



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 20, 2024 – 04:10 PM JST

PDB ID : 8ZNS  
Title : Type I-C CRISPR-associated protein, Cas3  
Authors : Kim, D.Y.; Park, H.H.  
Deposited on : 2024-05-28  
Resolution : 2.17 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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  
Xtriage (Phenix) : 1.13  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.003 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.39

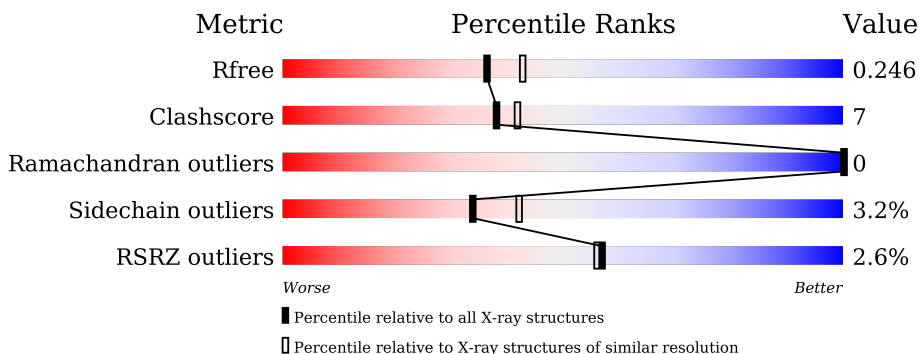
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.17 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	8336 (2.20-2.16)
Clashscore	180529	9404 (2.20-2.16)
Ramachandran outliers	177936	9297 (2.20-2.16)
Sidechain outliers	177891	9297 (2.20-2.16)
RSRZ outliers	164620	8337 (2.20-2.16)

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  $\geq 3$ , 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	854	

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 6569 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 CRISPR-associated endonuclease Cas3-HD.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	783	6216	3966	1088	1143	19	0	0	0

There are 21 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	initiating methionine	UNP D0W8X3
A	835	GLY	-	expression tag	UNP D0W8X3
A	836	GLY	-	expression tag	UNP D0W8X3
A	837	SER	-	expression tag	UNP D0W8X3
A	838	VAL	-	expression tag	UNP D0W8X3
A	839	GLY	-	expression tag	UNP D0W8X3
A	840	PRO	-	expression tag	UNP D0W8X3
A	841	LYS	-	expression tag	UNP D0W8X3
A	842	LYS	-	expression tag	UNP D0W8X3
A	843	LYS	-	expression tag	UNP D0W8X3
A	844	ARG	-	expression tag	UNP D0W8X3
A	845	LYS	-	expression tag	UNP D0W8X3
A	846	VAL	-	expression tag	UNP D0W8X3
A	847	LEU	-	expression tag	UNP D0W8X3
A	848	GLU	-	expression tag	UNP D0W8X3
A	849	HIS	-	expression tag	UNP D0W8X3
A	850	HIS	-	expression tag	UNP D0W8X3
A	851	HIS	-	expression tag	UNP D0W8X3
A	852	HIS	-	expression tag	UNP D0W8X3
A	853	HIS	-	expression tag	UNP D0W8X3
A	854	HIS	-	expression tag	UNP D0W8X3

- Molecule 2 is FE (III) ION (three-letter code: FE) (formula: Fe) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Fe	0	0
			2	2		

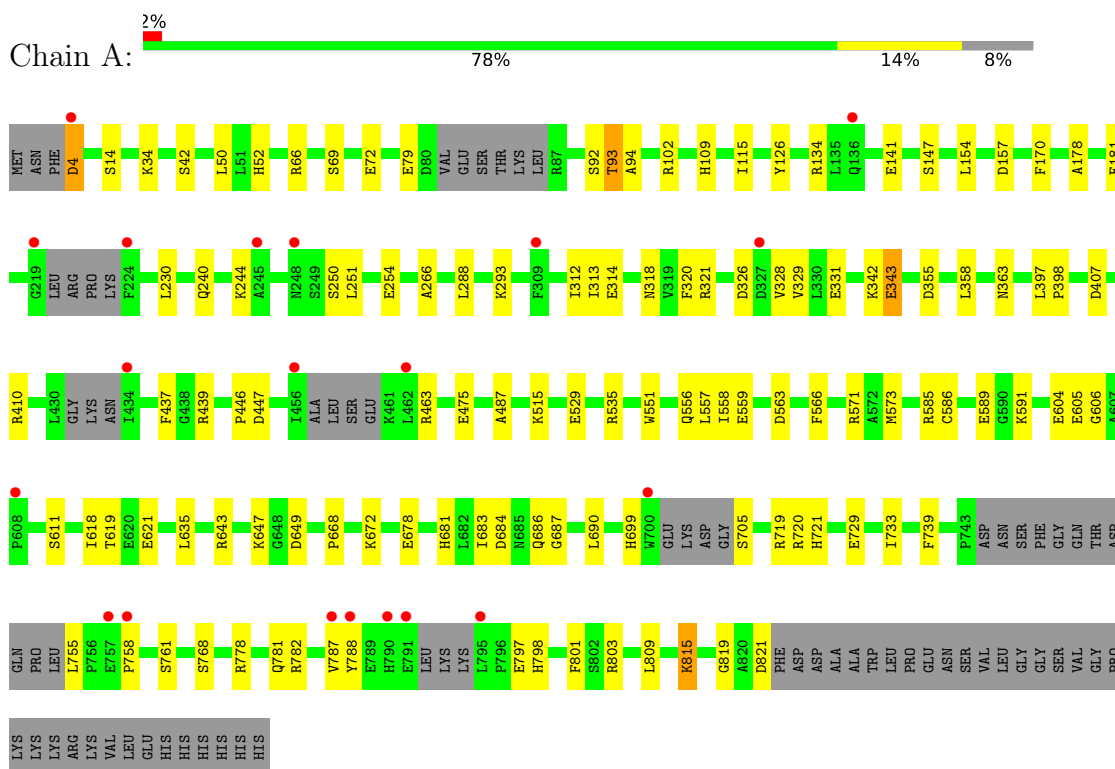
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	351	Total	O	0	0
			351	351		

### 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: CRISPR-associated endonuclease Cas3-HD



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	124.97Å 73.33Å 104.42Å 90.00° 99.75° 90.00°	Depositor
Resolution (Å)	29.09 – 2.17 29.09 – 2.17	Depositor EDS
% Data completeness (in resolution range)	99.9 (29.09-2.17) 99.9 (29.09-2.17)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.11 (at 2.18Å)	Xtrriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, $R_{free}$	0.195 , 0.249 0.193 , 0.246	Depositor DCC
$R_{free}$ test set	2468 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	37.4	Xtrriage
Anisotropy	0.170	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 42.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	6569	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	42.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.76% 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: FE

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	0.47	0/6358	0.64	0/8602

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	6216	0	6112	84	0
2	A	2	0	0	0	0
3	A	351	0	0	27	0
All	All	6569	0	6112	84	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 7.

All (84) 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:690:LEU:HD11	1:A:809:LEU:HB2	1.47	0.94

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:720:ARG:NH2	3:A:1003:HOH:O	2.06	0.88
1:A:363:ASN:ND2	3:A:1005:HOH:O	2.08	0.87
1:A:678:GLU:OE1	3:A:1001:HOH:O	1.92	0.86
1:A:321:ARG:NH2	1:A:331:GLU:OE2	2.12	0.82
1:A:529:GLU:OE2	3:A:1002:HOH:O	1.97	0.82
1:A:439:ARG:NH1	3:A:1007:HOH:O	2.13	0.81
1:A:329:VAL:HG22	1:A:358:LEU:HD23	1.65	0.77
1:A:535:ARG:NH2	1:A:563:ASP:O	2.19	0.76
1:A:604:GLU:OE1	3:A:1004:HOH:O	2.08	0.71
1:A:407:ASP:OD1	1:A:410:ARG:NH2	2.24	0.71
1:A:649:ASP:OD1	3:A:1006:HOH:O	2.10	0.70
1:A:240:GLN:O	1:A:244:LYS:HB2	1.93	0.69
1:A:788:TYR:HA	3:A:1008:HOH:O	1.91	0.68
1:A:312:ILE:HD11	1:A:557:LEU:HD13	1.76	0.68
1:A:686:GLN:O	3:A:1008:HOH:O	2.14	0.65
1:A:684:ASP:OD1	3:A:1009:HOH:O	2.15	0.64
1:A:251:LEU:HA	1:A:254:GLU:OE2	1.97	0.64
1:A:93:THR:HB	1:A:134:ARG:HH21	1.64	0.61
1:A:687:GLY:HA2	3:A:1008:HOH:O	1.99	0.61
1:A:94:ALA:HB2	1:A:141:GLU:HG2	1.83	0.60
1:A:705:SER:N	3:A:1022:HOH:O	2.34	0.60
1:A:230:LEU:HD21	1:A:328:VAL:HG11	1.85	0.59
1:A:250:SER:O	1:A:254:GLU:HG3	2.04	0.57
1:A:719:ARG:HG2	1:A:719:ARG:HH11	1.69	0.57
1:A:437:PHE:CE2	1:A:635:LEU:HD13	2.39	0.57
1:A:69:SER:OG	1:A:72:GLU:HG3	2.05	0.56
1:A:721:HIS:HE1	3:A:1003:HOH:O	1.88	0.55
1:A:755:LEU:N	3:A:1030:HOH:O	2.41	0.54
1:A:803:ARG:HD3	3:A:1027:HOH:O	2.10	0.52
1:A:803:ARG:NH1	3:A:1027:HOH:O	2.39	0.52
1:A:342:LYS:HD2	1:A:342:LYS:O	2.10	0.52
1:A:439:ARG:NH2	3:A:1032:HOH:O	2.42	0.52
1:A:343:GLU:OE1	3:A:1010:HOH:O	2.19	0.52
1:A:52:HIS:HA	1:A:115:ILE:HG23	1.92	0.51
1:A:318:ASN:OD1	1:A:321:ARG:NH1	2.41	0.51
1:A:535:ARG:NH1	3:A:1021:HOH:O	2.33	0.50
1:A:157:ASP:OD1	3:A:1011:HOH:O	2.19	0.50
1:A:93:THR:HB	1:A:134:ARG:NH2	2.27	0.49
1:A:314:GLU:OE2	1:A:782:ARG:NE	2.41	0.49
1:A:34:LYS:HG3	1:A:42:SER:HB2	1.95	0.49
1:A:170:PHE:HZ	1:A:178:ALA:HB2	1.77	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:618:ILE:HA	1:A:621:GLU:HG2	1.94	0.48
1:A:621:GLU:OE2	1:A:643:ARG:HD3	2.12	0.48
1:A:4:ASP:O	1:A:66:ARG:NH2	2.44	0.48
1:A:109:HIS:CE1	1:A:668:PRO:HG2	2.49	0.48
1:A:729:GLU:O	1:A:733:ILE:HD12	2.14	0.48
1:A:787:VAL:O	3:A:1008:HOH:O	2.19	0.48
1:A:589:GLU:HB2	1:A:591:LYS:HG3	1.94	0.47
1:A:815:LYS:HD2	1:A:819:GLY:O	2.13	0.47
1:A:719:ARG:HG2	1:A:719:ARG:NH1	2.30	0.47
1:A:93:THR:HG21	3:A:1056:HOH:O	2.14	0.47
1:A:397:LEU:HG	3:A:1005:HOH:O	2.16	0.46
1:A:778:ARG:O	1:A:781:GLN:HB2	2.15	0.46
1:A:559:GLU:OE2	1:A:571:ARG:NE	2.45	0.45
1:A:821:ASP:O	3:A:1012:HOH:O	2.20	0.45
1:A:475:GLU:OE2	3:A:1013:HOH:O	2.21	0.45
1:A:355:ASP:OD2	1:A:355:ASP:C	2.55	0.45
1:A:739:PHE:CD2	1:A:758:PRO:HD3	2.52	0.45
1:A:606:GLY:N	3:A:1042:HOH:O	2.49	0.44
1:A:566:PHE:O	1:A:586:CYS:HA	2.17	0.44
1:A:79:GLU:OE1	1:A:92:SER:OG	2.31	0.43
1:A:266:ALA:HB3	1:A:293:LYS:HD3	2.00	0.43
1:A:93:THR:HG23	1:A:141:GLU:OE1	2.18	0.43
1:A:755:LEU:HD21	1:A:801:PHE:HZ	1.83	0.43
1:A:170:PHE:CZ	1:A:178:ALA:HB2	2.53	0.43
1:A:398:PRO:HG2	1:A:683:ILE:HG13	2.01	0.43
1:A:328:VAL:HG23	1:A:329:VAL:HG23	2.01	0.43
1:A:126:TYR:H	1:A:672:LYS:NZ	2.15	0.42
1:A:126:TYR:H	1:A:672:LYS:HZ3	1.68	0.42
1:A:573:MET:HE1	1:A:619:THR:HG22	2.02	0.42
1:A:410:ARG:HD3	1:A:446:PRO:HD3	2.01	0.41
1:A:681:HIS:HD2	1:A:686:GLN:HG2	1.84	0.41
1:A:589:GLU:CB	1:A:591:LYS:HG3	2.51	0.41
1:A:288:LEU:HD22	1:A:320:PHE:CD1	2.56	0.41
1:A:515:LYS:HA	1:A:551:TRP:O	2.20	0.41
1:A:320:PHE:HB3	1:A:358:LEU:HD21	2.02	0.41
1:A:487:ALA:HA	1:A:551:TRP:CZ2	2.56	0.41
1:A:755:LEU:HD12	1:A:803:ARG:NH1	2.35	0.41
1:A:447:ASP:N	1:A:447:ASP:OD1	2.54	0.40
1:A:721:HIS:CD2	3:A:1317:HOH:O	2.73	0.40
1:A:154:LEU:H	1:A:154:LEU:HG	1.55	0.40
1:A:50:LEU:HD12	1:A:50:LEU:HA	1.93	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:102:ARG:HD3	1:A:102:ARG:HA	1.69	0.40

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	767/854 (90%)	746 (97%)	21 (3%)	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	649/715 (91%)	628 (97%)	21 (3%)	34 42

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	ASP
1	A	14	SER
1	A	93	THR
1	A	147	SER
1	A	181	GLU

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Mol	Chain	Res	Type
1	A	313	ILE
1	A	326	ASP
1	A	343	GLU
1	A	463	ARG
1	A	556	GLN
1	A	558	ILE
1	A	585	ARG
1	A	605	GLU
1	A	611	SER
1	A	647	LYS
1	A	699	HIS
1	A	761	SER
1	A	768	SER
1	A	797	GLU
1	A	798	HIS
1	A	815	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 2 ligands modelled in this entry, 2 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	783/854 (91%)	0.08	20 (2%) 57 56	24, 39, 66, 102	0

All (20) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	795	LEU	4.7
1	A	434	ILE	4.0
1	A	456	ILE	3.9
1	A	245	ALA	3.9
1	A	790	HIS	3.3
1	A	700	TRP	3.3
1	A	462	LEU	3.0
1	A	309	PHE	2.9
1	A	327	ASP	2.8
1	A	788	TYR	2.8
1	A	787	VAL	2.6
1	A	219	GLY	2.4
1	A	757	GLU	2.4
1	A	758	PRO	2.3
1	A	791	GLU	2.3
1	A	224	PHE	2.2
1	A	248	ASN	2.1
1	A	136	GLN	2.1
1	A	608	PRO	2.0
1	A	4	ASP	2.0

### 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 [i](#)

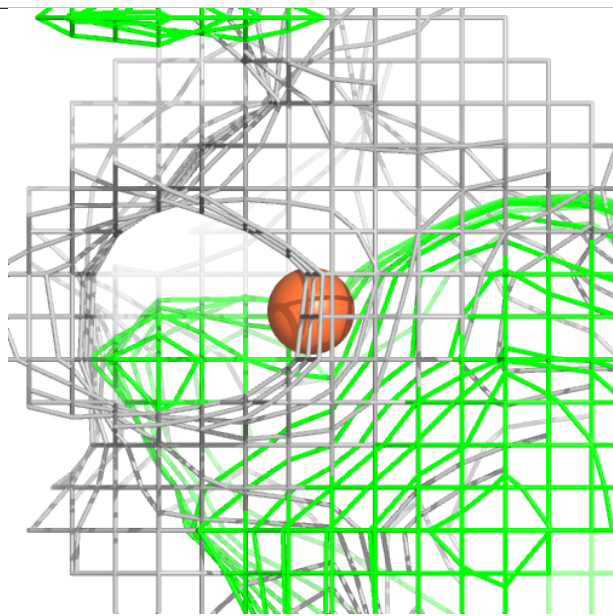
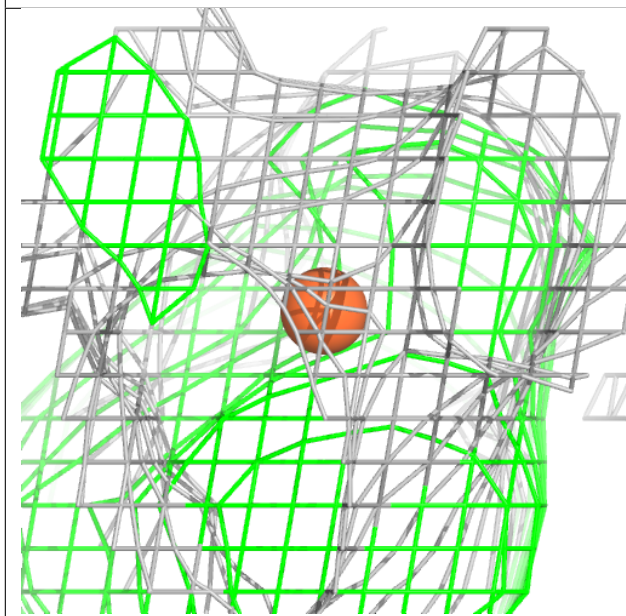
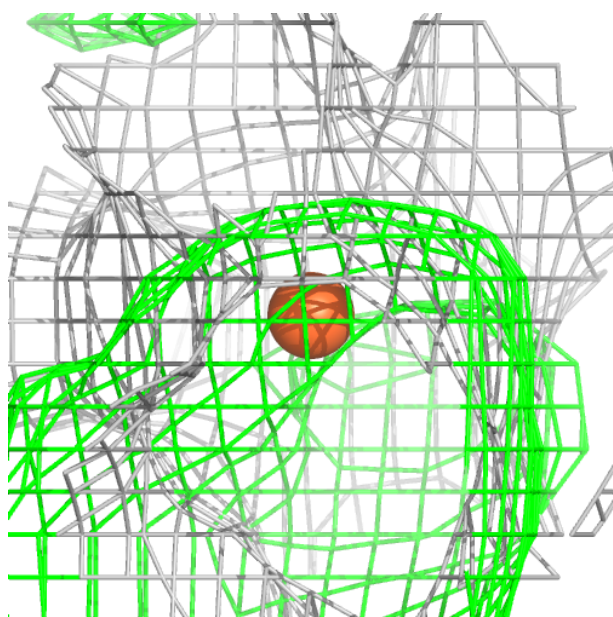
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

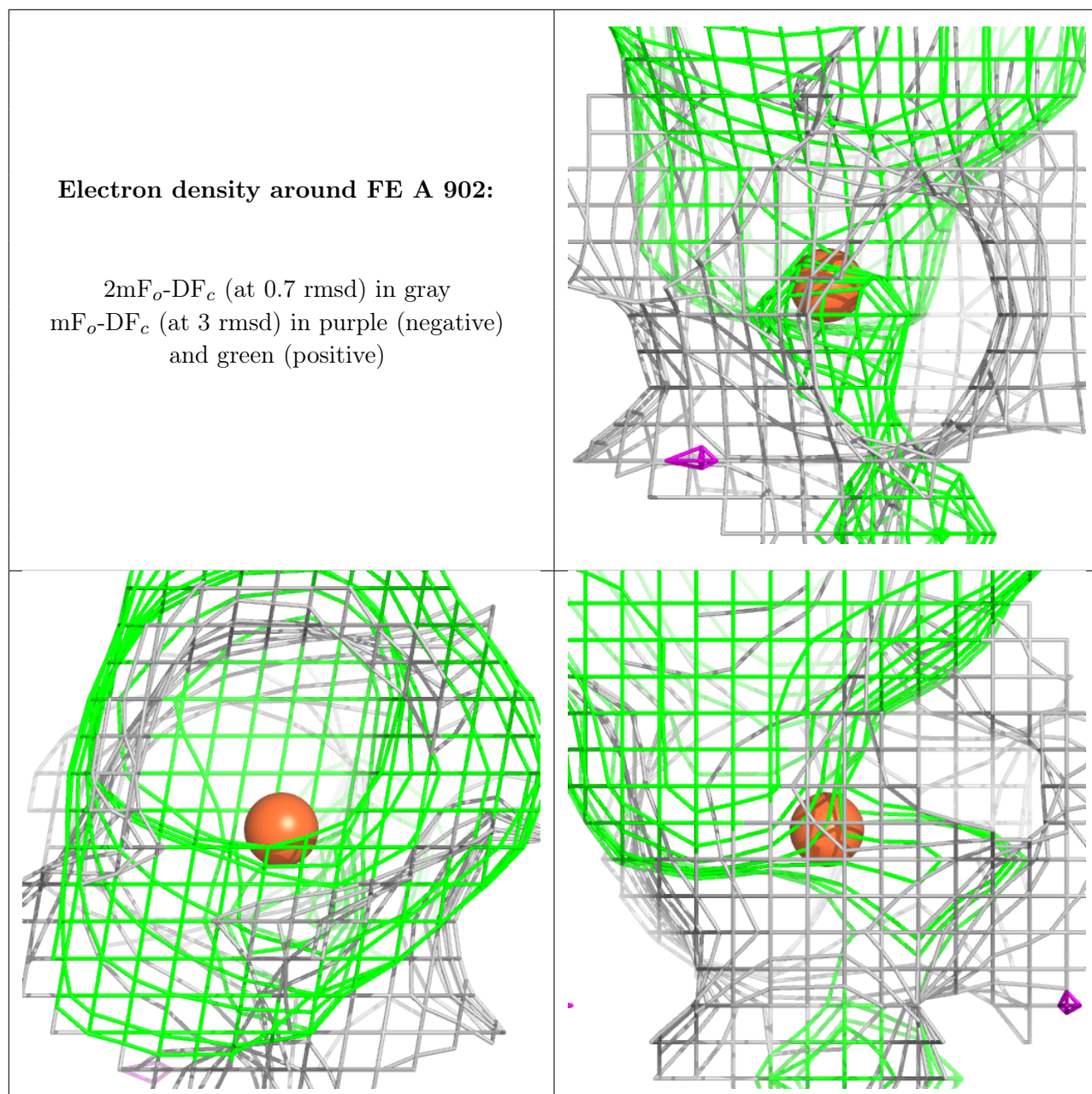
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	FE	A	901	1/1	0.97	0.07	28,28,28,28	0
2	FE	A	902	1/1	0.98	0.07	28,28,28,28	0

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 FE A 901:**

$2mF_o-DF_c$  (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.