wwPDB X-ray Structure Validation Summary Report (i)

Feb 11, 2026 – 06:08 PM EST

PDB ID	:	10UI / pdb_000010ui
Title	:	Crystal structure of Formyl-coenzyme A transferase from Brucella melitensis in complex with Zinc
Authors	:	Seattle Structural Genomics Center for Infectious Disease; Seattle Structural Genomics Center for Infectious Disease (SSGCID)
Deposited on	:	2026-02-09
Resolution	:	2.34 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*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references (1)) were used in the production of this report:

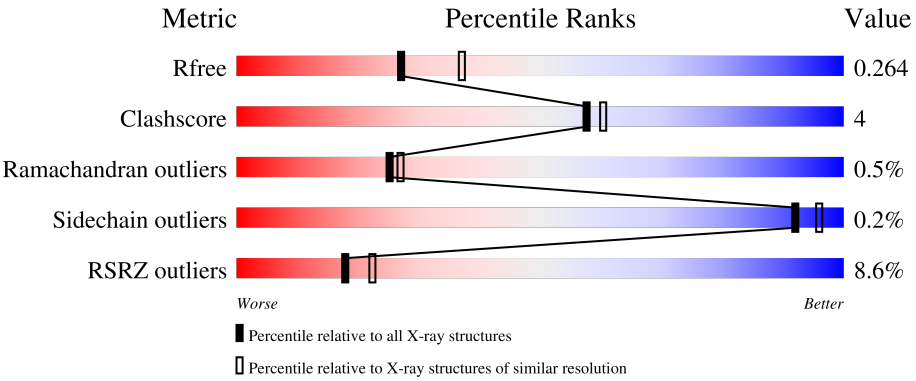
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.48

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 2.34 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	2747 (2.36-2.32)
Clashscore	180529	2936 (2.36-2.32)
Ramachandran outliers	177936	2912 (2.36-2.32)
Sidechain outliers	177891	2912 (2.36-2.32)
RSRZ outliers	164620	2747 (2.36-2.32)

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	409	2% 91% 7%
1	B	409	% 91% 8%
1	C	409	10% 90% 8%
1	D	409	21% 84% 14%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 12288 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 Formyl-coenzyme a transferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	403	Total	C	N	O	S	0	2	0
			3054	1928	538	573	15			
1	B	403	Total	C	N	O	S	0	1	0
			3047	1923	536	573	15			
1	C	402	Total	C	N	O	S	0	0	0
			3025	1909	529	572	15			
1	D	400	Total	C	N	O	S	0	1	0
			3012	1904	525	568	15			

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	42	MET	-	expression tag	UNP Q8YDF2
A	43	ALA	-	expression tag	UNP Q8YDF2
A	44	HIS	-	expression tag	UNP Q8YDF2
A	45	HIS	-	expression tag	UNP Q8YDF2
A	46	HIS	-	expression tag	UNP Q8YDF2
A	47	HIS	-	expression tag	UNP Q8YDF2
A	48	HIS	-	expression tag	UNP Q8YDF2
A	49	HIS	-	expression tag	UNP Q8YDF2
B	42	MET	-	expression tag	UNP Q8YDF2
B	43	ALA	-	expression tag	UNP Q8YDF2
B	44	HIS	-	expression tag	UNP Q8YDF2
B	45	HIS	-	expression tag	UNP Q8YDF2
B	46	HIS	-	expression tag	UNP Q8YDF2
B	47	HIS	-	expression tag	UNP Q8YDF2
B	48	HIS	-	expression tag	UNP Q8YDF2
B	49	HIS	-	expression tag	UNP Q8YDF2
C	42	MET	-	expression tag	UNP Q8YDF2
C	43	ALA	-	expression tag	UNP Q8YDF2
C	44	HIS	-	expression tag	UNP Q8YDF2
C	45	HIS	-	expression tag	UNP Q8YDF2
C	46	HIS	-	expression tag	UNP Q8YDF2

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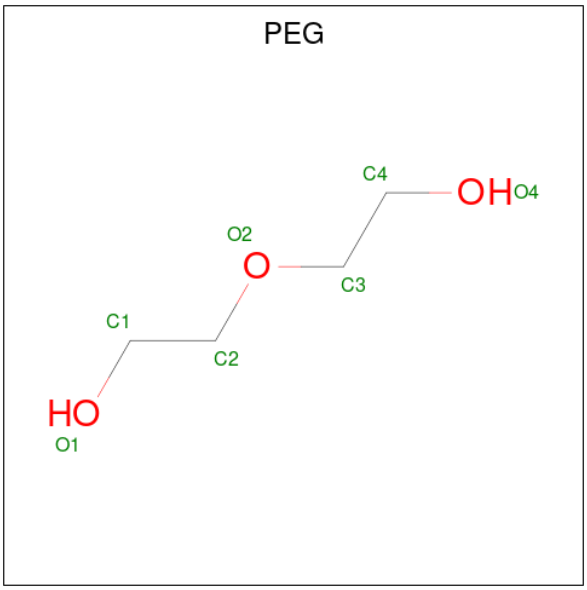
Chain	Residue	Modelled	Actual	Comment	Reference
C	47	HIS	-	expression tag	UNP Q8YDF2
C	48	HIS	-	expression tag	UNP Q8YDF2
C	49	HIS	-	expression tag	UNP Q8YDF2
D	42	MET	-	expression tag	UNP Q8YDF2
D	43	ALA	-	expression tag	UNP Q8YDF2
D	44	HIS	-	expression tag	UNP Q8YDF2
D	45	HIS	-	expression tag	UNP Q8YDF2
D	46	HIS	-	expression tag	UNP Q8YDF2
D	47	HIS	-	expression tag	UNP Q8YDF2
D	48	HIS	-	expression tag	UNP Q8YDF2
D	49	HIS	-	expression tag	UNP Q8YDF2

- Molecule 2 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 7 4 3	0	0
2	B	1	Total C O 7 4 3	0	0

- Molecule 3 is ZINC ION (CCD ID: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Zn 1 1	0	0

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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total Zn 1 1	0	0
3	C	1	Total Zn 1 1	0	0
3	D	1	Total Zn 1 1	0	0

- Molecule 4 is water.

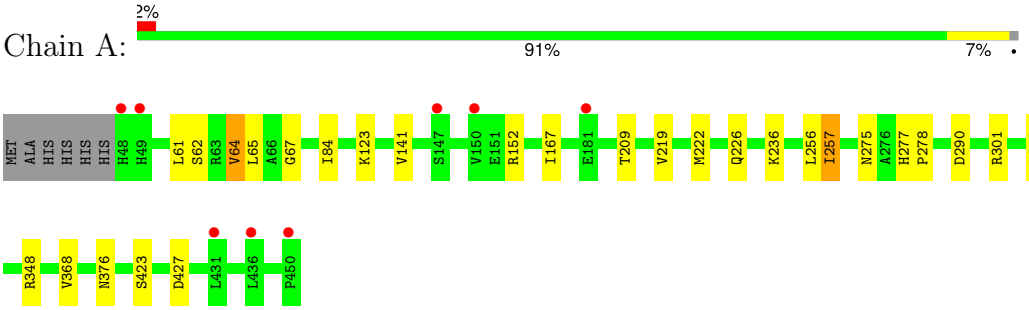
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	38	Total O 38 38	0	0
4	B	56	Total O 56 56	0	0
4	C	17	Total O 17 17	0	0
4	D	21	Total O 21 21	0	0

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.

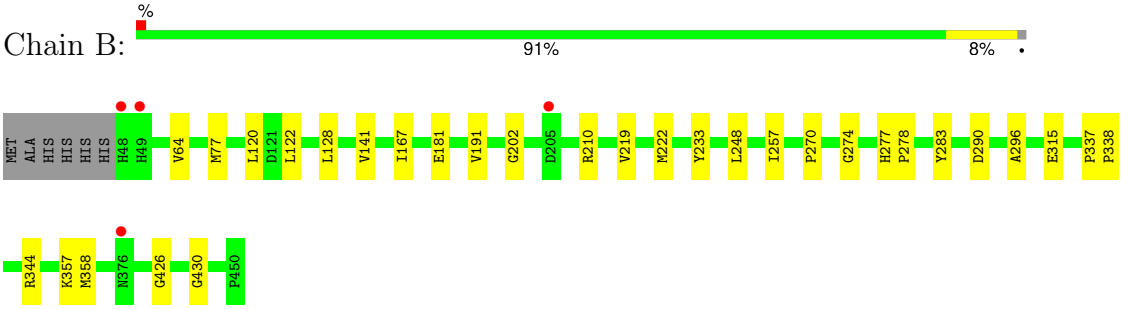
• Molecule 1: Formyl-coenzyme a transferase

Chain A:



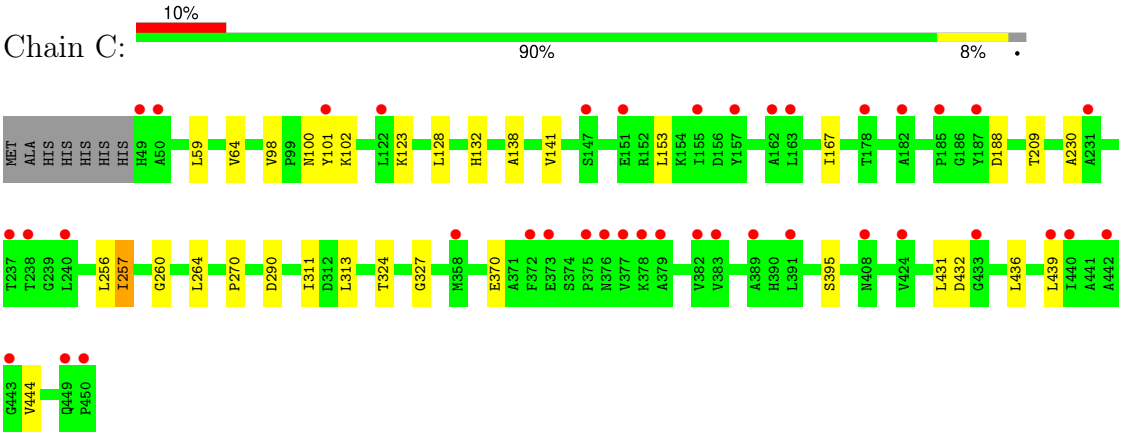
• Molecule 1: Formyl-coenzyme a transferase

Chain B:



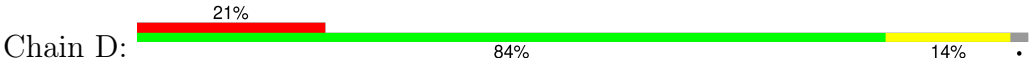
• Molecule 1: Formyl-coenzyme a transferase

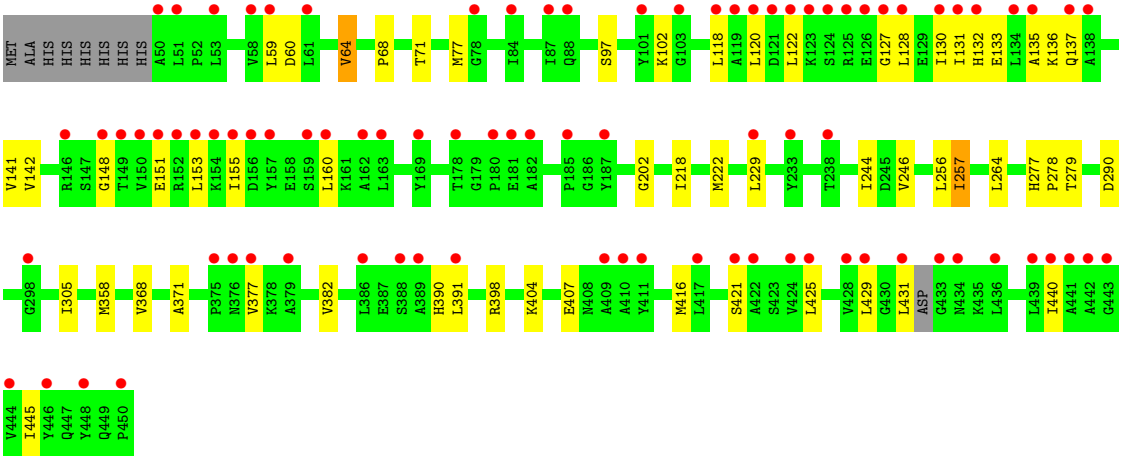
Chain C:



• Molecule 1: Formyl-coenzyme a transferase

Chain D:


21%
84%
14%


MET ALA HIS HIS HIS HIS HIS HIS A50 L51 P52 L53 V58 L59 D60 L61 V64 P68 T71 M77 G78 I84 I87 Q88 S97 Y101 K102 G103 L118 A119 L120 D121 L122 K123 S124 R125 E126 G127 L128 E129 I130 I131 H132 E133 L134 A135 K136 Q137 A138
V141 V142 R146 S147 G148 T149 V150 E151 R152 L153 K154 I155 D156 Y157 E158 S159 L160 K161 A162 L163 Y169 T178 G179 P180 E181 A182 P185 G186 Y187 G202 I218 M222 L229 Y233 T238 I244 D245 V246 L256 I257 L264 H277 P278 T279 D290
G298 I305 M358 V368 A371 P375 N376 V377 K378 A379 V382 L386 E387 S388 A389 H390 L391 R398 K404 E407 N408 A409 A410 Y411 M416 L417 S421 A422 S423 V424 L425 V428 L429 G430 L431 ASP G433 N434 K435 L436 L439 I440 A441 A442 G443
V444 I445 Y446 Q447 Y448 Q449 P450

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	54.27Å 127.95Å 224.32Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.85 – 2.34 48.85 – 2.34	Depositor EDS
% Data completeness (in resolution range)	100.0 (48.85-2.34) 100.0 (48.85-2.34)	Depositor EDS
R_{merge}	0.27	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.97 (at 2.34Å)	Xtriage
Refinement program	PHENIX (2.0_5936: ???)	Depositor
R, R_{free}	0.217 , 0.263 0.220 , 0.264	Depositor DCC
R_{free} test set	3418 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å^2)	37.2	Xtriage
Anisotropy	0.084	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 42.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	12288	wwPDB-VP
Average B, all atoms (Å^2)	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 27.35 % 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 2.2348e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[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: PEG, 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	0.18	0/3119	0.34	0/4232
1	B	0.21	0/3108	0.36	0/4217
1	C	0.17	0/3082	0.35	0/4184
1	D	0.17	0/3071	0.36	0/4167
All	All	0.19	0/12380	0.35	0/16800

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	3054	0	3070	25	0
1	B	3047	0	3063	29	0
1	C	3025	0	3032	25	0
1	D	3012	0	3027	48	0
2	A	7	0	10	0	0
2	B	7	0	10	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	D	1	0	0	0	0
4	A	38	0	0	1	0
4	B	56	0	0	0	0
4	C	17	0	0	0	0
4	D	21	0	0	0	0
All	All	12288	0	12212	107	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 4.

The worst 5 of 107 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:B:357:LYS:HG2	1:B:358:MET:HE2	1.62	0.81
1:D:218:ILE:HG22	1:D:222:MET:HE3	1.62	0.79
1:A:376:ASN:HB2	1:B:181:GLU:OE1	1.90	0.71
1:D:77:MET:HE1	1:D:229:LEU:HD11	1.74	0.68
1:D:59:LEU:HB3	1:D:141:VAL:HG22	1.77	0.65

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	403/409 (98%)	399 (99%)	2 (0%)	2 (0%)	25	27
1	B	402/409 (98%)	397 (99%)	3 (1%)	2 (0%)	25	27
1	C	400/409 (98%)	395 (99%)	3 (1%)	2 (0%)	25	27
1	D	397/409 (97%)	391 (98%)	4 (1%)	2 (0%)	25	27
All	All	1602/1636 (98%)	1582 (99%)	12 (1%)	8 (0%)	25	27

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	64	VAL
1	A	257	ILE
1	B	64	VAL
1	B	257	ILE
1	C	64	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	318/322 (99%)	318 (100%)	0	100	100
1	B	317/322 (98%)	317 (100%)	0	100	100
1	C	314/322 (98%)	313 (100%)	1 (0%)	91	95
1	D	313/322 (97%)	312 (100%)	1 (0%)	91	95
All	All	1262/1288 (98%)	1260 (100%)	2 (0%)	92	96

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	188	ASP
1	D	97	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 13 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	132	HIS
1	C	177	GLN
1	D	390	HIS
1	D	177	GLN
1	D	349	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 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	PEG	A	501	-	6,6,6	0.25	0	5,5,5	0.33	0
2	PEG	B	501	-	6,6,6	0.26	0	5,5,5	0.32	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	PEG	A	501	-	-	3/4/4/4	-
2	PEG	B	501	-	-	1/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	501	PEG	O2-C3-C4-O4
2	A	501	PEG	O1-C1-C2-O2
2	B	501	PEG	O2-C3-C4-O4
2	A	501	PEG	C4-C3-O2-C2

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

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	403/409 (98%)	0.08	8 (1%) 64 69	19, 45, 82, 116	2 (0%)
1	B	403/409 (98%)	-0.13	4 (0%) 79 83	17, 39, 61, 76	1 (0%)
1	C	402/409 (98%)	0.79	39 (9%) 15 18	35, 65, 96, 124	0
1	D	400/409 (97%)	1.16	87 (21%) 3 3	23, 69, 110, 164	1 (0%)
All	All	1608/1636 (98%)	0.48	138 (8%) 18 22	17, 52, 96, 164	4 (0%)

The worst 5 of 138 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	155	ILE	6.0
1	D	122	LEU	5.6
1	D	150	VAL	5.2
1	D	431	LEU	5.1
1	B	48	HIS	4.4

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

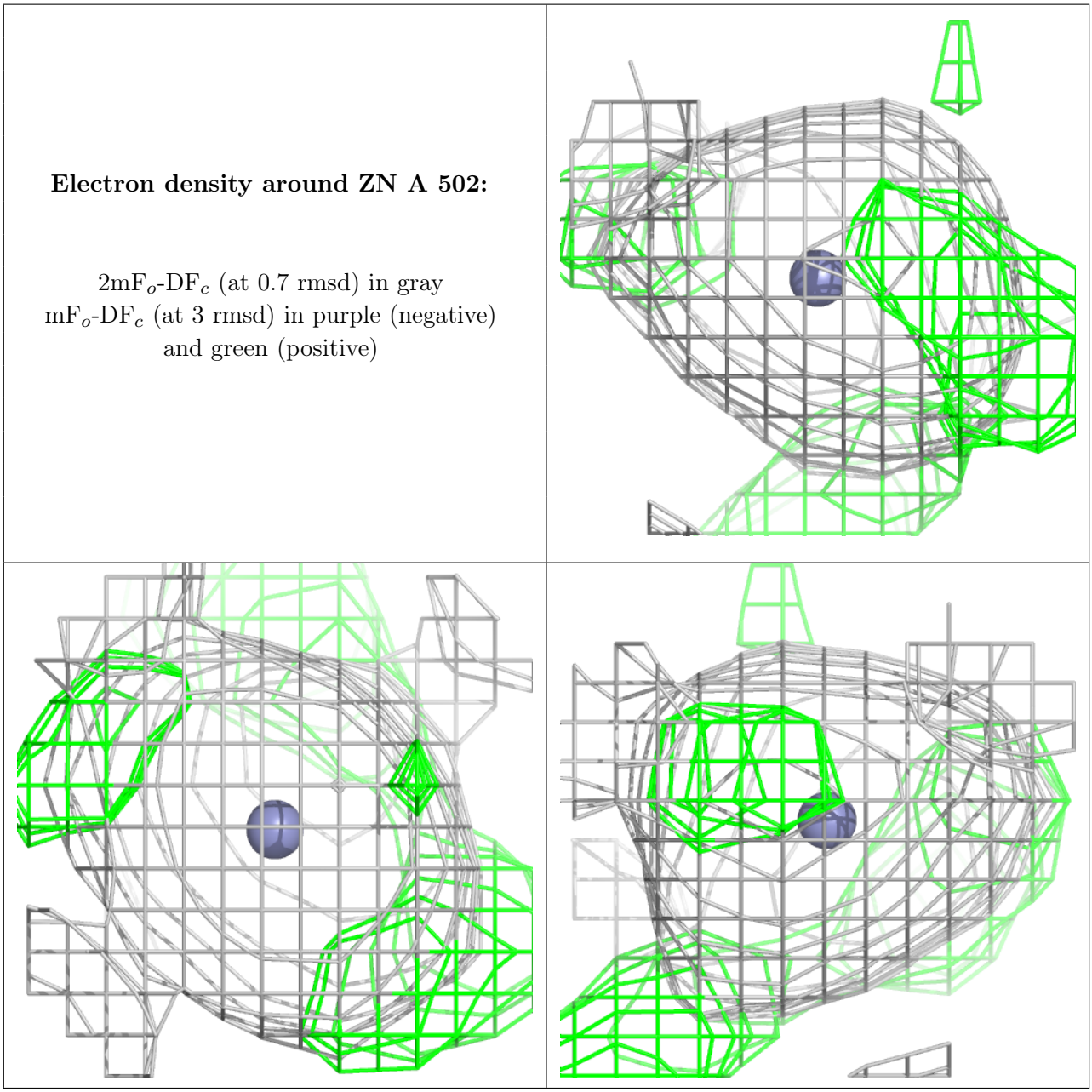
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' 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	PEG	B	501	7/7	0.84	0.13	46,48,50,53	0
2	PEG	A	501	7/7	0.87	0.13	52,59,69,71	0
3	ZN	A	502	1/1	0.94	0.08	62,62,62,62	0
3	ZN	C	501	1/1	0.96	0.07	55,55,55,55	0
3	ZN	D	501	1/1	0.97	0.07	54,54,54,54	0
3	ZN	B	502	1/1	0.98	0.09	40,40,40,40	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.

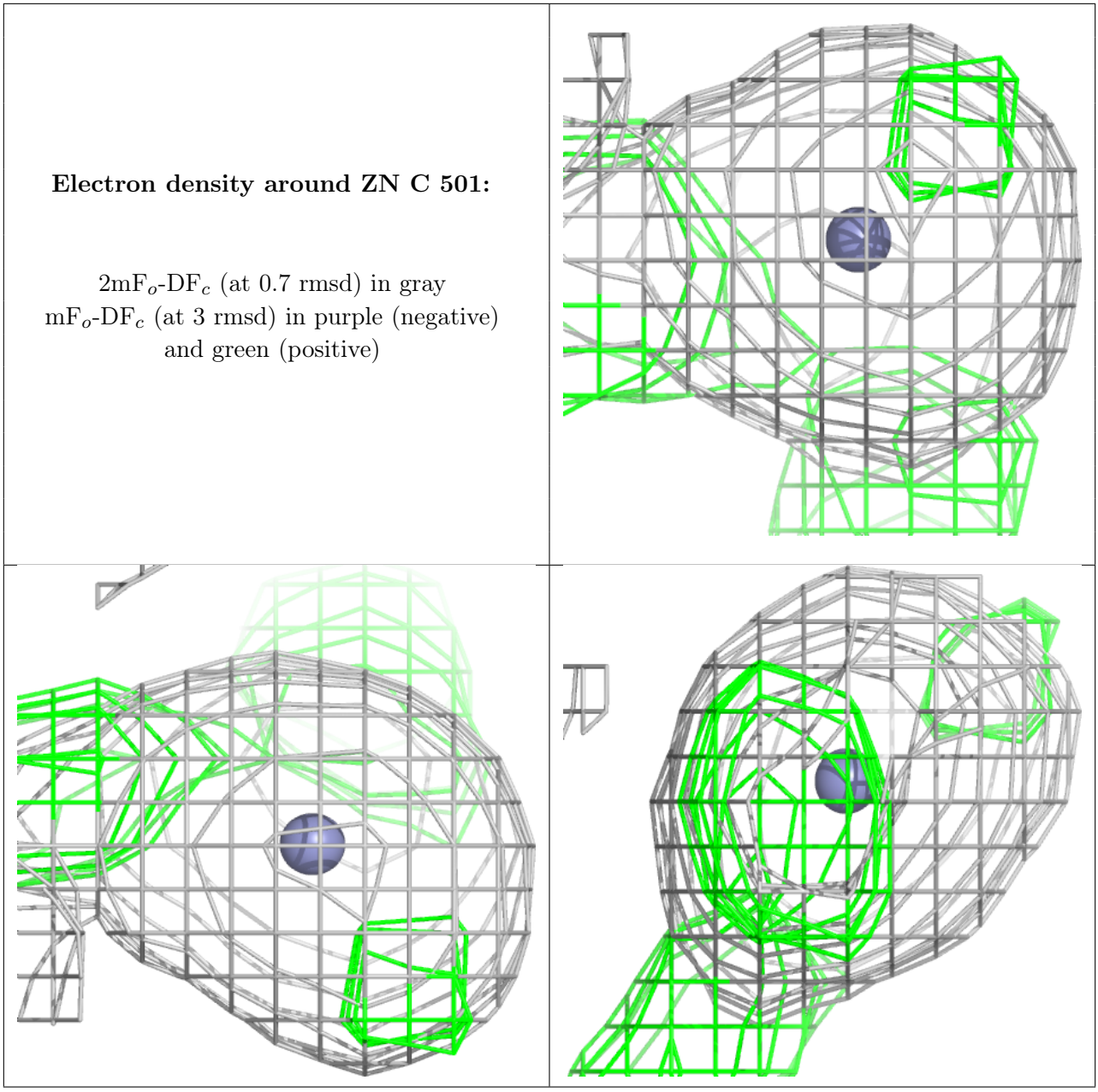
Electron density around ZN A 502:

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



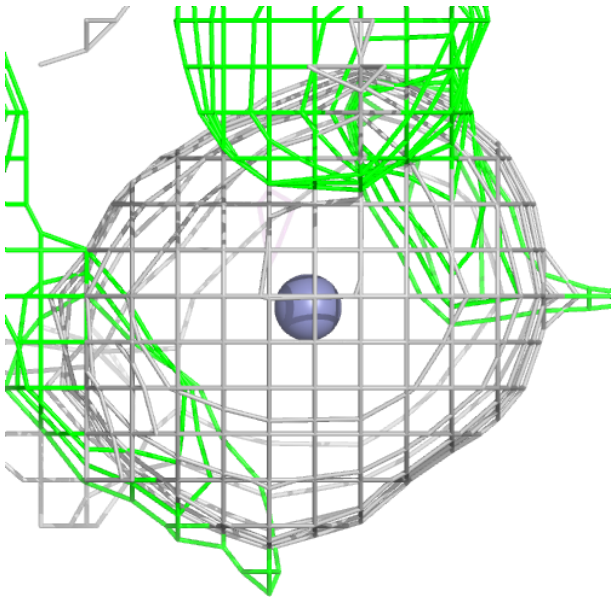
Electron density around ZN C 501:

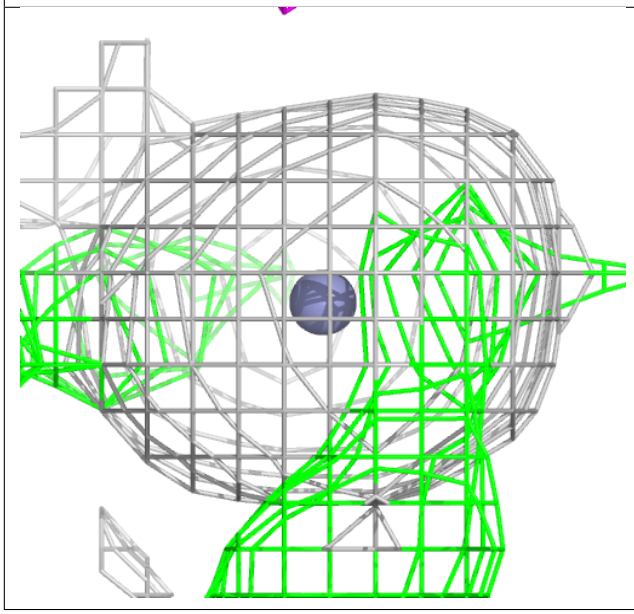
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

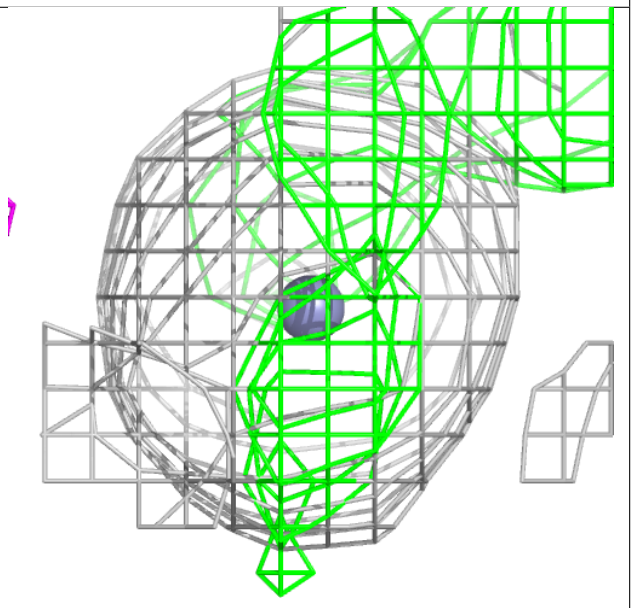


Electron density around ZN D 501:

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

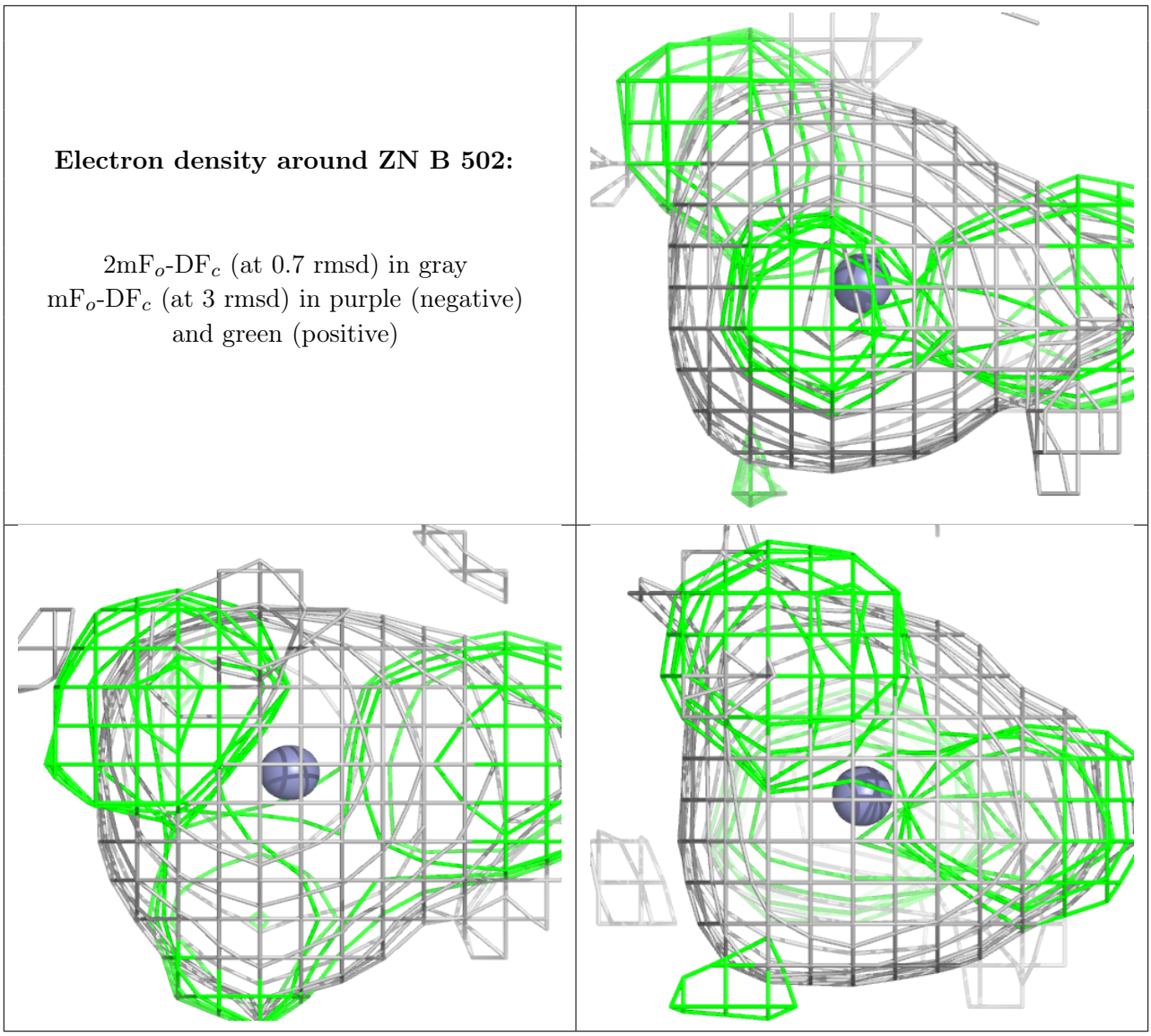






Electron density around ZN B 502:

$2mF_o$-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.