



# Full wwPDB X-ray Structure Validation Report ⓘ

Dec 10, 2023 – 09:34 pm GMT

PDB ID : 7AV4  
Title : Dark state structure of the C432S mutant of Fatty Acid Photodecarboxylase (FAP)  
Authors : Schlichting, I.; Hartmann, E.; Arnoux, P.; Sorigue, D.; Beisson, F.  
Deposited on : 2020-11-04  
Resolution : 1.94 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  
Mogul : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
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) : 2.36

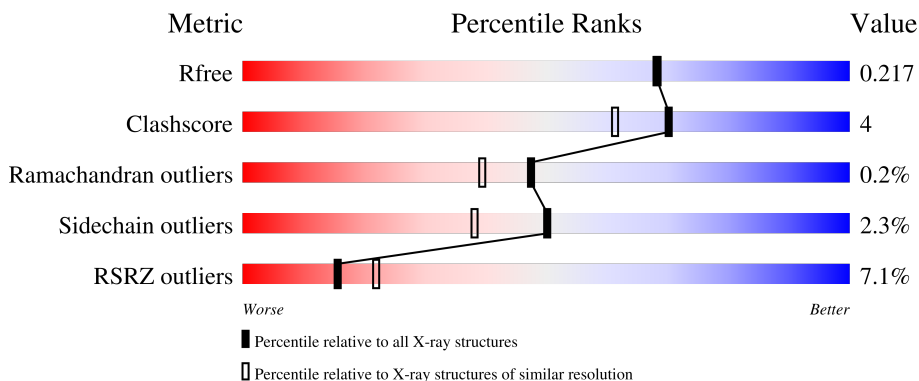
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.94 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	4310 (1.96-1.92)
Clashscore	141614	1023 (1.94-1.94)
Ramachandran outliers	138981	1007 (1.94-1.94)
Sidechain outliers	138945	1007 (1.94-1.94)
RSRZ outliers	127900	4250 (1.96-1.92)

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	AAA	654	

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 4714 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.

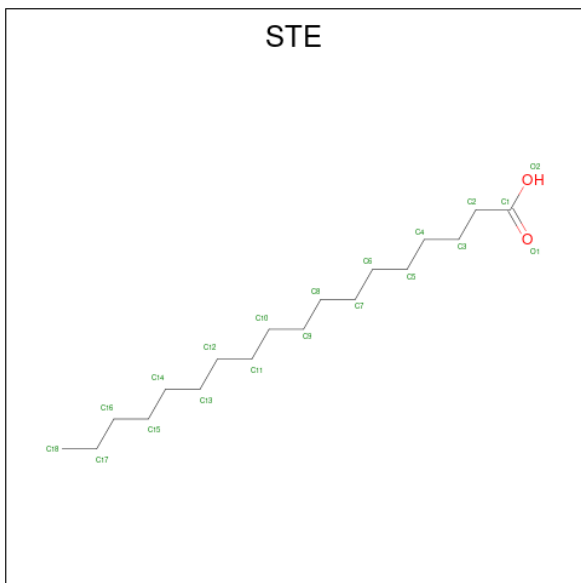
- Molecule 1 is a protein called Fatty acid photodecarboxylase, chloroplastic.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	AAA	567	4272	2673	764	821	14	0	7	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
AAA	432	SER	CYS	engineered mutation	UNP A0A248QE08

- Molecule 2 is STEARIC ACID (three-letter code: STE) (formula:  $C_{18}H_{36}O_2$ ) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	AAA	1	Total	C	O	0	0
			20	18	2		
2	AAA	1	Total	C	O	0	0
			20	18	2		

- Molecule 3 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula:  $C_{27}H_{33}N_9O_{15}P_2$ ) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
3	AAA	1	53	27	9	15	2	0	0

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
4	AAA	1	6	3	3	0	0

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	AAA	1	Total	C	O	0	0
			6	3	3		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	AAA	337	Total	O	0	0
			337	337		



## 4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	93.38Å 104.68Å 156.18Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.73 – 1.94 46.69 – 1.94	Depositor EDS
% Data completeness (in resolution range)	99.4 (46.73-1.94) 99.4 (46.69-1.94)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.30 (at 1.94Å)	Xtrriage
Refinement program	REFMAC 5.8.0258	Depositor
R, $R_{free}$	0.175 , 0.212 0.184 , 0.217	Depositor DCC
$R_{free}$ test set	2809 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	39.9	Xtrriage
Anisotropy	0.399	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 44.8	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	0.97	EDS
Total number of atoms	4714	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	39.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.09% 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: FAD, STE, GOL

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	AAA	0.73	0/4374	0.87	2/5933 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	AAA	0	1

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	AAA	135	ARG	NE-CZ-NH1	5.61	123.11	120.30
1	AAA	539	ARG	NE-CZ-NH2	-5.45	117.58	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	AAA	309	LYS	Peptide

### 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	AAA	4272	0	4225	31	0
2	AAA	40	0	70	2	0
3	AAA	53	0	31	3	0
4	AAA	12	0	16	2	0
5	AAA	337	0	0	3	0
All	All	4714	0	4342	31	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.

All (31) 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:AAA:304:ASP:HB2	1:AAA:313:LEU:HD11	1.60	0.82
1:AAA:170:ASN:HB2	3:AAA:703:FAD:C5X	2.26	0.65
1:AAA:270:LYS:NZ	5:AAA:801:HOH:O	2.32	0.62
1:AAA:420:LEU:HD21	2:AAA:702:STE:H51	1.82	0.61
1:AAA:383:PRO:HB2	1:AAA:571:ILE:HD11	1.83	0.60
1:AAA:620:GLN:HB3	3:AAA:703:FAD:C2	2.40	0.52
1:AAA:358:SER:HB2	1:AAA:368:VAL:HG21	1.91	0.52
1:AAA:303:ILE:HG21	1:AAA:369:VAL:HG11	1.92	0.50
1:AAA:126:ILE:HD11	2:AAA:702:STE:H42	1.94	0.49
1:AAA:615:LYS:HD3	5:AAA:1088:HOH:O	2.12	0.49
1:AAA:406:ASN:HD21	1:AAA:410:GLN:HB2	1.78	0.48
1:AAA:615:LYS:CD	5:AAA:1088:HOH:O	2.63	0.47
1:AAA:203:GLU:OE1	1:AAA:214:HIS:HA	2.16	0.46
1:AAA:384:ALA:HA	1:AAA:487:LEU:O	2.16	0.46
1:AAA:135:ARG:HG3	4:AAA:704:GOL:O1	2.17	0.45
1:AAA:170:ASN:HB2	3:AAA:703:FAD:C9A	2.46	0.45
1:AAA:345:HIS:CD2	4:AAA:705:GOL:H12	2.52	0.45
1:AAA:607:VAL:HG11	1:AAA:611[B]:SER:OG	2.17	0.45
1:AAA:379:LEU:C	1:AAA:379:LEU:HD23	2.38	0.44
1:AAA:593:VAL:HA	1:AAA:598:ARG:O	2.16	0.44
1:AAA:407:GLU:HA	1:AAA:478:LYS:HG2	2.00	0.44
1:AAA:282:LYS:N	1:AAA:283:PRO:CD	2.79	0.44
1:AAA:277:TYR:CE2	1:AAA:282:LYS:HD3	2.53	0.43
1:AAA:404:ILE:O	1:AAA:411:ILE:HA	2.18	0.43
1:AAA:354:GLY:HA2	1:AAA:361:LEU:HD13	2.00	0.43
1:AAA:377:GLN:O	1:AAA:580:THR:HA	2.18	0.43
1:AAA:553:PRO:HB2	1:AAA:557:VAL:HB	2.00	0.43
1:AAA:298:VAL:HG13	1:AAA:315:VAL:HG13	2.02	0.42
1:AAA:406:ASN:ND2	1:AAA:410:GLN:HB2	2.34	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:AAA:450:VAL:HG21	1:AAA:533:TRP:CZ3	2.56	0.40
1:AAA:272[B]:THR:HG22	1:AAA:419:TYR:OH	2.22	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	AAA	572/654 (88%)	546 (96%)	25 (4%)	1 (0%)	47 39

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	AAA	577	ILE

### 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	AAA	444/495 (90%)	433 (98%)	11 (2%)	47 35

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	AAA	82	GLN

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Mol	Chain	Res	Type
1	AAA	148	GLU
1	AAA	234	THR
1	AAA	272[A]	THR
1	AAA	272[B]	THR
1	AAA	408	LYS
1	AAA	414	ARG
1	AAA	465	THR
1	AAA	502	SER
1	AAA	519	LYS
1	AAA	582	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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

5 ligands are modelled in this entry.

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	STE	AAA	702	-	19,19,19	0.44	0	19,19,19	1.14	1 (5%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
4	GOL	AAA	704	-	5,5,5	0.22	0	5,5,5	0.47	0
2	STE	AAA	701	-	19,19,19	0.58	0	19,19,19	1.49	5 (26%)
4	GOL	AAA	705	-	5,5,5	0.22	0	5,5,5	0.43	0
3	FAD	AAA	703	-	53,58,58	0.65	0	68,89,89	0.83	1 (1%)

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	STE	AAA	702	-	-	10/17/17/17	-
4	GOL	AAA	704	-	-	2/4/4/4	-
2	STE	AAA	701	-	-	9/17/17/17	-
4	GOL	AAA	705	-	-	4/4/4/4	-
3	FAD	AAA	703	-	-	2/30/50/50	0/6/6/6

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	AAA	701	STE	O1-C1-C2	-2.72	114.33	123.08
2	AAA	701	STE	O2-C1-C2	2.61	122.40	114.03
2	AAA	701	STE	C5-C4-C3	-2.57	101.39	114.42
2	AAA	701	STE	C6-C5-C4	2.52	127.22	114.42
3	AAA	703	FAD	O4B-C1B-C2B	-2.43	103.38	106.93
2	AAA	702	STE	C3-C2-C1	-2.38	108.47	114.47
2	AAA	701	STE	C14-C13-C12	-2.18	103.37	114.42

There are no chirality outliers.

All (27) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	AAA	704	GOL	O1-C1-C2-C3
4	AAA	705	GOL	C1-C2-C3-O3
4	AAA	705	GOL	O2-C2-C3-O3
2	AAA	702	STE	C1-C2-C3-C4
2	AAA	701	STE	C5-C6-C7-C8
4	AAA	705	GOL	O1-C1-C2-C3

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Mol	Chain	Res	Type	Atoms
2	AAA	701	STE	C12-C13-C14-C15
2	AAA	702	STE	C12-C13-C14-C15
4	AAA	704	GOL	O1-C1-C2-O2
4	AAA	705	GOL	O1-C1-C2-O2
2	AAA	701	STE	C9-C10-C11-C12
2	AAA	702	STE	C7-C8-C9-C10
2	AAA	702	STE	C11-C10-C9-C8
2	AAA	701	STE	C13-C14-C15-C16
2	AAA	701	STE	C4-C5-C6-C7
3	AAA	703	FAD	PA-O3P-P-O5'
2	AAA	701	STE	C15-C16-C17-C18
2	AAA	702	STE	C14-C15-C16-C17
3	AAA	703	FAD	O4B-C4B-C5B-O5B
2	AAA	702	STE	C5-C6-C7-C8
2	AAA	701	STE	O1-C1-C2-C3
2	AAA	701	STE	C6-C7-C8-C9
2	AAA	702	STE	O2-C1-C2-C3
2	AAA	702	STE	O1-C1-C2-C3
2	AAA	701	STE	O2-C1-C2-C3
2	AAA	702	STE	C6-C7-C8-C9
2	AAA	702	STE	C3-C4-C5-C6

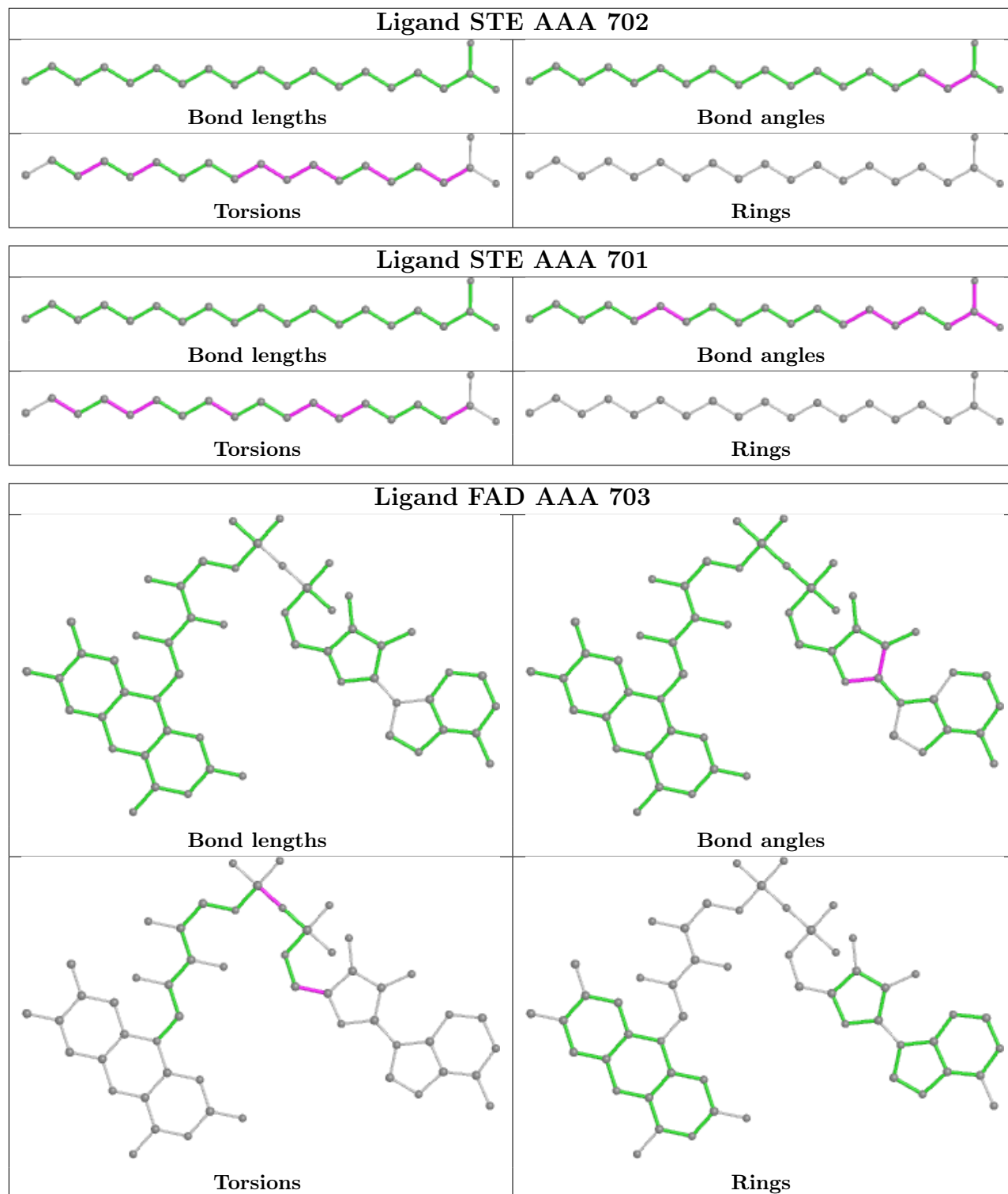
There are no ring outliers.

4 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	AAA	702	STE	2	0
4	AAA	704	GOL	1	0
4	AAA	705	GOL	1	0
3	AAA	703	FAD	3	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

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<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	AAA	567/654 (86%)	0.47	40 (7%) <b>16</b> <b>22</b>	28, 36, 57, 100	0

All (40) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	AAA	307	ALA	8.7
1	AAA	306	ALA	5.8
1	AAA	308	GLY	5.2
1	AAA	320	ASP	5.1
1	AAA	323	THR	5.0
1	AAA	79	VAL	4.7
1	AAA	77	SER	4.3
1	AAA	78	PRO	4.2
1	AAA	81	GLY	4.2
1	AAA	288	ARG	4.0
1	AAA	519	LYS	3.8
1	AAA	477	LEU	3.6
1	AAA	332	ALA	3.5
1	AAA	80	ALA	3.5
1	AAA	407	GLU	3.4
1	AAA	286	GLY	3.3
1	AAA	393	GLU	3.2
1	AAA	625	VAL	3.1
1	AAA	107	SER	3.0
1	AAA	408	LYS	2.9
1	AAA	309	LYS	2.7
1	AAA	105	ASP	2.6
1	AAA	478	LYS	2.6
1	AAA	82	GLN	2.6
1	AAA	479	TRP	2.6
1	AAA	321	GLY	2.5
1	AAA	325	GLU	2.5

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Mol	Chain	Res	Type	RSRZ
1	AAA	626	VAL	2.4
1	AAA	331	LEU	2.4
1	AAA	520	ASP	2.3
1	AAA	628	ILE	2.3
1	AAA	475	GLN	2.3
1	AAA	304	ASP	2.3
1	AAA	421	LEU	2.2
1	AAA	338[A]	ILE	2.2
1	AAA	333	PRO	2.1
1	AAA	106	GLY	2.1
1	AAA	152	GLU	2.1
1	AAA	610	ALA	2.1
1	AAA	607	VAL	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](#)

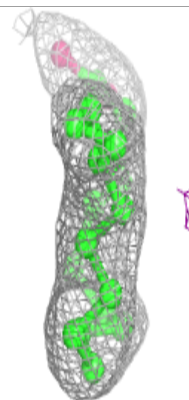
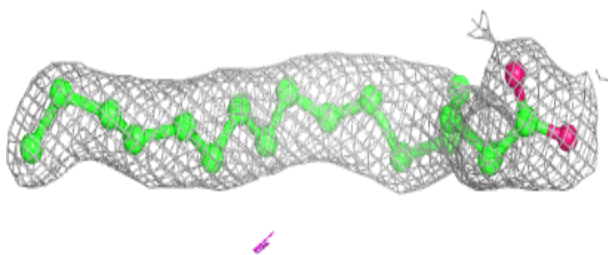
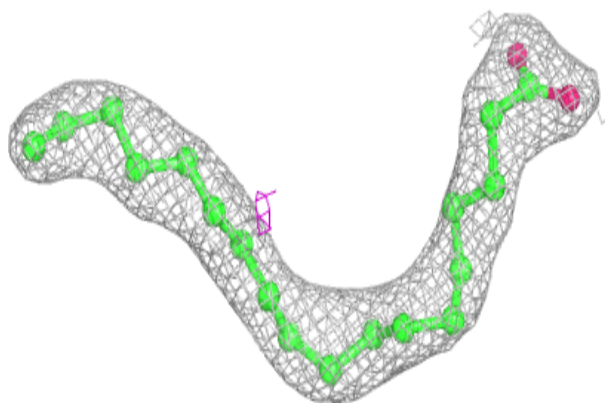
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 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
4	GOL	AAA	704	6/6	0.90	0.18	41,54,62,71	0
2	STE	AAA	702	20/20	0.92	0.14	48,55,62,67	0
4	GOL	AAA	705	6/6	0.93	0.14	47,53,60,64	0
2	STE	AAA	701	20/20	0.94	0.14	30,40,46,47	0
3	FAD	AAA	703	53/53	0.96	0.14	27,30,35,35	0

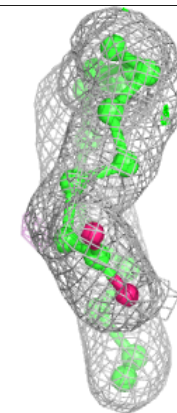
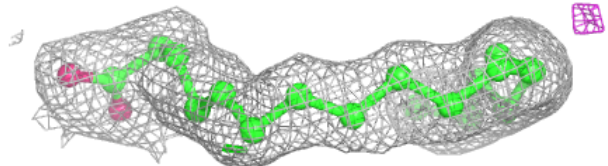
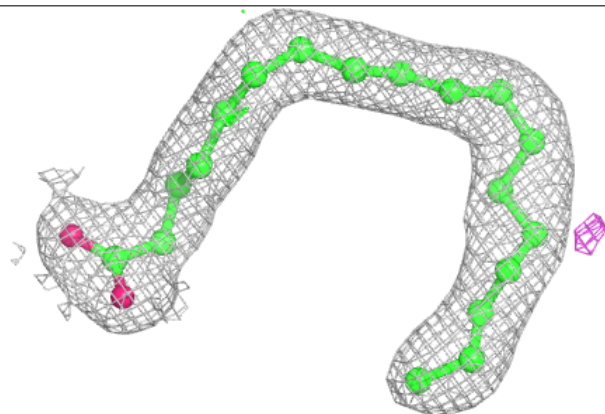
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

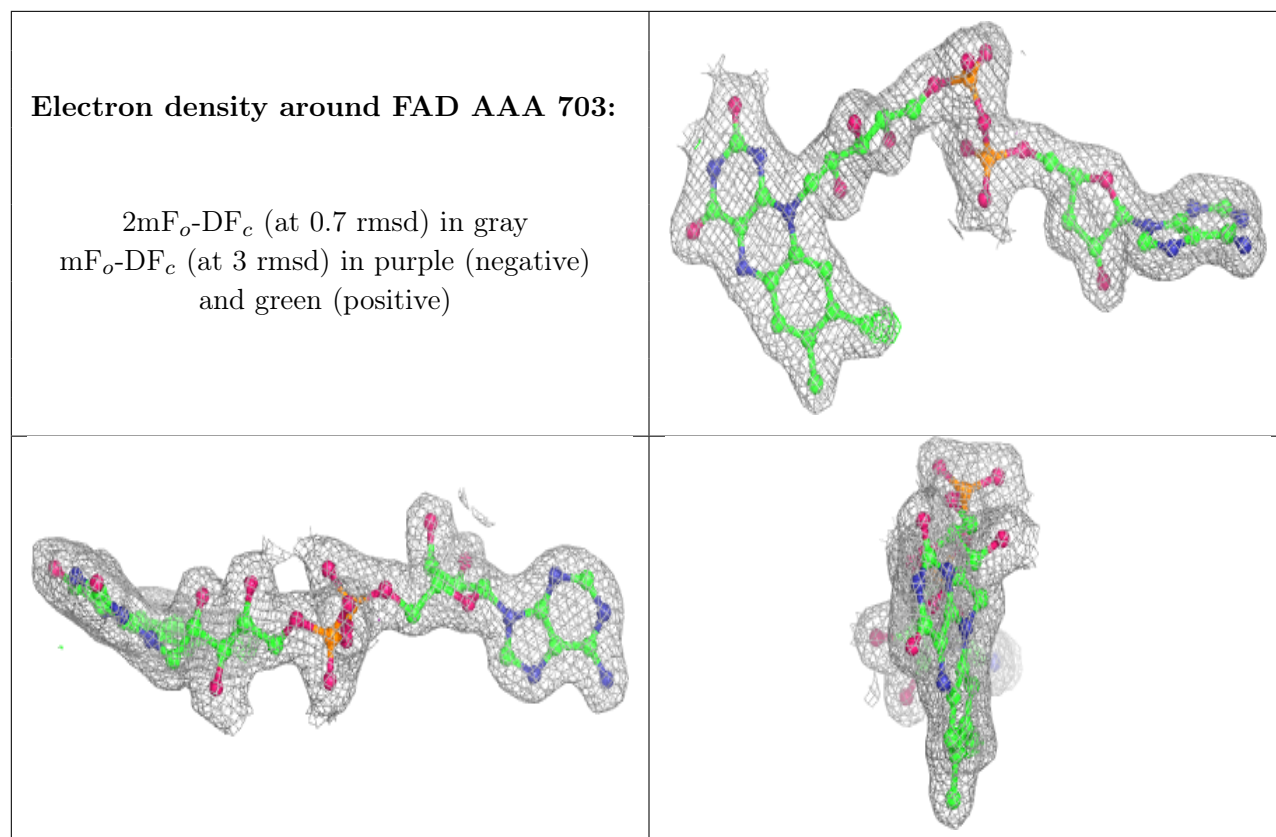
**Electron density around STE AAA 702:**

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

**Electron density around STE AAA 701:**

$2mF_o-DF_c$  (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.