Full wwPDB X-ray Structure Validation Report ⓘ

Oct 14, 2025 – 12:08 PM JST

PDB ID	:	9K6O / pdb_00009k6o
Title	:	Crystal structure of designed zinc-induced homopentamer C5-Zn1-HEHE-1
Authors	:	Qu, Y.N.; Cao, L.X.
Deposited on	:	2024-10-22
Resolution	:	2.15 Å(reported)

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

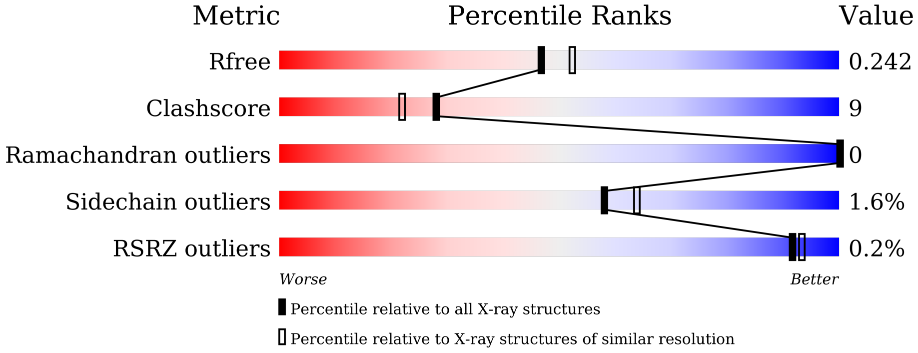
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.46

1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

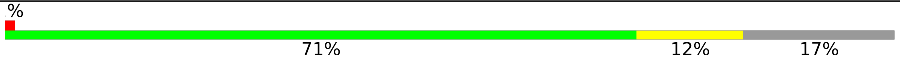
The reported resolution of this entry is 2.15 Å.

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	1881 (2.16-2.16)
Clashscore	180529	2047 (2.16-2.16)
Ramachandran outliers	177936	2027 (2.16-2.16)
Sidechain outliers	177891	2026 (2.16-2.16)
RSRZ outliers	164620	1882 (2.16-2.16)

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 >=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 <=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	112	
1	B	112	
1	C	112	
1	D	112	
1	E	112	

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 3823 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 C5-Zn1-HEHE-1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
1	A	90	714	453	118	143	0	0	0
			Total	C	N	O			
1	B	89	710	451	117	142	0	0	0
			Total	C	N	O			
1	C	93	729	462	121	146	0	0	0
			Total	C	N	O			
1	D	93	729	462	121	146	0	0	0
			Total	C	N	O			
1	E	90	714	453	118	143	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
			Total	Zn		
2	A	2	2	2	0	0
			Total	Zn		
2	C	2	2	2	0	0
			Total	Zn		
2	D	1	1	1	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	38	38	38	0	0
			Total	O		
3	B	31	31	31	0	0
			Total	O		
3	C	59	59	59	0	0
			Total	O		
3	D	59	59	59	0	0

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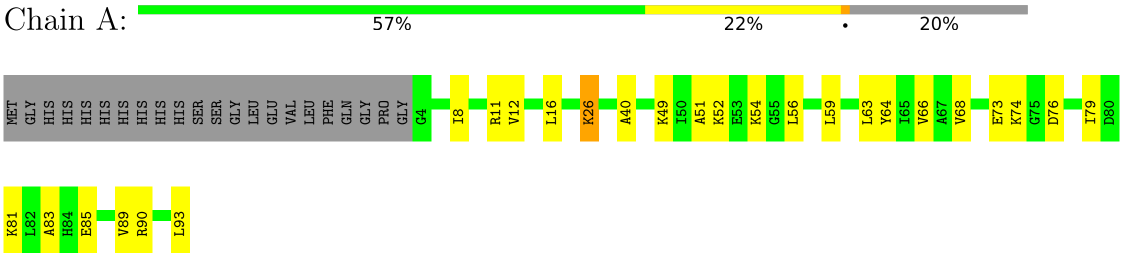
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	E	35	35	35	0	0

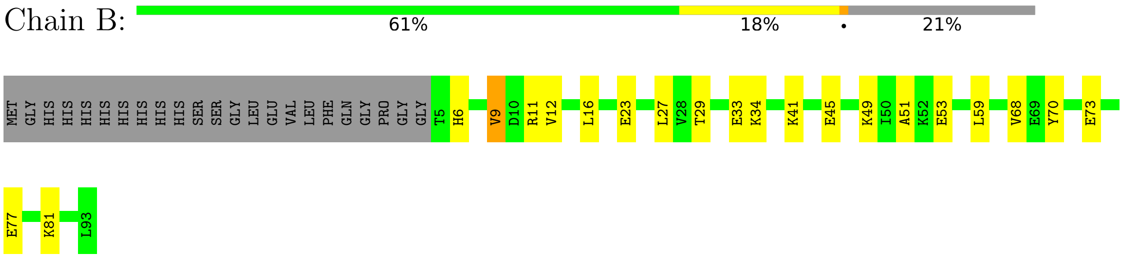
3 Residue-property plots

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.

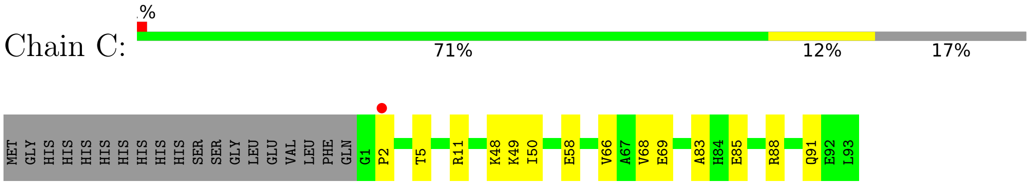
- Molecule 1: C5-Zn1-HEHE-1



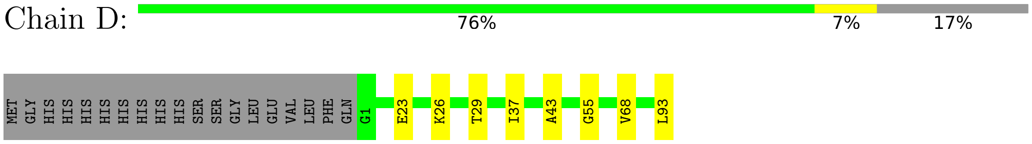
- Molecule 1: C5-Zn1-HEHE-1



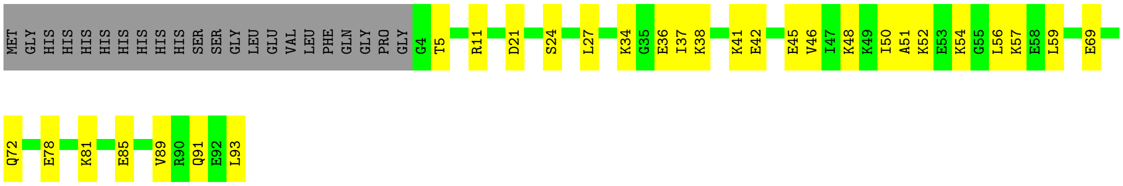
- Molecule 1: C5-Zn1-HEHE-1



- Molecule 1: C5-Zn1-HEHE-1



- Molecule 1: C5-Zn1-HEHE-1


MET
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PHE
GLN
GLY
PRO
GLY
G4
T5
R11
D21
S24
L27
K34
G35
E36
I37
K38
K41
E42
E45
V46
I47
K48
K49
I50
A51
K52
E53
K54
G55
L56
K57
E58
L59
E69
Q72
E78
K81
E85
V89
R90
Q91
E92
L93

4 Data and refinement statistics ⓘ

Property	**Value**	**Source**
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	38.13Å 108.33Å 54.58Å 90.00° 95.64° 90.00°	Depositor
Resolution (Å)	28.70 – 2.15 28.70 – 2.15	Depositor EDS
% Data completeness (in resolution range)	96.8 (28.70-2.15) 96.7 (28.70-2.15)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.44 (at 2.00Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487: ???)	Depositor
R, R_{free}	0.188 , 0.241 0.188 , 0.242	Depositor DCC
R_{free} test set	1914 reflections (6.44%)	wwPDB-VP
Wilson B-factor (Å^2)	28.0	Xtriage
Anisotropy	0.237	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 40.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	3823	wwPDB-VP
Average B, all atoms (Å^2)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.65% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: 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	0.30	0/717	0.45	0/958
1	B	0.34	0/713	0.42	0/953
1	C	0.36	0/733	0.46	0/980
1	D	0.38	0/733	0.49	0/980
1	E	0.29	0/717	0.43	0/958
All	All	0.34	0/3613	0.45	0/4829

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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	714	0	755	16	0
1	B	710	0	752	13	0
1	C	729	0	771	12	0
1	D	729	0	771	4	0
1	E	714	0	755	20	0
2	A	2	0	0	0	0
2	C	2	0	0	0	0
2	D	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	38	0	0	1	0
3	B	31	0	0	3	0
3	C	59	0	0	4	0
3	D	59	0	0	0	0
3	E	35	0	0	4	0
All	All	3823	0	3804	65	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 9.

All (65) 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:E:41:LYS:HD2	1:E:41:LYS:H	1.33	0.92
1:E:51:ALA:HA	1:E:56:LEU:HD12	1.75	0.69
1:E:72:GLN:NE2	3:E:101:HOH:O	2.25	0.68
1:C:48:LYS:HE3	1:C:85:GLU:HB3	1.76	0.68
1:C:11:ARG:HD3	1:C:66:VAL:HG22	1.79	0.64
1:B:34:LYS:NZ	3:B:104:HOH:O	2.29	0.64
1:B:23:GLU:H	1:B:23:GLU:CD	2.07	0.63
1:C:85:GLU:HG2	1:C:88:ARG:HH21	1.63	0.63
1:C:11:ARG:NH1	1:C:69:GLU:OE1	2.25	0.62
1:A:11:ARG:NH1	3:A:201:HOH:O	2.34	0.61
1:B:49:LYS:O	1:B:53:GLU:HG3	2.00	0.60
1:D:37:ILE:HD13	1:D:43:ALA:HA	1.84	0.60
1:E:81:LYS:NZ	3:E:105:HOH:O	2.35	0.60
1:E:48:LYS:HD2	1:E:85:GLU:HG3	1.85	0.59
1:C:85:GLU:HG2	1:C:88:ARG:NH2	2.19	0.57
1:E:21:ASP:OD2	1:E:24:SER:OG	2.20	0.57
1:E:51:ALA:HB2	1:E:59:LEU:HD23	1.88	0.56
1:A:51:ALA:HB2	1:A:59:LEU:HD23	1.88	0.56
1:B:12:VAL:O	1:B:16:LEU:HG	2.09	0.52
1:E:91:GLN:NE2	3:E:107:HOH:O	2.43	0.51
1:E:41:LYS:H	1:E:41:LYS:CD	2.09	0.51
1:E:34:LYS:HB2	1:E:36:GLU:HG3	1.92	0.51
1:B:41:LYS:NZ	1:B:45:GLU:OE2	2.40	0.50
1:E:42:GLU:HA	1:E:45:GLU:OE1	2.12	0.49
1:A:11:ARG:HG2	1:A:66:VAL:HG22	1.94	0.49
1:C:49:LYS:NZ	3:C:209:HOH:O	2.45	0.49
1:E:56:LEU:HB3	3:E:121:HOH:O	2.12	0.49
3:C:224:HOH:O	1:D:29:THR:HG22	2.12	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:73:GLU:HG2	1:A:74:LYS:HG2	1.95	0.48
1:E:46:VAL:O	1:E:50:ILE:HG13	2.14	0.48
1:A:64:TYR:O	1:A:68:VAL:HG22	2.14	0.48
1:B:45:GLU:HG2	3:B:109:HOH:O	2.14	0.47
1:C:48:LYS:NZ	3:C:203:HOH:O	2.36	0.47
1:B:29:THR:O	1:B:33:GLU:HG2	2.15	0.46
1:A:8:ILE:HG13	1:A:40:ALA:HB1	1.98	0.46
1:C:68:VAL:HG13	1:C:83:ALA:HB1	1.98	0.45
1:A:76:ASP:CG	1:A:79:ILE:HG13	2.42	0.45
1:B:51:ALA:HB2	1:B:59:LEU:HD23	1.99	0.45
1:B:23:GLU:O	1:B:27:LEU:HG	2.16	0.45
1:D:23:GLU:CD	1:D:26:LYS:HZ1	2.24	0.45
1:C:2:PRO:HA	1:C:5:THR:HB	1.98	0.44
1:B:6:HIS:HB2	1:B:9:VAL:CG1	2.47	0.44
1:B:77:GLU:H	1:B:77:GLU:CD	2.24	0.43
1:E:11:ARG:NH2	1:E:69:GLU:OE1	2.52	0.43
1:E:52:LYS:HB2	1:E:89:VAL:HG11	2.01	0.43
1:B:11:ARG:NH2	1:B:73:GLU:OE2	2.52	0.43
1:E:36:GLU:C	1:E:37:ILE:HD13	2.43	0.43
1:A:63:LEU:HD12	1:A:63:LEU:HA	1.87	0.43
1:A:90:ARG:O	1:A:93:LEU:HB2	2.19	0.43
1:A:49:LYS:HB3	1:A:49:LYS:HE3	1.57	0.42
1:A:52:LYS:HB2	1:A:89:VAL:HG11	2.01	0.42
1:E:27:LEU:HD11	1:E:54:LYS:HE2	2.01	0.42
1:A:68:VAL:HG13	1:A:83:ALA:HB1	2.01	0.42
1:A:81:LYS:O	1:A:85:GLU:HG3	2.20	0.42
1:A:26:LYS:HB2	1:A:26:LYS:HE2	1.80	0.42
1:D:55:GLY:HA2	1:D:93:LEU:HD22	2.01	0.42
1:C:91:GLN:NE2	3:C:211:HOH:O	2.53	0.42
1:E:5:THR:HG23	1:E:37:ILE:CG2	2.49	0.42
1:E:57:LYS:HG3	1:E:93:LEU:HD22	2.03	0.41
1:C:58:GLU:OE1	1:C:58:GLU:N	2.51	0.41
1:A:54:LYS:HB2	1:A:56:LEU:HG	2.01	0.41
1:B:70:TYR:OH	3:B:101:HOH:O	2.21	0.41
1:E:38:LYS:HB2	1:E:42:GLU:OE1	2.21	0.41
1:C:49:LYS:HG3	1:C:50:ILE:N	2.35	0.40
1:A:12:VAL:O	1:A:16:LEU:HG	2.22	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	88/112 (79%)	85 (97%)	3 (3%)	0	100	100
1	B	87/112 (78%)	86 (99%)	1 (1%)	0	100	100
1	C	91/112 (81%)	91 (100%)	0	0	100	100
1	D	91/112 (81%)	88 (97%)	3 (3%)	0	100	100
1	E	88/112 (79%)	87 (99%)	1 (1%)	0	100	100
All	All	445/560 (80%)	437 (98%)	8 (2%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains ⓘ

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	77/95 (81%)	76 (99%)	1 (1%)	65	71
1	B	77/95 (81%)	74 (96%)	3 (4%)	27	26
1	C	78/95 (82%)	78 (100%)	0	100	100
1	D	78/95 (82%)	77 (99%)	1 (1%)	65	71
1	E	77/95 (81%)	76 (99%)	1 (1%)	65	71
All	All	387/475 (82%)	381 (98%)	6 (2%)	58	64

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	26	LYS
1	B	9	VAL
1	B	68	VAL
1	B	81	LYS
1	D	68	VAL
1	E	78	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	72	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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 ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

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^{th} 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^2)	Q<0.9
1	A	90/112 (80%)	-0.12	0	100	100	24, 37, 53, 62	0
1	B	89/112 (79%)	0.07	0	100	100	21, 39, 56, 60	0
1	C	93/112 (83%)	-0.37	1 (1%)	77	81	16, 28, 48, 58	0
1	D	93/112 (83%)	-0.33	0	100	100	17, 27, 50, 58	0
1	E	90/112 (80%)	-0.07	0	100	100	21, 39, 54, 60	0
All	All	455/560 (81%)	-0.17	1 (0%)	92	93	16, 35, 54, 62	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	2	PRO	2.0

6.2 Non-standard residues in protein, DNA, RNA chains

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

6.3 Carbohydrates

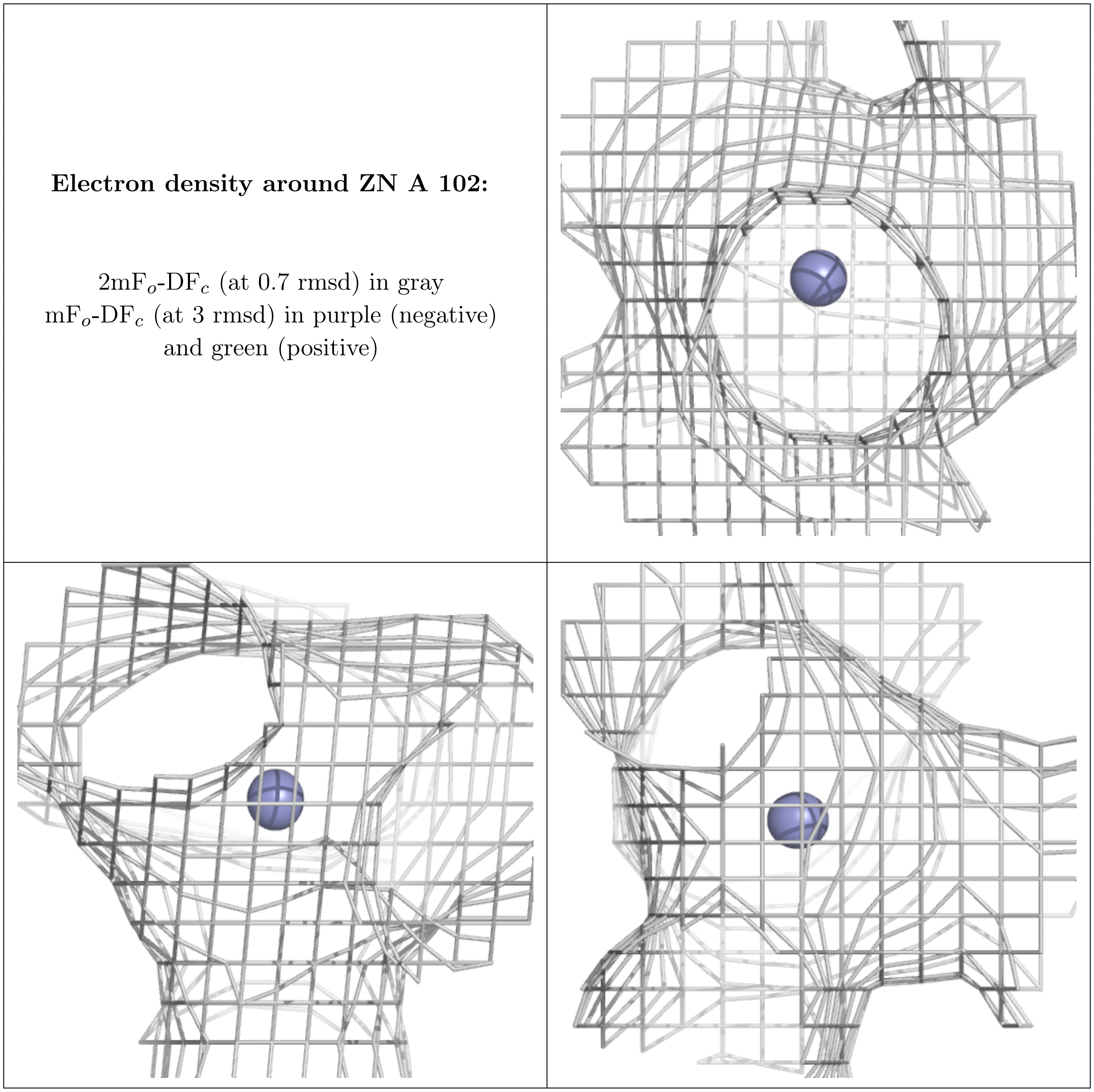
There are no oligosaccharides in this entry.

6.4 Ligands

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^{th} 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.

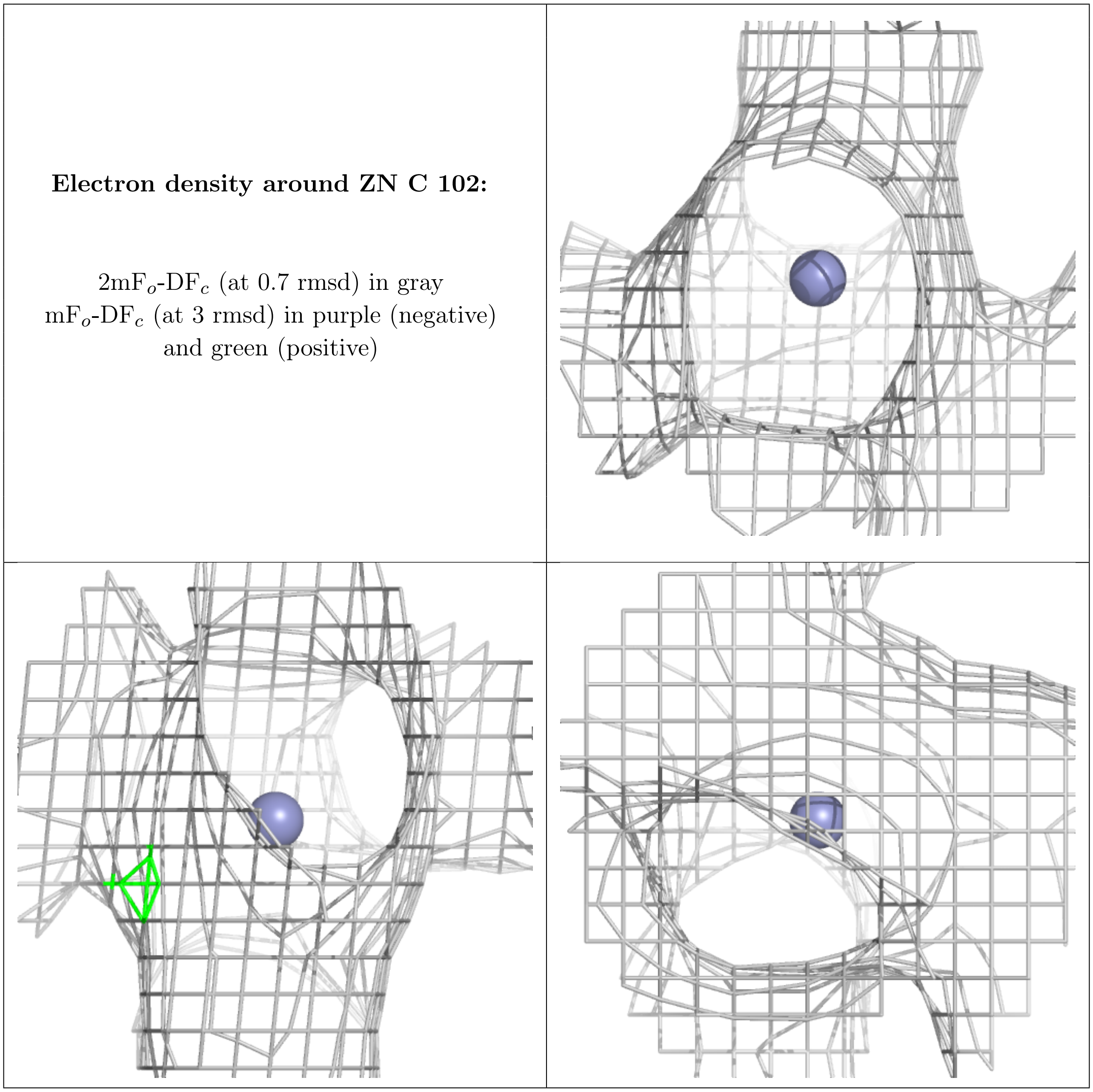
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($Å^2$)	Q<0.9
2	ZN	A	102	1/1	0.99	0.03	33,33,33,33	0
2	ZN	C	102	1/1	0.99	0.02	25,25,25,25	0
2	ZN	D	101	1/1	0.99	0.02	27,27,27,27	0
2	ZN	A	101	1/1	1.00	0.02	43,43,43,43	0
2	ZN	C	101	1/1	1.00	0.02	30,30,30,30	0

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 A 102:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)

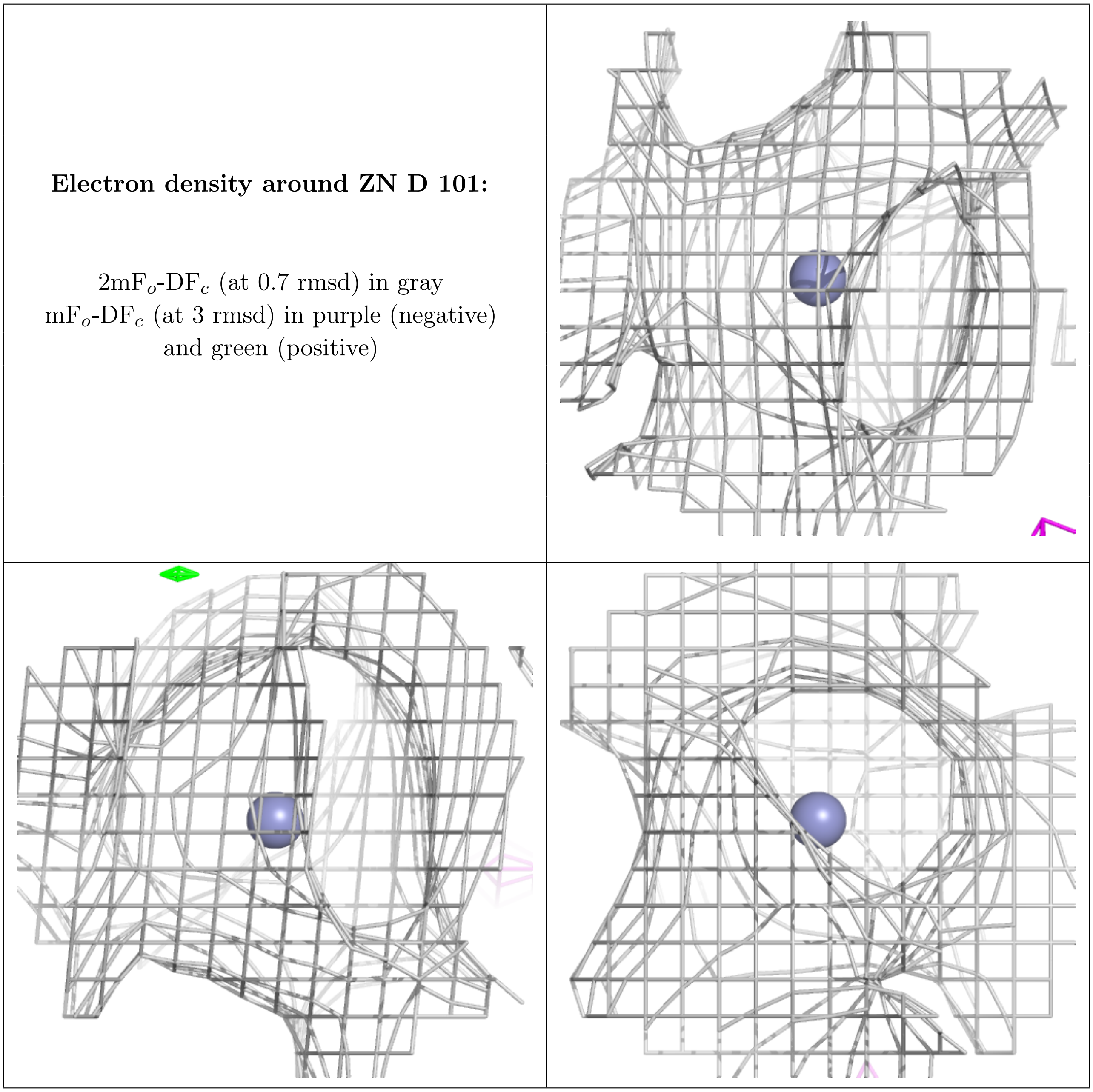


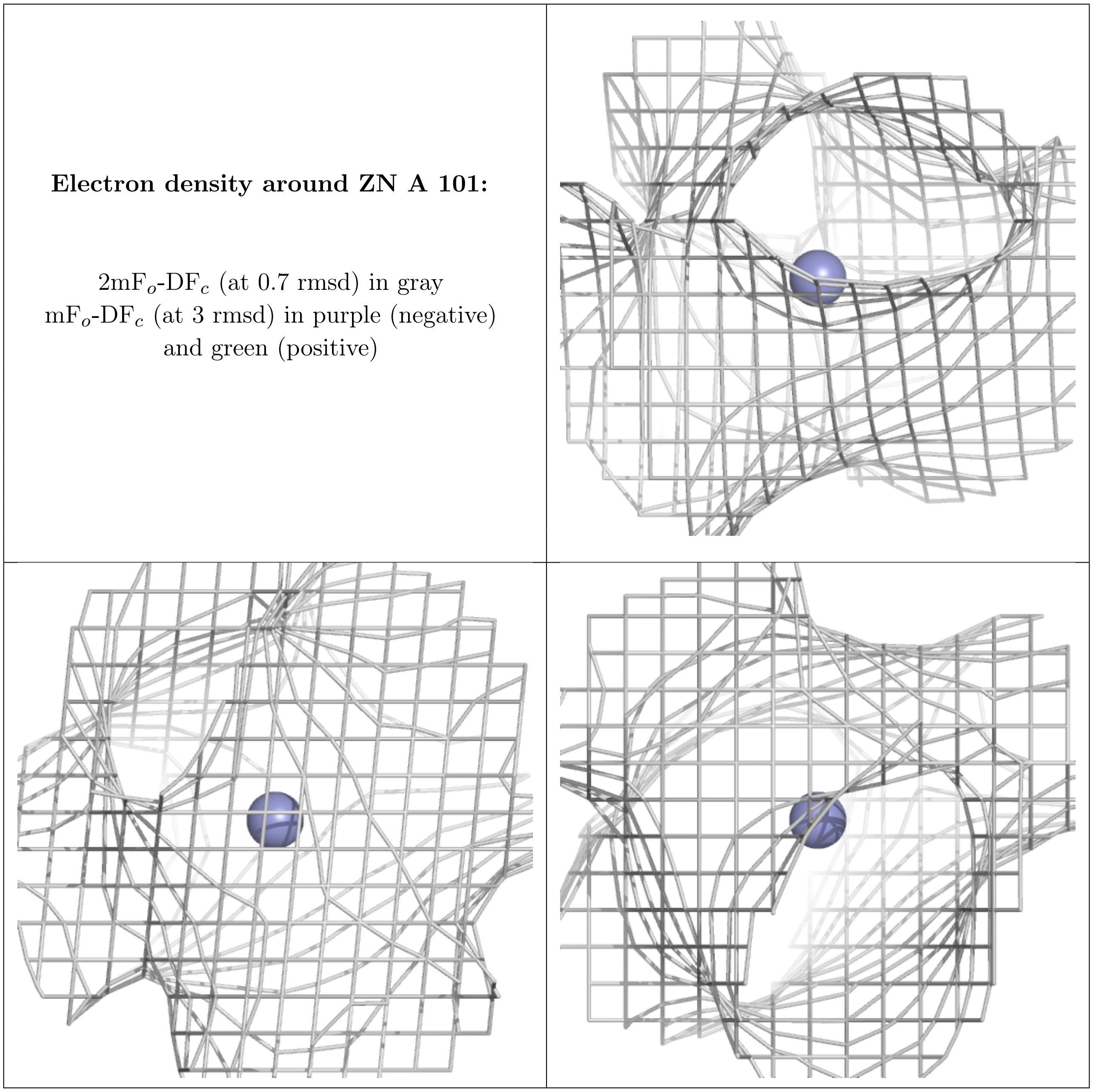
Electron density around ZN C 102:

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 101:

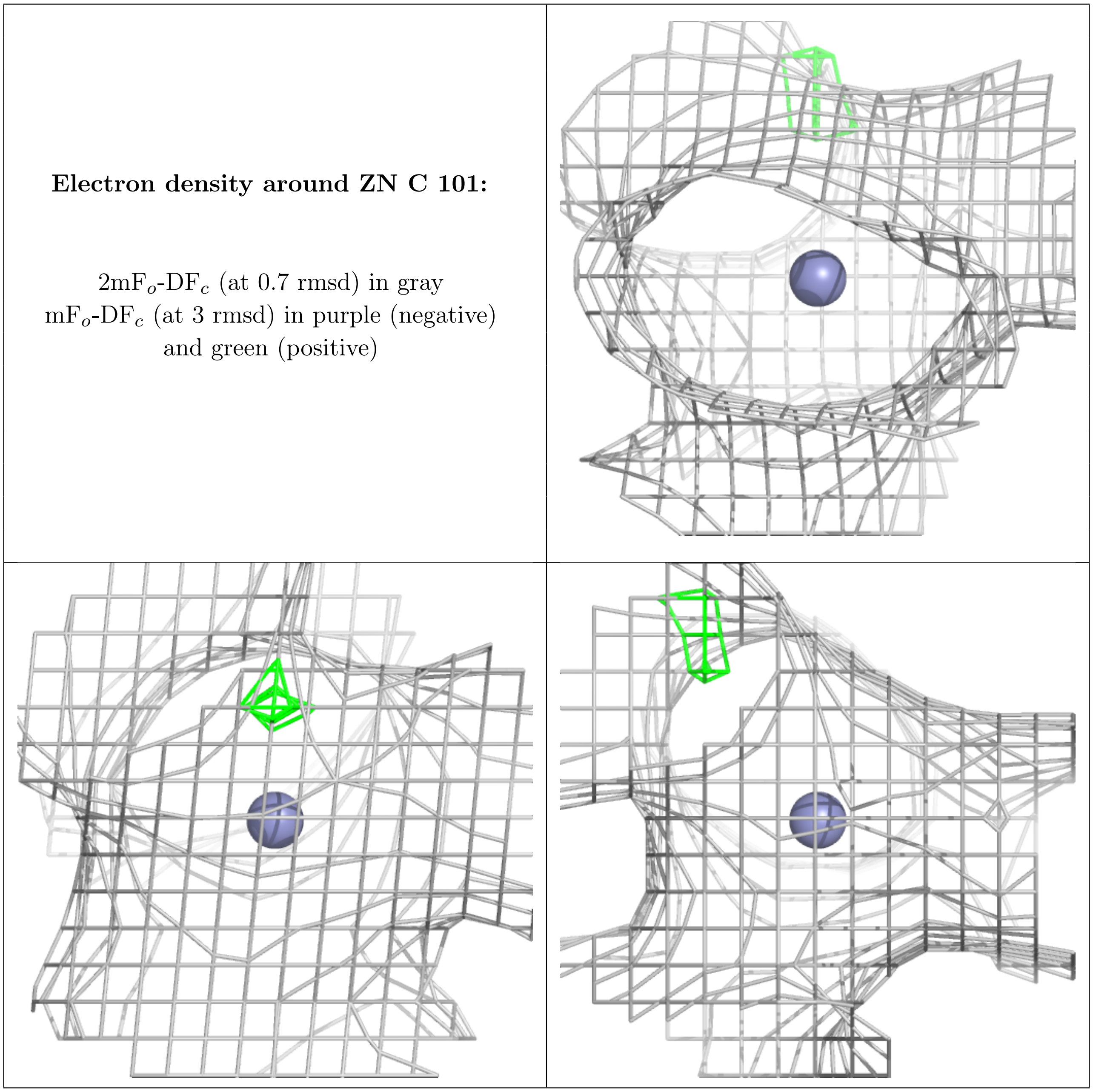
2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)





Electron density around ZN A 101:

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 C 101:

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 ⓘ

There are no such residues in this entry.