



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 24, 2021 – 10:08 AM JST

PDB ID : 7ETL  
Title : The crystal structure of FtmOx1-Y68F  
Authors : Zhou, J.H.; Wu, L.  
Deposited on : 2021-05-13  
Resolution : 1.99 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.

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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  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.23.2  
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) : 2.23.2



## 2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 4837 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 Verruculogen synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	294	Total	C	N	O	S	0	0	0
			2319	1472	405	429	13			
1	B	285	Total	C	N	O	S	0	0	0
			2253	1432	395	413	13			

There are 44 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	68	PHE	TYR	engineered mutation	UNP Q4WAW9
A	292	LEU	-	expression tag	UNP Q4WAW9
A	293	GLU	-	expression tag	UNP Q4WAW9
A	294	VAL	-	expression tag	UNP Q4WAW9
A	295	ASP	-	expression tag	UNP Q4WAW9
A	296	LEU	-	expression tag	UNP Q4WAW9
A	297	GLN	-	expression tag	UNP Q4WAW9
A	298	GLY	-	expression tag	UNP Q4WAW9
A	299	ASP	-	expression tag	UNP Q4WAW9
A	300	HIS	-	expression tag	UNP Q4WAW9
A	301	GLY	-	expression tag	UNP Q4WAW9
A	302	LEU	-	expression tag	UNP Q4WAW9
A	303	SER	-	expression tag	UNP Q4WAW9
A	304	ALA	-	expression tag	UNP Q4WAW9
A	305	TRP	-	expression tag	UNP Q4WAW9
A	306	SER	-	expression tag	UNP Q4WAW9
A	307	HIS	-	expression tag	UNP Q4WAW9
A	308	PRO	-	expression tag	UNP Q4WAW9
A	309	GLN	-	expression tag	UNP Q4WAW9
A	310	PHE	-	expression tag	UNP Q4WAW9
A	311	GLU	-	expression tag	UNP Q4WAW9
A	312	LYS	-	expression tag	UNP Q4WAW9
B	68	PHE	TYR	engineered mutation	UNP Q4WAW9
B	292	LEU	-	expression tag	UNP Q4WAW9
B	293	GLU	-	expression tag	UNP Q4WAW9

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Chain	Residue	Modelled	Actual	Comment	Reference
B	294	VAL	-	expression tag	UNP Q4WAW9
B	295	ASP	-	expression tag	UNP Q4WAW9
B	296	LEU	-	expression tag	UNP Q4WAW9
B	297	GLN	-	expression tag	UNP Q4WAW9
B	298	GLY	-	expression tag	UNP Q4WAW9
B	299	ASP	-	expression tag	UNP Q4WAW9
B	300	HIS	-	expression tag	UNP Q4WAW9
B	301	GLY	-	expression tag	UNP Q4WAW9
B	302	LEU	-	expression tag	UNP Q4WAW9
B	303	SER	-	expression tag	UNP Q4WAW9
B	304	ALA	-	expression tag	UNP Q4WAW9
B	305	TRP	-	expression tag	UNP Q4WAW9
B	306	SER	-	expression tag	UNP Q4WAW9
B	307	HIS	-	expression tag	UNP Q4WAW9
B	308	PRO	-	expression tag	UNP Q4WAW9
B	309	GLN	-	expression tag	UNP Q4WAW9
B	310	PHE	-	expression tag	UNP Q4WAW9
B	311	GLU	-	expression tag	UNP Q4WAW9
B	312	LYS	-	expression tag	UNP Q4WAW9

- Molecule 2 is COBALT (II) ION (three-letter code: CO) (formula: Co).

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

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).

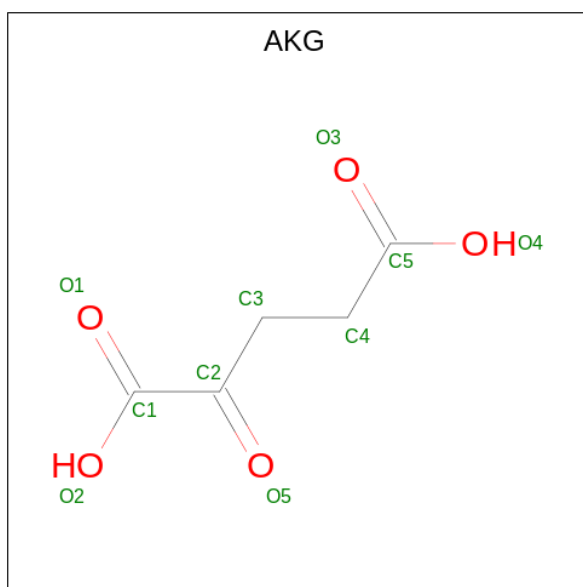


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	S	0	0
			5	4	1		
3	B	1	Total	O	S	0	0
			5	4	1		
3	B	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Cl	0	0
			1	1		

- Molecule 5 is 2-OXOGLUTARIC ACID (three-letter code: AKG) (formula: C<sub>5</sub>H<sub>6</sub>O<sub>5</sub>) (labeled as "Ligand of Interest" by depositor).

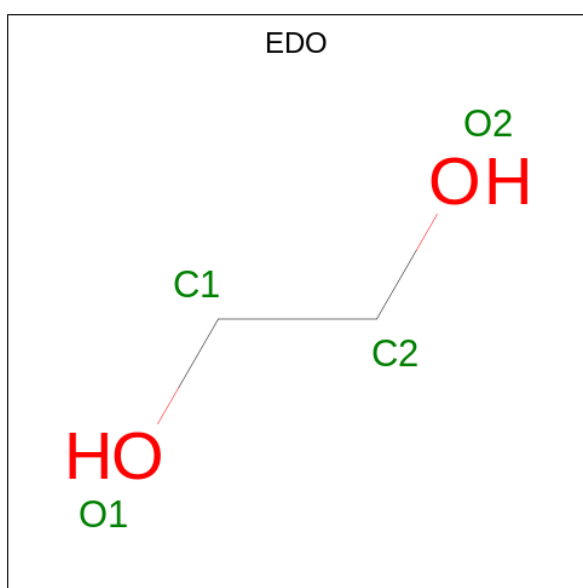


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			10	5	5		

- Molecule 6 is FE (II) ION (three-letter code: FE2) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	B	1	Total	Fe	0	0
			1	1		

- Molecule 7 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>).



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

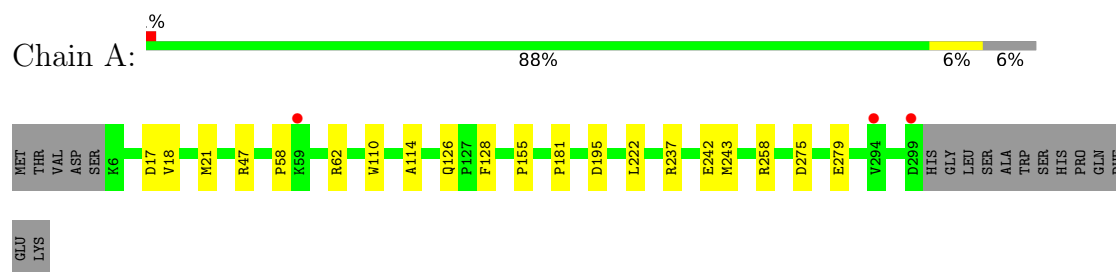
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	129	Total	O	0	0
			129	129		
8	B	103	Total	O	0	0
			103	103		

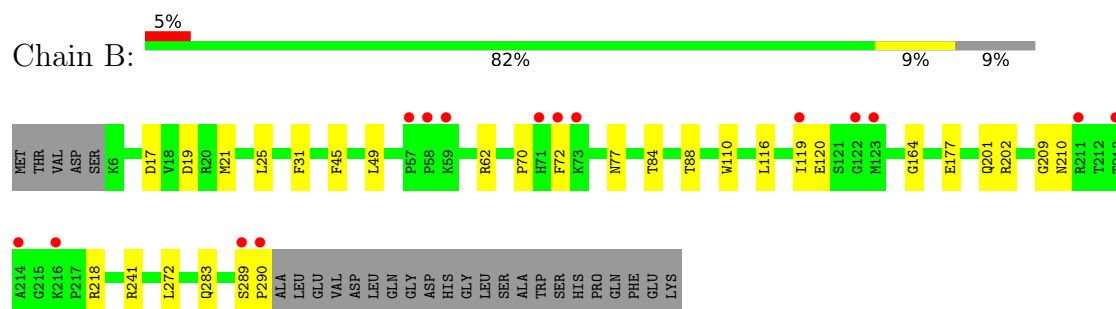
### 3 Residue-property plots [i](#)

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: Verruculogen synthase



- Molecule 1: Verruculogen synthase





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	60.25Å 45.38Å 104.96Å 90.00° 100.26° 90.00°	Depositor
Resolution (Å)	27.71 – 1.99 47.87 – 1.99	Depositor EDS
% Data completeness (in resolution range)	94.3 (27.71-1.99) 94.3 (47.87-1.99)	Depositor EDS
$R_{merge}$	0.17	Depositor
$R_{sym}$	0.17	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.79 (at 2.00Å)	Xtriage
Refinement program	PHENIX 1.11.1_2575	Depositor
R, $R_{free}$	0.171 , 0.220 0.172 , 0.220	Depositor DCC
$R_{free}$ test set	1859 reflections (5.10%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	25.5	Xtriage
Anisotropy	0.035	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.41 , 52.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	4837	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.00% 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: SO4, CO, CL, EDO, FE2, AKG

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	0.38	0/2375	0.56	0/3235
1	B	0.35	0/2309	0.54	0/3145
All	All	0.37	0/4684	0.55	0/6380

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	2319	0	2307	13	0
1	B	2253	0	2246	15	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	5	0	0	0	0
3	B	10	0	0	1	0
4	A	1	0	0	0	0
5	A	10	0	4	1	0
6	B	1	0	0	0	0
7	B	4	0	6	0	0
8	A	129	0	0	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
8	B	103	0	0	0	0
All	All	4837	0	4563	28	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.

All (28) 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:126:GLN:NE2	8:A:502:HOH:O	2.19	0.76
5:A:404:AKG:O3	8:A:501:HOH:O	2.18	0.55
1:A:237:ARG:NH2	8:A:506:HOH:O	2.34	0.52
1:B:120:GLU:O	1:B:210:ASN:HB3	2.13	0.47
1:B:49:LEU:HD13	1:B:116:LEU:HD12	1.96	0.47
1:B:164:GLY:HA3	1:B:209:GLY:O	2.14	0.47
1:A:18:VAL:HA	1:A:21:MET:CE	2.45	0.46
1:B:177:GLU:HB2	3:B:403:SO4:O4	2.14	0.46
1:A:114:ALA:HA	1:A:222:LEU:O	2.16	0.46
1:A:155:PRO:HD2	1:A:195:ASP:O	2.15	0.45
1:A:242:GLU:HG3	1:A:243:MET:N	2.33	0.44
1:B:17:ASP:OD2	1:B:19:ASP:HB2	2.19	0.43
1:B:62:ARG:HA	1:B:62:ARG:HD3	1.73	0.43
1:B:119:ILE:HG13	1:B:218:ARG:NH2	2.33	0.43
1:A:128:PHE:CD2	1:A:181:PRO:HG2	2.53	0.43
1:B:25:LEU:HD23	1:B:25:LEU:HA	1.80	0.43
1:B:70:PRO:C	1:B:72:PHE:H	2.22	0.43
1:B:201:GLN:O	1:B:202:ARG:HB2	2.19	0.43
1:A:17:ASP:OD1	8:A:503:HOH:O	2.21	0.42
1:A:47:ARG:HH11	1:A:47:ARG:HG3	1.84	0.42
1:B:21:MET:HB3	1:B:31:PHE:CZ	2.54	0.42
1:A:275:ASP:HB3	1:B:62:ARG:HD2	2.01	0.42
1:A:58:PRO:HG3	1:A:62:ARG:CZ	2.50	0.41
1:A:18:VAL:HA	1:A:21:MET:HE3	2.02	0.41
1:A:258:ARG:HG2	1:A:279:GLU:HB3	2.03	0.41
1:B:241:ARG:NH2	1:B:283:GLN:O	2.54	0.41
1:B:289:SER:HA	1:B:290:PRO:HD2	1.68	0.40
1:B:84:THR:O	1:B:88:THR:HB	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	292/312 (94%)	287 (98%)	5 (2%)	0	100	100
1	B	283/312 (91%)	277 (98%)	6 (2%)	0	100	100
All	All	575/624 (92%)	564 (98%)	11 (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	254/270 (94%)	253 (100%)	1 (0%)	91	93
1	B	247/270 (92%)	243 (98%)	4 (2%)	62	67
All	All	501/540 (93%)	496 (99%)	5 (1%)	76	81

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	110	TRP
1	B	45	PHE
1	B	77	ASN
1	B	110	TRP
1	B	272	LEU

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

### 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 monosaccharides in this entry.

## 5.6 Ligand geometry ⓘ

Of 9 ligands modelled in this entry, 4 are monoatomic - leaving 5 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	$\# Z  > 2$
3	SO4	A	402	-	4,4,4	0.16	0	6,6,6	0.16	0
5	AKG	A	404	2	3,9,9	0.10	0	4,11,11	2.36	1 (25%)
7	EDO	B	406	-	3,3,3	0.51	0	2,2,2	0.33	0
3	SO4	B	403	-	4,4,4	0.18	0	6,6,6	0.12	0
3	SO4	B	402	-	4,4,4	0.18	0	6,6,6	0.20	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	AKG	A	404	2	-	0/3/9/9	-
7	EDO	B	406	-	-	0/1/1/1	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	404	AKG	C3-C4-C5	-4.63	104.89	112.67

There are no chirality outliers.

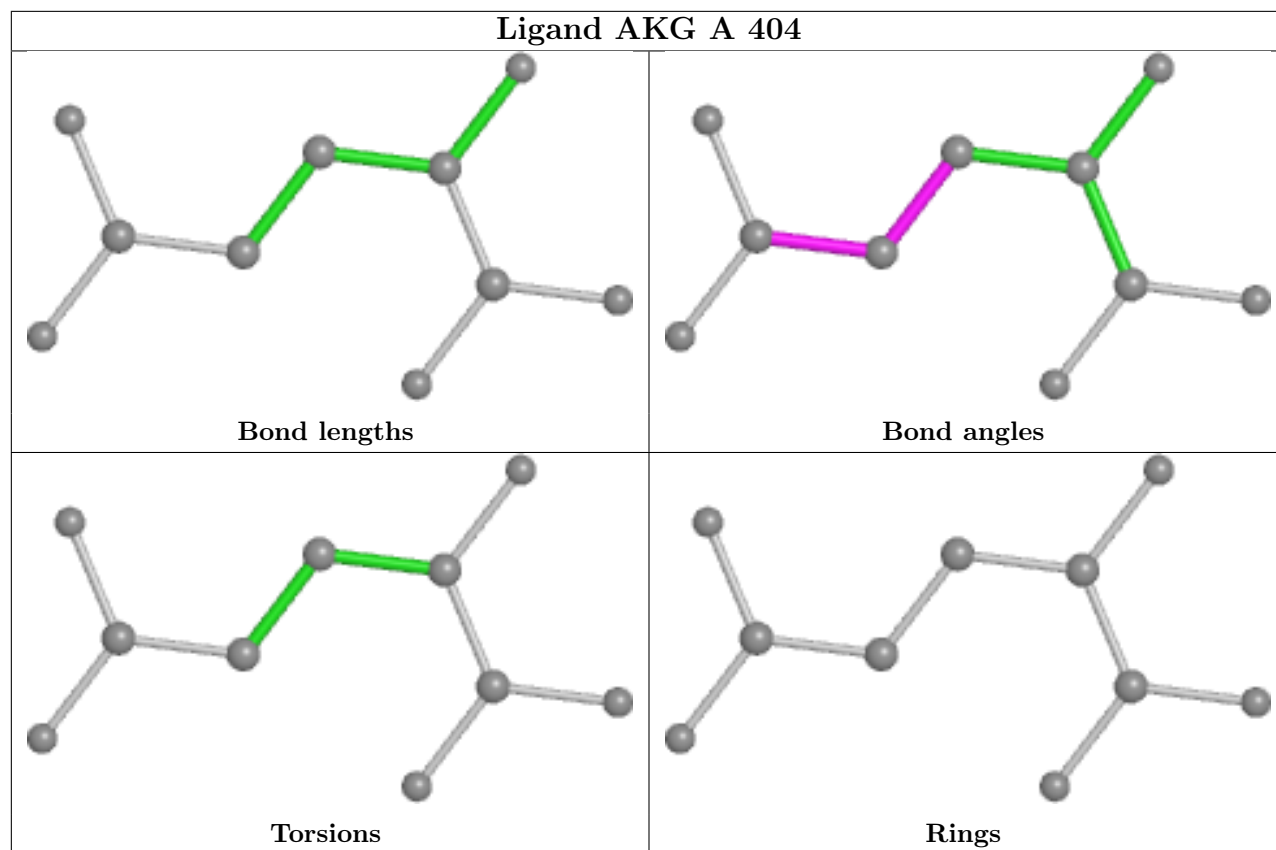
There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	404	AKG	1	0
3	B	403	SO4	1	0

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, 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	294/312 (94%)	-0.16	3 (1%) 82 81	12, 21, 39, 60	0
1	B	285/312 (91%)	0.02	15 (5%) 26 25	12, 26, 56, 71	0
All	All	579/624 (92%)	-0.08	18 (3%) 49 48	12, 23, 49, 71	0

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	57	PRO	5.2
1	B	290	PRO	5.1
1	A	59	LYS	4.7
1	B	289	SER	3.1
1	B	214	ALA	2.7
1	B	211	ARG	2.7
1	B	72	PHE	2.6
1	A	299	ASP	2.6
1	B	213	THR	2.5
1	B	122	GLY	2.5
1	B	123	MET	2.5
1	B	71	HIS	2.3
1	B	216	LYS	2.2
1	B	58	PRO	2.2
1	B	119	ILE	2.1
1	B	73	LYS	2.1
1	A	294	VAL	2.1
1	B	59	LYS	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](#)

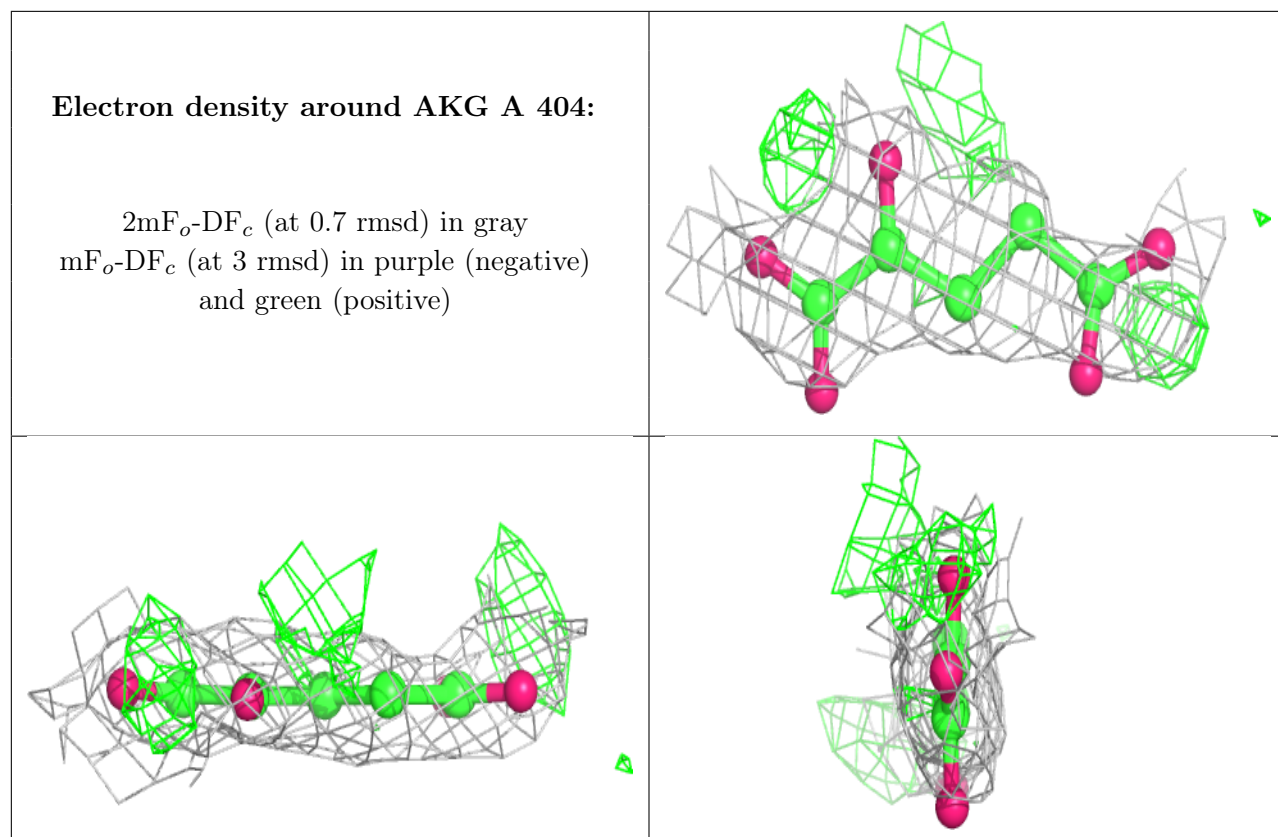
There are no monosaccharides in this entry.

### 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( $\text{\AA}^2$ )	Q<0.9
5	AKG	A	404	10/10	0.82	0.28	24,29,34,35	10
7	EDO	B	406	4/4	0.87	0.12	35,35,36,41	0
3	SO4	B	403	5/5	0.93	0.20	50,52,59,61	0
4	CL	A	403	1/1	0.96	0.08	48,48,48,48	0
3	SO4	A	402	5/5	0.97	0.17	46,59,64,64	0
3	SO4	B	402	5/5	0.98	0.13	36,37,42,43	0
6	FE2	B	404	1/1	0.99	0.08	28,28,28,28	0
2	CO	B	401	1/1	0.99	0.14	33,33,33,33	0
2	CO	A	401	1/1	1.00	0.13	22,22,22,22	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.



## 6.5 Other polymers [i](#)

There are no such residues in this entry.