



Full wwPDB EM Validation Report ⓘ

Sep 20, 2025 – 08:00 am BST

PDB ID : 8RIG / pdb_00008rig
EMDB ID : EMD-19187
Title : Cryo-EM structure of an MCM helicase single hexamer loaded onto dsDNA.
Authors : Miller, T.C.R.; Lim, C.T.; Diffley, J.F.X.; Costa, A.
Deposited on : 2023-12-18
Resolution : 3.41 Å(reported)
Based on initial model : 7P30

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

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

A user guide is available at

<https://www.wwpdb.org/validation/2017/EMValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

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

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

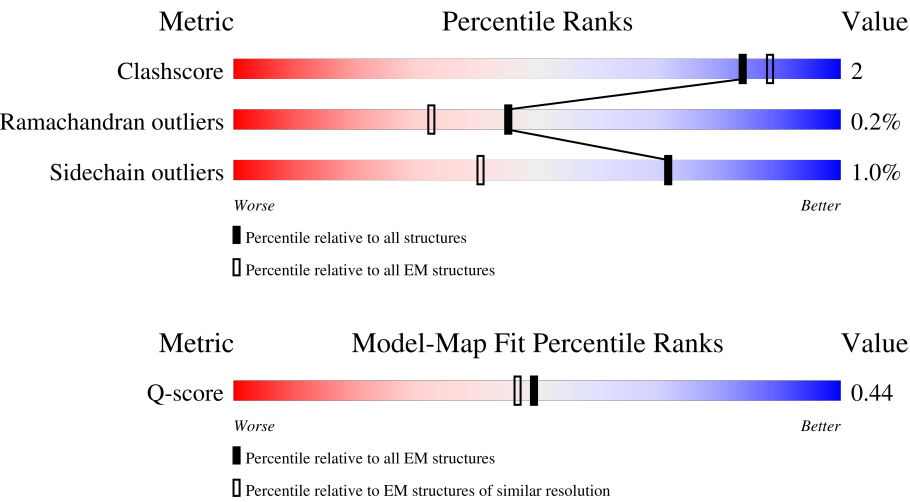
EMDB validation analysis : 0.0.1.dev129
Mogul : 1.8.4, CSD as541be (2020)
MolProbity : 4-5-2 with Phenix2.0
buster-report : 1.1.7 (2018)
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.46

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 3.41 Å.

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



Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	210492	15764	-
Ramachandran outliers	207382	16835	-
Sidechain outliers	206894	16415	-
Q-score	-	25397	13997 (2.91 - 3.91)

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	2	868	
2	3	1006	
3	4	933	
4	5	775	

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Mol	Chain	Length	Quality of chain
5	6	1017	
6	7	845	
7	X	19	
8	Y	17	

2 Entry composition

There are 12 unique types of molecules in this entry. The entry contains 30208 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 DNA replication licensing factor MCM2.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	2	626	Total	C	N	O	S	0	0
			4955	3123	881	932	19		

- Molecule 2 is a protein called DNA replication licensing factor MCM3.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	3	611	Total	C	N	O	S	0	0
			4787	3021	853	900	13		

There are 35 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
3	-34	MET	-	initiating methionine	UNP P24279
3	-33	LYS	-	expression tag	UNP P24279
3	-32	ARG	-	expression tag	UNP P24279
3	-31	ARG	-	expression tag	UNP P24279
3	-30	TRP	-	expression tag	UNP P24279
3	-29	LYS	-	expression tag	UNP P24279
3	-28	LYS	-	expression tag	UNP P24279
3	-27	ASN	-	expression tag	UNP P24279
3	-26	PHE	-	expression tag	UNP P24279
3	-25	ILE	-	expression tag	UNP P24279
3	-24	ALA	-	expression tag	UNP P24279
3	-23	VAL	-	expression tag	UNP P24279
3	-22	SER	-	expression tag	UNP P24279
3	-21	ALA	-	expression tag	UNP P24279
3	-20	ALA	-	expression tag	UNP P24279
3	-19	ASN	-	expression tag	UNP P24279
3	-18	ARG	-	expression tag	UNP P24279
3	-17	PHE	-	expression tag	UNP P24279
3	-16	LYS	-	expression tag	UNP P24279
3	-15	LYS	-	expression tag	UNP P24279
3	-14	ILE	-	expression tag	UNP P24279

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Chain	Residue	Modelled	Actual	Comment	Reference
3	-13	SER	-	expression tag	UNP P24279
3	-12	SER	-	expression tag	UNP P24279
3	-11	SER	-	expression tag	UNP P24279
3	-10	GLY	-	expression tag	UNP P24279
3	-9	ALA	-	expression tag	UNP P24279
3	-8	LEU	-	expression tag	UNP P24279
3	-7	GLU	-	expression tag	UNP P24279
3	-6	ASN	-	expression tag	UNP P24279
3	-5	LEU	-	expression tag	UNP P24279
3	-4	TYR	-	expression tag	UNP P24279
3	-3	PHE	-	expression tag	UNP P24279
3	-2	GLN	-	expression tag	UNP P24279
3	-1	GLY	-	expression tag	UNP P24279
3	0	GLU	-	expression tag	UNP P24279

- Molecule 3 is a protein called DNA replication licensing factor MCM4.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	4	629	Total	C	N	O	S	0	0
			4985	3127	858	972	28		

- Molecule 4 is a protein called Minichromosome maintenance protein 5.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	5	606	Total	C	N	O	S	0	0
			4757	2997	814	922	24		

- Molecule 5 is a protein called DNA replication licensing factor MCM6.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	6	611	Total	C	N	O	S	0	0
			4847	3062	843	917	25		

- Molecule 6 is a protein called DNA replication licensing factor MCM7.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	7	632	Total	C	N	O	S	0	0
			4959	3133	855	943	28		

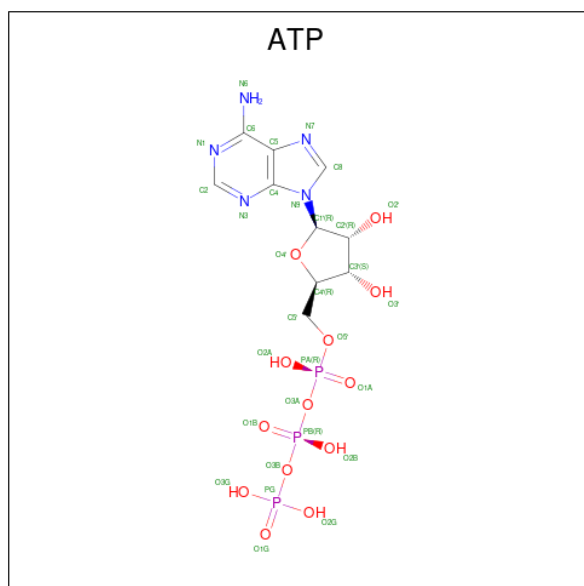
- Molecule 7 is a DNA chain called DNA (5'-D(P*GP*CP*AP*TP*GP*CP*AP*TP*GP*CP*AP*TP*GP*CP*AP*TP*GP*CP*AP*T)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
7	X	19	Total	C	N	O	P	0	0
			388	185	70	114	19		

- Molecule 8 is a DNA chain called DNA (5'-D(P*AP*TP*GP*CP*AP*TP*GP*CP*AP*TP*GP*CP*AP*TP*GP*CP*AP*T)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
8	Y	17	Total	C	N	O	P	0	0
			349	166	65	101	17		

- Molecule 9 is ADENOSINE-5'-TRIPHOSPHATE (CCD ID: ATP) (formula: C₁₀H₁₆N₅O₁₃P₃) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					AltConf
9	2	1	Total	C	N	O	P	0
			31	10	5	13	3	
9	6	1	Total	C	N	O	P	0
			31	10	5	13	3	

- Molecule 10 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
10	2	1	Total	Mg	0
			1	1	
10	3	1	Total	Mg	0
			1	1	

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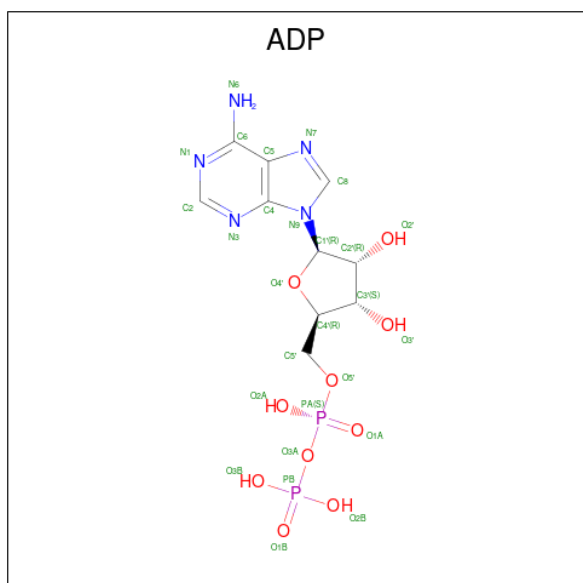
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Mol	Chain	Residues	Atoms		AltConf
10	4	1	Total	Mg	0
			1	1	
10	5	1	Total	Mg	0
			1	1	
10	6	1	Total	Mg	0
			1	1	
10	7	1	Total	Mg	0
			1	1	

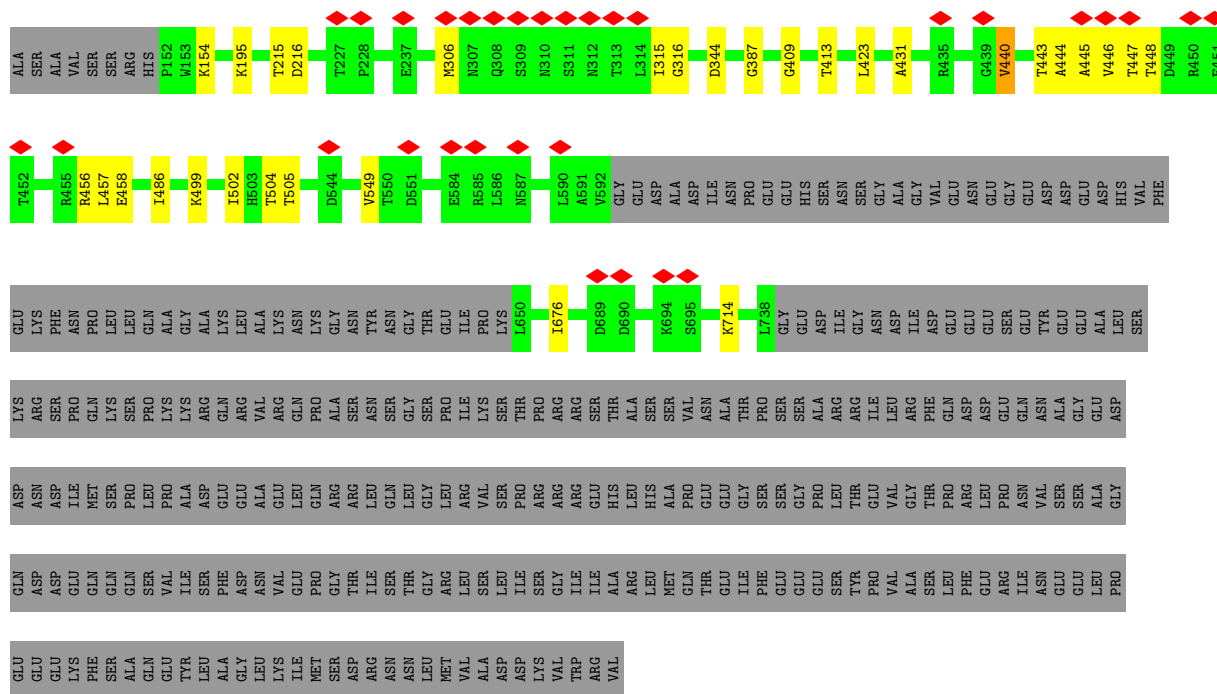
- Molecule 11 is ZINC ION (CCD ID: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
11	2	1	Total	Zn	0
			1	1	
11	4	1	Total	Zn	0
			1	1	
11	5	1	Total	Zn	0
			1	1	
11	6	1	Total	Zn	0
			1	1	
11	7	1	Total	Zn	0
			1	1	

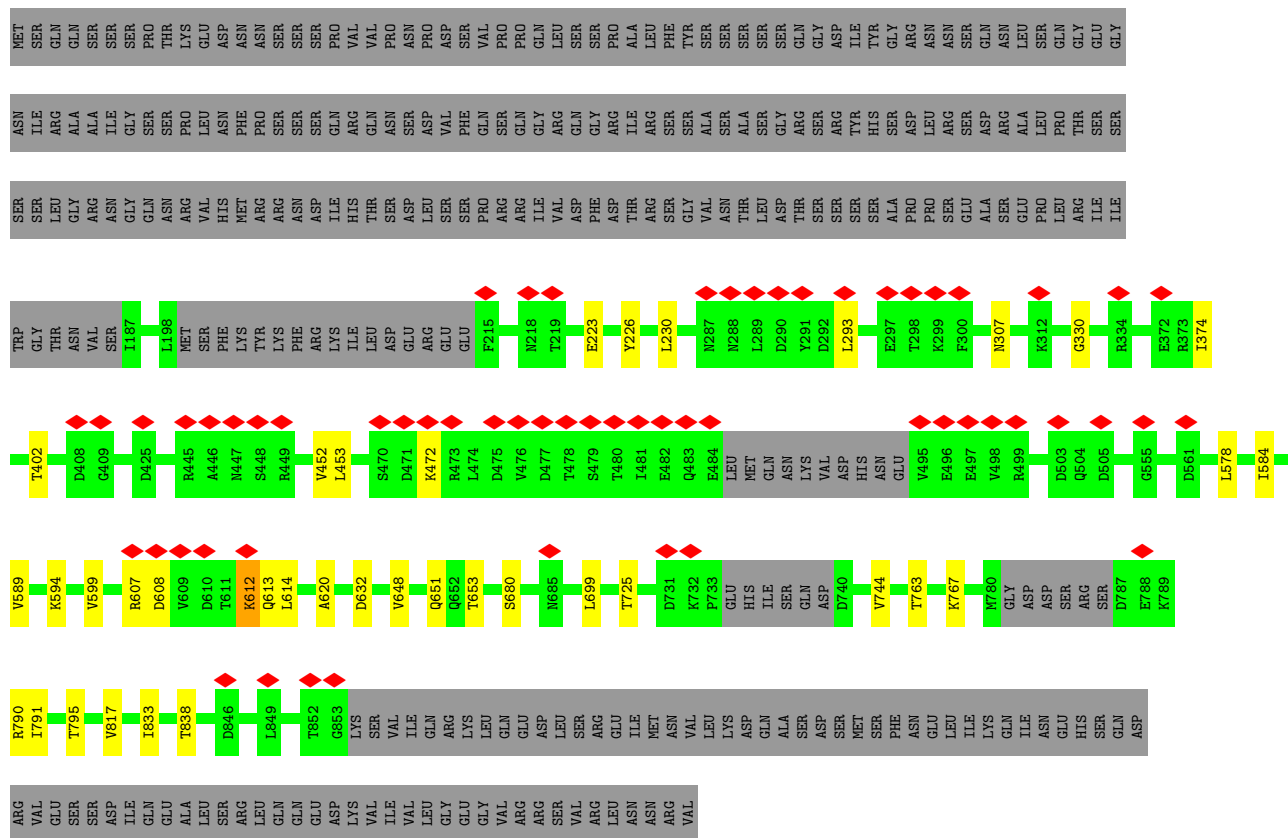
- Molecule 12 is ADENOSINE-5'-DIPHOSPHATE (CCD ID: ADP) (formula: C₁₀H₁₅N₅O₁₀P₂) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					AltConf
12	3	1	Total	C	N	O	P	0
			27	10	5	10	2	
12	4	1	Total	C	N	O	P	0
			27	10	5	10	2	
12	5	1	Total	C	N	O	P	0
			27	10	5	10	2	
12	7	1	Total	C	N	O	P	0
			27	10	5	10	2	

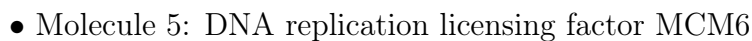


• Molecule 3: DNA replication licensing factor MCM4



• Molecule 4: Minichromosome maintenance protein 5

Response	Percentage
Doing a good job	74%
Not doing a good job	22%

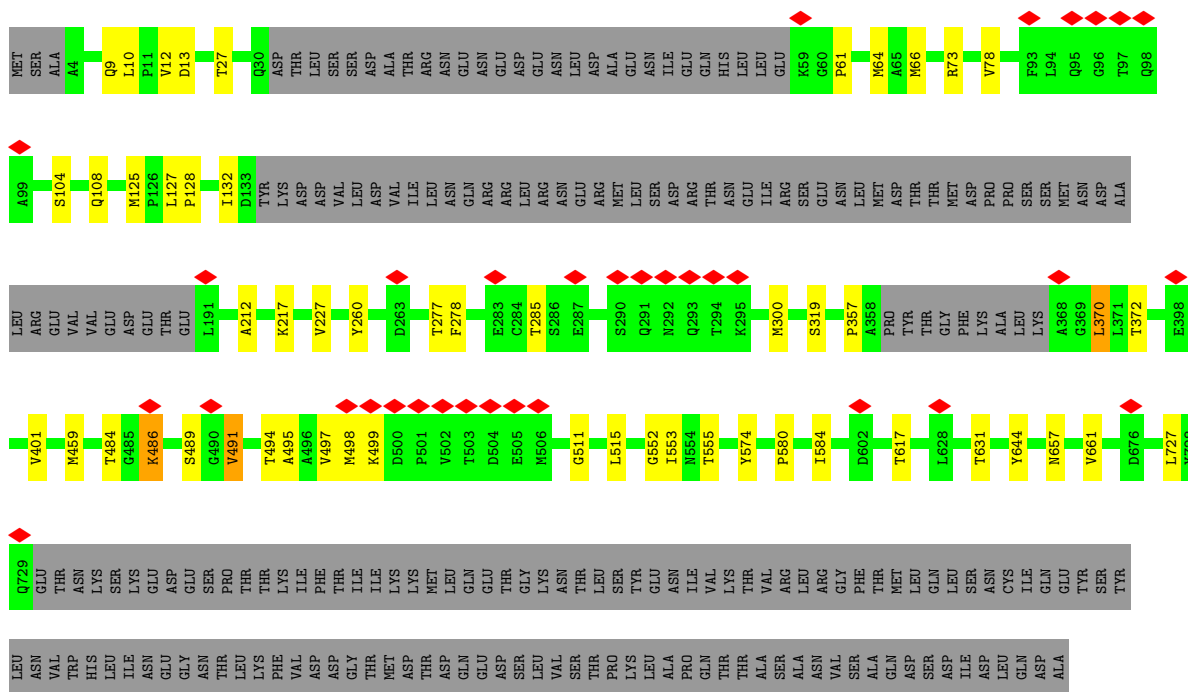


57%

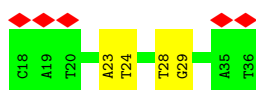
40%



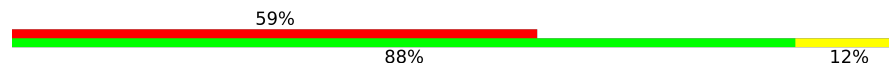
Chain 7:



Chain X:



Chain Y:



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	396366	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 ($e^-/\text{\AA}^2$)	51.2	Depositor
Minimum defocus (nm)	1500	Depositor
Maximum defocus (nm)	4500	Depositor
Magnification	130000	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	0.033	Depositor
Minimum map value	-0.008	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.001	Depositor
Recommended contour level	0.011	Depositor
Map size (Å)	453.6, 453.6, 453.6	wwPDB
Map dimensions	420, 420, 420	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.08, 1.08, 1.08	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MG, ZN, ATP, ADP

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	2	0.32	1/5042 (0.0%)	0.46	1/6813 (0.0%)
2	3	0.38	0/4868	0.56	3/6600 (0.0%)
3	4	0.39	0/5053	0.52	0/6831
4	5	0.30	0/4824	0.44	1/6522 (0.0%)
5	6	0.31	0/4926	0.44	0/6644
6	7	0.37	0/5037	0.52	0/6807
7	X	0.41	0/434	0.83	0/667
8	Y	0.41	0/391	0.75	0/601
All	All	0.35	1/30575 (0.0%)	0.50	5/41485 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	2	706	SER	CA-CB	-5.09	1.45	1.53

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	3	42	VAL	N-CA-C	-6.85	105.08	111.45
2	3	39	ARG	N-CA-C	-6.13	104.68	111.36
4	5	598	LYS	N-CA-C	-6.00	104.36	111.03
1	2	708	PRO	CB-CA-C	-5.49	102.51	111.56
2	3	94	HIS	CB-CA-C	-5.10	104.15	111.91

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts ⓘ

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	2	4955	0	5008	20	0
2	3	4787	0	4875	22	0
3	4	4985	0	5047	22	0
4	5	4757	0	4845	20	0
5	6	4847	0	4879	20	0
6	7	4959	0	5034	32	0
7	X	388	0	215	4	0
8	Y	349	0	192	2	0
9	2	31	0	12	0	0
9	6	31	0	12	1	0
10	2	1	0	0	0	0
10	3	1	0	0	0	0
10	4	1	0	0	0	0
10	5	1	0	0	0	0
10	6	1	0	0	0	0
10	7	1	0	0	0	0
11	2	1	0	0	0	0
11	4	1	0	0	0	0
11	5	1	0	0	0	0
11	6	1	0	0	0	0
11	7	1	0	0	0	0
12	3	27	0	12	0	0
12	4	27	0	12	0	0
12	5	27	0	12	0	0
12	7	27	0	12	0	0
All	All	30208	0	30167	131	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 2.

All (131) 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)
6:7:491:VAL:HG11	7:X:23:DA:H5''	1.89	0.55
5:6:262:VAL:HG23	5:6:262:VAL:O	2.10	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:3:446:VAL:HB	2:3:458:GLU:H	1.74	0.52
3:4:226:TYR:O	3:4:230:LEU:HD23	2.10	0.52
6:7:401:VAL:HG11	6:7:644:TYR:HD2	1.75	0.52
8:Y:8:DC:H2"	8:Y:9:DA:C8	2.45	0.52
2:3:443:THR:O	2:3:444:ALA:HB3	2.10	0.52
4:5:596:ILE:H	4:5:596:ILE:HD12	1.76	0.51
2:3:676:ILE:HG23	6:7:617:THR:HG21	1.92	0.51
1:2:337:VAL:CG1	1:2:375:VAL:HG22	2.40	0.51
4:5:291:ARG:HB2	4:5:337:VAL:HB	1.92	0.50
4:5:53:ASN:HA	4:5:56:VAL:HG12	1.93	0.50
5:6:333:CYS:HB2	5:6:340:ASN:HB3	1.92	0.49
6:7:552:GLY:C	6:7:553:ILE:HD13	2.37	0.49
2:3:306:MET:HE2	4:5:179:LEU:HD11	1.95	0.49
2:3:444:ALA:O	2:3:446:VAL:N	2.45	0.49
6:7:27:THR:HG22	6:7:27:THR:O	2.13	0.48
6:7:73:ARG:NH1	6:7:132:ILE:HG23	2.29	0.48
7:X:28:DT:H2"	7:X:29:DG:C8	2.48	0.48
5:6:503:VAL:HG13	5:6:503:VAL:O	2.14	0.48
2:3:195:LYS:HG3	6:7:370:LEU:HB3	1.96	0.48
4:5:321:VAL:O	4:5:321:VAL:HG13	2.13	0.48
2:3:413:THR:O	2:3:413:THR:HG22	2.14	0.48
3:4:584:ILE:HG22	3:4:584:ILE:O	2.14	0.48
6:7:212:ALA:HB1	6:7:217:LYS:O	2.14	0.48
4:5:185:ASN:HD22	4:5:236:CYS:HA	1.79	0.47
3:4:791:ILE:HD12	3:4:791:ILE:N	2.29	0.47
3:4:307:ASN:O	3:4:307:ASN:ND2	2.47	0.47
3:4:648:VAL:HG12	3:4:648:VAL:O	2.14	0.46
4:5:161:ARG:O	4:5:162:LEU:HD23	2.14	0.46
6:7:285:THR:O	6:7:285:THR:HG22	2.14	0.46
1:2:585:ILE:HG23	1:2:586:THR:HG23	1.97	0.46
6:7:553:ILE:HG22	6:7:555:THR:HG22	1.97	0.46
3:4:293:LEU:H	3:4:293:LEU:HD23	1.80	0.46
1:2:279:THR:HG21	1:2:293:ILE:HD12	1.97	0.46
2:3:486:ILE:O	2:3:486:ILE:HG22	2.15	0.46
4:5:469:MET:O	4:5:515:SER:OG	2.26	0.46
3:4:767:LYS:HG3	5:6:732:VAL:HG11	1.98	0.46
4:5:627:VAL:O	4:5:627:VAL:HG12	2.15	0.46
6:7:552:GLY:O	6:7:553:ILE:HD13	2.16	0.45
3:4:651:GLN:HB3	3:4:653:THR:HG22	1.99	0.45
2:3:440:VAL:HB	2:3:445:ALA:HB3	1.99	0.45
6:7:459:MET:SD	6:7:584:ILE:HG22	2.56	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:3:423:LEU:HD22	2:3:431:ALA:HB2	1.97	0.45
4:5:261:ILE:O	4:5:261:ILE:HG23	2.16	0.45
2:3:456:ARG:HE	2:3:457:LEU:H	1.65	0.45
1:2:774:ILE:HG22	1:2:776:PRO:HD3	1.98	0.45
3:4:453:LEU:N	6:7:278:PHE:O	2.49	0.45
5:6:628:LEU:O	5:6:676:THR:HG21	2.17	0.45
2:3:504:THR:HG22	2:3:505:THR:N	2.31	0.45
2:3:413:THR:HG21	2:3:549:VAL:HB	1.99	0.45
1:2:494:ILE:H	1:2:494:ILE:HD12	1.83	0.44
2:3:387:GLY:O	2:3:714:LYS:NZ	2.48	0.44
3:4:589:VAL:HG21	3:4:620:ALA:HB1	1.98	0.44
4:5:276:MET:HG2	4:5:328:ILE:HB	1.98	0.44
6:7:12:VAL:HG22	6:7:13:ASP:N	2.32	0.44
1:2:624:MET:CG	1:2:646:ILE:HD12	2.48	0.44
6:7:484:THR:HG22	6:7:486:LYS:HG3	1.99	0.44
3:4:763:THR:HG22	3:4:817:VAL:O	2.18	0.44
5:6:631:ALA:O	5:6:676:THR:HG22	2.17	0.44
4:5:278:CYS:HB3	4:5:330:ILE:HD12	1.99	0.44
5:6:559:THR:HG22	5:6:560:VAL:N	2.33	0.44
5:6:313:MET:SD	5:6:340:ASN:HB2	2.57	0.43
4:5:556:VAL:HG13	4:5:556:VAL:O	2.18	0.43
2:3:447:THR:HG22	2:3:502:ILE:HG21	2.01	0.43
1:2:314:LEU:HD22	1:2:432:ASN:OD1	2.19	0.43
3:4:699:LEU:HD23	3:4:699:LEU:O	2.18	0.43
6:7:497:VAL:HG22	6:7:498:MET:N	2.33	0.43
4:5:437:VAL:HG23	4:5:472:ALA:HB2	1.99	0.43
5:6:555:VAL:HG22	5:6:808:GLU:OE2	2.19	0.43
1:2:386:GLN:HB2	1:2:415:VAL:HG13	2.00	0.43
6:7:631:THR:O	6:7:631:THR:OG1	2.37	0.43
7:X:29:DG:H1	8:Y:8:DC:H42	1.67	0.43
6:7:61:PRO:HG2	6:7:64:MET:HB2	2.01	0.43
6:7:66:MET:SD	6:7:78:VAL:HG23	2.59	0.43
5:6:799:GLN:OE1	5:6:799:GLN:N	2.52	0.42
1:2:597:VAL:CG2	1:2:629:ILE:HD12	2.50	0.42
2:3:505:THR:HG23	6:7:319:SER:OG	2.18	0.42
6:7:486:LYS:HE2	6:7:486:LYS:HB2	1.41	0.42
1:2:384:ASN:HB3	1:2:415:VAL:HG21	2.00	0.42
3:4:791:ILE:HD13	3:4:833:ILE:HD11	2.01	0.42
6:7:9:GLN:C	6:7:10:LEU:HD12	2.44	0.42
6:7:580:PRO:HG3	6:7:727:LEU:HD21	2.01	0.42
2:3:103:LEU:HD21	2:3:114:ILE:HD12	2.00	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:4:725:THR:HG22	3:4:725:THR:O	2.18	0.42
5:6:816:VAL:HG12	5:6:818:GLU:H	1.83	0.42
1:2:253:LYS:HB3	1:2:256:LEU:HD23	2.01	0.42
3:4:578:LEU:HD22	3:4:632:ASP:OD1	2.20	0.42
4:5:28:ILE:H	4:5:28:ILE:HD12	1.85	0.42
2:3:215:THR:HG22	2:3:216:ASP:N	2.34	0.42
4:5:639:GLU:OE1	4:5:700:LEU:HD13	2.20	0.42
6:7:657:ASN:O	6:7:661:VAL:HG23	2.19	0.42
1:2:527:VAL:HG13	4:5:581:ASN:HA	2.01	0.41
3:4:452:VAL:HG12	6:7:277:THR:HB	2.02	0.41
6:7:104:SER:O	6:7:108:GLN:HG2	2.19	0.41
5:6:348:VAL:O	5:6:348:VAL:HG22	2.19	0.41
5:6:622:THR:HG22	5:6:623:ILE:N	2.34	0.41
6:7:486:LYS:HG3	6:7:486:LYS:H	1.54	0.41
5:6:115:PHE:O	5:6:119:LEU:HD13	2.20	0.41
6:7:511:GLY:O	6:7:515:LEU:HD13	2.21	0.41
1:2:438:LEU:HD23	5:6:327:TYR:CD1	2.56	0.41
1:2:523:VAL:O	1:2:523:VAL:HG23	2.21	0.41
1:2:826:SER:OG	1:2:827:GLU:N	2.54	0.41
4:5:255:PHE:O	4:5:256:LEU:HD23	2.20	0.41
6:7:227:VAL:O	6:7:227:VAL:HG12	2.19	0.41
1:2:255:ILE:H	1:2:255:ILE:HD12	1.85	0.41
1:2:800:THR:HG21	1:2:857:LEU:HD22	2.03	0.41
3:4:472:LYS:HZ1	3:4:744:VAL:HG21	1.86	0.41
3:4:790:ARG:NH2	3:4:838:THR:HG21	2.35	0.41
5:6:773:LEU:HD21	5:6:804:ILE:CG1	2.51	0.41
7:X:23:DA:H2"	7:X:24:DT:OP2	2.21	0.41
1:2:687:VAL:O	1:2:687:VAL:HG13	2.21	0.41
5:6:299:GLU:H	5:6:299:GLU:CD	2.29	0.41
5:6:586:LYS:HA	5:6:589:VAL:HG12	2.03	0.41
6:7:494:THR:O	6:7:495:ALA:HB2	2.21	0.41
1:2:199:THR:O	1:2:199:THR:HG22	2.21	0.41
1:2:422:GLU:OE2	1:2:458:ARG:CZ	2.69	0.41
3:4:330:GLY:HA2	3:4:402:THR:HG23	2.02	0.41
4:5:169:THR:HG22	4:5:256:LEU:HD22	2.03	0.41
4:5:267:VAL:HG12	4:5:267:VAL:O	2.21	0.41
2:3:315:ILE:HG22	2:3:316:GLY:N	2.36	0.41
5:6:580:SER:HA	9:6:1101:ATP:O2A	2.20	0.41
2:3:344:ASP:OD1	2:3:344:ASP:N	2.54	0.40
6:7:574:TYR:OH	6:7:727:LEU:HD13	2.20	0.40
2:3:409:GLY:HA3	2:3:549:VAL:CG2	2.52	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:4:374:ILE:H	3:4:374:ILE:HD12	1.86	0.40
3:4:795:THR:O	3:4:795:THR:HG22	2.20	0.40
6:7:260:TYR:CE2	6:7:300:MET:HG3	2.57	0.40
2:3:446:VAL:HB	2:3:458:GLU:CB	2.52	0.40
3:4:223:GLU:OE1	3:4:223:GLU:N	2.54	0.40
5:6:189:VAL:O	5:6:193:ALA:N	2.49	0.40

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	2	620/868 (71%)	593 (96%)	26 (4%)	1 (0%)	44	73
2	3	603/1006 (60%)	584 (97%)	19 (3%)	0	100	100
3	4	619/933 (66%)	590 (95%)	27 (4%)	2 (0%)	37	67
4	5	596/775 (77%)	580 (97%)	14 (2%)	2 (0%)	37	67
5	6	599/1017 (59%)	572 (96%)	27 (4%)	0	100	100
6	7	624/845 (74%)	591 (95%)	32 (5%)	1 (0%)	44	73
All	All	3661/5444 (67%)	3510 (96%)	145 (4%)	6 (0%)	45	73

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	2	444	PHE
3	4	612	LYS
4	5	581	ASN
6	7	128	PRO
3	4	680	SER
4	5	267	VAL

5.3.2 Protein sidechains ⓘ

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	2	550/770 (71%)	546 (99%)	4 (1%)	81	89
2	3	529/864 (61%)	518 (98%)	11 (2%)	48	69
3	4	569/848 (67%)	562 (99%)	7 (1%)	67	79
4	5	544/688 (79%)	543 (100%)	1 (0%)	92	96
5	6	536/886 (60%)	536 (100%)	0	100	100
6	7	555/753 (74%)	546 (98%)	9 (2%)	58	75
All	All	3283/4809 (68%)	3251 (99%)	32 (1%)	71	83

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	2	271	PHE
1	2	383	ARG
1	2	587	LYS
1	2	709	GLU
2	3	41	SER
2	3	45	ILE
2	3	50	SER
2	3	90	ASN
2	3	91	ILE
2	3	92	LEU
2	3	95	ARG
2	3	154	LYS
2	3	440	VAL
2	3	448	THR
2	3	499	LYS
3	4	594	LYS
3	4	599	VAL
3	4	607	ARG
3	4	608	ASP
3	4	612	LYS
3	4	613	GLN
3	4	614	LEU

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Mol	Chain	Res	Type
4	5	598	LYS
6	7	125	MET
6	7	127	LEU
6	7	357	PRO
6	7	370	LEU
6	7	372	THR
6	7	486	LYS
6	7	489	SER
6	7	491	VAL
6	7	499	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (28) such sidechains are listed below:

Mol	Chain	Res	Type
1	2	353	GLN
1	2	551	GLN
1	2	665	GLN
1	2	707	HIS
2	3	201	HIS
2	3	293	ASN
2	3	365	GLN
2	3	507	ASN
2	3	522	GLN
2	3	682	ASN
3	4	217	ASN
3	4	218	ASN
3	4	242	ASN
3	4	447	ASN
3	4	651	GLN
3	4	685	ASN
3	4	759	HIS
3	4	823	GLN
4	5	185	ASN
4	5	359	GLN
5	6	157	HIS
5	6	659	GLN
6	7	68	GLN
6	7	72	ASN
6	7	95	GLN
6	7	336	ASN
6	7	575	ASN
6	7	662	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 17 ligands modelled in this entry, 11 are monoatomic - leaving 6 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# $ Z > 2$	Counts	RMSZ	# $ Z > 2$
12	ADP	4	1000	10	24,29,29	0.67	0	29,45,45	1.20	3 (10%)
9	ATP	2	1000	10	26,33,33	0.85	0	31,52,52	0.94	2 (6%)
12	ADP	5	1000	10	24,29,29	0.67	0	29,45,45	1.17	3 (10%)
12	ADP	3	1000	10	24,29,29	0.73	0	29,45,45	1.10	3 (10%)
9	ATP	6	1101	10	26,33,33	0.83	0	31,52,52	1.01	1 (3%)
12	ADP	7	902	10	24,29,29	0.73	0	29,45,45	1.21	3 (10%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
12	ADP	4	1000	10	-	1/12/32/32	0/3/3/3
9	ATP	2	1000	10	-	5/18/38/38	0/3/3/3

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
12	ADP	5	1000	10	-	5/12/32/32	0/3/3/3
12	ADP	3	1000	10	-	5/12/32/32	0/3/3/3
9	ATP	6	1101	10	-	6/18/38/38	0/3/3/3
12	ADP	7	902	10	-	5/12/32/32	0/3/3/3

There are no bond length outliers.

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
12	7	902	ADP	PA-O3A-PB	-3.43	121.05	132.83
12	4	1000	ADP	PA-O3A-PB	-3.25	121.68	132.83
12	5	1000	ADP	PA-O3A-PB	-3.19	121.88	132.83
12	7	902	ADP	C3'-C2'-C1'	3.14	105.71	100.98
12	7	902	ADP	C5-C6-N6	2.76	124.54	120.35
12	4	1000	ADP	C5-C6-N6	2.65	124.38	120.35
12	3	1000	ADP	C5-C6-N6	2.61	124.32	120.35
12	3	1000	ADP	C3'-C2'-C1'	2.52	104.78	100.98
9	2	1000	ATP	C5-C6-N6	2.48	124.12	120.35
12	5	1000	ADP	C5-C6-N6	2.45	124.08	120.35
9	6	1101	ATP	C5-C6-N6	2.42	124.03	120.35
12	4	1000	ADP	C1'-N9-C4	2.39	130.84	126.64
12	5	1000	ADP	C3'-C2'-C1'	2.38	104.56	100.98
9	2	1000	ATP	O3'-C3'-C2'	-2.18	104.76	111.82
12	3	1000	ADP	PA-O3A-PB	-2.01	125.94	132.83

There are no chirality outliers.

All (27) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
9	6	1101	ATP	PB-O3B-PG-O3G
9	6	1101	ATP	C5'-O5'-PA-O1A
12	3	1000	ADP	PA-O3A-PB-O2B
12	5	1000	ADP	C5'-O5'-PA-O1A
12	5	1000	ADP	C5'-O5'-PA-O2A
12	7	902	ADP	C5'-O5'-PA-O3A
12	5	1000	ADP	C3'-C4'-C5'-O5'
12	3	1000	ADP	O4'-C4'-C5'-O5'
9	2	1000	ATP	PB-O3B-PG-O1G
9	6	1101	ATP	PB-O3B-PG-O2G
9	6	1101	ATP	C5'-O5'-PA-O3A

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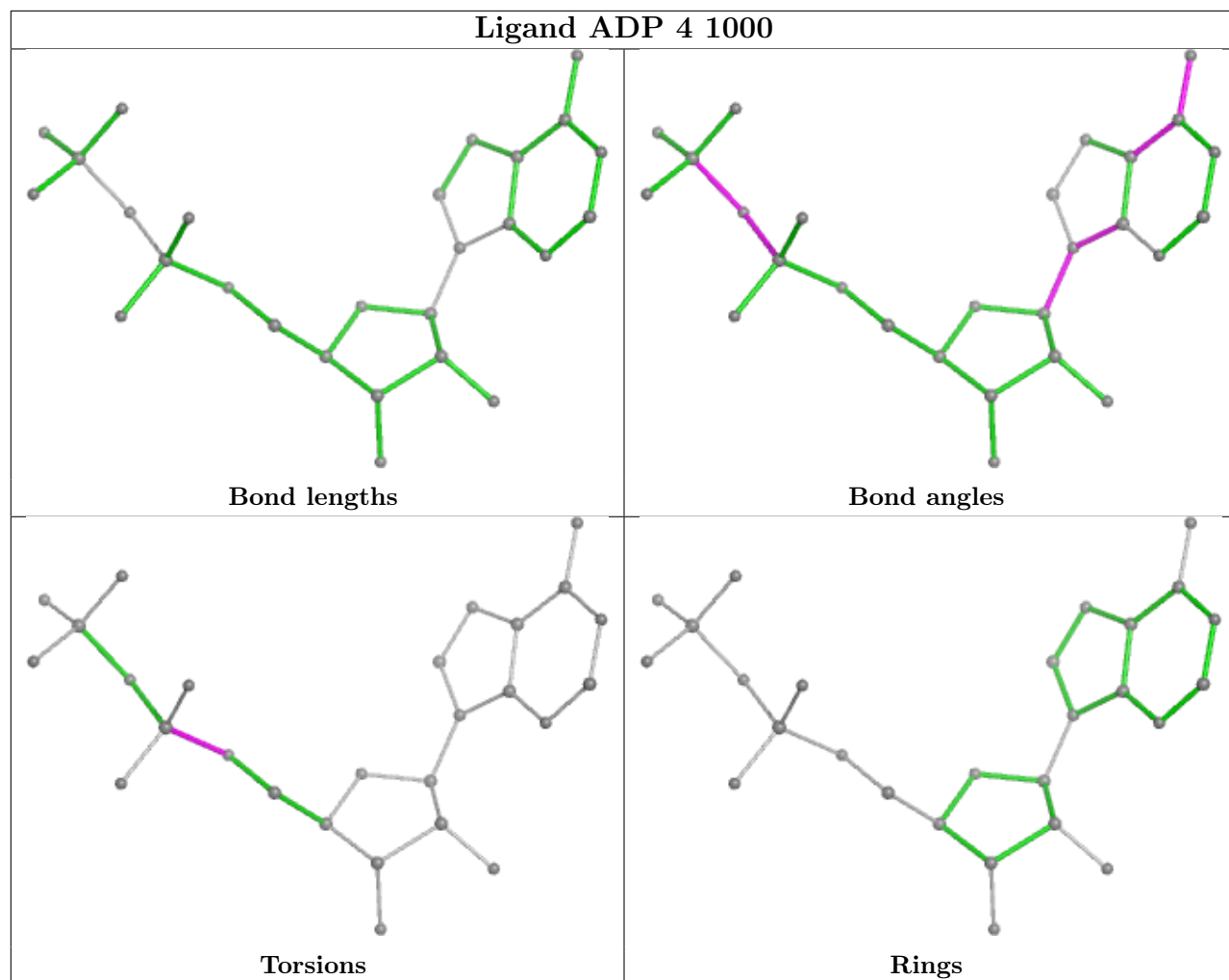
Mol	Chain	Res	Type	Atoms
9	6	1101	ATP	C5'-O5'-PA-O2A
12	7	902	ADP	C5'-O5'-PA-O1A
12	7	902	ADP	C5'-O5'-PA-O2A
12	5	1000	ADP	O4'-C4'-C5'-O5'
9	2	1000	ATP	PG-O3B-PB-O1B
9	6	1101	ATP	PB-O3B-PG-O1G
12	3	1000	ADP	PA-O3A-PB-O1B
12	7	902	ADP	O4'-C4'-C5'-O5'
9	2	1000	ATP	PB-O3B-PG-O2G
9	2	1000	ATP	PB-O3B-PG-O3G
12	3	1000	ADP	PA-O3A-PB-O3B
12	7	902	ADP	PA-O3A-PB-O2B
12	5	1000	ADP	C5'-O5'-PA-O3A
9	2	1000	ATP	O4'-C4'-C5'-O5'
12	3	1000	ADP	C5'-O5'-PA-O1A
12	4	1000	ADP	C5'-O5'-PA-O1A

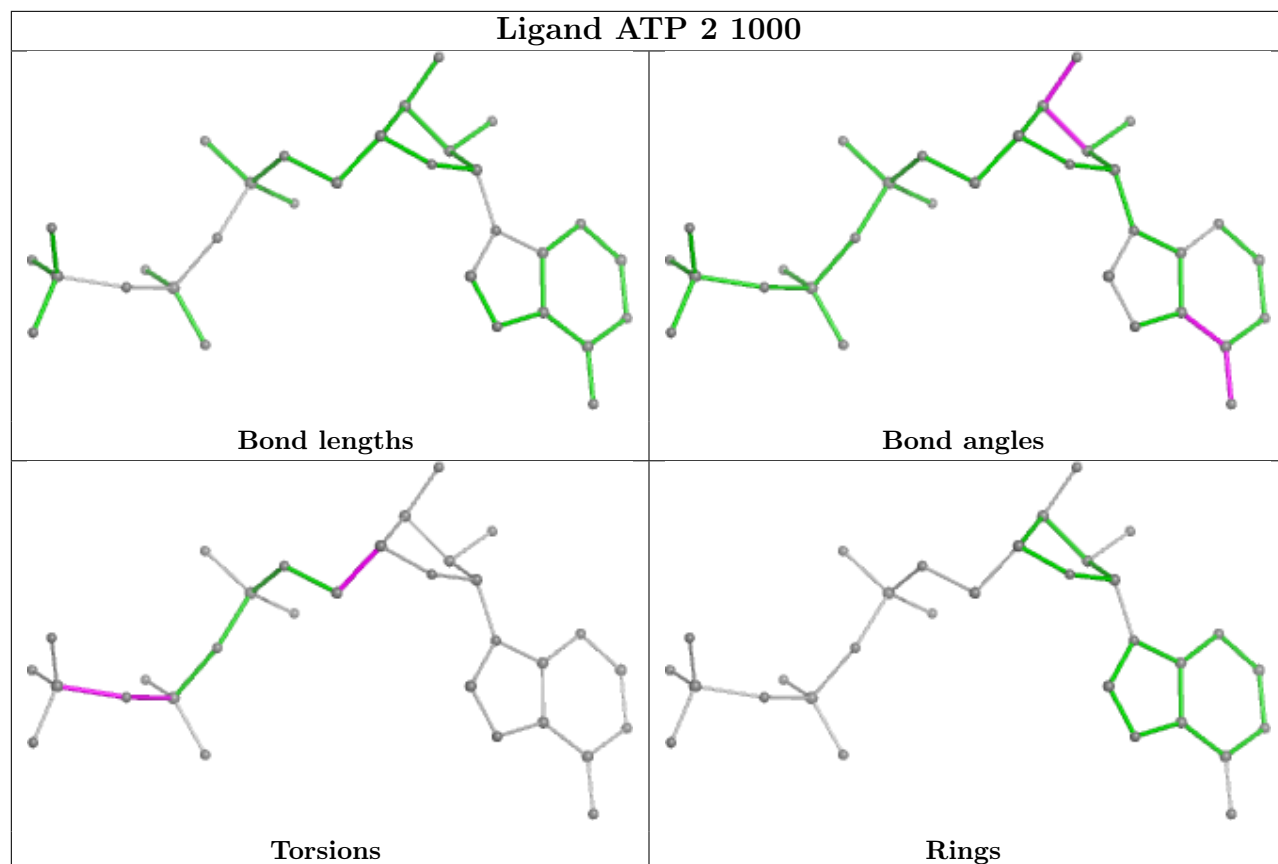
There are no ring outliers.

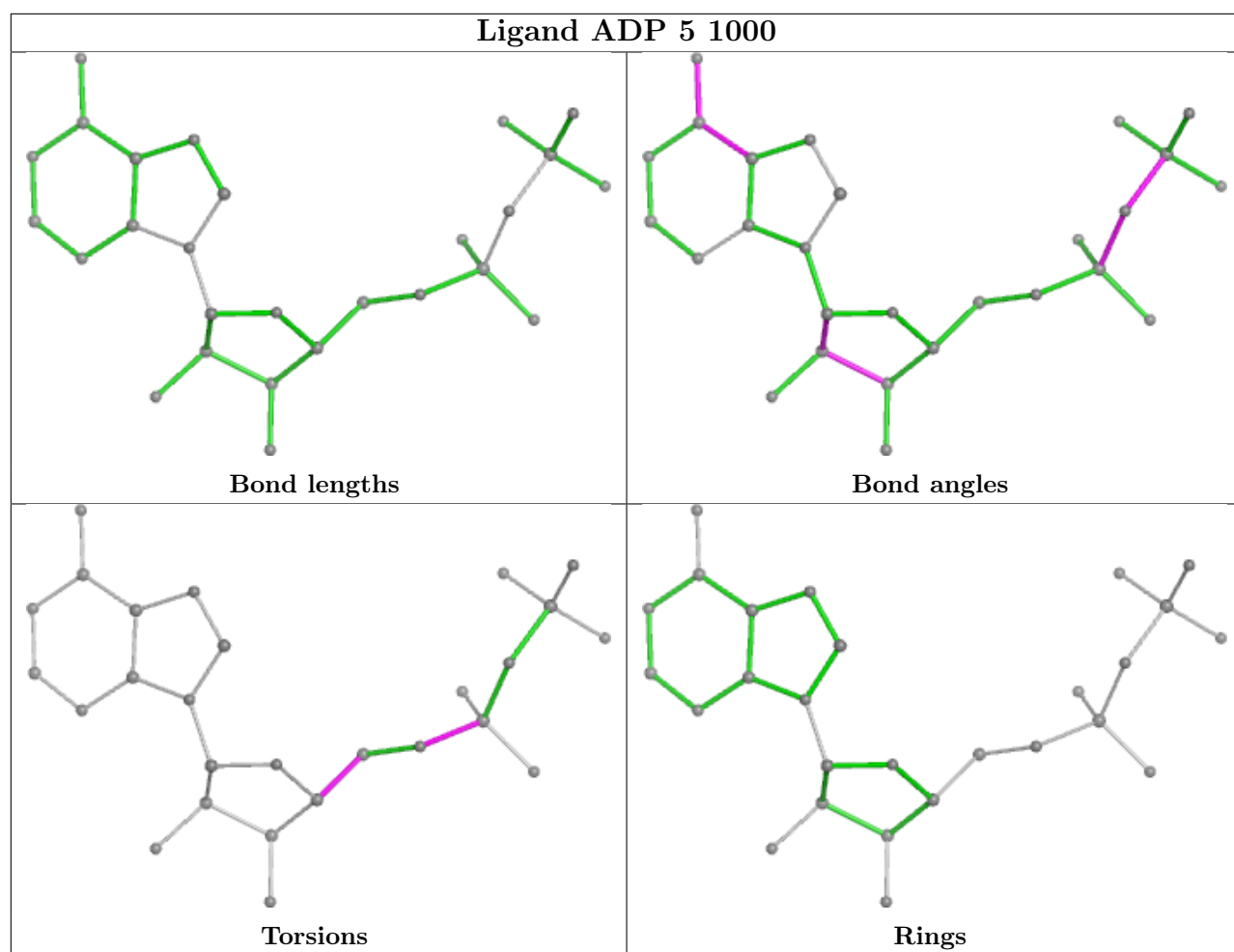
1 monomer is involved in 1 short contact:

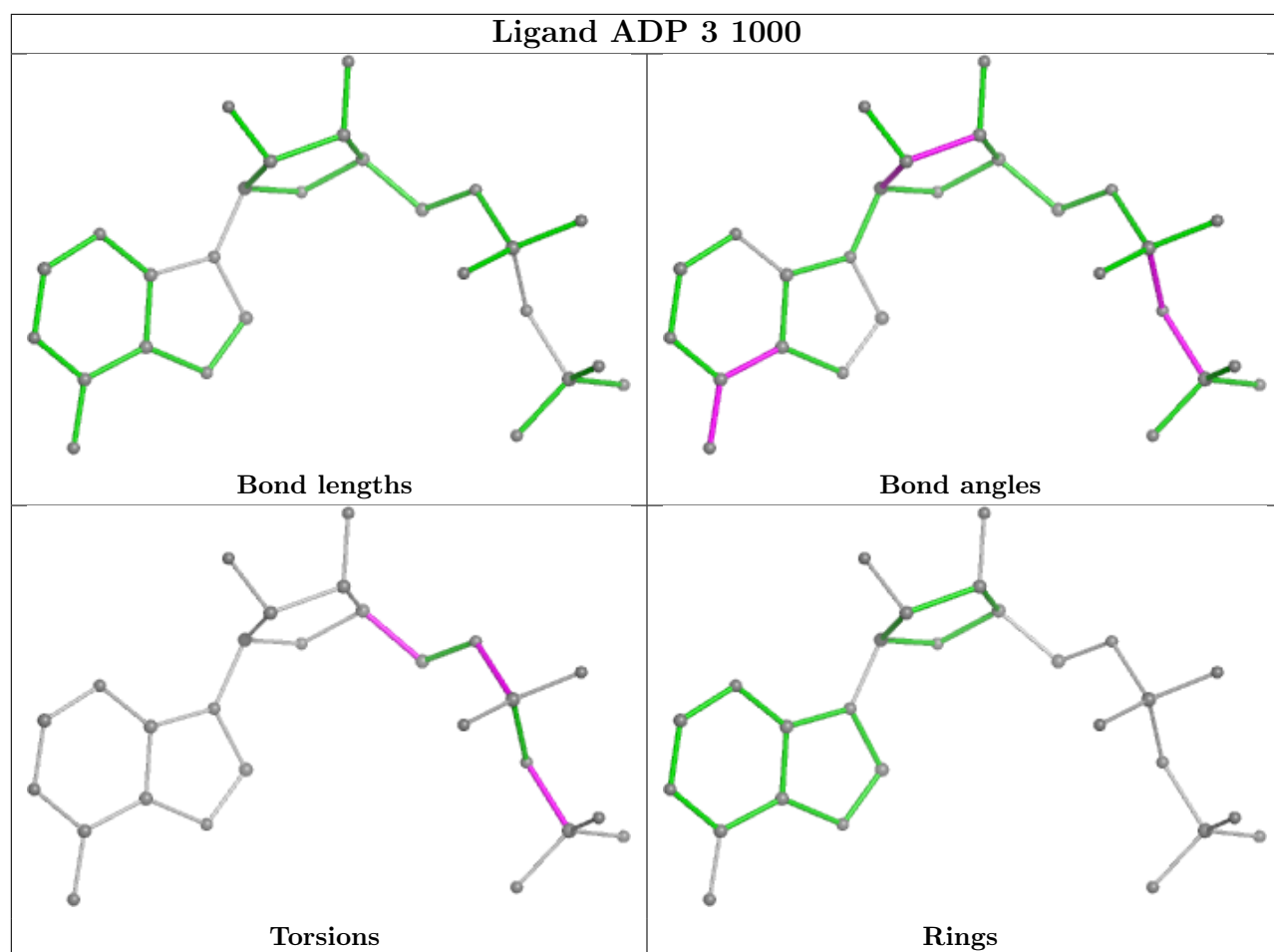
Mol	Chain	Res	Type	Clashes	Symm-Clashes
9	6	1101	ATP	1	0

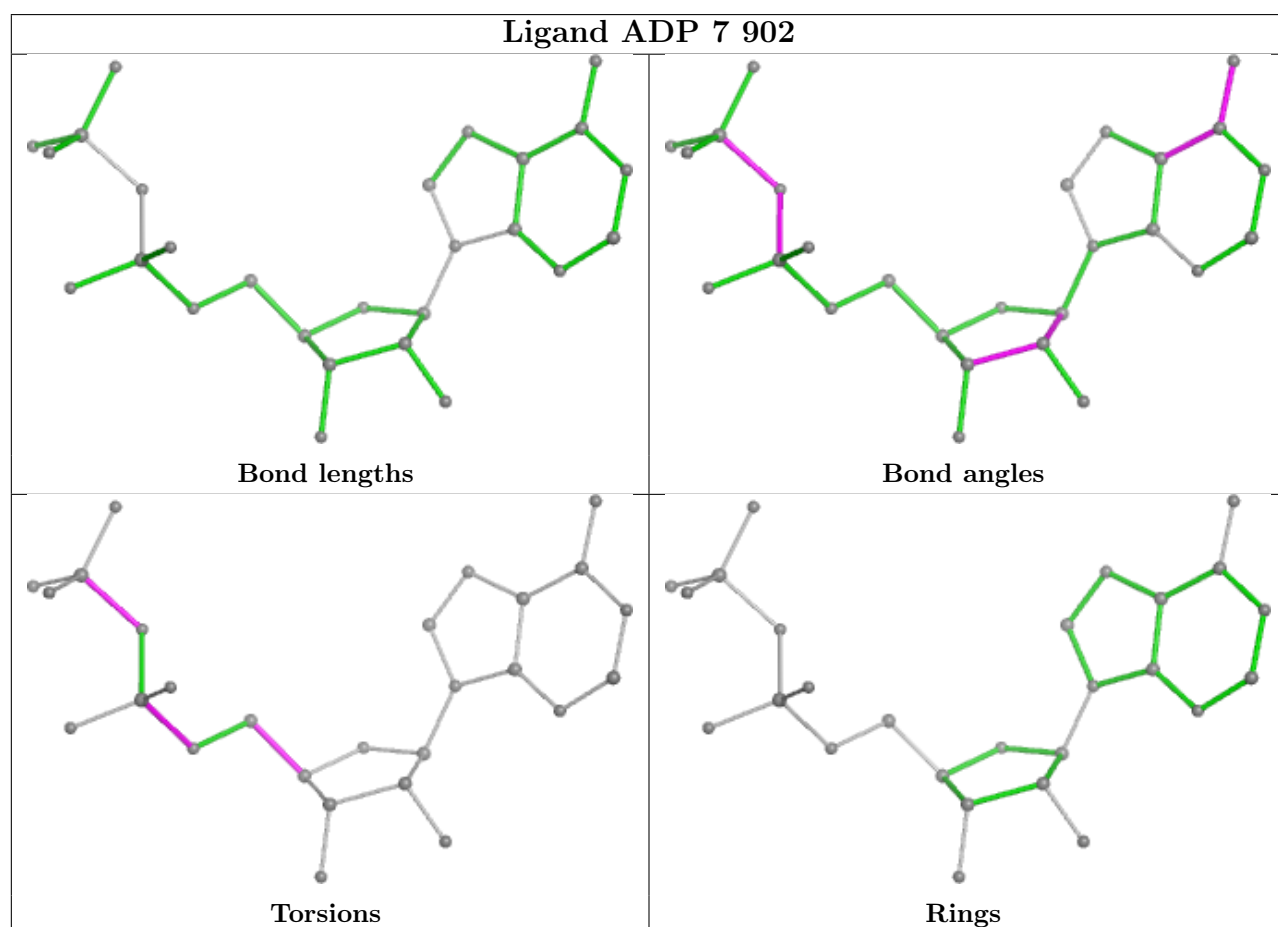
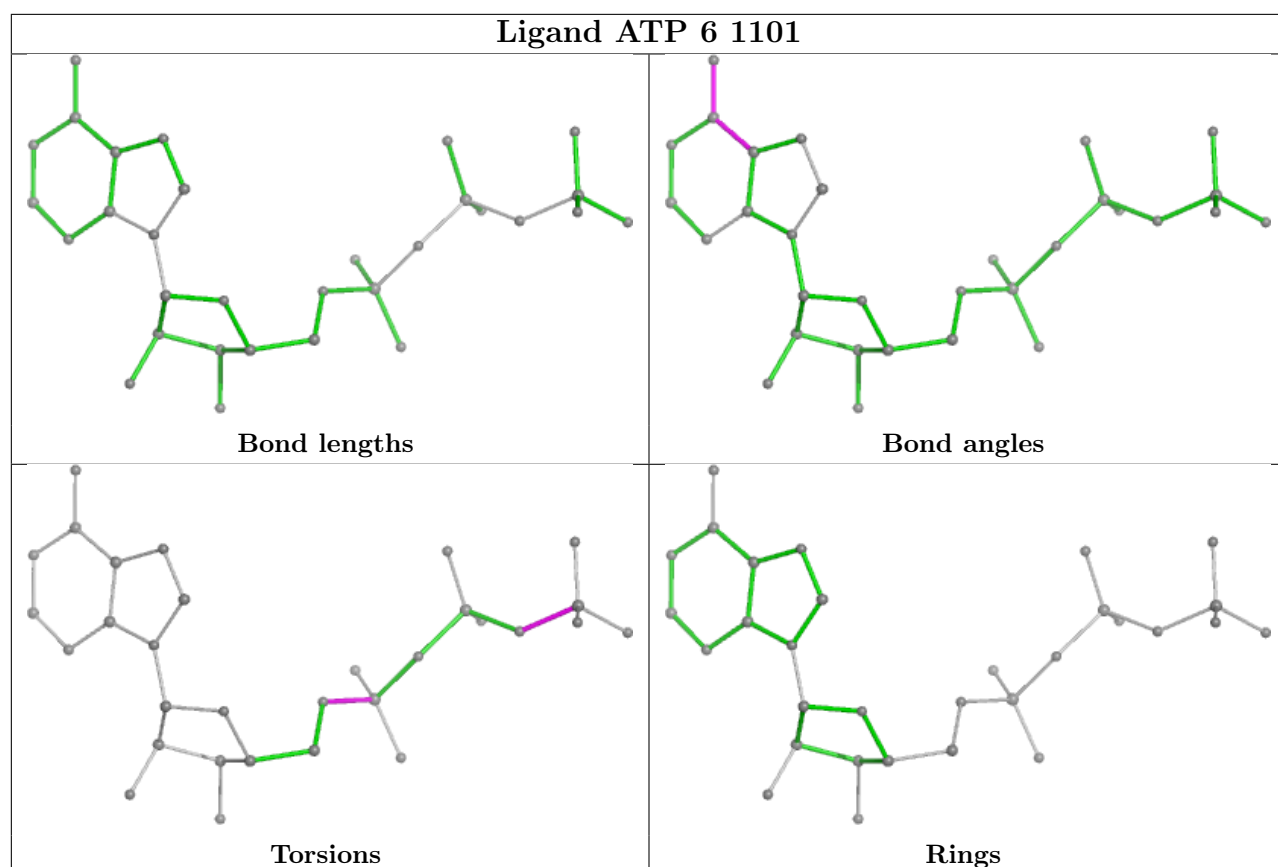
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.











5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

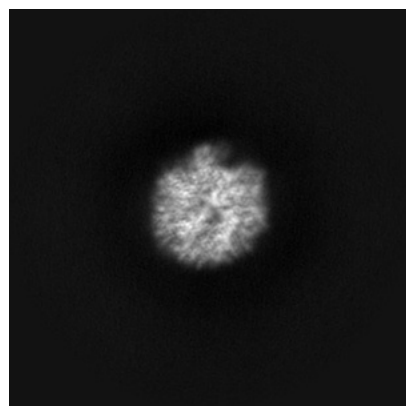
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-19187. These allow visual inspection of the internal detail of the map and identification of artifacts.

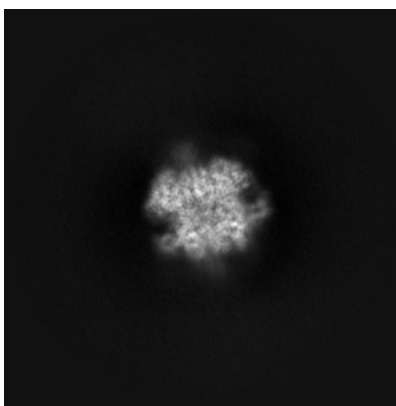
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

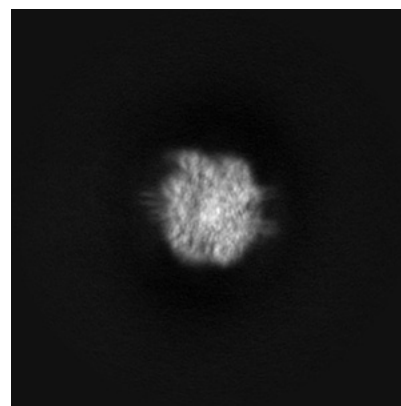
6.1.1 Primary map



X

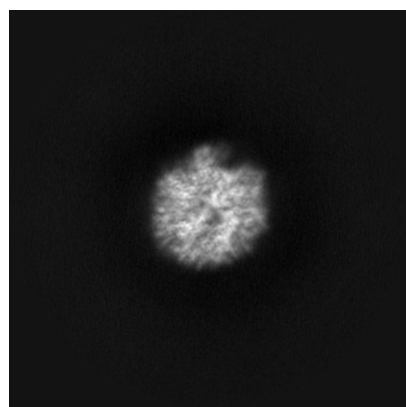


Y

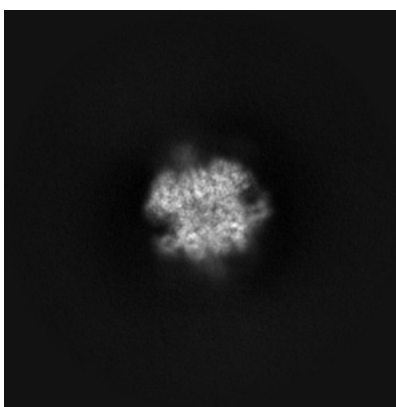


Z

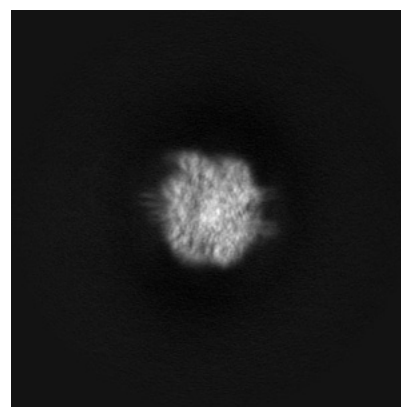
6.1.2 Raw map



X



Y

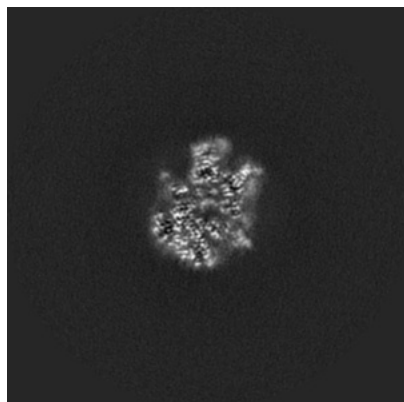


Z

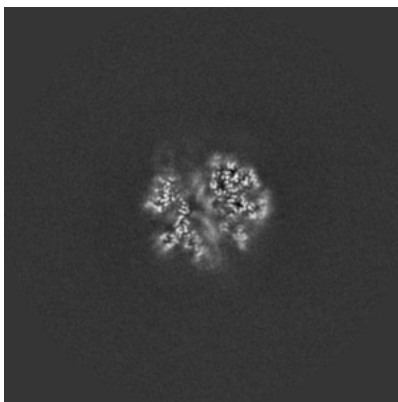
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

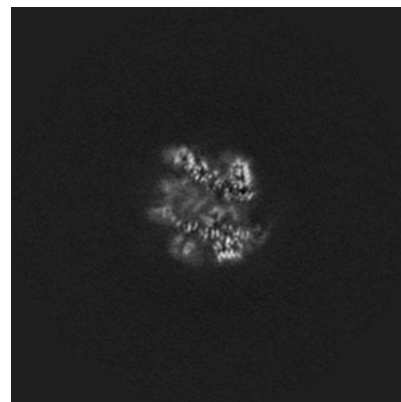
6.2.1 Primary map



X Index: 210

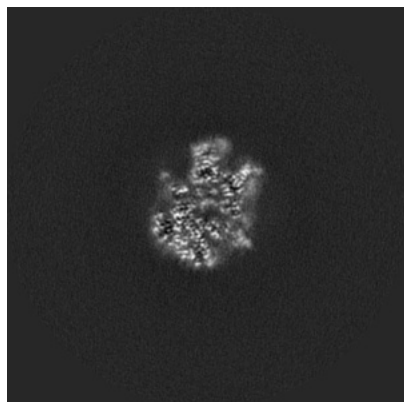


Y Index: 210

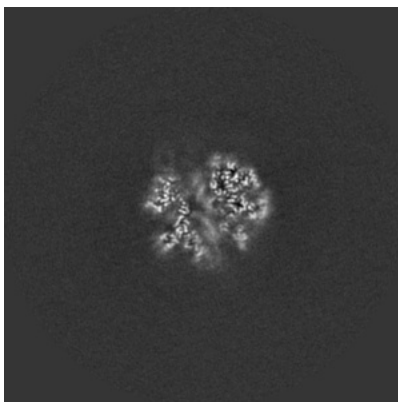


Z Index: 210

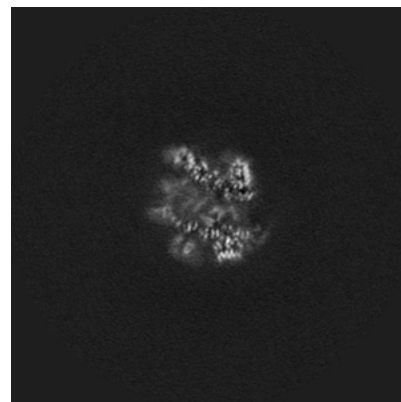
6.2.2 Raw map



X Index: 210



Y Index: 210

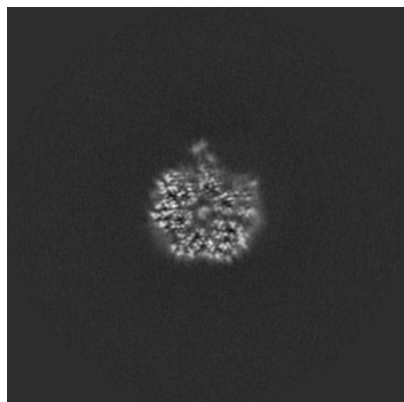


Z Index: 210

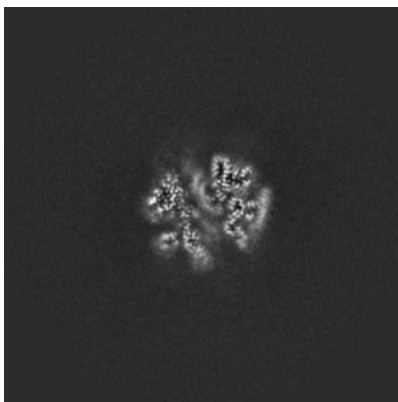
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

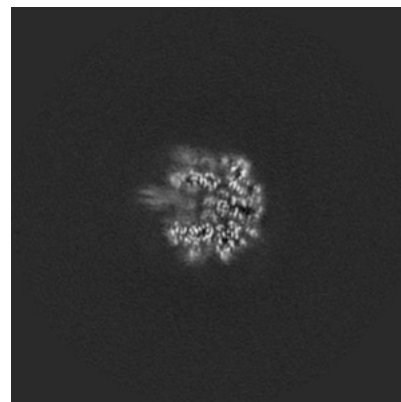
6.3.1 Primary map



X Index: 228

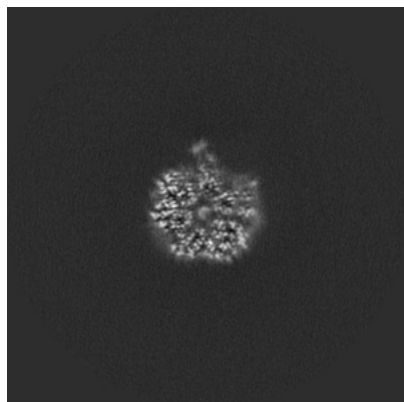


Y Index: 205

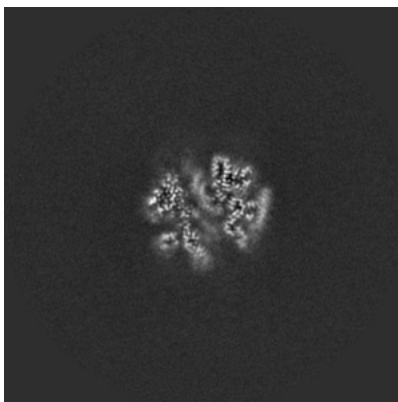


Z Index: 226

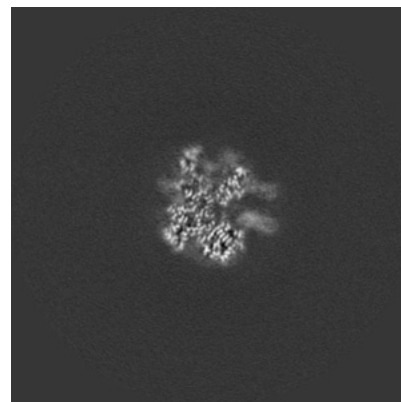
6.3.2 Raw map



X Index: 228



Y Index: 205



Z Index: 193

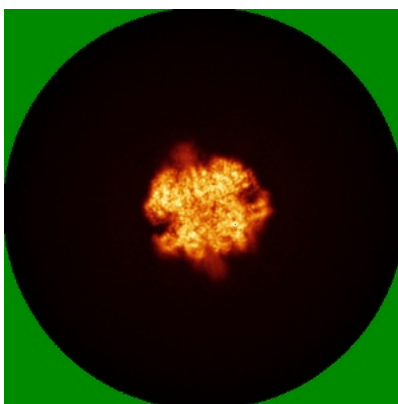
The images above show the largest variance slices of the map in three orthogonal directions.

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

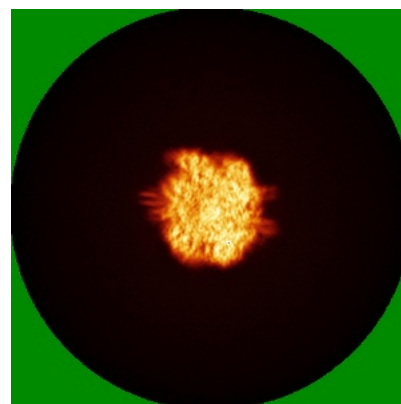
6.4.1 Primary map



X

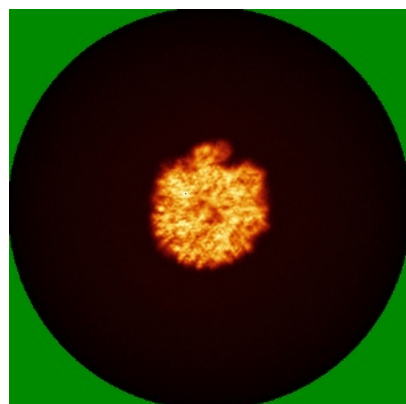


Y

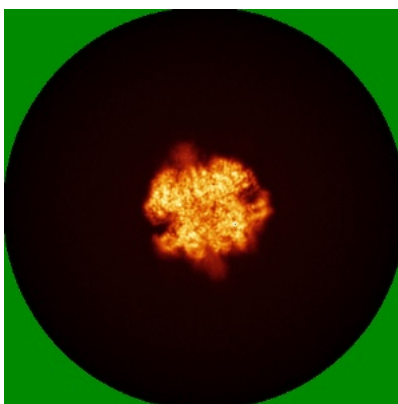


Z

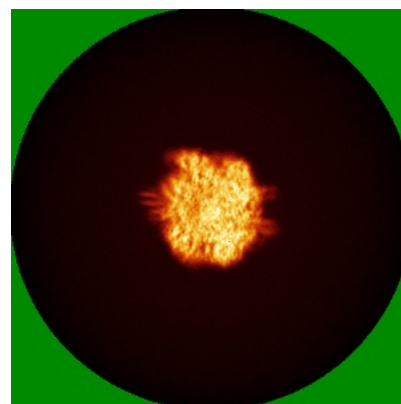
6.4.2 Raw map



X



Y

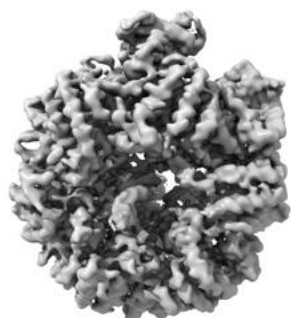


Z

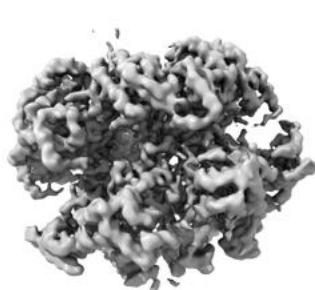
The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

6.5 Orthogonal surface views [i](#)

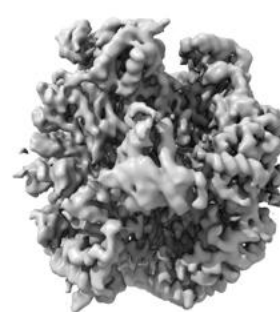
6.5.1 Primary map



X



Y



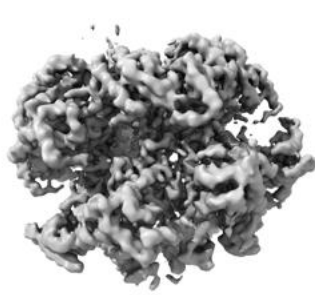
Z

The images above show the 3D surface view of the map at the recommended contour level 0.011. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

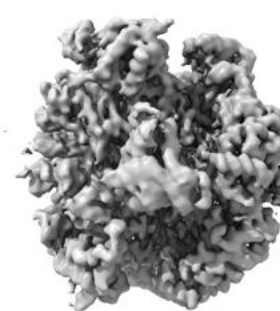
6.5.2 Raw map



X



Y



Z

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.

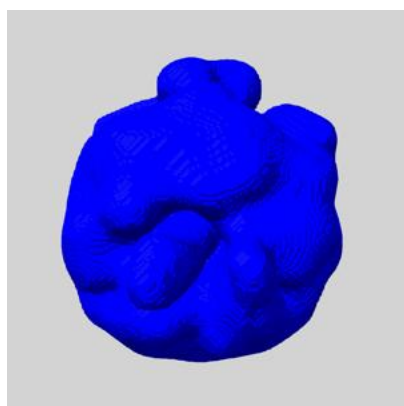
6.6 Mask visualisation [i](#)

This section shows the 3D surface view of the primary map at 50% transparency overlaid with the specified mask at 0% transparency

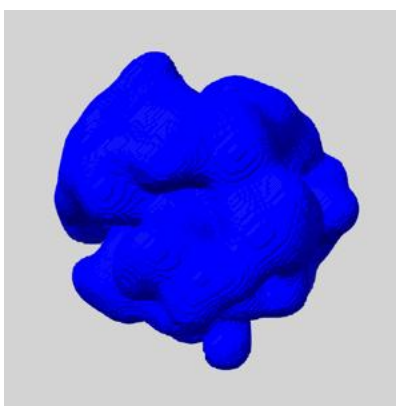
A mask typically either:

- Encompasses the whole structure
- Separates out a domain, a functional unit, a monomer or an area of interest from a larger structure

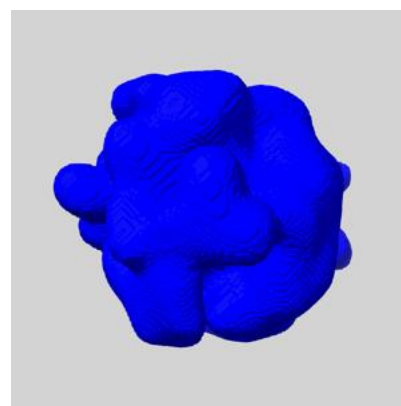
6.6.1 emd_19187_msk_1.map [i](#)



X



Y

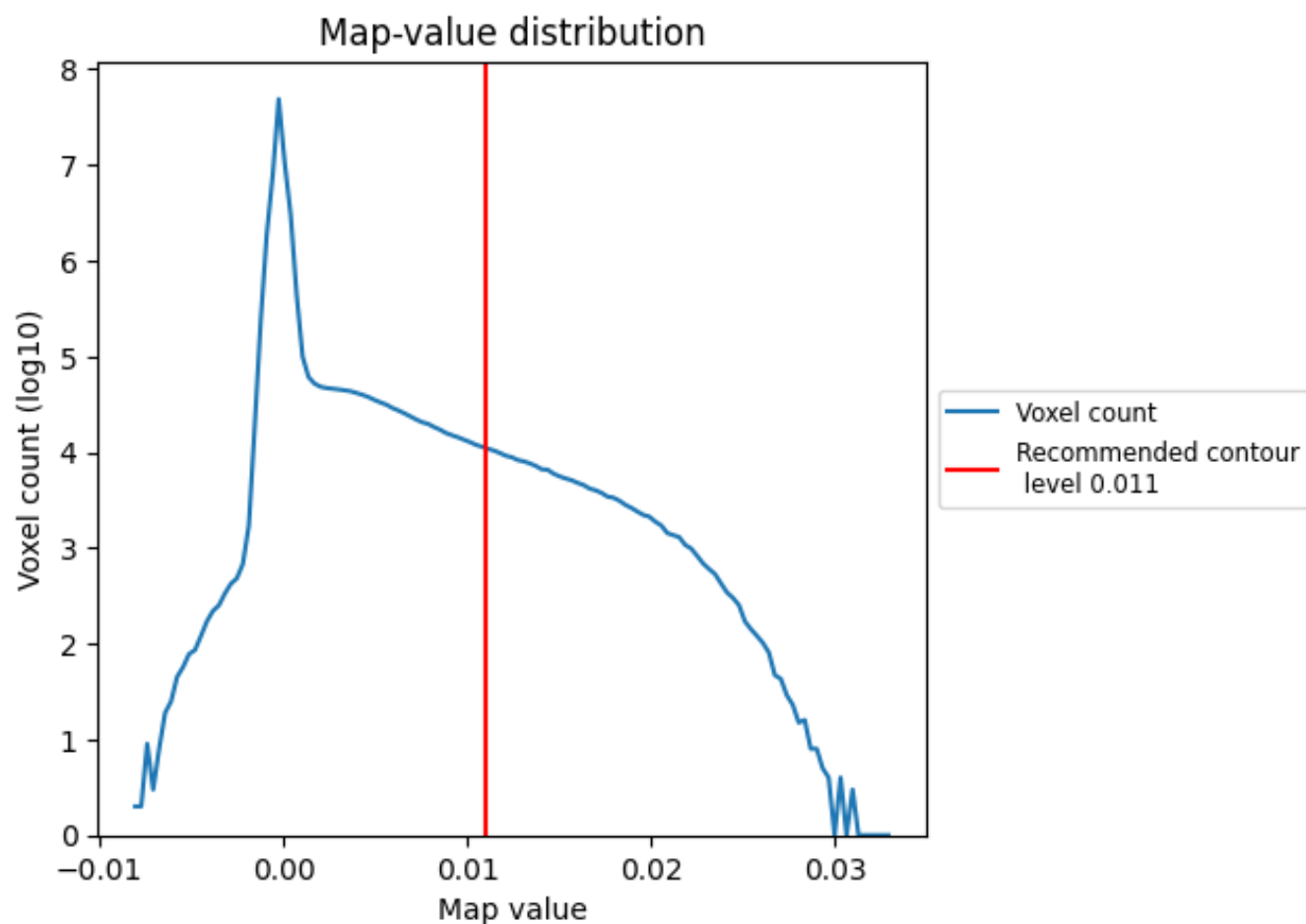


Z

7 Map analysis [i](#)

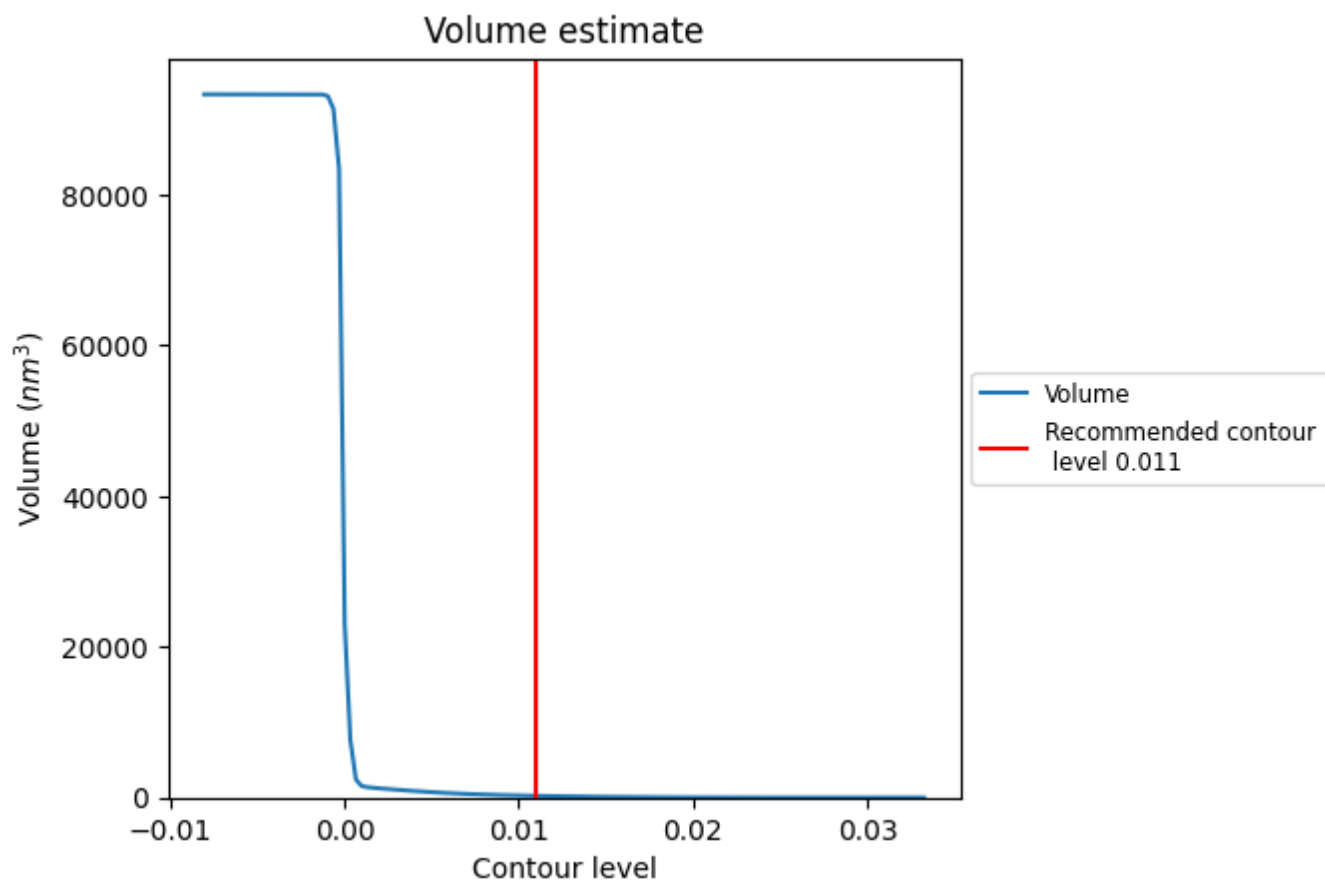
This section contains the results of statistical analysis of the map.

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.

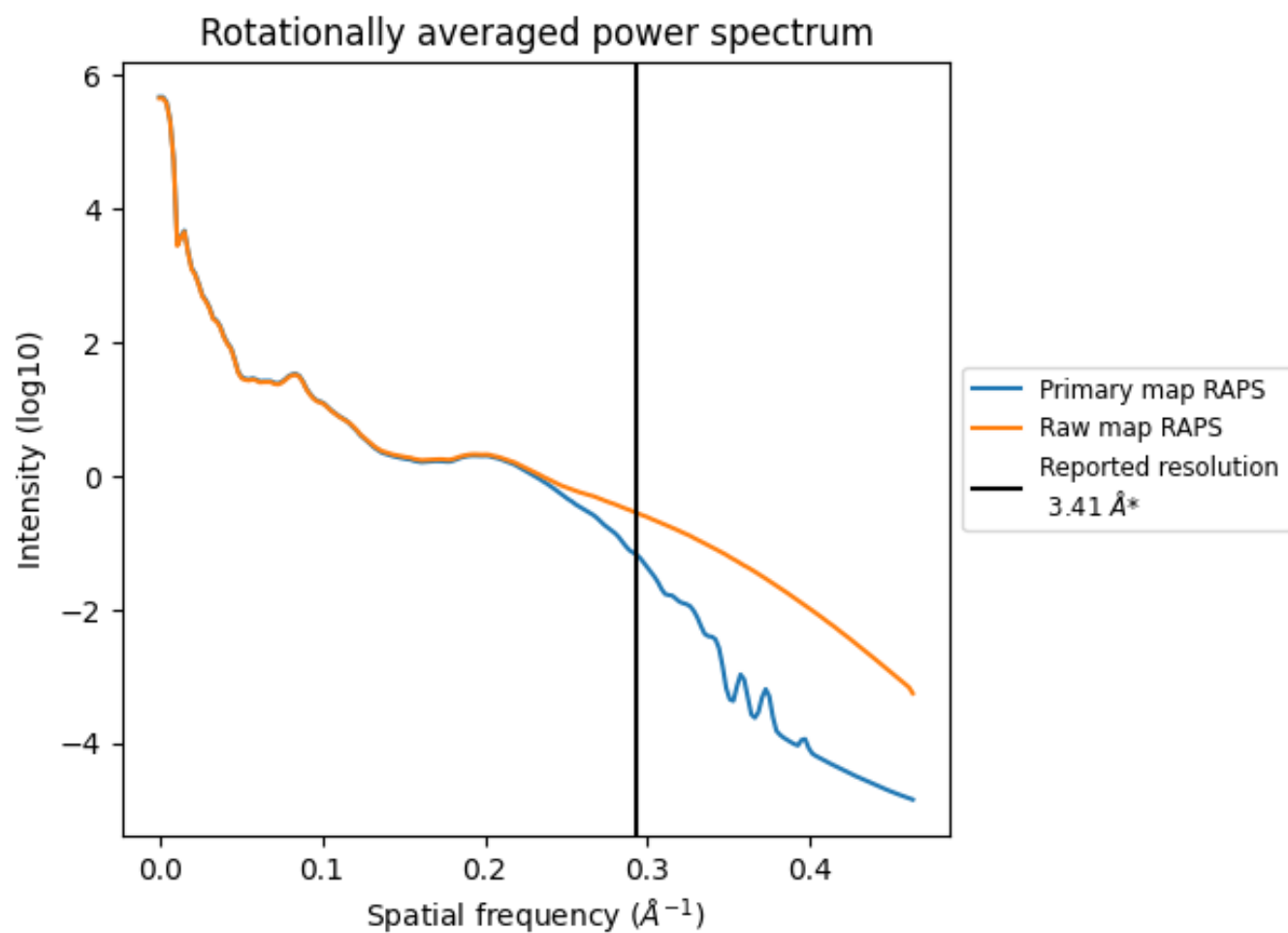
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 224 nm³; this corresponds to an approximate mass of 203 kDa.

The volume estimate graph shows how the enclosed volume varies with the contour level. The recommended contour level is shown as a vertical line and the intersection between the line and the curve gives the volume of the enclosed surface at the given level.

7.3 Rotationally averaged power spectrum ⓘ

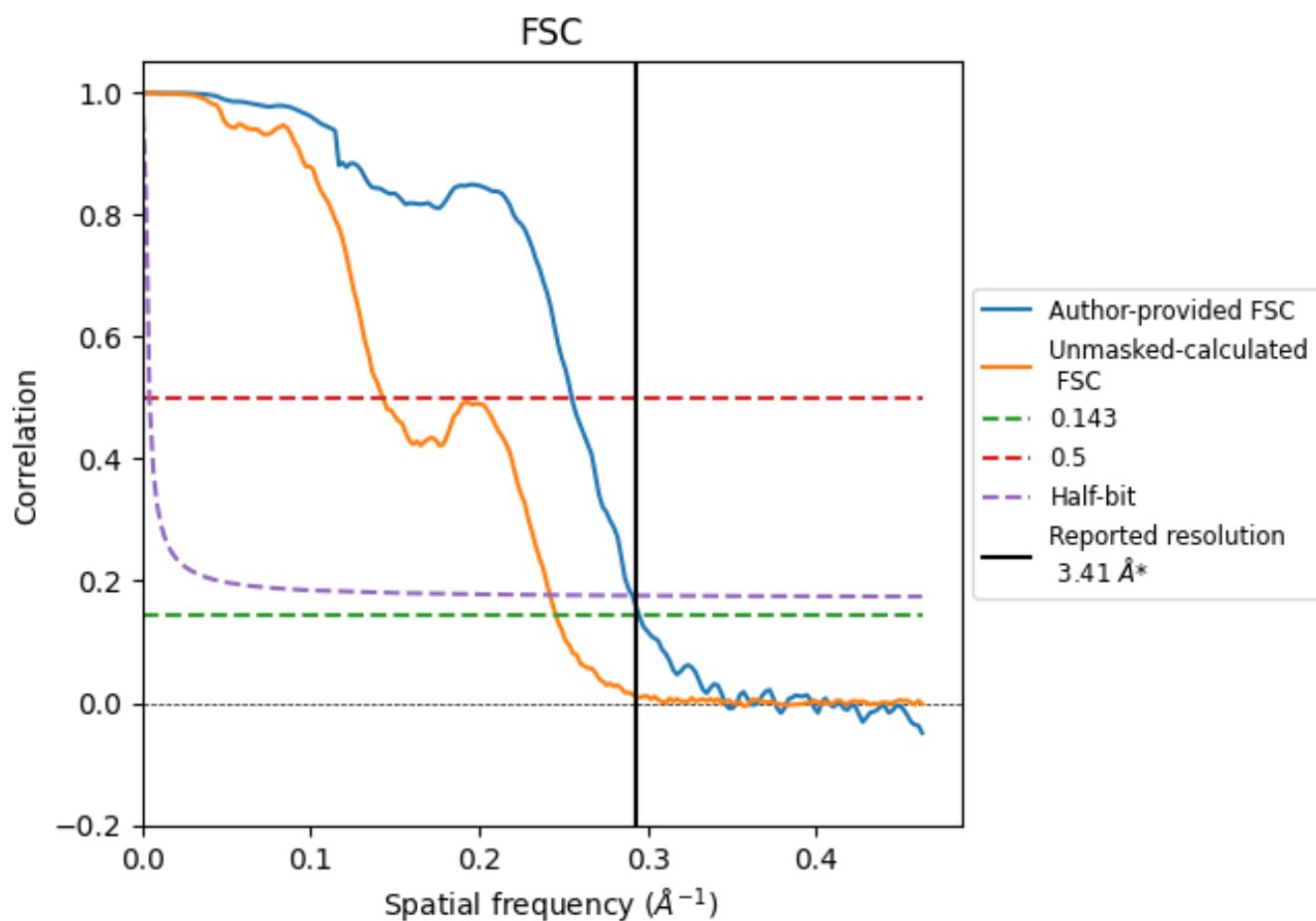


*Reported resolution corresponds to spatial frequency of 0.293 $\text{\AA}^{-1}$

8 Fourier-Shell correlation [i](#)

Fourier-Shell Correlation (FSC) is the most commonly used method to estimate the resolution of single-particle and subtomogram-averaged maps. The shape of the curve depends on the imposed symmetry, mask and whether or not the two 3D reconstructions used were processed from a common reference. The reported resolution is shown as a black line. A curve is displayed for the half-bit criterion in addition to lines showing the 0.143 gold standard cut-off and 0.5 cut-off.

8.1 FSC [i](#)



*Reported resolution corresponds to spatial frequency of 0.293 $\text{\AA}^{-1}$

8.2 Resolution estimates [i](#)

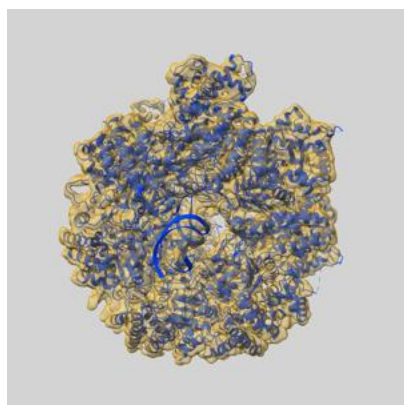
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.41	-	-
Author-provided FSC curve	3.39	3.92	3.44
Unmasked-calculated*	4.07	7.00	4.13

*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 4.07 differs from the reported value 3.41 by more than 10 %

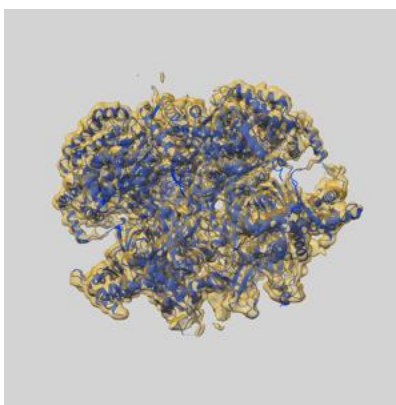
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-19187 and PDB model 8RIG. Per-residue inclusion information can be found in section [3](#) on page [9](#).

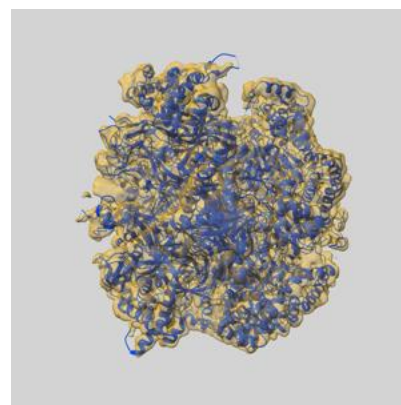
9.1 Map-model overlay [i](#)



X



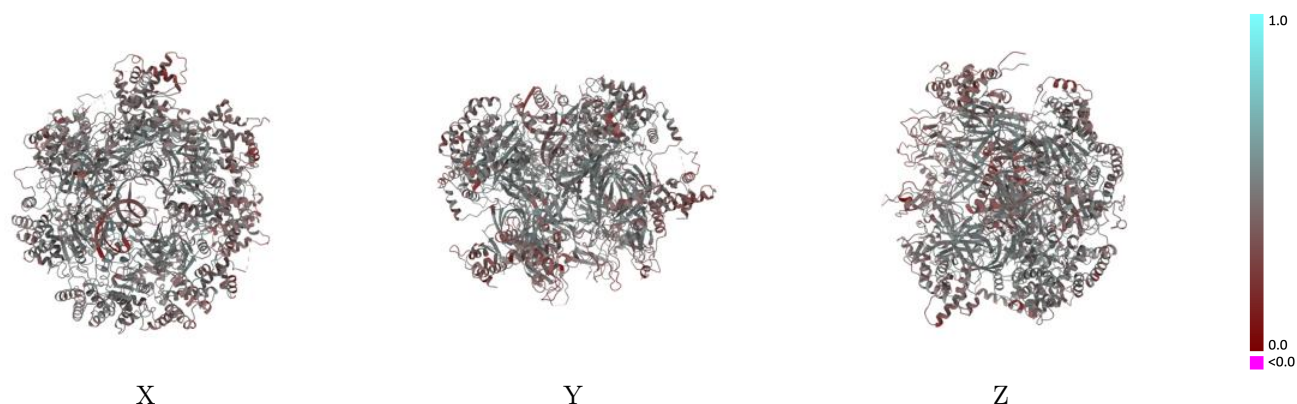
Y



Z

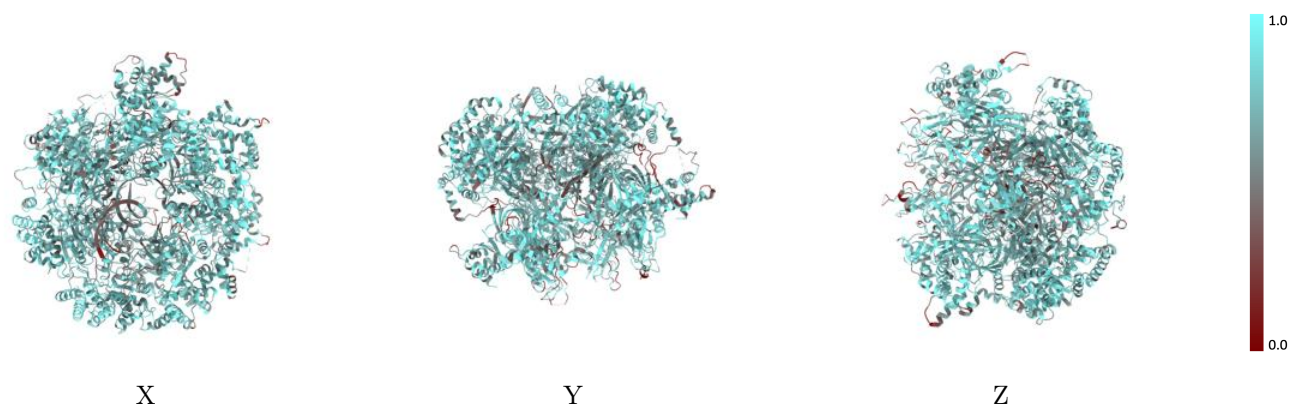
The images above show the 3D surface view of the map at the recommended contour level 0.011 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



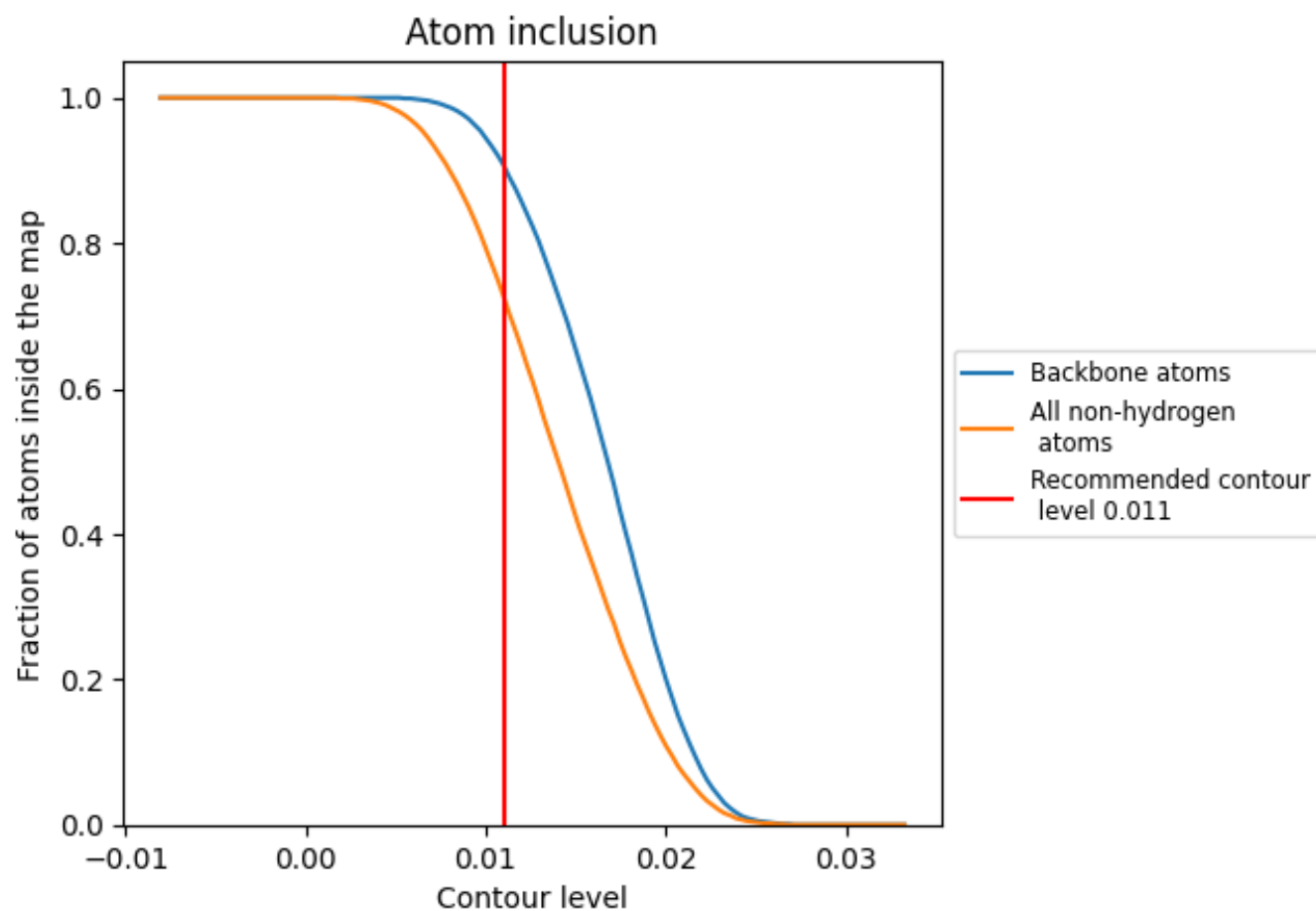
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.011).

9.4 Atom inclusion [i](#)



At the recommended contour level, 91% of all backbone atoms, 73% 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 (0.011) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.7260	0.4400
2	0.7230	0.4300
3	0.7680	0.4590
4	0.6950	0.4360
5	0.7430	0.4500
6	0.7350	0.4320
7	0.7340	0.4510
X	0.5080	0.3790
Y	0.4350	0.2850

1.0

0.0

<0.0