



# Full wwPDB X-ray Structure Validation Report ⓘ

May 21, 2020 – 10:14 pm BST

PDB ID : 5BQA  
Title : Structure of the yeast F1FO ATPase C10 ring with oligomycin C  
Authors : Symersky, J.; Xu, T.; Mueller, D.M.  
Deposited on : 2015-05-28  
Resolution : 2.10 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 : 2.11  
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) : 2.11

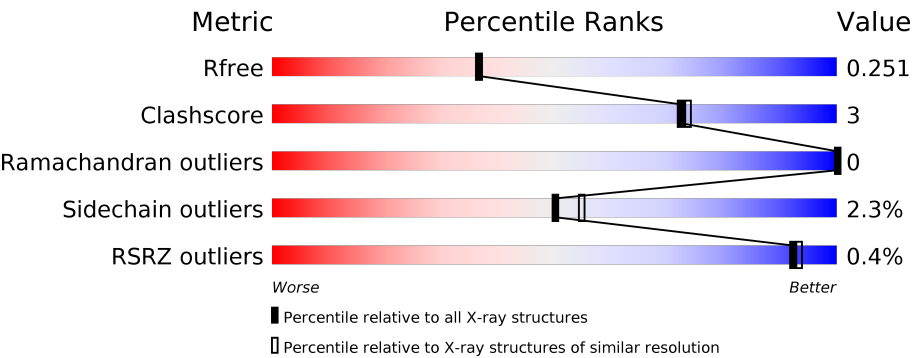
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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 on 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	76	<div><div>%</div><div><div></div><div>91%</div><div>5%</div><div>••</div></div></div>
1	B	76	<div><div></div><div>89%</div><div>9%</div><div>•</div></div>
1	C	76	<div><div></div><div>91%</div><div>8%</div><div>•</div></div>
1	D	76	<div><div></div><div>91%</div><div>7%</div><div>•</div></div>
1	E	76	<div><div></div><div>92%</div><div>5%</div><div>•</div></div>
1	K	76	<div><div></div><div>91%</div><div>5%</div><div>••</div></div>

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Mol	Chain	Length	Quality of chain
1	L	76	<div><div><div>%</div><div><div></div><div></div><div></div></div><div>89%</div><div>9%</div><div></div></div></div>
1	M	76	<div><div><div>%</div><div><div></div><div></div><div></div></div><div>88%</div><div>8%</div><div></div></div></div>
1	N	76	<div><div><div></div><div></div><div></div></div><div>93%</div><div></div><div></div></div>
1	O	76	<div><div><div></div><div></div><div></div></div><div>96%</div><div></div><div></div></div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5971 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 ATP synthase subunit 9, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	74	Total	C	N	O	S	0	3	0
			545	365	82	95	3			
1	B	75	Total	C	N	O	S	0	3	0
			549	367	83	96	3			
1	C	75	Total	C	N	O	S	0	3	0
			550	368	83	96	3			
1	D	74	Total	C	N	O	S	0	3	0
			549	367	83	96	3			
1	E	74	Total	C	N	O	S	0	3	0
			546	366	82	95	3			
1	K	75	Total	C	N	O	S	0	3	0
			546	364	83	96	3			
1	L	75	Total	C	N	O	S	0	3	0
			545	364	82	96	3			
1	M	75	Total	C	N	O	S	0	3	0
			537	355	83	96	3			
1	N	75	Total	C	N	O	S	0	3	0
			552	369	83	96	4			
1	O	75	Total	C	N	O	S	0	3	0
			550	368	83	96	3			

There are 10 discrepancies between the modelled and reference sequences:

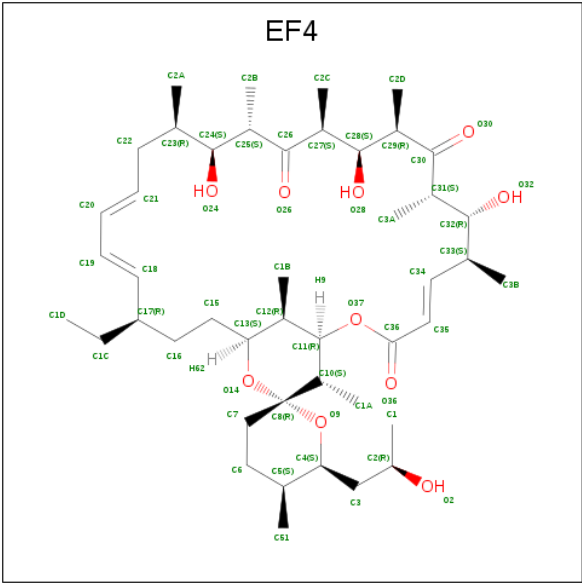
Chain	Residue	Modelled	Actual	Comment	Reference
A	1	FME	-	initiating methionine	UNP P61829
B	1	FME	-	initiating methionine	UNP P61829
C	1	FME	-	initiating methionine	UNP P61829
D	1	FME	-	initiating methionine	UNP P61829
E	1	FME	-	initiating methionine	UNP P61829
K	1	FME	-	initiating methionine	UNP P61829
L	1	FME	-	initiating methionine	UNP P61829
M	1	FME	-	initiating methionine	UNP P61829
N	1	FME	-	initiating methionine	UNP P61829

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Chain	Residue	Modelled	Actual	Comment	Reference
O	1	FME	-	initiating methionine	UNP P61829

- Molecule 2 is oligomycin C (three-letter code: EF4) (formula: C<sub>45</sub>H<sub>74</sub>O<sub>10</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 55 45 10	0	0
2	B	1	Total C O 55 45 10	0	0
2	B	1	Total C O 55 45 10	0	0
2	E	1	Total C O 55 45 10	0	0
2	L	1	Total C O 55 45 10	0	0
2	M	1	Total C O 55 45 10	0	0
2	O	1	Total C O 55 45 10	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	13	Total O 13 13	0	0
3	B	11	Total O 11 11	0	0

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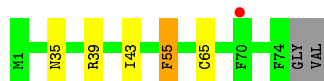
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	C	11	Total 11	O 11	0	0
3	D	12	Total 12	O 12	0	0
3	E	13	Total 13	O 13	0	0
3	K	10	Total 10	O 10	0	0
3	L	12	Total 12	O 12	0	0
3	M	12	Total 12	O 12	0	0
3	N	7	Total 7	O 7	0	0
3	O	16	Total 16	O 16	0	0

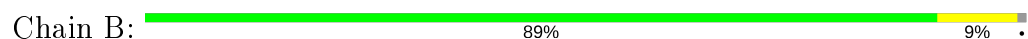
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: ATP synthase subunit 9, mitochondrial



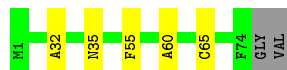
- Molecule 1: ATP synthase subunit 9, mitochondrial



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- Molecule 1: ATP synthase subunit 9, mitochondrial

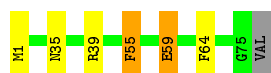


- Molecule 1: ATP synthase subunit 9, mitochondrial

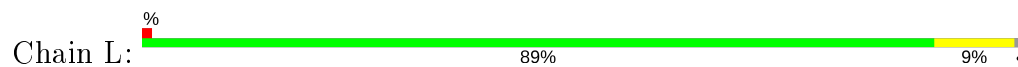


- Molecule 1: ATP synthase subunit 9, mitochondrial

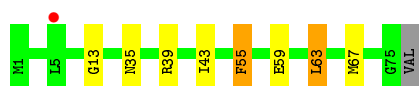
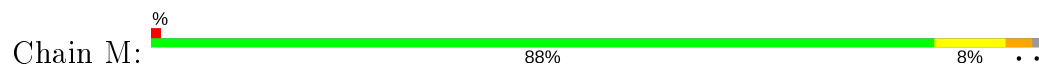




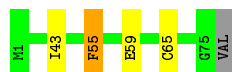
- Molecule 1: ATP synthase subunit 9, mitochondrial



- Molecule 1: ATP synthase subunit 9, mitochondrial



- Molecule 1: ATP synthase subunit 9, mitochondrial



- Molecule 1: ATP synthase subunit 9, mitochondrial





## 4 Data and refinement statistics

Property	Value	Source
Space group	I 41 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	76.07Å 76.07Å 488.49Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.10 49.22 – 2.10	Depositor EDS
% Data completeness (in resolution range)	99.1 (50.00-2.10) 99.2 (49.22-2.10)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.96 (at 2.10Å)	Xtriage
Refinement program	REFMAC 5.6.0117	Depositor
R, $R_{free}$	0.203 , 0.250 0.203 , 0.251	Depositor DCC
$R_{free}$ test set	2144 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	26.4	Xtriage
Anisotropy	0.386	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 73.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.52$ , $\langle L^2 \rangle = 0.36$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5971	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	33.0	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 23.70 % 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 4.4242e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: FME, EF4

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	0.48	0/561	0.57	0/760
1	B	0.51	0/565	0.55	0/765
1	C	0.52	0/565	0.58	0/765
1	D	0.51	0/565	0.54	0/765
1	E	0.50	0/561	0.57	0/760
1	K	0.51	0/562	0.56	0/761
1	L	0.48	0/561	0.56	0/761
1	M	0.49	0/551	0.63	0/747
1	N	0.51	0/565	0.56	0/765
1	O	0.50	0/565	0.57	0/765
All	All	0.50	0/5621	0.57	0/7614

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	C	0	1
1	K	0	1
1	L	0	1
1	O	0	1
All	All	0	4

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	1	FME	Mainchain
1	K	1	FME	Mainchain
1	L	1	FME	Mainchain
1	O	1	FME	Mainchain

## 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	545	0	591	5	0
1	B	549	0	594	6	0
1	C	550	0	596	4	0
1	D	549	0	597	4	0
1	E	546	0	593	2	0
1	K	546	0	585	4	0
1	L	545	0	583	8	0
1	M	537	0	580	7	0
1	N	552	0	601	4	0
1	O	550	0	596	0	0
2	A	55	0	74	0	0
2	B	110	0	148	6	0
2	E	55	0	74	1	0
2	L	55	0	74	4	0
2	M	55	0	74	1	0
2	O	55	0	74	0	0
3	A	13	0	0	2	0
3	B	11	0	0	0	0
3	C	11	0	0	0	0
3	D	12	0	0	1	0
3	E	13	0	0	0	0
3	K	10	0	0	2	0
3	L	12	0	0	2	0
3	M	12	0	0	2	0
3	N	7	0	0	0	0
3	O	16	0	0	0	0
All	All	5971	0	6434	42	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 (42) 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:L:63:LEU:HB2	2:L:101:EF4:O2	1.92	0.70
1:D:35[B]:ASN:ND2	3:D:101:HOH:O	2.35	0.59
2:B:101:EF4:H18	2:B:102:EF4:H56	1.83	0.59
1:B:60:ALA:CB	2:B:101:EF4:O36	2.54	0.56
1:E:8:LYS:HE2	1:E:72:LEU:O	2.06	0.55
1:A:39:ARG:HD2	3:A:201:HOH:O	2.07	0.54
1:C:35[B]:ASN:HD21	1:C:39:ARG:HE	1.55	0.54
1:M:35[B]:ASN:ND2	3:M:201:HOH:O	2.43	0.52
1:K:35[A]:ASN:ND2	3:K:102:HOH:O	2.42	0.52
1:B:64:PHE:HZ	2:B:101:EF4:H7	1.74	0.52
1:A:35[B]:ASN:ND2	3:A:201:HOH:O	2.44	0.51
1:A:43:ILE:HD13	1:B:41:PRO:HG3	1.93	0.51
1:B:59:GLU:HG2	2:B:102:EF4:H61	1.92	0.51
1:N:55:PHE:C	1:N:55:PHE:CD1	2.87	0.48
1:N:55:PHE:HE1	1:N:59:GLU:OE1	1.96	0.48
1:M:63:LEU:HD22	1:M:67:MET:CE	2.44	0.47
1:L:35[B]:ASN:ND2	3:L:202:HOH:O	2.48	0.46
1:L:15[C]:SER:OG	1:M:13:GLY:HA2	2.16	0.46
1:K:55:PHE:O	1:K:59:GLU:HB3	2.17	0.45
1:C:35[B]:ASN:ND2	1:C:39:ARG:HE	2.14	0.44
1:B:63:LEU:HA	2:B:102:EF4:H2	1.98	0.44
1:L:63:LEU:HD13	2:L:101:EF4:H73	2.00	0.44
1:N:43:ILE:HD12	1:N:43:ILE:HA	1.85	0.44
1:M:55:PHE:C	1:M:55:PHE:CD1	2.92	0.44
1:K:64:PHE:HZ	2:L:101:EF4:H7	1.83	0.43
2:B:101:EF4:H61	1:C:59:GLU:HG2	2.01	0.42
1:D:60:ALA:CB	2:E:101:EF4:O36	2.68	0.42
1:M:59:GLU:HG2	2:M:101:EF4:C16	2.50	0.41
1:K:39:ARG:HD2	3:K:102:HOH:O	2.20	0.41
1:L:63:LEU:HA	2:L:101:EF4:H2	2.03	0.41
1:M:43:ILE:HA	1:M:43:ILE:HD12	1.97	0.41
1:A:55:PHE:CD1	1:A:55:PHE:C	2.95	0.41
1:D:32:ALA:HB2	1:E:31:ALA:HB1	2.03	0.41
1:L:43:ILE:HD12	1:L:43:ILE:HA	1.95	0.41
1:L:39:ARG:HD2	3:L:202:HOH:O	2.22	0.40
1:M:39:ARG:HD2	3:M:201:HOH:O	2.21	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	77/76 (101%)	77 (100%)	0	0	100	100
1	B	78/76 (103%)	78 (100%)	0	0	100	100
1	C	78/76 (103%)	77 (99%)	1 (1%)	0	100	100
1	D	77/76 (101%)	77 (100%)	0	0	100	100
1	E	77/76 (101%)	77 (100%)	0	0	100	100
1	K	78/76 (103%)	78 (100%)	0	0	100	100
1	L	78/76 (103%)	78 (100%)	0	0	100	100
1	M	78/76 (103%)	78 (100%)	0	0	100	100
1	N	78/76 (103%)	78 (100%)	0	0	100	100
1	O	78/76 (103%)	78 (100%)	0	0	100	100
All	All	777/760 (102%)	776 (100%)	1 (0%)	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	58/55 (106%)	57 (98%)	1 (2%)	60	67
1	B	58/55 (106%)	57 (98%)	1 (2%)	60	67
1	C	58/55 (106%)	57 (98%)	1 (2%)	60	67
1	D	59/55 (107%)	58 (98%)	1 (2%)	60	67

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	E	58/55 (106%)	57 (98%)	1 (2%)	60	67
1	K	57/55 (104%)	55 (96%)	2 (4%)	36	38
1	L	57/55 (104%)	56 (98%)	1 (2%)	59	65
1	M	56/55 (102%)	54 (96%)	2 (4%)	35	36
1	N	58/55 (106%)	57 (98%)	1 (2%)	60	67
1	O	58/55 (106%)	57 (98%)	1 (2%)	60	67
All	All	577/550 (105%)	565 (98%)	12 (2%)	50	59

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	55	PHE
1	B	55	PHE
1	C	55	PHE
1	D	55	PHE
1	E	55	PHE
1	K	55	PHE
1	K	59	GLU
1	L	55	PHE
1	M	55	PHE
1	M	63	LEU
1	N	55	PHE
1	O	55	PHE

Some 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 ⓘ

10 non-standard protein/DNA/RNA residues 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	$\# Z  > 2$
1	FME	K	1	1	5,6,10	0.75	0	3,6,11	0.96	0
1	FME	D	1	1	5,6,10	0.79	0	3,6,11	0.90	0
1	FME	M	1	1	5,6,10	0.76	0	3,6,11	0.77	0
1	FME	O	1	1	6,7,10	0.70	0	6,7,11	1.23	1 (16%)
1	FME	B	1	1	5,6,10	0.70	0	3,6,11	1.51	1 (33%)
1	FME	L	1	1	5,6,10	0.73	0	3,6,11	0.99	0
1	FME	N	1	1	8,9,10	0.68	0	7,9,11	1.36	1 (14%)
1	FME	A	1	1	5,6,10	0.75	0	3,6,11	1.08	0
1	FME	C	1	1	6,7,10	0.63	0	6,7,11	1.81	2 (33%)
1	FME	E	1	1	6,7,10	0.64	0	6,7,11	1.85	2 (33%)

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
1	FME	K	1	1	-	1/2/5/11	-
1	FME	D	1	1	-	1/2/5/11	-
1	FME	M	1	1	-	1/2/5/11	-
1	FME	O	1	1	-	2/5/7/11	-
1	FME	B	1	1	-	1/2/5/11	-
1	FME	L	1	1	-	1/2/5/11	-
1	FME	N	1	1	-	6/7/9/11	-
1	FME	A	1	1	-	0/2/5/11	-
1	FME	C	1	1	-	3/5/7/11	-
1	FME	E	1	1	-	4/5/7/11	-

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	1	FME	O-C-CA	-2.96	117.03	124.78
1	E	1	FME	O-C-CA	-2.72	117.66	124.78
1	N	1	FME	O-C-CA	-2.71	117.67	124.78
1	O	1	FME	O-C-CA	-2.48	118.28	124.78

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	1	FME	CB-CA-N	2.19	112.05	109.61
1	E	1	FME	CA-N-CN	-2.12	119.57	122.82
1	C	1	FME	CG-CB-CA	-2.01	108.76	113.45

There are no chirality outliers.

All (20) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	O	1	FME	O1-CN-N-CA
1	O	1	FME	N-CA-CB-CG
1	B	1	FME	O1-CN-N-CA
1	L	1	FME	O1-CN-N-CA
1	N	1	FME	O1-CN-N-CA
1	N	1	FME	N-CA-CB-CG
1	N	1	FME	O-C-CA-CB
1	C	1	FME	O1-CN-N-CA
1	C	1	FME	C-CA-CB-CG
1	E	1	FME	O1-CN-N-CA
1	E	1	FME	CB-CA-N-CN
1	E	1	FME	N-CA-CB-CG
1	E	1	FME	C-CA-CB-CG
1	N	1	FME	CA-CB-CG-SD
1	C	1	FME	N-CA-CB-CG
1	N	1	FME	C-CA-CB-CG
1	K	1	FME	O1-CN-N-CA
1	D	1	FME	O1-CN-N-CA
1	M	1	FME	O1-CN-N-CA
1	N	1	FME	CB-CA-N-CN

There are no ring outliers.

No monomer is involved in short contacts.

## 5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

7 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	EF4	E	101	-	57,57,57	2.34	11 (19%)	77,82,82	1.41	7 (9%)
2	EF4	A	101	-	57,57,57	2.55	15 (26%)	77,82,82	1.36	8 (10%)
2	EF4	B	101	-	57,57,57	2.54	14 (24%)	77,82,82	1.42	9 (11%)
2	EF4	B	102	-	57,57,57	2.49	13 (22%)	77,82,82	1.38	6 (7%)
2	EF4	O	101	-	57,57,57	2.43	10 (17%)	77,82,82	1.24	10 (12%)
2	EF4	L	101	-	57,57,57	2.54	12 (21%)	77,82,82	1.59	12 (15%)
2	EF4	M	101	-	57,57,57	2.44	11 (19%)	77,82,82	1.46	11 (14%)

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	EF4	E	101	-	-	3/68/106/106	0/2/3/3
2	EF4	A	101	-	-	10/68/106/106	0/2/3/3
2	EF4	B	101	-	-	5/68/106/106	0/2/3/3
2	EF4	B	102	-	-	4/68/106/106	0/2/3/3
2	EF4	O	101	-	-	1/68/106/106	0/2/3/3
2	EF4	L	101	-	-	7/68/106/106	0/2/3/3
2	EF4	M	101	-	-	3/68/106/106	0/2/3/3

All (86) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	101	EF4	C25-C26	-8.10	1.40	1.52
2	L	101	EF4	C31-C30	-7.89	1.40	1.52
2	M	101	EF4	C27-C26	-7.86	1.40	1.52
2	B	101	EF4	C25-C26	-7.64	1.40	1.52
2	L	101	EF4	C29-C30	-7.63	1.40	1.52
2	M	101	EF4	C29-C30	-7.58	1.41	1.52
2	O	101	EF4	C27-C26	-7.46	1.41	1.52

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	O	101	EF4	C29-C30	-7.46	1.41	1.52
2	B	101	EF4	C29-C30	-7.16	1.41	1.52
2	L	101	EF4	C25-C26	-7.05	1.41	1.52
2	B	102	EF4	C31-C30	-7.05	1.41	1.52
2	A	101	EF4	C27-C26	-7.03	1.41	1.52
2	O	101	EF4	C25-C26	-6.91	1.42	1.52
2	E	101	EF4	C25-C26	-6.89	1.42	1.52
2	E	101	EF4	C29-C30	-6.80	1.42	1.52
2	M	101	EF4	C25-C26	-6.79	1.42	1.52
2	E	101	EF4	C27-C26	-6.78	1.42	1.52
2	A	101	EF4	C31-C30	-6.78	1.42	1.52
2	B	102	EF4	C29-C30	-6.74	1.42	1.52
2	L	101	EF4	C27-C26	-6.68	1.42	1.52
2	O	101	EF4	C31-C30	-6.67	1.42	1.52
2	E	101	EF4	C31-C30	-6.66	1.42	1.52
2	B	101	EF4	C27-C26	-6.63	1.42	1.52
2	B	101	EF4	C31-C30	-6.62	1.42	1.52
2	A	101	EF4	C29-C30	-6.54	1.42	1.52
2	B	102	EF4	C27-C26	-6.37	1.42	1.52
2	M	101	EF4	C31-C30	-6.37	1.42	1.52
2	B	102	EF4	C25-C26	-6.03	1.43	1.52
2	L	101	EF4	C33-C34	-5.26	1.37	1.51
2	A	101	EF4	C8-C10	4.79	1.59	1.53
2	L	101	EF4	C17-C18	-4.56	1.40	1.50
2	M	101	EF4	C33-C34	-4.52	1.39	1.51
2	O	101	EF4	C33-C34	-4.42	1.39	1.51
2	B	101	EF4	C17-C18	-4.40	1.40	1.50
2	E	101	EF4	C17-C18	-4.31	1.41	1.50
2	E	101	EF4	C33-C34	-4.29	1.40	1.51
2	A	101	EF4	C7-C8	4.17	1.58	1.52
2	B	102	EF4	C17-C18	-4.17	1.41	1.50
2	B	102	EF4	C7-C8	4.16	1.58	1.52
2	A	101	EF4	C33-C34	-4.14	1.40	1.51
2	O	101	EF4	C17-C18	-4.13	1.41	1.50
2	B	101	EF4	C33-C34	-4.01	1.40	1.51
2	B	101	EF4	C7-C8	3.98	1.58	1.52
2	B	102	EF4	C33-C34	-3.96	1.41	1.51
2	E	101	EF4	C35-C36	-3.82	1.39	1.48
2	M	101	EF4	C7-C8	3.79	1.58	1.52
2	B	102	EF4	C22-C23	3.75	1.60	1.54
2	B	102	EF4	C35-C36	-3.74	1.39	1.48
2	L	101	EF4	C35-C36	-3.67	1.39	1.48

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	M	101	EF4	C35-C36	-3.64	1.39	1.48
2	O	101	EF4	C35-C36	-3.58	1.39	1.48
2	A	101	EF4	C22-C21	-3.57	1.39	1.50
2	L	101	EF4	C22-C21	-3.51	1.39	1.50
2	B	102	EF4	C29-C28	3.51	1.60	1.53
2	A	101	EF4	C35-C36	-3.50	1.40	1.48
2	A	101	EF4	C17-C18	-3.47	1.42	1.50
2	B	102	EF4	C35-C34	3.45	1.40	1.32
2	B	101	EF4	C35-C36	-3.43	1.40	1.48
2	B	101	EF4	C23-C24	3.41	1.59	1.53
2	L	101	EF4	C7-C8	3.41	1.57	1.52
2	B	101	EF4	C35-C34	3.32	1.40	1.32
2	B	101	EF4	C22-C21	-3.28	1.40	1.50
2	O	101	EF4	C35-C34	3.25	1.40	1.32
2	M	101	EF4	C22-C21	-3.25	1.40	1.50
2	B	101	EF4	O9-C8	3.19	1.49	1.42
2	A	101	EF4	C35-C34	3.19	1.39	1.32
2	M	101	EF4	C35-C34	3.13	1.39	1.32
2	O	101	EF4	C22-C21	-3.13	1.40	1.50
2	E	101	EF4	C22-C21	-3.01	1.40	1.50
2	M	101	EF4	C17-C18	-3.01	1.43	1.50
2	L	101	EF4	C35-C34	2.99	1.39	1.32
2	E	101	EF4	C35-C34	2.96	1.39	1.32
2	A	101	EF4	O14-C8	2.71	1.48	1.42
2	B	102	EF4	C22-C21	-2.70	1.41	1.50
2	B	101	EF4	O14-C8	2.55	1.48	1.42
2	A	101	EF4	C23-C24	2.48	1.58	1.53
2	M	101	EF4	C1C-C17	2.47	1.56	1.53
2	A	101	EF4	C31-C32	2.46	1.58	1.53
2	E	101	EF4	C12-C11	2.34	1.58	1.53
2	E	101	EF4	O14-C8	2.33	1.47	1.42
2	B	102	EF4	O14-C8	2.31	1.47	1.42
2	A	101	EF4	O9-C8	2.25	1.47	1.42
2	O	101	EF4	O9-C8	2.20	1.47	1.42
2	L	101	EF4	O9-C8	2.20	1.47	1.42
2	L	101	EF4	O14-C8	2.19	1.47	1.42
2	B	101	EF4	C25-C24	2.04	1.58	1.53

All (63) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	L	101	EF4	O9-C4-C3	5.72	113.26	105.95

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	101	EF4	O9-C4-C3	4.99	112.32	105.95
2	B	102	EF4	O14-C13-C15	4.95	111.79	106.07
2	E	101	EF4	O14-C13-C15	4.93	111.76	106.07
2	A	101	EF4	C2C-C27-C28	-4.64	104.62	112.37
2	L	101	EF4	C11-O37-C36	-4.54	110.11	117.47
2	M	101	EF4	O9-C4-C3	4.52	111.72	105.95
2	M	101	EF4	O9-C8-C10	4.48	109.55	106.28
2	L	101	EF4	O9-C8-C10	4.11	109.28	106.28
2	O	101	EF4	O9-C4-C3	3.99	111.04	105.95
2	L	101	EF4	O14-C13-C15	3.96	110.65	106.07
2	B	101	EF4	O37-C36-C35	3.93	120.30	111.38
2	A	101	EF4	O9-C8-C10	3.82	109.07	106.28
2	A	101	EF4	O14-C13-C15	3.75	110.41	106.07
2	B	101	EF4	O14-C13-C15	3.69	110.33	106.07
2	E	101	EF4	C22-C21-C20	-3.61	120.75	125.41
2	E	101	EF4	C33-C34-C35	-3.60	116.61	126.44
2	B	102	EF4	C23-C22-C21	-3.57	108.50	113.98
2	O	101	EF4	O9-C8-C10	3.46	108.81	106.28
2	B	102	EF4	C15-C16-C17	-3.38	108.83	114.00
2	B	102	EF4	C2C-C27-C28	-3.29	106.88	112.37
2	E	101	EF4	O9-C4-C3	3.29	110.15	105.95
2	B	102	EF4	C17-C18-C19	-3.26	118.18	126.48
2	M	101	EF4	C11-O37-C36	-3.25	112.21	117.47
2	B	101	EF4	C11-O37-C36	-3.21	112.28	117.47
2	E	101	EF4	C2C-C27-C28	-3.21	107.02	112.37
2	L	101	EF4	C22-C21-C20	-3.17	121.32	125.41
2	M	101	EF4	C17-C18-C19	-3.14	118.49	126.48
2	O	101	EF4	C17-C18-C19	-3.12	118.54	126.48
2	L	101	EF4	O37-C36-C35	3.08	118.36	111.38
2	B	101	EF4	C23-C22-C21	-3.01	109.36	113.98
2	M	101	EF4	O37-C36-C35	2.97	118.13	111.38
2	E	101	EF4	O37-C36-C35	2.93	118.03	111.38
2	A	101	EF4	O14-C8-C10	2.91	114.42	110.22
2	B	101	EF4	C17-C18-C19	-2.87	119.17	126.48
2	O	101	EF4	O14-C13-C15	2.85	109.36	106.07
2	A	101	EF4	O37-C36-C35	2.83	117.81	111.38
2	M	101	EF4	C34-C35-C36	-2.79	116.35	122.62
2	B	101	EF4	C2C-C27-C28	-2.77	107.74	112.37
2	L	101	EF4	C17-C18-C19	-2.76	119.44	126.48
2	O	101	EF4	C15-C16-C17	-2.58	110.05	114.00
2	O	101	EF4	O37-C36-C35	2.53	117.11	111.38
2	M	101	EF4	C2C-C27-C28	-2.49	108.21	112.37

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	M	101	EF4	C15-C16-C17	-2.48	110.21	114.00
2	A	101	EF4	C17-C18-C19	-2.47	120.20	126.48
2	M	101	EF4	O14-C13-C15	2.42	108.86	106.07
2	B	102	EF4	O37-C36-C35	2.41	116.85	111.38
2	E	101	EF4	C15-C16-C17	-2.36	110.40	114.00
2	L	101	EF4	C33-C34-C35	-2.30	120.16	126.44
2	O	101	EF4	C33-C34-C35	-2.30	120.16	126.44
2	O	101	EF4	C1C-C17-C16	-2.29	106.60	124.63
2	L	101	EF4	C34-C35-C36	-2.27	117.52	122.62
2	L	101	EF4	C2C-C27-C28	-2.27	108.58	112.37
2	O	101	EF4	C2C-C27-C28	-2.24	108.62	112.37
2	A	101	EF4	C1C-C17-C16	-2.22	107.10	124.63
2	M	101	EF4	C16-C15-C13	-2.19	109.03	113.88
2	L	101	EF4	C23-C22-C21	-2.14	110.69	113.98
2	B	101	EF4	C2C-C27-C26	2.14	111.80	108.08
2	M	101	EF4	C1C-C17-C16	-2.10	108.11	124.63
2	B	101	EF4	C33-C34-C35	-2.09	120.72	126.44
2	A	101	EF4	C33-C34-C35	-2.09	120.73	126.44
2	L	101	EF4	C1D-C1C-C17	-2.00	109.40	113.72
2	O	101	EF4	C16-C15-C13	-2.00	109.45	113.88

There are no chirality outliers.

All (33) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	E	101	EF4	C18-C17-C1C-C1D
2	E	101	EF4	C16-C17-C1C-C1D
2	A	101	EF4	C1-C2-C3-C4
2	A	101	EF4	O2-C2-C3-C4
2	A	101	EF4	C2-C3-C4-O9
2	A	101	EF4	C2-C3-C4-C5
2	B	101	EF4	C18-C17-C1C-C1D
2	B	101	EF4	C16-C17-C1C-C1D
2	L	101	EF4	C16-C17-C1C-C1D
2	M	101	EF4	C18-C17-C1C-C1D
2	M	101	EF4	C16-C17-C1C-C1D
2	B	102	EF4	C2D-C29-C30-C31
2	A	101	EF4	C2D-C29-C30-C31
2	A	101	EF4	C28-C29-C30-C31
2	B	102	EF4	C28-C29-C30-C31
2	A	101	EF4	C2D-C29-C30-O30
2	L	101	EF4	C26-C27-C28-C29

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Mol	Chain	Res	Type	Atoms
2	A	101	EF4	C28-C29-C30-O30
2	L	101	EF4	C2D-C29-C30-C31
2	B	101	EF4	C31-C32-C33-C34
2	L	101	EF4	C28-C29-C30-C31
2	B	102	EF4	C2D-C29-C30-O30
2	B	102	EF4	C28-C29-C30-O30
2	A	101	EF4	O14-C13-C15-C16
2	L	101	EF4	C28-C29-C30-O30
2	L	101	EF4	C2D-C29-C30-O30
2	B	101	EF4	O32-C32-C33-C34
2	L	101	EF4	C18-C17-C1C-C1D
2	E	101	EF4	C28-C29-C30-C31
2	B	101	EF4	C28-C29-C30-C31
2	O	101	EF4	C28-C29-C30-C31
2	M	101	EF4	C28-C29-C30-C31
2	A	101	EF4	C26-C27-C28-C29

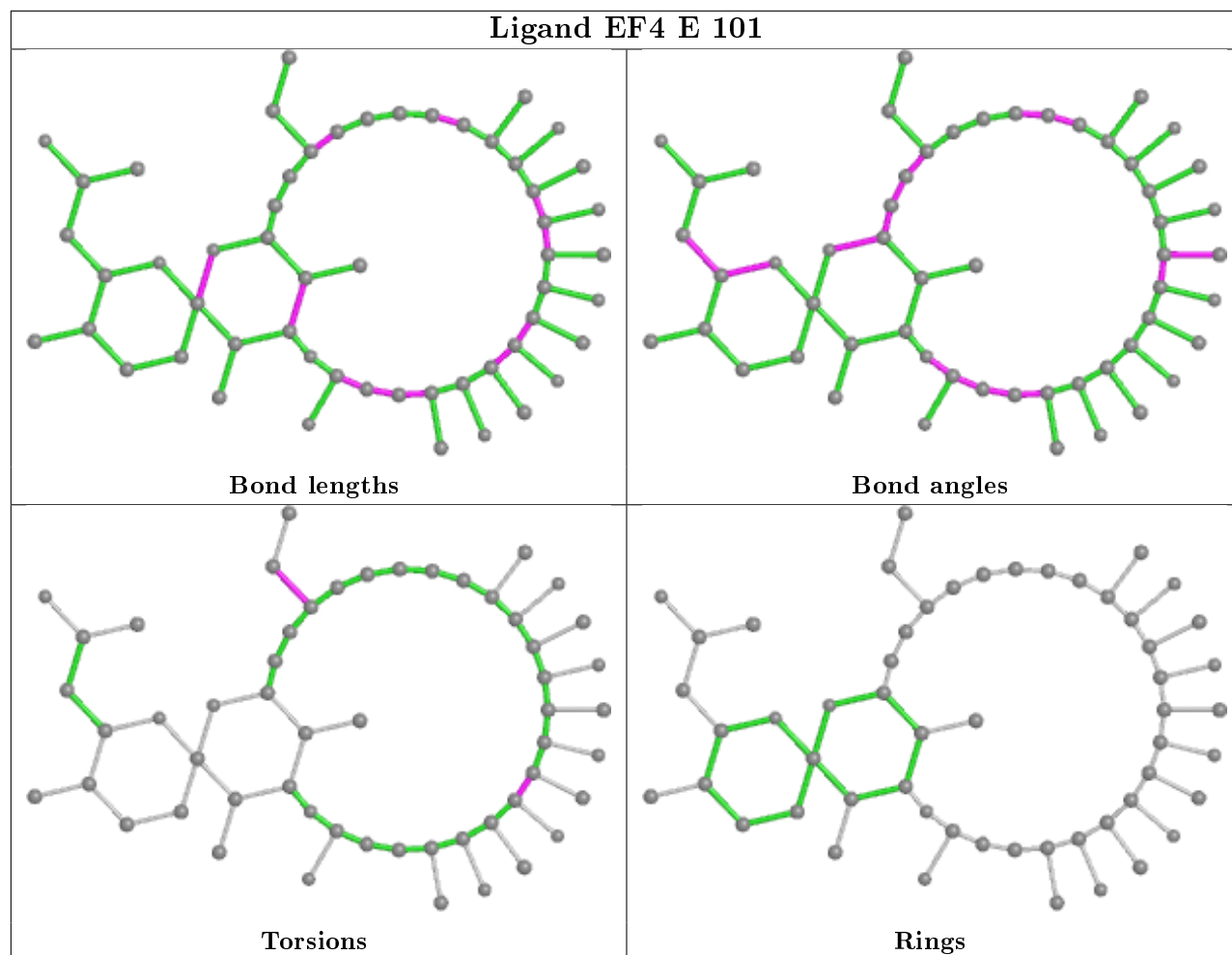
There are no ring outliers.

5 monomers are involved in 12 short contacts:

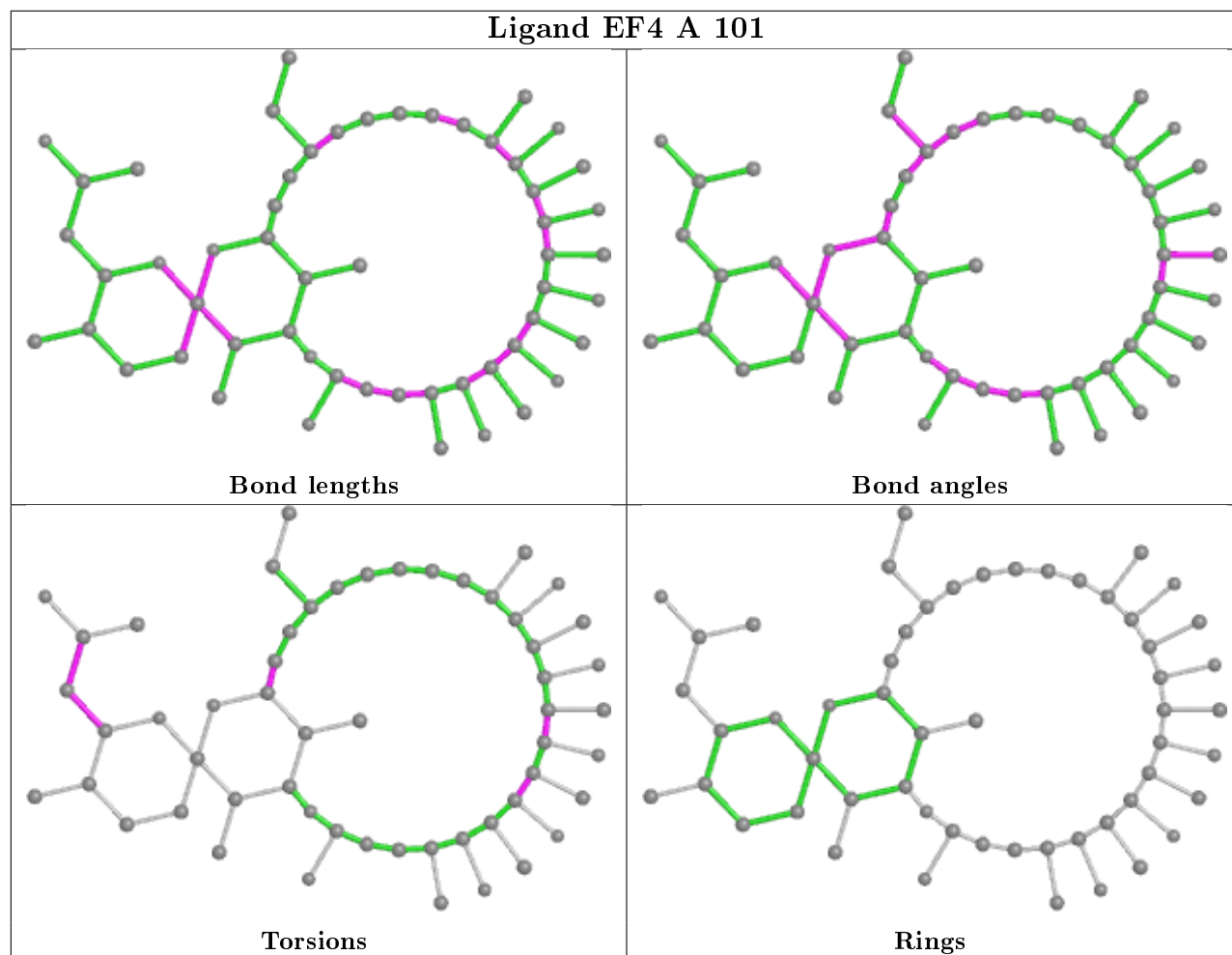
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	E	101	EF4	1	0
2	B	101	EF4	4	0
2	B	102	EF4	3	0
2	L	101	EF4	4	0
2	M	101	EF4	1	0

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.

## Ligand EF4 E 101

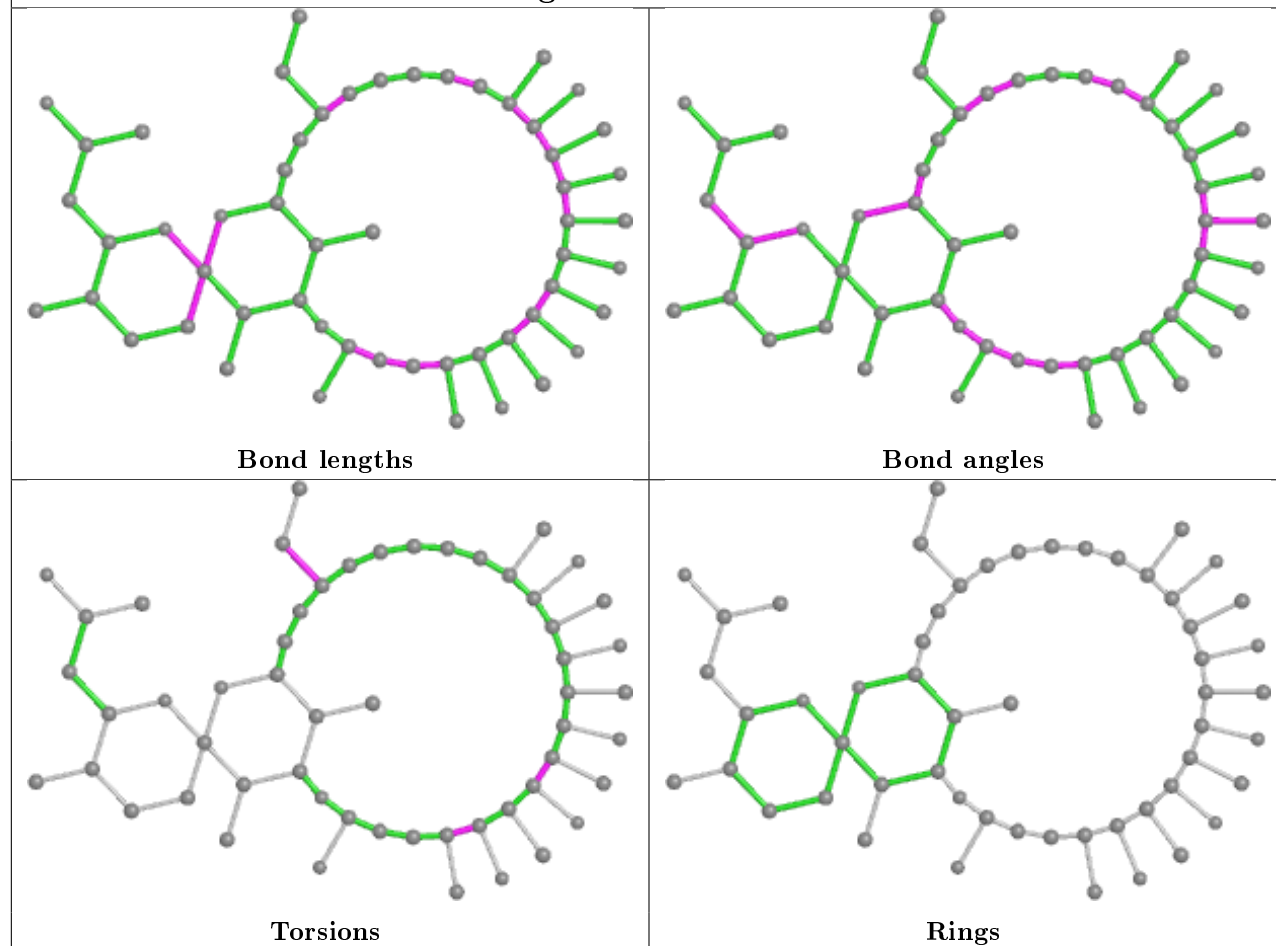


## Ligand EF4 A 101

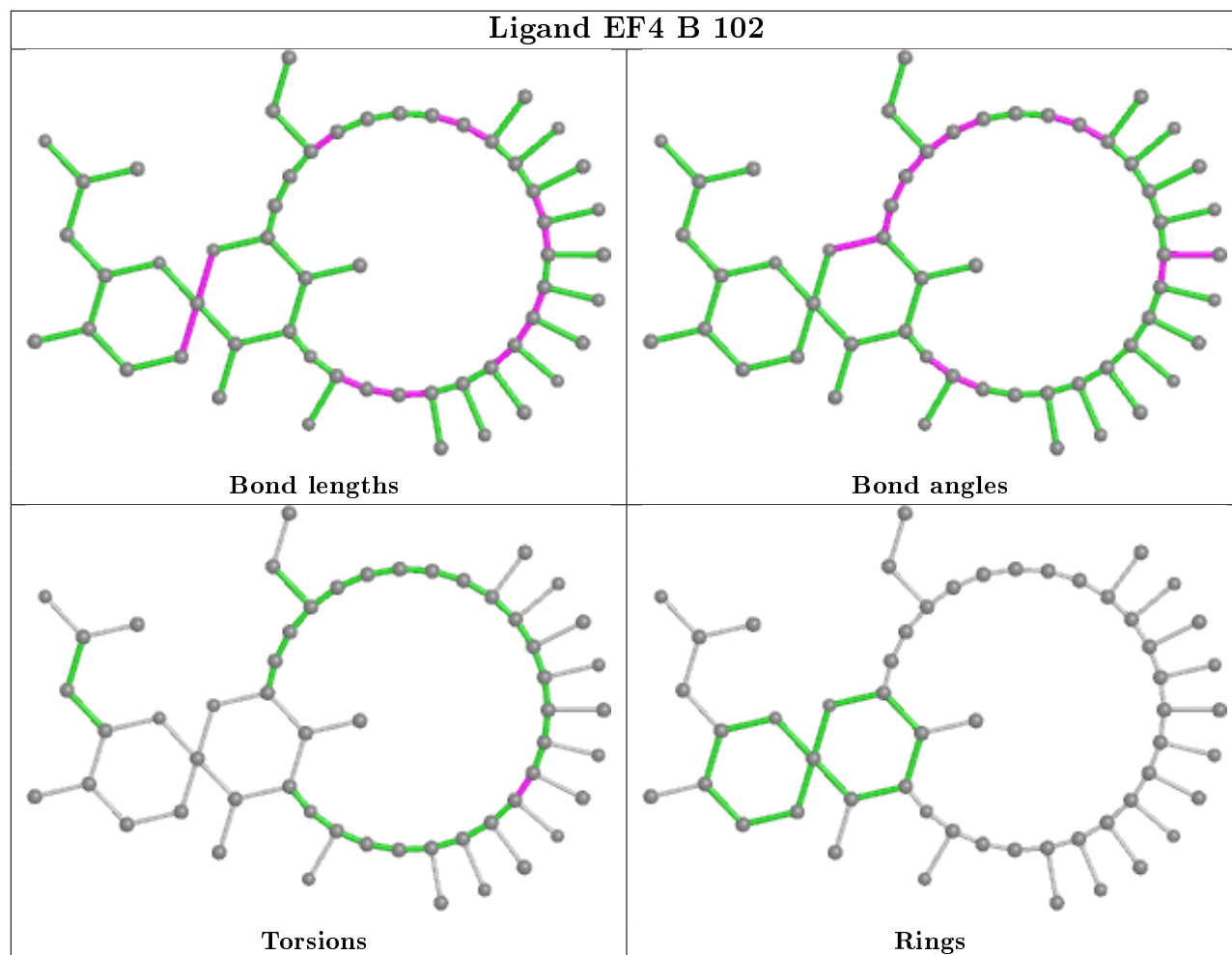




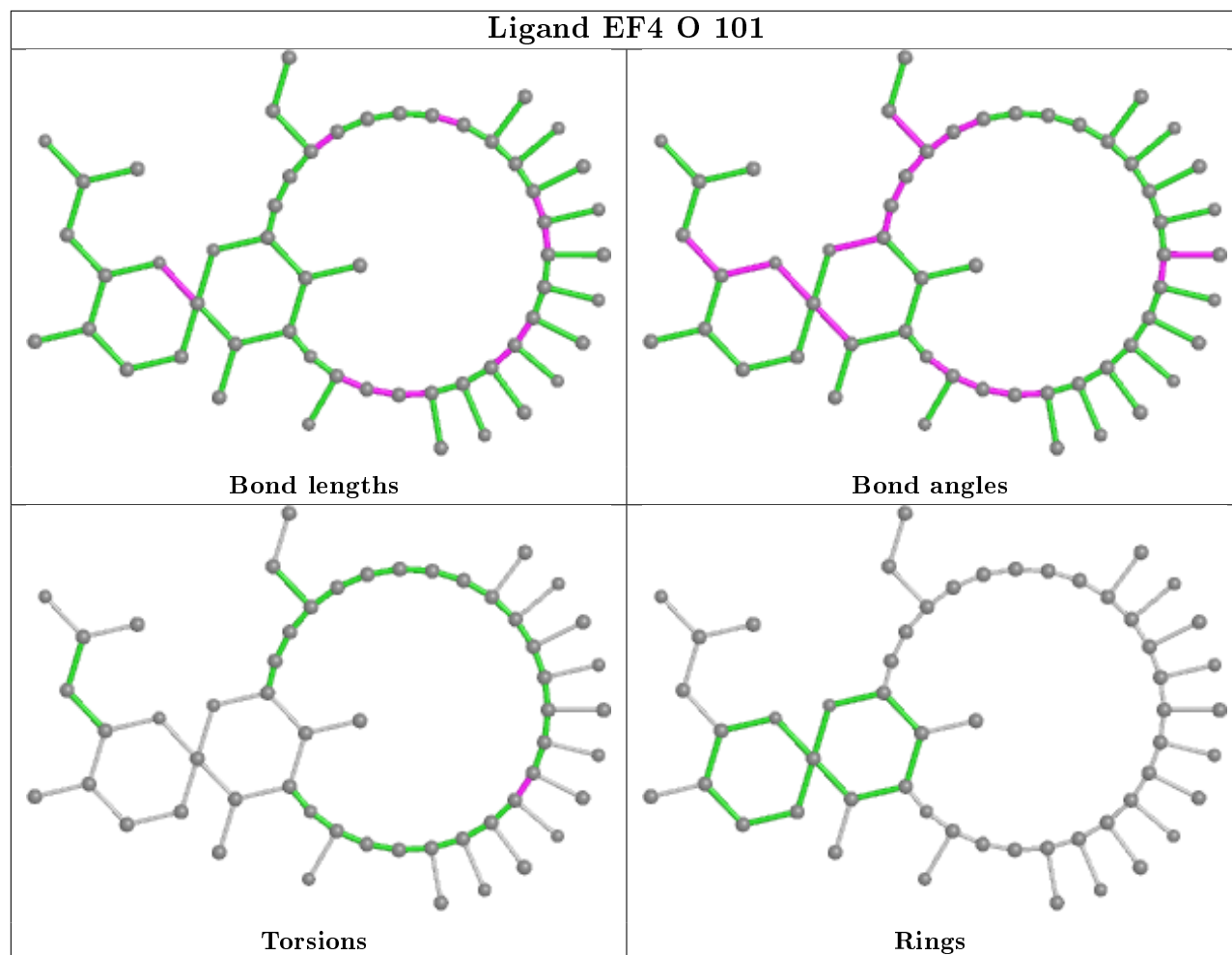
## Ligand EF4 B 101



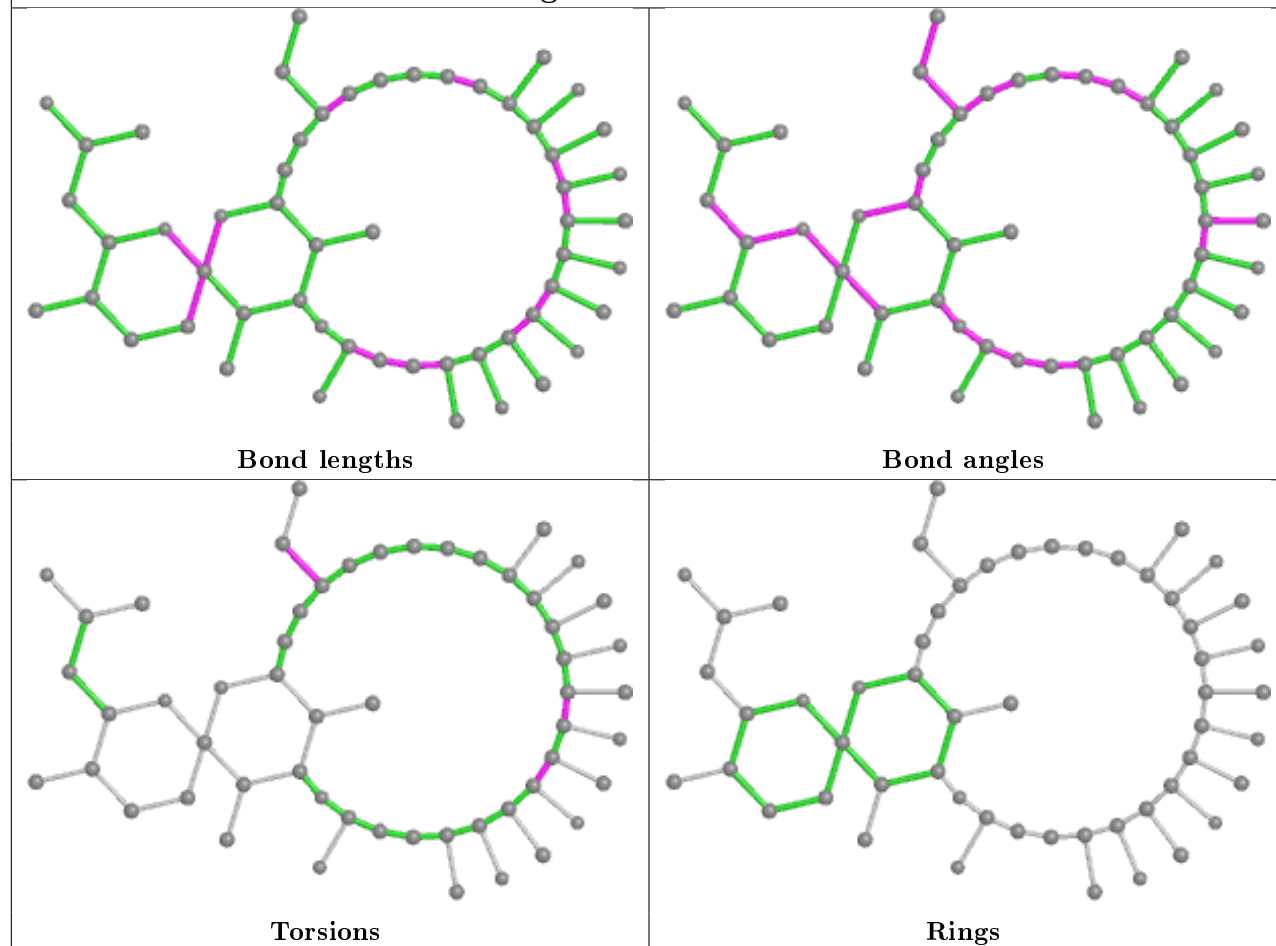
## Ligand EF4 B 102

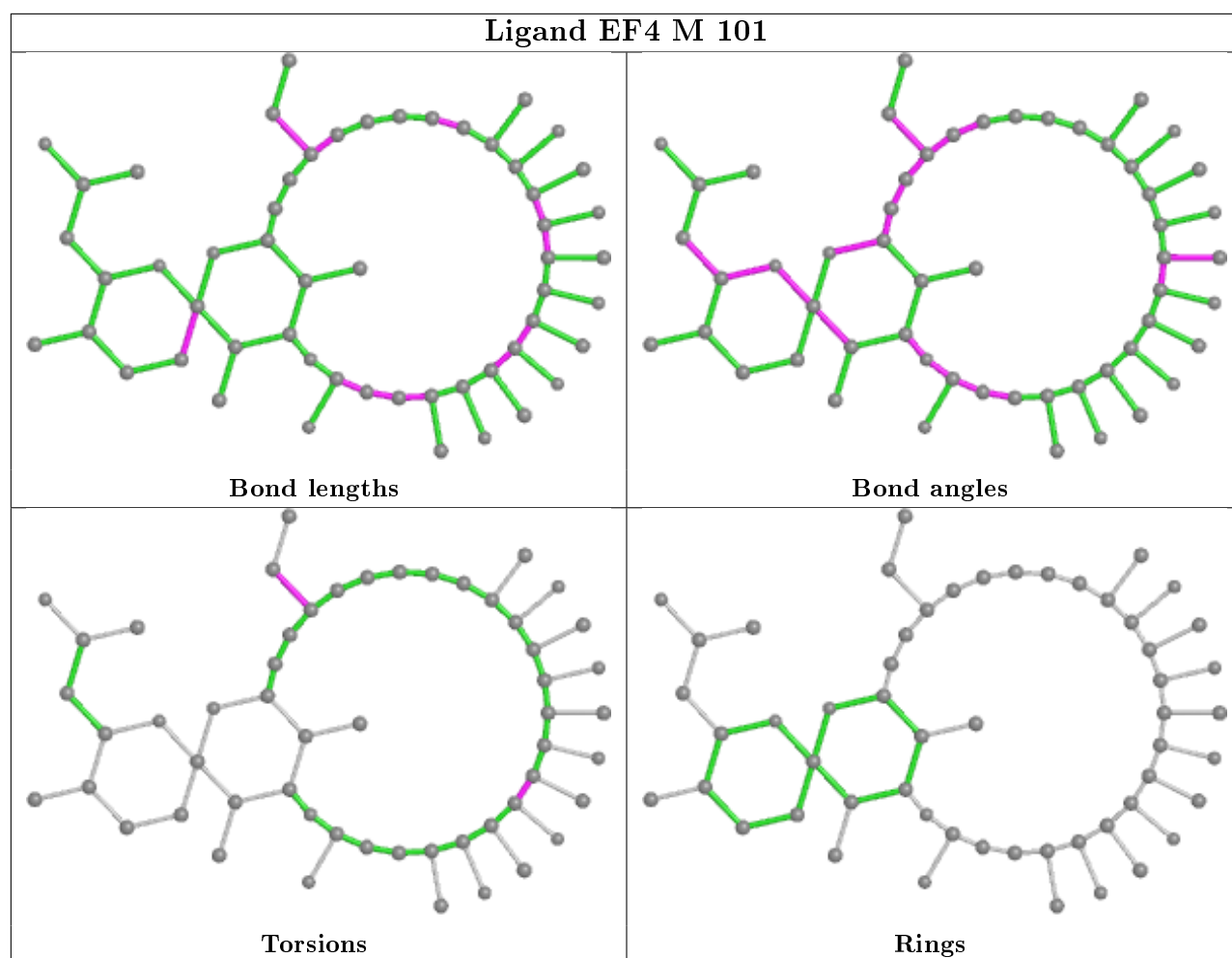


## Ligand EF4 O 101



## Ligand EF4 L 101





## 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	73/76 (96%)	-0.21	1 (1%) 75 78	19, 30, 46, 58	0
1	B	74/76 (97%)	-0.26	0 100 100	19, 29, 48, 62	0
1	C	74/76 (97%)	-0.14	0 100 100	20, 30, 49, 63	0
1	D	73/76 (96%)	-0.33	0 100 100	18, 29, 45, 61	0
1	E	73/76 (96%)	-0.26	0 100 100	19, 31, 48, 63	0
1	K	74/76 (97%)	-0.25	0 100 100	17, 30, 49, 59	0
1	L	74/76 (97%)	-0.23	1 (1%) 75 78	19, 30, 50, 59	0
1	M	74/76 (97%)	-0.25	1 (1%) 75 78	18, 30, 49, 69	0
1	N	74/76 (97%)	-0.28	0 100 100	19, 28, 50, 61	0
1	O	74/76 (97%)	-0.28	0 100 100	19, 28, 50, 61	0
All	All	737/760 (96%)	-0.25	3 (0%) 92 93	17, 30, 50, 69	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	70	PHE	2.5
1	M	5	LEU	2.4
1	L	5	LEU	2.2

### 6.2 Non-standard residues in protein, DNA, RNA chains [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
1	FME	L	1	7/11	0.57	0.23	57,61,63,68	0

*Continued on next page...*

*Continued from previous page...*

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
1	FME	D	1	7/11	0.62	0.24	59,60,64,67	0
1	FME	N	1	10/11	0.69	0.21	61,71,81,83	0
1	FME	B	1	7/11	0.74	0.22	54,57,59,62	0
1	FME	E	1	8/11	0.76	0.25	56,62,67,71	0
1	FME	A	1	7/11	0.81	0.15	55,58,61,65	0
1	FME	M	1	7/11	0.81	0.17	54,55,58,61	0
1	FME	C	1	8/11	0.83	0.21	60,63,70,74	0
1	FME	O	1	8/11	0.83	0.26	56,58,63,65	0
1	FME	K	1	7/11	0.84	0.21	61,63,67,71	0

### 6.3 Carbohydrates [i](#)

There are no carbohydrates in this entry.

### 6.4 Ligands [i](#)

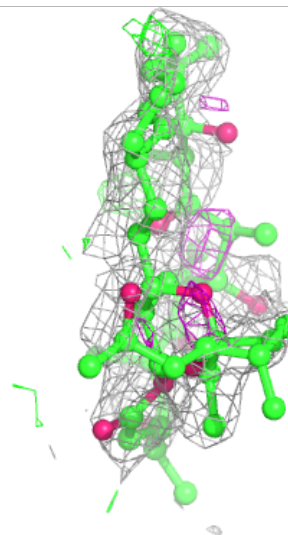
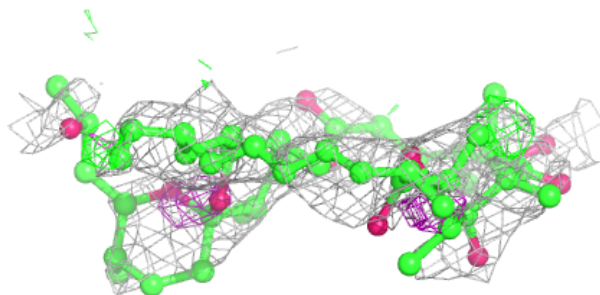
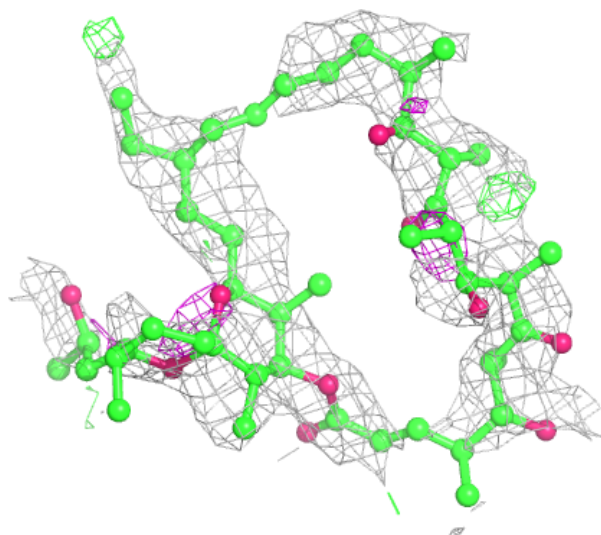
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 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
2	EF4	B	101	55/55	0.68	0.34	49,65,70,77	0
2	EF4	A	101	55/55	0.76	0.30	40,52,65,70	0
2	EF4	B	102	55/55	0.80	0.22	36,40,44,47	0
2	EF4	L	101	55/55	0.84	0.24	42,50,53,54	0
2	EF4	M	101	55/55	0.85	0.17	33,41,49,51	0
2	EF4	E	101	55/55	0.88	0.16	39,46,52,55	0
2	EF4	O	101	55/55	0.90	0.14	30,36,44,46	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 EF4 B 101:**

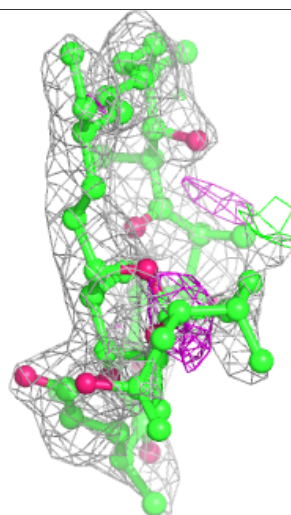
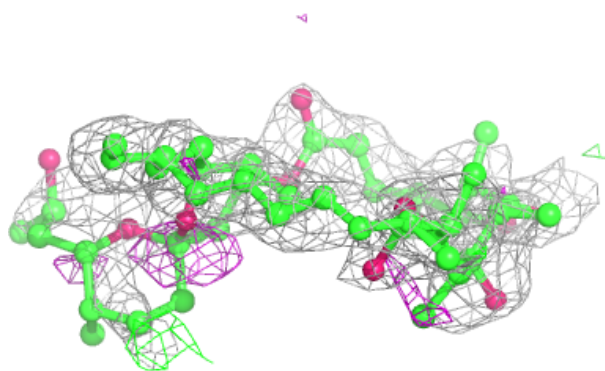
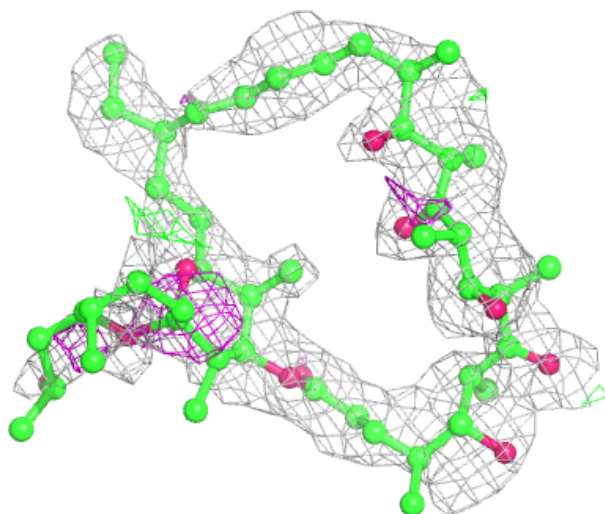
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





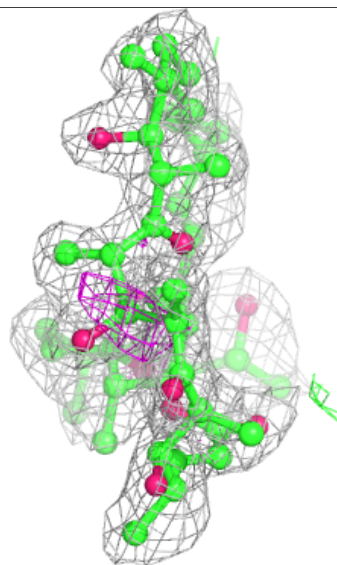
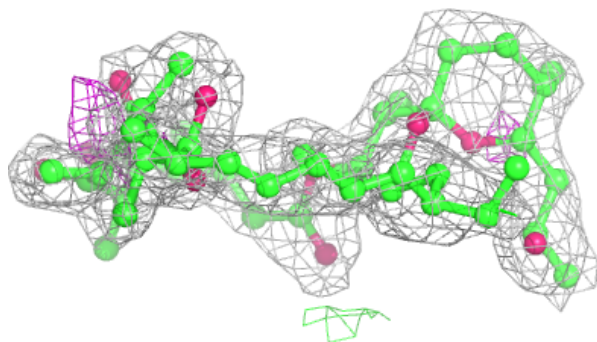
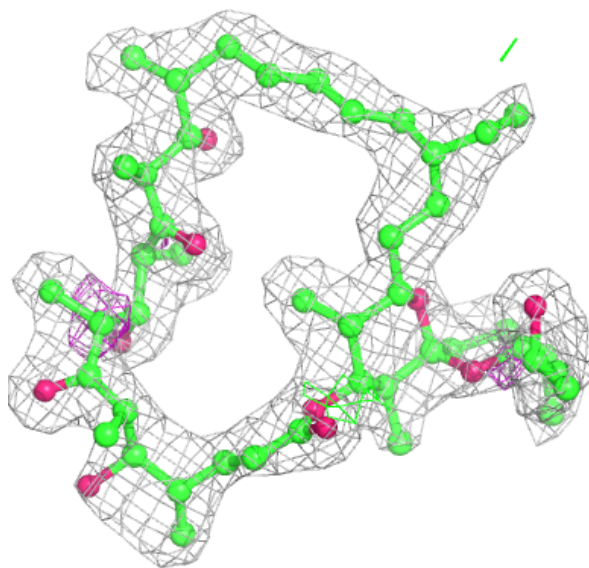
**Electron density around EF4 A 101:**

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



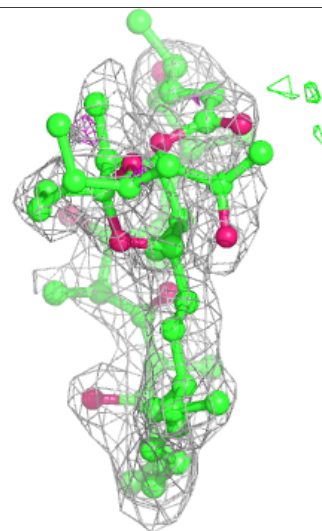
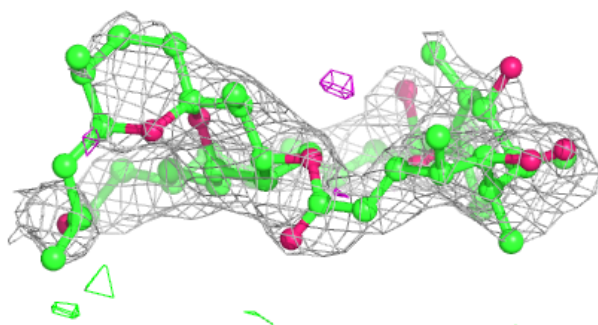
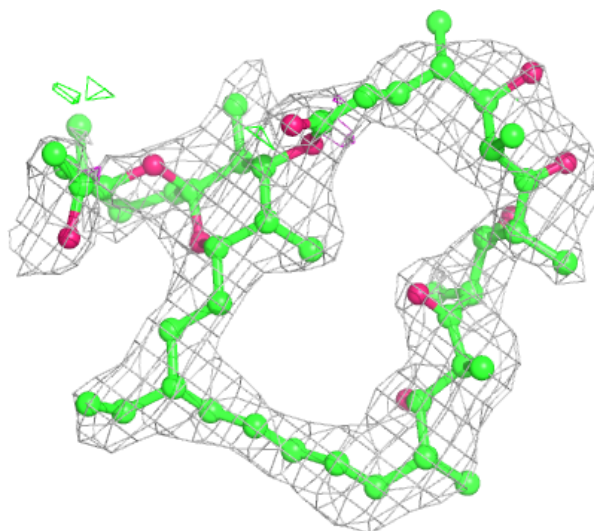
**Electron density around EF4 B 102:**

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



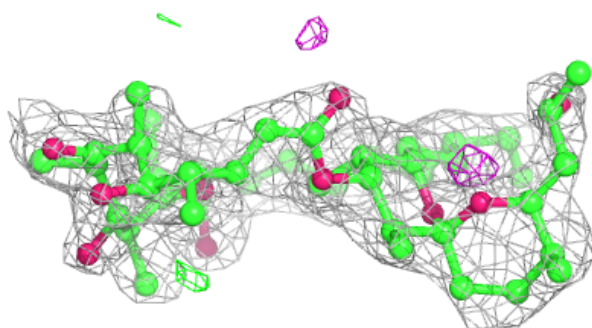
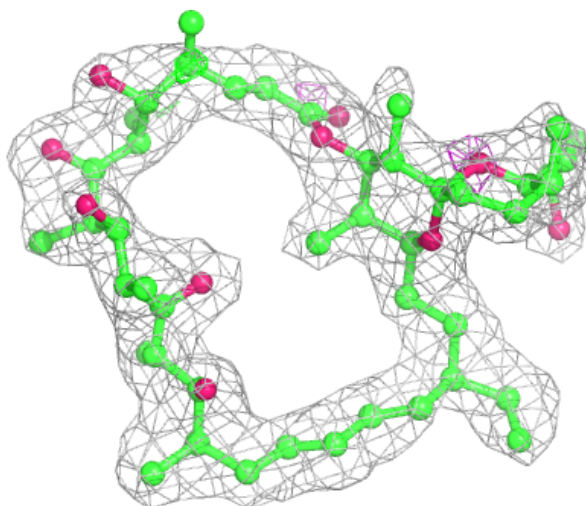
**Electron density around EF4 L 101:**

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



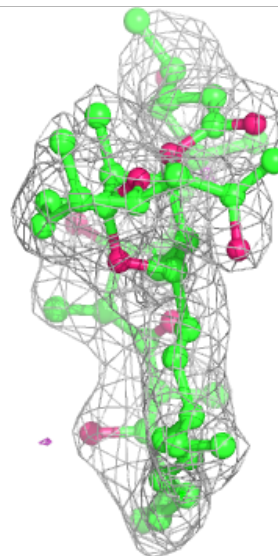
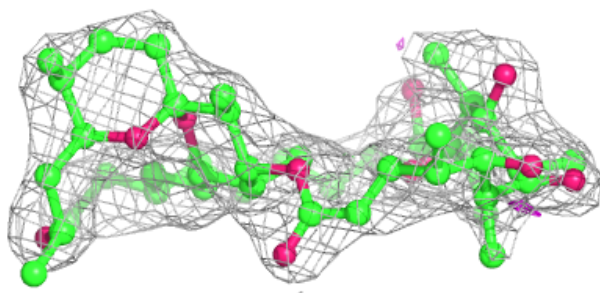
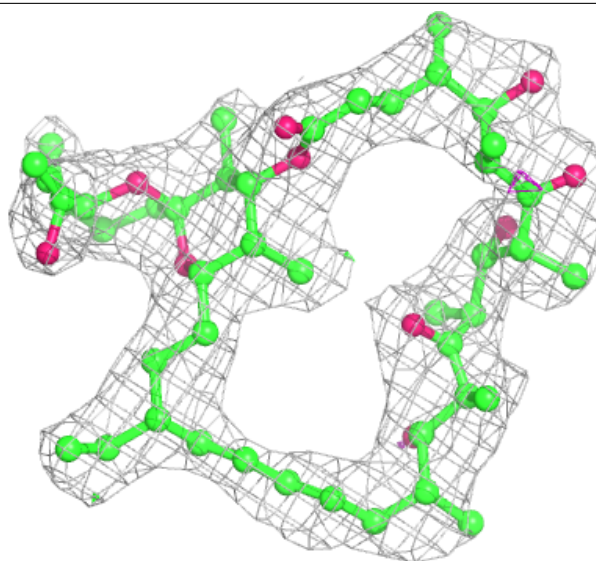
**Electron density around EF4 M 101:**

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



**Electron density around EF4 E 101:**

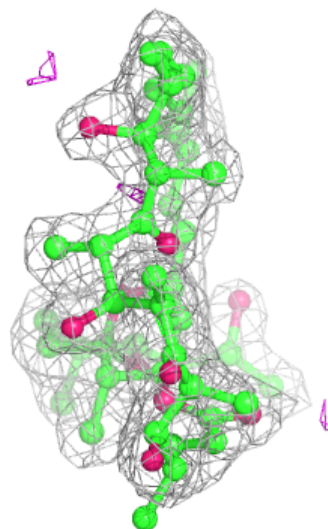
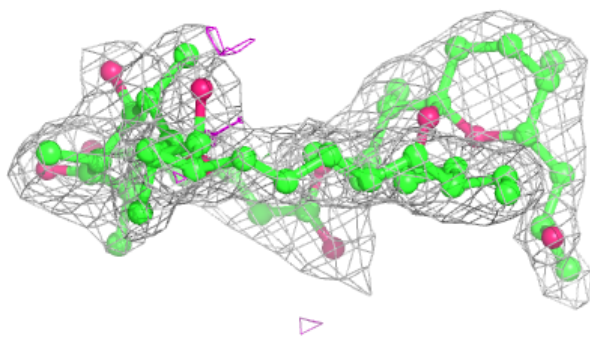
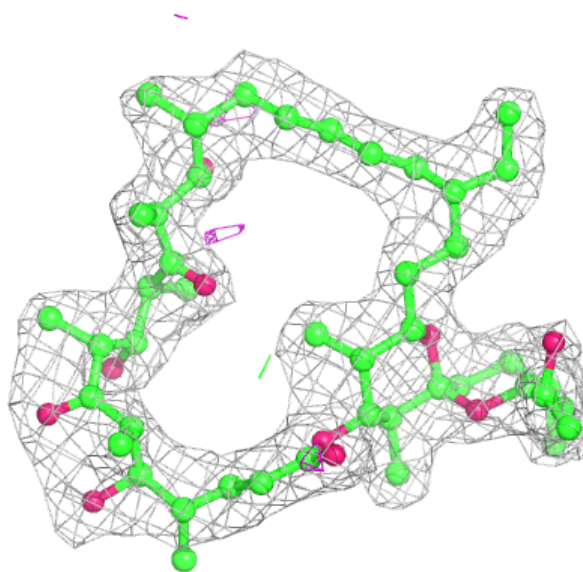
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





**Electron density around EF4 O 101:**

$2mF_o-DF_c$  (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.