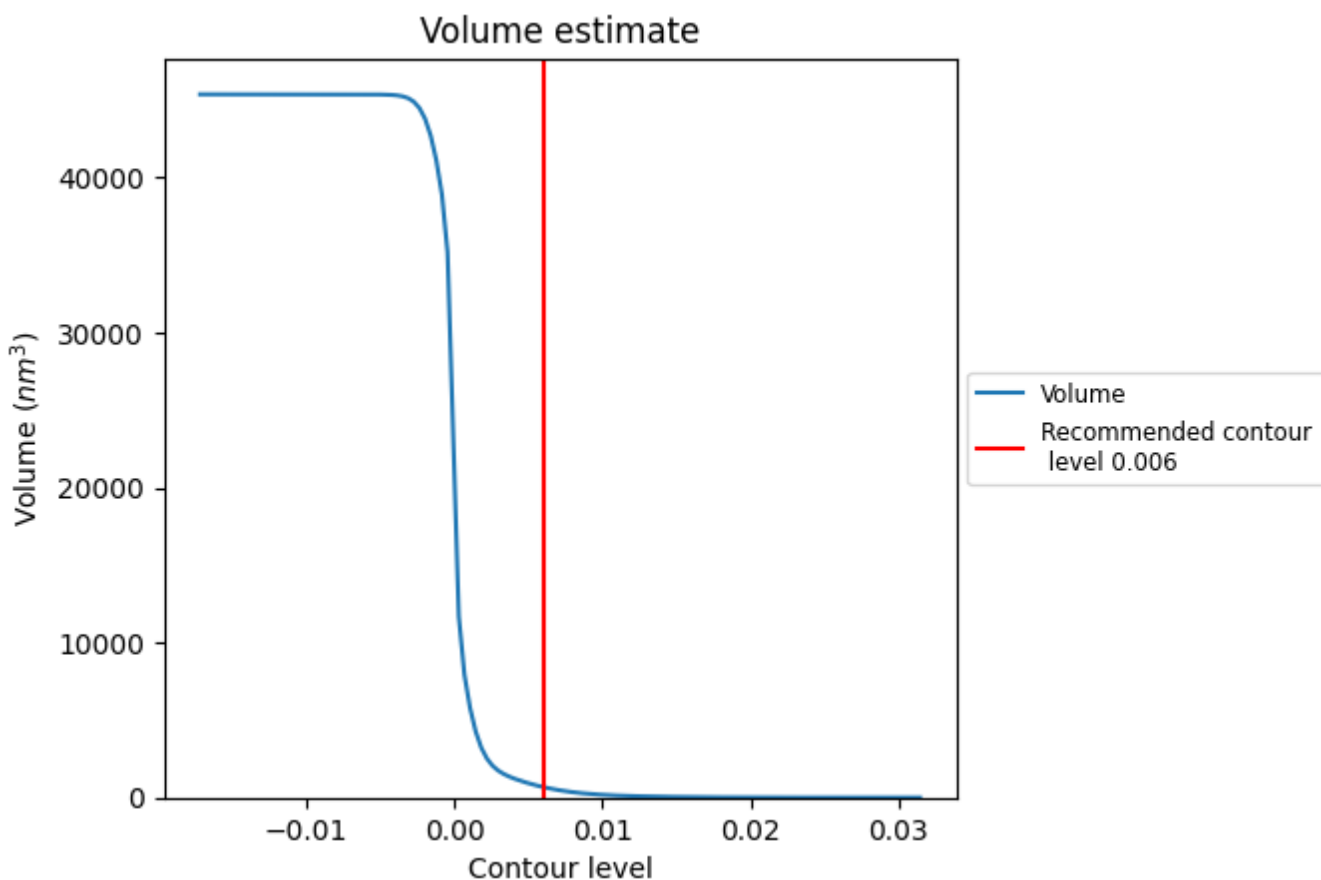
This section contains the results of statistical analysis of the map.

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.

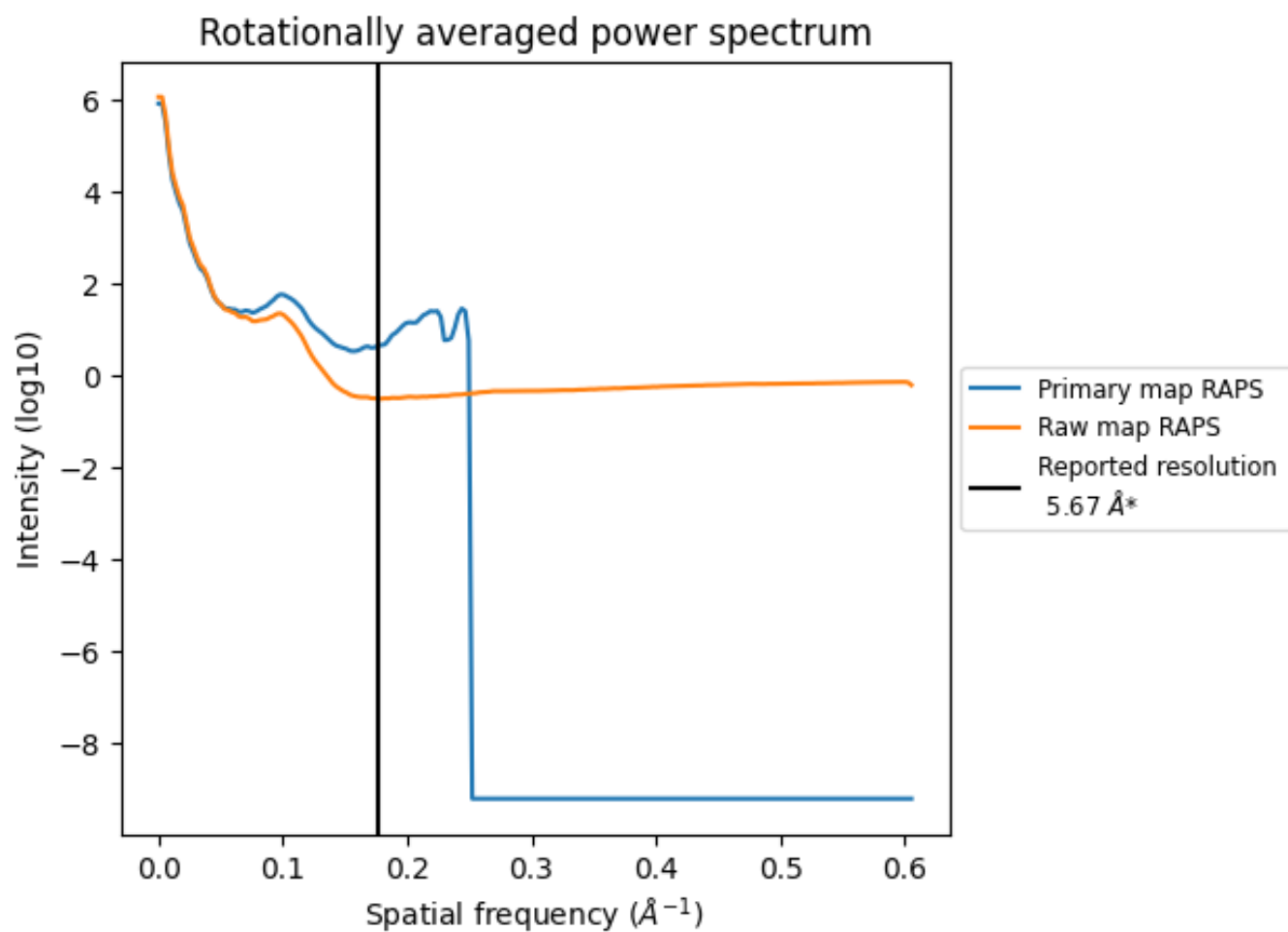
7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 677 nm^3 ; this corresponds to an approximate mass of 612 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

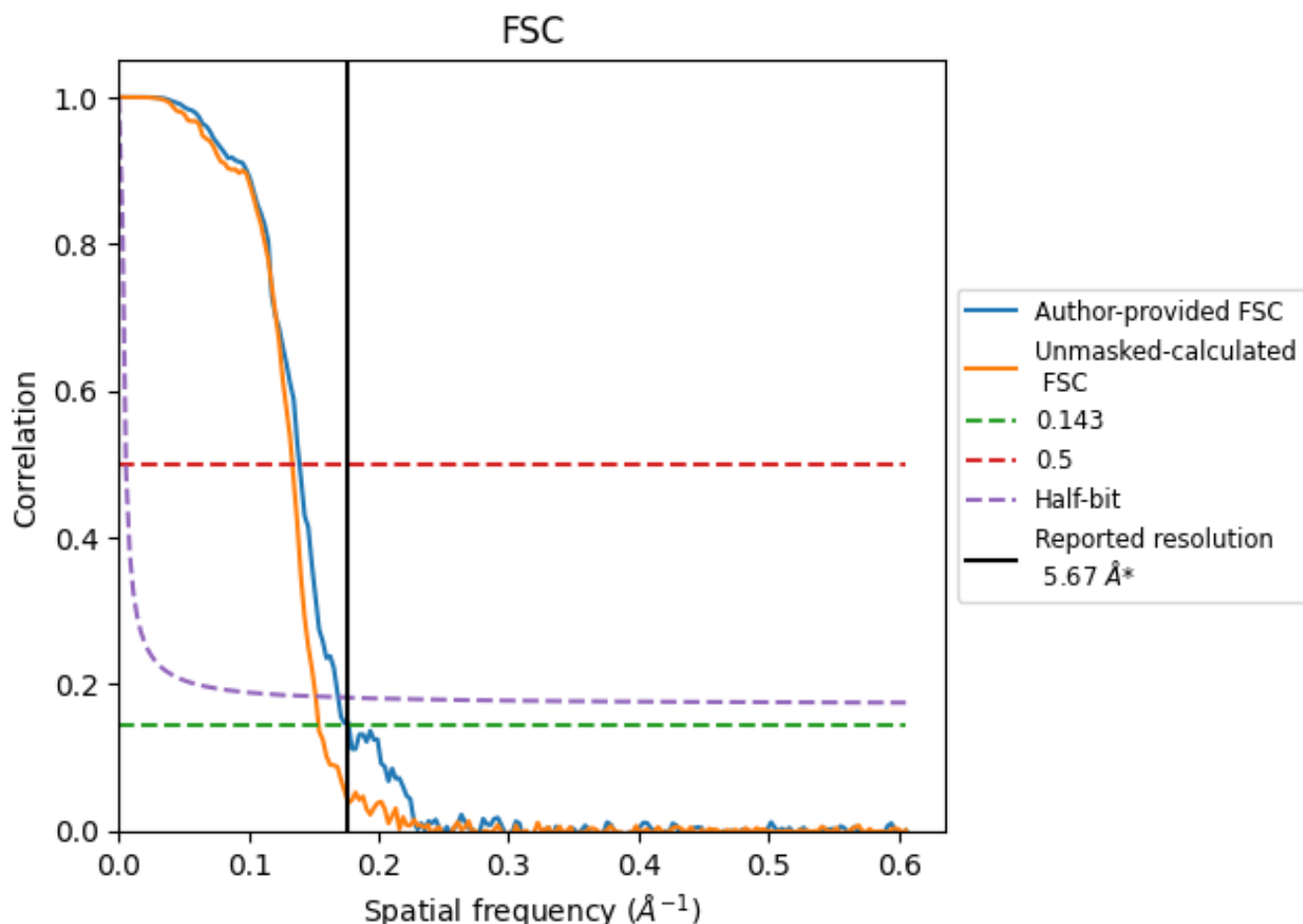


*Reported resolution corresponds to spatial frequency of 0.176 Å⁻¹

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 0.176 Å⁻¹

8.2 Resolution estimates [i](#)

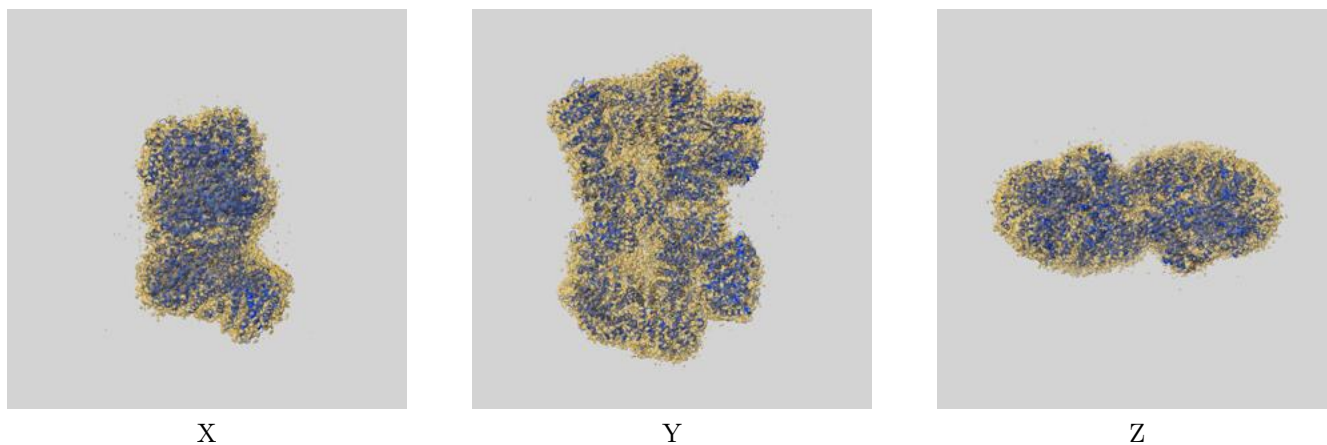
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	5.67	-	-
Author-provided FSC curve	5.65	7.19	5.92
Unmasked-calculated*	6.50	7.49	6.60

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from deposited half-maps intersecting FSC 0.143 CUT-OFF 6.50 differs from the reported value 5.67 by more than 10 %

9 Map-model fit [i](#)

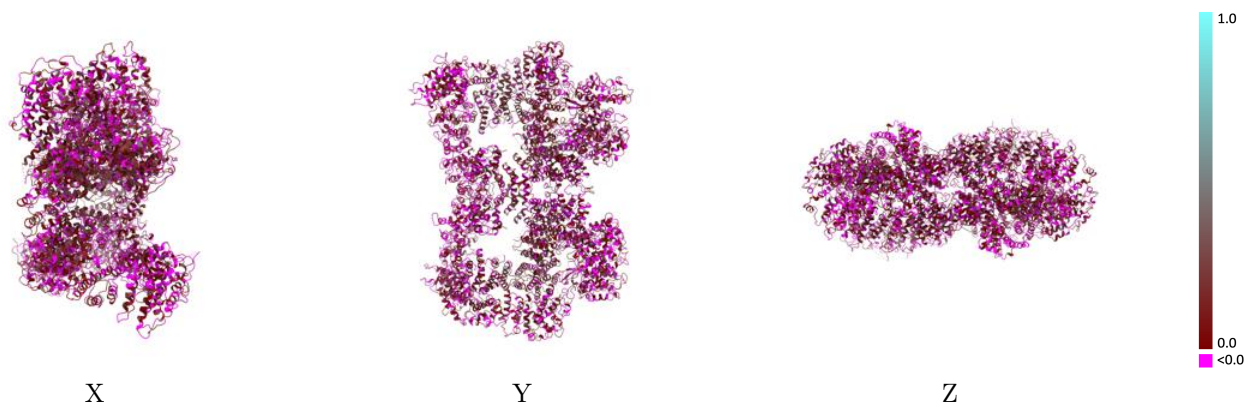
This section contains information regarding the fit between EMDB map EMD-28731 and PDB model 8EZ9. Per-residue inclusion information can be found in section [3](#) on page [4](#).

9.1 Map-model overlay [i](#)



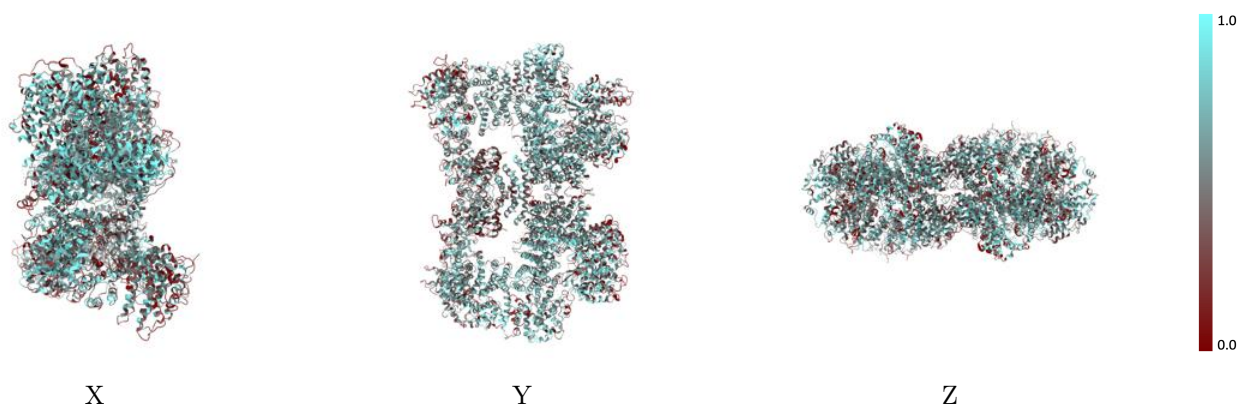
The images above show the 3D surface view of the map at the recommended contour level 0.006 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



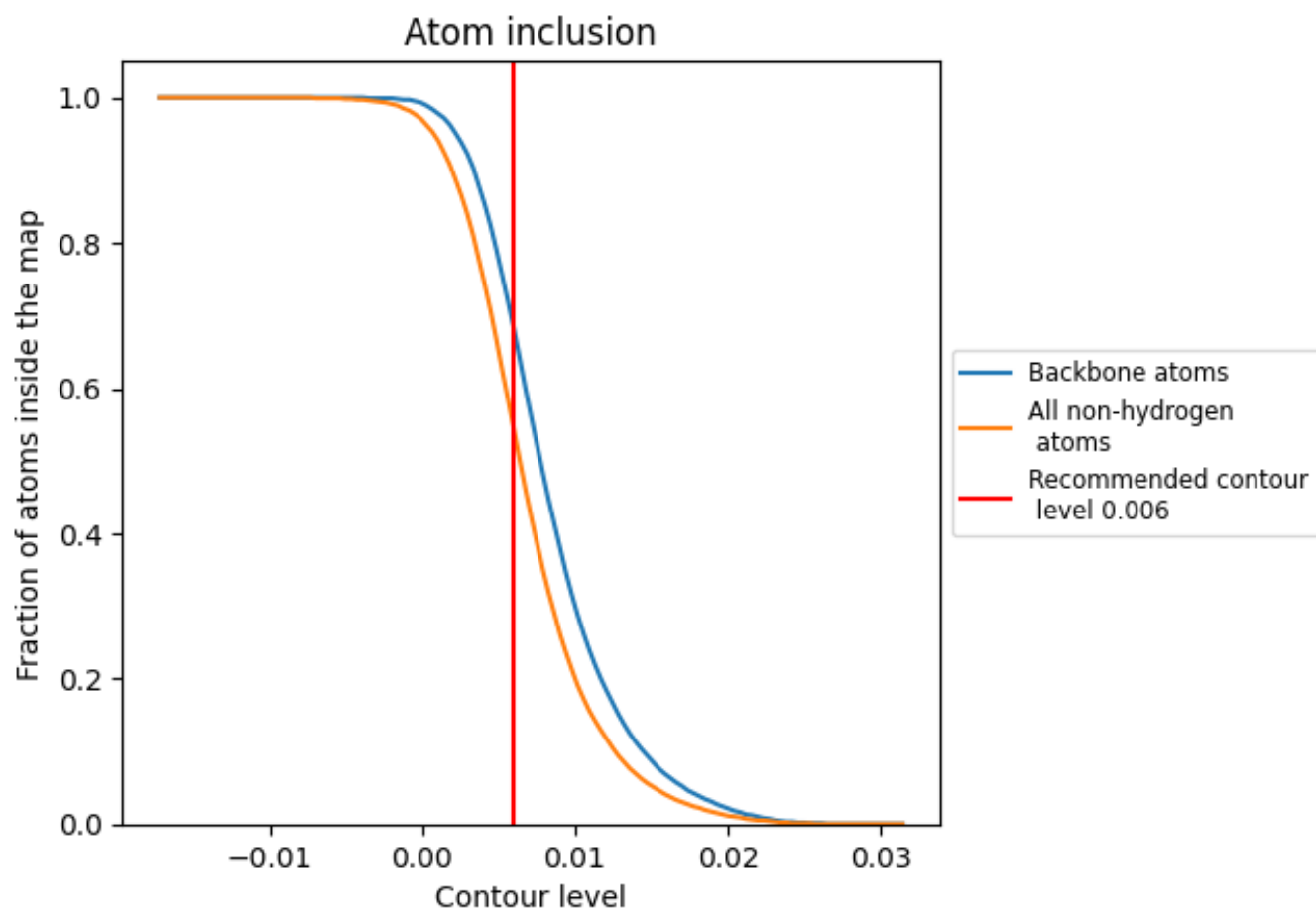
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.006).











9.4 Atom inclusion [i](#)



At the recommended contour level, 68% of all backbone atoms, 54% 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 (0.006) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.5420	 0.0740
C	 0.5420	 0.0740
L	 0.5420	 0.0720
Q	 0.6040	 0.2000
R	 0.6240	 0.1960

