



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 9, 2023 – 08:31 AM EDT

PDB ID : 7U5Y  
Title : Crystal structure of ribulose-phosphate 3-epimerase from *Pseudomonas aeruginosa*  
Authors : Seattle Structural Genomics Center for Infectious Disease (SSGCID)  
Deposited on : 2022-03-02  
Resolution : 2.55 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  
Xtrriage (Phenix) : 1.13  
EDS : 2.35.1  
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) : 2.35.1

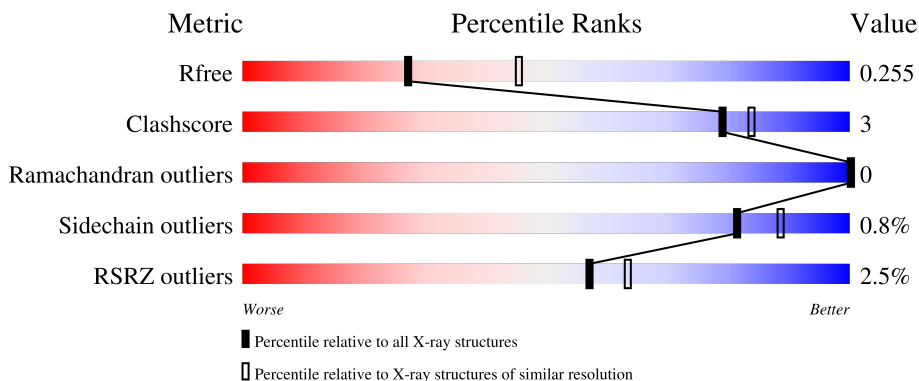
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.55 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	1284 (2.56-2.52)
Clashscore	141614	1332 (2.56-2.52)
Ramachandran outliers	138981	1315 (2.56-2.52)
Sidechain outliers	138945	1315 (2.56-2.52)
RSRZ outliers	127900	1272 (2.56-2.52)

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	232	
1	B	232	
1	C	232	
1	D	232	
1	E	232	

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Mol	Chain	Length	Quality of chain
1	F	232	 <p>A horizontal bar chart representing the quality of chain. The bar is divided into three segments: a large green segment labeled '88%', a smaller yellow segment labeled '8%', and a very small grey segment labeled '5%'. A small red square is at the beginning of the bar, and a '%' symbol is above it.</p>

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 9982 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 Ribulose-phosphate 3-epimerase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	227	1698	1079	297	312	10	0	0	0
1	B	222	1616	1032	276	298	10	0	0	0
1	C	220	1639	1045	278	306	10	0	0	0
1	D	223	1645	1049	278	308	10	0	0	0
1	E	223	1623	1036	273	304	10	0	0	0
1	F	221	1619	1033	274	302	10	0	0	0

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-7	MET	-	expression tag	UNP Q9I5T1
A	-6	ALA	-	expression tag	UNP Q9I5T1
A	-5	HIS	-	expression tag	UNP Q9I5T1
A	-4	HIS	-	expression tag	UNP Q9I5T1
A	-3	HIS	-	expression tag	UNP Q9I5T1
A	-2	HIS	-	expression tag	UNP Q9I5T1
A	-1	HIS	-	expression tag	UNP Q9I5T1
A	0	HIS	-	expression tag	UNP Q9I5T1
B	-7	MET	-	expression tag	UNP Q9I5T1
B	-6	ALA	-	expression tag	UNP Q9I5T1
B	-5	HIS	-	expression tag	UNP Q9I5T1
B	-4	HIS	-	expression tag	UNP Q9I5T1
B	-3	HIS	-	expression tag	UNP Q9I5T1
B	-2	HIS	-	expression tag	UNP Q9I5T1
B	-1	HIS	-	expression tag	UNP Q9I5T1
B	0	HIS	-	expression tag	UNP Q9I5T1
C	-7	MET	-	expression tag	UNP Q9I5T1

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Chain	Residue	Modelled	Actual	Comment	Reference
C	-6	ALA	-	expression tag	UNP Q9I5T1
C	-5	HIS	-	expression tag	UNP Q9I5T1
C	-4	HIS	-	expression tag	UNP Q9I5T1
C	-3	HIS	-	expression tag	UNP Q9I5T1
C	-2	HIS	-	expression tag	UNP Q9I5T1
C	-1	HIS	-	expression tag	UNP Q9I5T1
C	0	HIS	-	expression tag	UNP Q9I5T1
D	-7	MET	-	expression tag	UNP Q9I5T1
D	-6	ALA	-	expression tag	UNP Q9I5T1
D	-5	HIS	-	expression tag	UNP Q9I5T1
D	-4	HIS	-	expression tag	UNP Q9I5T1
D	-3	HIS	-	expression tag	UNP Q9I5T1
D	-2	HIS	-	expression tag	UNP Q9I5T1
D	-1	HIS	-	expression tag	UNP Q9I5T1
D	0	HIS	-	expression tag	UNP Q9I5T1
E	-7	MET	-	expression tag	UNP Q9I5T1
E	-6	ALA	-	expression tag	UNP Q9I5T1
E	-5	HIS	-	expression tag	UNP Q9I5T1
E	-4	HIS	-	expression tag	UNP Q9I5T1
E	-3	HIS	-	expression tag	UNP Q9I5T1
E	-2	HIS	-	expression tag	UNP Q9I5T1
E	-1	HIS	-	expression tag	UNP Q9I5T1
E	0	HIS	-	expression tag	UNP Q9I5T1
F	-7	MET	-	expression tag	UNP Q9I5T1
F	-6	ALA	-	expression tag	UNP Q9I5T1
F	-5	HIS	-	expression tag	UNP Q9I5T1
F	-4	HIS	-	expression tag	UNP Q9I5T1
F	-3	HIS	-	expression tag	UNP Q9I5T1
F	-2	HIS	-	expression tag	UNP Q9I5T1
F	-1	HIS	-	expression tag	UNP Q9I5T1
F	0	HIS	-	expression tag	UNP Q9I5T1

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

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Zn 1 1	0	0
2	B	1	Total Zn 1 1	0	0
2	C	1	Total Zn 1 1	0	0

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
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.

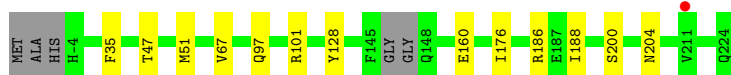
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	40	Total 40	O 40	0	0
3	B	18	Total 18	O 18	0	0
3	C	25	Total 25	O 25	0	0
3	D	22	Total 22	O 22	0	0
3	E	16	Total 16	O 16	0	0
3	F	15	Total 15	O 15	0	0

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

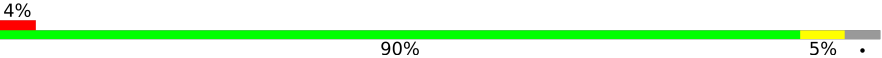
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: Ribulose-phosphate 3-epimerase

Chain A: 




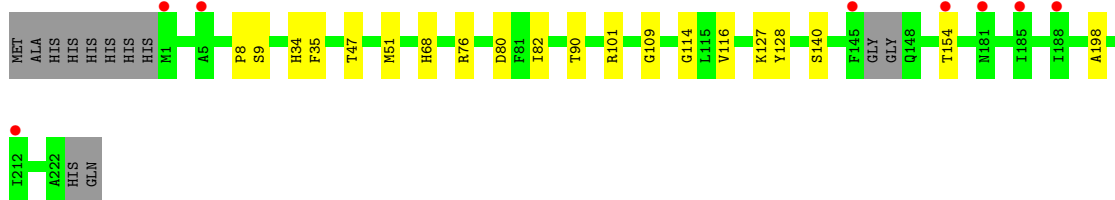
- Molecule 1: Ribulose-phosphate 3-epimerase

Chain B: 




- Molecule 1: Ribulose-phosphate 3-epimerase

Chain C: 




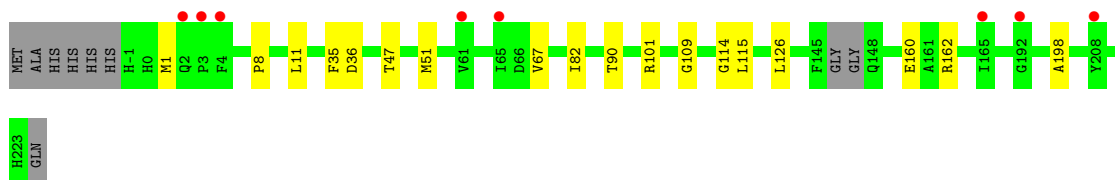
- Molecule 1: Ribulose-phosphate 3-epimerase

Chain D: 

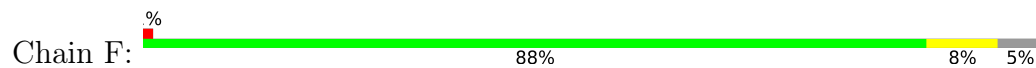


- Molecule 1: Ribulose-phosphate 3-epimerase

Chain E: 



- Molecule 1: Ribulose-phosphate 3-epimerase





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	99.01Å 110.13Å 126.76Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.03 – 2.55 48.03 – 2.55	Depositor EDS
% Data completeness (in resolution range)	99.7 (48.03-2.55) 99.7 (48.03-2.55)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.15 (at 2.54Å)	Xtrriage
Refinement program	PHENIX 1.20.1	Depositor
R, $R_{free}$	0.203 , 0.258 0.201 , 0.255	Depositor DCC
$R_{free}$ test set	1985 reflections (4.34%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	55.3	Xtrriage
Anisotropy	0.605	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 43.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	9982	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	68.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.38% 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	0.32	0/1734	0.56	0/2359
1	B	0.30	0/1647	0.53	0/2247
1	C	0.32	0/1670	0.54	0/2272
1	D	0.30	0/1677	0.54	0/2285
1	E	0.29	0/1655	0.51	0/2257
1	F	0.30	0/1651	0.52	0/2253
All	All	0.30	0/10034	0.53	0/13673

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 [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	1698	0	1658	9	0
1	B	1616	0	1572	9	0
1	C	1639	0	1623	12	0
1	D	1645	0	1606	13	0
1	E	1623	0	1565	11	0
1	F	1619	0	1572	11	0
2	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	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	40	0	0	1	0
3	B	18	0	0	1	0
3	C	25	0	0	1	0
3	D	22	0	0	1	0
3	E	16	0	0	0	0
3	F	15	0	0	0	0
All	All	9982	0	9596	54	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 3.

The worst 5 of 54 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:51:MET:HE1	1:E:47:THR:HG22	1.71	0.72
1:C:51:MET:HE1	1:D:47:THR:HG22	1.72	0.70
1:A:160:GLU:OE1	1:D:128:TYR:OH	2.11	0.69
1:A:128:TYR:OH	1:F:160:GLU:OE1	2.13	0.66
1:B:51:MET:HE1	1:F:47:THR:HA	1.83	0.59

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	223/232 (96%)	214 (96%)	9 (4%)	0	<b>100</b> <b>100</b>

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	218/232 (94%)	209 (96%)	9 (4%)	0	100	100
1	C	216/232 (93%)	207 (96%)	9 (4%)	0	100	100
1	D	219/232 (94%)	211 (96%)	8 (4%)	0	100	100
1	E	219/232 (94%)	210 (96%)	9 (4%)	0	100	100
1	F	217/232 (94%)	209 (96%)	8 (4%)	0	100	100
All	All	1312/1392 (94%)	1260 (96%)	52 (4%)	0	100	100

There are no Ramachandran outliers to report.

### 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	173/184 (94%)	171 (99%)	2 (1%)	71	81
1	B	161/184 (88%)	160 (99%)	1 (1%)	86	92
1	C	169/184 (92%)	167 (99%)	2 (1%)	71	81
1	D	167/184 (91%)	166 (99%)	1 (1%)	86	92
1	E	161/184 (88%)	160 (99%)	1 (1%)	86	92
1	F	163/184 (89%)	162 (99%)	1 (1%)	86	92
All	All	994/1104 (90%)	986 (99%)	8 (1%)	81	88

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	101	ARG
1	E	101	ARG
1	C	101	ARG
1	C	35	PHE
1	D	101	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	204	ASN
1	C	216	HIS
1	C	221	GLN
1	D	204	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 monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

Of 6 ligands modelled in this entry, 6 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	227/232 (97%)	-0.15	1 (0%) 92 96	43, 56, 71, 110	0
1	B	222/232 (95%)	0.14	10 (4%) 33 40	45, 70, 94, 133	0
1	C	220/232 (94%)	0.06	8 (3%) 42 49	45, 65, 95, 122	0
1	D	223/232 (96%)	0.05	3 (1%) 77 82	42, 64, 96, 132	0
1	E	223/232 (96%)	0.17	8 (3%) 42 49	46, 76, 119, 133	0
1	F	221/232 (95%)	0.07	3 (1%) 75 81	43, 72, 105, 120	0
All	All	1336/1392 (95%)	0.05	33 (2%) 57 63	42, 67, 101, 133	0

The worst 5 of 33 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	4	PHE	4.5
1	C	188	ILE	4.0
1	E	4	PHE	3.5
1	B	222	ALA	3.3
1	D	212	ILE	3.1

### 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

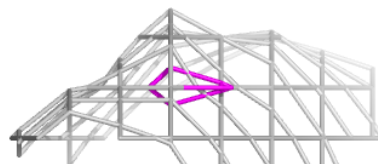
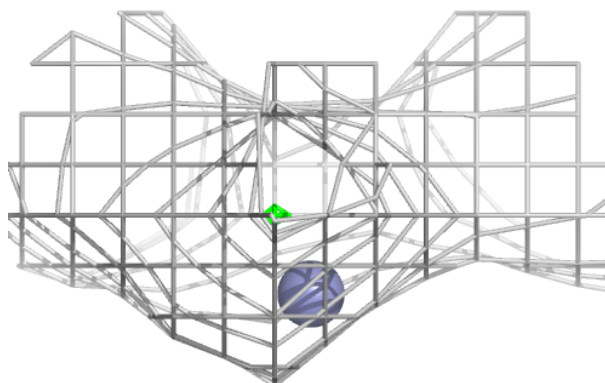
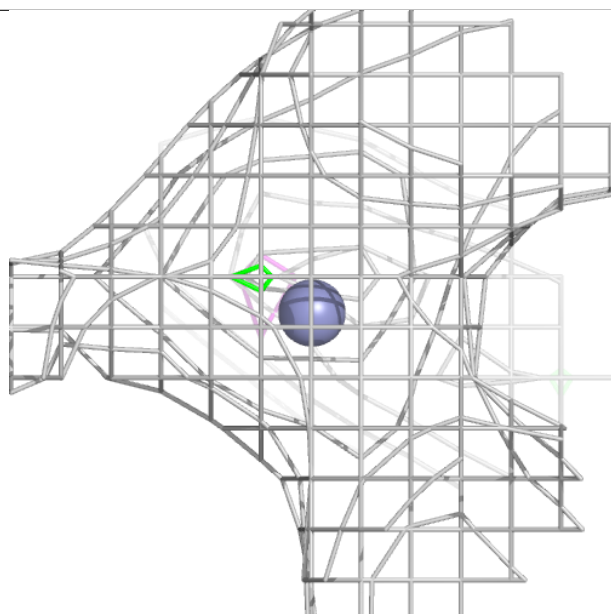
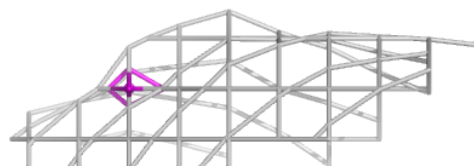
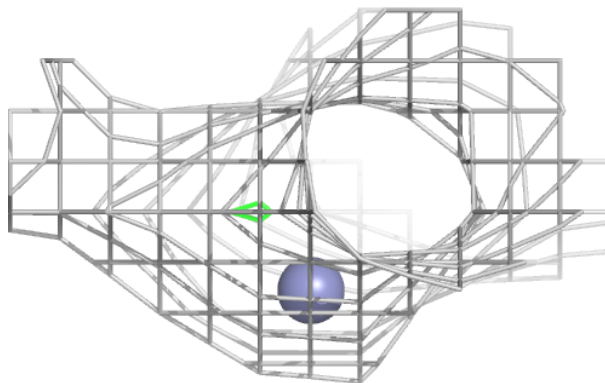
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 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	300	1/1	0.64	0.34	116,116,116,116	1
2	ZN	D	300	1/1	0.85	0.09	72,72,72,72	1
2	ZN	F	300	1/1	0.91	0.10	77,77,77,77	1
2	ZN	E	300	1/1	0.94	0.11	93,93,93,93	1
2	ZN	B	300	1/1	0.94	0.10	81,81,81,81	1
2	ZN	A	300	1/1	0.97	0.05	54,54,54,54	1

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 300:**

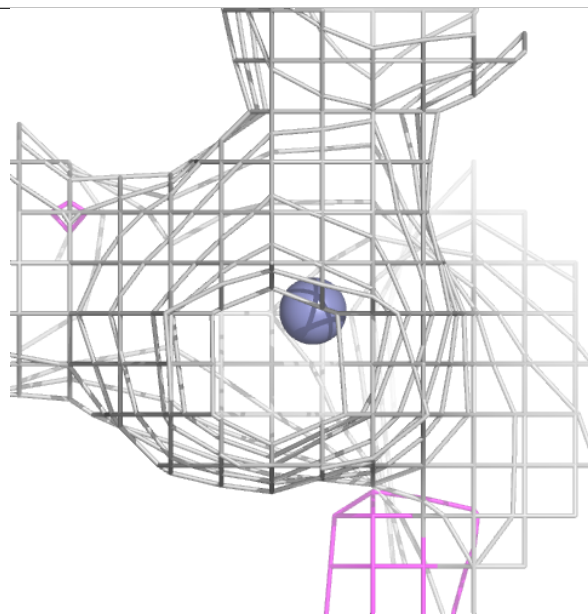
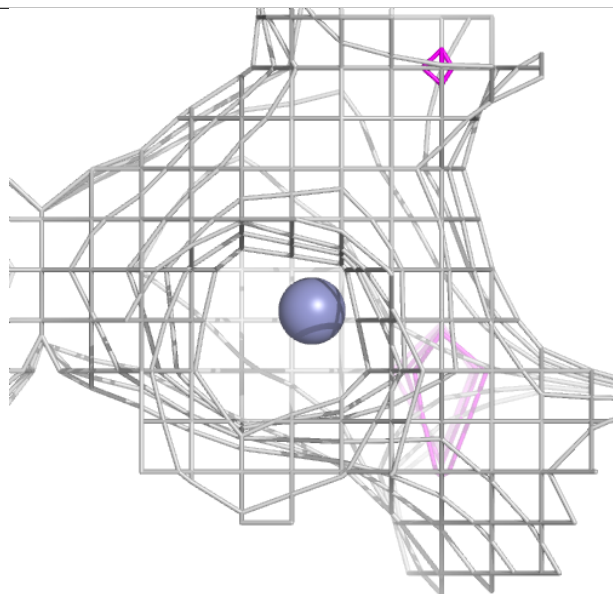
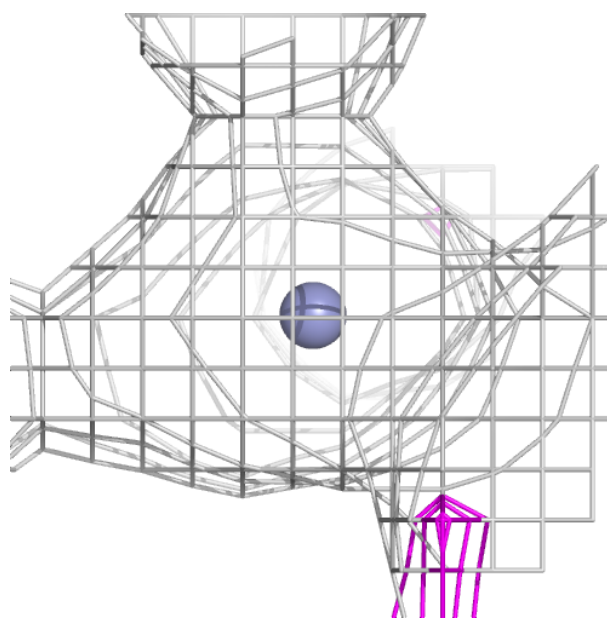
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





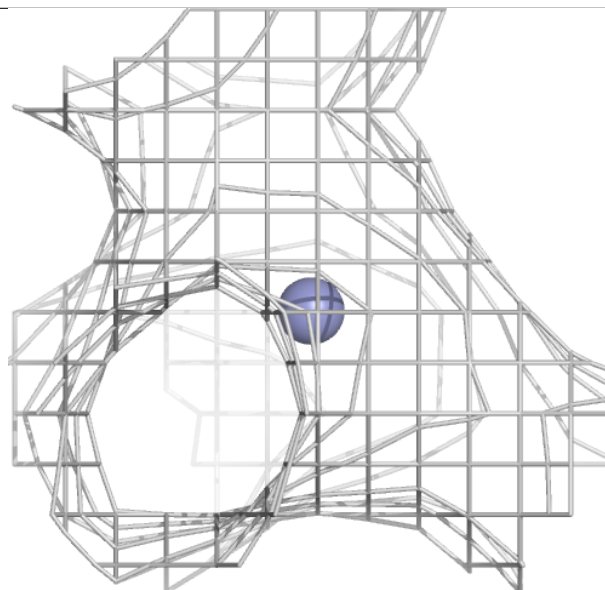
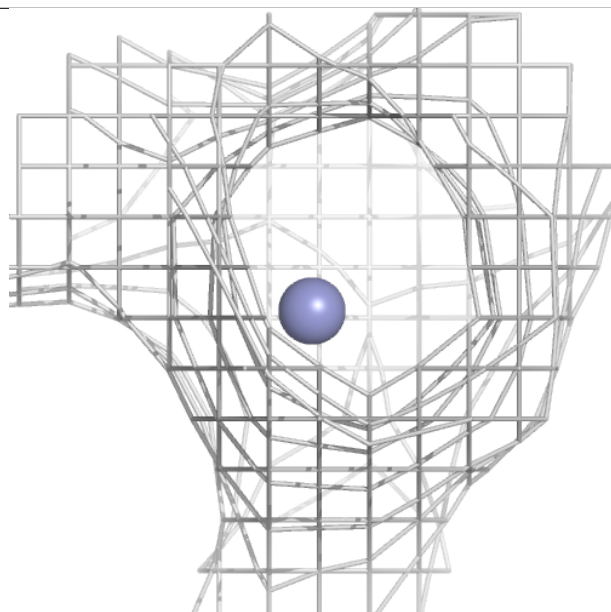
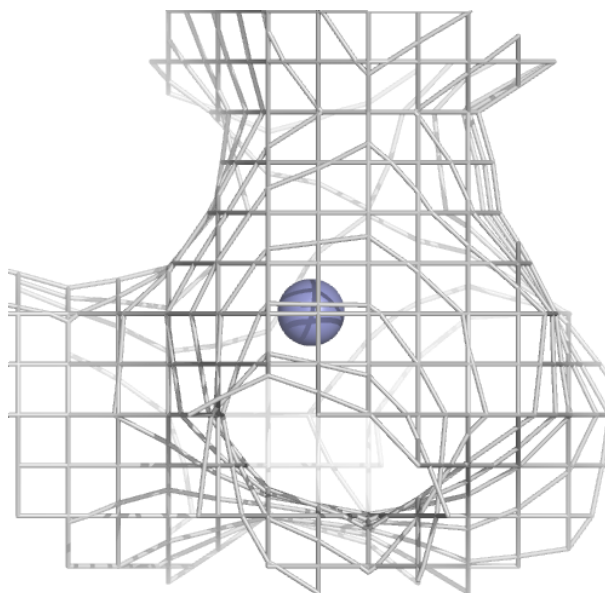
**Electron density around ZN D 300:**

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



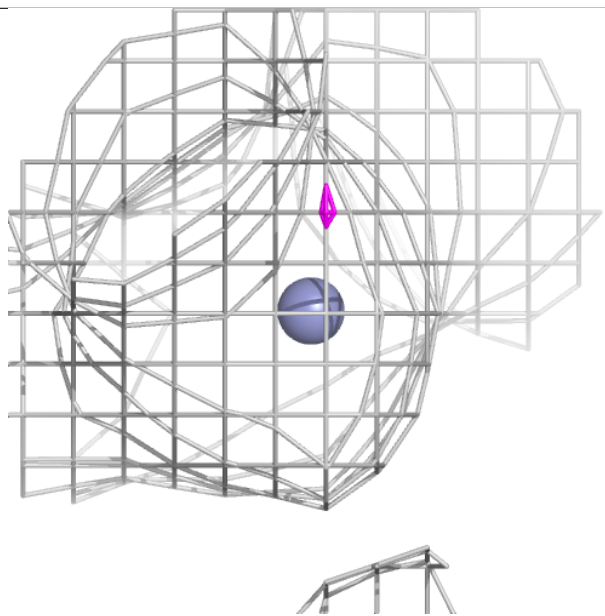
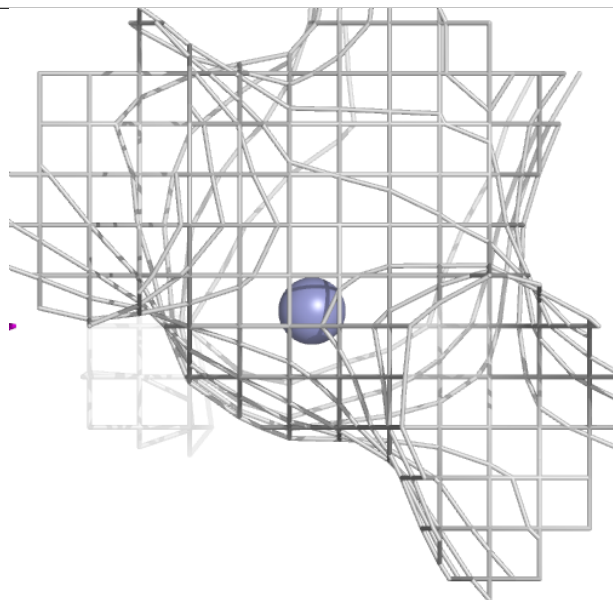
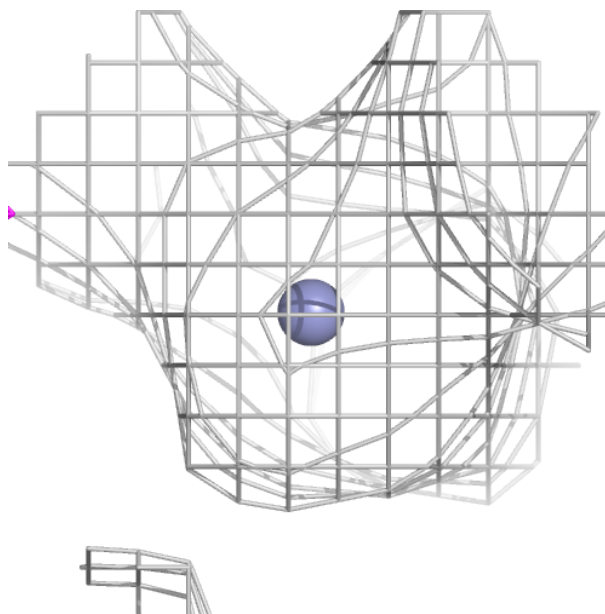
**Electron density around ZN F 300:**

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



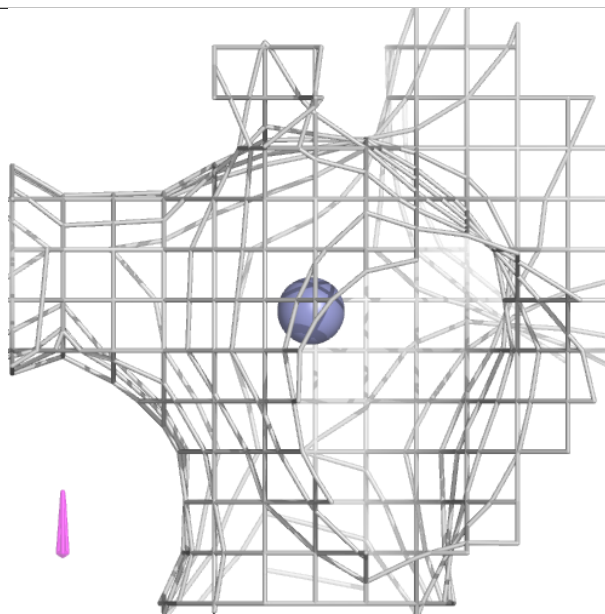
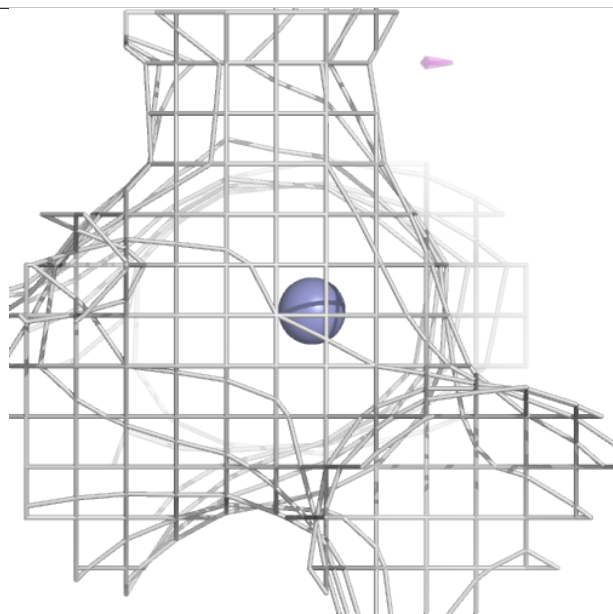
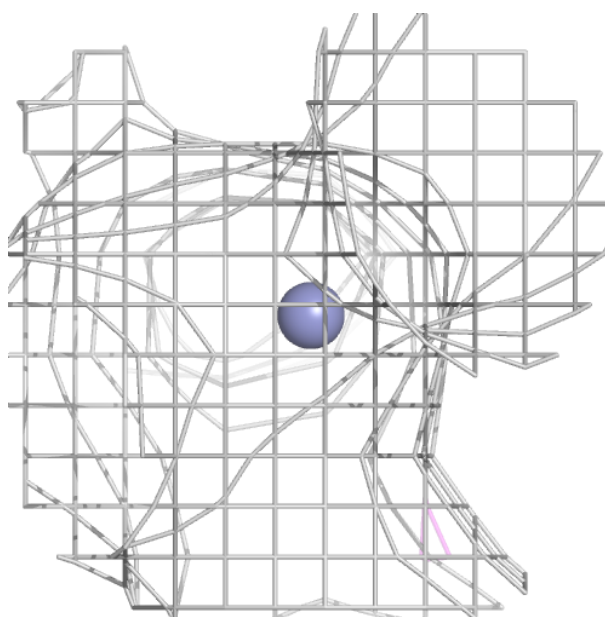
**Electron density around ZN E 300:**

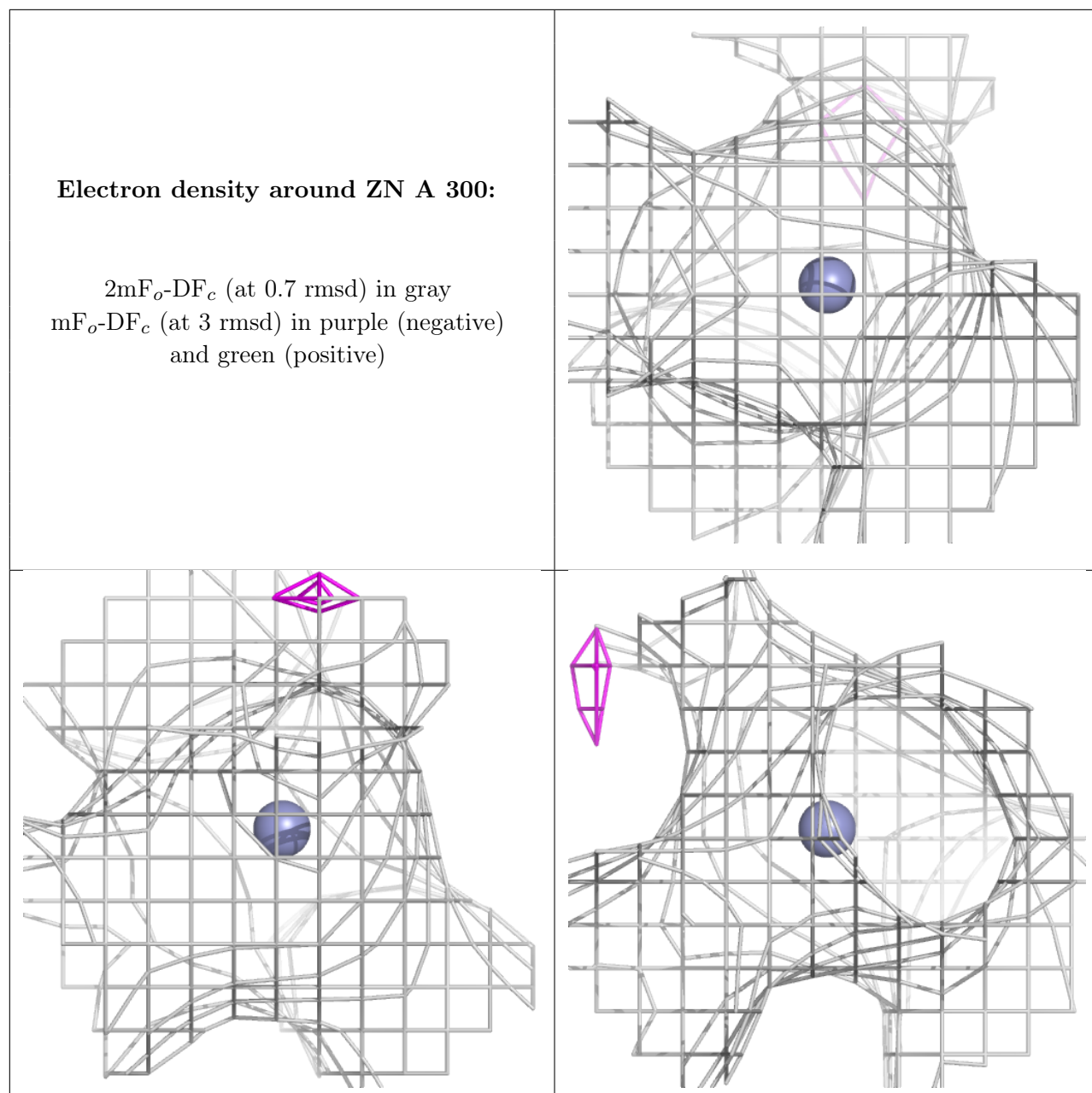
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



**Electron density around ZN B 300:**

$2mF_o-DF_c$  (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.