



# wwPDB X-ray Structure Validation Summary Report

May 7, 2026 – 09:22 AM EDT

PDB ID : 8BAL / pdb\_00008bal  
Title : Niako3494, a bacterial protein structure in glycoside hydrolase family 20  
Authors : Dong, M.D.; Roth, C.R.; Jin, Y.J.  
Deposited on : 2022-10-11  
Resolution : 2.27 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

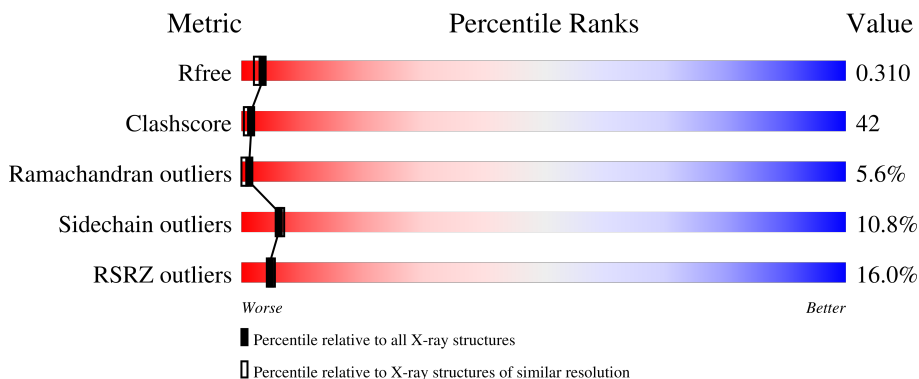
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.27 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	9078 (2.30-2.26)
Clashscore	190562	9802 (2.30-2.26)
Ramachandran outliers	187476	9690 (2.30-2.26)
Sidechain outliers	187428	9691 (2.30-2.26)
RSRZ outliers	180081	9085 (2.30-2.26)

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	380	
1	C	380	
1	D	380	
1	E	380	
1	F	380	

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 13749 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 Beta-N-acetylhexosaminidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	345	Total 2795	C 1802	N 472	O 500	S 21	0	1	0
1	C	330	Total 2657	C 1715	N 447	O 475	S 20	0	0	0
1	D	343	Total 2763	C 1783	N 467	O 494	S 19	0	0	0
1	E	335	Total 2697	C 1733	N 459	O 486	S 19	0	0	0
1	F	348	Total 2804	C 1808	N 473	O 503	S 20	0	0	0

- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total 1	Zn 1	0	0
2	C	1	Total 1	Zn 1	0	0
2	D	1	Total 1	Zn 1	0	0
2	E	1	Total 1	Zn 1	0	0
2	F	1	Total 1	Zn 1	0	0

- Molecule 3 is water.

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

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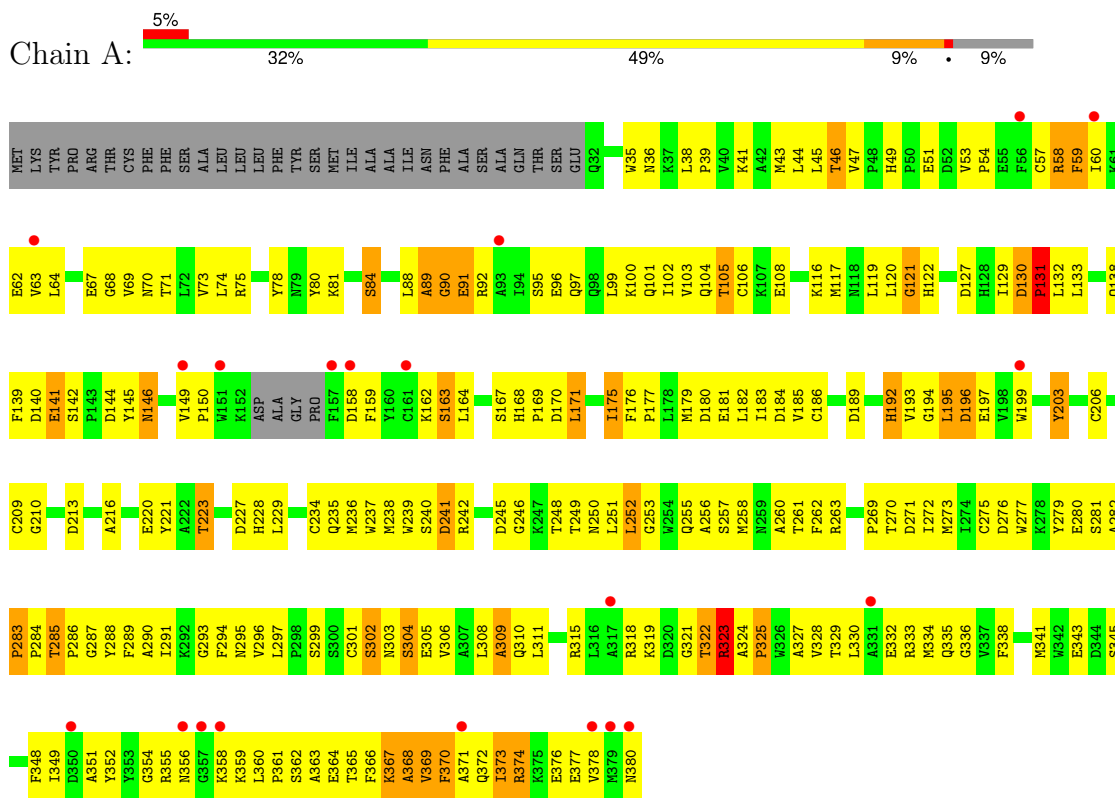
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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	D	9	Total O 9 9	0	0
3	E	3	Total O 3 3	0	0
3	F	8	Total O 8 8	0	0

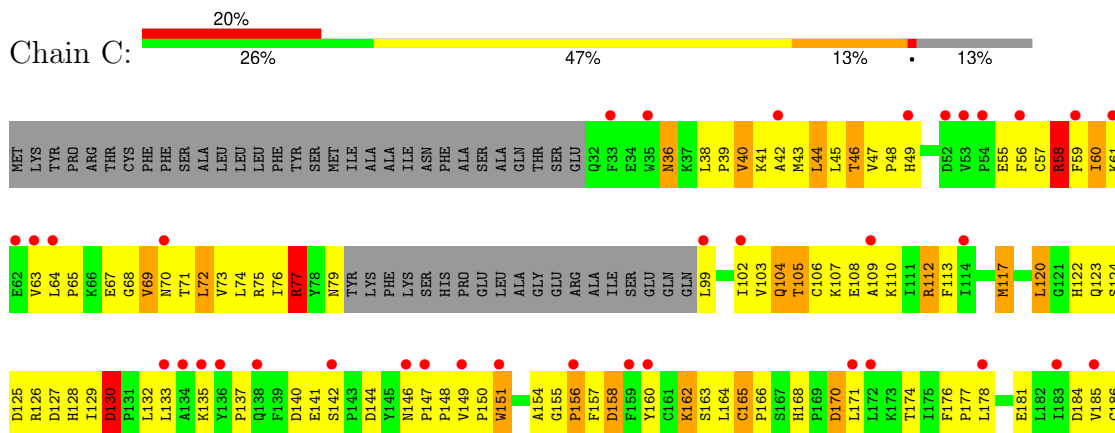
### 3 Residue-property plots [i](#)

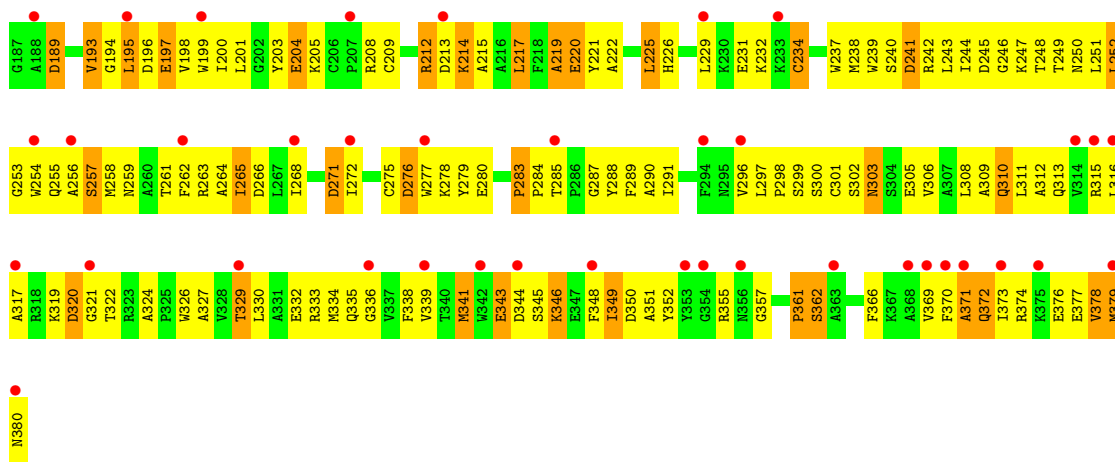
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: Beta-N-acetylhexosaminidase

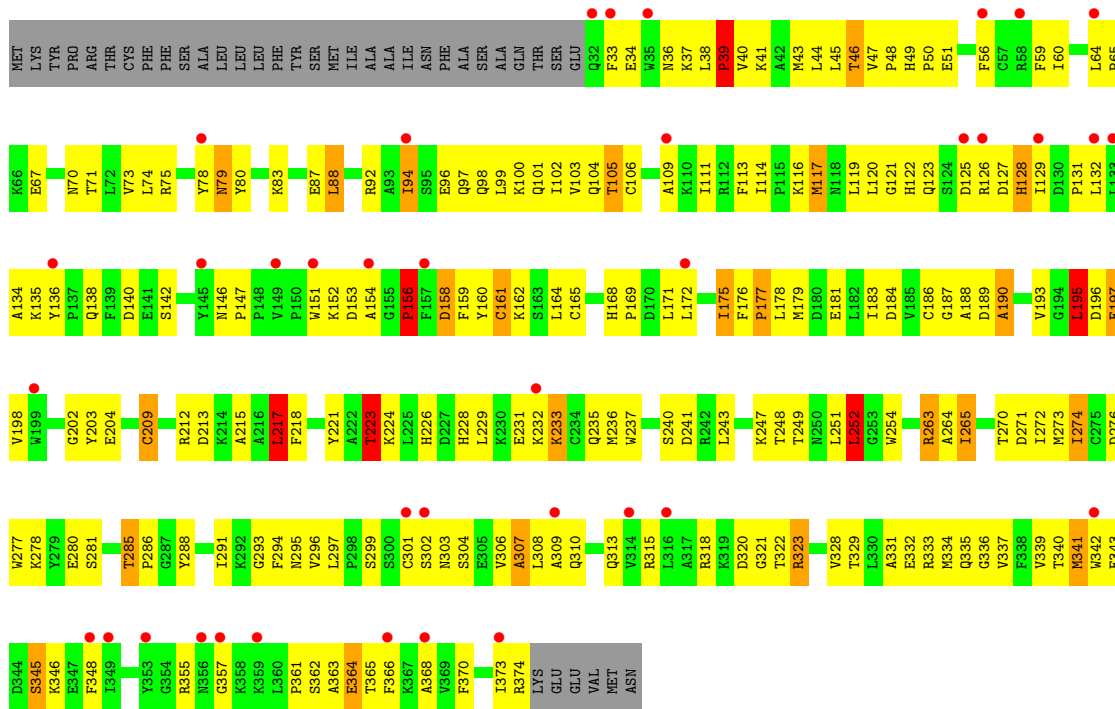


- Molecule 1: Beta-N-acetylhexosaminidase

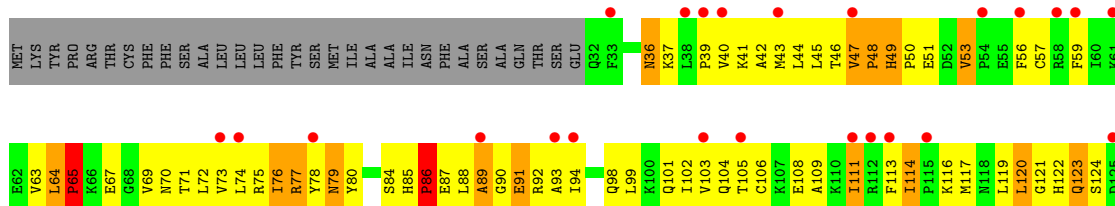
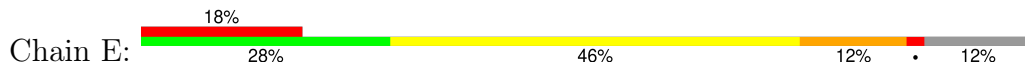


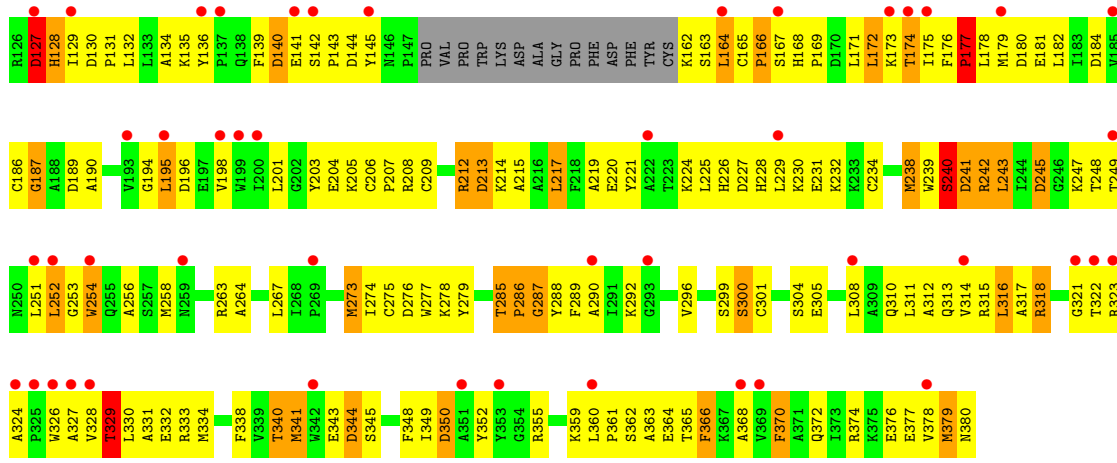


● Molecule 1: Beta-N-acetylhexosaminidase

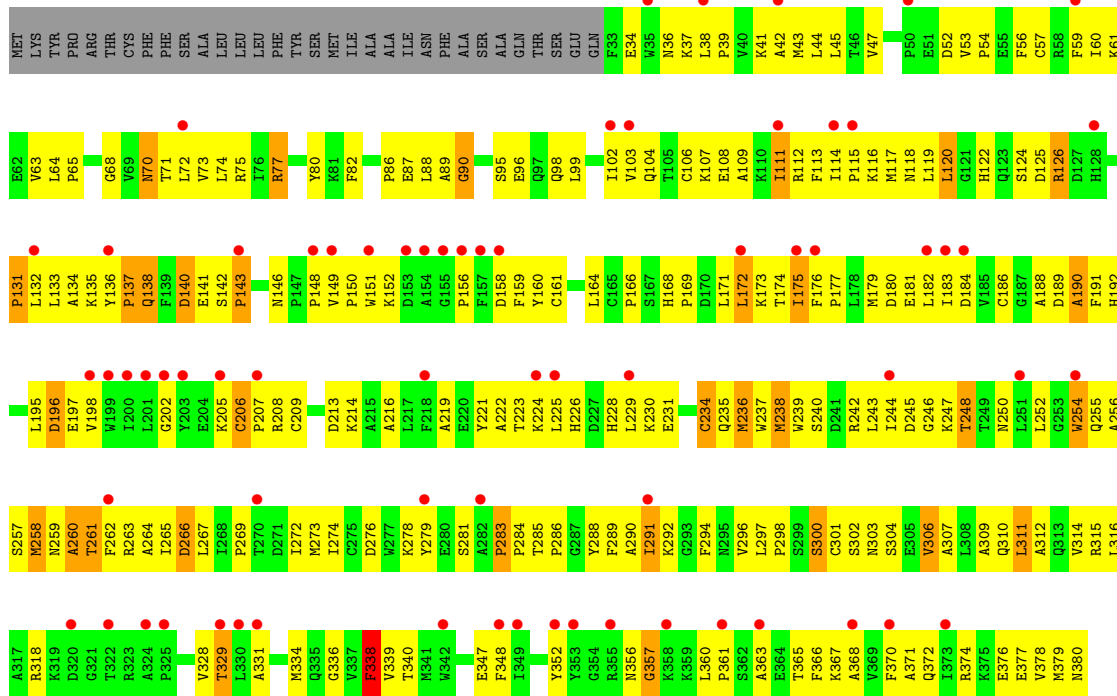


● Molecule 1: Beta-N-acetylhexosaminidase





● Molecule 1: Beta-N-acetylhexosaminidase



## 4 Data and refinement statistics i

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	146.99Å 254.59Å 139.58Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	73.49 – 2.27 73.49 – 2.27	Depositor EDS
% Data completeness (in resolution range)	99.9 (73.49-2.27) 99.7 (73.49-2.27)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.66 (at 2.27Å)	Xtrriage
Refinement program	REFMAC 5.8.0352	Depositor
R, $R_{free}$	0.283 , 0.356 0.248 , 0.310	Depositor DCC
$R_{free}$ test set	6126 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	35.1	Xtrriage
Anisotropy	0.085	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 28.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	0.064 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.069 for 1/2*h+1/2*k,3/2*h-1/2*k,-l	Xtrriage
Reported twinning fraction	0.332 for H, K, L 0.334 for 1/2H+1/2K, 3/2H-1/2K, -L 0.334 for 1/2H-1/2K, -3/2H-1/2K, -L	Depositor
Outliers	0 of 120467 reflections	Xtrriage
$F_o, F_c$ correlation	0.90	EDS
Total number of atoms	13749	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.10% 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:  
ZN

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	0.62	0/2872	1.28	11/3890 (0.3%)
1	C	0.54	0/2731	1.14	6/3703 (0.2%)
1	D	0.58	0/2842	1.24	11/3854 (0.3%)
1	E	0.54	0/2767	1.15	8/3745 (0.2%)
1	F	0.53	0/2883	1.13	6/3908 (0.2%)
All	All	0.56	0/14095	1.19	42/19100 (0.2%)

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	C	0	6
1	D	0	3
1	E	0	6
1	F	0	1
All	All	0	21

There are no bond length outliers.

The worst 5 of 42 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	283	PRO	N-CA-C	11.94	125.27	110.70
1	C	320	ASP	CA-CB-CG	9.57	122.17	112.60
1	A	196	ASP	CA-CB-CG	8.72	121.32	112.60
1	D	156	PRO	N-CA-CB	-8.64	94.18	103.25
1	D	223	THR	CA-CB-OG1	-7.89	97.77	109.60

There are no chirality outliers.

5 of 21 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	121	GLY	Peptide
1	A	203	TYR	Peptide
1	A	242	ARG	Sidechain
1	A	323	ARG	Sidechain
1	A	374	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	2795	0	2771	226	0
1	C	2657	0	2638	279	0
1	D	2763	0	2741	212	0
1	E	2697	0	2686	251	0
1	F	2804	0	2780	240	0
2	A	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
2	E	1	0	0	0	0
2	F	1	0	0	0	0
3	A	5	0	0	3	0
3	C	3	0	0	0	0
3	D	9	0	0	1	0
3	E	3	0	0	4	0
3	F	8	0	0	6	0
All	All	13749	0	13616	1151	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 42.

The worst 5 of 1151 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:302:SER:O	1:A:365:THR:OG1	1.56	1.22

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:245:ASP:O	1:A:249:THR:OG1	1.69	1.09
1:E:165:CYS:SG	1:E:208:ARG:NH1	2.27	1.05
1:C:158:ASP:O	1:F:247:LYS:HE3	1.58	1.03
1:A:39:PRO:HD2	1:A:335:GLN:O	1.59	1.03

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	342/380 (90%)	283 (83%)	44 (13%)	15 (4%)	2	1
1	C	326/380 (86%)	239 (73%)	67 (21%)	20 (6%)	1	0
1	D	341/380 (90%)	268 (79%)	59 (17%)	14 (4%)	2	1
1	E	331/380 (87%)	250 (76%)	54 (16%)	27 (8%)	0	0
1	F	346/380 (91%)	264 (76%)	64 (18%)	18 (5%)	1	0
All	All	1686/1900 (89%)	1304 (77%)	288 (17%)	94 (6%)	1	0

5 of 94 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	252	LEU
1	A	367	LYS
1	A	368	ALA
1	A	369	VAL
1	C	58	ARG

### 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	303/330 (92%)	273 (90%)	30 (10%)	7	8
1	C	288/330 (87%)	248 (86%)	40 (14%)	3	3
1	D	298/330 (90%)	271 (91%)	27 (9%)	9	10
1	E	292/330 (88%)	260 (89%)	32 (11%)	6	6
1	F	303/330 (92%)	272 (90%)	31 (10%)	7	7
All	All	1484/1650 (90%)	1324 (89%)	160 (11%)	6	6

5 of 160 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	238	MET
1	F	234	CYS
1	E	245	ASP
1	F	52	ASP
1	F	258	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 29 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	36	ASN
1	F	122	HIS
1	E	79	ASN
1	F	36	ASN
1	E	70	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 5 ligands modelled in this entry, 5 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	345/380 (90%)	0.60	20 (5%) 29 30	9, 24, 39, 51	1 (0%)
1	C	330/380 (86%)	1.36	75 (22%) 2 2	22, 36, 49, 61	0
1	D	343/380 (90%)	0.84	38 (11%) 10 11	12, 28, 43, 54	0
1	E	335/380 (88%)	1.31	70 (20%) 2 2	23, 35, 47, 58	0
1	F	348/380 (91%)	1.36	69 (19%) 3 3	20, 35, 48, 72	0
All	All	1701/1900 (89%)	1.09	272 (15%) 5 5	9, 33, 46, 72	1 (0%)

The worst 5 of 272 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	154	ALA	6.4
1	E	142	SER	5.7
1	C	353	TYR	5.4
1	F	262	PHE	4.9
1	F	157	PHE	4.6

### 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,

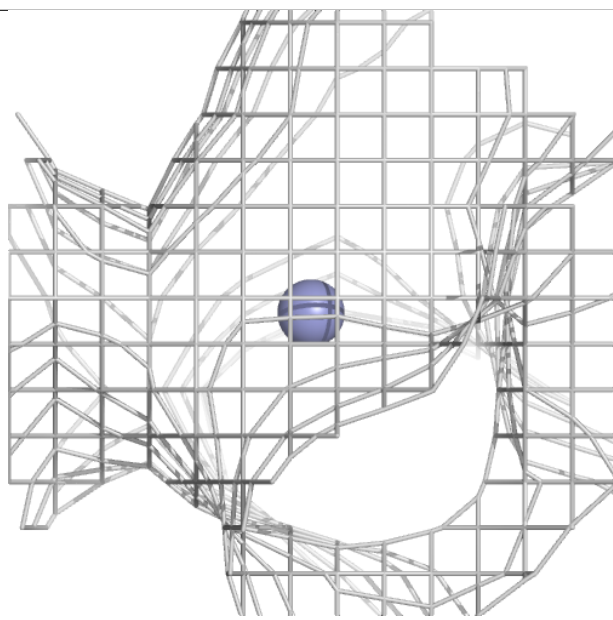
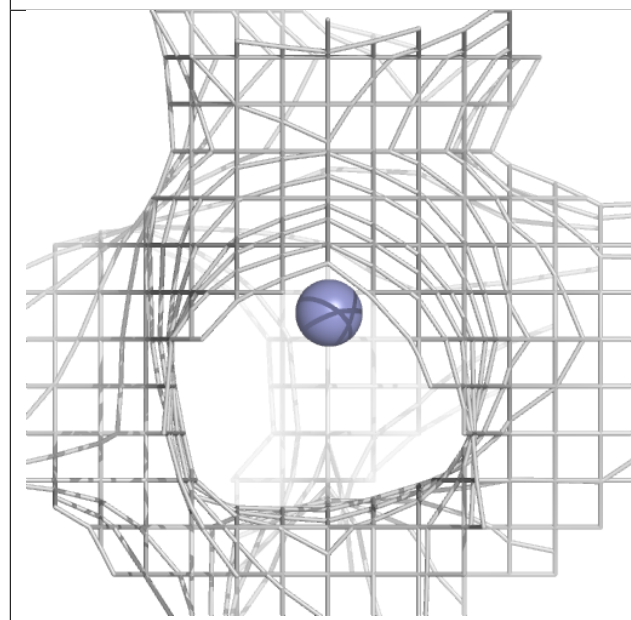
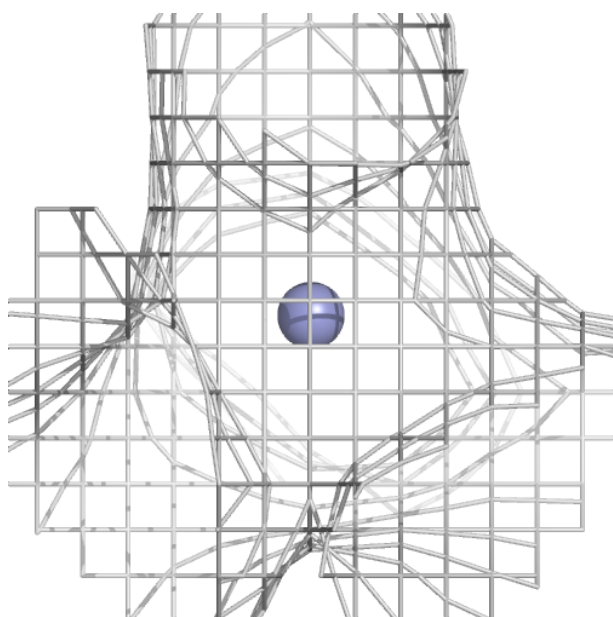
median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	ZN	C	401	1/1	0.97	0.06	42,42,42,42	0
2	ZN	D	401	1/1	0.99	0.04	39,39,39,39	1
2	ZN	E	401	1/1	0.99	0.03	52,52,52,52	0
2	ZN	F	401	1/1	0.99	0.03	44,44,44,44	0
2	ZN	A	401	1/1	1.00	0.01	31,31,31,31	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.

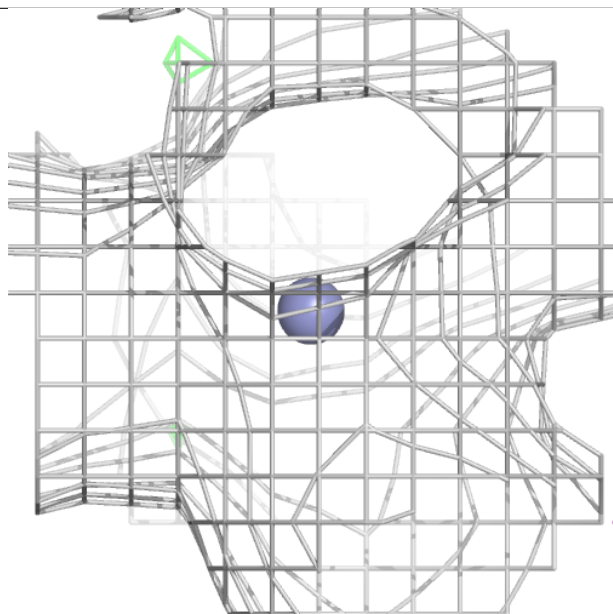
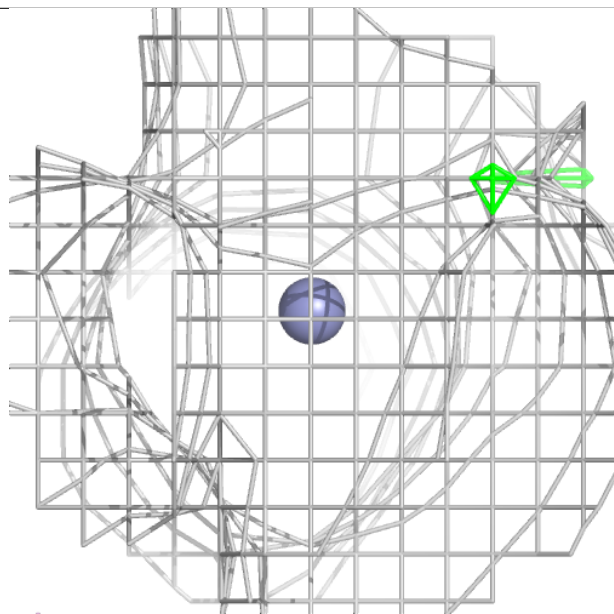
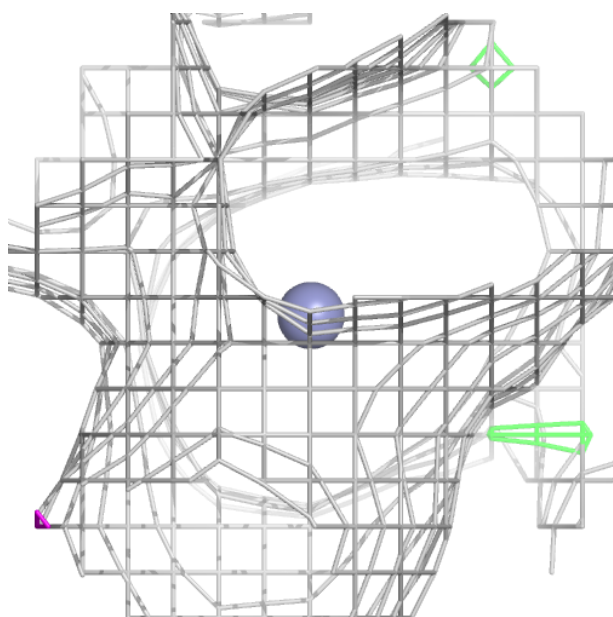
**Electron density around ZN C 401:**

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



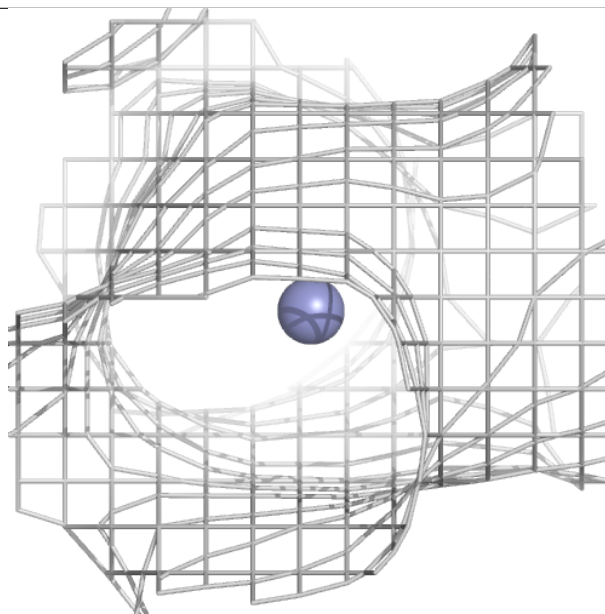
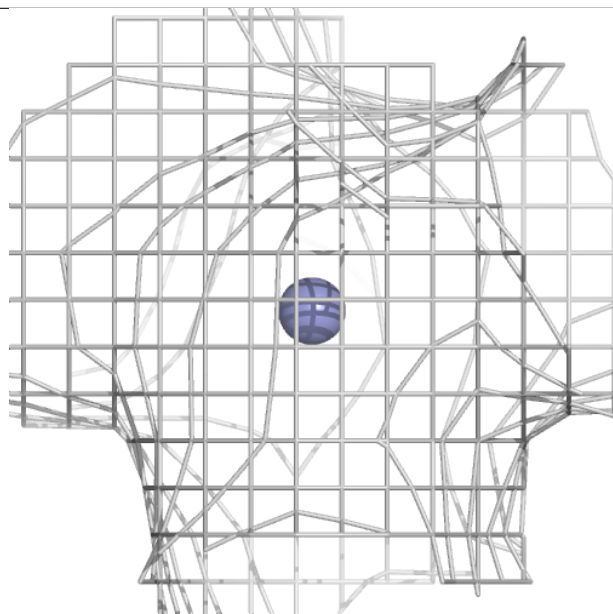
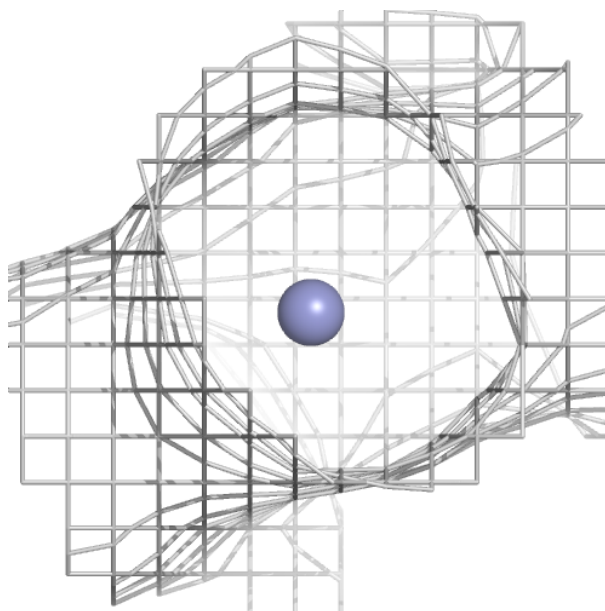
**Electron density around ZN D 401:**

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



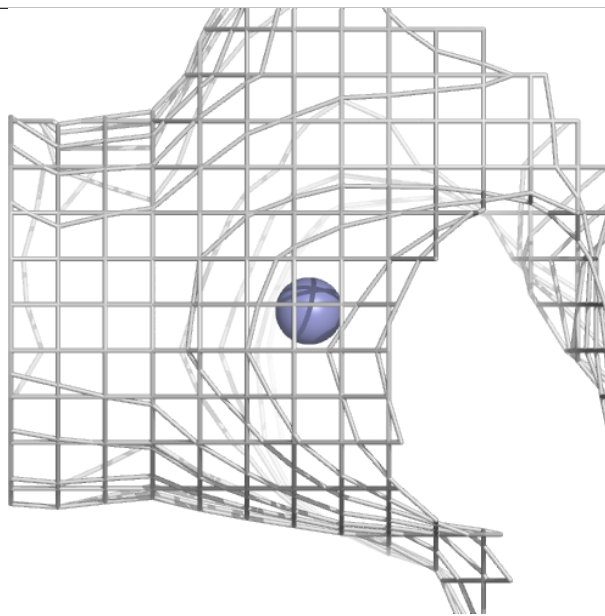
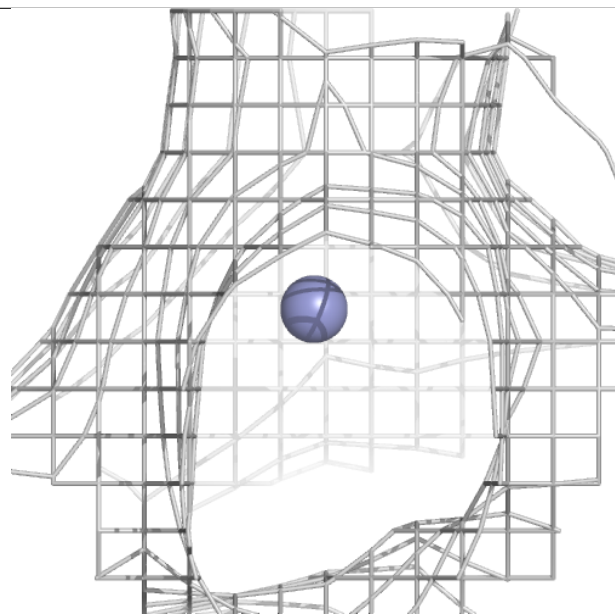
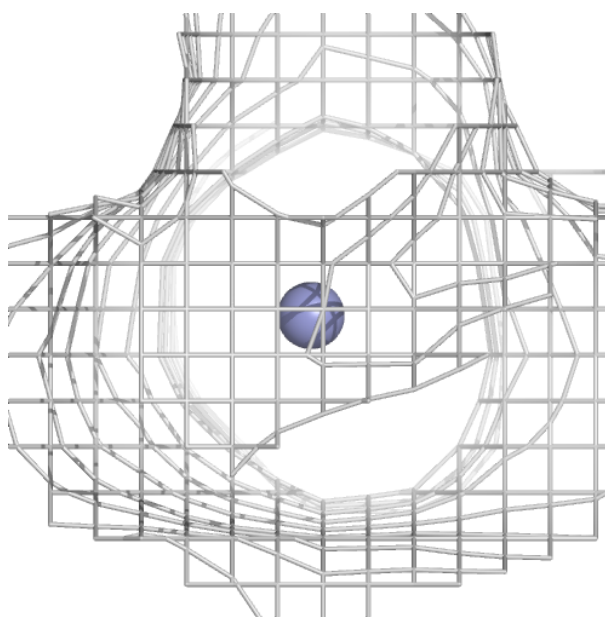
**Electron density around ZN E 401:**

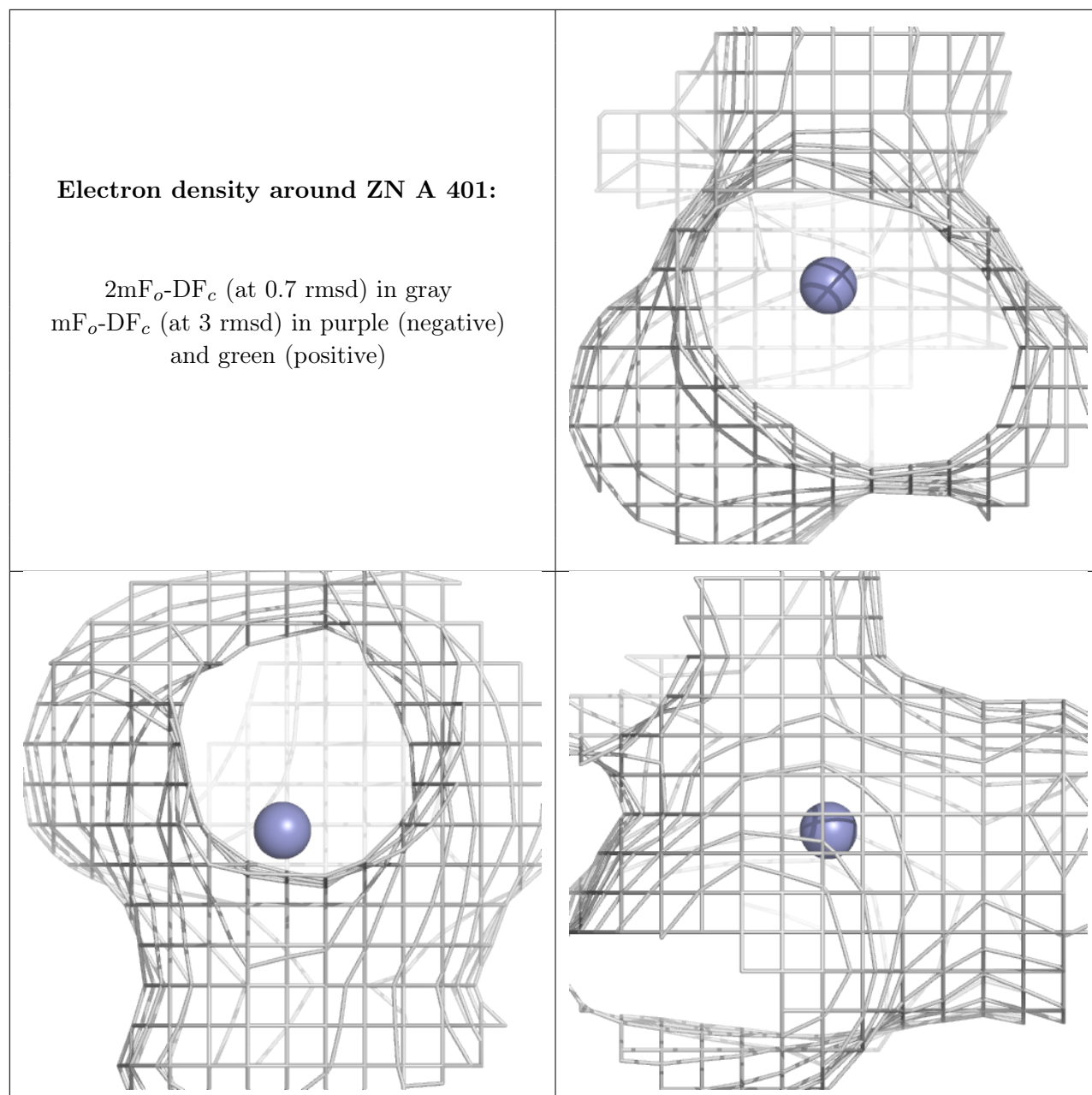
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



**Electron density around ZN 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.