



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 02:09 PM EST

PDB ID : 9PCO / pdb_00009pco
Title : Crystal structure of Rv0097 with 5 mM CADA soaked (CADA not bound)
and 5 mM alpha-ketoglutarate soaked (alpha-ketoglutarate bound)
Authors : Ye, N.; Drennan, C.L.
Deposited on : 2025-06-27
Resolution : 1.82 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 ⓘ 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 ⓘ](#)) 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
buster-report : 1.1.7 (2018)
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

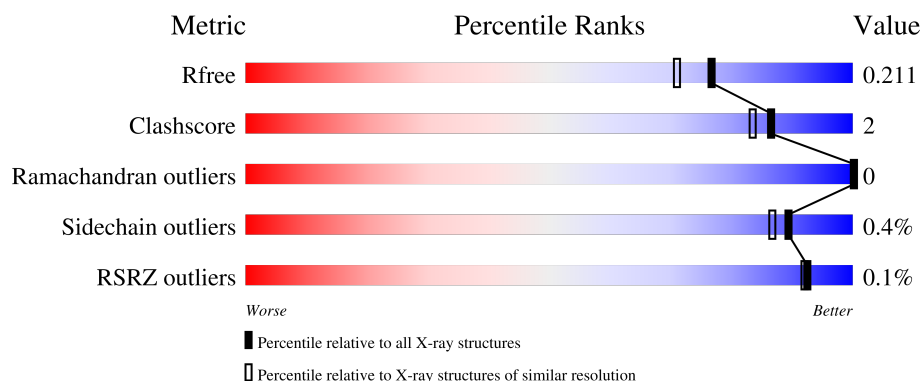
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

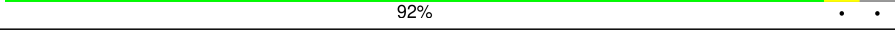
The reported resolution of this entry is 1.82 Å.

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	9242 (1.84-1.80)
Clashscore	180529	1080 (1.82-1.82)
Ramachandran outliers	177936	1073 (1.82-1.82)
Sidechain outliers	177891	1073 (1.82-1.82)
RSRZ outliers	164620	9241 (1.84-1.80)

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 $\leq 5\%$. 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	302	 89% 5% 6%
1	B	302	 89% 6% 5%
1	C	302	 88% 6% 6%
1	D	302	 92% . .

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 10110 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 (3R)-3-[(carboxymethyl)amino]fatty acid oxygenase/decarboxylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	285	Total	C	N	O	S	51	7	0
			2320	1485	401	426	8			
1	B	286	Total	C	N	O	S	69	2	0
			2294	1470	396	420	8			
1	C	283	Total	C	N	O	S	39	3	0
			2281	1462	394	416	9			
1	D	289	Total	C	N	O	S	13	4	0
			2323	1485	402	428	8			

There are 52 discrepancies between the modelled and reference sequences:

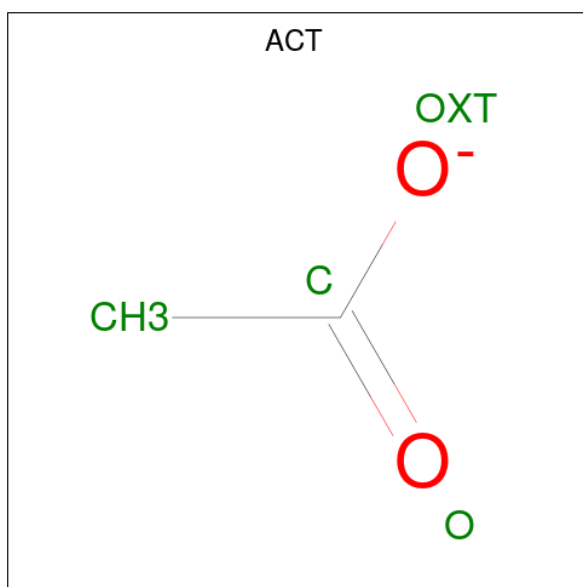
Chain	Residue	Modelled	Actual	Comment	Reference
A	290	LYS	-	expression tag	UNP P9WG83
A	291	LEU	-	expression tag	UNP P9WG83
A	292	ALA	-	expression tag	UNP P9WG83
A	293	ALA	-	expression tag	UNP P9WG83
A	294	ALA	-	expression tag	UNP P9WG83
A	295	LEU	-	expression tag	UNP P9WG83
A	296	GLU	-	expression tag	UNP P9WG83
A	297	HIS	-	expression tag	UNP P9WG83
A	298	HIS	-	expression tag	UNP P9WG83
A	299	HIS	-	expression tag	UNP P9WG83
A	300	HIS	-	expression tag	UNP P9WG83
A	301	HIS	-	expression tag	UNP P9WG83
A	302	HIS	-	expression tag	UNP P9WG83
B	290	LYS	-	expression tag	UNP P9WG83
B	291	LEU	-	expression tag	UNP P9WG83
B	292	ALA	-	expression tag	UNP P9WG83
B	293	ALA	-	expression tag	UNP P9WG83
B	294	ALA	-	expression tag	UNP P9WG83
B	295	LEU	-	expression tag	UNP P9WG83
B	296	GLU	-	expression tag	UNP P9WG83

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Chain	Residue	Modelled	Actual	Comment	Reference
B	297	HIS	-	expression tag	UNP P9WG83
B	298	HIS	-	expression tag	UNP P9WG83
B	299	HIS	-	expression tag	UNP P9WG83
B	300	HIS	-	expression tag	UNP P9WG83
B	301	HIS	-	expression tag	UNP P9WG83
B	302	HIS	-	expression tag	UNP P9WG83
C	290	LYS	-	expression tag	UNP P9WG83
C	291	LEU	-	expression tag	UNP P9WG83
C	292	ALA	-	expression tag	UNP P9WG83
C	293	ALA	-	expression tag	UNP P9WG83
C	294	ALA	-	expression tag	UNP P9WG83
C	295	LEU	-	expression tag	UNP P9WG83
C	296	GLU	-	expression tag	UNP P9WG83
C	297	HIS	-	expression tag	UNP P9WG83
C	298	HIS	-	expression tag	UNP P9WG83
C	299	HIS	-	expression tag	UNP P9WG83
C	300	HIS	-	expression tag	UNP P9WG83
C	301	HIS	-	expression tag	UNP P9WG83
C	302	HIS	-	expression tag	UNP P9WG83
D	290	LYS	-	expression tag	UNP P9WG83
D	291	LEU	-	expression tag	UNP P9WG83
D	292	ALA	-	expression tag	UNP P9WG83
D	293	ALA	-	expression tag	UNP P9WG83
D	294	ALA	-	expression tag	UNP P9WG83
D	295	LEU	-	expression tag	UNP P9WG83
D	296	GLU	-	expression tag	UNP P9WG83
D	297	HIS	-	expression tag	UNP P9WG83
D	298	HIS	-	expression tag	UNP P9WG83
D	299	HIS	-	expression tag	UNP P9WG83
D	300	HIS	-	expression tag	UNP P9WG83
D	301	HIS	-	expression tag	UNP P9WG83
D	302	HIS	-	expression tag	UNP P9WG83

- Molecule 2 is ACETATE ION (CCD ID: ACT) (formula: C₂H₃O₂).

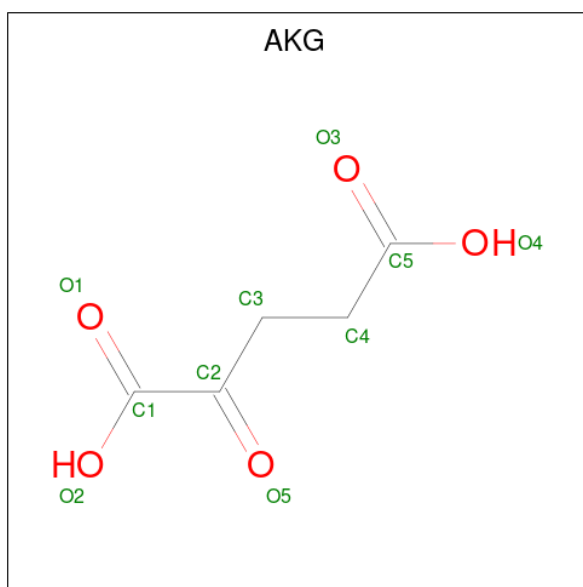


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			4	2	2		
2	B	1	Total	C	O	0	0
			4	2	2		
2	D	1	Total	C	O	0	0
			4	2	2		
2	D	1	Total	C	O	0	0
			4	2	2		

- Molecule 3 is FE (III) ION (CCD ID: FE) (formula: Fe) (labeled as "Ligand of Interest" by depositor).

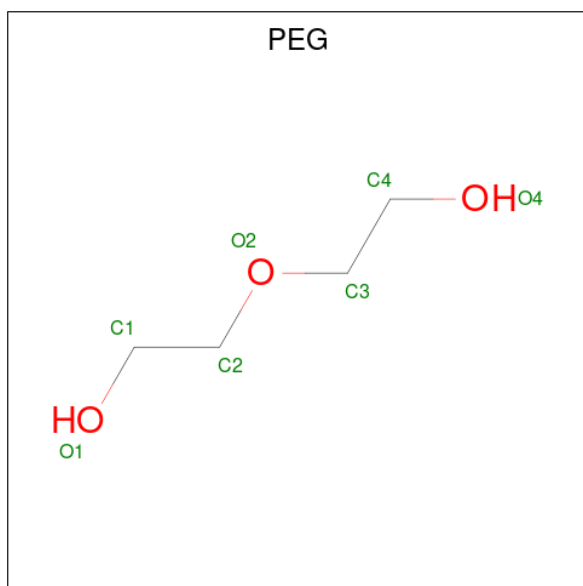
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Fe	0	0
			1	1		
3	B	1	Total	Fe	0	0
			1	1		
3	C	1	Total	Fe	0	0
			1	1		
3	D	1	Total	Fe	0	0
			1	1		

- Molecule 4 is 2-OXOGLUTARIC ACID (CCD ID: AKG) (formula: C₅H₆O₅) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	C	1	Total	C	O	0	0
			10	5	5		

- Molecule 5 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



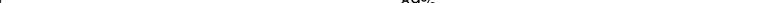
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	D	1	Total	C	O	0	0
			7	4	3		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	162	Total 162	O 162	0	0
6	B	127	Total 127	O 127	0	0
6	C	284	Total 284	O 284	0	0
6	D	282	Total 282	O 282	0	0

- Molecule 1: (3R)-3-[(carboxymethyl)amino]fatty acid oxygenase/decarboxylase



- Chain B:  89% 6% 5%



- Chain C: 88% 6% 6%



- Chain D: 92% . .



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	88.44Å 63.54Å 106.59Å 90.00° 97.89° 90.00°	Depositor
Resolution (Å)	28.39 – 1.82 28.39 – 1.82	Depositor EDS
% Data completeness (in resolution range)	98.5 (28.39-1.82) 98.5 (28.39-1.82)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.47 (at 1.82Å)	Xtriage
Refinement program	PHENIX 1.21.2_5419	Depositor
R, R_{free}	0.172 , 0.211 0.172 , 0.211	Depositor DCC
R_{free} test set	5185 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å ²)	27.0	Xtriage
Anisotropy	0.406	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 38.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	10110	wwPDB-VP
Average B, all atoms (Å ²)	34.0	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 40.67 % 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 2.6443e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹Intensities estimated from amplitudes.

²Theoretical 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: PEG, AKG, FE, ACT

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	0.24	0/2398	0.47	0/3268
1	B	0.24	0/2366	0.45	0/3225
1	C	0.31	0/2356	0.52	0/3211
1	D	0.30	0/2393	0.52	0/3263
All	All	0.28	0/9513	0.49	0/12967

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	2320	0	2303	9	0
1	B	2294	0	2275	11	0
1	C	2281	0	2267	9	0
1	D	2323	0	2298	8	0
2	A	4	0	3	0	0
2	B	4	0	3	0	0
2	D	8	0	6	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	1	0	0	0	0
3	D	1	0	0	0	0
4	C	10	0	4	0	0
5	D	7	0	10	0	0
6	A	162	0	0	3	0
6	B	127	0	0	3	0
6	C	284	0	0	2	0
6	D	282	0	0	2	0
All	All	10110	0	9169	36	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 2.

The worst 5 of 36 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:D:133:TRP:CH2	1:D:141:ARG:HB2	2.17	0.80
1:C:67:GLU:OE2	6:C:501:HOH:O	2.00	0.79
1:D:134:GLN:OE1	6:D:501:HOH:O	2.03	0.76
1:A:120:HIS:NE2	1:B:77:GLU:OE2	2.21	0.72
1:D:136:LEU:O	1:D:141:ARG:NH1	2.26	0.69

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	288/302 (95%)	278 (96%)	10 (4%)	0	100	100
1	B	284/302 (94%)	278 (98%)	6 (2%)	0	100	100
1	C	282/302 (93%)	278 (99%)	4 (1%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	D	291/302 (96%)	285 (98%)	6 (2%)	0	100	100
All	All	1145/1208 (95%)	1119 (98%)	26 (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	255/261 (98%)	254 (100%)	1 (0%)	89	87
1	B	251/261 (96%)	250 (100%)	1 (0%)	89	87
1	C	250/261 (96%)	249 (100%)	1 (0%)	89	87
1	D	253/261 (97%)	252 (100%)	1 (0%)	89	87
All	All	1009/1044 (97%)	1005 (100%)	4 (0%)	89	87

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	THR
1	B	145	ARG
1	C	84	GLU
1	D	73	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	13	GLN
1	C	120	HIS
1	D	176	ASN

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 10 ligands modelled in this entry, 4 are monoatomic - leaving 6 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	$\# Z > 2$
5	PEG	D	401	-	6,6,6	0.24	0	5,5,5	0.25	0
2	ACT	A	401	-	3,3,3	1.14	0	3,3,3	1.22	0
2	ACT	B	401	-	3,3,3	1.15	0	3,3,3	1.26	0
2	ACT	D	402	-	3,3,3	1.14	0	3,3,3	1.19	0
4	AKG	C	401	3	9,9,9	1.54	2 (22%)	11,11,11	2.31	1 (9%)
2	ACT	D	403	-	3,3,3	1.25	0	3,3,3	1.05	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
5	PEG	D	401	-	-	1/4/4/4	-
4	AKG	C	401	3	-	2/9/9/9	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	401	AKG	C2-C1	2.93	1.57	1.53
4	C	401	AKG	C4-C5	2.03	1.55	1.50

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	C	401	AKG	O1-C1-C2	-6.55	113.66	121.81

There are no chirality outliers.

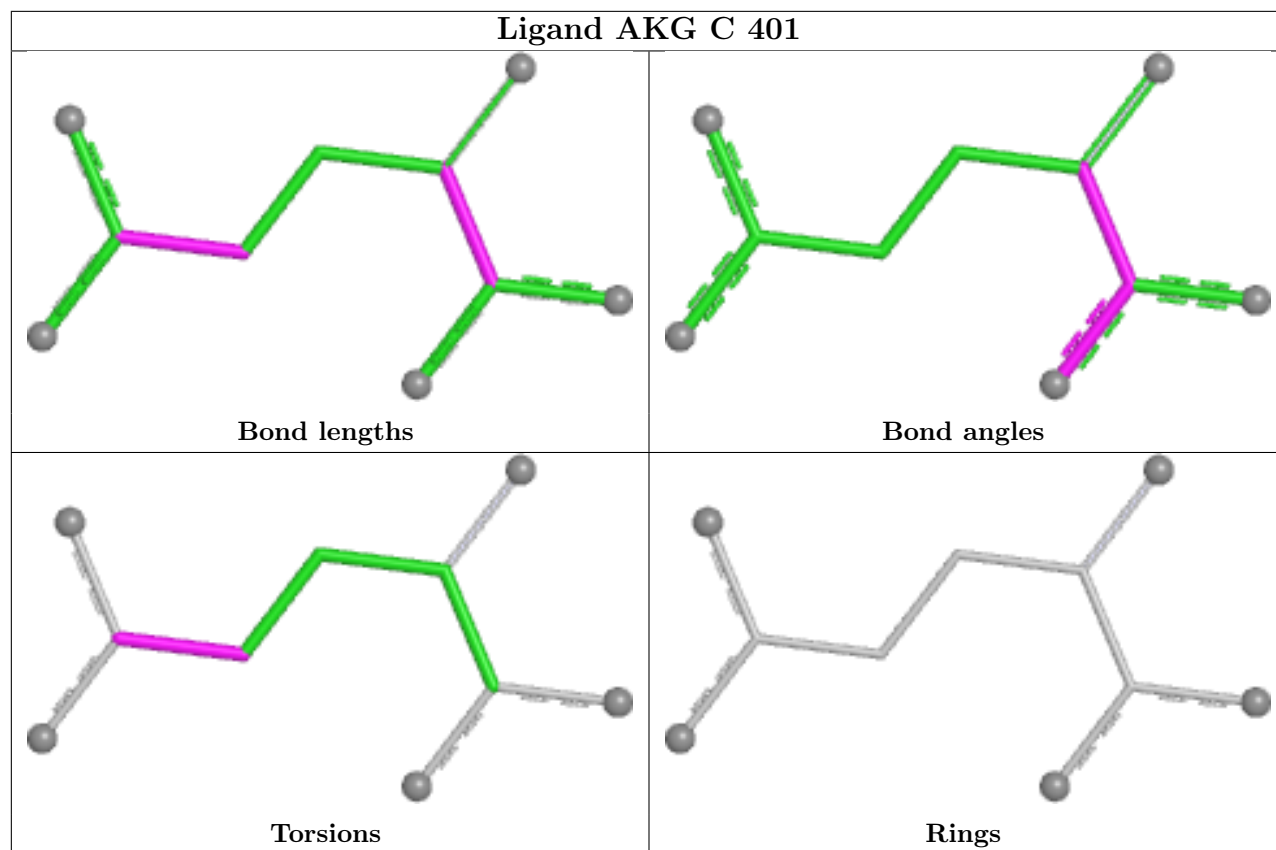
All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	D	401	PEG	O2-C3-C4-O4
4	C	401	AKG	C3-C4-C5-O4
4	C	401	AKG	C3-C4-C5-O3

There are no ring outliers.

No monomer is involved in short contacts.

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



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, 95th 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	285/302 (94%)	-0.21	0 100 100	15, 34, 55, 67	20 (7%)
1	B	286/302 (94%)	-0.06	0 100 100	20, 40, 60, 74	17 (5%)
1	C	283/302 (93%)	-0.46	1 (0%) 89 89	13, 26, 44, 65	13 (4%)
1	D	289/302 (95%)	-0.47	0 100 100	11, 27, 46, 63	8 (2%)
All	All	1143/1208 (94%)	-0.30	1 (0%) 92 92	11, 32, 55, 74	58 (5%)

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	1	MET	2.2

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, 95th 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.

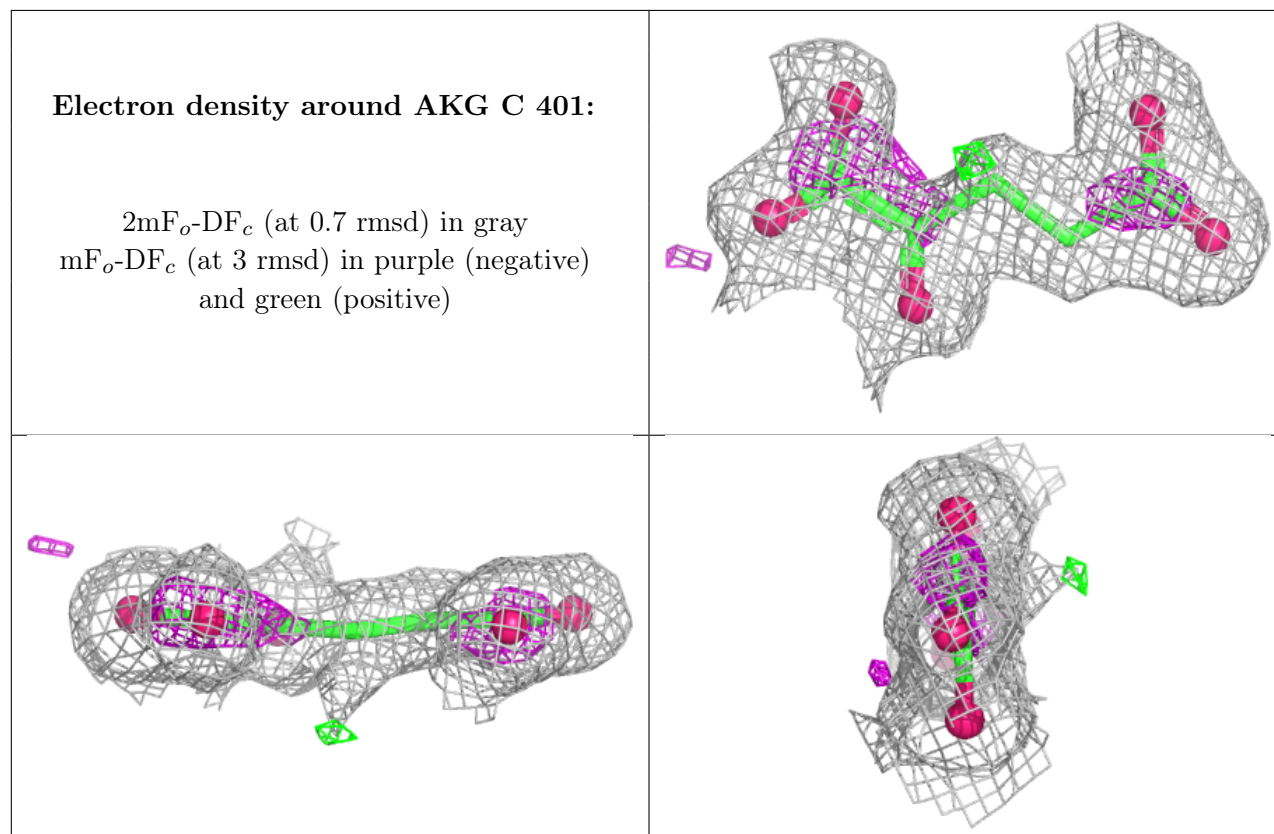
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	ACT	B	401	4/4	0.80	0.16	35,37,37,41	0

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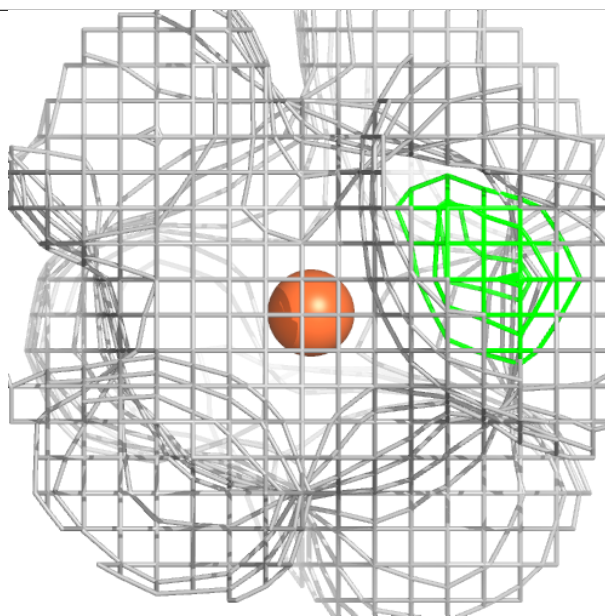
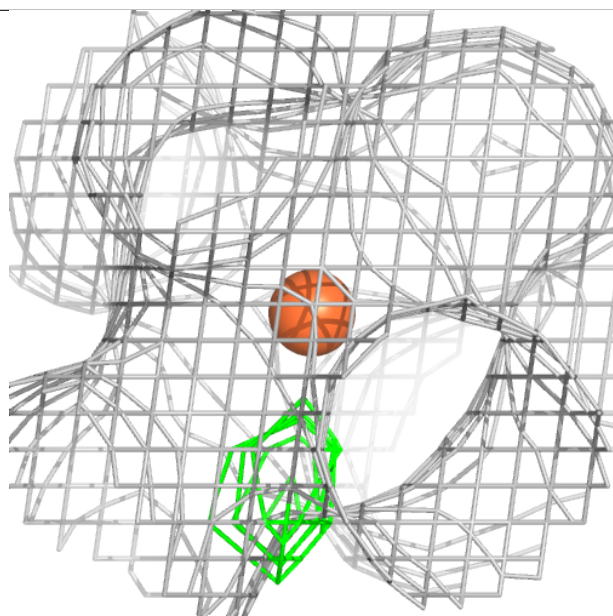
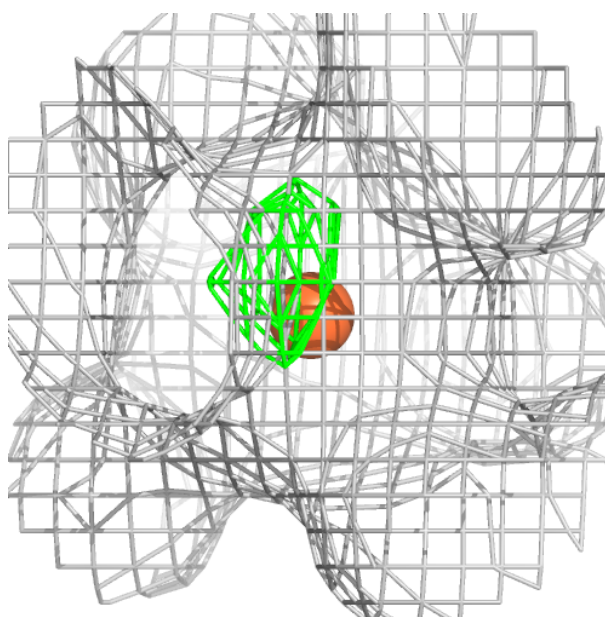
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
5	PEG	D	401	7/7	0.81	0.11	32,40,46,52	0
2	ACT	D	402	4/4	0.82	0.18	30,30,30,33	0
2	ACT	D	403	4/4	0.89	0.17	27,33,34,34	0
2	ACT	A	401	4/4	0.90	0.18	39,39,41,44	0
4	AKG	C	401	10/10	0.92	0.08	24,30,35,36	0
3	FE	A	402	1/1	0.99	0.02	25,25,25,25	0
3	FE	B	402	1/1	0.99	0.02	27,27,27,27	0
3	FE	C	402	1/1	1.00	0.01	19,19,19,19	0
3	FE	D	404	1/1	1.00	0.01	19,19,19,19	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.



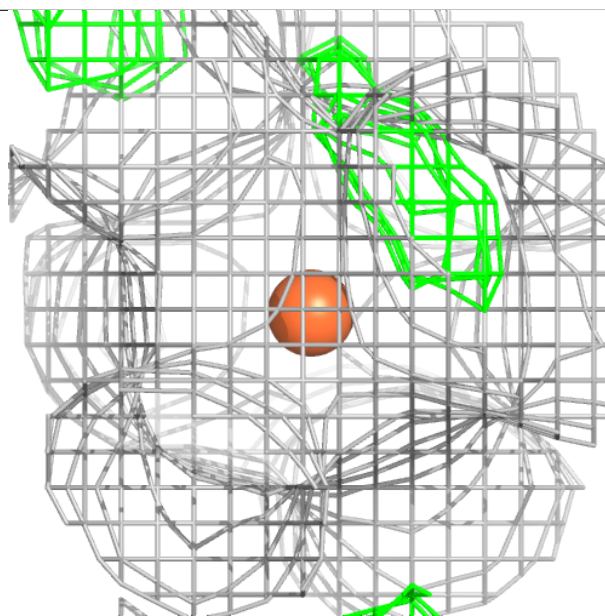
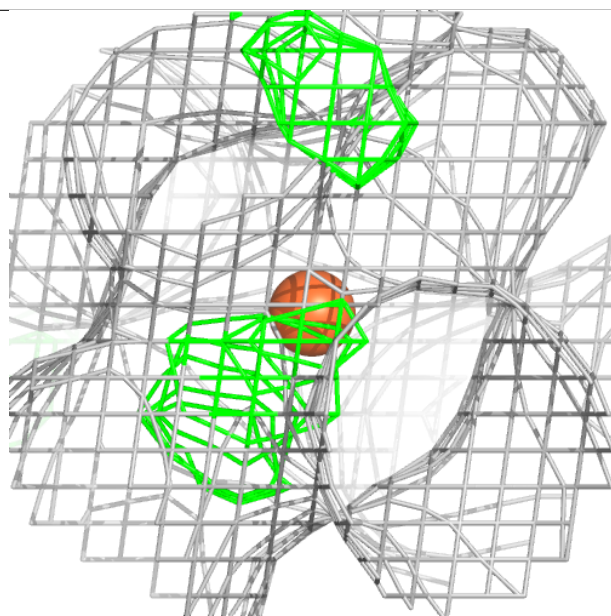
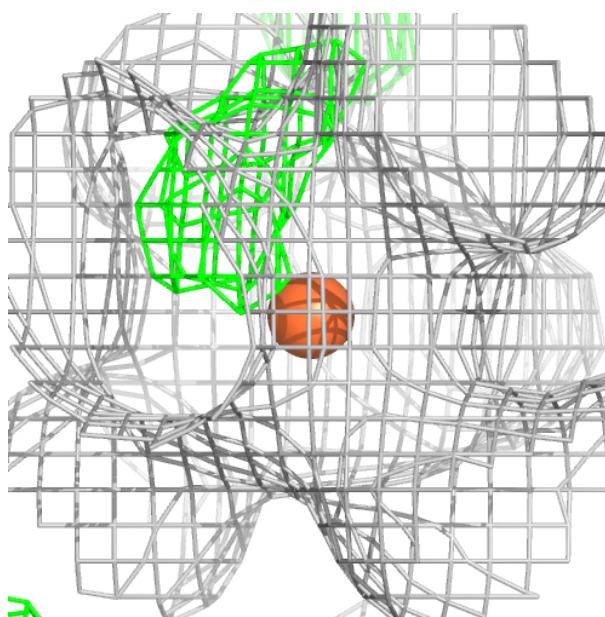
Electron density around FE A 402:

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



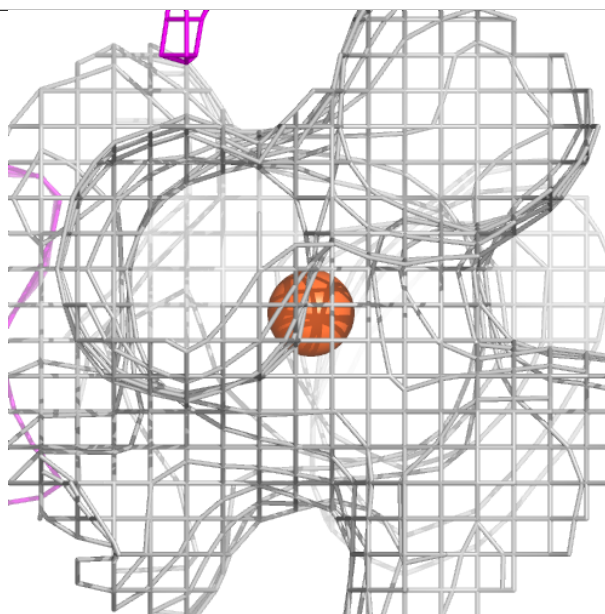
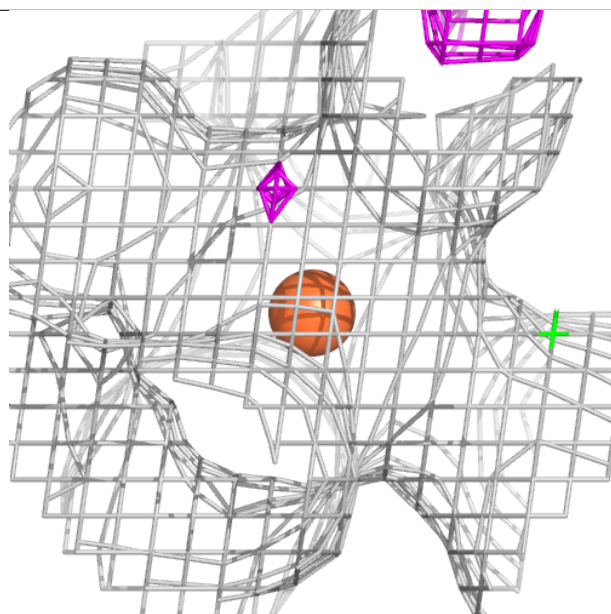
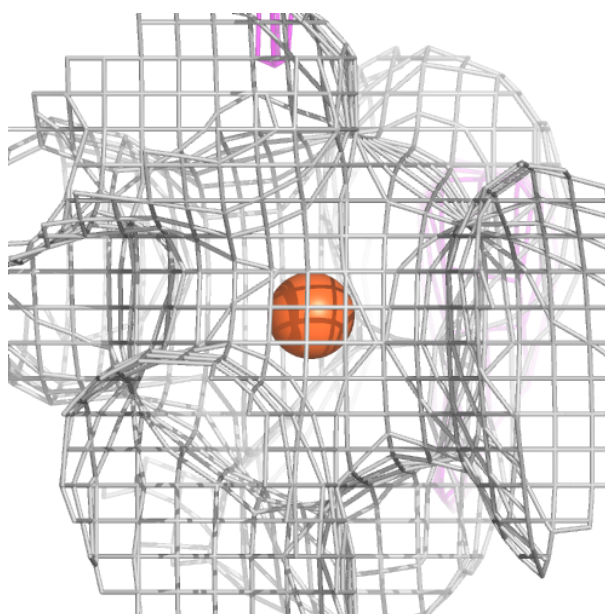
Electron density around FE B 402:

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



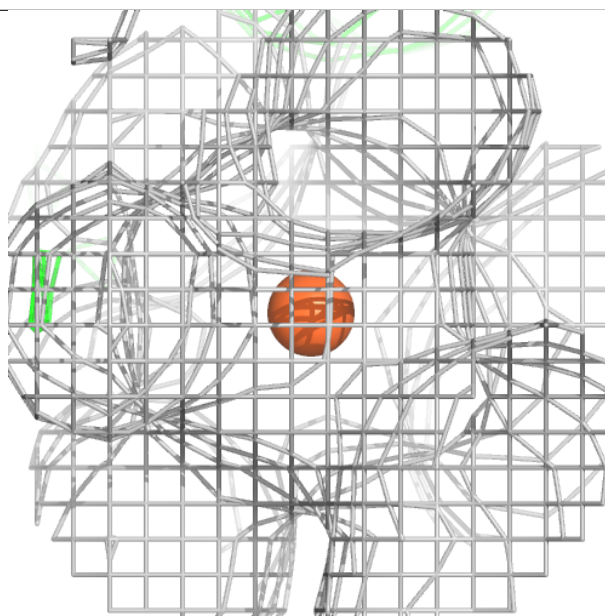
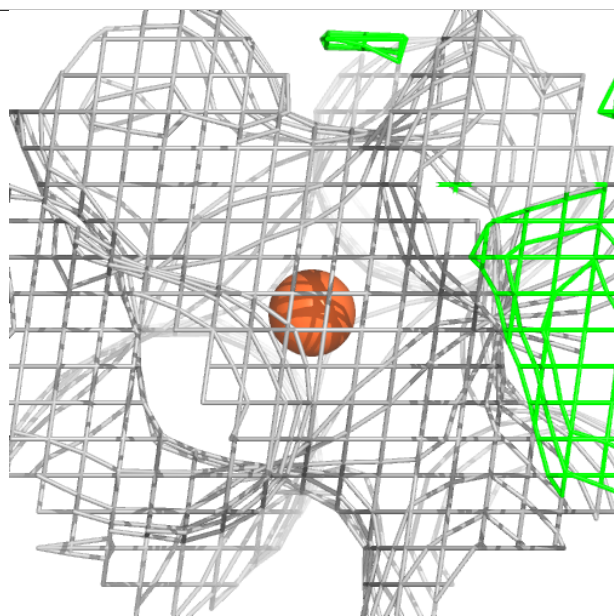
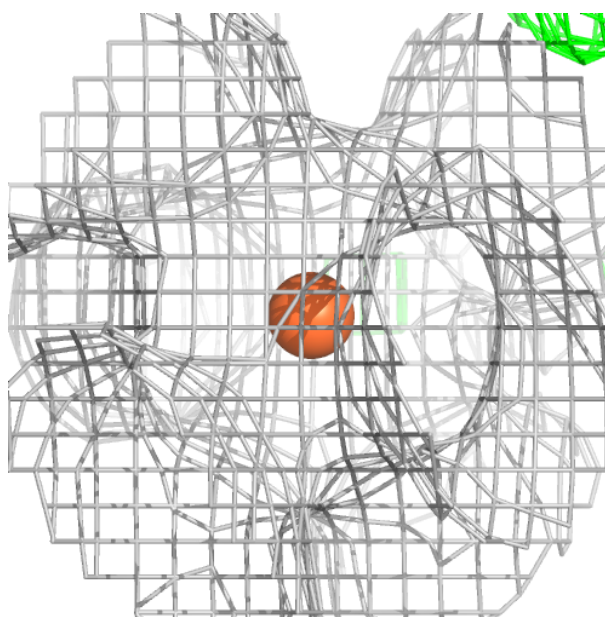
Electron density around FE C 402:

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



Electron density around FE D 404:

$2mF_o-DF_c$ (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.