



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 10:36 AM UTC

PDB ID : 8SNF / pdb\_00008snf  
Title : Crystal structure of metformin hydrolase (MfmAB) from *Pseudomonas mendocina* sp. MET-2 with Ni<sup>2+</sup> bound  
Authors : Tassoulas, L.J.; Rankin, J.A.; Elias, M.H.; Wackett, L.P.  
Deposited on : 2023-04-27  
Resolution : 2.30 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 : 4-5-2 with Phenix2.0  
Xtrriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
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) : 2.49

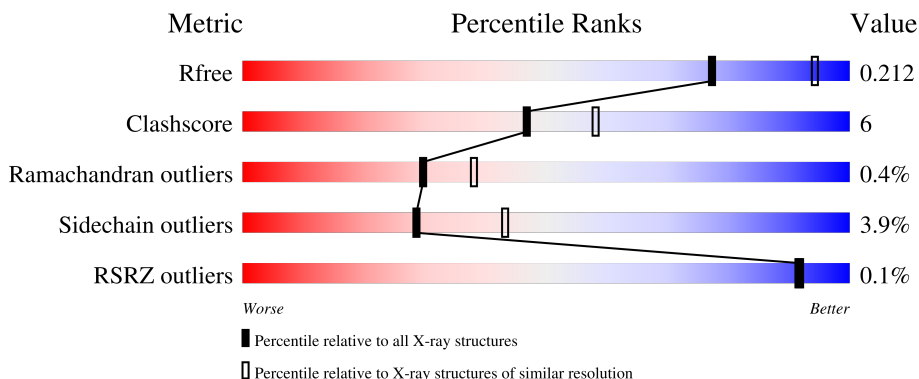
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 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))
$R_{free}$	180053	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	79% 13% .. 6%
1	B	348	81% 11% • 6%
1	C	348	79% 12% .. 6%
1	E	348	82% 11% • 6%
2	D	364	79% 14% .. 5%

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Mol	Chain	Length	Quality of chain
2	F	364	 81% 13% .. 5%

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 15792 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	326	2507	1579	439	470	19	0	0	0
1	B	326	2507	1579	439	470	19	0	0	0
1	C	326	2507	1579	439	470	19	0	0	0
1	E	326	2507	1579	439	470	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	D	347	2715	1711	476	505	23	0	0	0
2	F	347	2715	1711	476	505	23	0	0	0

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

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	D	2	Total Ni 2 2	0	0
3	F	2	Total Ni 2 2	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	55	Total O 55 55	0	0

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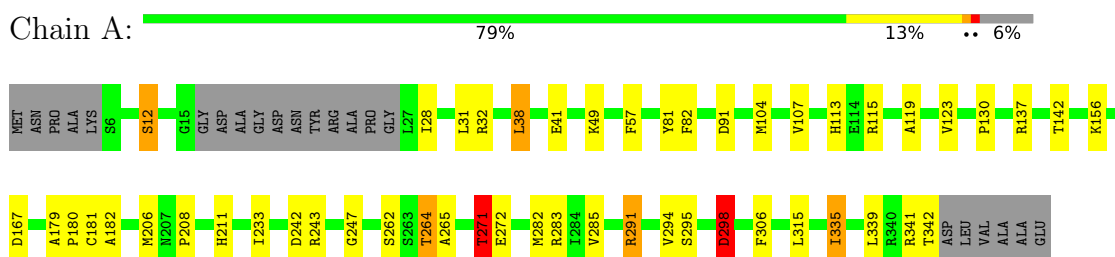
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<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>	<b>ZeroOcc</b>	<b>AltConf</b>
4	B	27	Total O 27 27	0	0
4	C	24	Total O 24 24	0	0
4	D	91	Total O 91 91	0	0
4	E	57	Total O 57 57	0	0
4	F	76	Total O 76 76	0	0

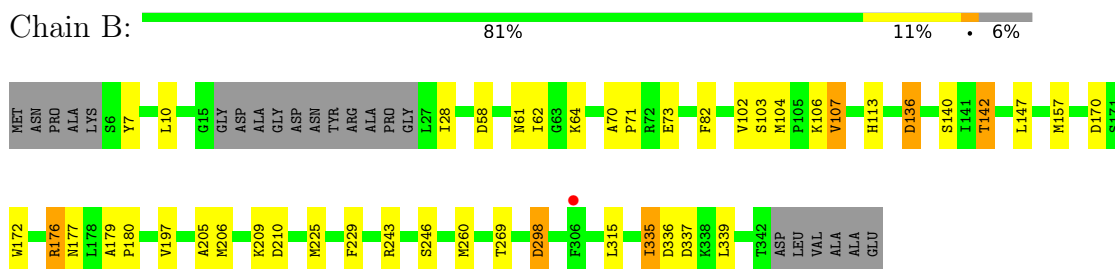
### 3 Residue-property plots [i](#)

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.

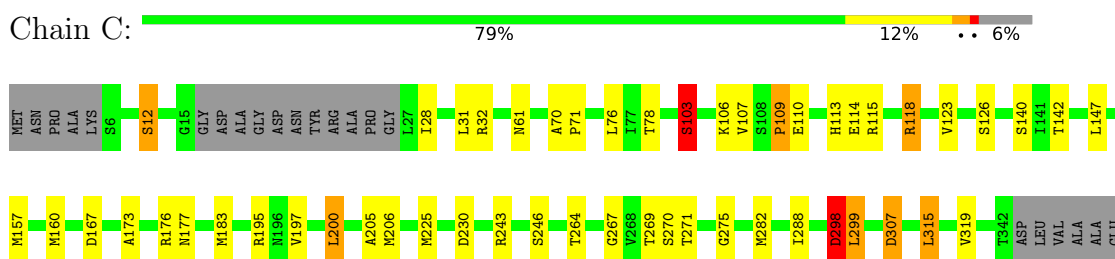
- Molecule 1: metformin hydrolase subunit B



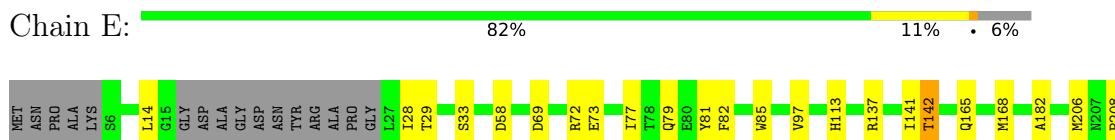
- Molecule 1: metformin hydrolase subunit B



- Molecule 1: metformin hydrolase subunit B



- Molecule 1: metformin hydrolase subunit B





- Molecule 2: metformin hydrolase subunit A

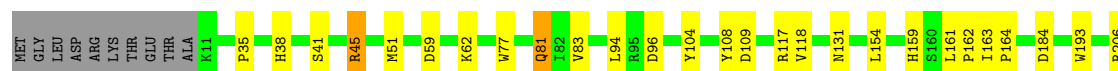
Chain D: 79% 14% 5%



GLN

- Molecule 2: metformin hydrolase subunit A

Chain F: 81% 13% 5%



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	83.40Å 96.40Å 96.70Å 115.50° 106.20° 101.10°	Depositor
Resolution (Å)	19.86 – 2.30 19.86 – 2.30	Depositor EDS
% Data completeness (in resolution range)	91.6 (19.86-2.30) 91.6 (19.86-2.30)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.99 (at 2.30Å)	Xtrriage
Refinement program	REFMAC 5.8.0411	Depositor
R, $R_{free}$	0.172 , 0.219 0.171 , 0.212	Depositor DCC
$R_{free}$ test set	5056 reflections (4.68%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	69.3	Xtrriage
Anisotropy	0.122	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 51.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.98	EDS
Total number of atoms	15792	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	78.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.92% 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

### 5.1 Standard geometry

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	0.63	0/2558	1.06	4/3459 (0.1%)
1	B	0.56	0/2558	0.92	1/3459 (0.0%)
1	C	0.57	0/2558	0.96	2/3459 (0.1%)
1	E	0.62	0/2558	1.03	2/3459 (0.1%)
2	D	0.60	0/2787	1.07	8/3777 (0.2%)
2	F	0.60	0/2787	1.02	4/3777 (0.1%)
All	All	0.60	0/15806	1.01	21/21390 (0.1%)

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	5
1	E	0	3
2	D	0	2
2	F	0	4
All	All	0	14

There are no bond length outliers.

The worst 5 of 21 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	318	ASP	CA-CB-CG	8.18	120.78	112.60
2	D	158	ASP	CB-CA-C	-7.90	94.70	110.42
1	E	298	ASP	CA-CB-CG	7.76	120.36	112.60
2	D	336	THR	N-CA-CB	-6.85	100.02	110.16
1	A	271	THR	CB-CA-C	-6.56	96.24	109.68

There are no chirality outliers.

5 of 14 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	115	ARG	Sidechain
1	A	137	ARG	Sidechain
1	A	243	ARG	Sidechain
1	A	291	ARG	Sidechain
1	A	32	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	2507	0	2475	25	0
1	B	2507	0	2475	33	0
1	C	2507	0	2475	36	0
1	E	2507	0	2475	28	0
2	D	2715	0	2600	38	0
2	F	2715	0	2600	35	0
3	D	2	0	0	0	0
3	F	2	0	0	0	0
4	A	55	0	0	0	0
4	B	27	0	0	0	0
4	C	24	0	0	1	0
4	D	91	0	0	1	0
4	E	57	0	0	1	0
4	F	76	0	0	0	0
All	All	15792	0	15100	174	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 174 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:D:94:LEU:HD23	2:D:336:THR:CG2	2.04	0.88
2:F:94:LEU:HD23	2:F:336:THR:HG23	1.59	0.84

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:113:HIS:ND1	1:B:142:THR:HG21	1.95	0.81
1:A:81:TYR:HA	1:B:206:MET:HE1	1.61	0.80
2:D:94:LEU:HD23	2:D:336:THR:HG23	1.64	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	322/348 (92%)	311 (97%)	10 (3%)	1 (0%)	36	46
1	B	322/348 (92%)	311 (97%)	10 (3%)	1 (0%)	36	46
1	C	322/348 (92%)	307 (95%)	12 (4%)	3 (1%)	14	17
1	E	322/348 (92%)	311 (97%)	10 (3%)	1 (0%)	36	46
2	D	345/364 (95%)	323 (94%)	21 (6%)	1 (0%)	36	46
2	F	345/364 (95%)	323 (94%)	22 (6%)	0	100	100
All	All	1978/2120 (93%)	1886 (95%)	85 (4%)	7 (0%)	30	38

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	103	SER
1	B	107	VAL
1	C	107	VAL
1	E	233	ILE
2	D	83	VAL

### 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	265/279 (95%)	250 (94%)	15 (6%)	18	27
1	B	265/279 (95%)	255 (96%)	10 (4%)	29	44
1	C	265/279 (95%)	250 (94%)	15 (6%)	18	27
1	E	265/279 (95%)	258 (97%)	7 (3%)	40	59
2	D	287/302 (95%)	279 (97%)	8 (3%)	38	56
2	F	287/302 (95%)	279 (97%)	8 (3%)	38	56
All	All	1634/1720 (95%)	1571 (96%)	63 (4%)	28	43

5 of 63 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	106	LYS
2	F	41	SER
1	C	270	SER
1	E	335	ILE
2	F	318	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	89	ASN
1	E	161	HIS
2	F	338	ASN
2	F	217	ASN
1	C	177	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](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 4 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	326/348 (93%)	-0.45	0 <a href="#">100</a> <a href="#">100</a>	54, 72, 103, 150	0
1	B	326/348 (93%)	-0.36	1 (0%) <a href="#">90</a> <a href="#">90</a>	62, 82, 115, 181	0
1	C	326/348 (93%)	-0.33	0 <a href="#">100</a> <a href="#">100</a>	63, 84, 117, 174	0
1	E	326/348 (93%)	-0.49	0 <a href="#">100</a> <a href="#">100</a>	53, 70, 101, 139	0
2	D	347/364 (95%)	-0.43	0 <a href="#">100</a> <a href="#">100</a>	54, 70, 95, 149	0
2	F	347/364 (95%)	-0.42	1 (0%) <a href="#">90</a> <a href="#">90</a>	55, 72, 100, 140	0
All	All	1998/2120 (94%)	-0.41	2 (0%) <a href="#">92</a> <a href="#">91</a>	53, 75, 108, 181	0

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	F	227	LEU	2.6
1	B	306	PHE	2.5

### 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](#)

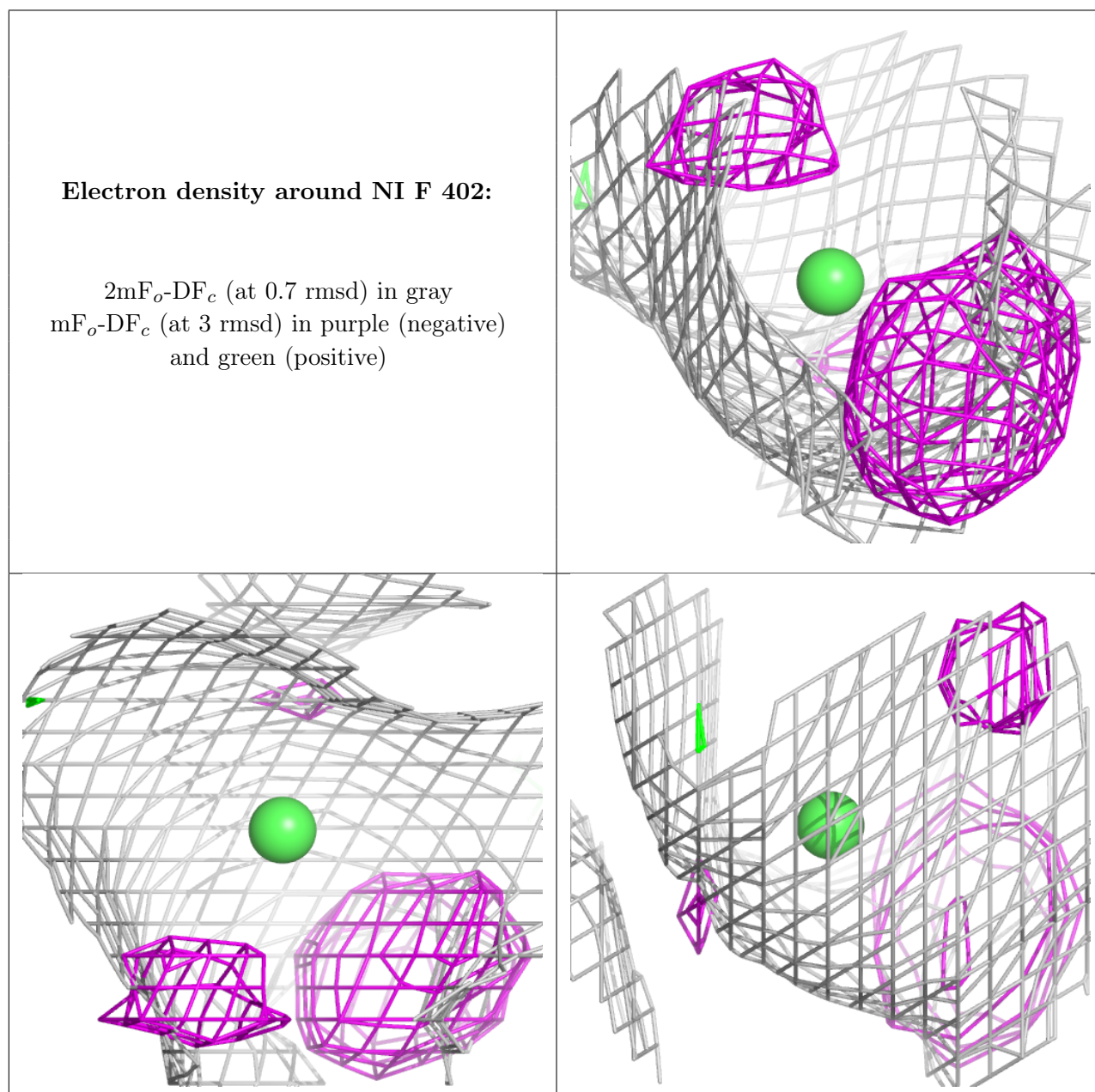
There are no oligosaccharides in this entry.

### 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.

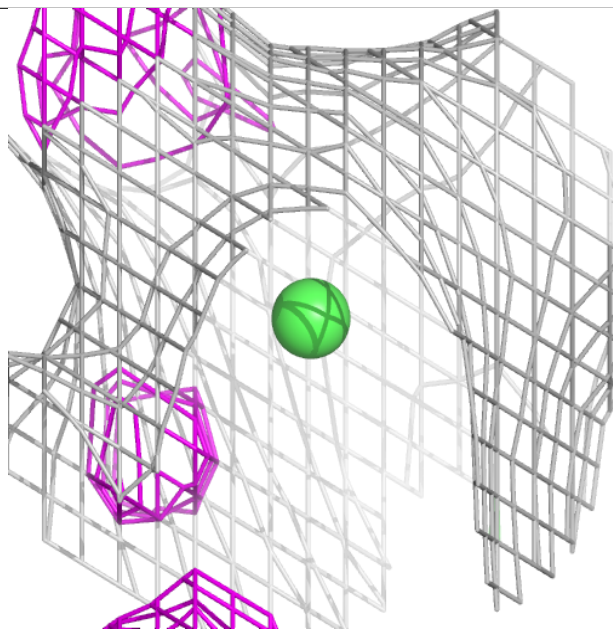
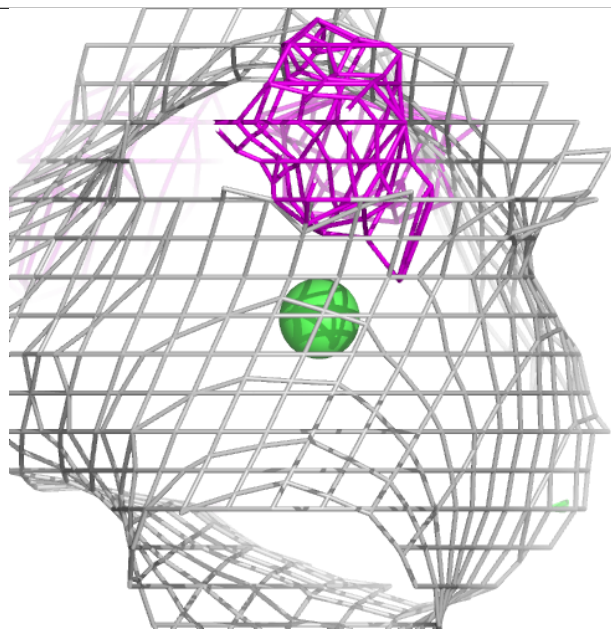
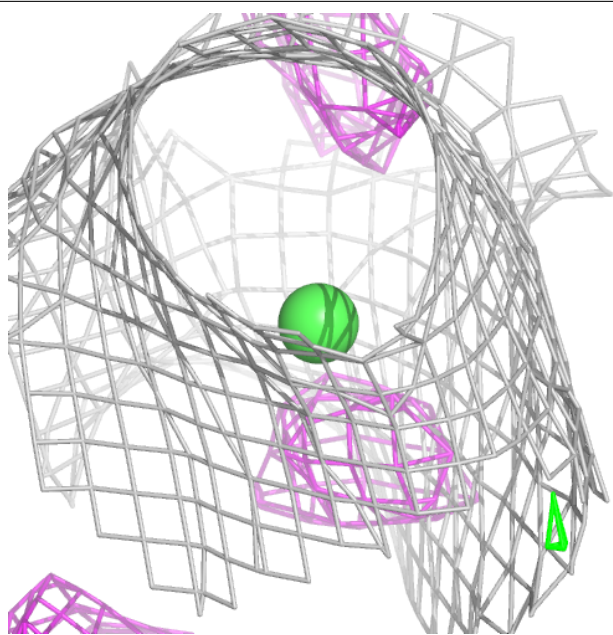
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	NI	F	402	1/1	0.95	0.09	125,125,125,125	0
3	NI	F	401	1/1	0.98	0.06	95,95,95,95	0
3	NI	D	401	1/1	0.98	0.06	112,112,112,112	0
3	NI	D	402	1/1	0.99	0.04	87,87,87,87	0

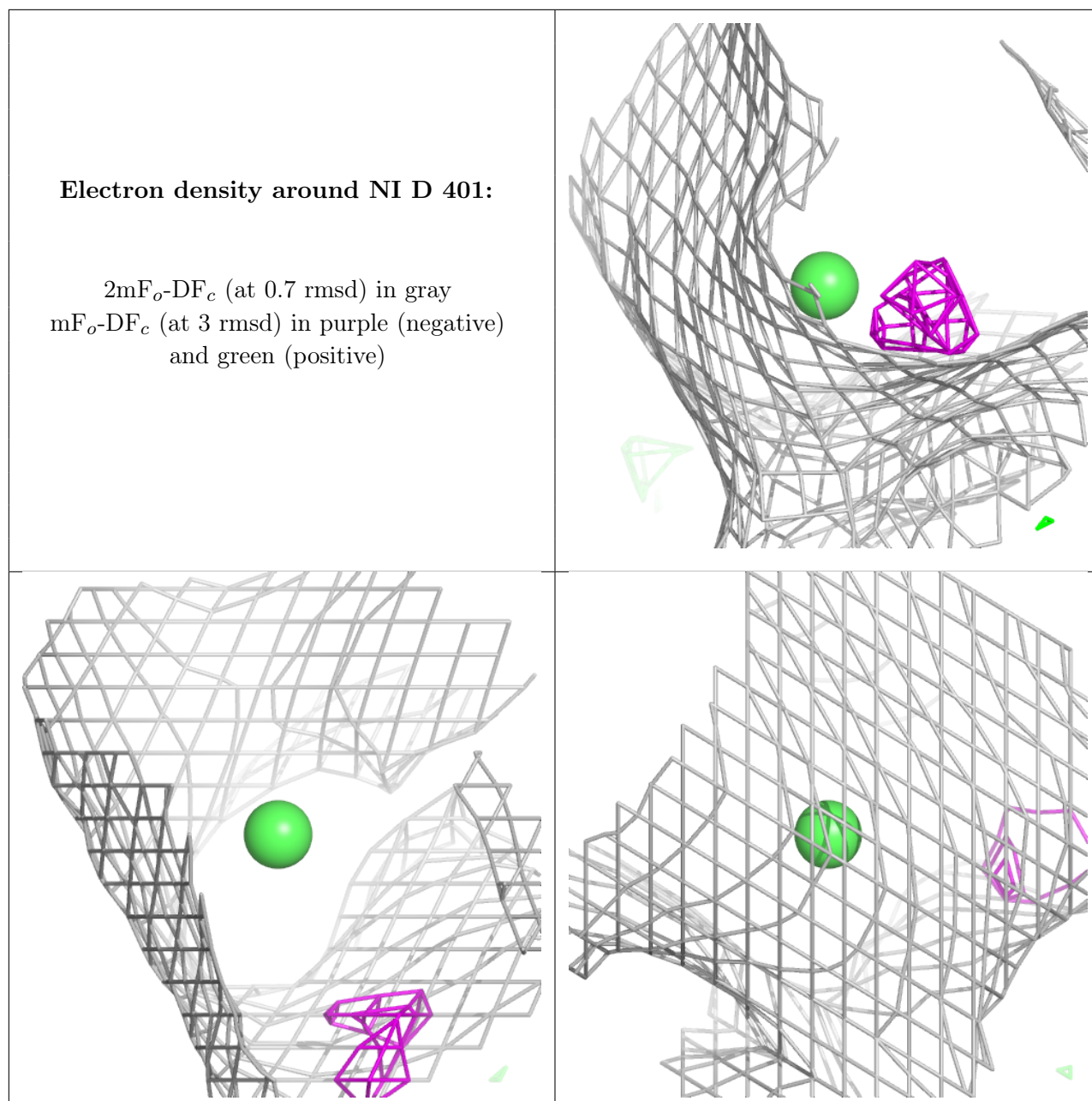
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

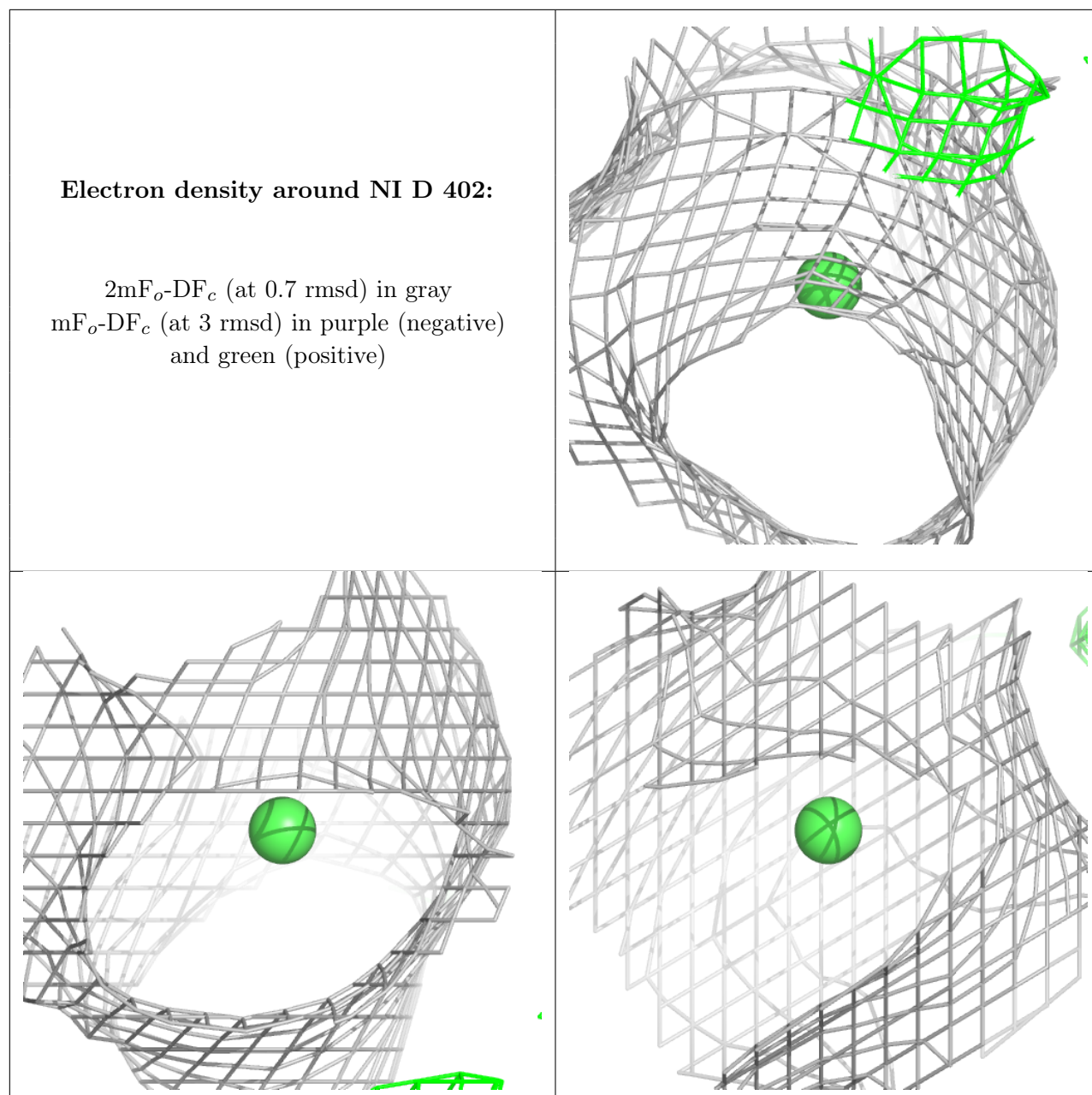


**Electron density around NI F 401:**

$2mF_o-DF_c$  (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.