



Full wwPDB EM Validation Report ⓘ

Oct 21, 2024 – 07:04 AM EDT

PDB ID : 8T23
EMDB ID : EMD-40979
Title : Cryo-EM structure of the RBD-ACE2 interface of the SARS-CoV-2 trimeric spike protein bound to ACE2 receptor after local refinement at upRBD conformation
Authors : Ahn, H.M.; Calderon, B.; Fan, X.; Gao, Y.; Horgan, N.; Zhou, B.; Liang, B.
Deposited on : 2023-06-05
Resolution : 3.87 Å(reported)

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.dev113
Mogul : 2022.3.0, CSD as543be (2022)
MolProbity : 4.02b-467
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.39

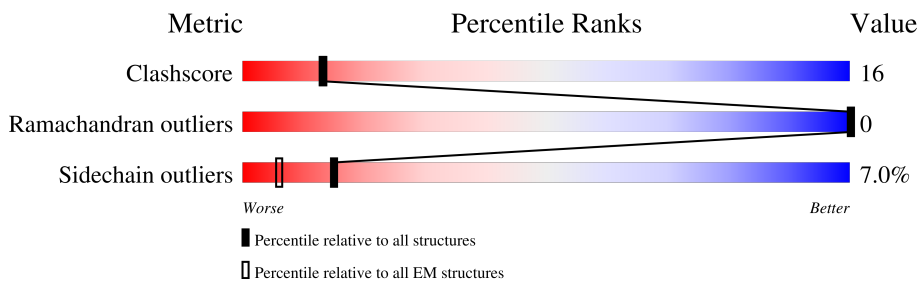
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.87 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	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

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	771	
2	B	208	
3	G	2	
4	H	2	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 6451 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 Angiotensin-converting enzyme.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	596	4904	3133	824	918	29	0	0

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	740	GLY	-	expression tag	UNP A0A7T0Q2W2
A	741	SER	-	expression tag	UNP A0A7T0Q2W2
A	742	GLY	-	expression tag	UNP A0A7T0Q2W2
A	743	SER	-	expression tag	UNP A0A7T0Q2W2
A	744	GLY	-	expression tag	UNP A0A7T0Q2W2
A	745	SER	-	expression tag	UNP A0A7T0Q2W2
A	746	GLY	-	expression tag	UNP A0A7T0Q2W2
A	747	HIS	-	expression tag	UNP A0A7T0Q2W2
A	748	HIS	-	expression tag	UNP A0A7T0Q2W2
A	749	HIS	-	expression tag	UNP A0A7T0Q2W2
A	750	HIS	-	expression tag	UNP A0A7T0Q2W2
A	751	HIS	-	expression tag	UNP A0A7T0Q2W2
A	752	HIS	-	expression tag	UNP A0A7T0Q2W2
A	753	GLY	-	expression tag	UNP A0A7T0Q2W2
A	754	SER	-	expression tag	UNP A0A7T0Q2W2
A	755	GLY	-	expression tag	UNP A0A7T0Q2W2
A	756	SER	-	expression tag	UNP A0A7T0Q2W2
A	757	GLY	-	expression tag	UNP A0A7T0Q2W2
A	758	LEU	-	expression tag	UNP A0A7T0Q2W2
A	759	ASN	-	expression tag	UNP A0A7T0Q2W2
A	760	ASP	-	expression tag	UNP A0A7T0Q2W2
A	761	ILE	-	expression tag	UNP A0A7T0Q2W2
A	762	PHE	-	expression tag	UNP A0A7T0Q2W2
A	763	GLU	-	expression tag	UNP A0A7T0Q2W2
A	764	ALA	-	expression tag	UNP A0A7T0Q2W2
A	765	GLN	-	expression tag	UNP A0A7T0Q2W2
A	766	LYS	-	expression tag	UNP A0A7T0Q2W2
A	767	ILE	-	expression tag	UNP A0A7T0Q2W2

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Chain	Residue	Modelled	Actual	Comment	Reference
A	768	GLU	-	expression tag	UNP A0A7T0Q2W2
A	769	TRP	-	expression tag	UNP A0A7T0Q2W2
A	770	HIS	-	expression tag	UNP A0A7T0Q2W2
A	771	GLU	-	expression tag	UNP A0A7T0Q2W2

- Molecule 2 is a protein called Spike glycoprotein.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	B	185	1467	942	246	271	8	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	453	PHE	TYR	variant	UNP P0DTC2

- Molecule 3 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



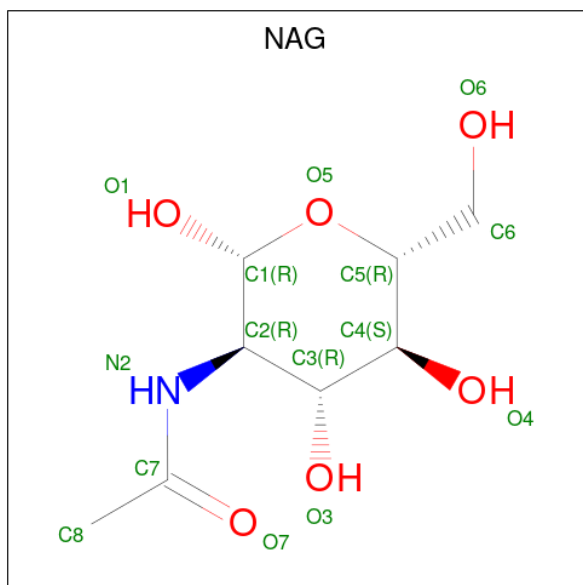
Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
3	G	2	28	16	2	10	0	0

- Molecule 4 is an oligosaccharide called alpha-L-fucopyranose-(1-6)-2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
4	H	2	24	14	1	9	0	0

- Molecule 5 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: C₈H₁₅NO₆).

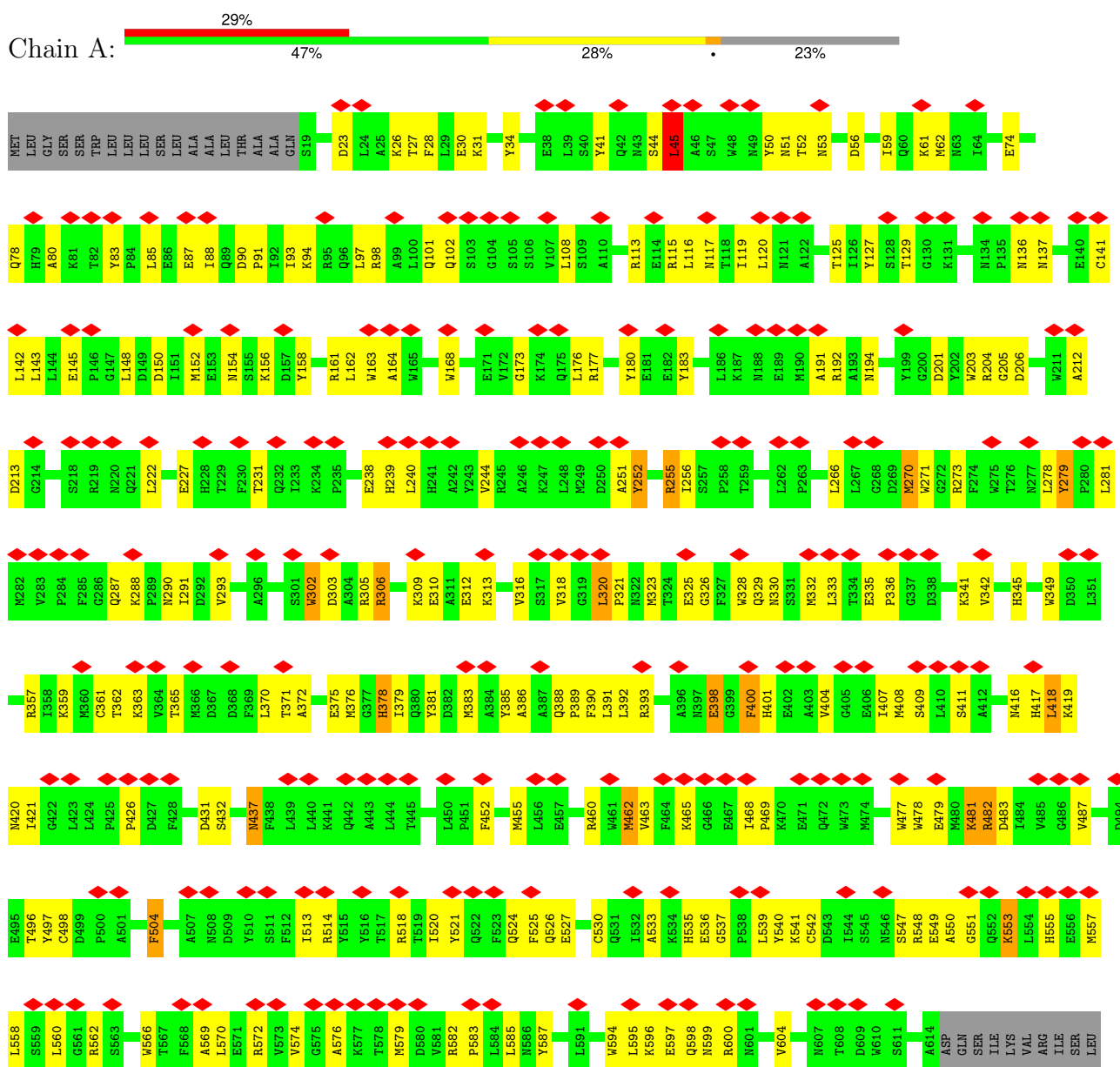


Mol	Chain	Residues	Atoms				AltConf
			Total	C	N	O	
5	A	1	14	8	1	5	0
5	B	1	14	8	1	5	0

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: Angiotensin-converting enzyme



LYS SER ALA
SER PRO LEU
GLY LEU
GLY MET
LYS ALA
TYR ASP
TRP ILE
TRP ILE
ASP ASN
ASN ASP
GLU MET
MET MET
TYR PHE
PHE PHE
GLN ILE
SER ILE
SER ILE
ALA TYR
ALA ILE
MET MET
GLU ASP
TYR PHE
PHE ASP
LYS VAL
VAL VAL
LYS ASP
ASP ASP
GLN LYS
LEU THR
THR ILE
PRO PHE
PRO PHE
VAL GLY
ASP ILE
LEU ASP
LYS ASP
ASP ASP
VAL THR
ARG VAL
VAL VAL
SER ASP
ASP LEU
LEU ILE
VAL ILE
SER ILE
ASP ASP
GLN PRO
THR THR
VAL VAL
ARG VAL
GLU VAL
PRO PRO
PRO ASP
LEU LEU
LYS TYR
GLN TYR
PRO PRO
ARG VAL
ILE ILE
SER SER
PHE PHE
ASN ASN
PHE PHE
ILE ILE

VAL THR
SER PRO
LEU LEU
GLY ASN
MET MET
SER SER
ASP ASP
ILE ILE
TRP TRP
PRO PRO
ASP ASP
ALA ILE
ASN ASN
GLY ILE
LEU LEU
ASP ASP
ASP ASP
GLN ILE
LEU LEU
THR THR
ILE ILE
PHE PHE
GLY GLY
VAL VAL
ASP ASP
LYS LYS
LEU LEU
PRO PRO
ARG ARG
ILE ILE
SER SER
PHE PHE
ASN ASN
PHE PHE
ILE ILE

SER GLY
HIS HIS
HIS HIS
HIS HIS
HIS HIS
GLY GLY
SER SER
GLY GLY
SER SER
LEU LEU
ASN ASN
ASP ASP
ASP ASP
PHE PHE
GLU GLU
ALA ILE
GLN ILE
ILE ILE
TRP TRP
HIS HIS
GLU GLU

• Molecule 2: Spike glycoprotein

Chain B: 

GLN PRO
THR THR
GLU GLU
SER SER
ILE ILE
VAL VAL
ARG ARG
PHE PHE
PRO PRO
ASN ASN
ILE ILE
THR THR
ASN ASN
L335
R346
F347
K348
S349
V350
Y351
A352
W353
N354
R355
K356
R357
I358
S359
N360
D364
Y365
SER SER
VAL VAL
LEU LEU
TYR TYR
ASN ASN
SER SER
ALA ALA
SER SER
PHE PHE
S375
K378
C379
Y380
P384
I385
K386
L387
F392
V395
D398
S399

F400
A411
P412
G413
Q414
K417
I418
A419
D420
Y421
L425
P426
F429
T430
M437
S438
M439
K444
Y451
L452
R457
M460
L461
K462
P463
R466
D467
I472
Y473
Q474
A475
P479
E484
C485
F486
M487
C488
Y489
S494
Y495
G496
F497
Q498
P499
P507

Y508
F515
E516
L517
L518
H519
A522
T523
V524
C525
G526
F527
K528

• Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain G: 

MAG1
MAG2

• Molecule 4: alpha-L-fucopyranose-(1-6)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain H: 

MAG1
FUC2

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	512722	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 ($e^-/\text{\AA}^2$)	49.98	Depositor
Minimum defocus (nm)	750	Depositor
Maximum defocus (nm)	1750	Depositor
Magnification	81000	Depositor
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	2.243	Depositor
Minimum map value	-2.099	Depositor
Average map value	-0.001	Depositor
Map value standard deviation	0.019	Depositor
Recommended contour level	0.3	Depositor
Map size (\AA)	568.32, 568.32, 568.32	wwPDB
Map dimensions	512, 512, 512	wwPDB
Map angles ($^\circ$)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (\AA)	1.11, 1.11, 1.11	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: FUC, NAG

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	0.28	0/5047	0.62	5/6854 (0.1%)
2	B	0.26	0/1508	0.58	1/2049 (0.0%)
All	All	0.27	0/6555	0.61	6/8903 (0.1%)

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	389	PRO	CA-N-CD	-11.59	95.27	111.50
1	A	45	LEU	CA-CB-CG	7.39	132.29	115.30
1	A	320	LEU	CA-CB-CG	6.02	129.14	115.30
1	A	389	PRO	N-CD-CG	-5.77	94.54	103.20
2	B	517	LEU	CA-CB-CG	5.65	128.29	115.30
1	A	595	LEU	CA-CB-CG	5.17	127.19	115.30

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4904	0	4663	162	0
2	B	1467	0	1396	40	0
3	G	28	0	25	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	H	24	0	22	0	0
5	A	14	0	13	0	0
5	B	14	0	13	0	0
All	All	6451	0	6132	201	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.

All (201) 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:A:320:LEU:HD12	1:A:321:PRO:HD2	1.59	0.83
1:A:392:LEU:HD23	1:A:562:ARG:H	1.44	0.83
1:A:91:PRO:HA	1:A:94:LYS:HD3	1.64	0.78
1:A:28:PHE:HA	1:A:31:LYS:HE2	1.67	0.76
1:A:316:VAL:HG13	1:A:320:LEU:HG	1.68	0.74
2:B:353:TRP:HH2	2:B:466:ARG:HB2	1.53	0.73
2:B:358:ILE:HG13	2:B:395:VAL:HG11	1.71	0.71
1:A:204:ARG:HA	1:A:513:ILE:HA	1.71	0.71
1:A:305:ARG:O	1:A:309:LYS:NZ	2.23	0.70
1:A:524:GLN:HG3	1:A:579:MET:HA	1.71	0.70
2:B:355:ARG:NH2	2:B:398:ASP:OD2	2.24	0.70
1:A:381:TYR:HB2	1:A:558:LEU:HD13	1.74	0.69
1:A:303:ASP:O	1:A:306:ARG:NH1	2.27	0.67
2:B:412:PRO:HG2	2:B:429:PHE:HB2	1.76	0.67
1:A:376:MET:HA	1:A:379:ILE:HG22	1.76	0.67
1:A:41:TYR:O	1:A:45:LEU:HD12	1.95	0.66
1:A:478:TRP:HA	1:A:481:LYS:HE2	1.78	0.66
1:A:326:GLY:HA2	1:A:329:GLN:HE21	1.61	0.66
1:A:310:GLU:OE2	1:A:417:HIS:NE2	2.30	0.65
1:A:535:HIS:CE1	1:A:541:LYS:HB3	2.31	0.65
1:A:113:ARG:O	1:A:117:ASN:ND2	2.30	0.64
1:A:52:THR:HA	1:A:342:VAL:HG12	1.80	0.64
1:A:418:LEU:HD23	1:A:421:ILE:HD11	1.79	0.64
1:A:460:ARG:HA	1:A:463:VAL:HG22	1.80	0.63
1:A:201:ASP:O	1:A:205:GLY:C	2.37	0.62
1:A:598:GLN:O	1:A:600:ARG:NH1	2.30	0.62
1:A:288:LYS:NZ	1:A:437:ASN:OD1	2.32	0.62
2:B:421:TYR:HE1	2:B:457:ARG:HB3	1.63	0.62
1:A:203:TRP:HD1	1:A:204:ARG:HG3	1.64	0.62
1:A:574:VAL:HG23	1:A:576:ALA:H	1.63	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:335:GLU:H	1:A:362:THR:HG22	1.65	0.62
1:A:372:ALA:O	1:A:376:MET:HG2	2.00	0.62
1:A:388:GLN:HB3	1:A:392:LEU:HD13	1.81	0.61
1:A:180:TYR:OH	1:A:496:THR:O	2.14	0.61
1:A:238:GLU:HA	1:A:604:VAL:HG11	1.83	0.61
1:A:238:GLU:HG2	1:A:604:VAL:HG21	1.82	0.60
1:A:143:LEU:HD12	1:A:145:GLU:H	1.67	0.59
1:A:312:GLU:O	1:A:316:VAL:HG23	2.03	0.59
1:A:222:LEU:HB3	1:A:520:ILE:HG21	1.85	0.58
1:A:168:TRP:O	1:A:173:GLY:N	2.31	0.58
1:A:330:ASN:HB3	1:A:357:ARG:HD2	1.84	0.58
2:B:346:ARG:NH1	2:B:347:PHE:O	2.37	0.58
1:A:477:TRP:O	1:A:481:LYS:HG3	2.05	0.57
1:A:370:LEU:HB2	1:A:409:SER:HB3	1.88	0.56
1:A:287:GLN:OE1	1:A:287:GLN:N	2.39	0.56
1:A:312:GLU:HG3	1:A:316:VAL:HG21	1.88	0.56
2:B:412:PRO:O	2:B:414:GLN:NE2	2.39	0.56
1:A:251:ALA:HA	1:A:281:LEU:HD22	1.88	0.55
1:A:455:MET:SD	1:A:455:MET:N	2.79	0.55
1:A:74:GLU:O	1:A:78:GLN:HG2	2.06	0.55
2:B:351:TYR:OH	2:B:467:ASP:O	2.25	0.54
1:A:90:ASP:O	1:A:94:LYS:HG3	2.07	0.54
1:A:431:ASP:OD1	1:A:432:SER:N	2.40	0.54
1:A:302:TRP:HE1	1:A:417:HIS:CE1	2.26	0.53
1:A:530:CYS:HA	1:A:533:ALA:HB3	1.89	0.53
1:A:535:HIS:HE1	1:A:541:LYS:HB3	1.73	0.53
1:A:479:GLU:N	1:A:479:GLU:OE1	2.39	0.53
1:A:309:LYS:N	1:A:309:LYS:HD3	2.22	0.53
2:B:364:ASP:OD1	2:B:365:TYR:N	2.42	0.53
1:A:61:LYS:HG2	1:A:62:MET:N	2.23	0.53
1:A:400:PHE:O	1:A:404:VAL:HG13	2.09	0.53
1:A:150:ASP:HB2	1:A:154:ASN:ND2	2.24	0.53
1:A:158:TYR:HE1	1:A:266:LEU:HD21	1.73	0.53
2:B:462:LYS:HG2	2:B:463:PRO:HD2	1.91	0.53
1:A:290:ASN:OD1	1:A:291:ILE:N	2.41	0.53
2:B:525:CYS:SG	2:B:526:GLY:N	2.82	0.53
1:A:336:PRO:HB2	1:A:341:LYS:HD3	1.91	0.52
1:A:419:LYS:HG3	1:A:426:PRO:HB3	1.90	0.52
1:A:176:LEU:HB2	1:A:177:ARG:NH2	2.24	0.52
1:A:27:THR:HG21	2:B:489:TYR:CZ	2.45	0.52
2:B:384:PRO:HA	2:B:387:LEU:HD23	1.90	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:318:VAL:HG22	1:A:548:ARG:HH12	1.74	0.52
1:A:136:ASN:OD1	1:A:136:ASN:N	2.43	0.51
1:A:481:LYS:HD2	1:A:487:VAL:HB	1.90	0.51
1:A:180:TYR:OH	1:A:498:CYS:N	2.35	0.51
1:A:391:LEU:HD12	1:A:392:LEU:HG	1.92	0.51
1:A:407:ILE:H	1:A:407:ILE:HD12	1.75	0.51
1:A:56:ASP:HA	1:A:59:ILE:HG12	1.93	0.51
1:A:388:GLN:HB2	1:A:393:ARG:NH1	2.26	0.50
1:A:240:LEU:O	1:A:244:VAL:HG13	2.10	0.50
1:A:323:MET:N	1:A:323:MET:SD	2.85	0.50
1:A:526:GLN:N	1:A:526:GLN:OE1	2.45	0.50
1:A:570:LEU:O	1:A:574:VAL:HG22	2.12	0.50
1:A:320:LEU:HD12	1:A:321:PRO:CD	2.37	0.49
2:B:355:ARG:HG3	2:B:357:ARG:CZ	2.43	0.49
1:A:116:LEU:O	1:A:119:ILE:HG13	2.12	0.49
1:A:514:ARG:HH21	1:A:518:ARG:H	1.61	0.49
1:A:560:LEU:HD13	1:A:569:ALA:HB2	1.95	0.48
1:A:388:GLN:HB2	1:A:393:ARG:HH12	1.78	0.48
1:A:158:TYR:OH	1:A:255:ARG:NH1	2.46	0.48
1:A:557:MET:HB2	1:A:572:ARG:HE	1.79	0.48
1:A:551:GLY:O	1:A:555:HIS:ND1	2.47	0.48
1:A:227:GLU:O	1:A:231:THR:HG23	2.14	0.48
1:A:271:TRP:NE1	1:A:273:ARG:HB2	2.29	0.48
2:B:485:GLY:N	2:B:488:CYS:O	2.46	0.48
1:A:191:ALA:O	1:A:194:ASN:ND2	2.33	0.48
2:B:495:TYR:HB3	2:B:497:PHE:CE1	2.49	0.48
1:A:463:VAL:HG12	1:A:468:ILE:HD13	1.94	0.48
1:A:150:ASP:OD2	1:A:150:ASP:N	2.48	0.47
1:A:168:TRP:NE1	1:A:270:MET:HG2	2.30	0.47
1:A:108:LEU:HD12	1:A:113:ARG:HD3	1.95	0.47
1:A:363:LYS:HE3	1:A:365:THR:HG23	1.97	0.47
1:A:404:VAL:O	1:A:408:MET:HE2	2.15	0.47
1:A:125:THR:O	1:A:129:THR:HG23	2.15	0.47
1:A:332:MET:CE	1:A:333:LEU:H	2.28	0.47
2:B:378:LYS:HD2	2:B:379:CYS:N	2.30	0.47
1:A:335:GLU:HB3	1:A:361:CYS:HB3	1.98	0.46
1:A:482:ARG:NH1	1:A:483:ASP:OD2	2.48	0.46
2:B:392:PHE:O	2:B:522:ALA:HA	2.15	0.46
1:A:26:LYS:O	1:A:30:GLU:HG2	2.15	0.46
1:A:482:ARG:HH11	1:A:483:ASP:HA	1.80	0.46
1:A:41:TYR:CZ	1:A:45:LEU:HD11	2.50	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:303:ASP:H	1:A:306:ARG:NH2	2.13	0.46
1:A:177:ARG:O	1:A:180:TYR:N	2.45	0.46
1:A:326:GLY:O	1:A:329:GLN:NE2	2.48	0.46
1:A:390:PHE:O	1:A:393:ARG:HG2	2.15	0.46
1:A:530:CYS:SG	1:A:535:HIS:HB3	2.56	0.46
1:A:212:ALA:O	1:A:213:ASP:OD2	2.34	0.46
1:A:80:ALA:O	1:A:101:GLN:NE2	2.49	0.45
1:A:115:ARG:O	1:A:119:ILE:HG12	2.17	0.45
1:A:535:HIS:HD2	1:A:536:GLU:N	2.14	0.45
1:A:41:TYR:CE2	1:A:45:LEU:HD11	2.51	0.45
2:B:355:ARG:HG3	2:B:357:ARG:NH1	2.31	0.45
2:B:430:THR:HG22	2:B:515:PHE:CE2	2.51	0.45
1:A:383:MET:HA	1:A:386:ALA:HB2	1.97	0.45
1:A:535:HIS:CD2	1:A:537:GLY:H	2.35	0.45
2:B:353:TRP:CH2	2:B:466:ARG:HB2	2.41	0.45
1:A:326:GLY:CA	1:A:329:GLN:HE21	2.30	0.44
1:A:164:ALA:O	1:A:168:TRP:HD1	2.00	0.44
1:A:325:GLU:HA	1:A:328:TRP:HD1	1.81	0.44
2:B:517:LEU:HD12	2:B:517:LEU:O	2.17	0.44
1:A:293:VAL:HG21	1:A:365:THR:HA	2.00	0.44
2:B:494:SER:OG	2:B:495:TYR:N	2.51	0.44
1:A:127:TYR:HE2	1:A:504:PHE:HA	1.83	0.44
2:B:430:THR:HG22	2:B:515:PHE:HE2	1.82	0.44
2:B:472:ILE:HD11	2:B:488:CYS:HB3	2.00	0.44
1:A:385:TYR:O	1:A:393:ARG:NH2	2.47	0.43
1:A:383:MET:SD	1:A:383:MET:N	2.92	0.43
1:A:541:LYS:O	1:A:541:LYS:HD3	2.19	0.43
1:A:371:THR:O	1:A:375:GLU:HG2	2.17	0.43
2:B:444:LYS:O	2:B:499:PRO:HD3	2.18	0.43
1:A:252:TYR:HB2	1:A:256:ILE:HD13	1.99	0.43
1:A:51:ASN:HD21	1:A:349:TRP:HZ2	1.66	0.43
1:A:201:ASP:O	1:A:205:GLY:CA	2.66	0.43
1:A:547:SER:OG	1:A:549:GLU:HG3	2.18	0.43
1:A:333:LEU:O	1:A:362:THR:HB	2.19	0.43
1:A:303:ASP:OD1	1:A:305:ARG:HG2	2.19	0.43
1:A:378:HIS:ND1	1:A:381:TYR:HE2	2.17	0.43
1:A:378:HIS:HA	1:A:381:TYR:CD2	2.54	0.43
1:A:108:LEU:HB2	1:A:113:ARG:HD3	2.01	0.43
1:A:404:VAL:O	1:A:408:MET:HG2	2.18	0.43
2:B:387:LEU:HD13	2:B:392:PHE:CZ	2.54	0.43
1:A:116:LEU:O	1:A:120:LEU:HG	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:312:GLU:OE2	1:A:313:LYS:NZ	2.44	0.42
1:A:550:ALA:HA	1:A:553:LYS:HD2	2.00	0.42
1:A:582:ARG:N	1:A:583:PRO:HD2	2.33	0.42
2:B:349:SER:OG	2:B:350:VAL:N	2.52	0.42
2:B:351:TYR:HB2	2:B:452:LEU:HD21	2.00	0.42
2:B:439:ASN:HA	2:B:507:PRO:HG2	1.99	0.42
2:B:473:TYR:O	2:B:488:CYS:HA	2.20	0.42
1:A:23:ASP:HA	1:A:26:LYS:HD2	2.01	0.42
1:A:156:LYS:HE2	1:A:156:LYS:HB2	1.90	0.42
1:A:87:GLU:O	1:A:88:ILE:HD13	2.19	0.42
1:A:158:TYR:CZ	1:A:162:LEU:HD22	2.55	0.42
1:A:468:ILE:HA	1:A:469:PRO:HD3	1.93	0.42
1:A:239:HIS:ND1	1:A:599:ASN:HB3	2.34	0.41
1:A:462:MET:HA	1:A:465:LYS:HE2	2.02	0.41
1:A:94:LYS:HA	1:A:97:LEU:HD23	2.02	0.41
2:B:437:ASN:HB3	2:B:508:TYR:CZ	2.55	0.41
2:B:451:TYR:O	2:B:494:SER:HA	2.20	0.41
1:A:85:LEU:O	1:A:88:ILE:HG12	2.20	0.41
1:A:98:ARG:CZ	1:A:102:GLN:HB2	2.50	0.41
1:A:407:ILE:HB	1:A:408:MET:HE1	2.01	0.41
1:A:148:LEU:HD11	1:A:161:ARG:HA	2.02	0.41
1:A:305:ARG:HG2	1:A:305:ARG:H	1.71	0.41
1:A:41:TYR:O	1:A:44:SER:OG	2.27	0.41
1:A:597:GLU:N	1:A:597:GLU:OE2	2.53	0.41
1:A:206:ASP:H	1:A:513:ILE:HD11	1.85	0.41
2:B:486:PHE:O	2:B:487:ASN:HB3	2.21	0.41
1:A:549:GLU:O	1:A:553:LYS:HB3	2.20	0.41
2:B:360:ASN:HA	2:B:523:THR:HG22	2.03	0.41
1:A:56:ASP:OD1	1:A:56:ASP:N	2.53	0.41
1:A:61:LYS:HG2	1:A:62:MET:SD	2.61	0.41
1:A:279:TYR:O	1:A:281:LEU:N	2.51	0.41
1:A:306:ARG:O	1:A:310:GLU:HG2	2.21	0.41
1:A:527:GLU:HA	1:A:583:PRO:HD3	2.03	0.41
2:B:417:LYS:HG2	2:B:421:TYR:HD2	1.86	0.41
1:A:533:ALA:HA	1:A:549:GLU:OE1	2.21	0.41
2:B:411:ALA:O	2:B:414:GLN:HG2	2.21	0.41
1:A:50:TYR:CE2	1:A:59:ILE:HA	2.56	0.40
1:A:278:LEU:HA	1:A:278:LEU:HD12	1.86	0.40
1:A:398:GLU:HA	1:A:401:HIS:ND1	2.36	0.40
1:A:539:LEU:HD12	1:A:539:LEU:O	2.21	0.40
2:B:462:LYS:HD3	2:B:463:PRO:O	2.21	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:239:HIS:HB2	1:A:596:LYS:NZ	2.36	0.40
2:B:354:ASN:HD21	2:B:356:LYS:HD3	1.86	0.40
1:A:90:ASP:OD1	1:A:93:ILE:HG12	2.21	0.40
1:A:192:ARG:NH1	1:A:192:ARG:HB3	2.36	0.40
1:A:137:ASN:HB3	1:A:141:CYS:HB3	2.03	0.40
1:A:203:TRP:HD1	1:A:204:ARG:CG	2.31	0.40
2:B:355:ARG:C	2:B:356:LYS:HD2	2.42	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	A	594/771 (77%)	520 (88%)	74 (12%)	0	100	100
2	B	181/208 (87%)	163 (90%)	18 (10%)	0	100	100
All	All	775/979 (79%)	683 (88%)	92 (12%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	524/676 (78%)	485 (93%)	39 (7%)	11	35

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	B	159/181 (88%)	150 (94%)	9 (6%)	17	43
All	All	683/857 (80%)	635 (93%)	48 (7%)	15	36

All (48) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	34	TYR
1	A	45	LEU
1	A	53	ASN
1	A	83	TYR
1	A	142	LEU
1	A	152	MET
1	A	163	TRP
1	A	183	TYR
1	A	252	TYR
1	A	255	ARG
1	A	270	MET
1	A	279	TYR
1	A	302	TRP
1	A	306	ARG
1	A	345	HIS
1	A	359	LYS
1	A	378	HIS
1	A	398	GLU
1	A	400	PHE
1	A	411	SER
1	A	416	ASN
1	A	418	LEU
1	A	420	ASN
1	A	437	ASN
1	A	452	PHE
1	A	462	MET
1	A	481	LYS
1	A	482	ARG
1	A	497	TYR
1	A	504	PHE
1	A	521	TYR
1	A	525	PHE
1	A	540	TYR
1	A	542	CYS
1	A	553	LYS
1	A	566	TRP

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Mol	Chain	Res	Type
1	A	585	LEU
1	A	587	TYR
1	A	594	TRP
2	B	346	ARG
2	B	380	TYR
2	B	386	LYS
2	B	400	PHE
2	B	417	LYS
2	B	452	LEU
2	B	460	ASN
2	B	486	PHE
2	B	528	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	117	ASN
1	A	329	GLN
1	A	330	ASN
1	A	535	HIS
2	B	474	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](#)

4 monosaccharides are modelled in this entry.

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	NAG	G	1	3,1	14,14,15	0.89	1 (7%)	17,19,21	1.27	1 (5%)
3	NAG	G	2	3	14,14,15	0.22	0	17,19,21	0.44	0
4	NAG	H	1	4,1	14,14,15	0.63	1 (7%)	17,19,21	0.41	0
4	FUC	H	2	4	10,10,11	0.67	0	14,14,16	0.96	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	NAG	G	1	3,1	-	2/6/23/26	0/1/1/1
3	NAG	G	2	3	-	2/6/23/26	0/1/1/1
4	NAG	H	1	4,1	-	1/6/23/26	0/1/1/1
4	FUC	H	2	4	-	-	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	G	1	NAG	O5-C1	3.18	1.49	1.43
4	H	1	NAG	C1-C2	2.17	1.55	1.52

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	G	1	NAG	C1-O5-C5	5.01	118.90	112.19

There are no chirality outliers.

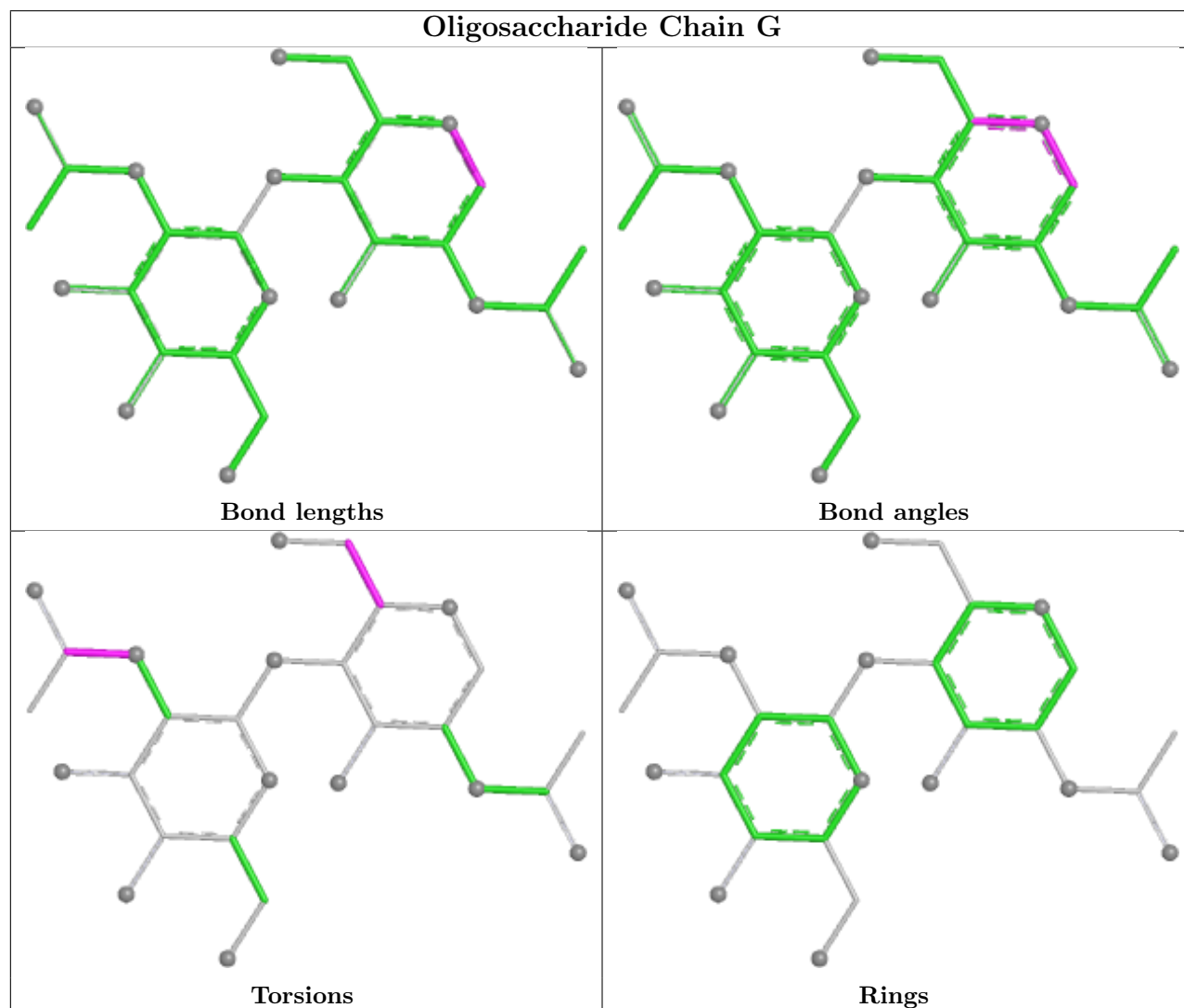
All (5) torsion outliers are listed below:

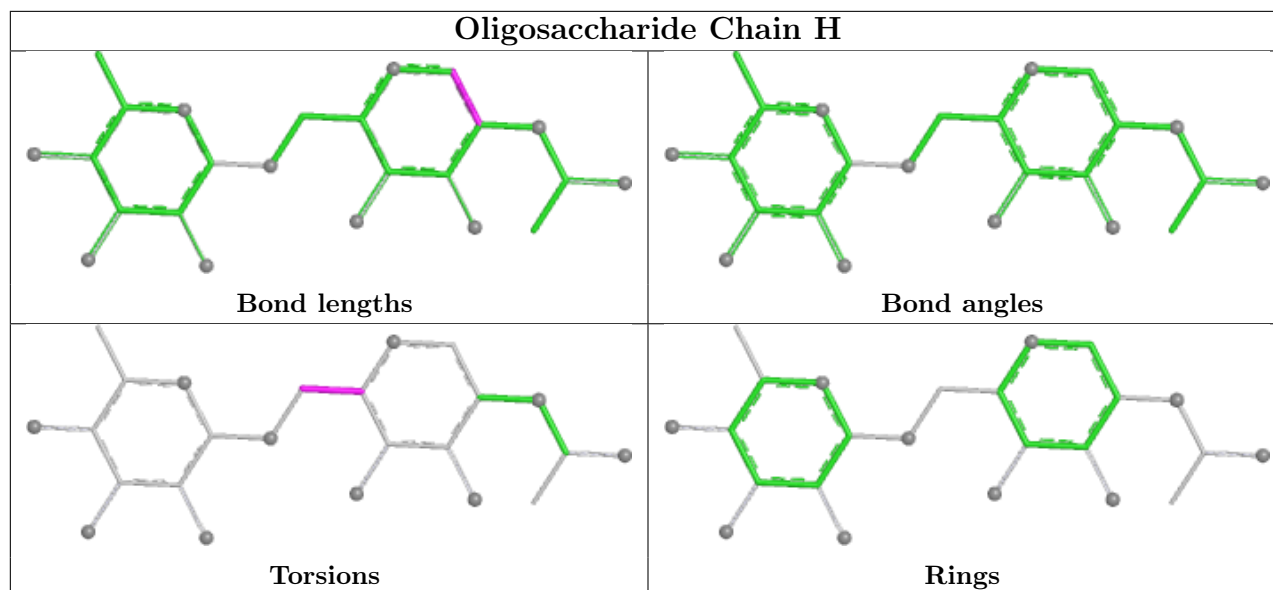
Mol	Chain	Res	Type	Atoms
3	G	1	NAG	O5-C5-C6-O6
3	G	2	NAG	C8-C7-N2-C2
3	G	2	NAG	O7-C7-N2-C2
4	H	1	NAG	O5-C5-C6-O6
3	G	1	NAG	C4-C5-C6-O6

There are no ring outliers.

No monomer is involved in short contacts.

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.





5.6 Ligand geometry [i](#)

2 ligands are modelled in this entry.

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
5	NAG	B	601	2	14,14,15	0.28	0	17,19,21	0.54	0
5	NAG	A	801	1	14,14,15	0.25	0	17,19,21	0.46	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. '2' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	NAG	B	601	2	-	4/6/23/26	0/1/1/1
5	NAG	A	801	1	-	2/6/23/26	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	B	601	NAG	C4-C5-C6-O6
5	B	601	NAG	O5-C5-C6-O6
5	A	801	NAG	O5-C5-C6-O6
5	A	801	NAG	C4-C5-C6-O6
5	B	601	NAG	C1-C2-N2-C7
5	B	601	NAG	C3-C2-N2-C7

There are no ring outliers.

No monomer is involved in short contacts.

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.

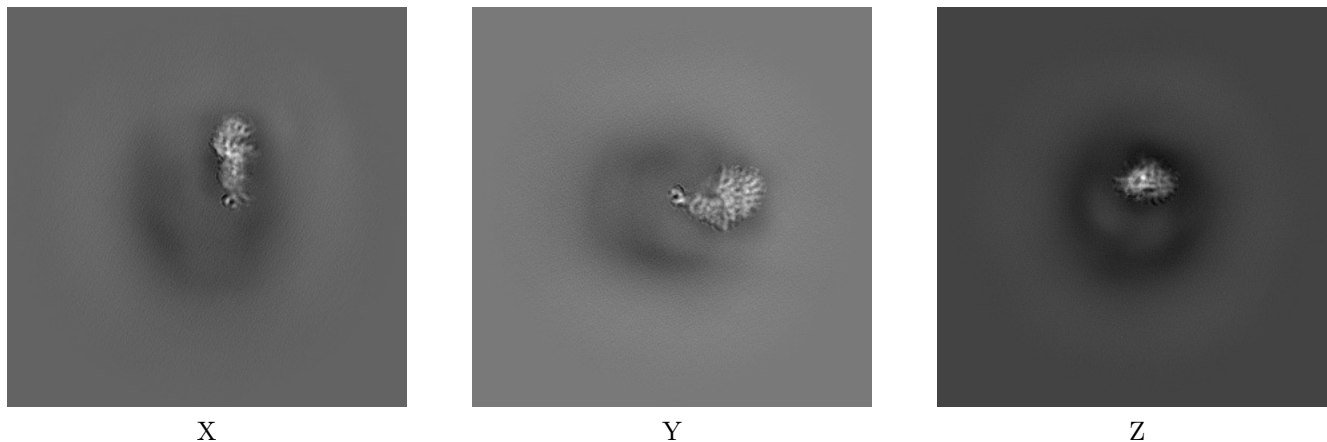
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-40979. These allow visual inspection of the internal detail of the map and identification of artifacts.

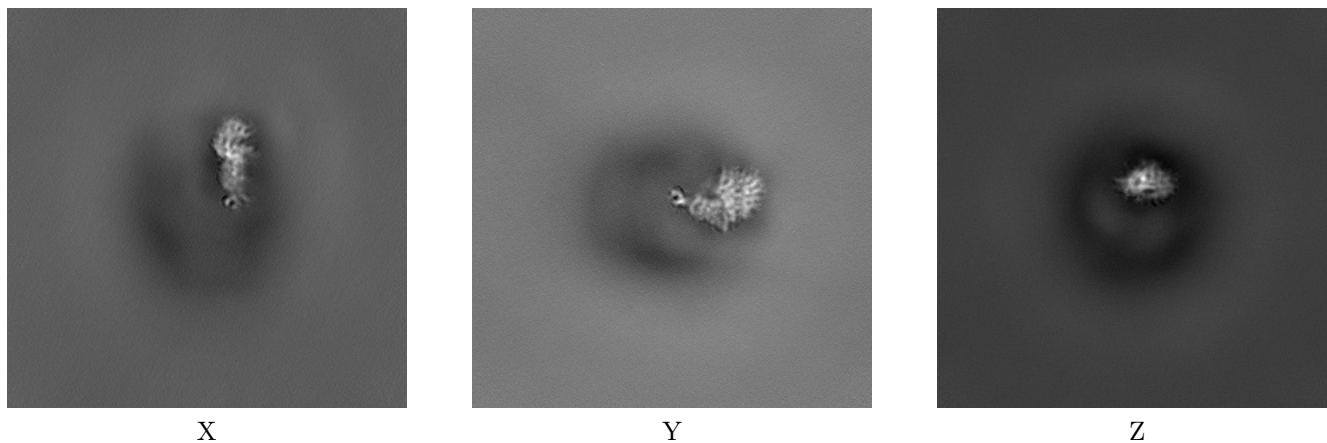
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

6.1.1 Primary map



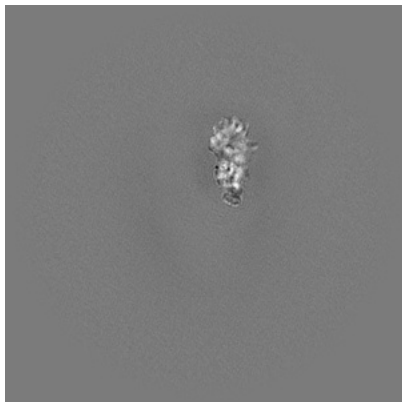
6.1.2 Raw map



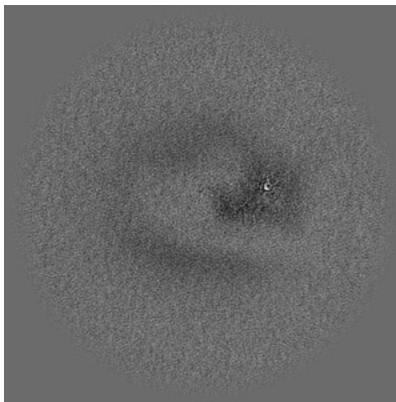
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

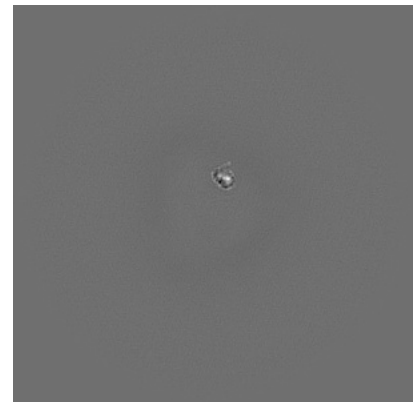
6.2.1 Primary map



X Index: 256

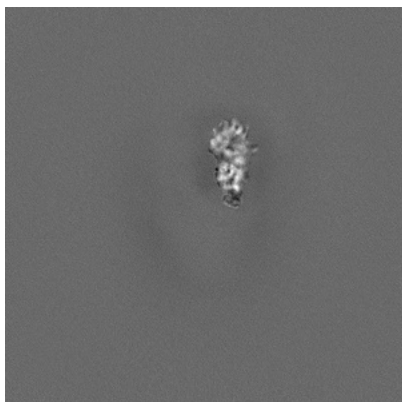


Y Index: 256

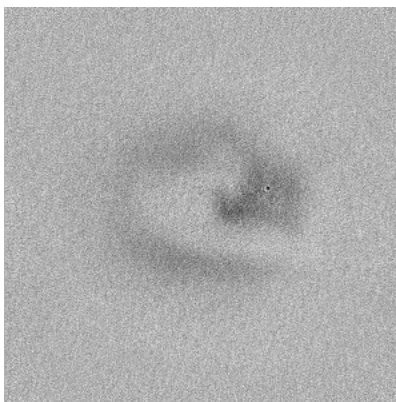


Z Index: 256

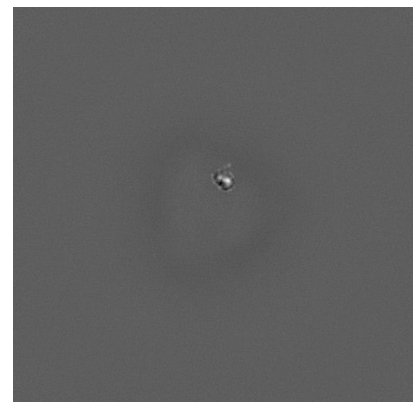
6.2.2 Raw map



X Index: 256



Y Index: 256

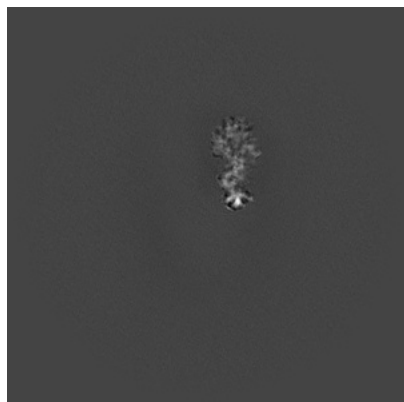


Z Index: 256

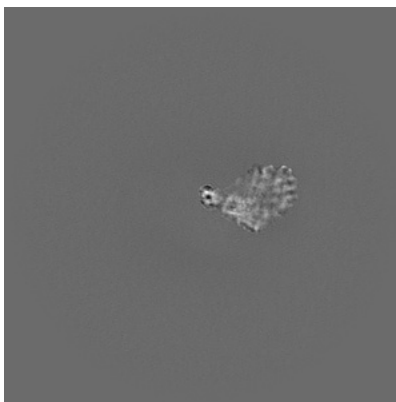
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

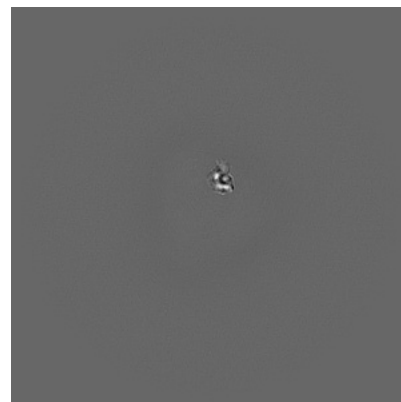
6.3.1 Primary map



X Index: 263

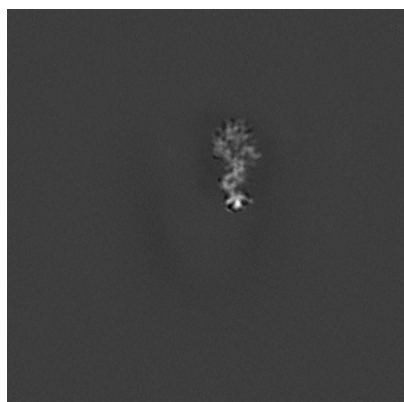


Y Index: 291

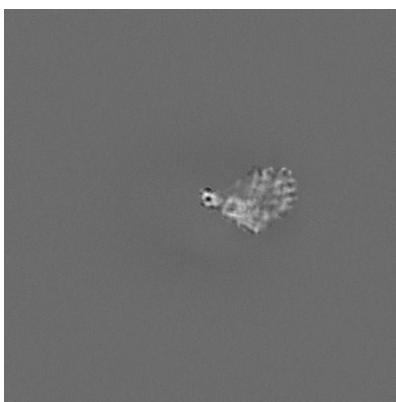


Z Index: 263

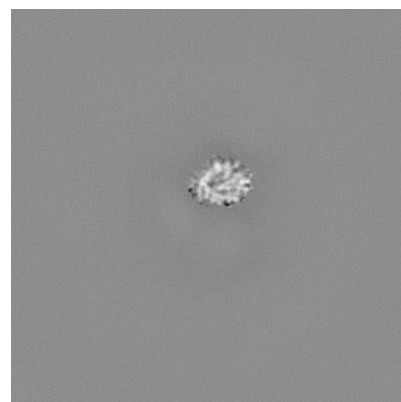
6.3.2 Raw map



X Index: 263



Y Index: 291

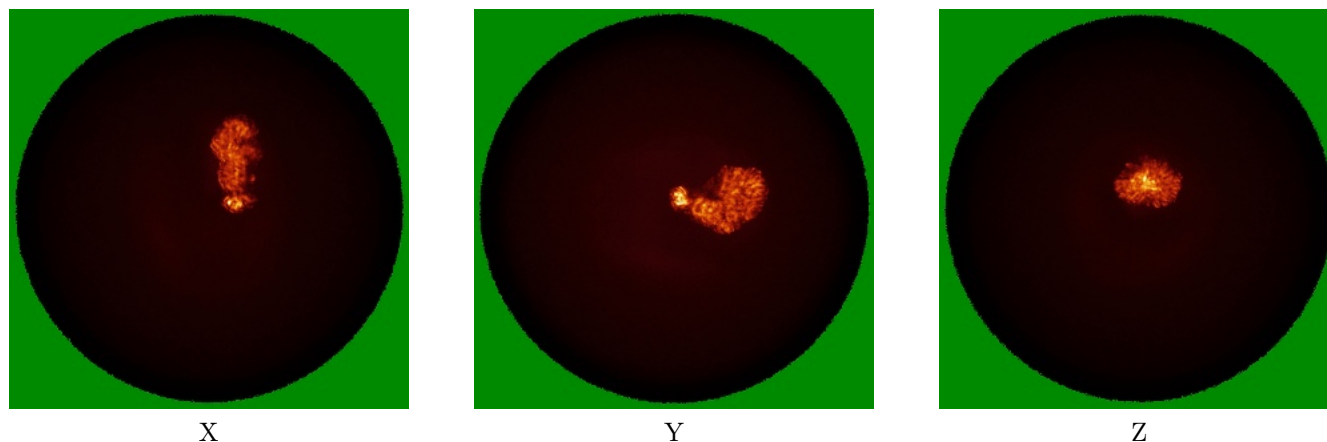


Z Index: 332

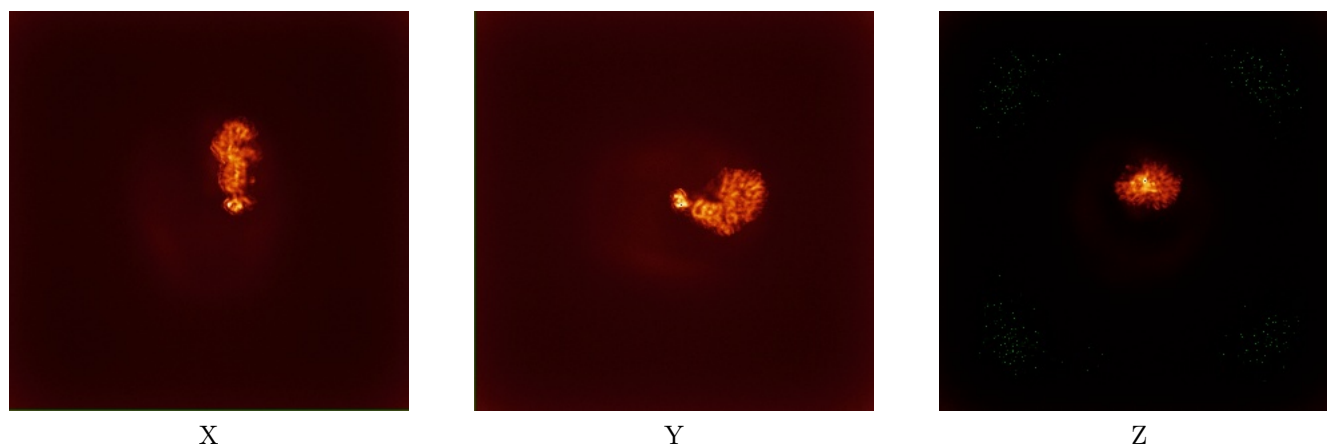
The images above show the largest variance slices of the map in three orthogonal directions.

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

6.4.1 Primary map



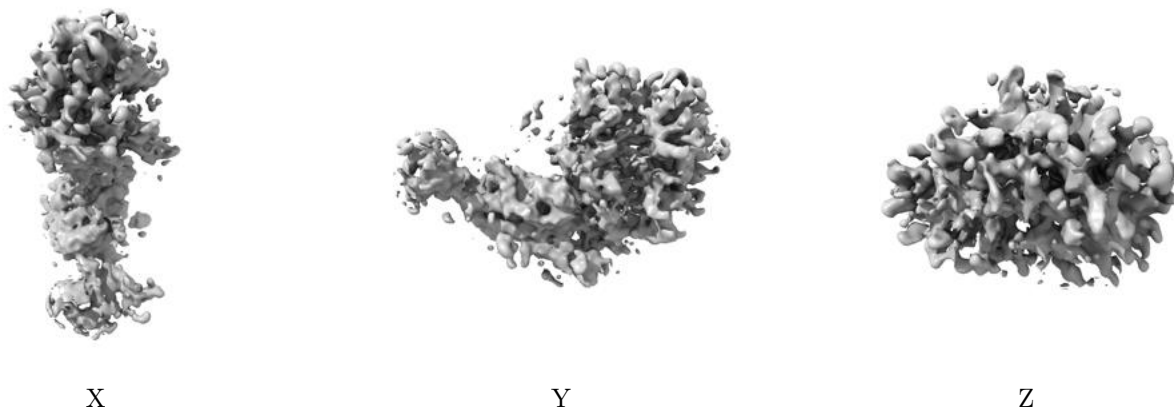
6.4.2 Raw map



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.

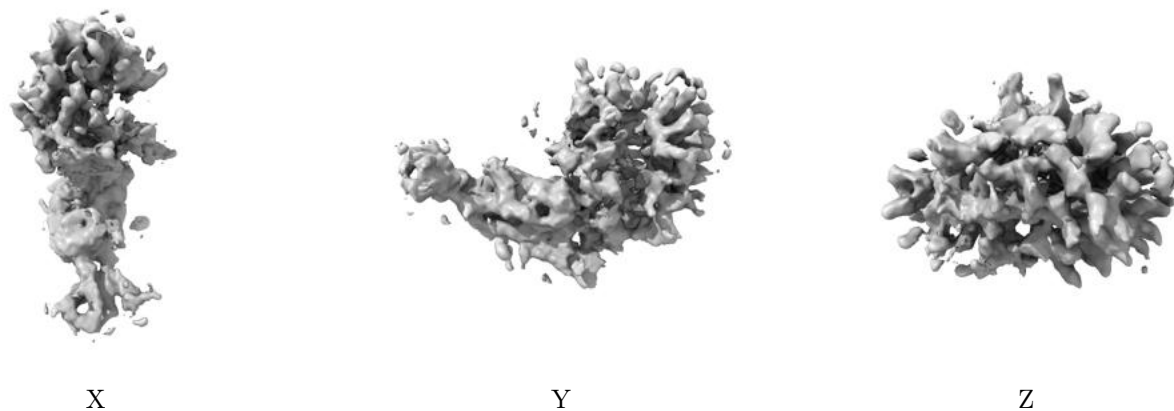
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.3. 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.

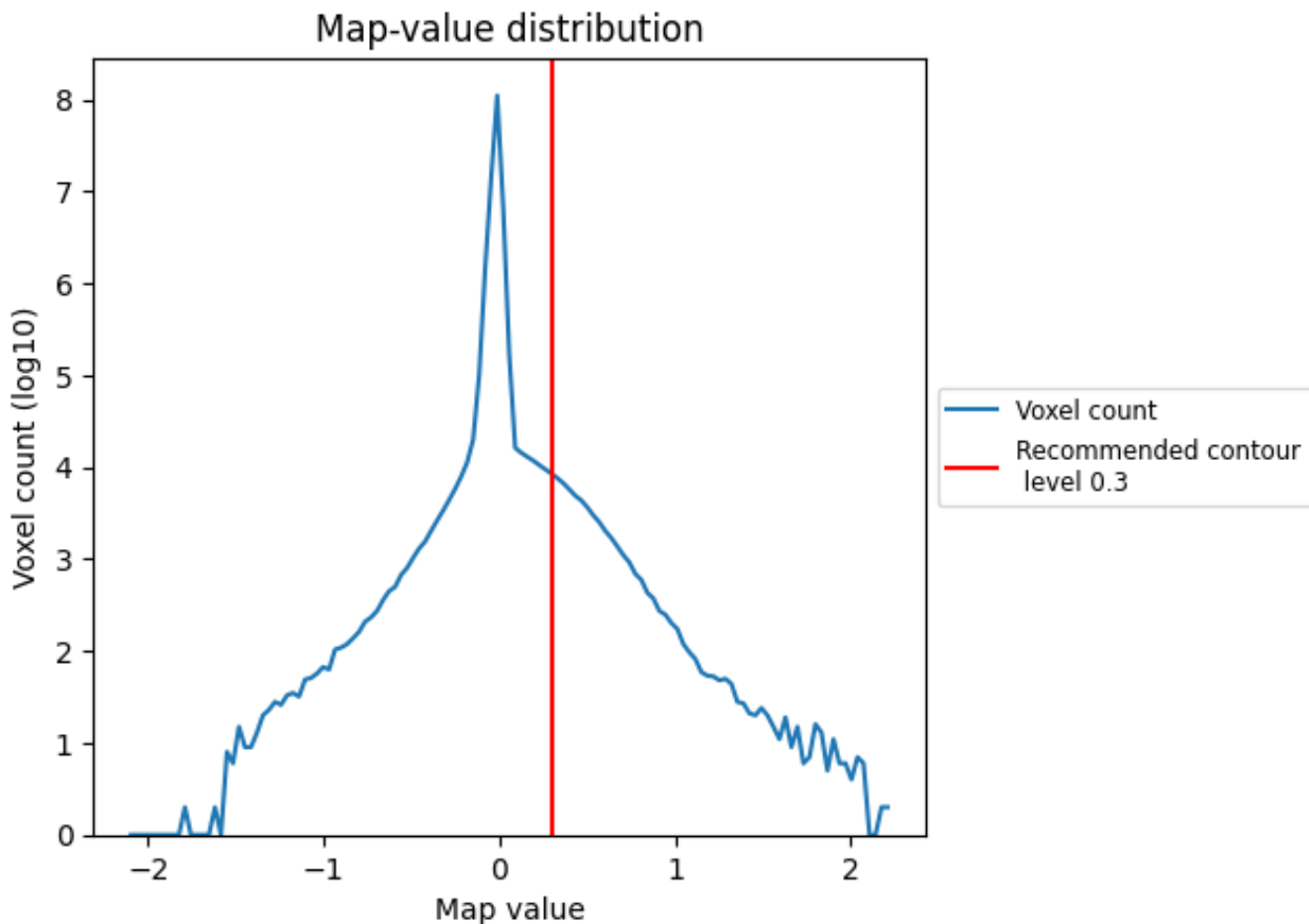
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

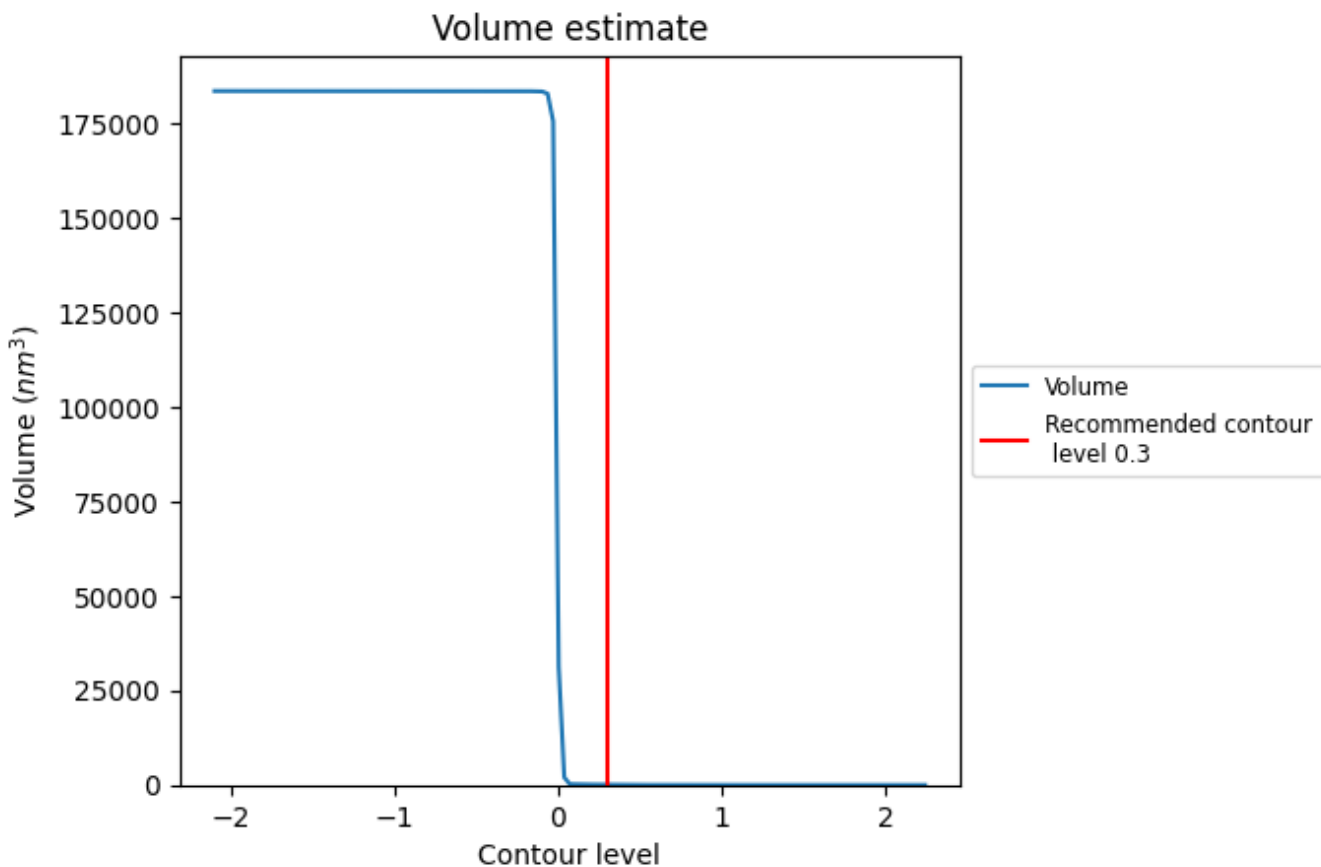
This section contains the results of statistical analysis of the map.

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.

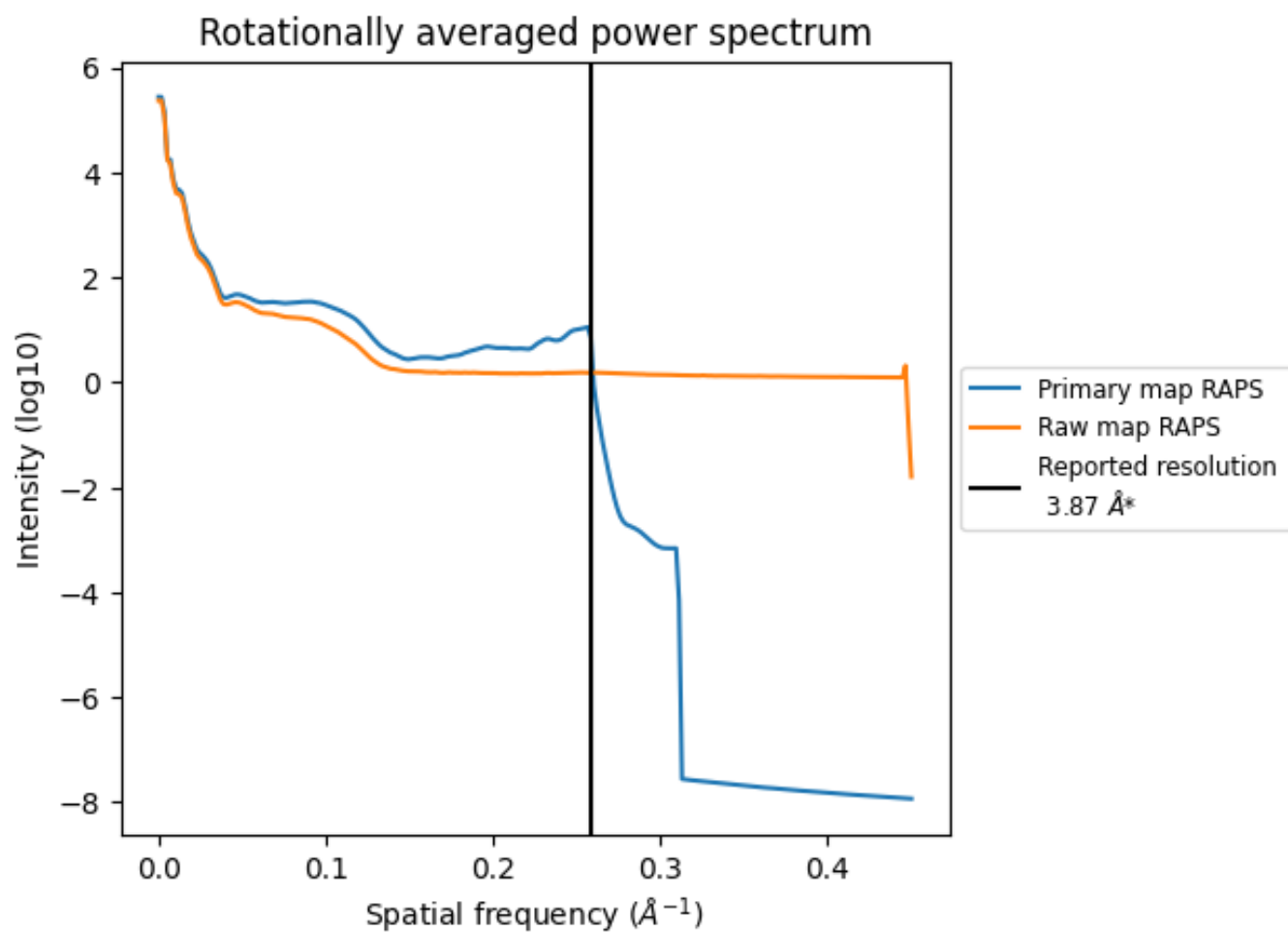
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 78 nm³; this corresponds to an approximate mass of 70 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

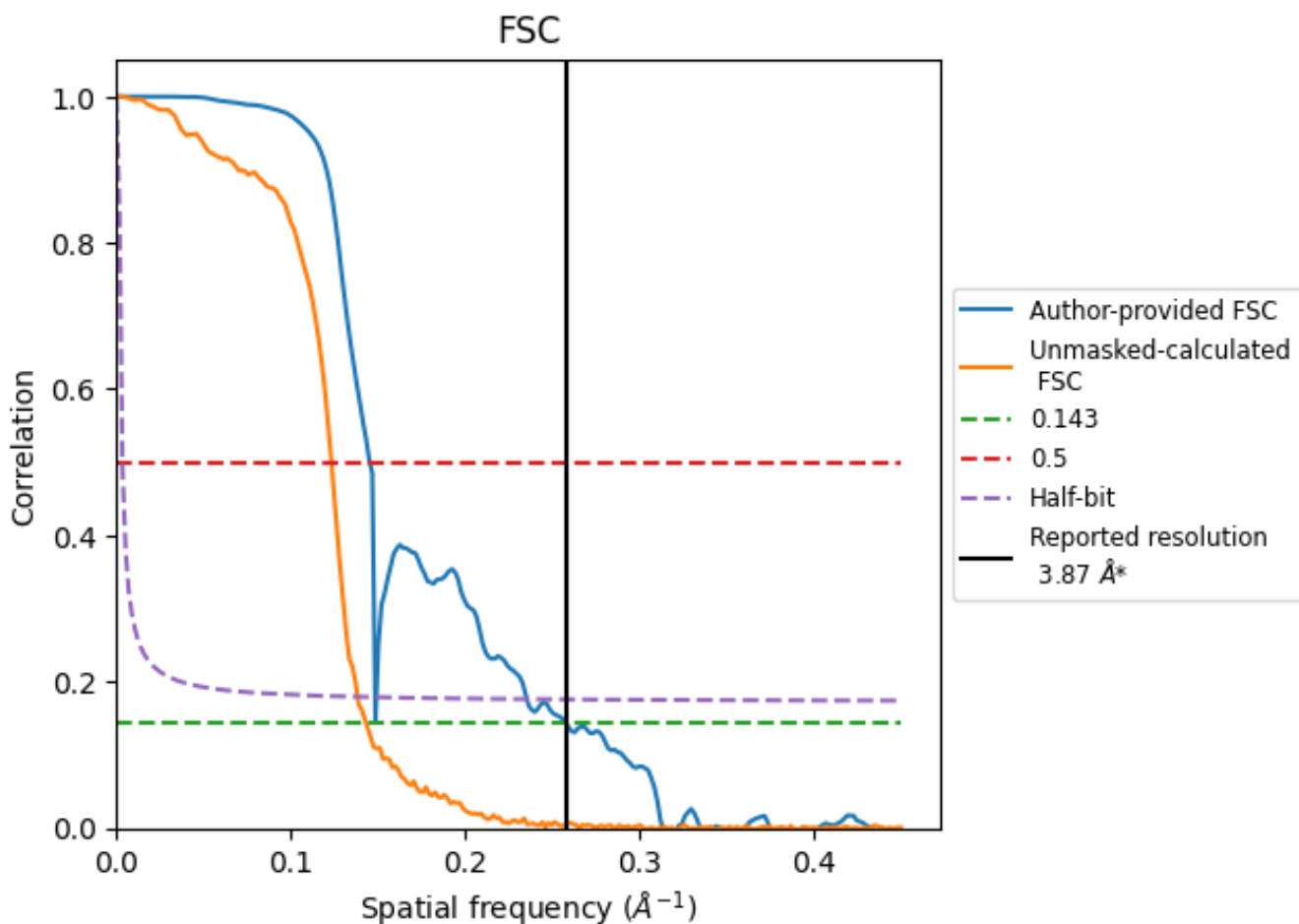


*Reported resolution corresponds to spatial frequency of 0.258 Å⁻¹

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 0.258 \AA^{-1}

8.2 Resolution estimates [i](#)

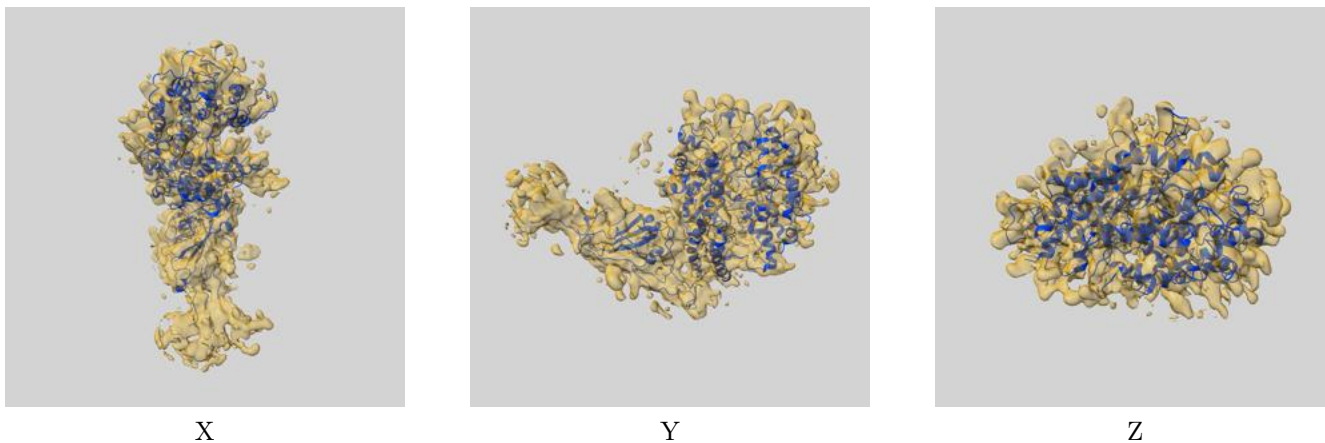
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.87	-	-
Author-provided FSC curve	3.87	6.88	6.73
Unmasked-calculated*	6.98	8.10	7.23

*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 6.98 differs from the reported value 3.87 by more than 10 %

9 Map-model fit [i](#)

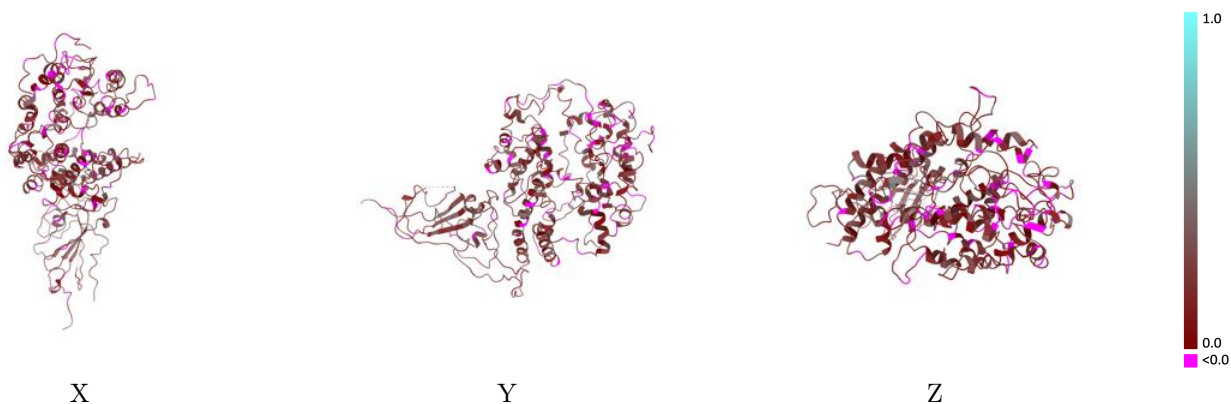
This section contains information regarding the fit between EMDB map EMD-40979 and PDB model 8T23. Per-residue inclusion information can be found in section 3 on page 6.

9.1 Map-model overlay [i](#)



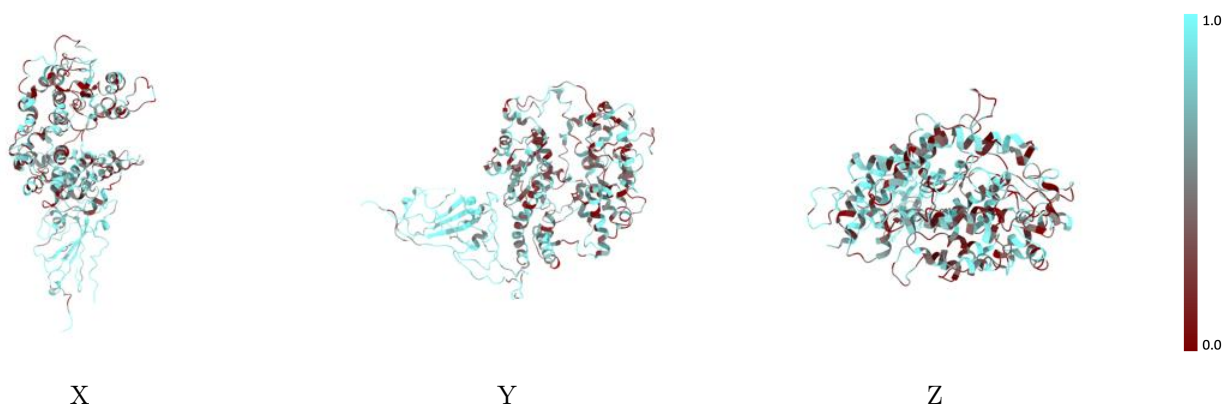
The images above show the 3D surface view of the map at the recommended contour level 0.3 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



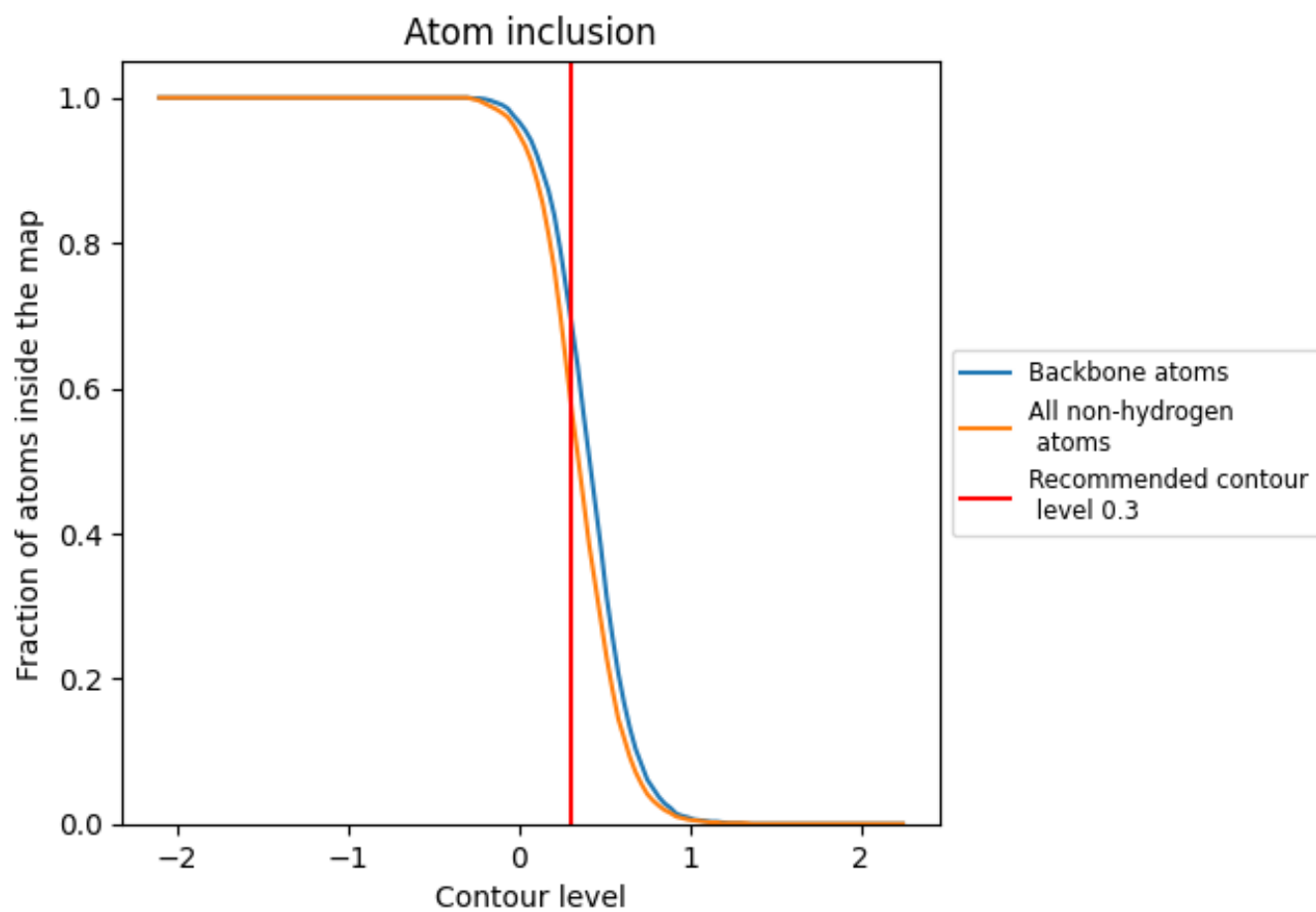
The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.3).











9.4 Atom inclusion [i](#)



At the recommended contour level, 70% of all backbone atoms, 59% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary [i](#)

The table lists the average atom inclusion at the recommended contour level (0.3) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.5880	 0.1680
A	 0.5210	 0.1500
B	 0.8190	 0.2280
G	 0.0360	 0.0570
H	 0.7080	 0.2990

