



Full wwPDB EM Validation Report ⓘ

Mar 9, 2026 – 07:21 PM UTC

PDB ID : 9GKK / pdb_00009gkk
EMDB ID : EMD-51422
Title : BetP heterotrimeric complex
Authors : Urbansky, K.; Fu, L.; Madej, M.G.; Ziegler, C.
Deposited on : 2024-08-25
Resolution : 3.04 Å(reported)
Based on initial model : 4C7R

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.dev132
Mogul : 2022.3.0, CSD as543be (2022)
MolProbity : 4-5-2 with Phenix2.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
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) : 2.49

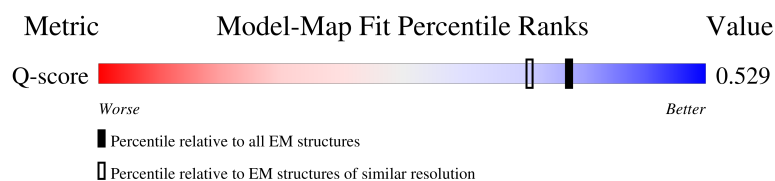
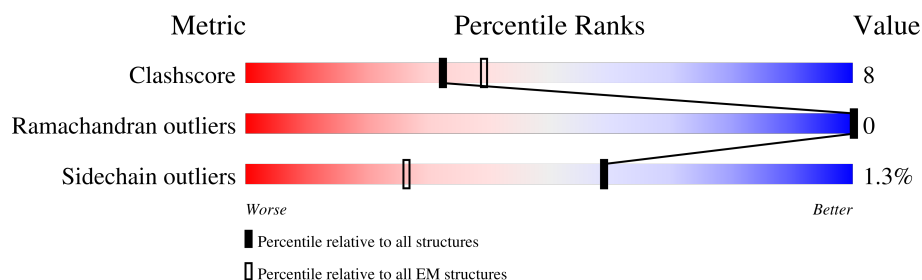
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.04 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	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	13952 (2.54 - 3.54)

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	A	603	 11% 72% 11% 16%
1	B	603	 11% 70% 13% 16%
1	C	603	 11% 74% 10% 16%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard

residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
5	CDL	A	604	-	-	X	-

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 11878 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 Glycine betaine transporter BetP.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	509	Total	C	N	O	S	0	0
			3857	2543	622	676	16		
1	B	509	Total	C	N	O	S	0	0
			3857	2543	622	676	16		
1	C	507	Total	C	N	O	S	0	0
			3858	2542	625	675	16		

There are 27 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-7	TRP	-	expression tag	UNP P54582
A	-6	SER	-	expression tag	UNP P54582
A	-5	HIS	-	expression tag	UNP P54582
A	-4	PRO	-	expression tag	UNP P54582
A	-3	GLN	-	expression tag	UNP P54582
A	-2	PHE	-	expression tag	UNP P54582
A	-1	GLU	-	expression tag	UNP P54582
A	0	LYS	-	expression tag	UNP P54582
A	584	CYS	ARG	engineered mutation	UNP P54582
B	-7	TRP	-	expression tag	UNP P54582
B	-6	SER	-	expression tag	UNP P54582
B	-5	HIS	-	expression tag	UNP P54582
B	-4	PRO	-	expression tag	UNP P54582
B	-3	GLN	-	expression tag	UNP P54582
B	-2	PHE	-	expression tag	UNP P54582
B	-1	GLU	-	expression tag	UNP P54582
B	0	LYS	-	expression tag	UNP P54582
B	584	CYS	ARG	engineered mutation	UNP P54582
C	-7	TRP	-	expression tag	UNP P54582
C	-6	SER	-	expression tag	UNP P54582
C	-5	HIS	-	expression tag	UNP P54582
C	-4	PRO	-	expression tag	UNP P54582
C	-3	GLN	-	expression tag	UNP P54582
C	-2	PHE	-	expression tag	UNP P54582

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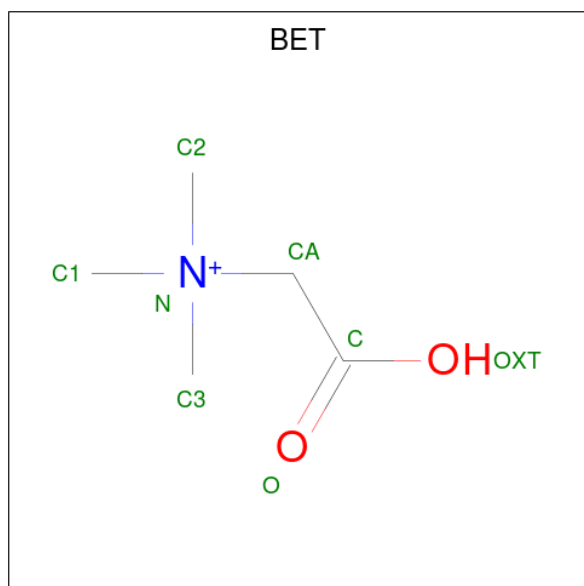
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Chain	Residue	Modelled	Actual	Comment	Reference
C	-1	GLU	-	expression tag	UNP P54582
C	0	LYS	-	expression tag	UNP P54582
C	584	CYS	ARG	engineered mutation	UNP P54582

- Molecule 2 is SODIUM ION (CCD ID: NA) (formula: Na).

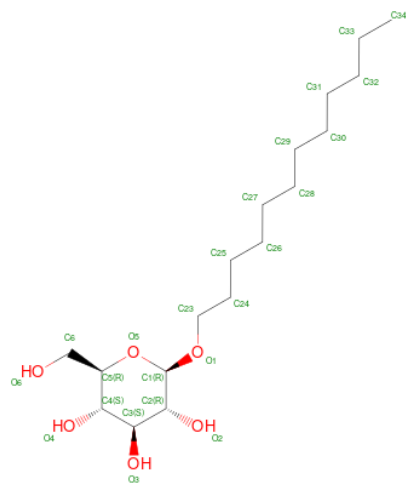
Mol	Chain	Residues	Atoms	AltConf
2	A	1	Total Na 1 1	0
2	B	1	Total Na 1 1	0
2	C	1	Total Na 1 1	0

- Molecule 3 is TRIMETHYL GLYCINE (CCD ID: BET) (formula: C₅H₁₂NO₂).



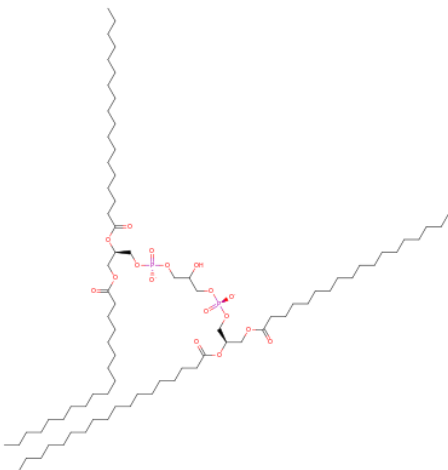
Mol	Chain	Residues	Atoms	AltConf
3	A	1	Total C N O 8 5 1 2	0
3	B	1	Total C N O 8 5 1 2	0
3	C	1	Total C N O 8 5 1 2	0

- Molecule 4 is dodecyl beta-D-glucopyranoside (CCD ID: XKJ) (formula: C₁₈H₃₆O₆).



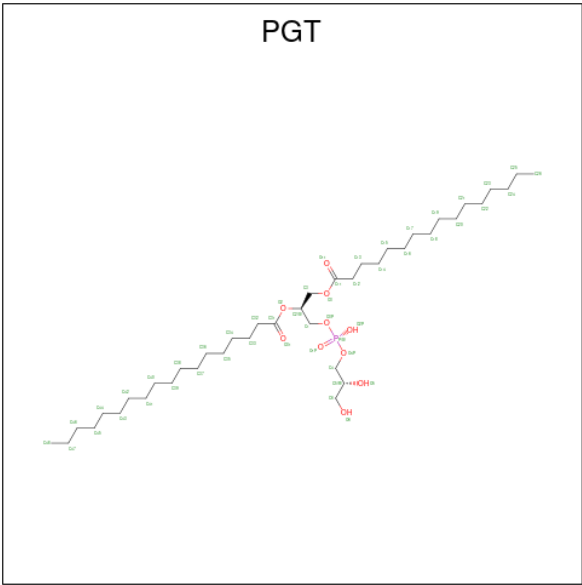
Mol	Chain	Residues	Atoms			AltConf
4	A	1	Total 24	C 18	O 6	0
4	C	1	Total 24	C 18	O 6	0

- Molecule 5 is CARDIOLIPIN (CCD ID: CDL) (formula: $\text{C}_{81}\text{H}_{156}\text{O}_{17}\text{P}_2$) (labeled as "Ligand of Interest" by depositor).



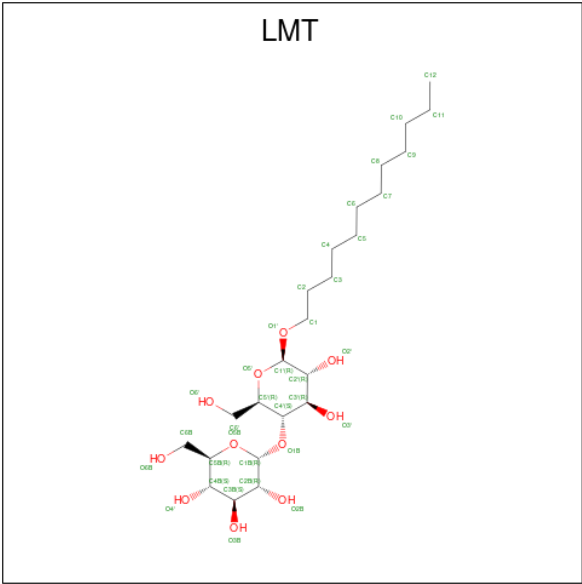
Mol	Chain	Residues	Atoms				AltConf
5	A	1	Total	C	O	P	0
			100	81	17	2	

- Molecule 6 is (1S)-2-{{[(2R)-2,3-DIHYDROXYPROPYL]OXY}(HYDROXY)PHOSPHORYL]OXY}-1-[(PALMITOYLOXY)METHYL]ETHYL STEARATE (CCD ID: PGT) (formula: C₄₀H₇₉O₁₀P).



Mol	Chain	Residues	Atoms				AltConf
6	B	1	Total	C	O	P	0
			44	33	10	1	
6	C	1	Total	C	O	P	0
			51	40	10	1	

- Molecule 7 is DODECYL-BETA-D-MALTOSIDE (CCD ID: LMT) (formula: C₂₄H₄₆O₁₁).



Mol	Chain	Residues	Atoms			AltConf
7	B	1	Total	C	O	0
			35	24	11	

- Molecule 8 is water.

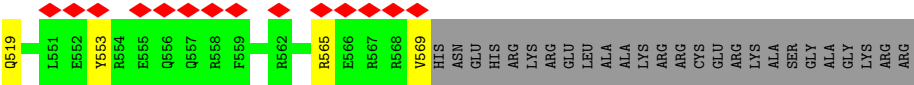
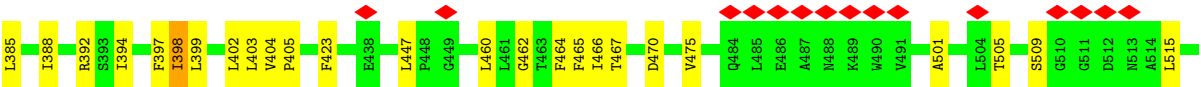
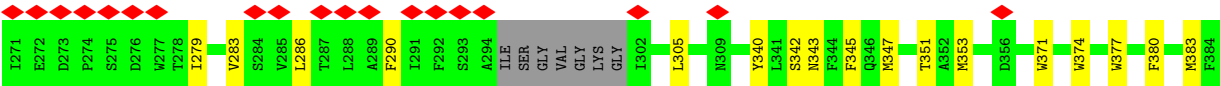
Mol	Chain	Residues	Atoms		AltConf
8	A	1	Total	O	0
			1	1	

ARG
ARG
VAL
HIS
ASN
GLU
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ARG
LYS
GLU
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ALA
ALA
LYS
ARG
ARG
CYS
GLU
ARG
LYS
ALA
ALA
SER
GLY
ALA
GLY
LYS
ARG
ARG

● Molecule 1: Glycine betaine transporter BetP



TRP
SER
HIS
PRO
GLN
PHE
GLU
LYS
MET
THR
THR
SER
ASP
PRO
ASN
PRO
PRO
LYS
PRO
TLE
VAL
GLU
ASP
ALA
ALA
GLN
PRO
GLU
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LYS
LEU
ALA
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GLU
GLU
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TLE
TLE
LEU
GLY
GLU



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	274359	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	JEOL CRYO ARM 200	Depositor
Voltage (kV)	200	Depositor
Electron dose ($e^-/\text{\AA}^2$)	53.5	Depositor
Minimum defocus (nm)	600	Depositor
Maximum defocus (nm)	1400	Depositor
Magnification	60000	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	2.315	Depositor
Minimum map value	-1.410	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.047	Depositor
Recommended contour level	0.18	Depositor
Map size (Å)	252.512, 252.512, 252.512	wwPDB
Map dimensions	320, 320, 320	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.7891, 0.7891, 0.7891	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: PGT, BET, LMT, XKJ, CDL, NA

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.55	0/3957	0.70	5/5396 (0.1%)
1	B	0.56	1/3957 (0.0%)	0.64	5/5396 (0.1%)
1	C	0.51	0/3957	0.61	3/5395 (0.1%)
All	All	0.54	1/11871 (0.0%)	0.65	13/16187 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	186	MET	C-O	-5.60	1.17	1.24

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	291	ILE	N-CA-C	-9.33	104.28	112.12
1	C	340	TYR	CA-C-O	-7.35	112.76	120.55
1	A	470	ASP	N-CA-C	-6.87	105.03	113.41
1	B	186	MET	CA-C-O	-6.38	114.07	120.90
1	B	345	PHE	N-CA-CB	5.88	118.85	110.67
1	A	464	PHE	CB-CA-C	5.51	119.54	110.88
1	B	345	PHE	N-CA-C	-5.47	106.97	113.97
1	C	345	PHE	CA-CB-CG	5.46	119.26	113.80
1	B	289	ALA	N-CA-C	-5.38	102.52	110.48
1	B	309	ASN	CB-CA-C	-5.29	102.58	110.88
1	A	289	ALA	N-CA-C	-5.29	102.66	110.48
1	C	340	TYR	CB-CA-C	-5.17	102.21	110.79
1	A	346	GLN	N-CA-C	-5.06	107.24	113.41

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	A	3857	0	3889	67	0
1	B	3857	0	3889	68	0
1	C	3858	0	3887	50	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
3	A	8	0	11	1	0
3	B	8	0	11	3	0
3	C	8	0	11	4	0
4	A	24	0	0	0	0
4	C	24	0	0	2	0
5	A	100	0	156	24	0
6	B	44	0	58	8	0
6	C	51	0	78	12	0
7	B	35	0	46	5	0
8	A	1	0	0	0	0
All	All	11878	0	12036	202	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 8.

All (202) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:142:ILE:HG21	1:C:404:VAL:HG11	1.49	0.93
1:C:462:GLY:HA2	1:C:465:PHE:CZ	2.03	0.92
1:B:186:MET:CG	6:B:603:PGT:C46	2.56	0.84
1:B:186:MET:SD	6:B:603:PGT:C46	2.69	0.80
1:C:286:LEU:HD11	1:C:465:PHE:CE2	2.17	0.79
1:B:186:MET:HG3	6:B:603:PGT:C46	2.13	0.78
1:A:260:GLN:HG2	1:A:461:LEU:HD11	1.63	0.78
1:A:398:ILE:O	1:A:398:ILE:HG22	1.85	0.76
1:A:290:PHE:CE1	1:A:469:ALA:O	2.42	0.73
1:A:398:ILE:O	1:A:398:ILE:CG2	2.38	0.71
1:A:126:ARG:HH12	1:B:557:GLN:NE2	1.89	0.71

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:374:TRP:CD2	3:C:603:BET:H13	2.26	0.71
1:A:294:ALA:HB2	1:A:470:ASP:OD1	1.94	0.68
1:B:152:ILE:HD11	1:B:465:PHE:HB2	1.76	0.68
1:B:501:ALA:O	1:B:505:THR:HG23	1.96	0.65
1:A:343:ASN:N	1:A:343:ASN:OD1	2.31	0.64
1:A:152:ILE:O	1:A:152:ILE:HG22	1.97	0.63
1:A:290:PHE:CD1	1:A:469:ALA:O	2.52	0.63
1:B:58:LEU:HD21	1:B:491:VAL:HG21	1.79	0.63
1:A:126:ARG:HH12	1:B:557:GLN:HE22	1.44	0.63
1:C:152:ILE:HD11	1:C:465:PHE:HD1	1.62	0.63
1:A:309:ASN:ND2	1:A:467:THR:HG21	2.13	0.62
5:A:604:CDL:H112	5:A:604:CDL:H711	1.81	0.62
1:B:59:ASN:O	1:B:60:TRP:HB2	2.00	0.62
1:C:142:ILE:CG2	1:C:404:VAL:HG11	2.29	0.61
1:A:202:LEU:HD22	1:A:398:ILE:HD11	1.81	0.61
1:A:142:ILE:HG21	1:A:404:VAL:HG11	1.82	0.60
1:B:186:MET:HB3	6:B:603:PGT:C46	2.32	0.60
6:C:602:PGT:H412	6:C:602:PGT:H452	1.81	0.60
1:B:142:ILE:HG21	1:B:404:VAL:HG11	1.84	0.60
3:B:602:BET:H22	3:B:602:BET:O	2.02	0.59
5:A:604:CDL:H602	6:C:602:PGT:H191	1.84	0.58
1:A:501:ALA:O	1:A:505:THR:HG23	2.04	0.58
1:B:343:ASN:N	1:B:343:ASN:OD1	2.36	0.58
1:C:279:ILE:O	1:C:283:VAL:HG23	2.05	0.57
1:A:59:ASN:O	1:A:60:TRP:HB2	2.04	0.57
1:A:399:LEU:HD21	5:A:604:CDL:H761	1.87	0.56
1:C:286:LEU:HD21	1:C:465:PHE:HE2	1.69	0.56
1:B:225:ILE:HG21	1:B:234:LEU:HD23	1.86	0.56
1:B:389:SER:HG	1:B:397:PHE:HE1	1.54	0.56
1:B:126:ARG:NH2	1:C:553:TYR:OH	2.39	0.56
1:C:501:ALA:O	1:C:505:THR:HG23	2.05	0.56
1:A:335:GLY:O	1:A:339:ASN:OD1	2.23	0.55
5:A:604:CDL:H372	5:A:604:CDL:H322	1.88	0.55
1:C:152:ILE:HG22	1:C:152:ILE:O	2.05	0.55
1:A:290:PHE:CD1	1:A:290:PHE:O	2.60	0.55
5:A:604:CDL:H742	5:A:604:CDL:H531	1.87	0.55
1:B:290:PHE:CD1	1:B:469:ALA:HB1	2.42	0.55
1:A:332:LEU:CD1	1:B:353:MET:SD	2.95	0.55
1:B:58:LEU:HD22	1:B:63:ILE:CD1	2.37	0.54
1:B:211:VAL:HG11	1:B:213:ARG:HH21	1.70	0.54
1:A:127:LEU:HD21	1:A:394:ILE:HG12	1.88	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:388:ILE:HG22	1:C:388:ILE:O	2.08	0.54
1:B:389:SER:OG	1:B:397:PHE:HE1	1.90	0.54
1:B:389:SER:OG	1:B:397:PHE:CE1	2.61	0.54
5:A:604:CDL:H202	1:B:112:PHE:CD1	2.43	0.54
1:B:112:PHE:CD2	7:B:604:LMT:H62	2.42	0.54
1:C:377:TRP:CD2	3:C:603:BET:H21	2.43	0.53
1:B:152:ILE:HG22	1:B:152:ILE:O	2.09	0.53
5:A:604:CDL:H711	5:A:604:CDL:C11	2.39	0.53
1:A:58:LEU:H	1:A:58:LEU:HD23	1.73	0.53
1:B:433:ASP:N	1:B:433:ASP:OD1	2.41	0.53
1:C:565:ARG:O	1:C:569:VAL:HG23	2.09	0.53
1:B:58:LEU:HD22	1:B:63:ILE:HD11	1.91	0.52
5:A:604:CDL:H322	5:A:604:CDL:C37	2.40	0.52
1:C:377:TRP:CG	3:C:603:BET:H21	2.44	0.52
1:A:395:ARG:CZ	5:A:604:CDL:OB9	2.58	0.52
1:B:112:PHE:HD2	7:B:604:LMT:H62	1.75	0.51
1:B:127:LEU:HD21	1:B:394:ILE:HG12	1.92	0.51
5:A:604:CDL:H192	6:B:603:PGT:C15	2.39	0.51
1:A:295:ILE:O	1:A:296:SER:C	2.52	0.51
5:A:604:CDL:H572	6:C:602:PGT:H161	1.92	0.51
5:A:604:CDL:H631	5:A:604:CDL:H591	1.93	0.51
1:B:380:PHE:C	1:B:380:PHE:CD1	2.88	0.51
1:A:145:MET:HE1	1:A:400:GLY:O	2.11	0.51
5:A:604:CDL:H372	5:A:604:CDL:C32	2.41	0.51
1:C:460:LEU:HG	1:C:464:PHE:CE2	2.45	0.51
1:C:404:VAL:HB	1:C:405:PRO:HD3	1.93	0.51
1:B:59:ASN:OD1	1:B:62:VAL:HG23	2.11	0.51
1:A:260:GLN:HG2	1:A:461:LEU:CD1	2.38	0.50
1:B:186:MET:CB	6:B:603:PGT:C46	2.89	0.50
1:B:225:ILE:HD12	1:B:229:GLY:C	2.37	0.50
1:A:125:ILE:HB	1:A:394:ILE:HD12	1.94	0.50
1:A:309:ASN:HD22	1:A:467:THR:HG21	1.77	0.50
1:B:332:LEU:HG	1:C:353:MET:SD	2.52	0.50
1:C:399:LEU:HG	4:C:604:XKJ:O3	2.11	0.50
1:C:114:ILE:HG23	1:C:398:ILE:HG23	1.92	0.49
1:B:506:LEU:HD23	1:B:518:LEU:HD23	1.94	0.49
1:B:380:PHE:HA	1:B:475:VAL:HG11	1.95	0.49
1:C:145:MET:HG2	1:C:385:LEU:HD22	1.94	0.49
1:A:374:TRP:CH2	3:A:602:BET:H21	2.48	0.49
1:A:78:ILE:HD11	1:A:505:THR:HG22	1.95	0.49
6:B:603:PGT:C31	6:B:603:PGT:O3	2.61	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:202:LEU:HD22	1:C:398:ILE:HD11	1.95	0.49
5:A:604:CDL:H192	6:B:603:PGT:H152	1.95	0.48
1:B:112:PHE:HD2	7:B:604:LMT:C6	2.26	0.48
1:A:60:TRP:HA	1:A:60:TRP:CE3	2.49	0.48
1:A:395:ARG:NE	5:A:604:CDL:OB9	2.46	0.48
1:B:424:GLU:OE1	1:B:429:SER:OG	2.30	0.48
5:A:604:CDL:H822	5:A:604:CDL:H351	1.95	0.48
1:C:152:ILE:HD11	1:C:465:PHE:CD1	2.46	0.48
1:B:154:LEU:CD2	1:B:413:PHE:CE2	2.97	0.48
1:C:462:GLY:O	1:C:466:ILE:HG13	2.14	0.48
1:C:423:PHE:HZ	1:C:447:LEU:HD21	1.79	0.48
1:A:112:PHE:CD1	6:C:602:PGT:H201	2.49	0.47
1:A:355:ALA:O	1:A:358:THR:HG22	2.15	0.47
1:C:343:ASN:O	1:C:347:MET:HE2	2.13	0.47
1:B:150:MET:SD	1:B:154:LEU:HG	2.55	0.47
1:C:114:ILE:CG2	1:C:398:ILE:HG23	2.44	0.47
1:C:191:LEU:HD22	1:C:402:LEU:HG	1.97	0.47
1:C:380:PHE:HA	1:C:475:VAL:HG11	1.96	0.47
1:B:493:ALA:O	1:B:497:VAL:HG23	2.15	0.47
6:C:602:PGT:H483	6:C:602:PGT:H441	1.96	0.47
1:A:332:LEU:HD12	1:B:353:MET:SD	2.56	0.46
1:A:145:MET:SD	1:A:401:VAL:HG22	2.55	0.46
1:C:74:VAL:HG13	1:C:505:THR:HG21	1.97	0.46
1:C:505:THR:O	1:C:509:SER:OG	2.25	0.46
1:C:192:HIS:N	1:C:193:PRO:HD2	2.31	0.46
1:B:374:TRP:CE2	3:B:602:BET:H13	2.51	0.46
1:A:222:VAL:N	1:A:223:PRO:CD	2.79	0.46
7:B:604:LMT:C1	7:B:604:LMT:O2'	2.64	0.46
1:C:127:LEU:HD21	1:C:394:ILE:CD1	2.46	0.46
1:C:398:ILE:HD13	1:C:398:ILE:N	2.31	0.46
1:B:290:PHE:CD1	1:B:290:PHE:O	2.68	0.46
1:B:351:THR:OG1	1:B:352:ALA:N	2.48	0.46
1:A:100:GLY:O	1:A:104:ILE:HD13	2.16	0.46
5:A:604:CDL:H391	7:B:604:LMT:H32	1.97	0.46
1:C:114:ILE:HG23	1:C:398:ILE:CG2	2.46	0.46
1:A:287:THR:HG21	1:A:500:ALA:HB2	1.98	0.45
1:C:380:PHE:C	1:C:380:PHE:CD1	2.94	0.45
1:A:133:ALA:HB1	1:B:561:ALA:HA	1.98	0.45
1:A:159:THR:HG23	1:A:420:ALA:HB2	1.97	0.45
1:B:287:THR:HG22	1:B:291:ILE:HD12	1.99	0.45
1:C:191:LEU:HD21	6:C:602:PGT:H422	1.99	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:123:GLY:O	1:B:393:SER:OG	2.34	0.45
1:A:290:PHE:HA	1:A:293:SER:OG	2.17	0.45
1:A:291:ILE:O	1:A:295:ILE:HG12	2.17	0.45
1:B:152:ILE:HG23	1:B:461:LEU:CD2	2.46	0.45
1:A:192:HIS:N	1:A:193:PRO:HD2	2.32	0.45
1:A:289:ALA:O	1:A:290:PHE:HB3	2.17	0.45
1:A:351:THR:OG1	1:A:352:ALA:N	2.50	0.45
1:A:124:THR:O	1:A:125:ILE:C	2.60	0.45
1:A:206:TYR:CE2	1:A:544:LEU:HD23	2.52	0.45
1:B:180:VAL:O	1:B:184:THR:HG22	2.17	0.45
1:B:302:ILE:HD13	1:B:470:ASP:OD2	2.17	0.45
1:A:130:ILE:H	1:A:130:ILE:HD12	1.80	0.45
1:B:192:HIS:N	1:B:193:PRO:HD2	2.33	0.44
1:B:332:LEU:HD21	1:C:353:MET:SD	2.57	0.44
1:C:222:VAL:N	1:C:223:PRO:HD2	2.33	0.44
1:A:337:ILE:HD13	5:A:604:CDL:C47	2.47	0.44
5:A:604:CDL:H621	5:A:604:CDL:H671	1.98	0.44
1:C:515:LEU:O	1:C:519:GLN:HG3	2.17	0.44
1:C:374:TRP:CE2	3:C:603:BET:H13	2.52	0.44
1:C:403:LEU:HD21	4:C:604:XKJ:O2	2.18	0.44
5:A:604:CDL:H601	6:C:602:PGT:H222	2.00	0.43
6:C:602:PGT:O31	6:C:602:PGT:C1	2.65	0.43
1:A:58:LEU:H	1:A:58:LEU:CD2	2.31	0.43
5:A:604:CDL:H622	5:A:604:CDL:H672	2.00	0.43
1:B:182:MET:O	1:B:186:MET:HG2	2.19	0.43
1:A:57:SER:OG	1:A:58:LEU:HD23	2.18	0.43
1:A:64:VAL:O	1:A:68:VAL:HG23	2.19	0.43
1:A:392:ARG:HH11	1:A:392:ARG:HG2	1.83	0.43
1:B:206:TYR:CE2	1:B:544:LEU:HD23	2.53	0.43
1:A:202:LEU:CD2	1:A:398:ILE:HD11	2.46	0.43
1:B:374:TRP:CE2	3:B:602:BET:C1	3.02	0.43
1:C:397:PHE:HD2	1:C:398:ILE:HD13	1.84	0.43
5:A:604:CDL:H561	6:C:602:PGT:H152	2.00	0.43
1:C:125:ILE:HG22	1:C:126:ARG:N	2.33	0.43
1:C:290:PHE:CE1	1:C:470:ASP:HA	2.54	0.43
1:C:152:ILE:N	1:C:152:ILE:HD12	2.34	0.43
1:B:161:GLU:OE1	1:B:189:TRP:NE1	2.47	0.42
1:A:465:PHE:O	1:A:466:ILE:C	2.62	0.42
1:A:119:ALA:HB1	5:A:604:CDL:H522	2.01	0.42
5:A:604:CDL:H661	6:C:602:PGT:H381	2.00	0.42
1:B:136:PHE:O	1:B:392:ARG:NH2	2.51	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:58:LEU:HD11	1:A:60:TRP:CZ2	2.54	0.42
1:B:387:ARG:HH22	1:B:478:THR:HG21	1.84	0.42
1:C:92:LEU:HD22	1:C:96:VAL:HG23	2.02	0.42
1:A:152:ILE:HG23	1:A:461:LEU:HD23	2.01	0.42
6:C:602:PGT:H332	6:C:602:PGT:H32	2.02	0.42
1:B:334:PRO:HG2	1:C:351:THR:HG21	2.01	0.41
1:B:474:THR:O	1:B:478:THR:HG23	2.19	0.41
1:A:118:ALA:HB2	1:A:398:ILE:HG21	2.03	0.41
1:A:397:PHE:O	1:A:401:VAL:HG23	2.19	0.41
1:C:136:PHE:O	1:C:392:ARG:NH2	2.53	0.41
1:A:222:VAL:N	1:A:223:PRO:HD2	2.36	0.41
1:A:283:VAL:O	1:A:287:THR:HG23	2.20	0.41
1:A:296:SER:OG	1:A:298:VAL:HG23	2.21	0.41
1:A:471:SER:O	1:A:475:VAL:HG23	2.20	0.41
1:B:510:GLY:O	1:B:514:ALA:N	2.54	0.41
1:A:142:ILE:CG2	1:A:404:VAL:HG11	2.47	0.41
1:B:265:LEU:N	1:B:458:MET:HE1	2.36	0.41
1:B:152:ILE:HG23	1:B:461:LEU:HD23	2.03	0.40
1:B:404:VAL:HB	1:B:405:PRO:HD3	2.03	0.40
1:B:129:ARG:O	1:B:130:ILE:C	2.62	0.40
1:B:202:LEU:HD22	1:B:398:ILE:HD11	2.03	0.40
1:C:466:ILE:O	1:C:466:ILE:HG22	2.21	0.40
1:A:346:GLN:O	1:A:346:GLN:HG2	2.21	0.40
1:B:92:LEU:HD22	1:B:96:VAL:HG23	2.03	0.40
6:C:602:PGT:H32	6:C:602:PGT:H122	1.88	0.40
1:A:130:ILE:HD12	1:A:130:ILE:N	2.36	0.40
1:B:112:PHE:CZ	1:B:345:PHE:HE1	2.40	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	507/603 (84%)	485 (96%)	22 (4%)	0	100	100
1	B	507/603 (84%)	488 (96%)	19 (4%)	0	100	100
1	C	503/603 (83%)	490 (97%)	13 (3%)	0	100	100
All	All	1517/1809 (84%)	1463 (96%)	54 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	A	396/475 (83%)	391 (99%)	5 (1%)	61	79
1	B	396/475 (83%)	391 (99%)	5 (1%)	61	79
1	C	396/475 (83%)	390 (98%)	6 (2%)	57	77
All	All	1188/1425 (83%)	1172 (99%)	16 (1%)	59	79

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	290	PHE
1	A	343	ASN
1	A	371	TRP
1	A	392	ARG
1	A	464	PHE
1	B	108	THR
1	B	150	MET
1	B	290	PHE
1	B	343	ASN
1	B	371	TRP
1	C	305	LEU
1	C	342	SER
1	C	371	TRP
1	C	383	MET
1	C	398	ILE

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Mol	Chain	Res	Type
1	C	467	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	173	HIS
1	A	307	ASN
1	A	557	GLN
1	B	215	GLN
1	B	260	GLN
1	B	439	GLN
1	B	557	GLN
1	C	192	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 12 ligands modelled in this entry, 3 are monoatomic - leaving 9 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
3	BET	B	602	-	7,7,7	1.02	1 (14%)	10,10,10	0.72	0
3	BET	A	602	-	7,7,7	0.81	0	10,10,10	1.10	1 (10%)
6	PGT	B	603	-	43,43,50	0.29	0	46,49,56	0.41	0
6	PGT	C	602	-	50,50,50	0.31	0	53,56,56	0.58	1 (1%)
7	LMT	B	604	-	36,36,36	0.23	0	47,47,47	0.72	1 (2%)
4	XKJ	C	604	-	24,24,24	0.23	0	29,29,29	0.46	0
5	CDL	A	604	-	99,99,99	0.32	0	105,111,111	0.42	0
3	BET	C	603	-	7,7,7	0.75	0	10,10,10	0.45	0
4	XKJ	A	603	-	24,24,24	0.23	0	29,29,29	0.49	0

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
3	BET	B	602	-	-	3/5/5/5	-
3	BET	A	602	-	-	0/5/5/5	-
6	PGT	B	603	-	-	24/48/48/55	-
6	PGT	C	602	-	-	18/55/55/55	-
7	LMT	B	604	-	-	5/21/61/61	0/2/2/2
4	XKJ	C	604	-	-	0/15/35/35	0/1/1/1
5	CDL	A	604	-	-	38/110/110/110	-
3	BET	C	603	-	-	2/5/5/5	-
4	XKJ	A	603	-	-	0/15/35/35	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	602	BET	OXT-C	-2.59	1.22	1.30

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	602	BET	C-CA-N	2.81	120.10	116.31
7	B	604	LMT	O1'-C1'-C2'	2.40	111.91	108.27
6	C	602	PGT	O2-C31-C32	-2.27	106.57	111.48

There are no chirality outliers.

All (90) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	602	BET	C-CA-N-C1
3	C	603	BET	O-C-CA-N
3	C	603	BET	OXT-C-CA-N
5	A	604	CDL	CA2-OA2-PA1-OA4
5	A	604	CDL	C11-CA5-OA6-CA4
5	A	604	CDL	C1-CB2-OB2-PB2
6	B	603	PGT	C2-C1-O3P-P
6	B	603	PGT	C1-O3P-P-O1P
6	B	603	PGT	C1-O3P-P-O4P
6	B	603	PGT	C4-O4P-P-O3P
6	B	603	PGT	C4-O4P-P-O1P
6	B	603	PGT	C5-C4-O4P-P
6	B	603	PGT	O4P-C4-C5-O5
6	B	603	PGT	O4P-C4-C5-C6
6	C	602	PGT	C4-O4P-P-O1P
7	B	604	LMT	O5'-C1'-O1'-C1
6	C	602	PGT	O11-C11-O3-C3
6	C	602	PGT	C12-C11-O3-C3
5	A	604	CDL	OB9-CB7-OB8-CB6
5	A	604	CDL	C71-CB7-OB8-CB6
5	A	604	CDL	O1-C1-CB2-OB2
5	A	604	CDL	C51-CB5-OB6-CB4
3	B	602	BET	C-CA-N-C3
5	A	604	CDL	CA2-C1-CB2-OB2
3	B	602	BET	C-CA-N-C2
5	A	604	CDL	OA7-CA5-OA6-CA4
7	B	604	LMT	C5'-C4'-O1B-C1B
5	A	604	CDL	C31-CA7-OA8-CA6
6	B	603	PGT	C32-C31-O2-C2
7	B	604	LMT	C3'-C4'-O1B-C1B
6	B	603	PGT	C35-C36-C37-C38
5	A	604	CDL	C56-C57-C58-C59
5	A	604	CDL	C42-C43-C44-C45
5	A	604	CDL	C63-C64-C65-C66
5	A	604	CDL	OB7-CB5-OB6-CB4
6	B	603	PGT	O31-C31-O2-C2
5	A	604	CDL	C33-C34-C35-C36
6	C	602	PGT	C22-C23-C24-C25
6	C	602	PGT	C32-C31-O2-C2
6	C	602	PGT	O31-C31-O2-C2
6	B	603	PGT	C11-C12-C13-C14
6	C	602	PGT	C37-C38-C39-C40

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Mol	Chain	Res	Type	Atoms
5	A	604	CDL	C80-C81-C82-C83
5	A	604	CDL	C15-C16-C17-C18
7	B	604	LMT	O5'-C5'-C6'-O6'
6	B	603	PGT	C38-C39-C40-C41
6	C	602	PGT	C1-C2-C3-O3
5	A	604	CDL	C19-C20-C21-C22
5	A	604	CDL	OA9-CA7-OA8-CA6
6	C	602	PGT	C1-C2-O2-C31
5	A	604	CDL	OB5-CB3-CB4-CB6
6	B	603	PGT	O3P-C1-C2-C3
5	A	604	CDL	C11-C12-C13-C14
5	A	604	CDL	C32-C33-C34-C35
5	A	604	CDL	OB5-CB3-CB4-OB6
6	C	602	PGT	C41-C42-C43-C44
5	A	604	CDL	OA6-CA4-CA6-OA8
6	B	603	PGT	C31-C32-C33-C34
5	A	604	CDL	C79-C80-C81-C82
5	A	604	CDL	C81-C82-C83-C84
7	B	604	LMT	C2'-C1'-O1'-C1
6	B	603	PGT	C40-C41-C42-C43
5	A	604	CDL	C59-C60-C61-C62
6	B	603	PGT	O3P-C1-C2-O2
5	A	604	CDL	C73-C74-C75-C76
6	B	603	PGT	C18-C19-C20-C21
6	C	602	PGT	O2-C2-C3-O3
5	A	604	CDL	C40-C41-C42-C43
5	A	604	CDL	CA2-OA2-PA1-OA3
5	A	604	CDL	CA2-OA2-PA1-OA5
5	A	604	CDL	CB2-OB2-PB2-OB3
5	A	604	CDL	CB3-OB5-PB2-OB3
6	B	603	PGT	C1-O3P-P-O2P
6	B	603	PGT	C4-O4P-P-O2P
6	C	602	PGT	C44-C45-C46-C47
5	A	604	CDL	CB4-CB3-OB5-PB2
5	A	604	CDL	CA3-CA4-OA6-CA5
5	A	604	CDL	C39-C40-C41-C42
6	C	602	PGT	C14-C15-C16-C17
5	A	604	CDL	C13-C14-C15-C16
6	C	602	PGT	C15-C16-C17-C18
6	B	603	PGT	C1-C2-O2-C31
6	B	603	PGT	C3-C2-O2-C31
6	C	602	PGT	C5-C4-O4P-P

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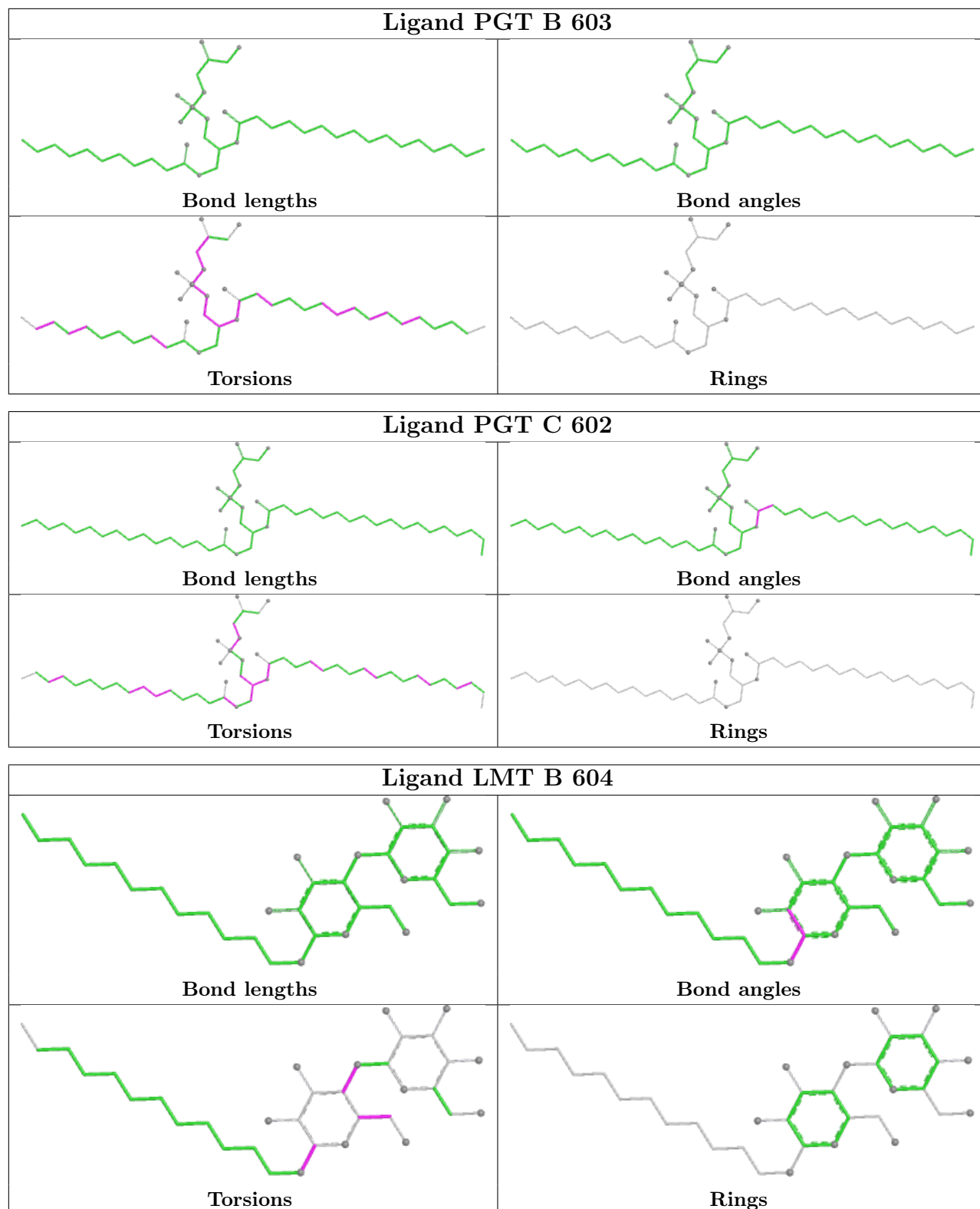
Mol	Chain	Res	Type	Atoms
6	C	602	PGT	C33-C34-C35-C36
6	B	603	PGT	C16-C17-C18-C19
6	C	602	PGT	O3P-C1-C2-C3
6	B	603	PGT	C36-C37-C38-C39
6	C	602	PGT	C16-C17-C18-C19
5	A	604	CDL	C76-C77-C78-C79

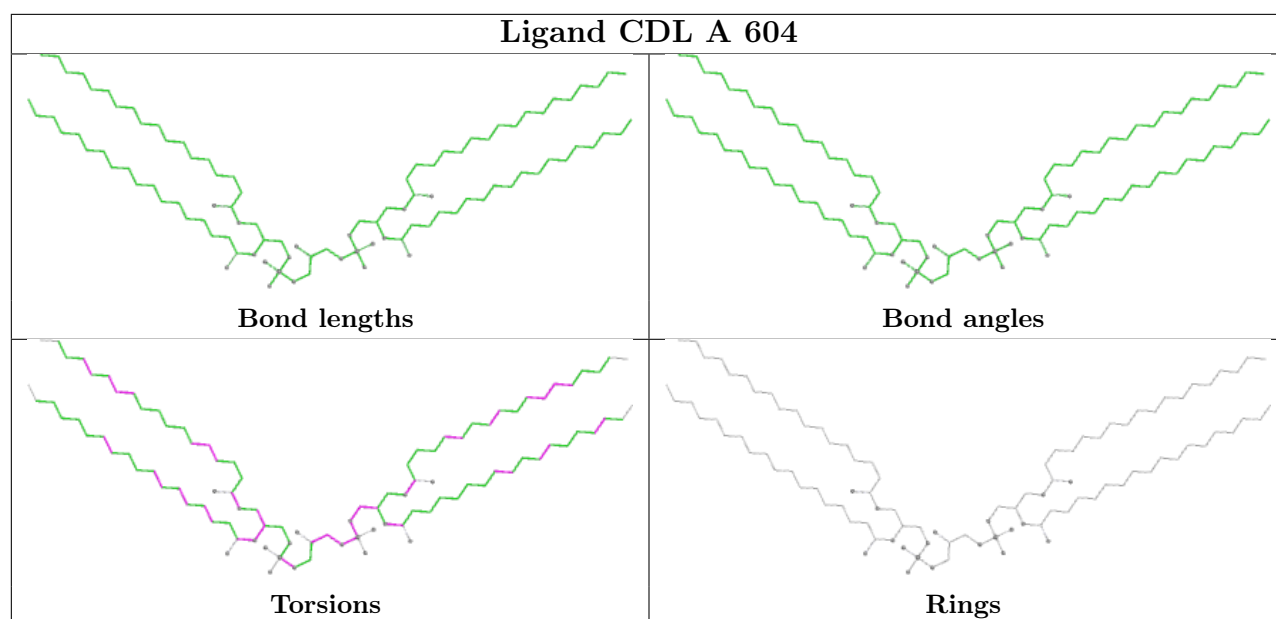
There are no ring outliers.

8 monomers are involved in 51 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	602	BET	3	0
3	A	602	BET	1	0
6	B	603	PGT	8	0
6	C	602	PGT	12	0
7	B	604	LMT	5	0
4	C	604	XKJ	2	0
5	A	604	CDL	24	0
3	C	603	BET	4	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 [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

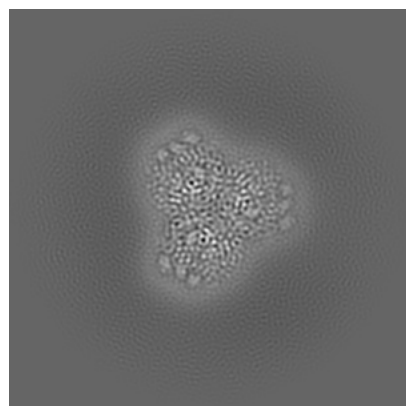
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-51422. These allow visual inspection of the internal detail of the map and identification of artifacts.

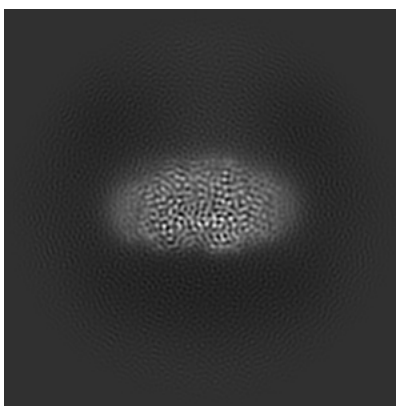
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

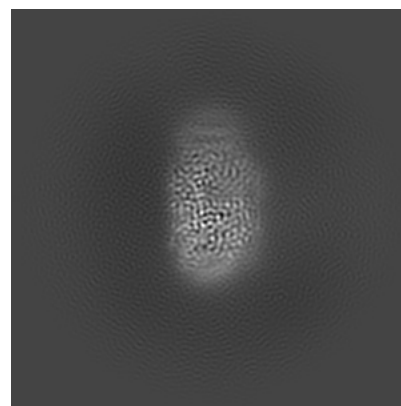
6.1.1 Primary map



X

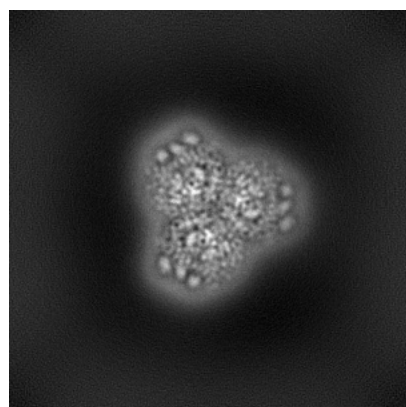


Y

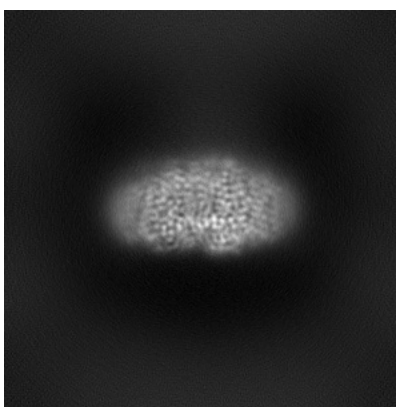


Z

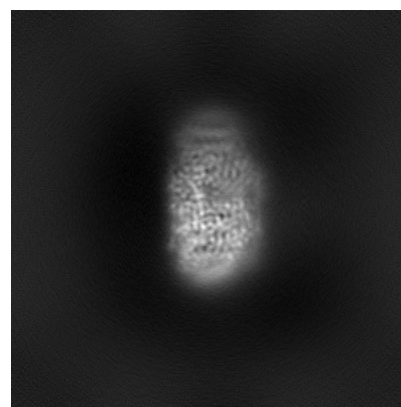
6.1.2 Raw map



X



Y

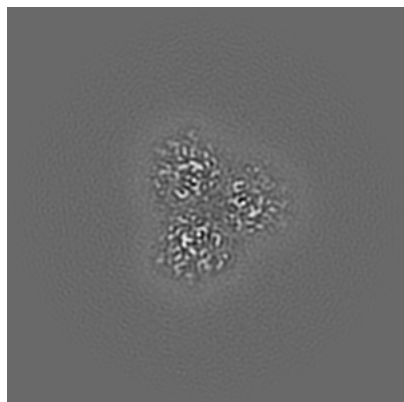


Z

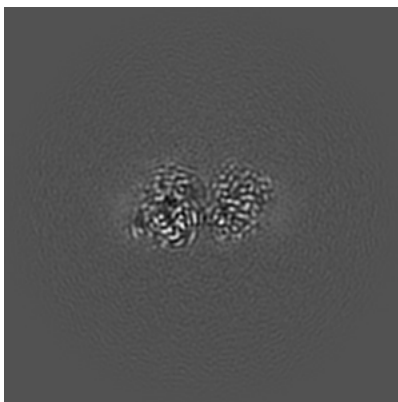
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

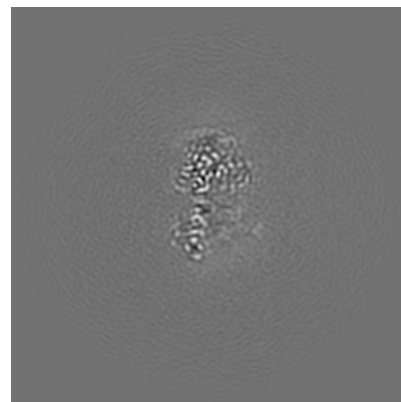
6.2.1 Primary map



X Index: 160

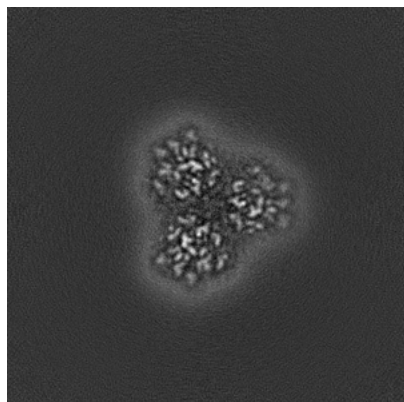


Y Index: 160

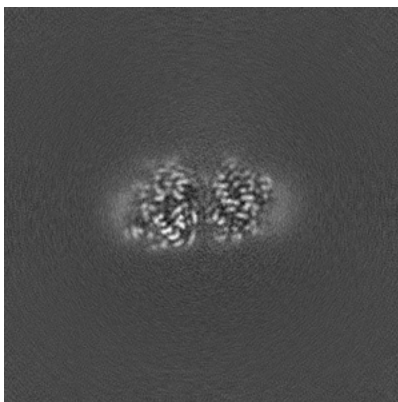


Z Index: 160

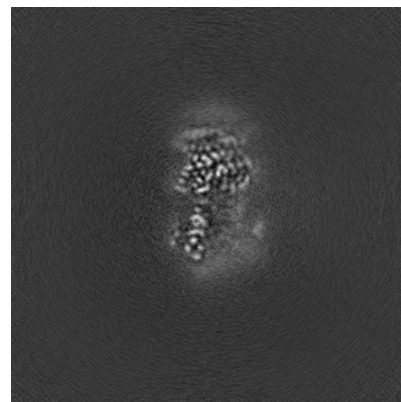
6.2.2 Raw map



X Index: 160



Y Index: 160

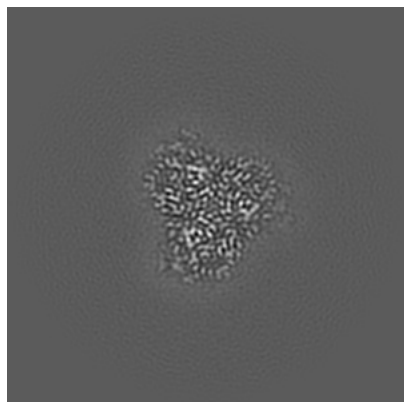


Z Index: 160

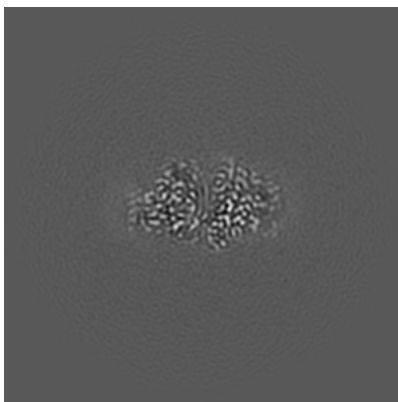
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

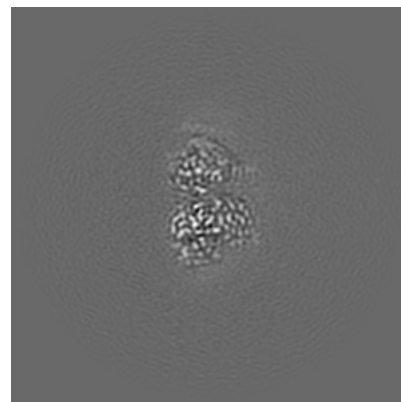
6.3.1 Primary map



X Index: 147

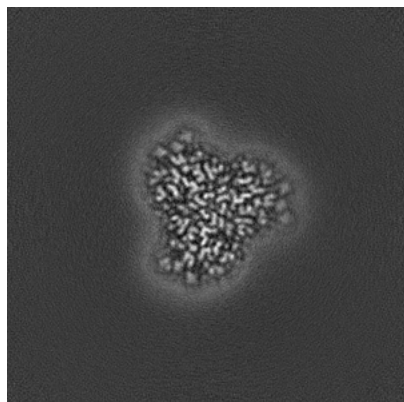


Y Index: 149

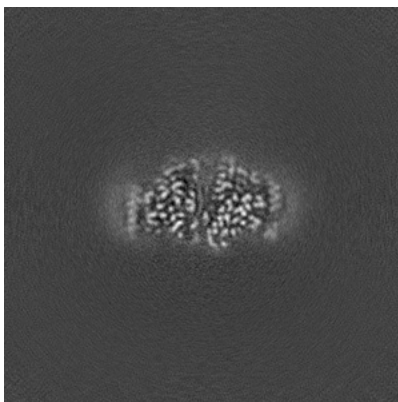


Z Index: 174

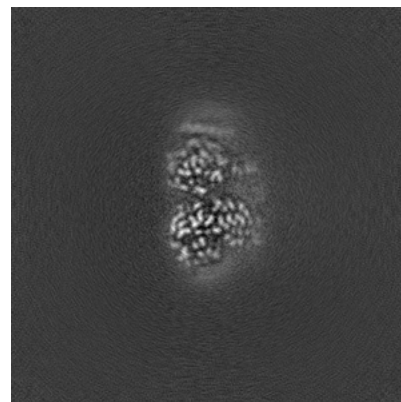
6.3.2 Raw map



X Index: 152



Y Index: 148

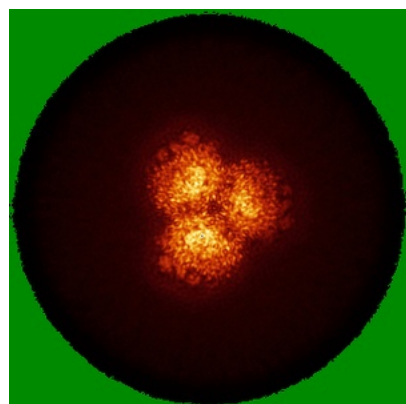


Z Index: 174

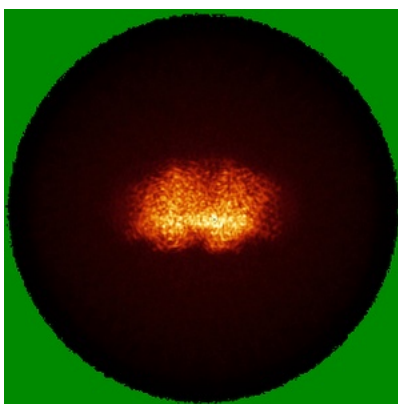
The images above show the largest variance slices of the map in three orthogonal directions.

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

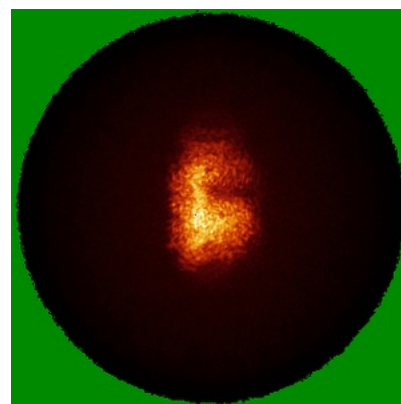
6.4.1 Primary map



X

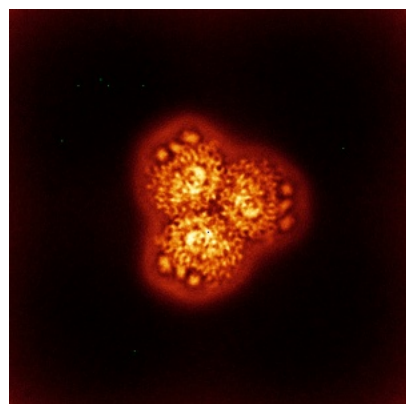


Y

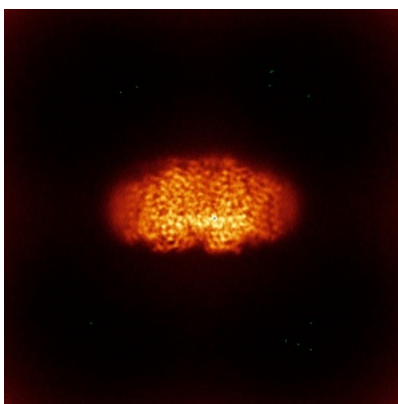


Z

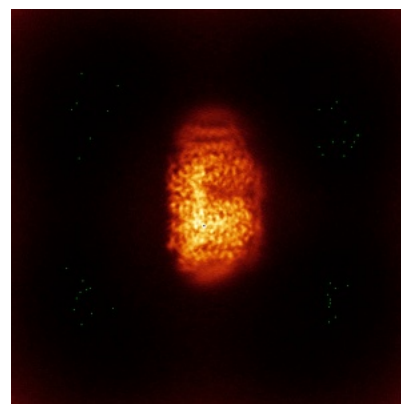
6.4.2 Raw map



X



Y

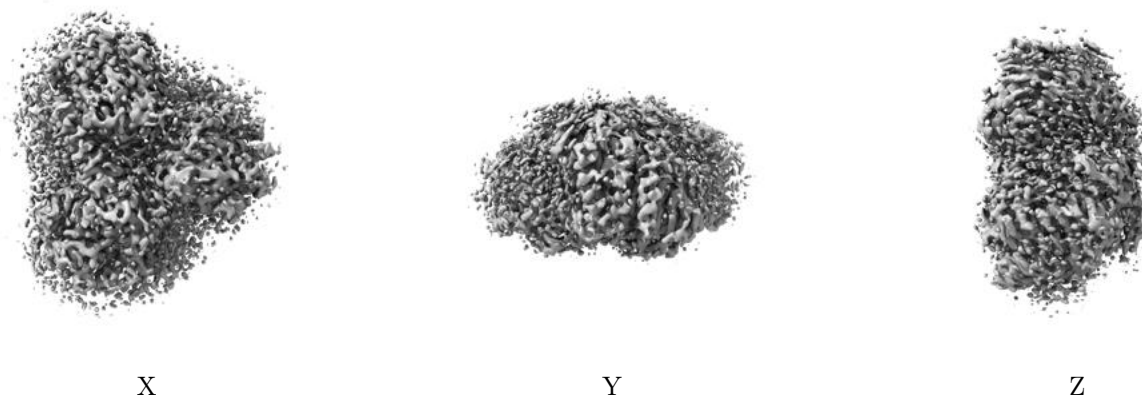


Z

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.

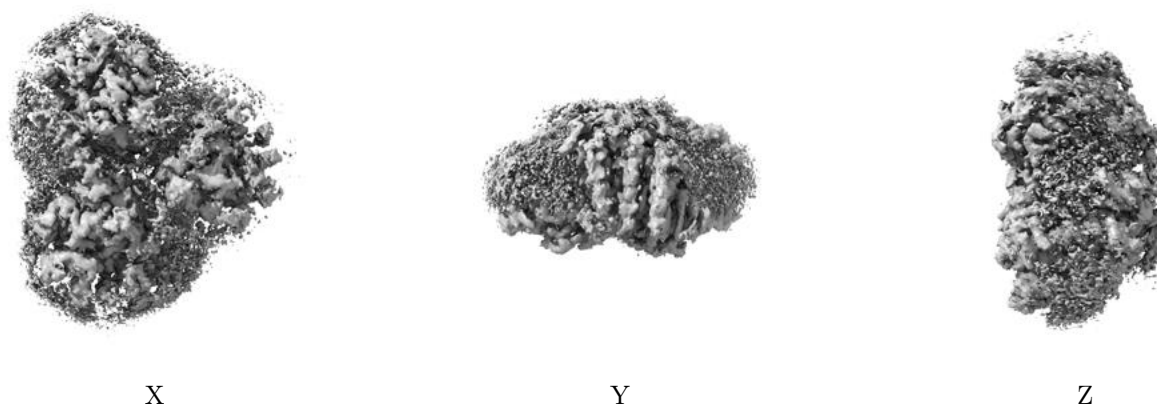
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.18. 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.

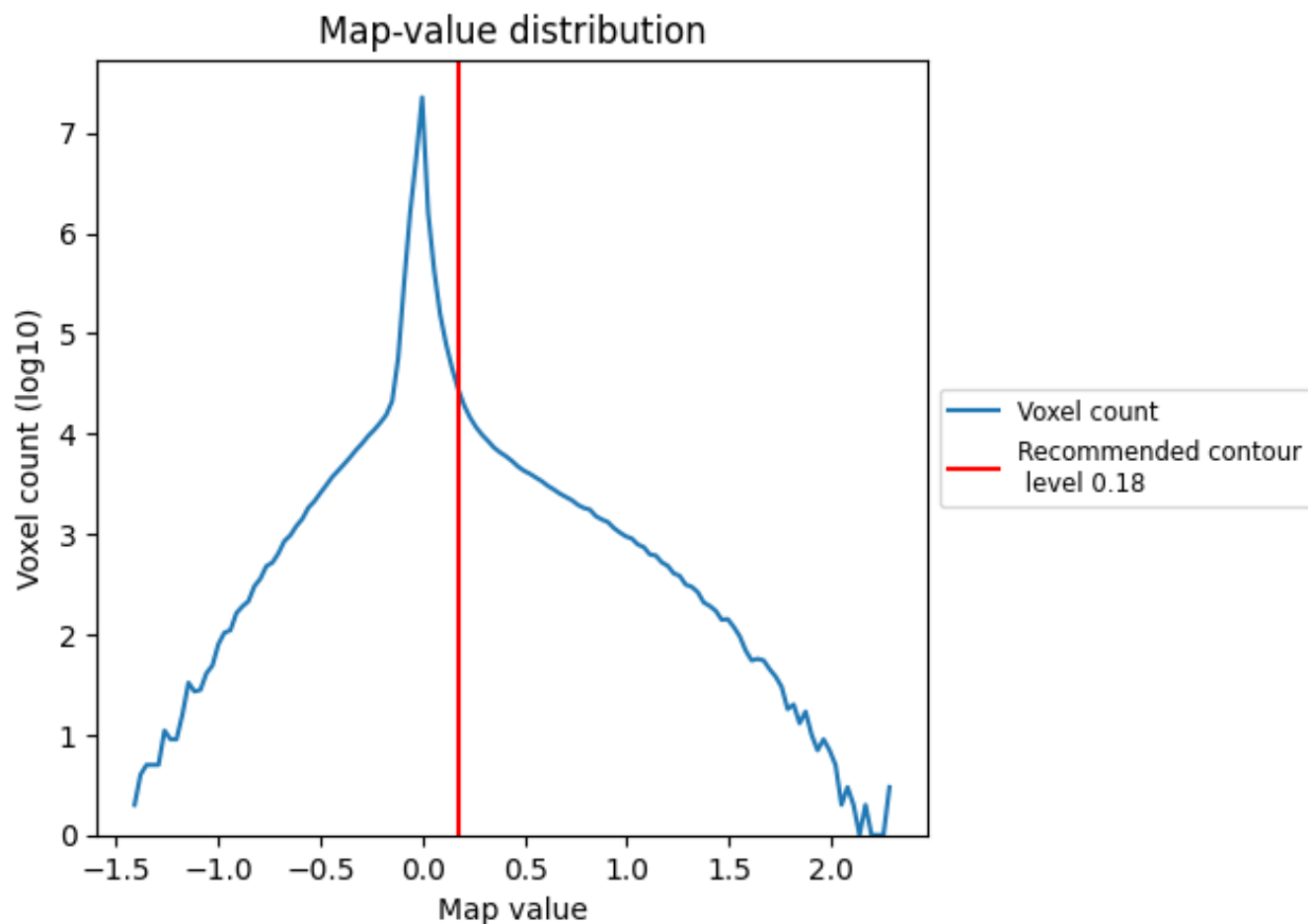
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

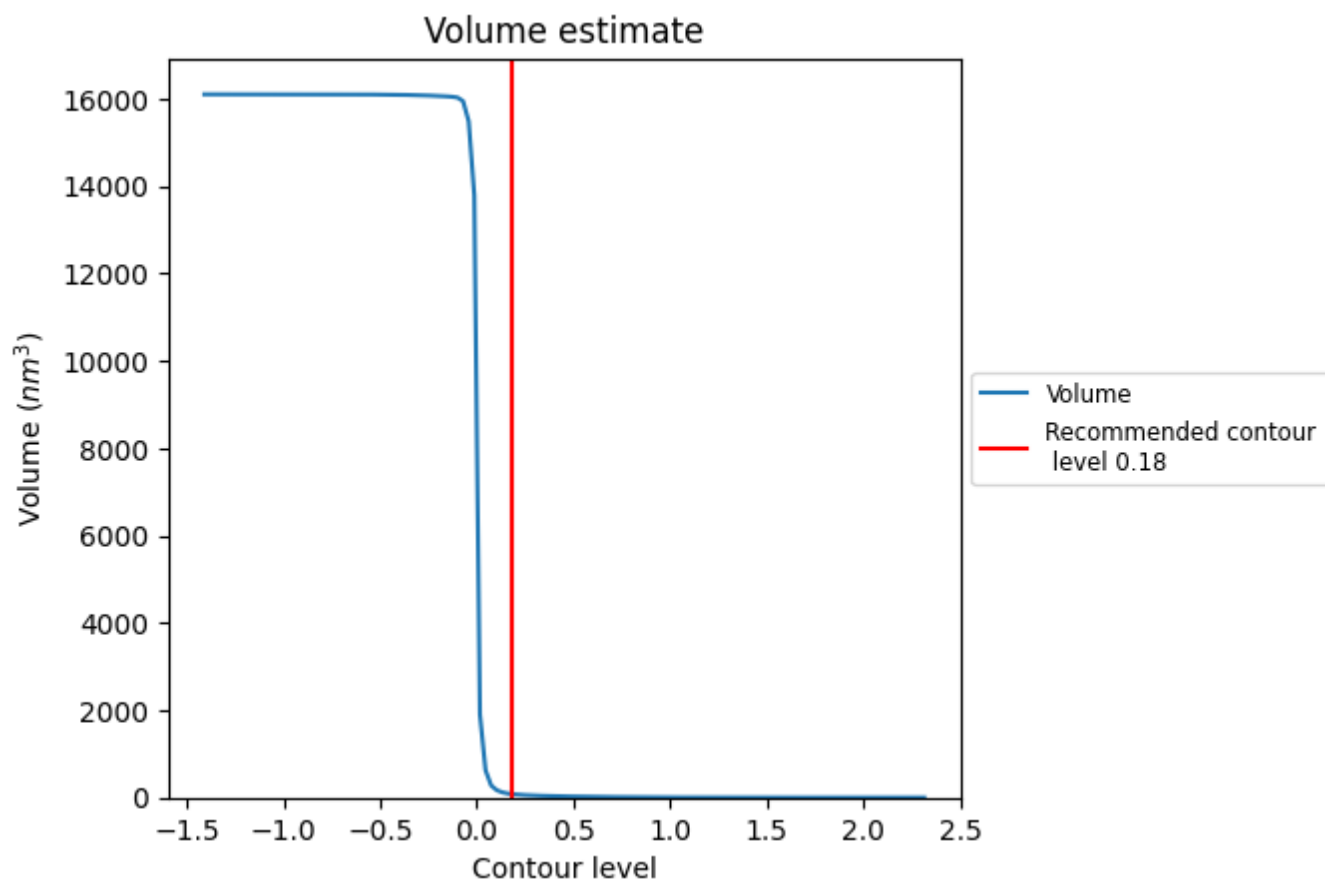
This section contains the results of statistical analysis of the map.

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.

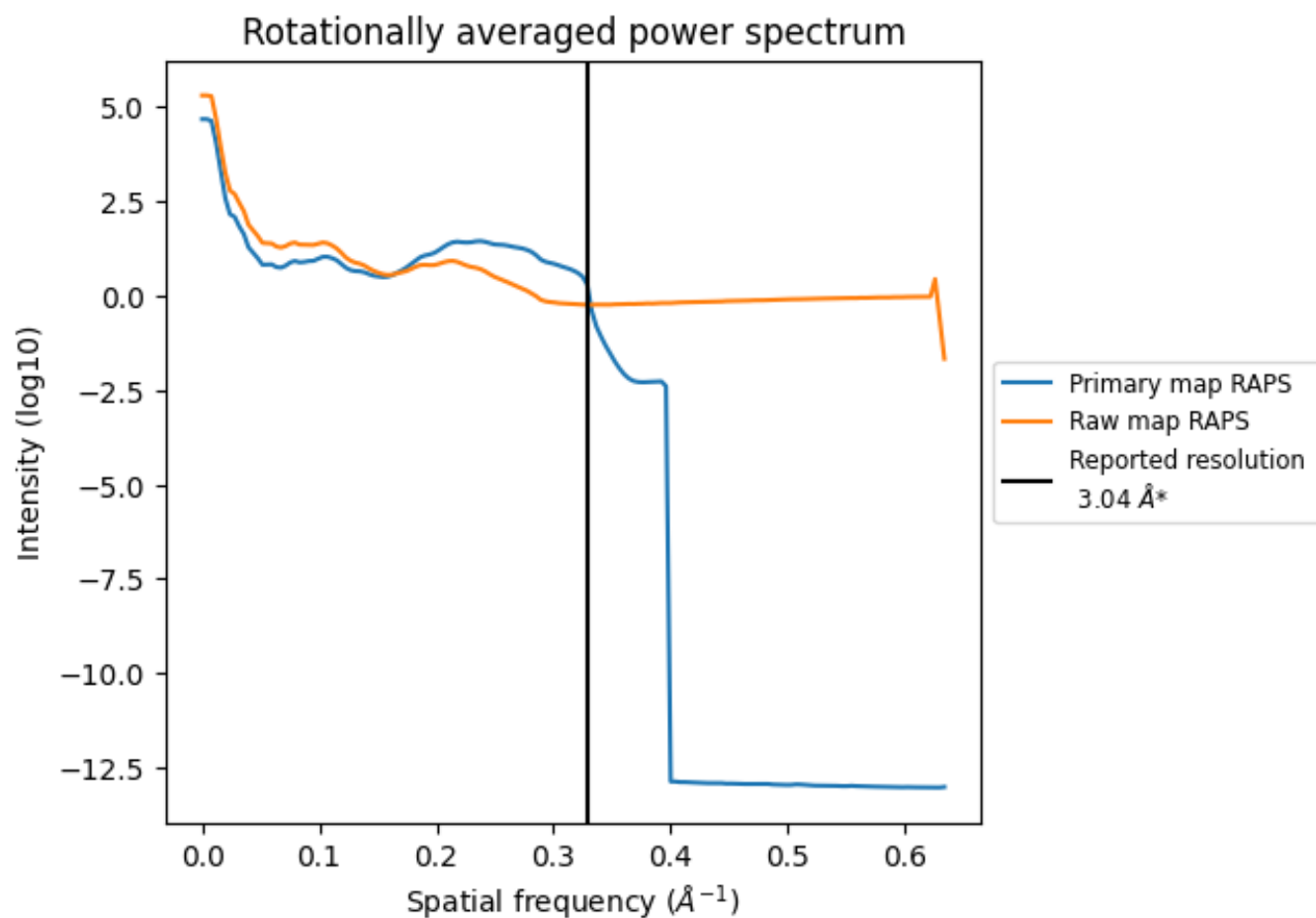
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 81 nm^3 ; this corresponds to an approximate mass of 73 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 ⓘ

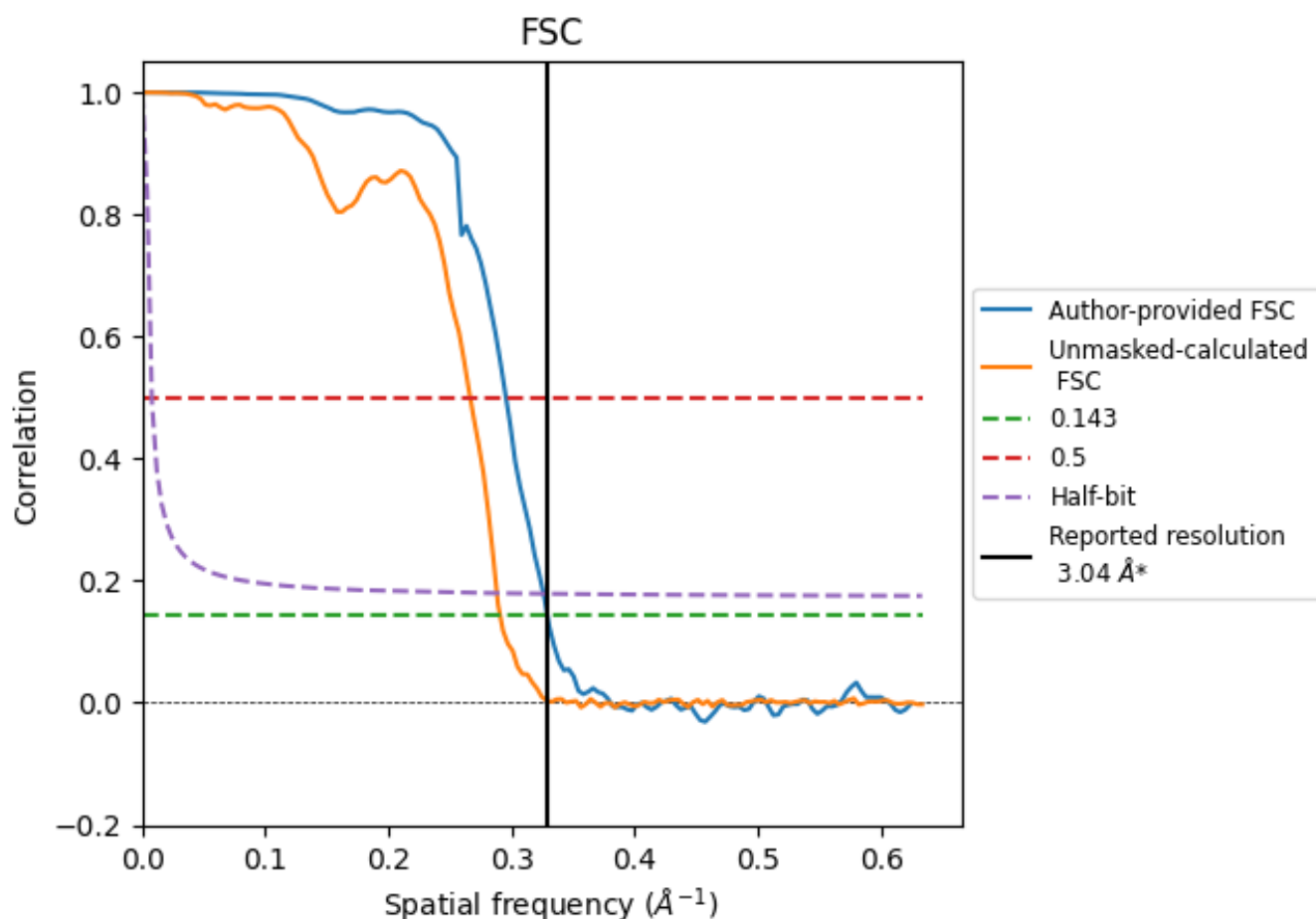


*Reported resolution corresponds to spatial frequency of 0.329 Å⁻¹

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 0.329 \AA^{-1}

8.2 Resolution estimates [i](#)

Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.04	-	-
Author-provided FSC curve	3.04	3.38	3.07
Unmasked-calculated*	3.44	3.75	3.47

*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 3.44 differs from the reported value 3.04 by more than 10 %

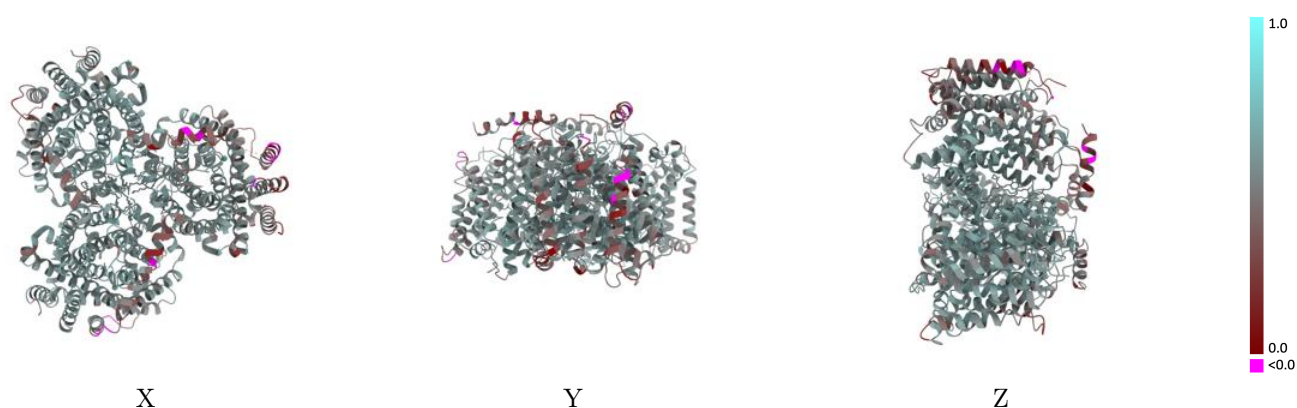
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-51422 and PDB model 9GKK. Per-residue inclusion information can be found in section 3 on page 9.

9.1 Map-model overlay [i](#)

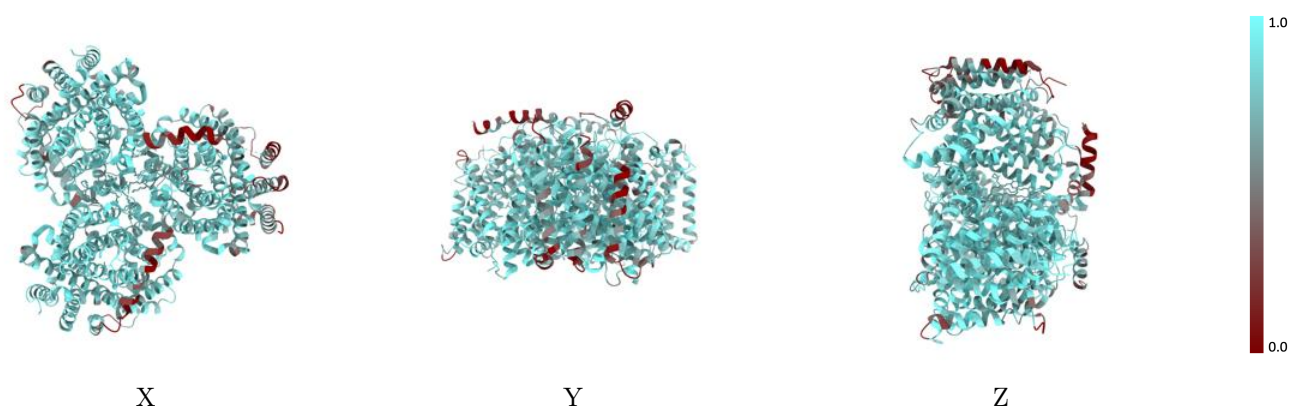
This section was not generated.

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



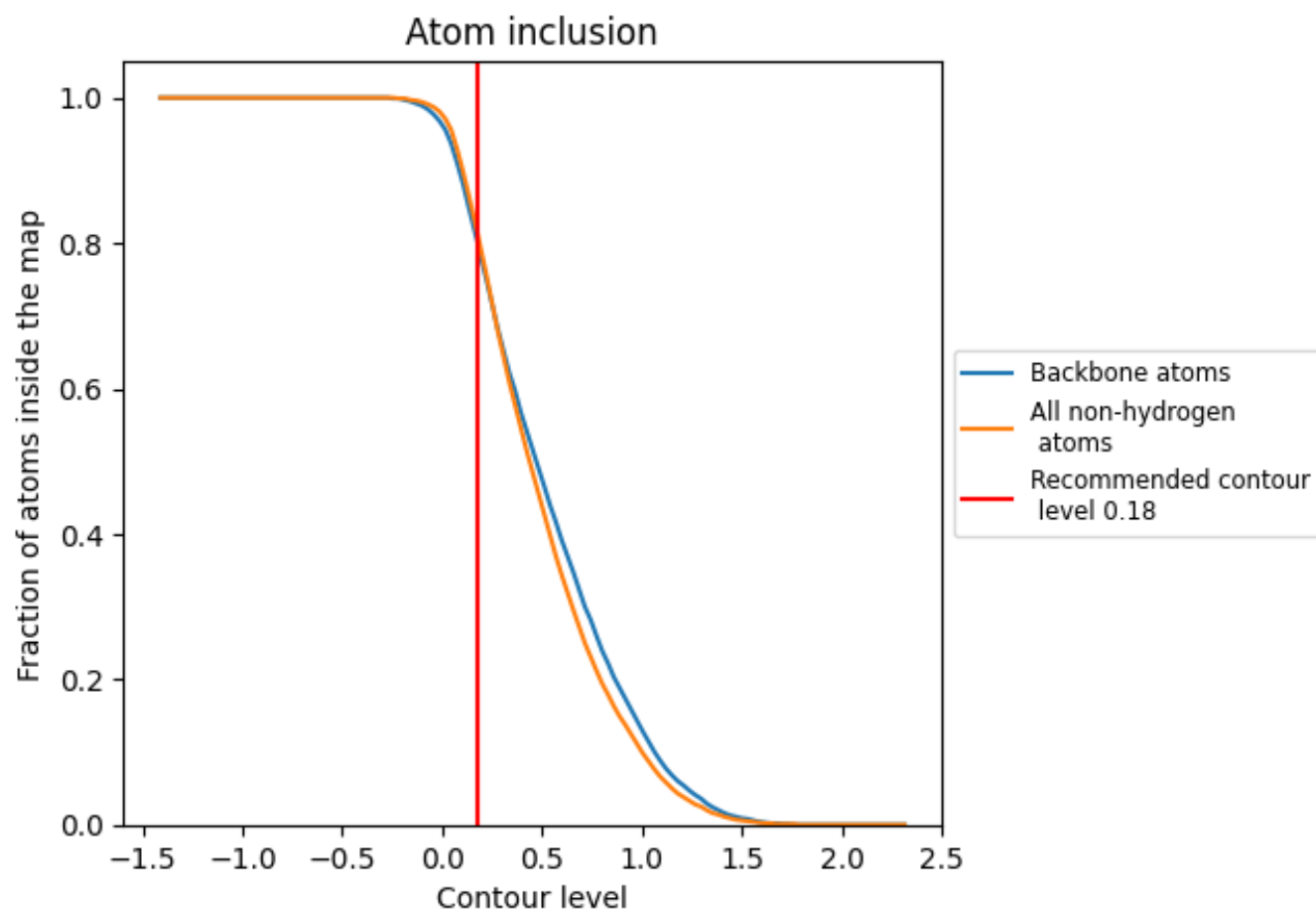
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.18).

9.4 Atom inclusion [i](#)



At the recommended contour level, 80% of all backbone atoms, 81% 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 (0.18) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div></div> 0.8100	<div></div> 0.5290
A	<div></div> 0.8350	<div></div> 0.5450
B	<div></div> 0.8550	<div></div> 0.5490
C	<div></div> 0.7440	<div></div> 0.4940

