



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 27, 2024 – 02:40 PM EST

PDB ID : 8SP2  
Title : Crystal structure of metformin hydrolase (MfmAB) from *Pseudomonas mendocina* sp. MET-2 apo form  
Authors : Tassoulas, L.J.; Rankin, J.A.; Elias, M.H.; Wackett, L.P.  
Deposited on : 2023-05-01  
Resolution : 2.20 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36

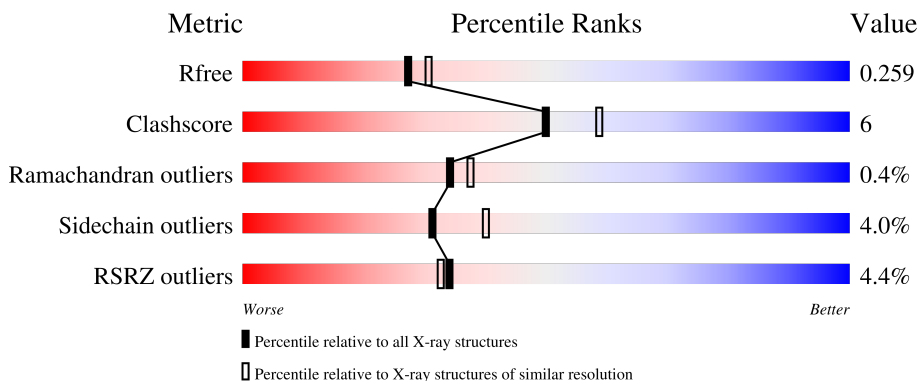
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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))
$R_{free}$	130704	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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	348	
1	B	348	
1	C	348	
1	D	348	
1	E	348	

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Mol	Chain	Length	Quality of chain
1	F	348	<p>8% 79% 15% • 5%</p>
1	K	348	<p>14% 78% 16% • 5%</p>
1	L	348	<p>5% 82% 11% • 5%</p>
2	G	364	<p>% 82% 12% • 5%</p>
2	H	364	<p>% 84% 10% • 5%</p>
2	I	364	<p>2% 79% 15% • 5%</p>
2	J	364	<p>% 79% 13% • 5%</p>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 32022 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 metformin hydrolase subunit B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	331	Total 2535	C 1595	N 444	O 477	S 19	0	0	0
1	B	331	Total 2535	C 1595	N 444	O 477	S 19	0	0	0
1	C	331	Total 2535	C 1595	N 444	O 477	S 19	0	0	0
1	D	331	Total 2535	C 1595	N 444	O 477	S 19	0	0	0
1	E	331	Total 2535	C 1595	N 444	O 477	S 19	0	0	0
1	F	331	Total 2535	C 1595	N 444	O 477	S 19	0	0	0
1	K	331	Total 2535	C 1595	N 444	O 477	S 19	0	0	0
1	L	331	Total 2535	C 1595	N 444	O 477	S 19	0	0	0

- Molecule 2 is a protein called metformin hydrolase subunit A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	G	346	Total 2706	C 1706	N 474	O 503	S 23	0	0	0
2	H	346	Total 2706	C 1706	N 474	O 503	S 23	0	0	0
2	I	346	Total 2706	C 1706	N 474	O 503	S 23	0	0	0
2	J	346	Total 2706	C 1706	N 474	O 503	S 23	0	0	0

- Molecule 3 is NICKEL (II) ION (three-letter code: NI) (formula: Ni) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	G	2	Total Ni 2 2	0	0
3	H	2	Total Ni 2 2	0	0
3	I	2	Total Ni 2 2	0	0
3	J	2	Total Ni 2 2	0	0


- Molecule 4 is water.

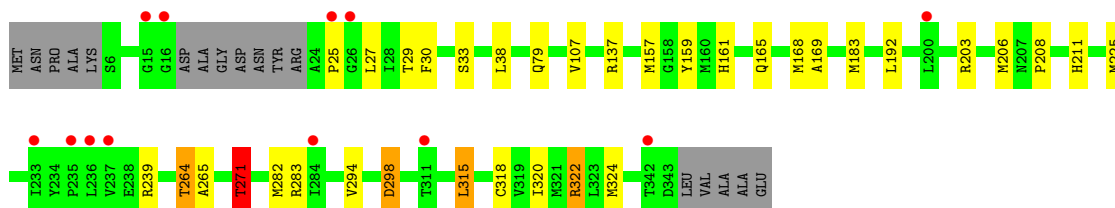
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	89	Total O 89 89	0	0
4	B	100	Total O 100 100	0	0
4	C	79	Total O 79 79	0	0
4	D	76	Total O 76 76	0	0
4	E	42	Total O 42 42	0	0
4	F	40	Total O 40 40	0	0
4	G	114	Total O 114 114	0	0
4	H	112	Total O 112 112	0	0
4	I	88	Total O 88 88	0	0
4	J	87	Total O 87 87	0	0
4	K	35	Total O 35 35	0	0
4	L	48	Total O 48 48	0	0

### 3 Residue-property plots [i](#)


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.

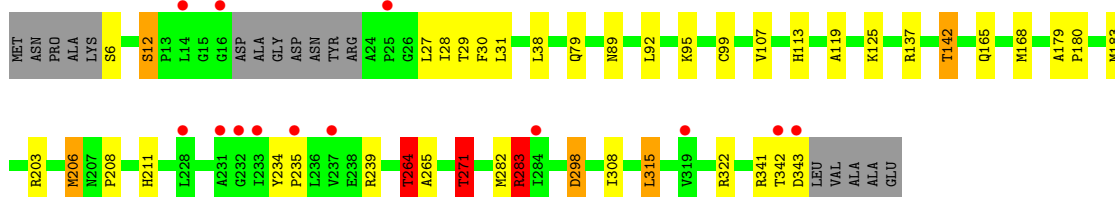
- Molecule 1: metformin hydrolase subunit B

Chain A: 




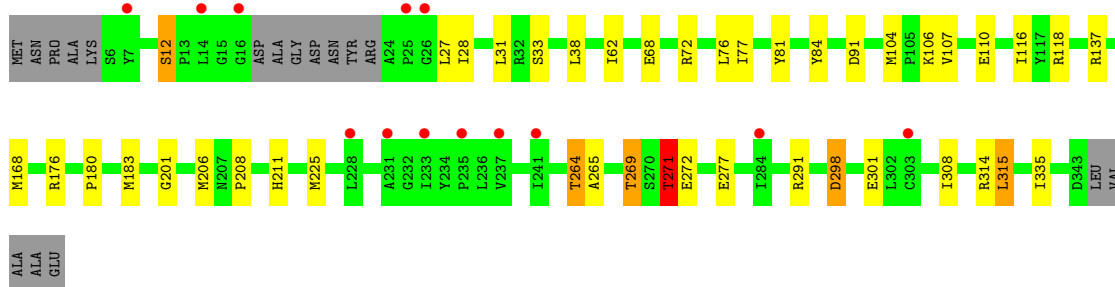
- Molecule 1: metformin hydrolase subunit B

Chain B: 




- Molecule 1: metformin hydrolase subunit B

Chain C: 

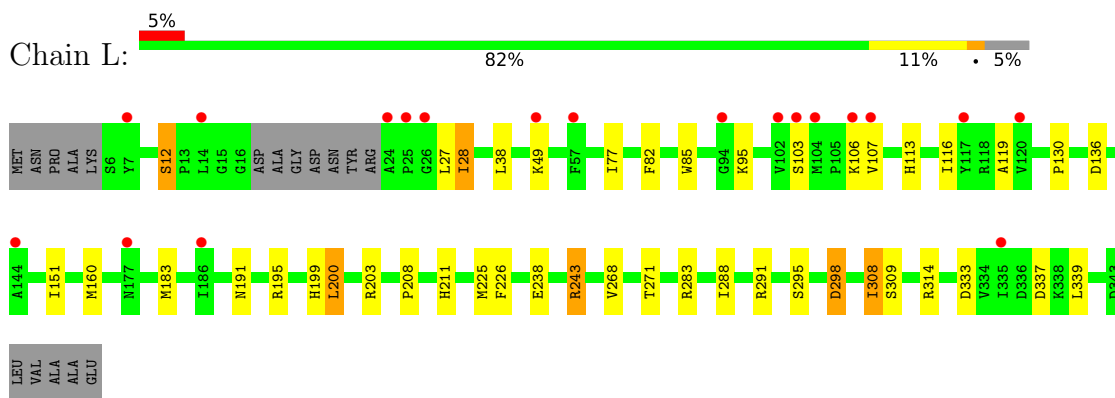


- Molecule 1: metformin hydrolase subunit B

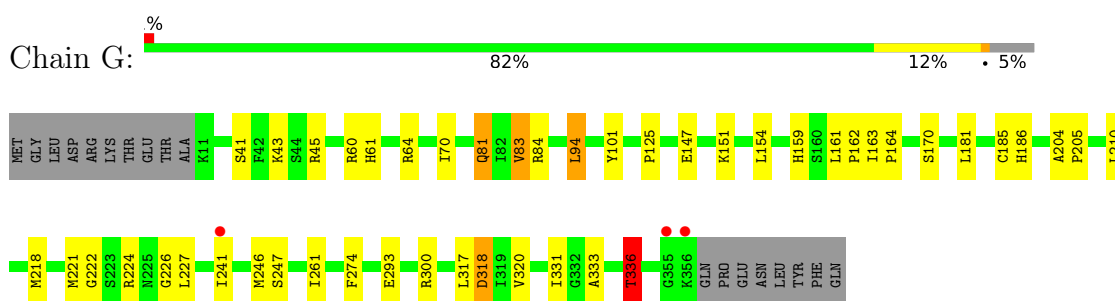
Chain D: 



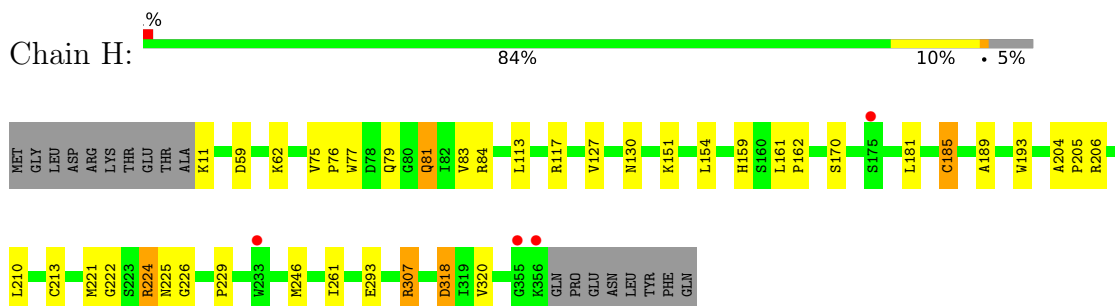
- Molecule 1: metformin hydrolase subunit B



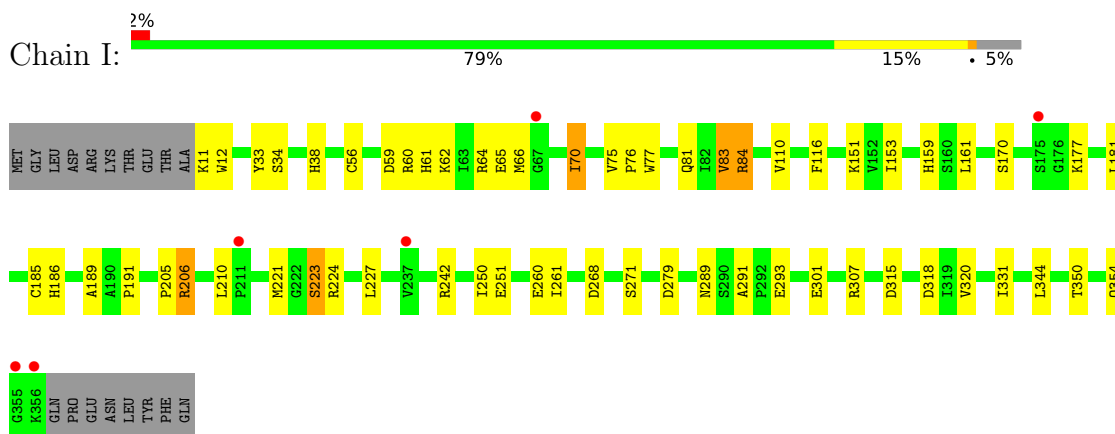
- Molecule 2: metformin hydrolase subunit A



- Molecule 2: metformin hydrolase subunit A

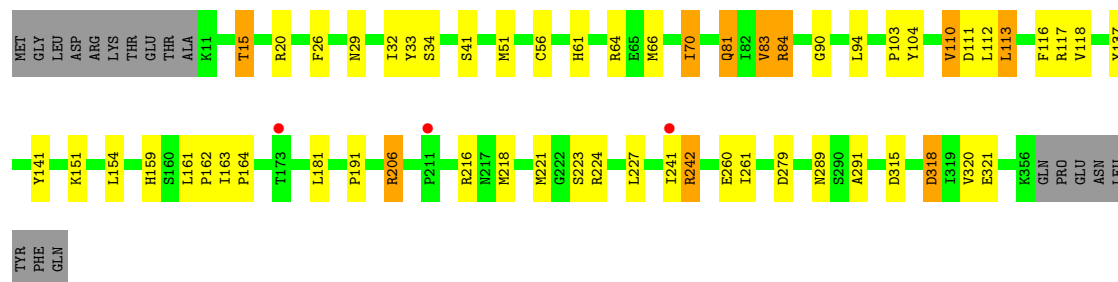
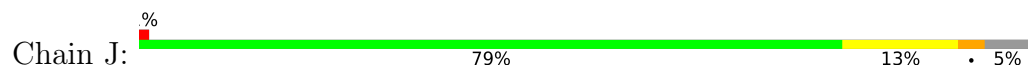


- Molecule 2: metformin hydrolase subunit A



- Molecule 2: metformin hydrolase subunit A





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	103.53Å 107.88Å 114.51Å 93.43° 97.62° 98.11°	Depositor
Resolution (Å)	74.61 – 2.20 74.61 – 2.20	Depositor EDS
% Data completeness (in resolution range)	91.2 (74.61-2.20) 91.2 (74.61-2.20)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.88 (at 2.20Å)	Xtrriage
Refinement program	REFMAC 5.8.0411	Depositor
R, $R_{free}$	0.212 , 0.257 0.218 , 0.259	Depositor DCC
$R_{free}$ test set	11220 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	41.6	Xtrriage
Anisotropy	0.071	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 49.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	32022	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	52.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 76.81 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 9.6659e-07. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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:  
NI

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	0.37	0/2587	0.68	1/3499 (0.0%)
1	B	0.37	0/2587	0.69	2/3499 (0.1%)
1	C	0.38	0/2587	0.70	1/3499 (0.0%)
1	D	0.35	0/2587	0.67	1/3499 (0.0%)
1	E	0.33	0/2587	0.65	1/3499 (0.0%)
1	F	0.33	0/2587	0.62	0/3499
1	K	0.32	0/2587	0.61	0/3499
1	L	0.32	0/2587	0.63	1/3499 (0.0%)
2	G	0.37	0/2778	0.71	2/3765 (0.1%)
2	H	0.36	0/2778	0.70	0/3765
2	I	0.35	0/2778	0.68	0/3765
2	J	0.34	0/2778	0.68	0/3765
All	All	0.35	0/31808	0.67	9/43052 (0.0%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1
1	B	0	1
1	C	0	2
1	D	0	3
1	E	0	1
1	F	0	2
1	K	0	1
2	G	0	1
2	H	0	3
2	I	0	1
2	J	0	2

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Mol	Chain	#Chirality outliers	#Planarity outliers
All	All	0	18

There are no bond length outliers.

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	279	ARG	CB-CG-CD	-6.85	93.79	111.60
1	B	271	THR	CB-CA-C	-6.54	93.93	111.60
1	C	271	THR	CB-CA-C	-6.35	94.45	111.60
1	D	271	THR	CB-CA-C	-6.10	95.14	111.60
1	A	271	THR	CB-CA-C	-5.74	96.09	111.60

There are no chirality outliers.

5 of 18 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	137	ARG	Sidechain
1	B	283	ARG	Sidechain
1	C	137	ARG	Sidechain
1	C	291	ARG	Sidechain
1	D	137	ARG	Sidechain

## 5.2 Too-close contacts [i](#)

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2535	0	2497	22	0
1	B	2535	0	2497	27	0
1	C	2535	0	2497	30	0
1	D	2535	0	2497	29	0
1	E	2535	0	2497	26	0
1	F	2535	0	2497	33	0
1	K	2535	0	2497	42	0
1	L	2535	0	2497	29	0
2	G	2706	0	2592	28	0
2	H	2706	0	2592	30	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	I	2706	0	2592	38	0
2	J	2706	0	2592	46	0
3	G	2	0	0	0	0
3	H	2	0	0	0	0
3	I	2	0	0	0	0
3	J	2	0	0	0	0
4	A	89	0	0	1	0
4	B	100	0	0	4	0
4	C	79	0	0	2	0
4	D	76	0	0	0	0
4	E	42	0	0	0	0
4	F	40	0	0	1	0
4	G	114	0	0	1	0
4	H	112	0	0	5	0
4	I	88	0	0	0	0
4	J	87	0	0	3	0
4	K	35	0	0	2	0
4	L	48	0	0	1	0
All	All	32022	0	30344	357	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 6.

The worst 5 of 357 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:J:56:CYS:SG	2:J:66:MET:HE3	2.09	0.92
2:J:56:CYS:SG	2:J:66:MET:CE	2.63	0.87
2:G:333:ALA:O	2:G:336:THR:HG22	1.79	0.83
1:C:104:MET:HE3	1:C:116:ILE:HG13	1.62	0.80
2:H:185:CYS:SG	2:H:293:GLU:HG3	2.22	0.80

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	327/348 (94%)	319 (98%)	7 (2%)	1 (0%)	41	46
1	B	327/348 (94%)	316 (97%)	9 (3%)	2 (1%)	25	26
1	C	327/348 (94%)	317 (97%)	9 (3%)	1 (0%)	41	46
1	D	327/348 (94%)	318 (97%)	7 (2%)	2 (1%)	25	26
1	E	327/348 (94%)	315 (96%)	10 (3%)	2 (1%)	25	26
1	F	327/348 (94%)	316 (97%)	8 (2%)	3 (1%)	17	16
1	K	327/348 (94%)	314 (96%)	12 (4%)	1 (0%)	41	46
1	L	327/348 (94%)	316 (97%)	10 (3%)	1 (0%)	41	46
2	G	344/364 (94%)	327 (95%)	16 (5%)	1 (0%)	41	46
2	H	344/364 (94%)	330 (96%)	13 (4%)	1 (0%)	41	46
2	I	344/364 (94%)	322 (94%)	21 (6%)	1 (0%)	41	46
2	J	344/364 (94%)	328 (95%)	15 (4%)	1 (0%)	41	46
All	All	3992/4240 (94%)	3838 (96%)	137 (3%)	17 (0%)	34	37

5 of 17 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	342	THR
1	B	342	THR
1	F	105	PRO
1	F	342	THR
1	E	105	PRO

### 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	267/279 (96%)	256 (96%)	11 (4%)	30	39
1	B	267/279 (96%)	256 (96%)	11 (4%)	30	39

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	267/279 (96%)	255 (96%)	12 (4%)	27	34
1	D	267/279 (96%)	253 (95%)	14 (5%)	23	28
1	E	267/279 (96%)	259 (97%)	8 (3%)	41	53
1	F	267/279 (96%)	251 (94%)	16 (6%)	19	22
1	K	267/279 (96%)	256 (96%)	11 (4%)	30	39
1	L	267/279 (96%)	255 (96%)	12 (4%)	27	34
2	G	286/302 (95%)	278 (97%)	8 (3%)	43	56
2	H	286/302 (95%)	279 (98%)	7 (2%)	49	62
2	I	286/302 (95%)	278 (97%)	8 (3%)	43	56
2	J	286/302 (95%)	273 (96%)	13 (4%)	27	34
All	All	3280/3440 (95%)	3149 (96%)	131 (4%)	31	40

5 of 131 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	K	270	SER
1	L	12	SER
1	L	339	LEU
1	E	58	ASP
1	D	337	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 18 such sidechains are listed below:

Mol	Chain	Res	Type
2	J	100	GLN
1	L	196	ASN
1	K	165	GLN
2	G	353	GLN
2	J	81	GLN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

## 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 8 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

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 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	331/348 (95%)	0.18	12 (3%) 42 41	24, 44, 77, 106	0
1	B	331/348 (95%)	0.19	13 (3%) 39 37	23, 43, 76, 106	0
1	C	331/348 (95%)	0.23	13 (3%) 39 37	22, 47, 84, 118	0
1	D	331/348 (95%)	0.28	13 (3%) 39 37	25, 53, 83, 110	0
1	E	331/348 (95%)	0.41	18 (5%) 25 24	34, 58, 85, 130	0
1	F	331/348 (95%)	0.61	28 (8%) 10 9	31, 61, 91, 148	0
1	K	331/348 (95%)	0.89	47 (14%) 2 2	34, 64, 92, 137	0
1	L	331/348 (95%)	0.53	19 (5%) 23 22	35, 57, 86, 138	0
2	G	346/364 (95%)	-0.11	3 (0%) 84 83	24, 43, 62, 117	0
2	H	346/364 (95%)	-0.12	4 (1%) 79 77	26, 44, 62, 96	0
2	I	346/364 (95%)	-0.08	6 (1%) 70 68	27, 46, 64, 116	0
2	J	346/364 (95%)	-0.03	3 (0%) 84 83	28, 48, 69, 93	0
All	All	4032/4240 (95%)	0.25	179 (4%) 34 32	22, 50, 81, 148	0

The worst 5 of 179 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	K	105	PRO	8.0
1	F	24	ALA	7.7
1	F	26	GLY	6.8
1	K	107	VAL	5.5
1	K	7	TYR	5.4

### 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](#)

There are no monosaccharides in this entry.

### 6.4 Ligands [i](#)

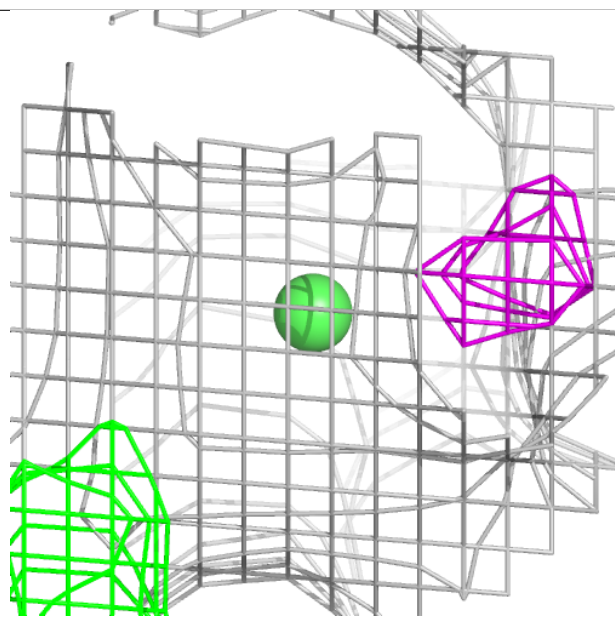
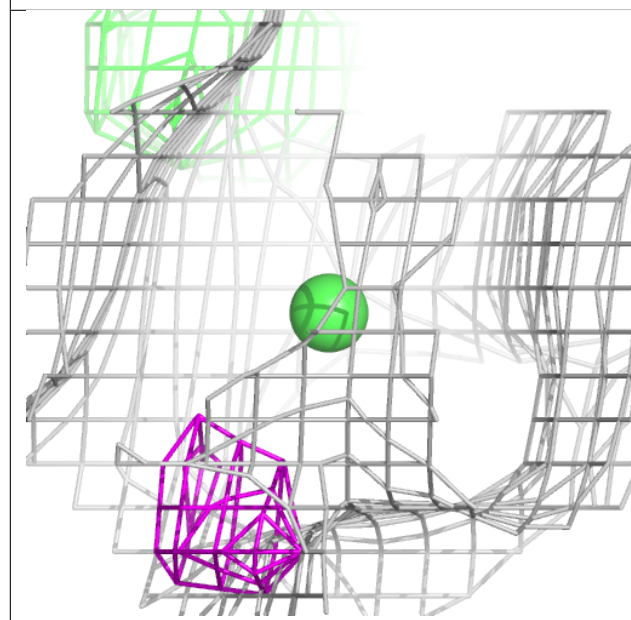
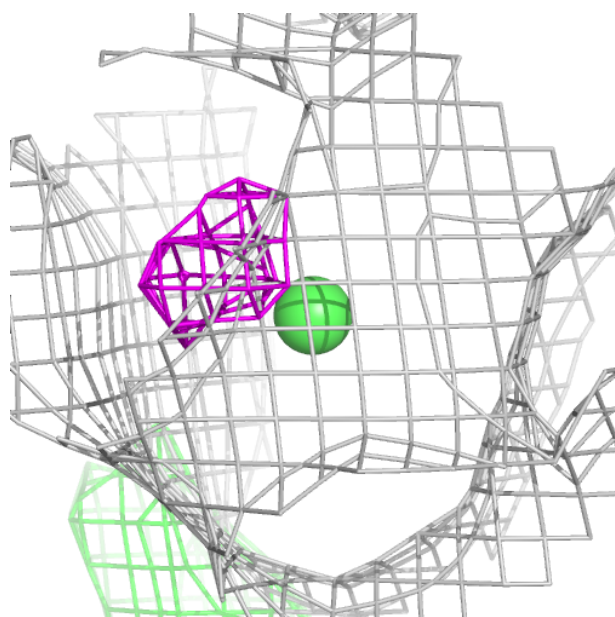
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 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
3	NI	J	401	1/1	0.97	0.09	59,59,59,59	0
3	NI	I	401	1/1	0.98	0.09	55,55,55,55	0
3	NI	G	401	1/1	0.98	0.09	49,49,49,49	0
3	NI	H	402	1/1	0.99	0.09	47,47,47,47	0
3	NI	G	402	1/1	0.99	0.10	49,49,49,49	0
3	NI	I	402	1/1	0.99	0.09	56,56,56,56	0
3	NI	H	401	1/1	0.99	0.10	50,50,50,50	0
3	NI	J	402	1/1	0.99	0.07	63,63,63,63	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.

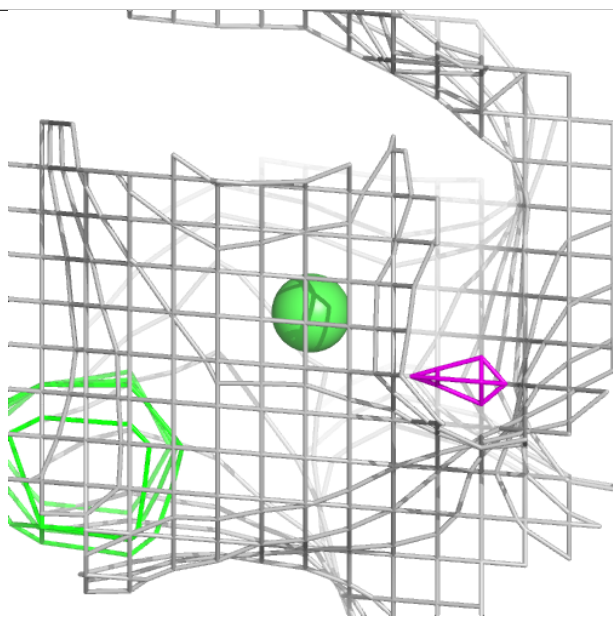
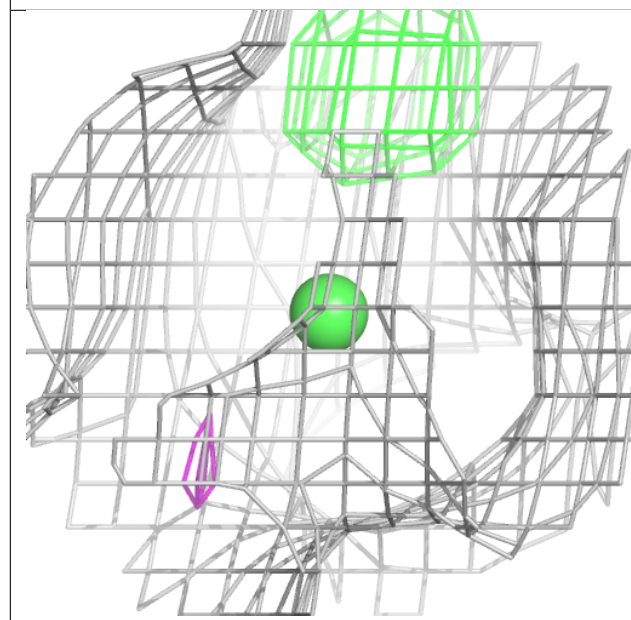
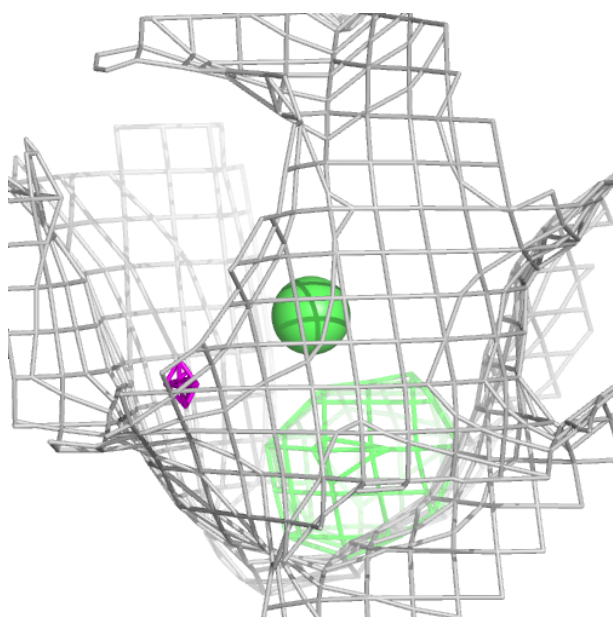
**Electron density around NI J 401:**

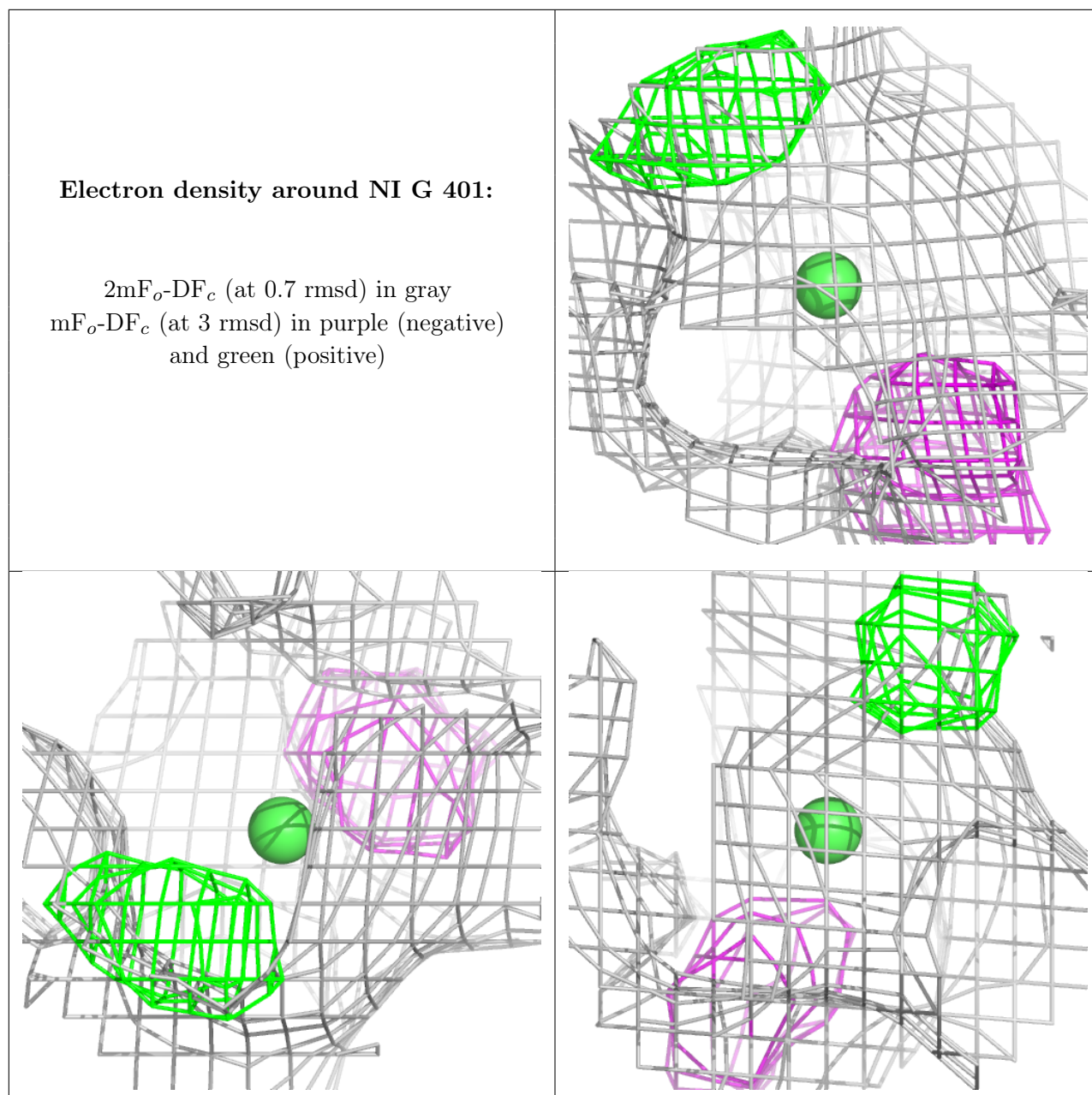
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



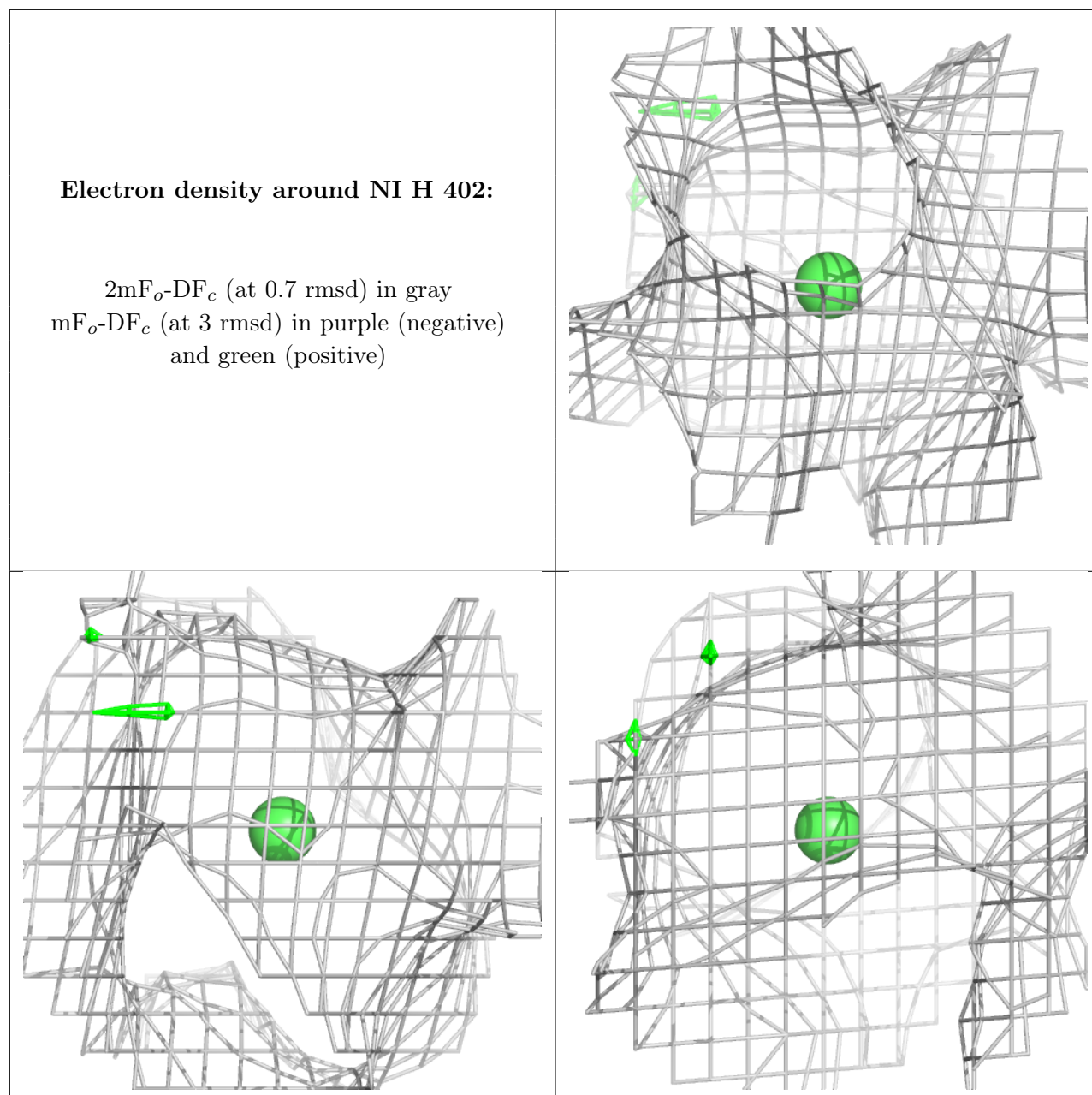
**Electron density around NI I 401:**

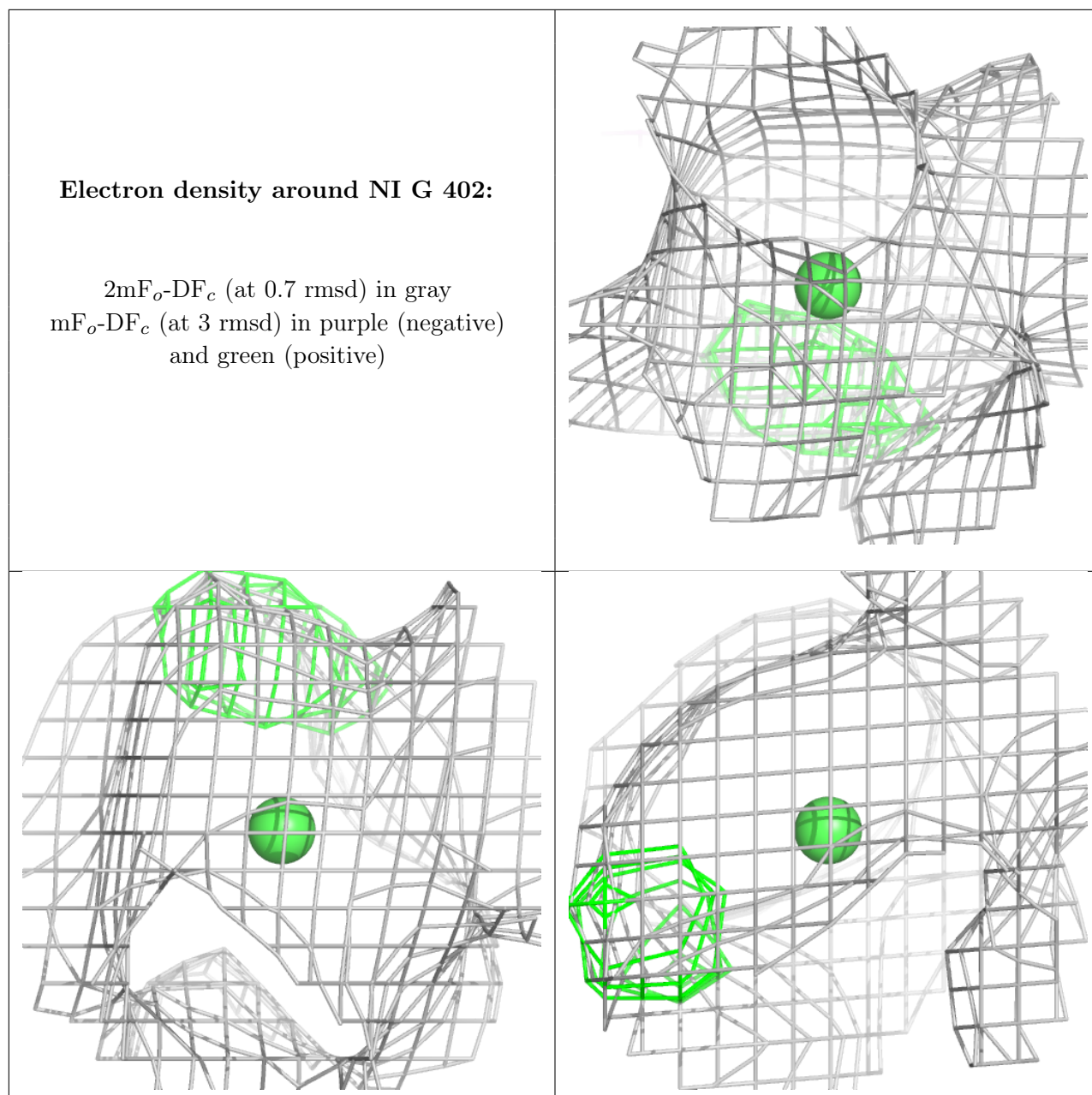
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





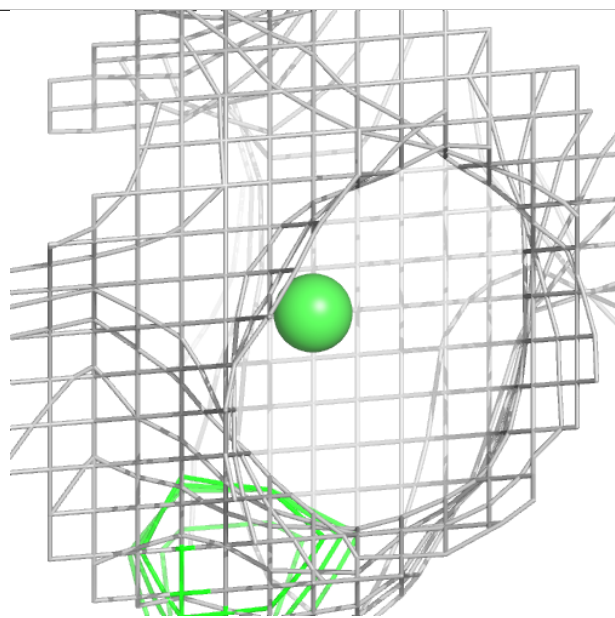
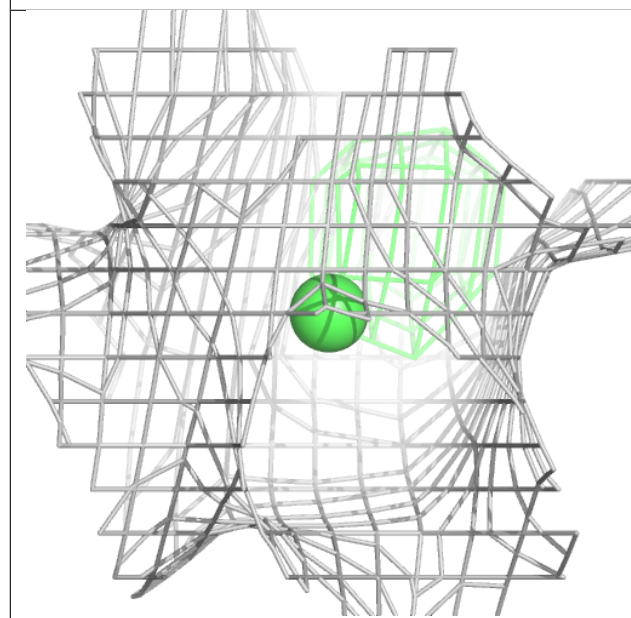
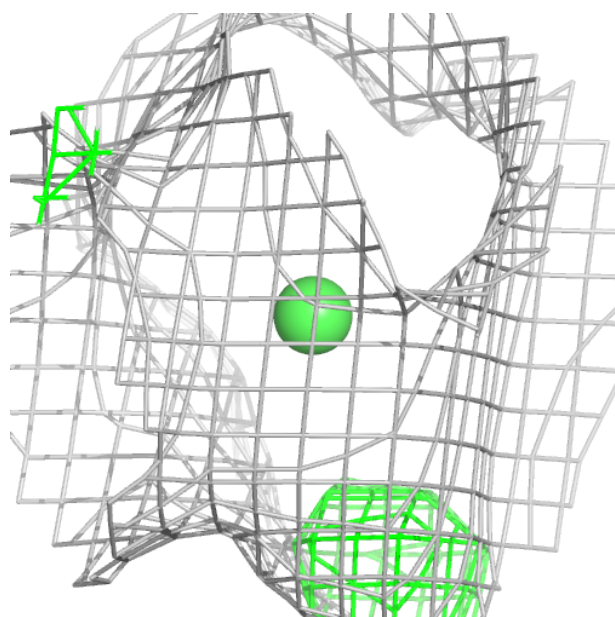




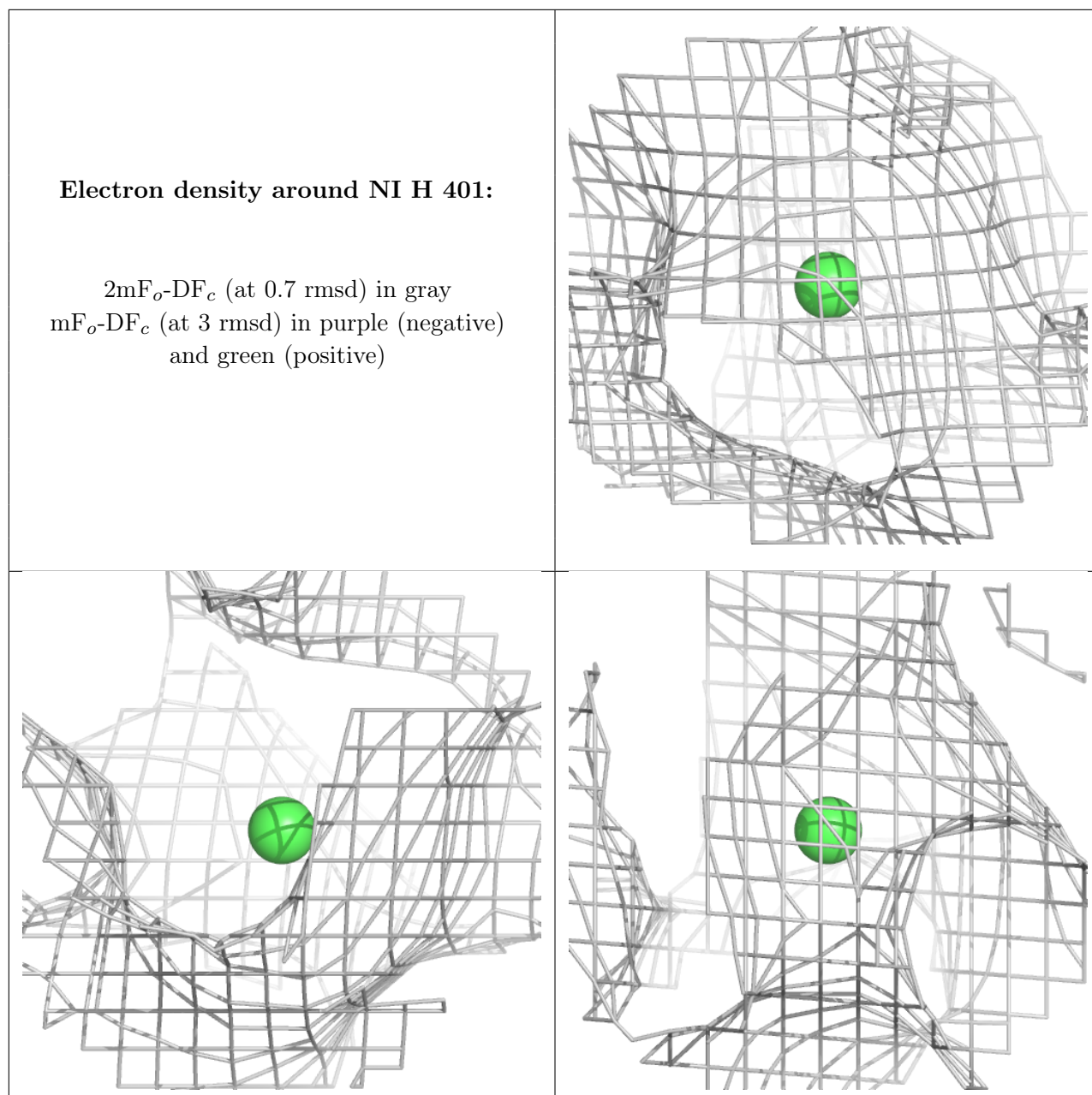


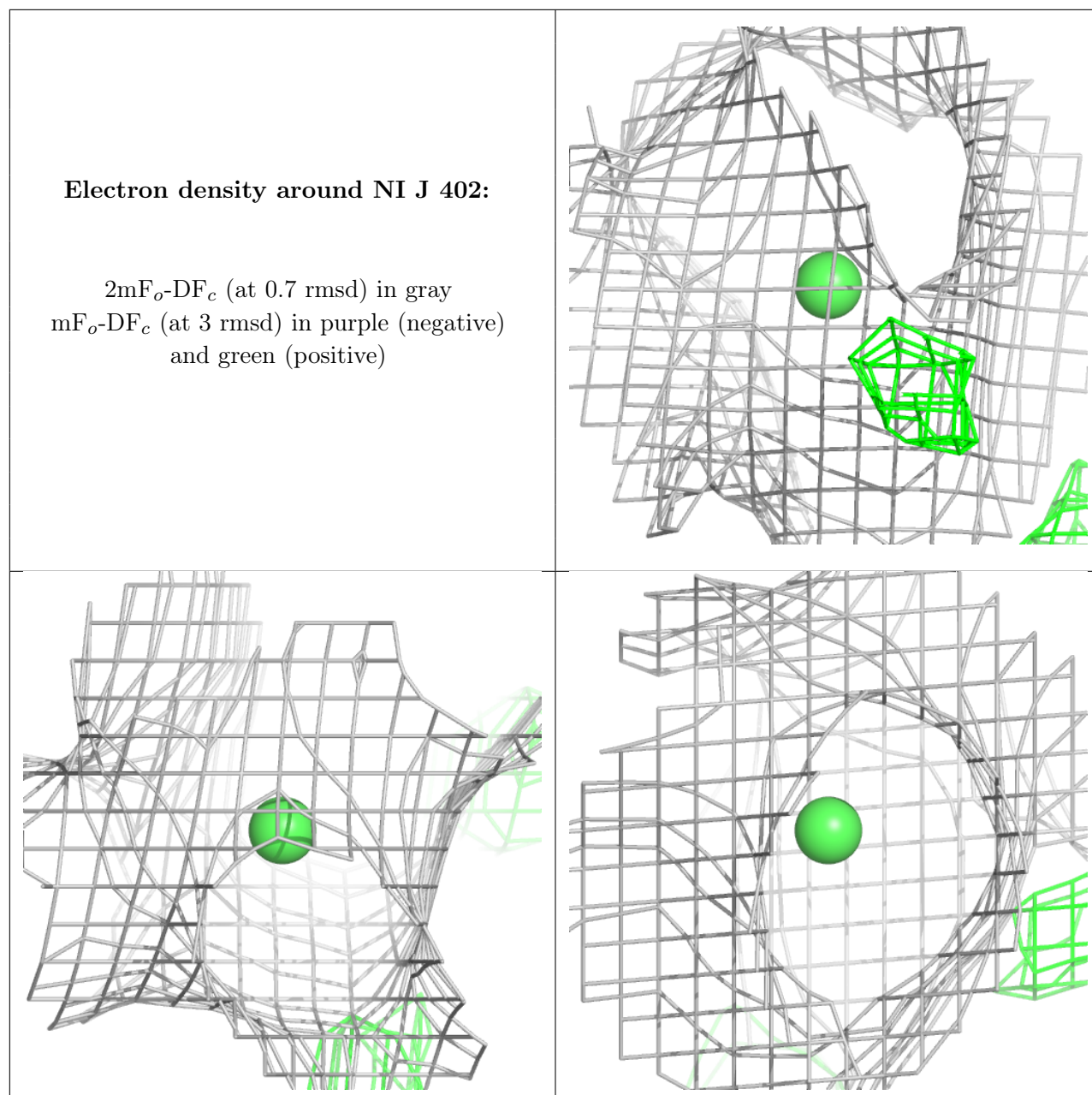
**Electron density around NI I 402:**

$2mF_o-DF_c$  (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.