



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 26, 2026 – 03:45 pm GMT

PDB ID : 9RFZ / pdb\_00009rfz  
Title : Unspecific peroxygenase from *Psathyrella aberdarensis*, Grogu variant, in complex with tetradecane  
Authors : Fernandez-Garcia, A.; Sanz-Aparicio, J.  
Deposited on : 2025-06-05  
Resolution : 2.12 Å (reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

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

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>.

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

MolProbity : 4-5-2 with Phenix2.0  
Mogul : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 2.0  
EDS : 3.0  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.010 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.48.1

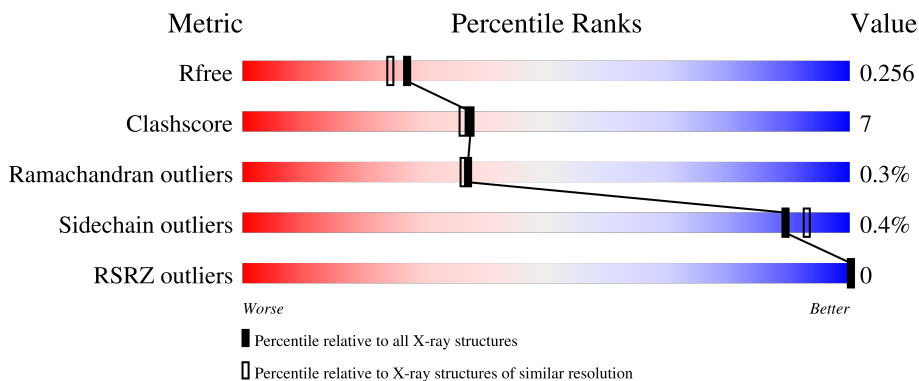
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.12 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)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	164625	7689 (2.14-2.10)
Clashscore	180529	8431 (2.14-2.10)
Ramachandran outliers	177936	8366 (2.14-2.10)
Sidechain outliers	177891	8367 (2.14-2.10)
RSRZ outliers	164620	7689 (2.14-2.10)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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 electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	334	91% (green), 8% (yellow)
1	B	334	90% (green), 9% (yellow), . (orange)
2	G	2	50% (green), 50% (yellow)
2	P	2	50% (green), 50% (yellow)
2	S	2	50% (green), 50% (yellow)

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:

<b>Mol</b>	<b>Type</b>	<b>Chain</b>	<b>Res</b>	<b>Chirality</b>	<b>Geometry</b>	<b>Clashes</b>	<b>Electron density</b>
5	GOL	B	412	-	-	X	-

## 2 Entry composition [i](#)

There are 10 unique types of molecules in this entry. The entry contains 5736 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, 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.

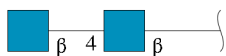
- Molecule 1 is a protein called Heme-thiolate peroxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	334	2593	1656	436	494	7	0	1	0
1	B	334	2597	1659	436	495	7	0	2	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	61	ALA	SER	engineered mutation	UNP A0A4Q2DF39
A	79	ILE	LEU	engineered mutation	UNP A0A4Q2DF39
A	252	LEU	ALA	engineered mutation	UNP A0A4Q2DF39
B	61	ALA	SER	engineered mutation	UNP A0A4Q2DF39
B	79	ILE	LEU	engineered mutation	UNP A0A4Q2DF39
B	252	LEU	ALA	engineered mutation	UNP A0A4Q2DF39

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



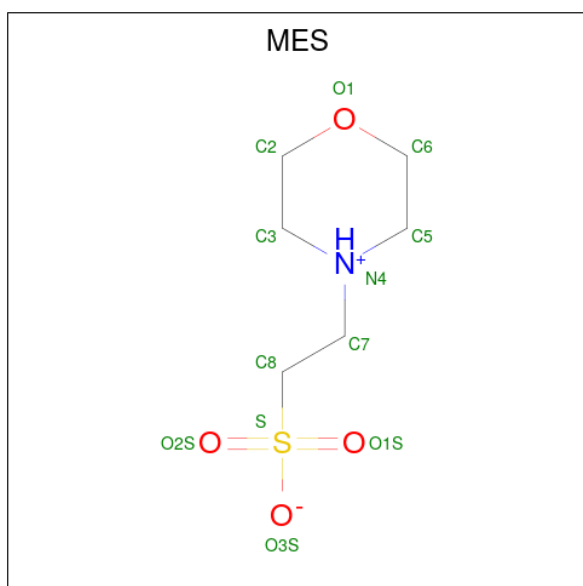
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	G	2	28	16	2	10	0	0	0
2	P	2	28	16	2	10	0	0	0
2	S	2	28	16	2	10	0	0	0

- Molecule 3 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C<sub>8</sub>H<sub>15</sub>NO<sub>6</sub>).



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

- Molecule 4 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula:  $C_6H_{13}NO_4S$ ).



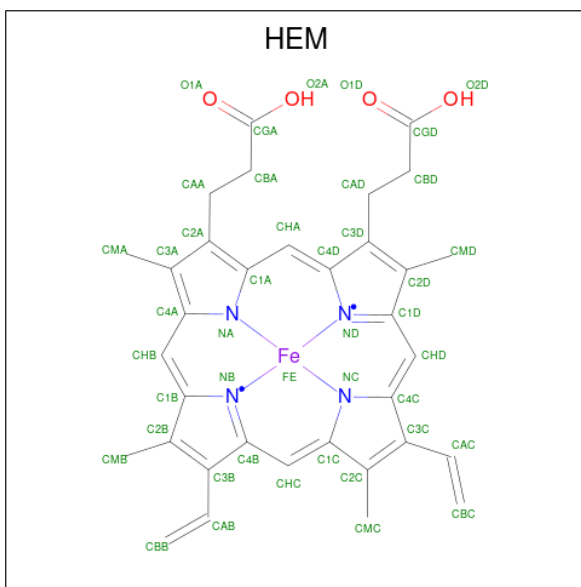
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
4	A	1	12	6	1	4	1	0	0
4	B	1	12	6	1	4	1	0	0

- Molecule 5 is GLYCEROL (CCD ID: GOL) (formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
5	A	1	6	3	3	0	0
5	A	1	6	3	3	0	0
5	B	1	6	3	3	0	0

- Molecule 6 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: HEM) (formula: C<sub>34</sub>H<sub>32</sub>FeN<sub>4</sub>O<sub>4</sub>) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
6	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
6	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

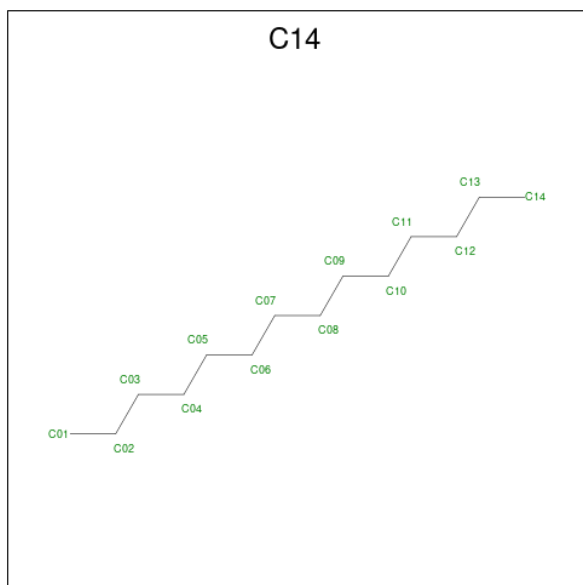
- Molecule 7 is ZINC ION (CCD ID: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	9	Total	Zn	0	0
			9	9		
7	B	5	Total	Zn	0	0
			5	5		

- Molecule 8 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	1	Total	Mg	0	0
			1	1		
8	B	1	Total	Mg	0	0
			1	1		

- Molecule 9 is TETRADECANE (CCD ID: C14) (formula: C<sub>14</sub>H<sub>30</sub>) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
9	B	1	Total C 14 14	0	0

- Molecule 10 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
10	A	129	Total O 129 129	0	0
10	B	119	Total O 119 119	0	0

### 3 Residue-property plots

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron 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 dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). 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.

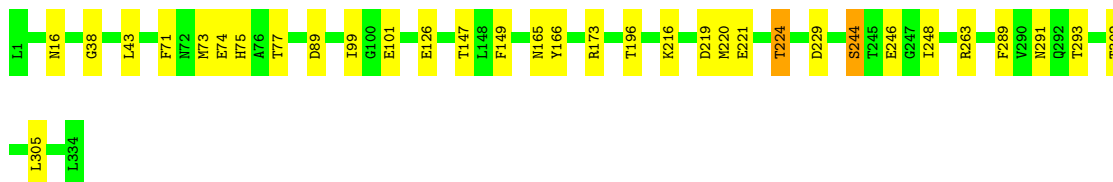
- Molecule 1: Heme-thiolate peroxidase

Chain A:  91% 8%



- Molecule 1: Heme-thiolate peroxidase

Chain B:  90% 9%



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

Chain G:  50% 50%



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

Chain P:  50% 50%



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

Chain S:  50% 50%



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	76.75Å 76.75Å 266.29Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	47.04 – 2.12 47.04 – 2.12	Depositor EDS
% Data completeness (in resolution range)	99.6 (47.04-2.12) 99.6 (47.04-2.12)	Depositor EDS
$R_{merge}$	0.20	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.60 (at 2.12Å)	Xtrriage
Refinement program	REFMAC 5.8.0419	Depositor
R, $R_{free}$	0.219 , 0.253 0.222 , 0.256	Depositor DCC
$R_{free}$ test set	2449 reflections (4.89%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	30.6	Xtrriage
Anisotropy	0.099	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 21.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.43$ , $\langle L^2 \rangle = 0.26$	Xtrriage
Estimated twinning fraction	0.114 for h,-h-k,-l	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	5736	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	34.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.71% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 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: MG, MES, HEM, GOL, ZN, NAG, C14

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	0.56	0/2672	1.01	3/3644 (0.1%)
1	B	0.55	0/2679	1.01	3/3654 (0.1%)
All	All	0.55	0/5351	1.01	6/7298 (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	259	PRO	N-CA-CB	6.01	108.66	103.31
1	B	246	GLU	CB-CG-CD	5.70	122.29	112.60
1	B	224	THR	CA-CB-OG1	-5.63	101.15	109.60
1	A	224	THR	CA-CB-OG1	-5.33	101.60	109.60
1	A	152	PHE	CA-CB-CG	5.20	119.00	113.80
1	B	219	ASP	CA-CB-CG	5.08	117.68	112.60

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	2593	0	2453	29	0
1	B	2597	0	2457	42	0
2	G	28	0	25	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	P	28	0	25	5	0
2	S	28	0	25	2	0
3	A	28	0	26	9	0
3	B	28	0	26	6	0
4	A	12	0	13	0	0
4	B	12	0	13	1	0
5	A	12	0	16	0	0
5	B	6	0	8	6	0
6	A	43	0	30	4	0
6	B	43	0	30	5	0
7	A	9	0	0	0	0
7	B	5	0	0	0	0
8	A	1	0	0	0	0
8	B	1	0	0	0	0
9	B	14	0	30	4	0
10	A	129	0	0	6	0
10	B	119	0	0	9	0
All	All	5736	0	5177	74	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 7.

All (74) 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:B:165:ASN:HD21	2:P:1:NAG:C1	0.97	1.55
1:B:16:ASN:ND2	3:B:401:NAG:C1	1.68	1.55
1:B:291:ASN:ND2	3:B:402:NAG:C1	1.68	1.53
1:A:145:ASN:HD21	3:A:401:NAG:C1	0.88	1.51
1:A:145:ASN:ND2	3:A:401:NAG:C1	1.73	1.51
1:B:165:ASN:ND2	2:P:1:NAG:C1	1.78	1.40
1:A:16:ASN:ND2	3:A:402:NAG:C1	1.95	1.29
1:B:291:ASN:CG	3:B:402:NAG:C1	2.27	1.07
1:B:221:GLU:HG3	10:B:613:HOH:O	1.57	1.03
1:A:16:ASN:HD22	3:A:402:NAG:C1	1.77	0.94
1:B:305:LEU:HD23	5:B:412:GOL:H12	1.53	0.89
1:A:16:ASN:HD21	3:A:402:NAG:C1	1.88	0.87
10:B:570:HOH:O	2:S:1:NAG:C7	2.27	0.82
1:B:263:ARG:HD3	10:B:605:HOH:O	1.78	0.82
1:A:73[A]:MET:HE2	1:A:77:THR:HG22	1.63	0.80
1:B:165:ASN:CG	2:P:1:NAG:C1	2.56	0.79

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:291:ASN:ND2	3:B:402:NAG:O5	2.16	0.78
1:A:73[B]:MET:HE3	6:A:405:HEM:HMC1	1.65	0.76
1:A:171:GLU:OE2	10:A:501:HOH:O	2.06	0.74
1:B:74:GLU:OE2	1:B:77:THR:HG23	1.87	0.74
1:B:302:THR:OG1	5:B:412:GOL:H32	1.88	0.73
1:B:149:PHE:CE2	1:B:224:THR:HG22	2.25	0.71
1:B:291:ASN:OD1	3:B:402:NAG:C1	2.39	0.69
1:B:75:HIS:HD2	10:B:592:HOH:O	1.76	0.69
1:A:149:PHE:CE2	1:A:224:THR:HG22	2.28	0.68
1:B:101:GLU:OE1	10:B:501:HOH:O	2.13	0.66
1:A:75:HIS:HD2	10:A:612:HOH:O	1.79	0.65
1:B:305:LEU:CD2	5:B:412:GOL:H12	2.26	0.64
1:A:235:ASP:OD2	10:A:502:HOH:O	2.15	0.64
1:B:75:HIS:CD2	10:B:592:HOH:O	2.51	0.64
1:B:73[B]:MET:HE3	6:B:405:HEM:CMC	2.30	0.61
1:A:16:ASN:ND2	3:A:402:NAG:C2	2.63	0.60
6:A:405:HEM:HBB2	6:A:405:HEM:HHC	1.84	0.60
1:A:145:ASN:CG	3:A:401:NAG:C1	2.68	0.59
1:B:73[B]:MET:HE3	6:B:405:HEM:HMC1	1.83	0.59
1:A:73[A]:MET:CE	1:A:77:THR:HG22	2.31	0.59
1:B:149:PHE:HE2	1:B:224:THR:HG22	1.68	0.59
1:B:302:THR:OG1	5:B:412:GOL:C3	2.51	0.59
1:B:221:GLU:CG	10:B:613:HOH:O	2.32	0.58
1:A:73[B]:MET:HE3	6:A:405:HEM:CMC	2.34	0.57
1:A:220:MET:O	1:A:224:THR:HG23	2.05	0.56
1:A:73[B]:MET:CE	6:A:405:HEM:HMC1	2.33	0.56
1:B:16:ASN:HD22	3:B:401:NAG:C1	2.06	0.56
1:A:149:PHE:HE2	1:A:224:THR:HG22	1.71	0.56
1:B:220:MET:O	1:B:224:THR:HG23	2.06	0.56
1:A:289:PHE:O	1:A:293:THR:OG1	2.23	0.55
1:A:16:ASN:HD21	3:A:402:NAG:C2	2.19	0.55
1:B:289:PHE:O	1:B:293:THR:OG1	2.25	0.53
1:A:145:ASN:ND2	3:A:401:NAG:C2	2.66	0.53
1:A:283:CYS:O	1:A:287:THR:HG23	2.09	0.52
1:B:147:THR:HB	2:S:1:NAG:H5	1.93	0.50
1:B:166:TYR:HB2	2:P:1:NAG:H82	1.94	0.50
1:B:165:ASN:ND2	2:P:1:NAG:C2	2.67	0.49
1:B:196:THR:HG22	9:B:404:C14:H031	1.95	0.48
1:A:38:GLY:HA3	1:A:99:ILE:O	2.13	0.47
1:B:43:LEU:HD11	6:B:405:HEM:C2B	2.50	0.47
1:B:302:THR:H	5:B:412:GOL:H11	1.81	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:38:GLY:HA3	1:B:99:ILE:O	2.15	0.46
1:A:321:ALA:O	10:A:503:HOH:O	2.21	0.46
1:B:71:PHE:CD2	6:B:405:HEM:HBC2	2.52	0.45
1:B:302:THR:O	5:B:412:GOL:H11	2.17	0.45
1:B:89:ASP:HA	10:B:541:HOH:O	2.16	0.45
1:A:314:ARG:HD3	1:A:327:GLU:OE2	2.17	0.45
1:A:139:GLY:C	10:A:532:HOH:O	2.62	0.43
1:B:248:ILE:HG21	9:B:404:C14:H121	2.00	0.42
1:B:196:THR:CG2	9:B:404:C14:H031	2.48	0.42
1:B:126:GLU:HA	6:B:405:HEM:HBA2	2.01	0.42
1:B:77:THR:HG21	1:B:244:SER:CB	2.50	0.42
1:B:229:ASP:HA	4:B:403:MES:H31	2.02	0.41
1:A:110:PRO:HB3	10:A:606:HOH:O	2.21	0.41
9:B:404:C14:H101	9:B:404:C14:H131	1.88	0.41
1:A:2:ASN:C	1:A:3:GLU:HG3	2.47	0.40
1:B:216:LYS:HD3	10:B:595:HOH:O	2.21	0.40
1:A:132:THR:HG21	1:A:227:ILE:HG21	2.03	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 X-ray entries followed by that with respect to entries of similar resolution.

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	333/334 (100%)	319 (96%)	13 (4%)	1 (0%)	37 36
1	B	334/334 (100%)	320 (96%)	13 (4%)	1 (0%)	37 36
All	All	667/668 (100%)	639 (96%)	26 (4%)	2 (0%)	37 36

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	244	SER

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Mol	Chain	Res	Type
1	B	244	SER

### 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 X-ray entries followed by that with respect to entries of similar resolution.

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	275/274 (100%)	274 (100%)	1 (0%)	89	93
1	B	276/274 (101%)	275 (100%)	1 (0%)	89	93
All	All	551/548 (100%)	549 (100%)	2 (0%)	89	93

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	173	ARG
1	B	173	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	16	ASN
1	A	33	GLN
1	A	145	ASN
1	B	146	GLN
1	B	165	ASN
1	B	312	ASN

### 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

6 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
2	NAG	G	1	2,1	14,14,15	0.42	0	17,19,21	1.37	2 (11%)
2	NAG	G	2	2	14,14,15	0.35	0	17,19,21	0.79	0
2	NAG	P	1	2	14,14,15	0.41	0	17,19,21	0.69	0
2	NAG	P	2	2	14,14,15	0.35	0	17,19,21	0.70	0
2	NAG	S	1	2	14,14,15	0.33	0	17,19,21	1.03	0
2	NAG	S	2	2	14,14,15	0.36	0	17,19,21	0.86	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
2	NAG	G	1	2,1	-	0/6/23/26	0/1/1/1
2	NAG	G	2	2	-	2/6/23/26	0/1/1/1
2	NAG	P	1	2	-	0/6/23/26	0/1/1/1
2	NAG	P	2	2	-	0/6/23/26	0/1/1/1
2	NAG	S	1	2	-	0/6/23/26	0/1/1/1
2	NAG	S	2	2	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	G	1	NAG	O5-C1-C2	4.05	117.69	111.29
2	G	1	NAG	O4-C4-C3	-2.43	104.73	110.35

There are no chirality outliers.

All (2) torsion outliers are listed below:

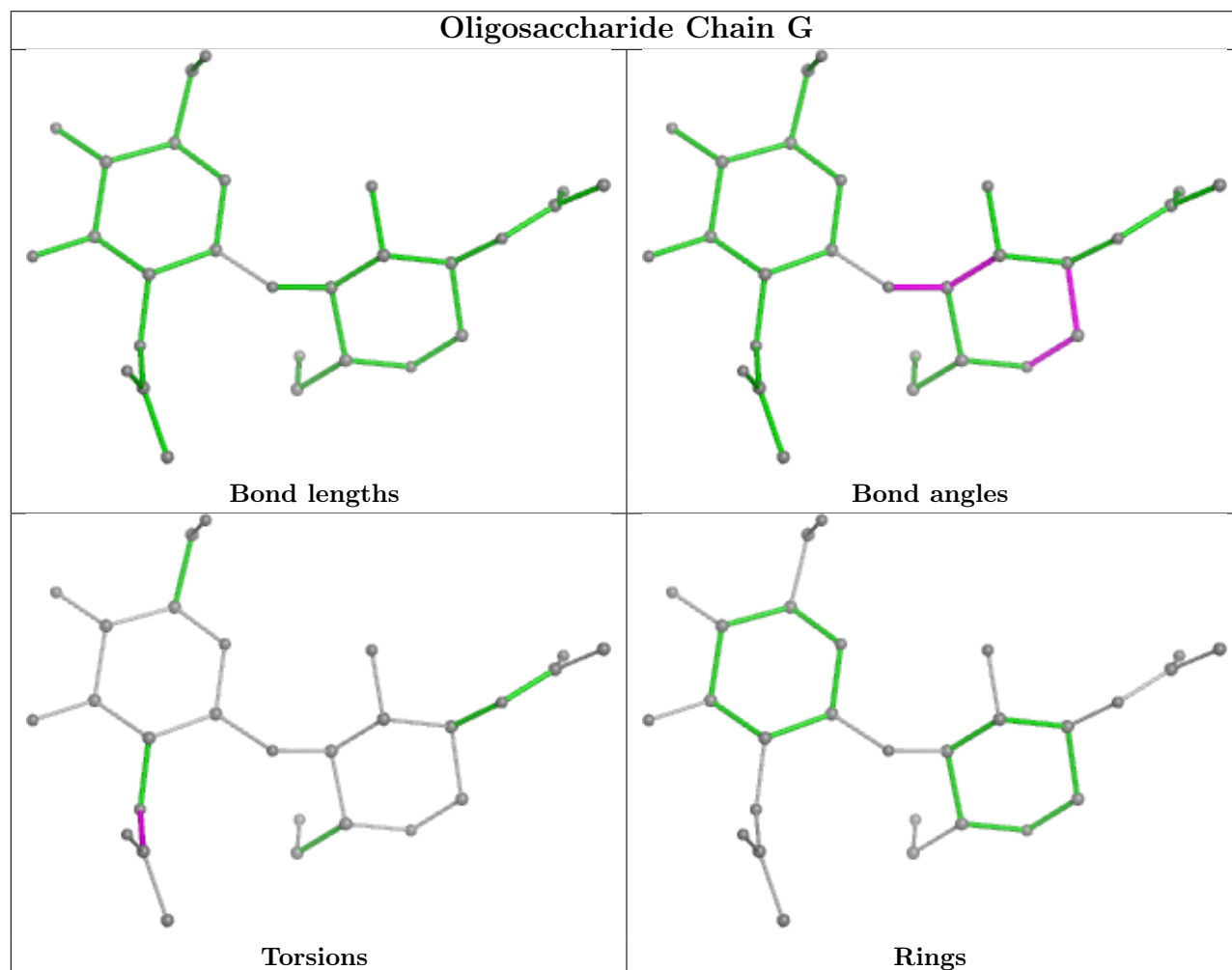
Mol	Chain	Res	Type	Atoms
2	G	2	NAG	C8-C7-N2-C2
2	G	2	NAG	O7-C7-N2-C2

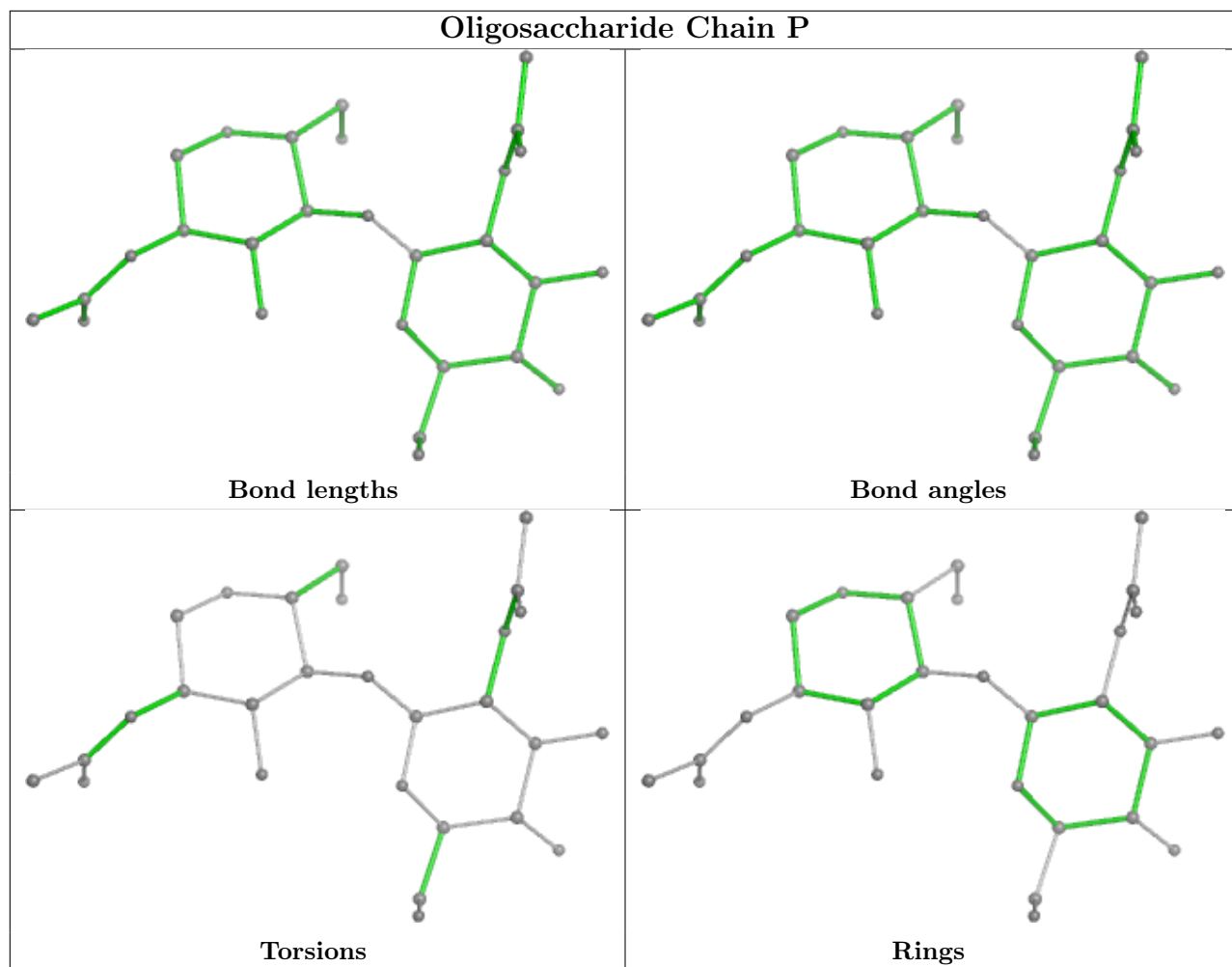
There are no ring outliers.

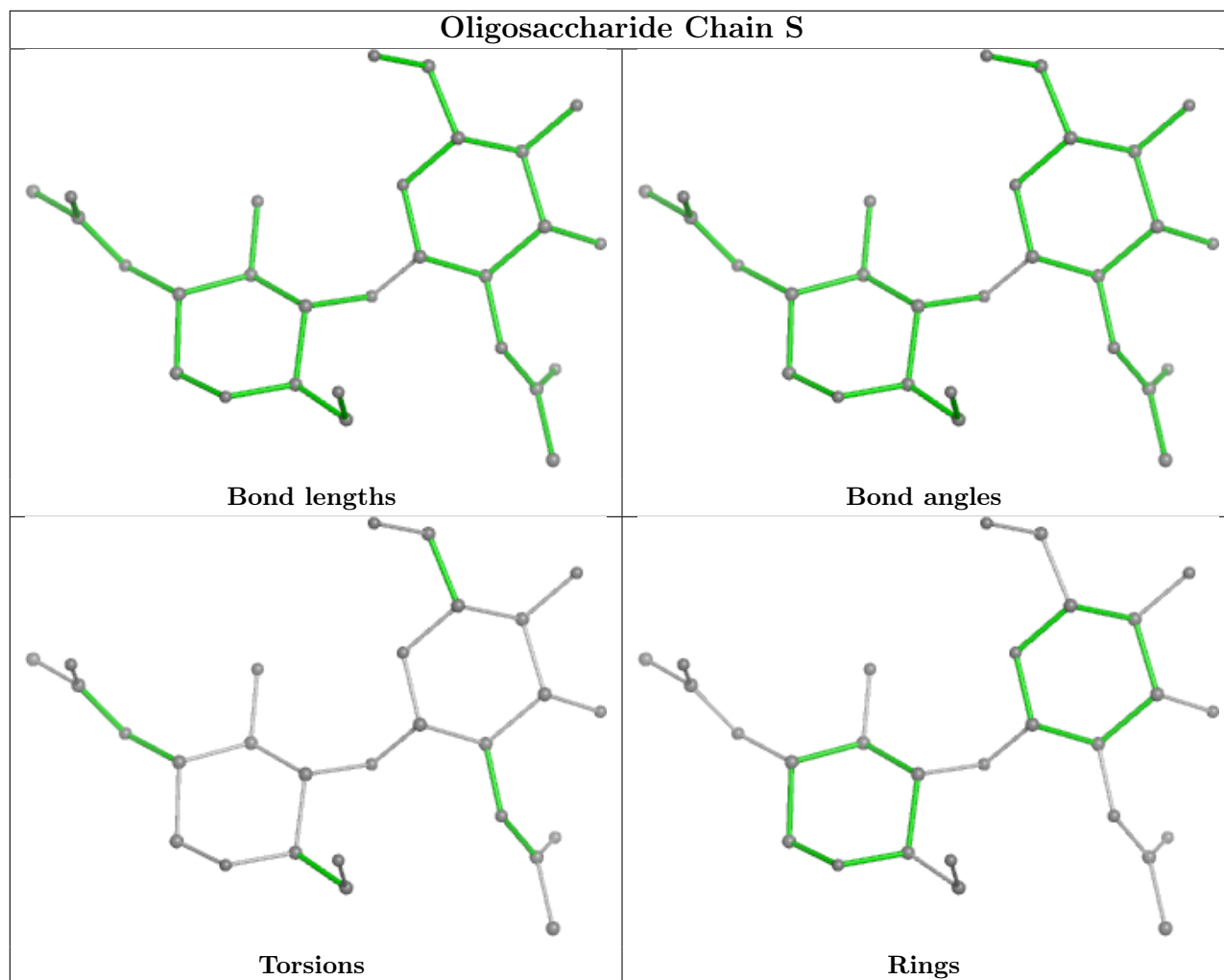
2 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	S	1	NAG	2	0
2	P	1	NAG	5	0

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](#)

Of 28 ligands modelled in this entry, 16 are monoatomic - leaving 12 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	$\# Z  > 2$
6	HEM	A	405	8,1	41,50,50	1.42	4 (9%)	45,82,82	1.74	12 (26%)
3	NAG	A	401	-	14,14,15	0.38	0	17,19,21	1.37	2 (11%)
3	NAG	B	401	-	14,14,15	0.39	0	17,19,21	0.99	1 (5%)
5	GOL	A	416	-	5,5,5	0.20	0	5,5,5	0.23	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
5	GOL	B	412	-	5,5,5	0.24	0	5,5,5	0.54	0
3	NAG	A	402	-	14,14,15	0.42	0	17,19,21	1.78	3 (17%)
4	MES	B	403	-	12,12,12	0.76	0	14,16,16	0.90	1 (7%)
9	C14	B	404	-	13,13,13	0.13	0	12,12,12	0.11	0
6	HEM	B	405	8,10,1	41,50,50	1.27	4 (9%)	45,82,82	2.02	17 (37%)
3	NAG	B	402	-	14,14,15	0.33	0	17,19,21	1.17	1 (5%)
4	MES	A	403	-	12,12,12	0.70	0	14,16,16	1.65	2 (14%)
5	GOL	A	404	-	5,5,5	0.10	0	5,5,5	0.25	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
6	HEM	A	405	8,1	-	3/12/54/54	-
3	NAG	A	401	-	-	4/6/23/26	0/1/1/1
3	NAG	B	401	-	-	0/6/23/26	0/1/1/1
5	GOL	A	416	-	-	2/4/4/4	-
5	GOL	B	412	-	-	0/4/4/4	-
3	NAG	A	402	-	-	3/6/23/26	0/1/1/1
4	MES	B	403	-	-	1/6/14/14	0/1/1/1
9	C14	B	404	-	-	8/11/11/11	-
6	HEM	B	405	8,10,1	-	3/12/54/54	-
3	NAG	B	402	-	-	3/6/23/26	0/1/1/1
4	MES	A	403	-	-	3/6/14/14	0/1/1/1
5	GOL	A	404	-	-	0/4/4/4	-

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	405	HEM	C4D-ND	-4.50	1.32	1.40
6	A	405	HEM	C1B-NB	-3.28	1.34	1.40
6	B	405	HEM	C1B-NB	-3.02	1.35	1.40
6	B	405	HEM	FE-ND	-2.82	1.82	1.96
6	A	405	HEM	C1D-ND	-2.75	1.33	1.38
6	B	405	HEM	FE-NB	2.60	2.09	1.96
6	B	405	HEM	CAA-C2A	-2.28	1.48	1.52
6	A	405	HEM	C1A-CHA	-2.28	1.34	1.41

All (39) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	402	NAG	O5-C1-C2	5.55	120.06	111.29
6	B	405	HEM	CHC-C4B-NB	5.41	130.31	124.43
4	A	403	MES	O1S-S-C8	-4.90	101.01	106.92
3	A	402	NAG	C2-N2-C7	4.03	128.65	122.90
3	A	401	NAG	C2-N2-C7	4.00	128.59	122.90
3	B	402	NAG	C2-N2-C7	3.67	128.13	122.90
6	B	405	HEM	CHD-C1D-ND	3.59	128.33	124.43
6	B	405	HEM	CHA-C4D-ND	3.42	128.61	124.38
6	A	405	HEM	CHD-C1D-ND	3.27	127.98	124.43
6	B	405	HEM	O2D-CGD-O1D	-3.23	115.25	123.30
6	B	405	HEM	C1B-NB-C4B	3.18	108.36	105.07
6	B	405	HEM	O2D-CGD-CBD	3.15	124.14	114.03
3	B	401	NAG	O5-C1-C2	3.10	116.19	111.29
6	A	405	HEM	CHD-C1D-C2D	-3.09	120.15	124.98
6	A	405	HEM	O2A-CGA-CBA	3.05	123.83	114.03
6	A	405	HEM	C1B-NB-C4B	3.05	108.22	105.07
4	B	403	MES	O2S-S-C8	-3.01	103.29	106.92
6	A	405	HEM	CHC-C4B-NB	2.82	127.50	124.43
6	A	405	HEM	O2A-CGA-O1A	-2.72	116.52	123.30
6	B	405	HEM	O2A-CGA-O1A	-2.71	116.56	123.30
6	B	405	HEM	CAA-CBA-CGA	-2.64	106.34	113.76
6	B	405	HEM	CHD-C1D-C2D	-2.63	120.86	124.98
4	A	403	MES	O3S-S-C8	2.62	110.01	105.77
6	A	405	HEM	CAD-C3D-C4D	2.56	129.14	124.66
6	B	405	HEM	C2C-C3C-C4C	2.50	108.64	106.90
6	B	405	HEM	CHB-C1B-NB	2.37	127.31	124.38
6	B	405	HEM	CBA-CAA-C2A	-2.36	108.59	112.62
6	A	405	HEM	CHA-C4D-ND	2.32	127.24	124.38
6	A	405	HEM	CHA-C4D-C3D	-2.31	121.00	125.33
6	A	405	HEM	C4B-C3B-C2B	-2.28	105.31	107.11
6	B	405	HEM	CMB-C2B-C1B	2.27	128.49	125.04
6	A	405	HEM	O2D-CGD-O1D	-2.24	117.72	123.30
3	A	402	NAG	C1-O5-C5	2.15	115.10	112.19
6	A	405	HEM	O2D-CGD-CBD	2.12	120.84	114.03
6	B	405	HEM	CMC-C2C-C3C	2.12	128.64	124.68
6	B	405	HEM	CAD-CBD-CGD	-2.06	109.17	113.60
3	A	401	NAG	O5-C1-C2	2.02	114.48	111.29
6	B	405	HEM	CMD-C2D-C1D	2.02	128.11	125.04
6	B	405	HEM	CHC-C4B-C3B	-2.01	121.49	124.57

There are no chirality outliers.

All (30) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	401	NAG	C8-C7-N2-C2
3	A	401	NAG	O7-C7-N2-C2
3	A	402	NAG	C3-C2-N2-C7
4	A	403	MES	C8-C7-N4-C5
4	A	403	MES	N4-C7-C8-S
4	B	403	MES	C8-C7-N4-C3
3	A	402	NAG	C8-C7-N2-C2
3	A	402	NAG	O7-C7-N2-C2
9	B	404	C14	C10-C11-C12-C13
9	B	404	C14	C08-C09-C10-C11
9	B	404	C14	C04-C05-C06-C07
3	B	402	NAG	C8-C7-N2-C2
3	B	402	NAG	O7-C7-N2-C2
9	B	404	C14	C02-C03-C04-C05
9	B	404	C14	C06-C07-C08-C09
3	A	401	NAG	C1-C2-N2-C7
3	B	402	NAG	O5-C5-C6-O6
5	A	416	GOL	O1-C1-C2-O2
9	B	404	C14	C03-C04-C05-C06
9	B	404	C14	C11-C12-C13-C14
5	A	416	GOL	O1-C1-C2-C3
6	B	405	HEM	C2A-CAA-CBA-CGA
9	B	404	C14	C05-C06-C07-C08
6	B	405	HEM	CAA-CBA-CGA-O1A
6	B	405	HEM	CAA-CBA-CGA-O2A
6	A	405	HEM	CAA-CBA-CGA-O1A
6	A	405	HEM	CAA-CBA-CGA-O2A
6	A	405	HEM	C4B-C3B-CAB-CBB
3	A	401	NAG	C3-C2-N2-C7
4	A	403	MES	C7-C8-S-O2S

There are no ring outliers.

9 monomers are involved in 35 short contacts:

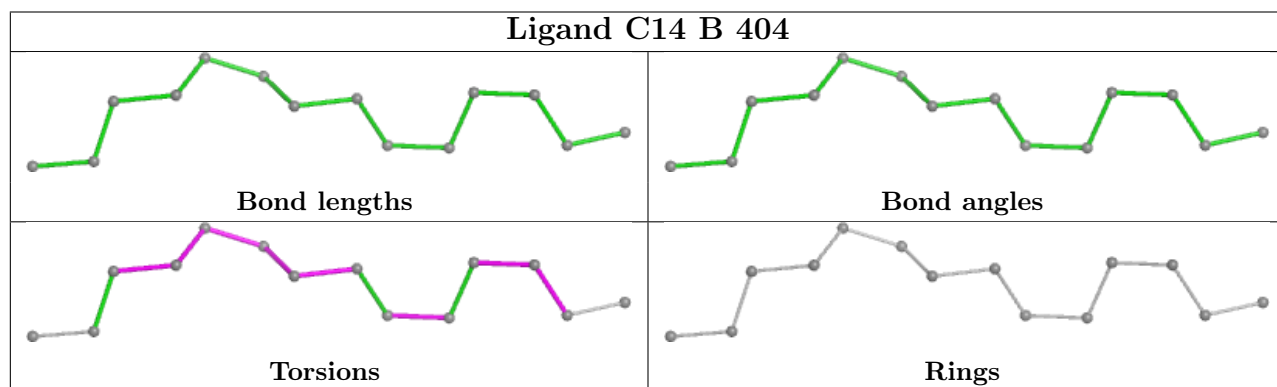
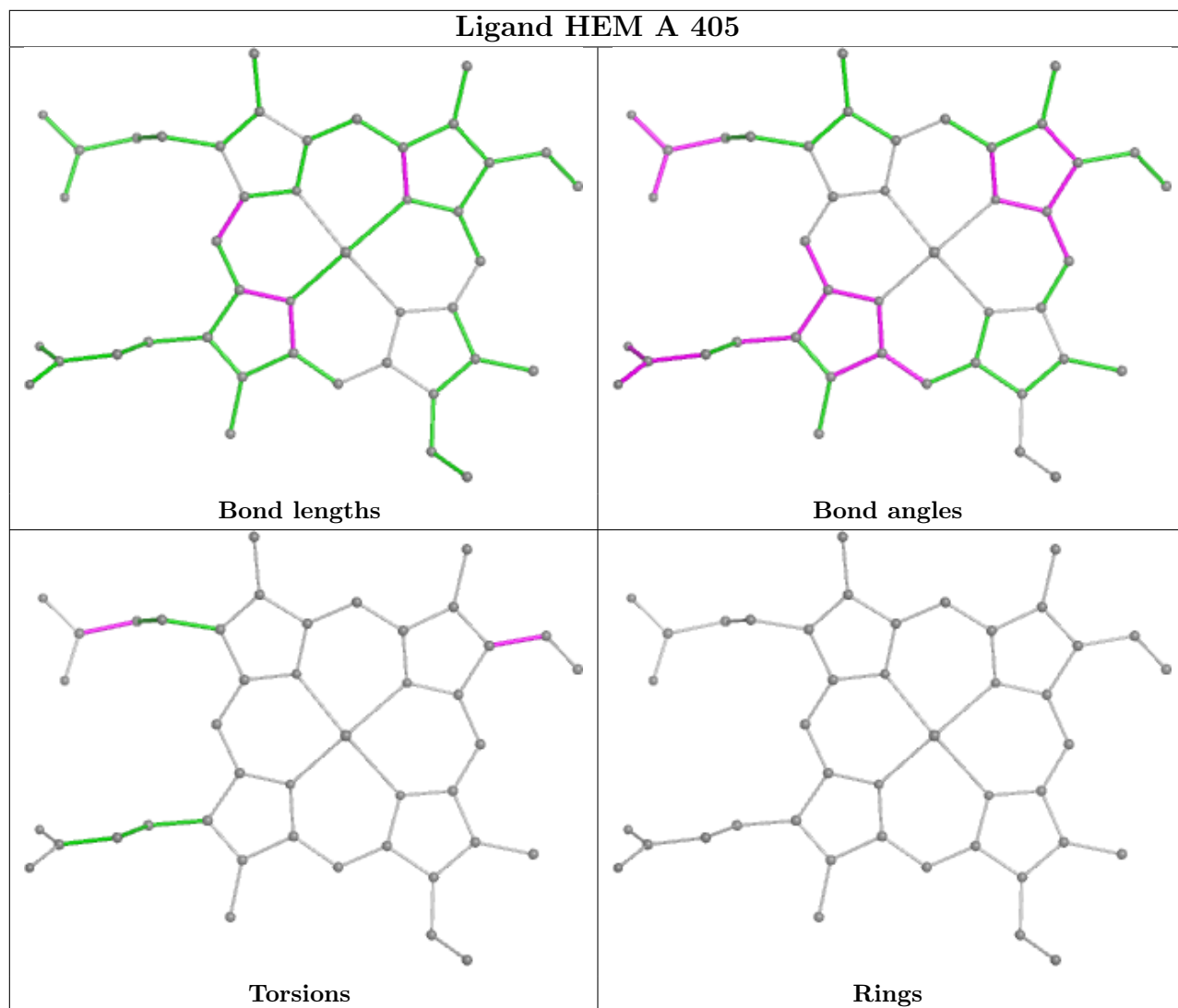
Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	405	HEM	4	0
3	A	401	NAG	4	0
3	B	401	NAG	2	0
5	B	412	GOL	6	0
3	A	402	NAG	5	0
4	B	403	MES	1	0

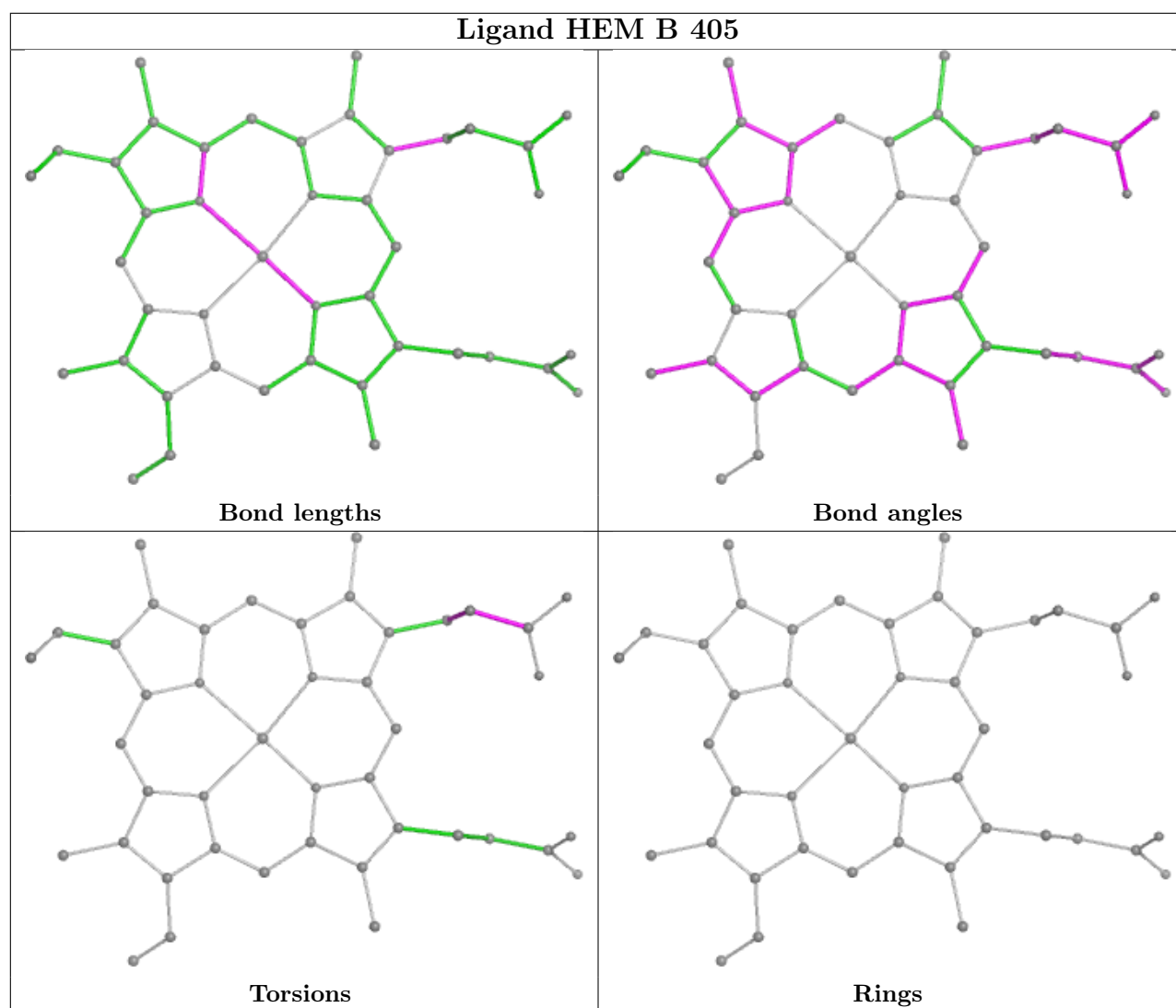
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Mol	Chain	Res	Type	Clashes	Symm-Clashes
9	B	404	C14	4	0
6	B	405	HEM	5	0
3	B	402	NAG	4	0

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 Fit of model and data [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	334/334 (100%)	-1.08	0 100 100	18, 32, 46, 85	1 (0%)
1	B	334/334 (100%)	-1.06	0 100 100	19, 34, 46, 76	2 (0%)
All	All	668/668 (100%)	-1.07	0 100 100	18, 33, 46, 85	3 (0%)

There are no RSRZ outliers to report.

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

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

### 6.3 Carbohydrates [i](#)

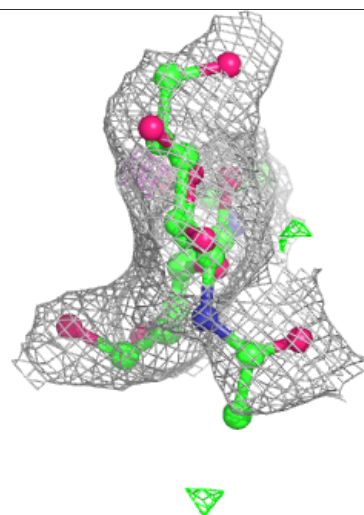
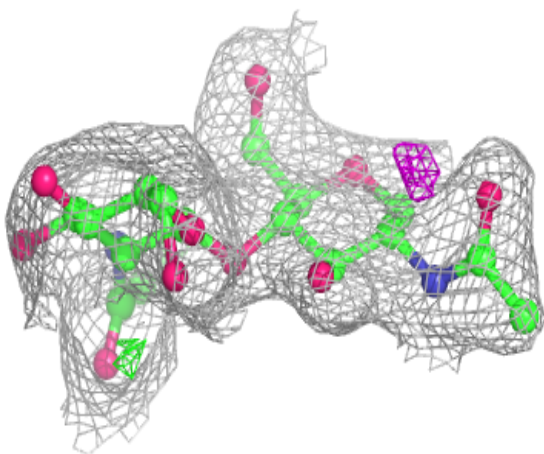
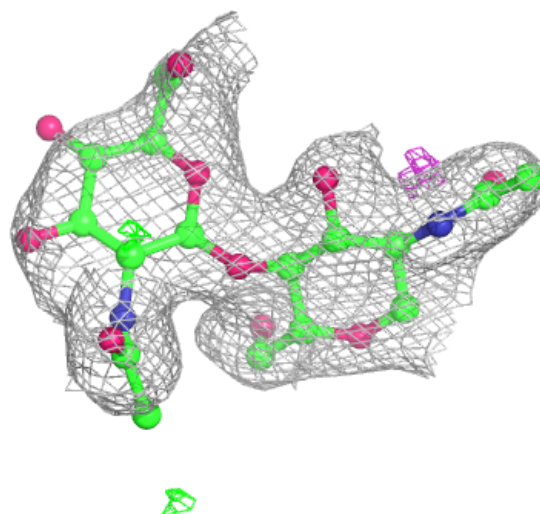
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q < 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	NAG	G	1	14/15	-	-	35,38,41,45	0
2	NAG	G	2	14/15	-	-	52,58,66,69	0
2	NAG	P	1	14/15	-	-	36,41,43,46	0
2	NAG	P	2	14/15	-	-	36,39,42,43	0
2	NAG	S	1	14/15	-	-	39,41,44,45	0
2	NAG	S	2	14/15	-	-	38,42,45,46	0

The following is a graphical depiction of the model fit to experimental electron density for oligosaccharide. Each fit is shown from different orientation to approximate a three-dimensional view.

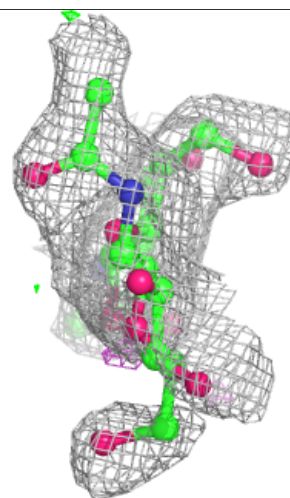
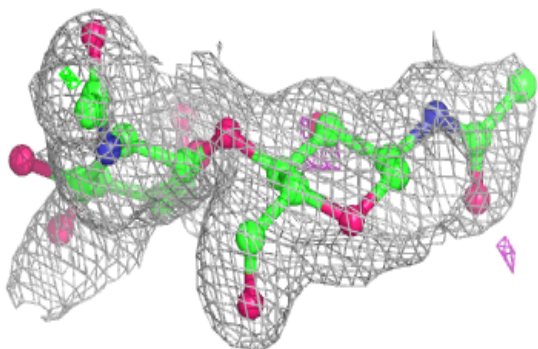
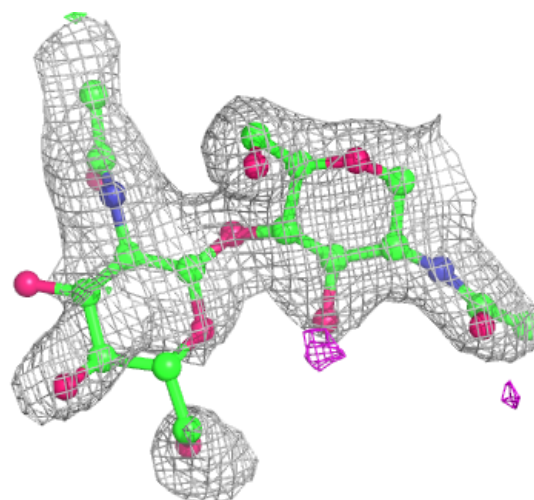
**Electron density around Chain G:**

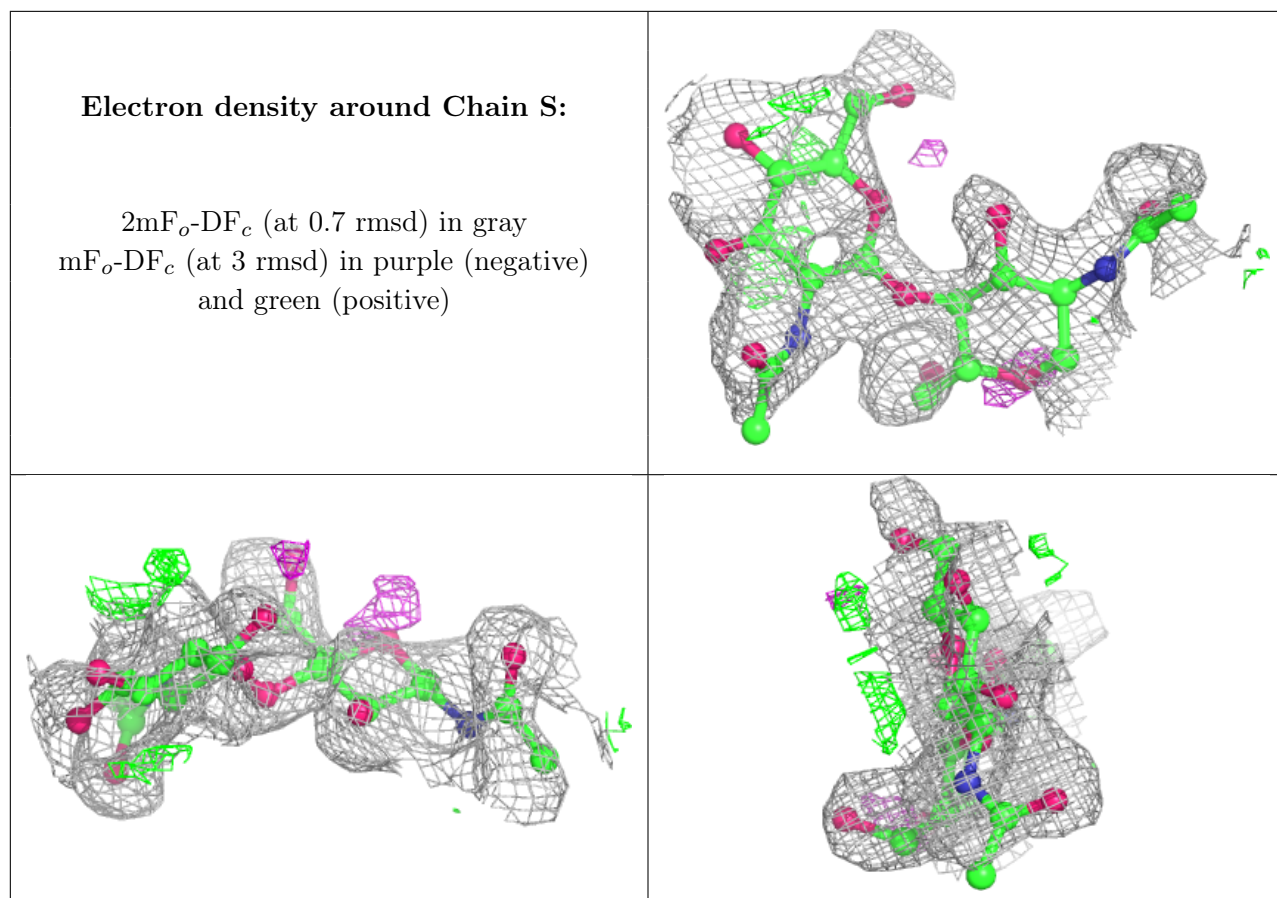
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



**Electron density around Chain P:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





## 6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

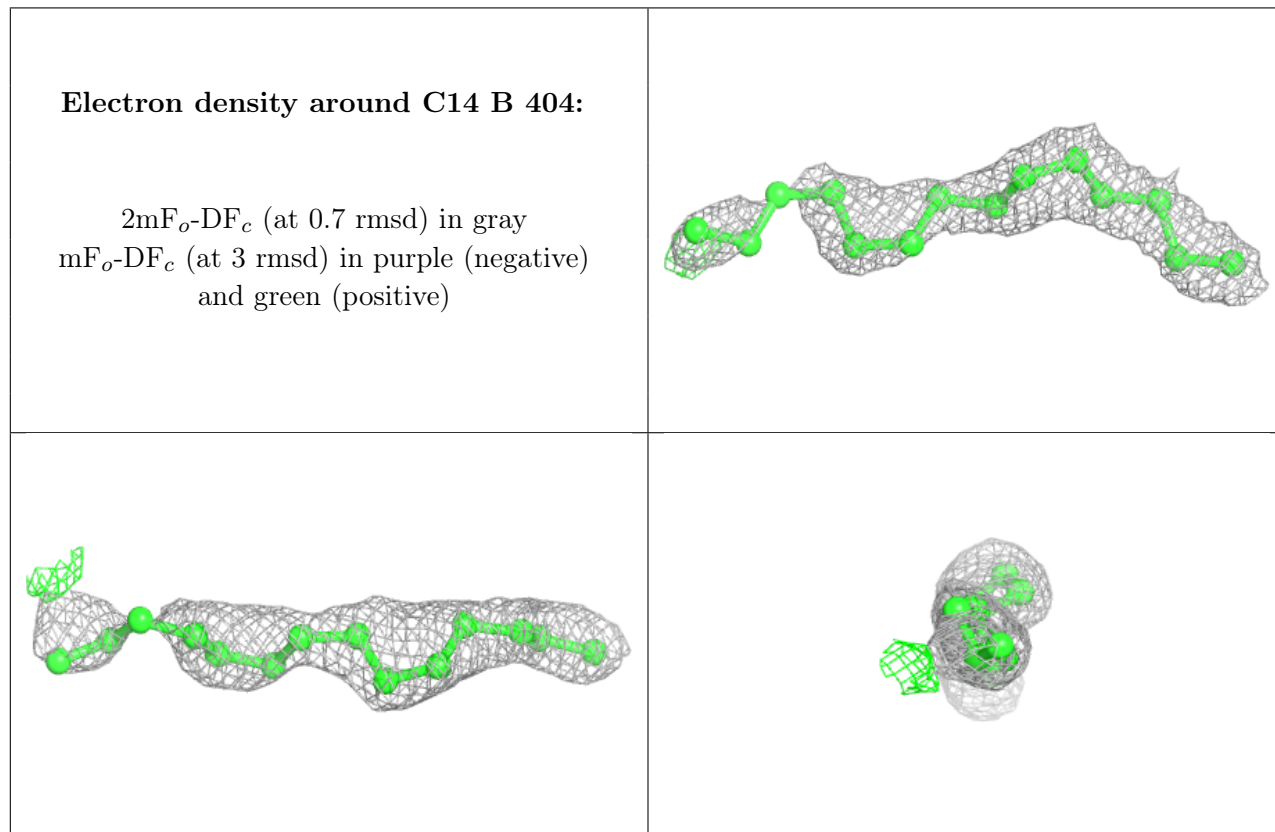
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
5	GOL	A	404	6/6	0.95	0.07	41,47,49,50	0
3	NAG	B	402	14/15	0.96	0.06	55,58,64,66	0
3	NAG	A	402	14/15	0.96	0.07	57,62,65,67	0
5	GOL	A	416	6/6	0.96	0.05	27,27,30,31	0
9	C14	B	404	14/14	0.96	0.07	34,36,39,39	0
3	NAG	A	401	14/15	0.97	0.06	34,38,41,44	0
3	NAG	B	401	14/15	0.98	0.06	40,45,54,58	0
4	MES	A	403	12/12	0.98	0.07	27,35,37,39	0
5	GOL	B	412	6/6	0.98	0.07	23,25,28,29	0
4	MES	B	403	12/12	0.98	0.07	27,38,40,40	0
6	HEM	B	405	43/43	0.99	0.04	23,27,30,31	0
7	ZN	A	406	1/1	0.99	0.02	42,42,42,42	0
7	ZN	A	413	1/1	0.99	0.03	51,51,51,51	0

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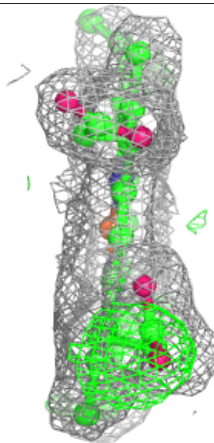
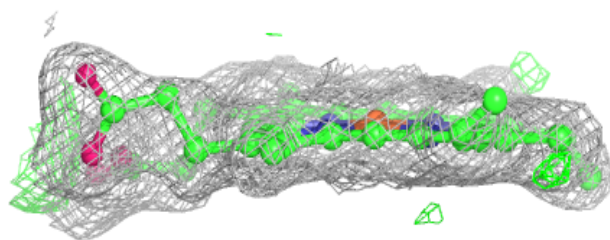
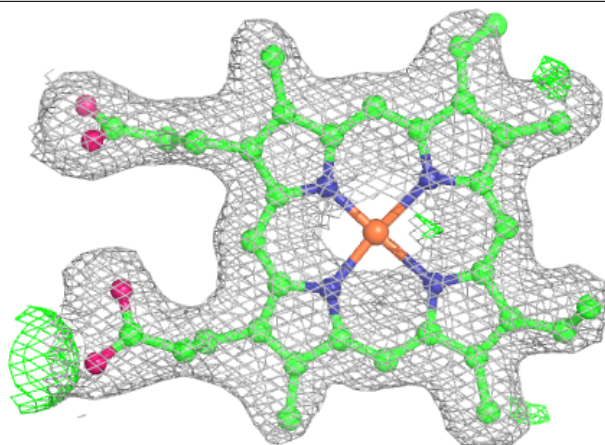
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
7	ZN	B	407	1/1	0.99	0.02	43,43,43,43	0
7	ZN	B	408	1/1	0.99	0.05	48,48,48,48	0
7	ZN	B	409	1/1	0.99	0.03	57,57,57,57	0
7	ZN	B	410	1/1	0.99	0.08	43,43,43,43	0
6	HEM	A	405	43/43	0.99	0.04	19,24,29,30	0
7	ZN	A	407	1/1	1.00	0.02	38,38,38,38	0
7	ZN	A	414	1/1	1.00	0.01	41,41,41,41	0
7	ZN	B	406	1/1	1.00	0.01	39,39,39,39	0
7	ZN	A	408	1/1	1.00	0.02	42,42,42,42	0
7	ZN	A	409	1/1	1.00	0.02	45,45,45,45	0
7	ZN	A	410	1/1	1.00	0.01	39,39,39,39	0
7	ZN	A	411	1/1	1.00	0.03	38,38,38,38	0
8	MG	A	415	1/1	1.00	0.09	16,16,16,16	0
8	MG	B	411	1/1	1.00	0.09	14,14,14,14	0
7	ZN	A	412	1/1	1.00	0.01	38,38,38,38	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.



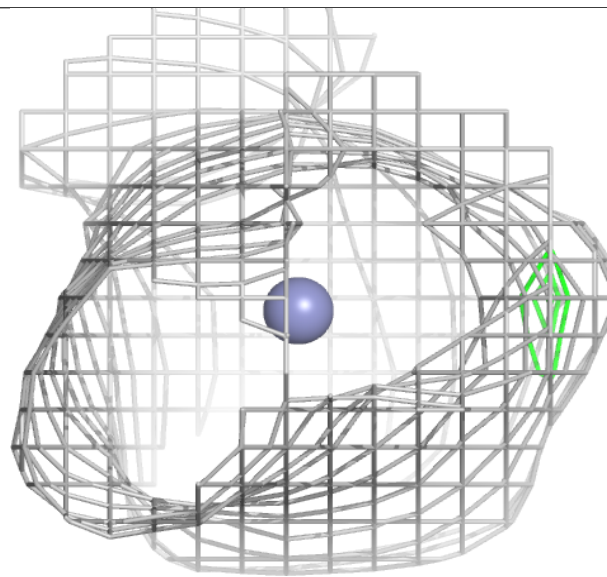
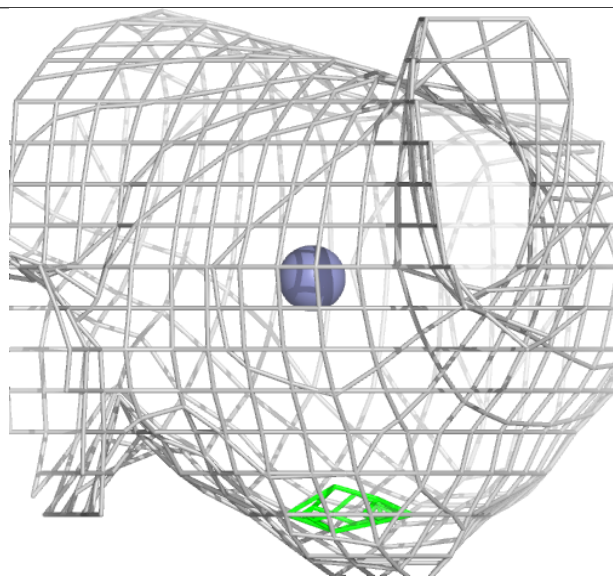
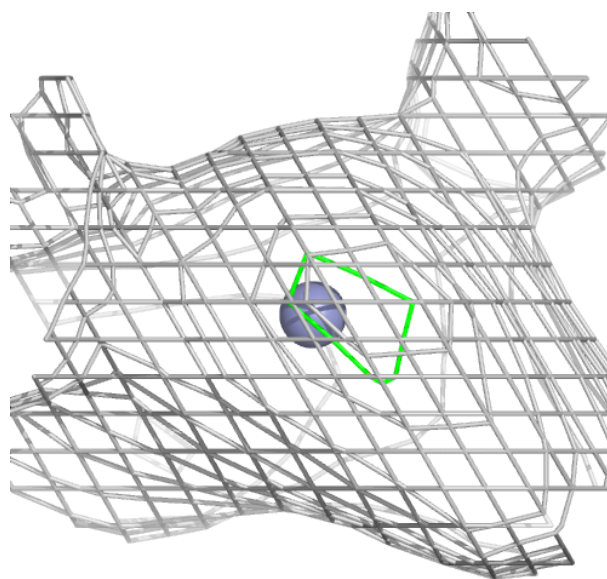
**Electron density around HEM B 405:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



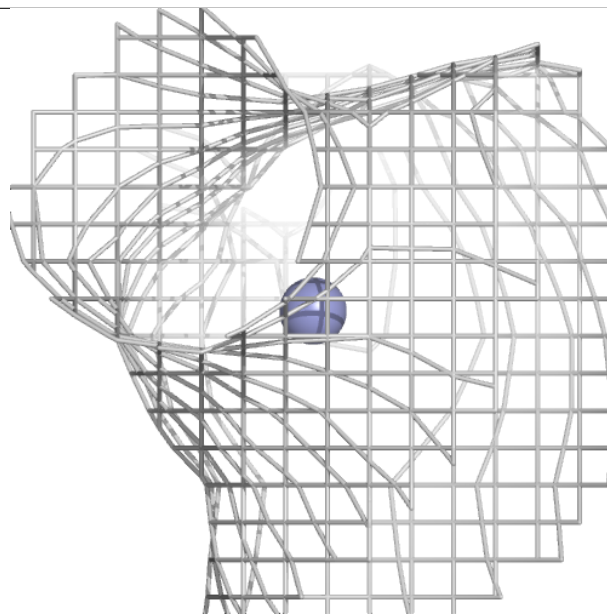
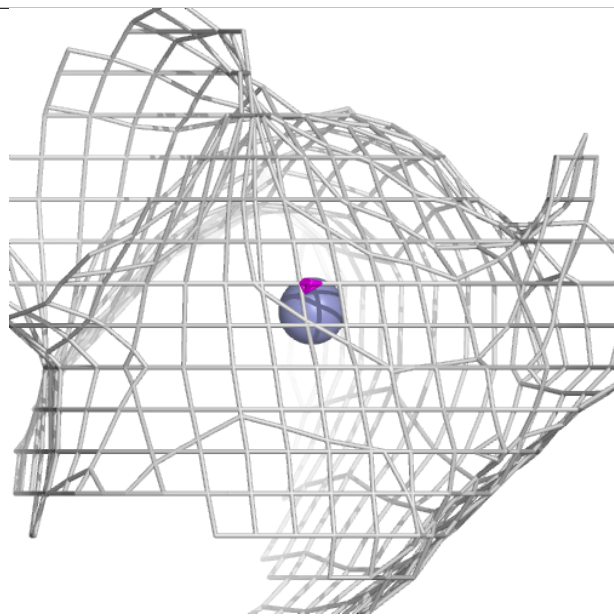
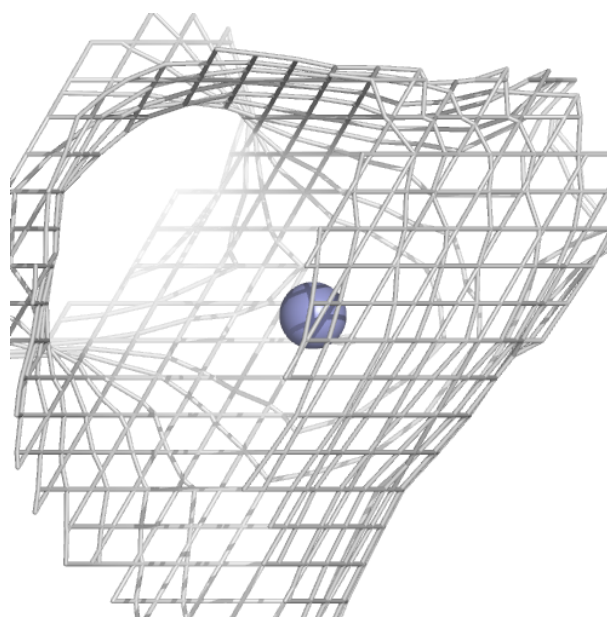
**Electron density around ZN A 406:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



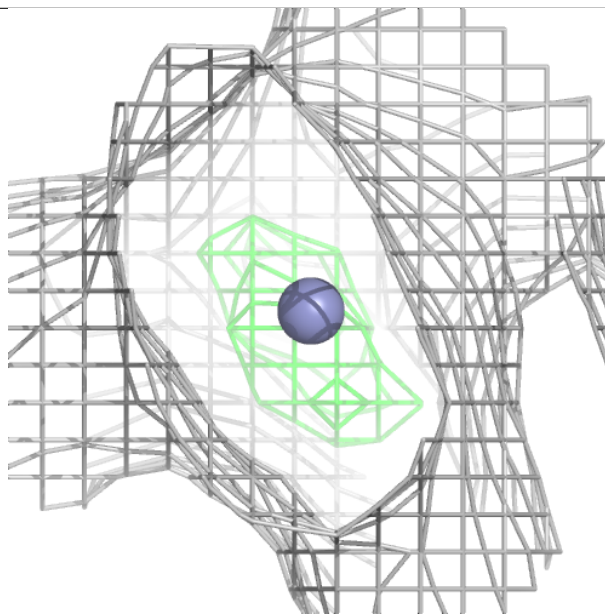
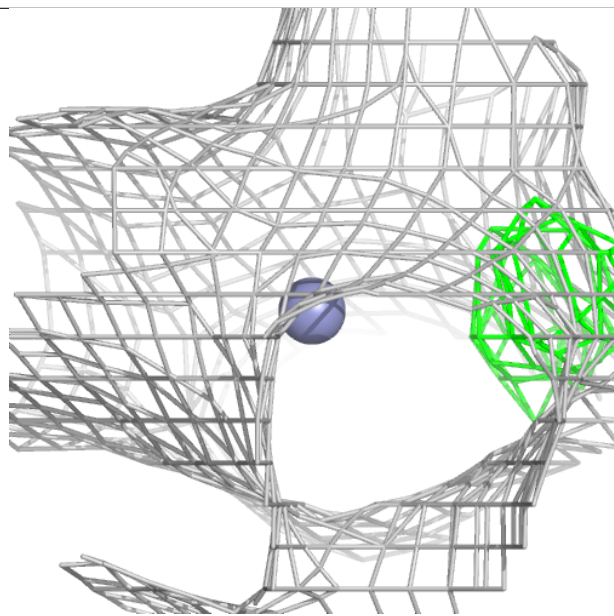
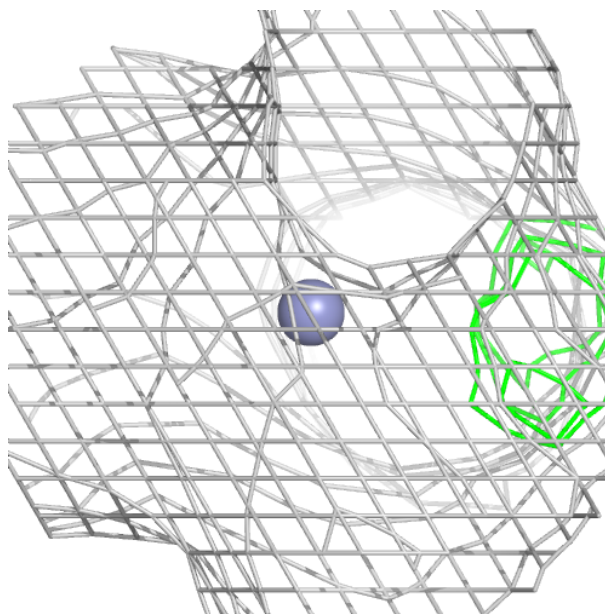
**Electron density around ZN A 413:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



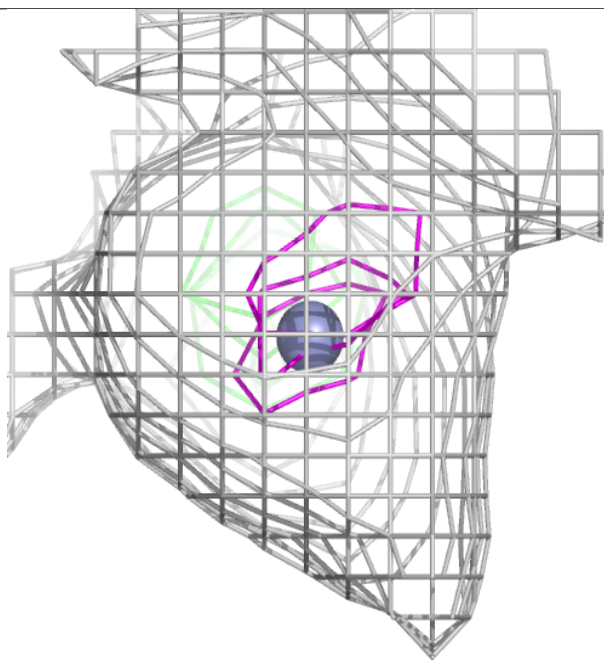
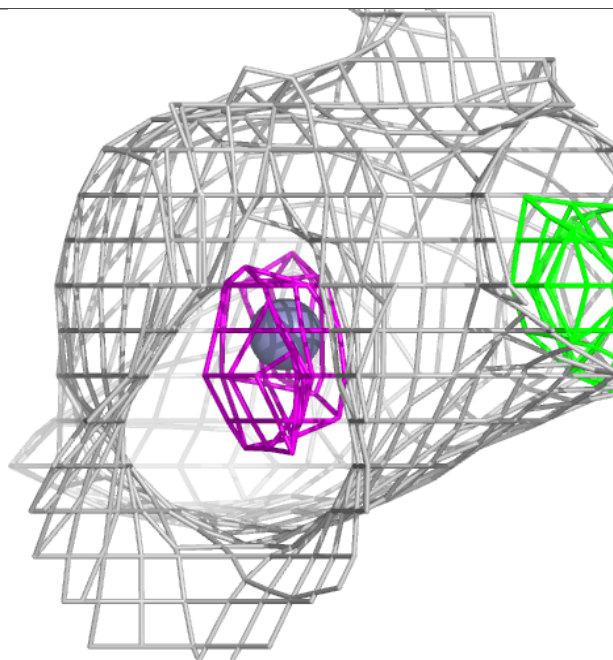
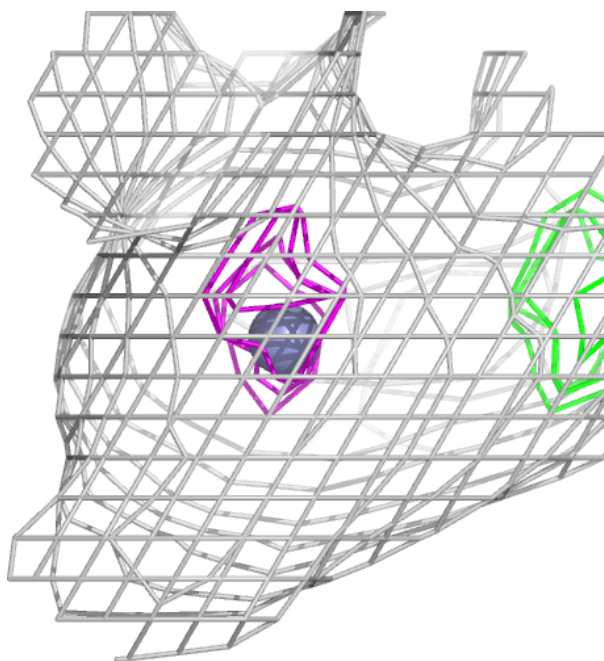
**Electron density around ZN B 407:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



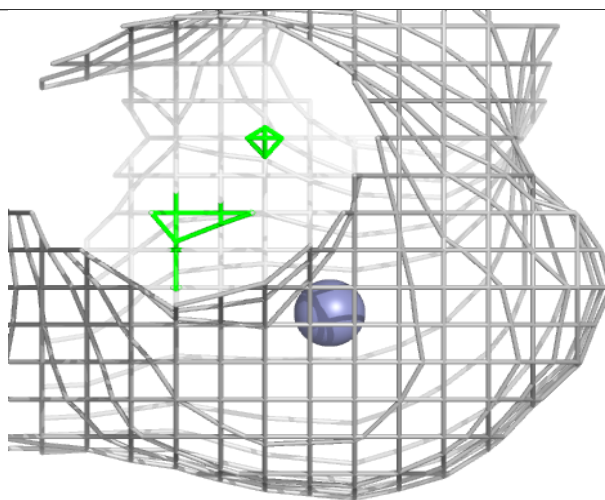
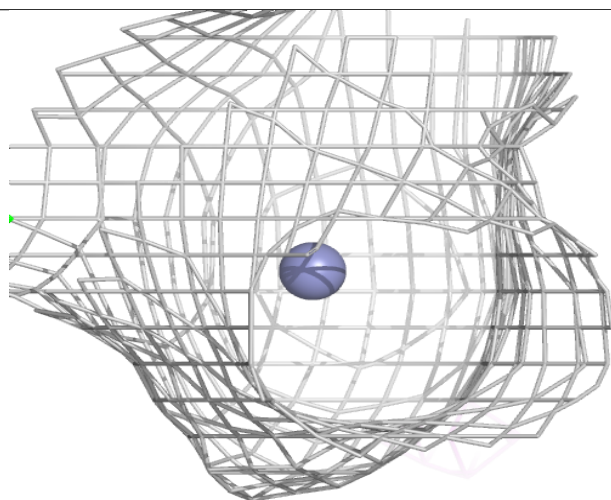
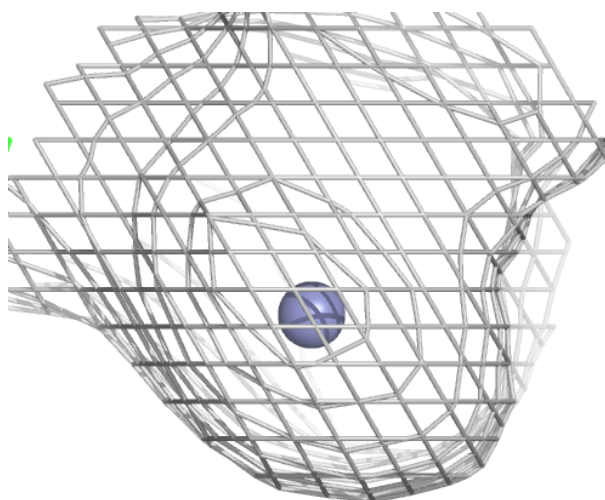
**Electron density around ZN B 408:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



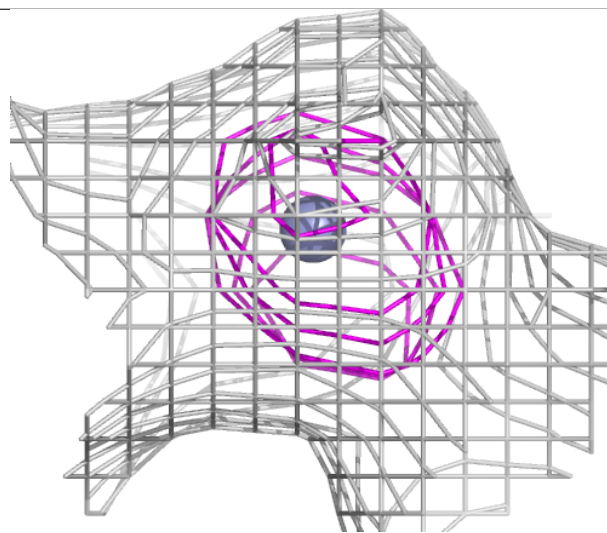
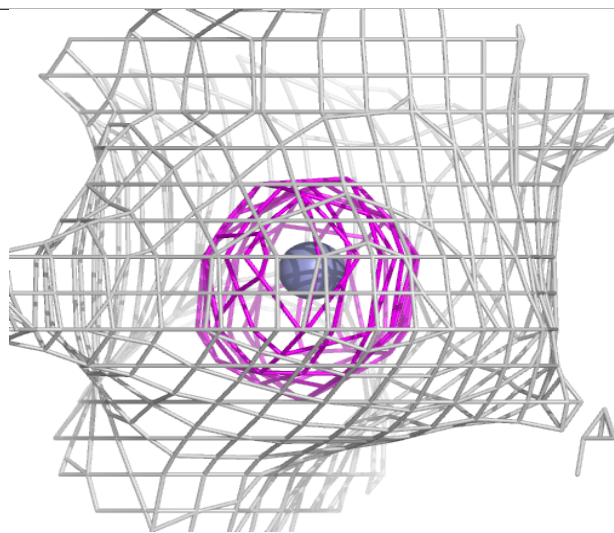
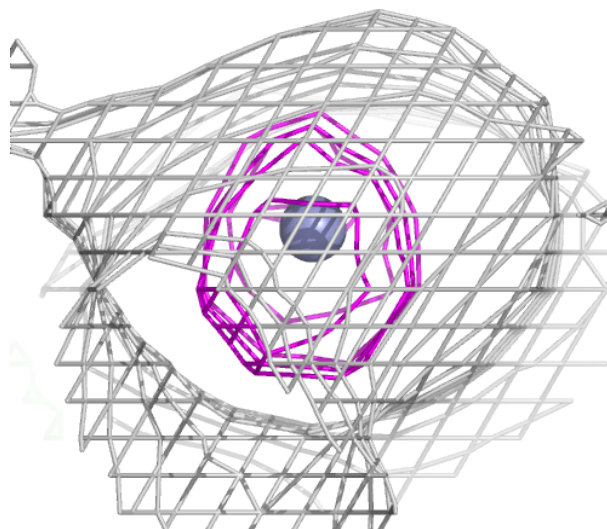
**Electron density around ZN B 409:**

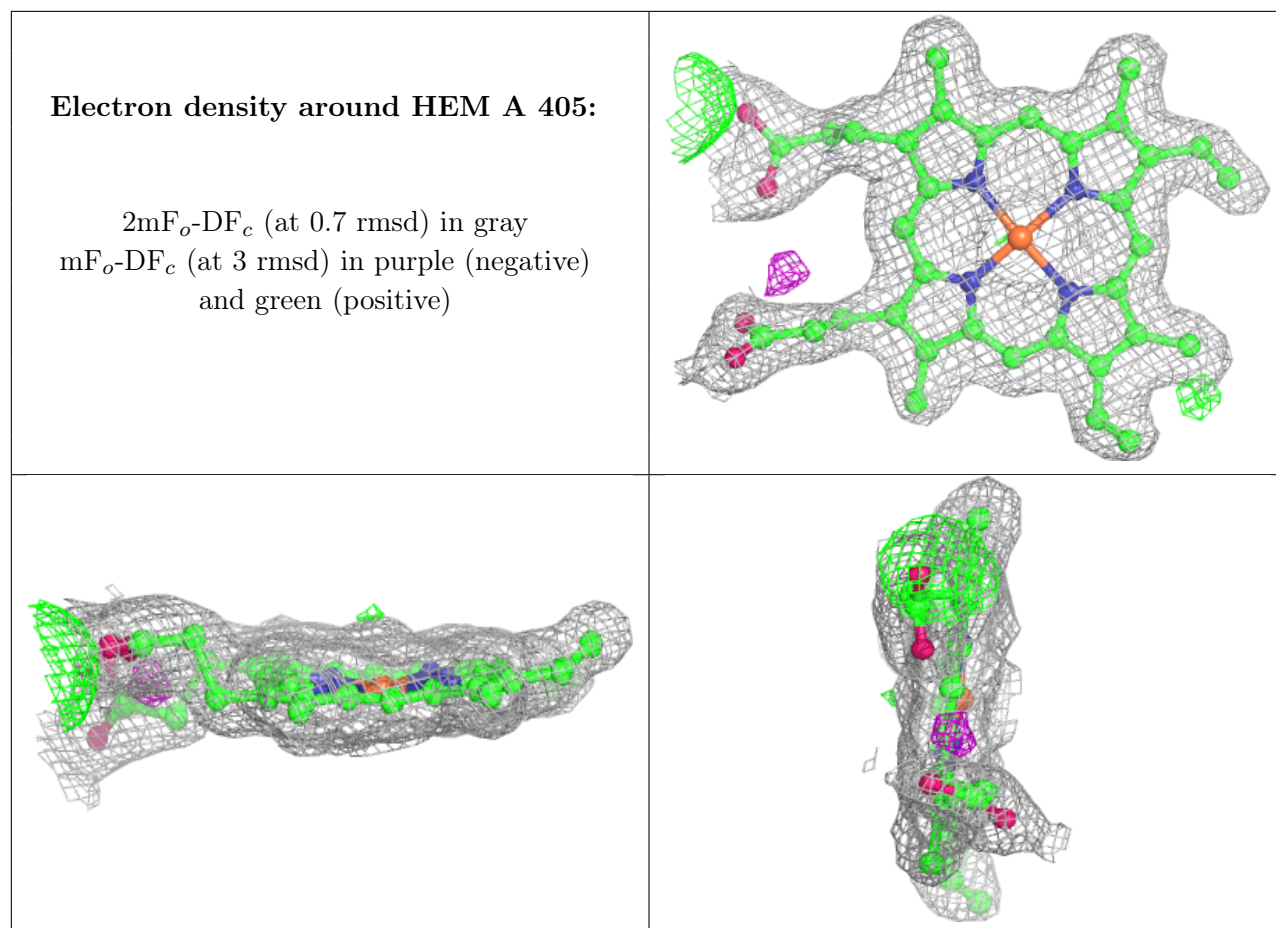
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



**Electron density around ZN B 410:**

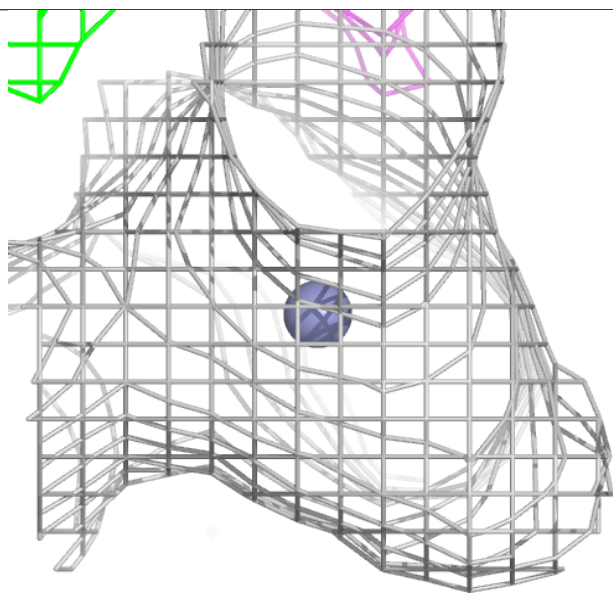
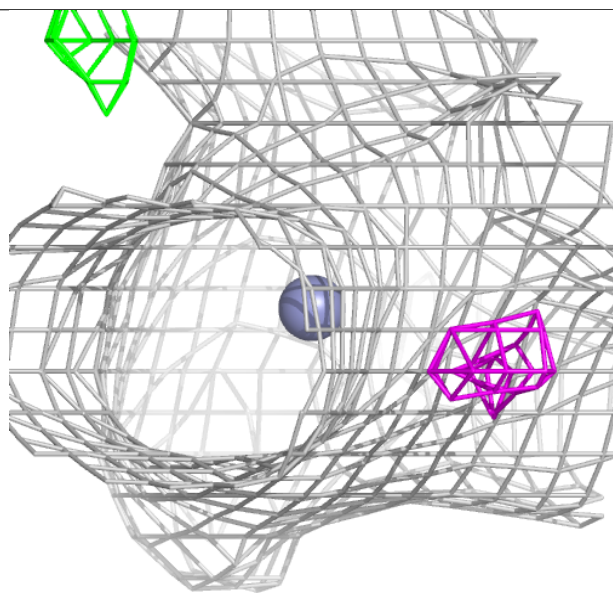
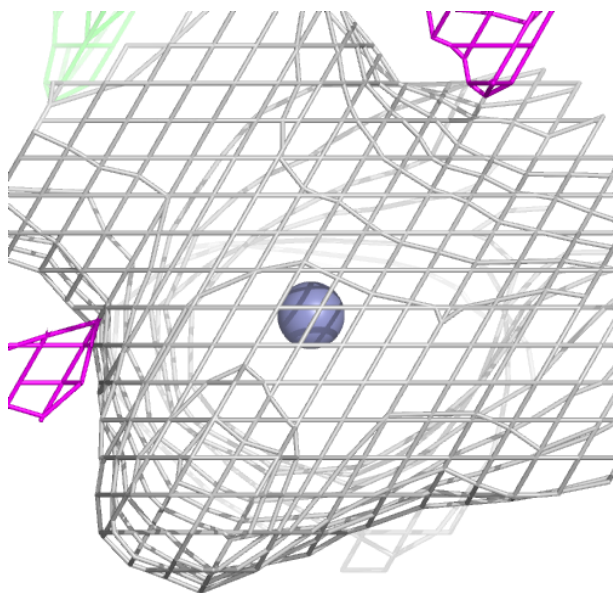
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





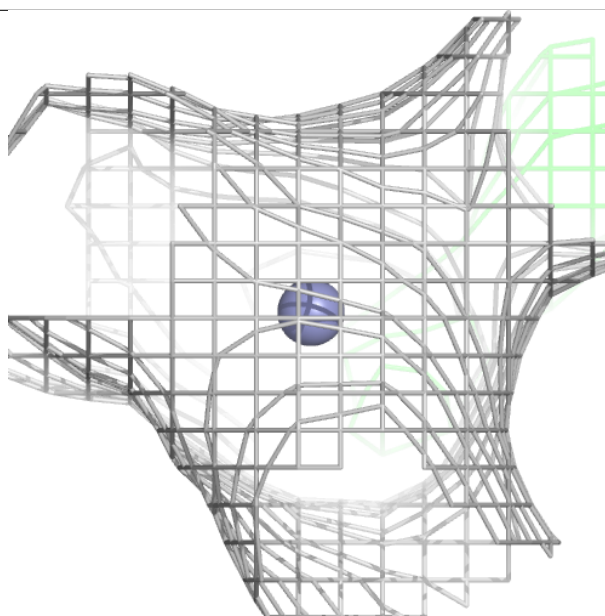
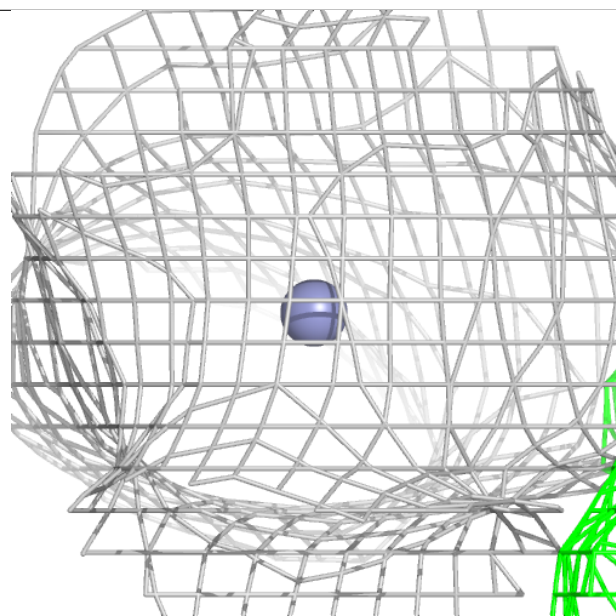
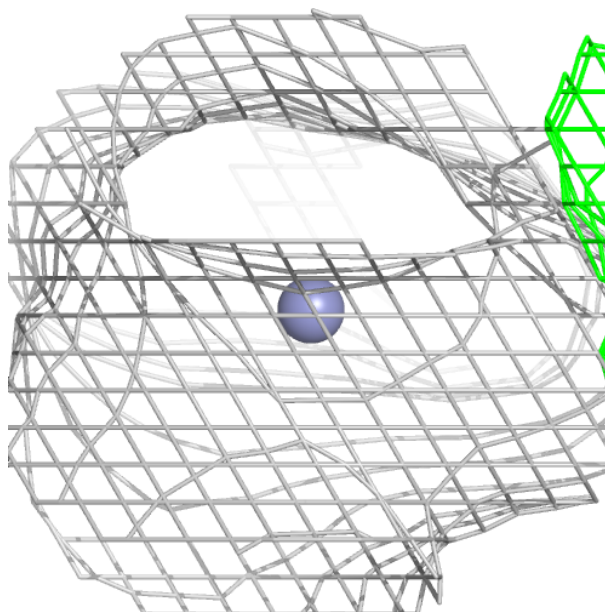
**Electron density around ZN A 407:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



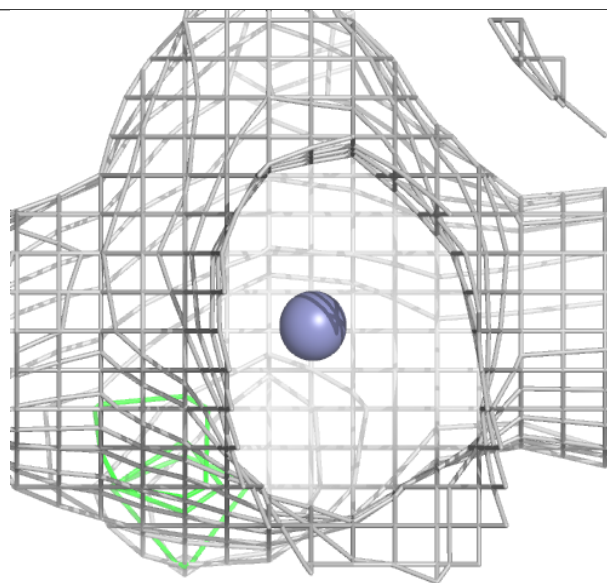
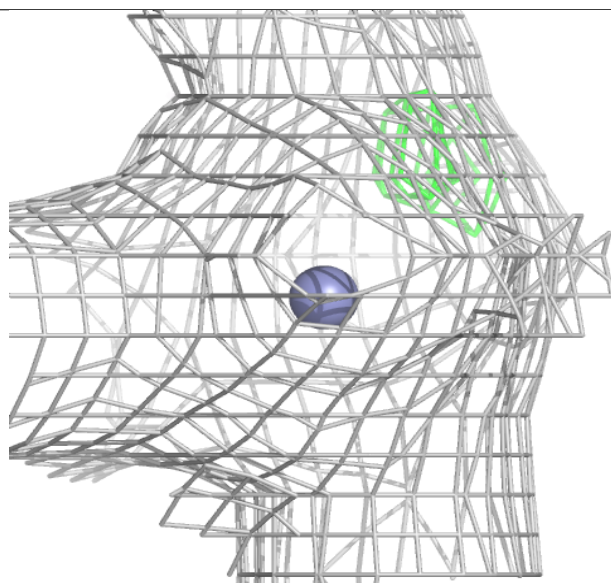
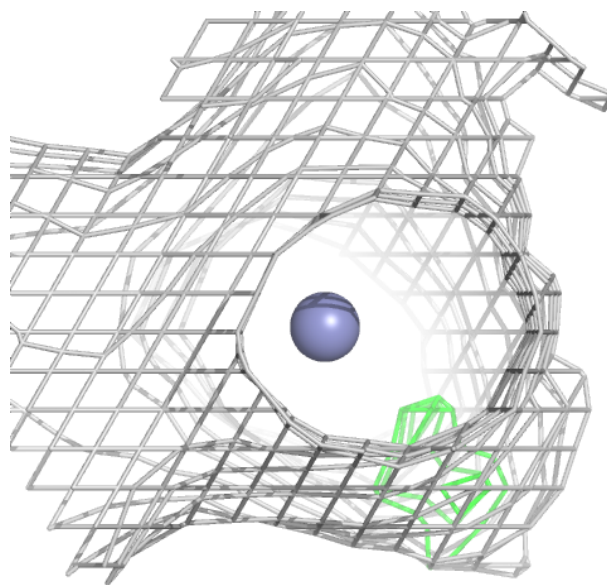
**Electron density around ZN A 414:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



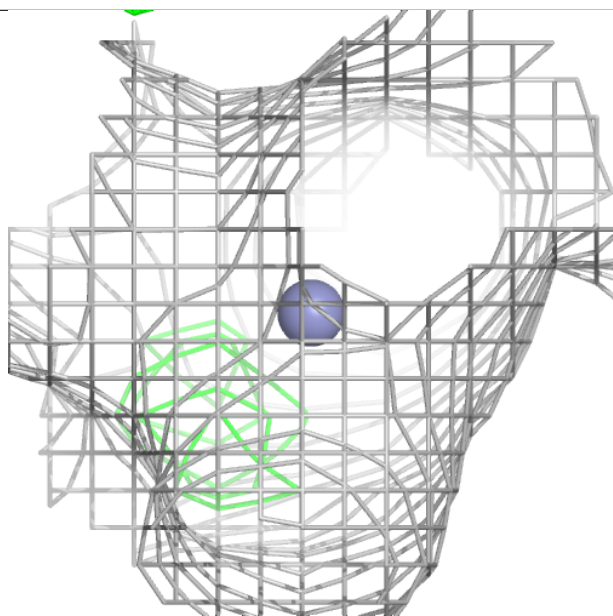
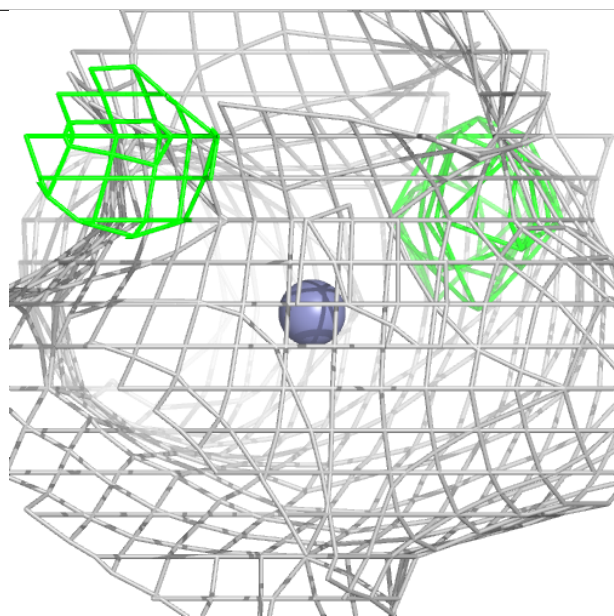
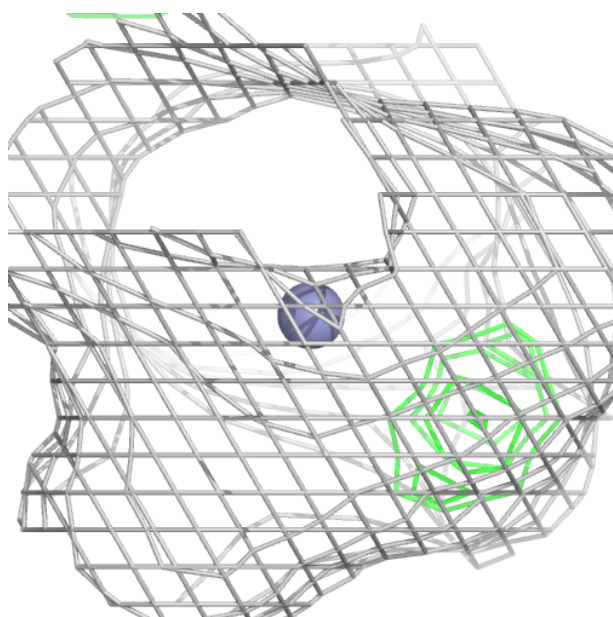
**Electron density around ZN B 406:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



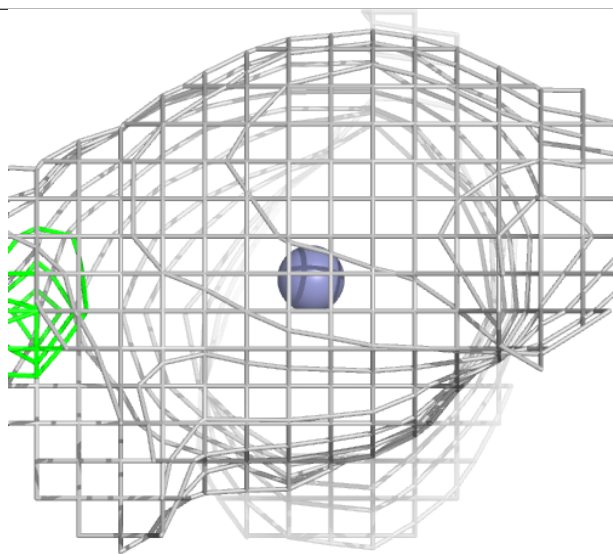
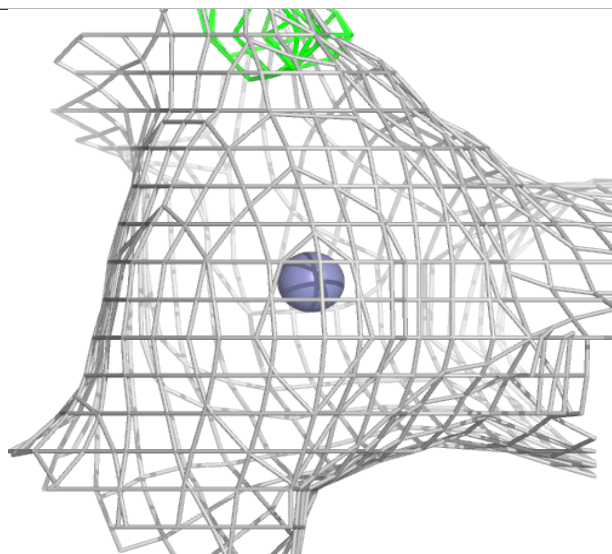
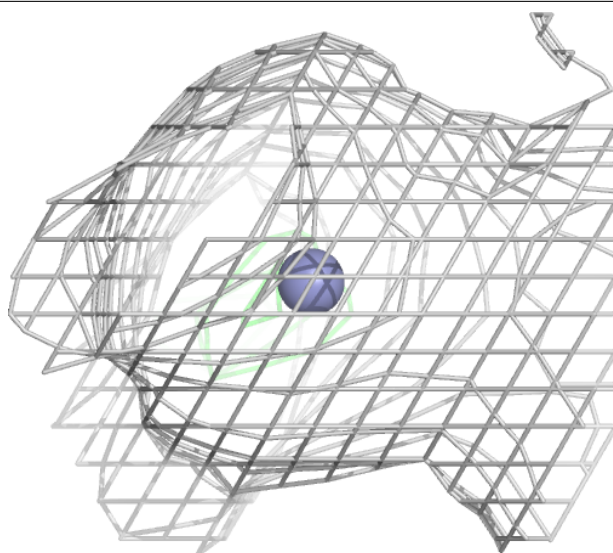
**Electron density around ZN A 408:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



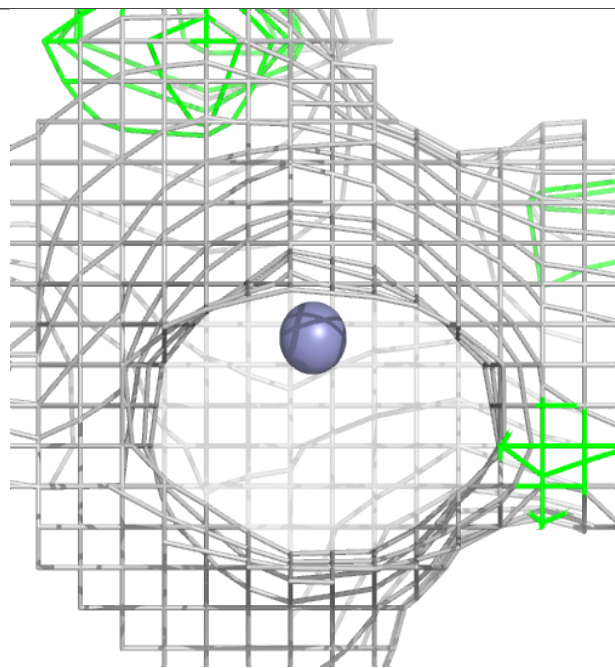
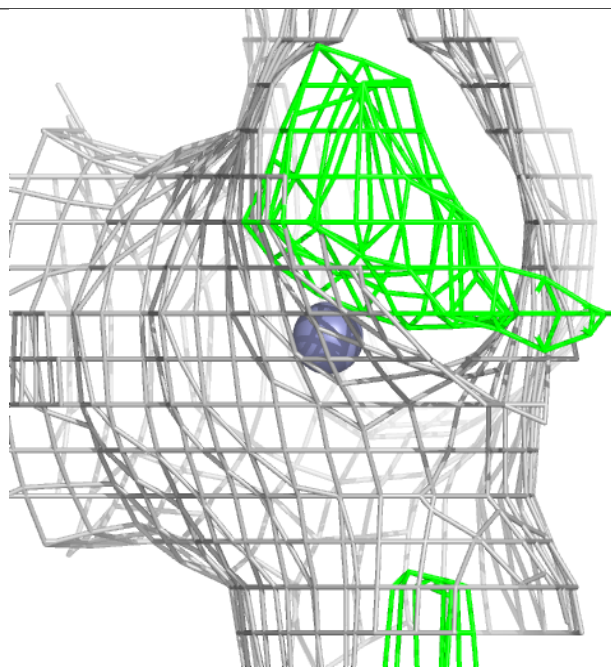
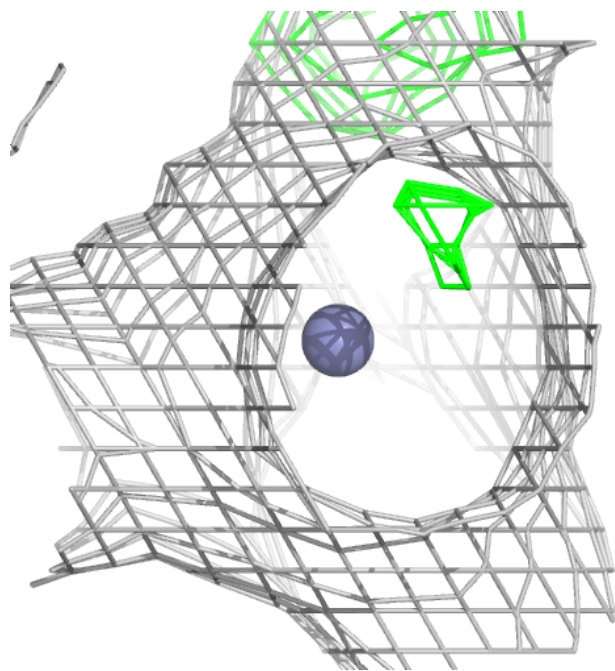
**Electron density around ZN A 409:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



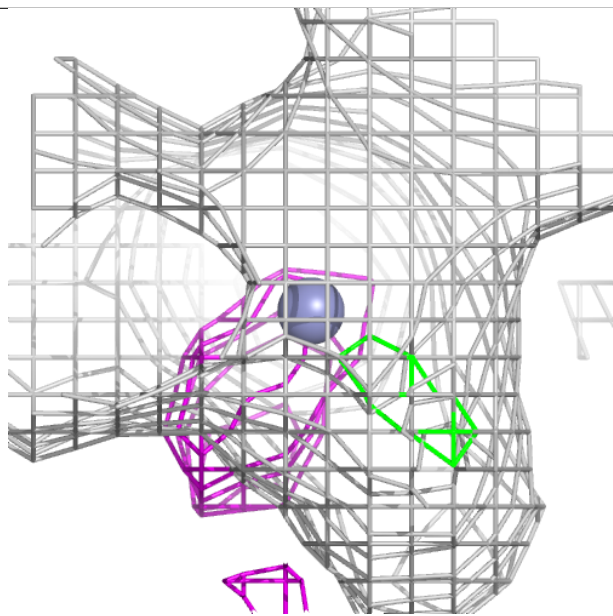
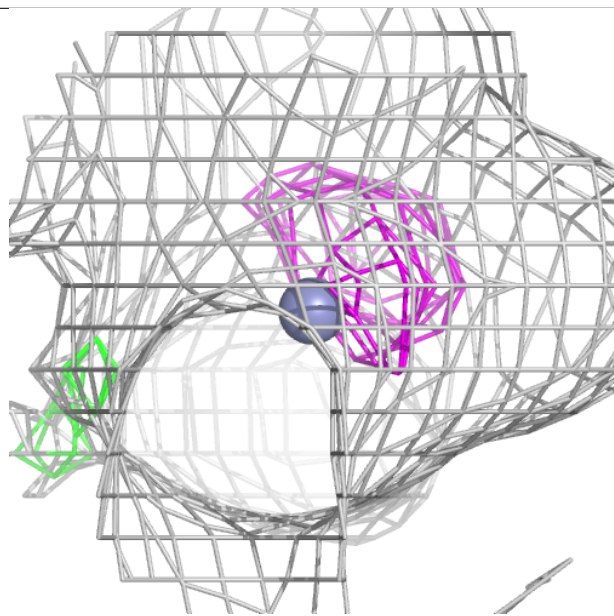
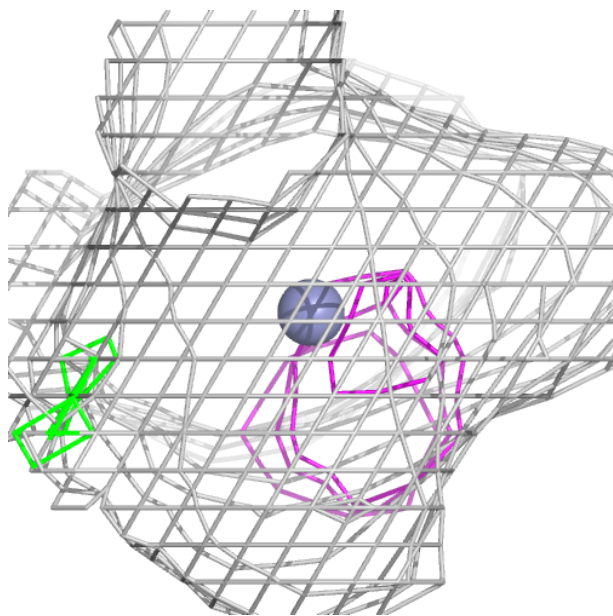
**Electron density around ZN A 410:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



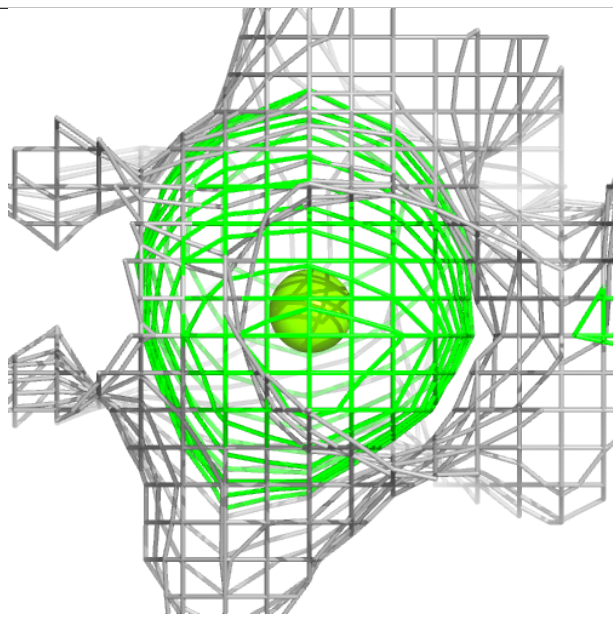
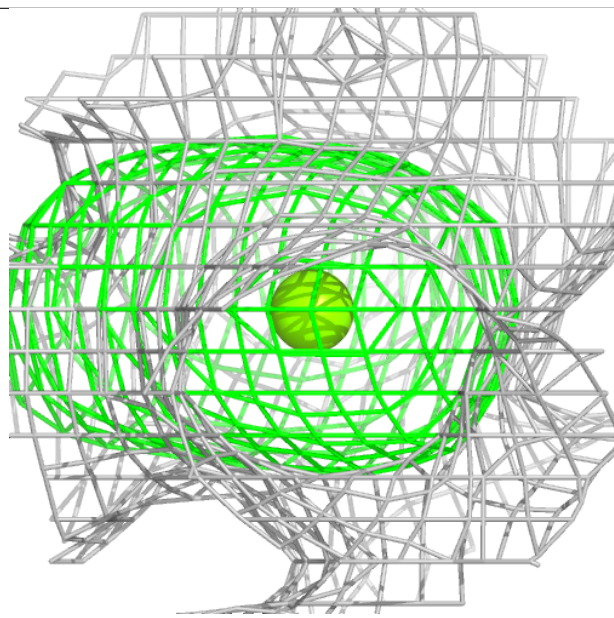
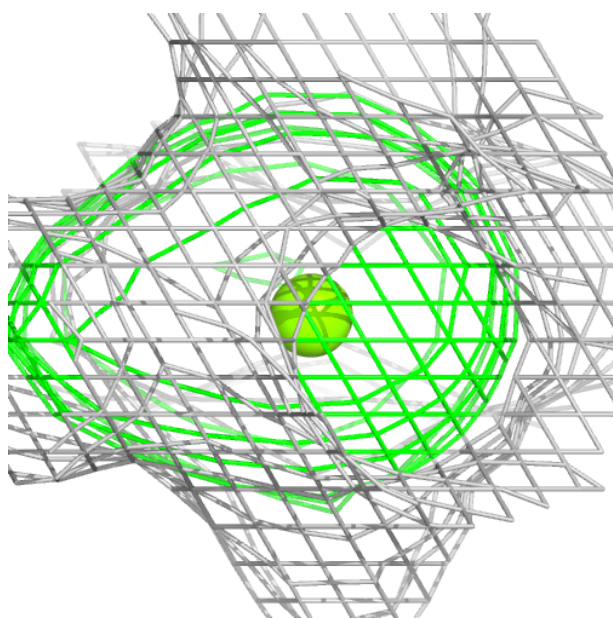
**Electron density around ZN A 411:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



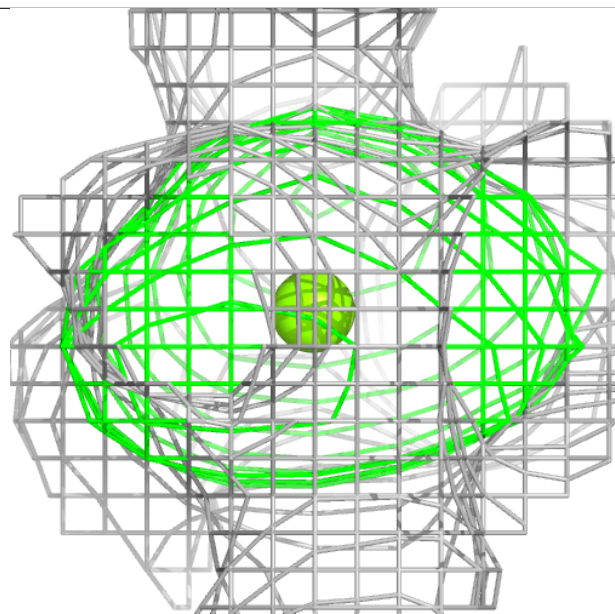
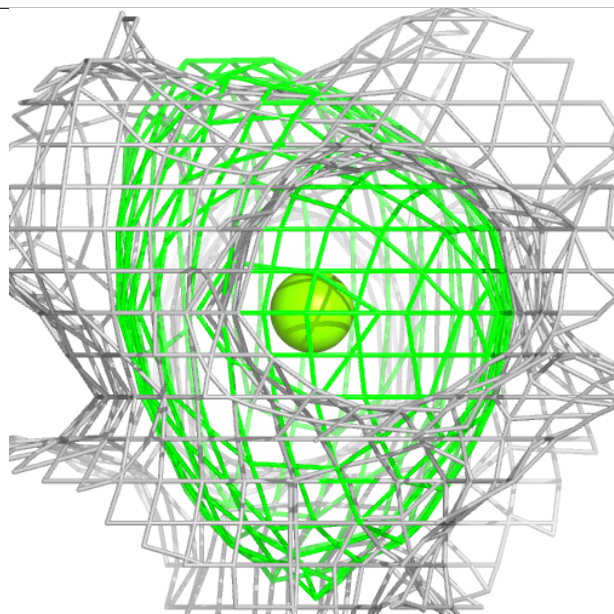
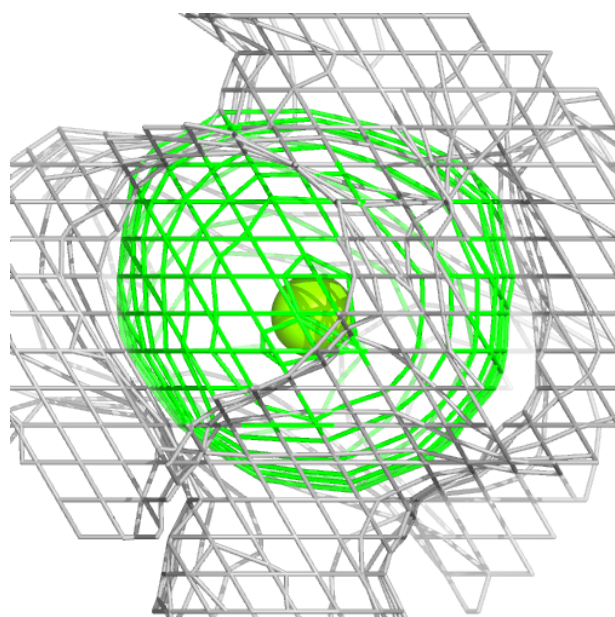
**Electron density around MG A 415:**

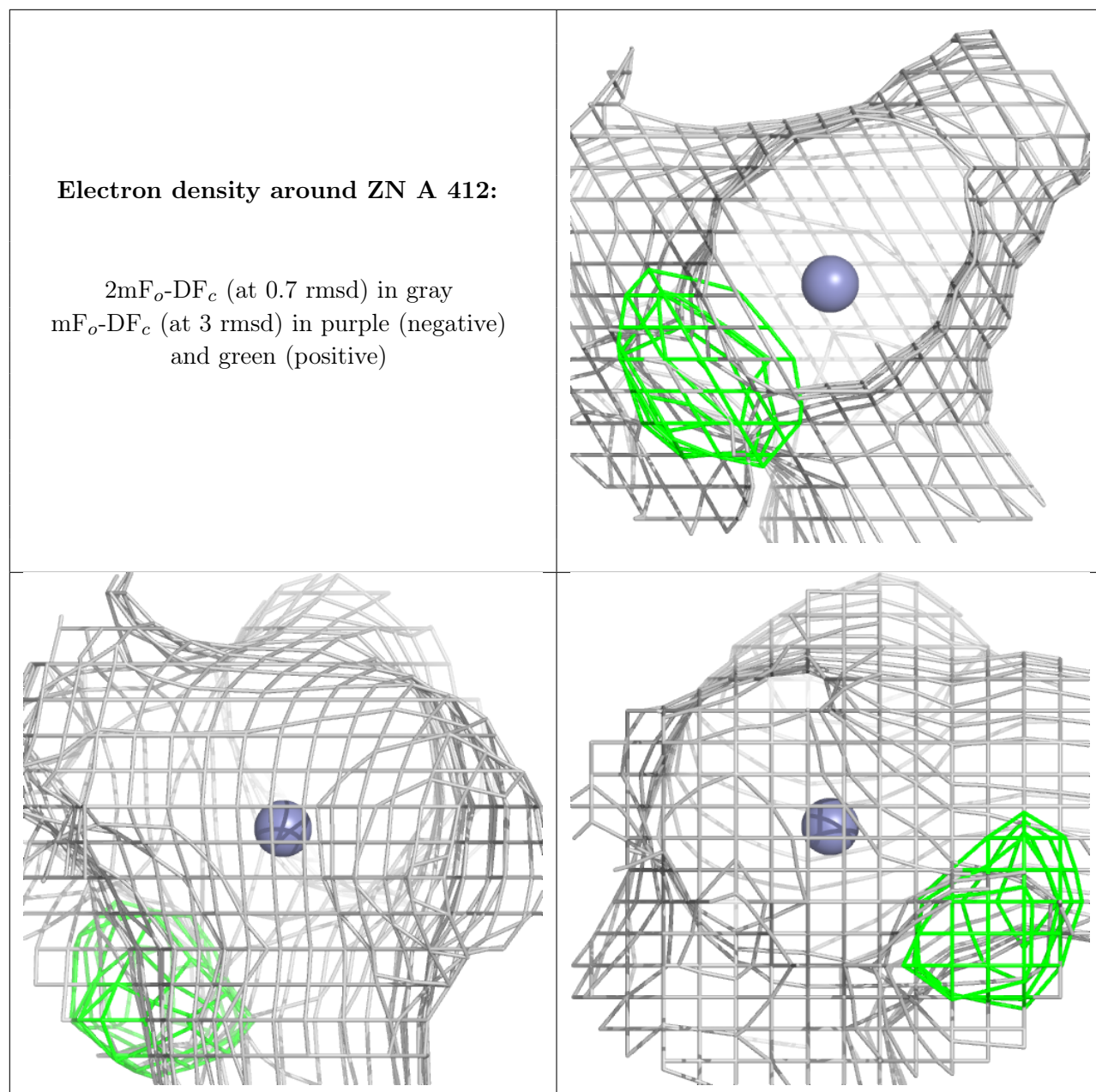
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



**Electron density around MG B 411:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





## 6.5 Other polymers [i](#)

There are no such residues in this entry.