



# Full wwPDB X-ray Structure Validation Report ⓘ

Jun 17, 2024 – 08:30 PM EDT

PDB ID : 2X72  
Title : CRYSTAL STRUCTURE OF THE CONSTITUTIVELY ACTIVE E113Q,D2C,D282C RHODOPSIN MUTANT WITH BOUND GALPHACT PEPTIDE.  
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Deposited on : 2010-02-22  
Resolution : 3.00 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](#) ①) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtrriage (Phenix) : 1.20.1  
EDS : 2.37.1  
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) : 2.37.1

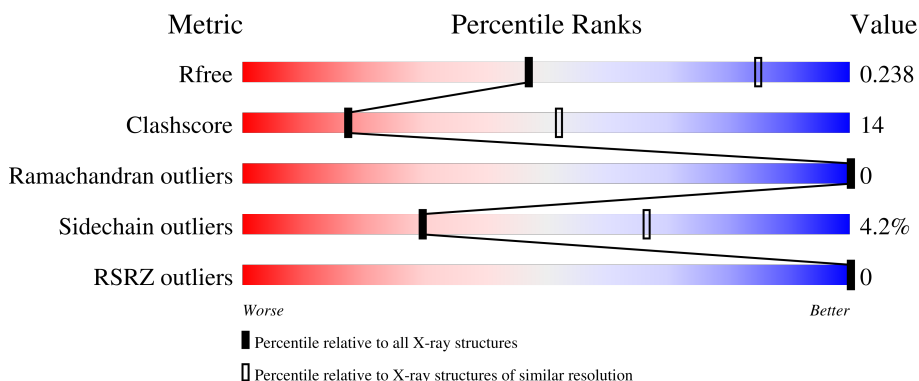
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.00 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	2092 (3.00-3.00)
Clashscore	141614	2416 (3.00-3.00)
Ramachandran outliers	138981	2333 (3.00-3.00)
Sidechain outliers	138945	2336 (3.00-3.00)
RSRZ outliers	127900	1990 (3.00-3.00)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	349	 69% 22% 6%
2	B	11	 45% 55%
3	C	5	 40% 60%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
7	RET	A	410	-	-	X	-

## 2 Entry composition i

There are 10 unique types of molecules in this entry. The entry contains 2932 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 RHODOPSIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	327	2602	1735	401	438	28	0	1	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	2	CYS	ASN	engineered mutation	UNP P02699
A	113	GLN	GLU	engineered mutation	UNP P02699
A	282	CYS	ASP	engineered mutation	UNP P02699

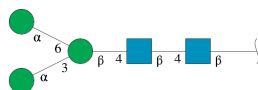
- Molecule 2 is a protein called GUANINE NUCLEOTIDE-BINDING PROTEIN G(T) SUB-UNIT ALPHA-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	11	88	57	13	17	1	0	0	0

There is a discrepancy between the modelled and reference sequences:

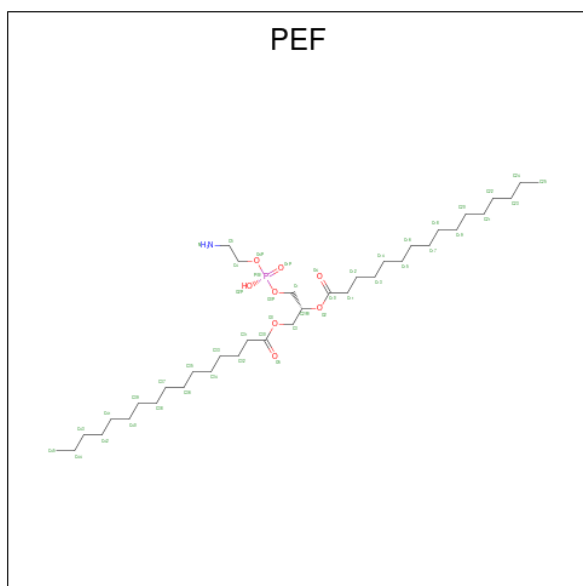
Chain	Residue	Modelled	Actual	Comment	Reference
B	341	LEU	LYS	engineered mutation	UNP P04695

- Molecule 3 is an oligosaccharide called alpha-D-mannopyranose-(1-3)-[alpha-D-mannopyranose-(1-6)]beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



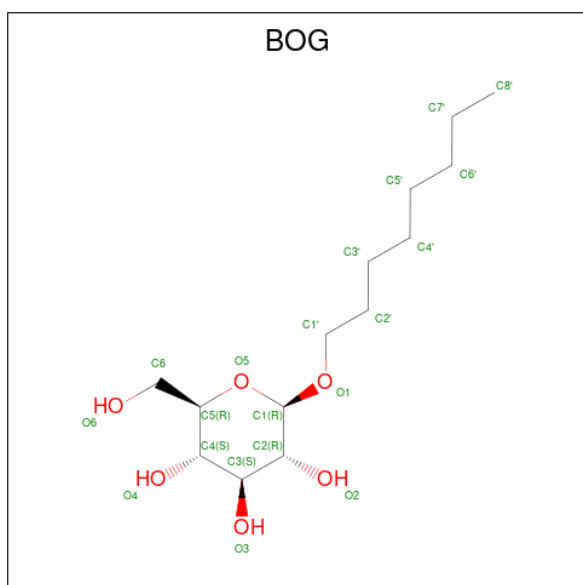
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	C	5	61	34	2	25	0	0	0

- Molecule 4 is DI-PALMITOYL-3-SN-PHOSPHATIDYLETHANOLAMINE (three-letter code: PEF) (formula:  $C_{37}H_{74}NO_8P$ ).



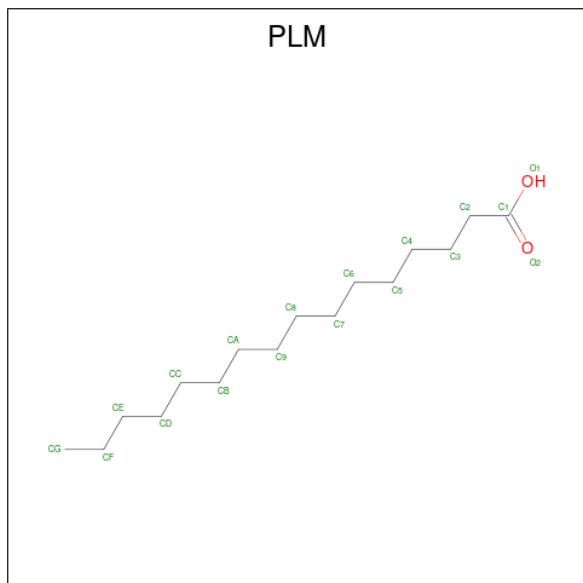
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
4	A	1	47	37	1	8	1	0	0

- Molecule 5 is octyl beta-D-glucopyranoside (three-letter code: BOG) (formula:  $C_{14}H_{28}O_6$ ).



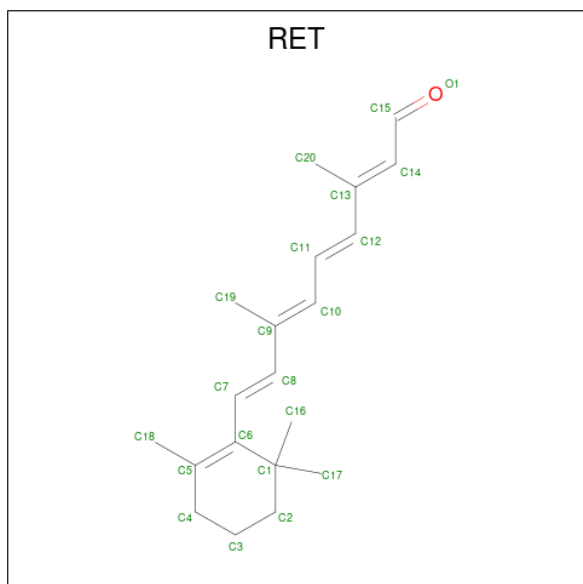
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf	
5	A	1	Total	C	O	0	0
			20	14	6		

- Molecule 6 is PALMITIC ACID (three-letter code: PLM) (formula:  $C_{16}H_{32}O_2$ ).



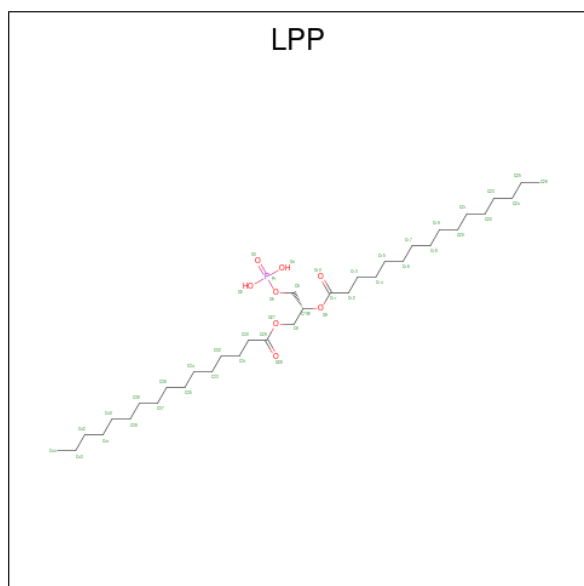
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf	
6	A	1	Total	C	O	0	0
			17	16	1		
6	A	1	Total	C	O	0	0
			17	16	1		

- Molecule 7 is RETINAL (three-letter code: RET) (formula:  $C_{20}H_{28}O$ ).



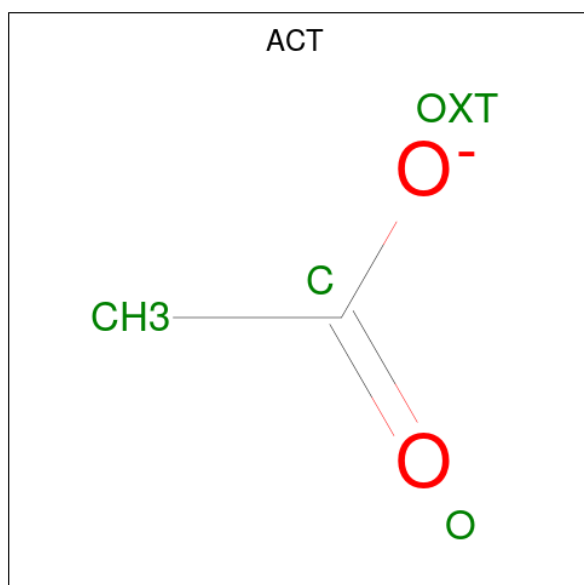
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	O	0	0
			21	20	1		

- Molecule 8 is 2-(HEXADECANOYLOXY)-1-[(PHOSPHONOXY)METHYL]ETHYL HEXADECANOATE (three-letter code: LPP) (formula: C<sub>35</sub>H<sub>69</sub>O<sub>8</sub>P).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
8	A	1	Total	C	O	P	0	0
			37	28	8	1		

- Molecule 9 is ACETATE ION (three-letter code: ACT) (formula: C<sub>2</sub>H<sub>3</sub>O<sub>2</sub><sup>-</sup>).





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

- Molecule 10 is water.

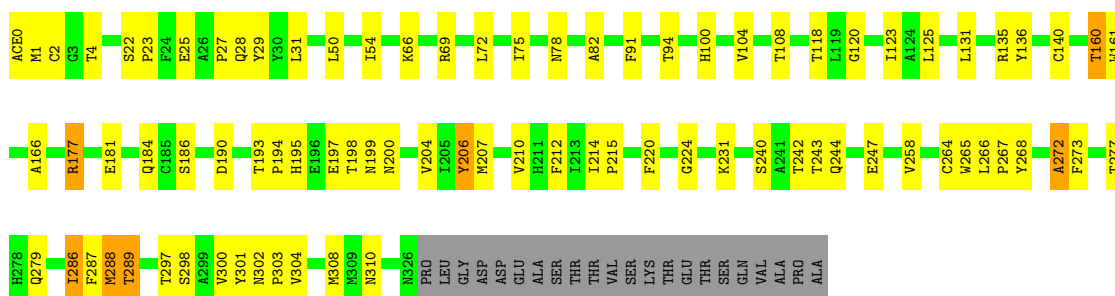
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	16	Total	O	0	0
			16	16		
10	B	2	Total	O	0	0
			2	2		

### 3 Residue-property plots

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: RHODOPSIN

Chain A: 



#### • Molecule 2: GUANINE NUCLEOTIDE-BINDING PROTEIN G(T) SUBUNIT ALPHA-1

Chain B: 



#### • Molecule 3: alpha-D-mannopyranose-(1-3)-[alpha-D-mannopyranose-(1-6)]beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain C: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	243.99Å 243.99Å 109.16Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	39.94 – 3.00 39.94 – 3.00	Depositor EDS
% Data completeness (in resolution range)	91.9 (39.94-3.00) 62.7 (39.94-3.00)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.13 (at 3.01Å)	Xtrriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, $R_{free}$	0.210 , 0.244 0.215 , 0.238	Depositor DCC
$R_{free}$ test set	810 reflections (5.18%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	65.9	Xtrriage
Anisotropy	0.663	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 59.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	2932	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	79.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.05% 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: ACT, ACE, LPP, PLM, MAN, BMA, RET, BOG, PEF, NAG

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	0.51	0/2687	0.65	2/3662 (0.1%)
2	B	0.72	0/88	0.61	0/115
All	All	0.52	0/2775	0.65	2/3777 (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	A	0	ACE	C-N-CA	8.50	142.95	121.70
1	A	272	ALA	CB-CA-C	-7.25	99.23	110.10

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	2602	0	2579	64	0
2	B	88	0	89	4	0
3	C	61	0	52	3	0
4	A	47	0	73	6	0
5	A	20	0	28	2	0
6	A	34	0	62	1	0
7	A	21	0	28	9	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
8	A	37	0	50	8	0
9	A	4	0	3	0	0
10	A	16	0	0	1	0
10	B	2	0	0	0	0
All	All	2932	0	2964	81	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 14.

All (81) 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:78:ASN:HD21	1:A:160:THR:HG21	1.17	1.08
1:A:200:ASN:O	1:A:204:VAL:HG23	1.67	0.94
1:A:78:ASN:ND2	1:A:160:THR:HG21	1.87	0.87
1:A:100:HIS:CE1	4:A:401:PEF:H111	2.19	0.77
1:A:214:ILE:HB	1:A:215:PRO:HD3	1.73	0.70
1:A:28:GLN:HB3	1:A:31:LEU:HD12	1.74	0.69
1:A:27:PRO:HB3	1:A:29:TYR:CE2	2.27	0.69
4:A:401:PEF:H12	4:A:401:PEF:O4	1.92	0.68
4:A:401:PEF:H351	4:A:401:PEF:H391	1.75	0.67
1:A:100:HIS:O	4:A:401:PEF:H52	1.98	0.64
1:A:75:ILE:HG21	1:A:131:LEU:HD13	1.80	0.62
1:A:75:ILE:CG2	1:A:131:LEU:HD13	2.30	0.62
1:A:224:GLY:N	5:A:402:BOG:H8'2	2.15	0.61
1:A:78:ASN:HD21	1:A:160:THR:CG2	2.05	0.61
1:A:181:GLU:HB3	10:A:511:HOH:O	2.01	0.61
1:A:4:THR:HG21	3:C:1:NAG:H82	1.83	0.61
7:A:410:RET:H8	7:A:410:RET:H181	1.82	0.60
1:A:123:ILE:HG23	1:A:160:THR:CG2	2.31	0.60
8:A:411:LPP:C8	8:A:411:LPP:H122	2.32	0.58
6:A:403:PLM:H22	8:A:411:LPP:H161	1.85	0.58
1:A:100:HIS:CD2	1:A:104:VAL:HG11	2.39	0.58
1:A:220:PHE:HA	5:A:402:BOG:H8'1	1.85	0.57
1:A:288:MET:HA	1:A:288:MET:CE	2.35	0.57
1:A:23:PRO:HB3	1:A:184:GLN:HB3	1.86	0.56
1:A:72:LEU:HD12	2:B:346:ASP:HB3	1.88	0.56
1:A:298:SER:O	1:A:302:ASN:HB2	2.06	0.56
1:A:264:CYS:HB2	1:A:301:TYR:OH	2.06	0.55
8:A:411:LPP:H122	8:A:411:LPP:HC81	1.89	0.54
1:A:118:THR:OG1	7:A:410:RET:H203	2.08	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:287:PHE:HD1	1:A:288:MET:HE3	1.73	0.54
8:A:411:LPP:C8	8:A:411:LPP:C12	2.86	0.53
1:A:272:ALA:HB2	7:A:410:RET:C16	2.39	0.53
1:A:300:VAL:O	1:A:303:PRO:HD2	2.08	0.53
1:A:66:LYS:HA	1:A:69:ARG:NH2	2.24	0.53
1:A:100:HIS:CG	1:A:104:VAL:HG11	2.46	0.51
4:A:401:PEF:H351	4:A:401:PEF:C39	2.42	0.50
1:A:286:ILE:HA	1:A:289:THR:HB	1.92	0.50
1:A:22:SER:HB3	1:A:25:GLU:HB2	1.94	0.50
1:A:304:VAL:HA	1:A:308:MET:HG3	1.93	0.50
7:A:410:RET:H181	7:A:410:RET:C8	2.42	0.50
1:A:210:VAL:O	1:A:215:PRO:HD3	2.13	0.49
1:A:135:ARG:HD3	2:B:349:LEU:HD11	1.94	0.48
1:A:272:ALA:HB2	7:A:410:RET:H162	1.95	0.48
1:A:4:THR:CG2	3:C:1:NAG:H82	2.43	0.48
1:A:198:THR:O	1:A:199:ASN:HB2	2.14	0.48
1:A:304:VAL:HA	1:A:308:MET:CG	2.44	0.47
1:A:297:THR:O	1:A:297:THR:HG22	2.14	0.47
1:A:288:MET:HA	1:A:288:MET:HE3	1.97	0.47
1:A:166:ALA:O	1:A:206:TYR:OH	2.26	0.46
8:A:411:LPP:HC81	8:A:411:LPP:C12	2.44	0.46
1:A:207:MET:HB2	7:A:410:RET:H173	1.98	0.46
1:A:123:ILE:HG23	1:A:160:THR:HG23	1.98	0.46
1:A:240:SER:O	1:A:244:GLN:HG2	2.15	0.45
1:A:197:GLU:OE1	1:A:197:GLU:N	2.50	0.45
1:A:94:THR:OG1	1:A:186:SER:HB3	2.17	0.45
1:A:207:MET:CB	7:A:410:RET:H173	2.46	0.44
1:A:28:GLN:CB	1:A:31:LEU:HD12	2.44	0.44
1:A:50:LEU:O	1:A:54:ILE:HG13	2.17	0.44
7:A:410:RET:H11	7:A:410:RET:H191	1.80	0.44
1:A:266:LEU:HB3	1:A:267:PRO:HD3	1.99	0.44
1:A:136:TYR:O	1:A:140:CYS:HB2	2.18	0.43
1:A:193:THR:HG22	1:A:195:HIS:HB2	2.00	0.43
1:A:1:MET:O	1:A:1:MET:HG3	2.18	0.43
8:A:411:LPP:O28	8:A:411:LPP:H332	2.19	0.43
2:B:345:LYS:HA	2:B:350:PHE:OXT	2.18	0.43
1:A:91:PHE:N	1:A:91:PHE:CD1	2.86	0.42
1:A:273:PHE:O	1:A:277:THR:HG23	2.19	0.42
1:A:194:PRO:HG3	1:A:279:GLN:OE1	2.18	0.42
7:A:410:RET:H7	7:A:410:RET:H161	1.84	0.42
1:A:177:ARG:NH1	1:A:190:ASP:OD2	2.49	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:C:3:BMA:H62	3:C:5:MAN:H2	1.86	0.42
1:A:231:LYS:NZ	1:A:247:GLU:OE2	2.53	0.41
1:A:240:SER:HB3	1:A:243:THR:HB	2.02	0.41
1:A:100:HIS:HA	4:A:401:PEF:H52	2.02	0.41
1:A:160:THR:HG22	1:A:161[A]:TRP:CD1	2.56	0.41
1:A:212:PHE:C	1:A:215:PRO:HD2	2.41	0.41
1:A:310:ASN:ND2	2:B:348:GLY:HA3	2.35	0.41
8:A:411:LPP:H122	8:A:411:LPP:HC82	2.02	0.40
1:A:82:ALA:HB1	1:A:120:GLY:O	2.21	0.40
8:A:411:LPP:H161	8:A:411:LPP:H132	1.80	0.40
1:A:125:LEU:HD13	1:A:265:TRP:NE1	2.36	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	326/349 (93%)	294 (90%)	32 (10%)	0	100	100
2	B	9/11 (82%)	9 (100%)	0	0	100	100
All	All	335/360 (93%)	303 (90%)	32 (10%)	0	100	100

There are no Ramachandran outliers to report.

### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	A	279/296 (94%)	268 (96%)	11 (4%)	32 69
2	B	10/10 (100%)	9 (90%)	1 (10%)	7 29
All	All	289/306 (94%)	277 (96%)	12 (4%)	30 66

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

Mol	Chain	Res	Type
1	A	2	CYS
1	A	108	THR
1	A	160	THR
1	A	177	ARG
1	A	206	TYR
1	A	242	THR
1	A	258	VAL
1	A	268	TYR
1	A	286	ILE
1	A	288	MET
1	A	289	THR
2	B	340	ILE

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](#)

5 monosaccharides 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
3	NAG	C	1	1,3	14,14,15	0.56	0	17,19,21	2.34	6 (35%)
3	NAG	C	2	3	14,14,15	0.62	0	17,19,21	1.23	1 (5%)
3	BMA	C	3	3	11,11,12	0.87	0	15,15,17	1.71	3 (20%)
3	MAN	C	4	3	11,11,12	0.52	0	15,15,17	1.06	1 (6%)
3	MAN	C	5	3	11,11,12	0.88	1 (9%)	15,15,17	1.69	3 (20%)

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
3	NAG	C	1	1,3	-	2/6/23/26	0/1/1/1
3	NAG	C	2	3	-	0/6/23/26	0/1/1/1
3	BMA	C	3	3	-	2/2/19/22	0/1/1/1
3	MAN	C	4	3	-	2/2/19/22	0/1/1/1
3	MAN	C	5	3	-	2/2/19/22	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	5	MAN	C2-C3	2.02	1.55	1.52

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	1	NAG	C1-O5-C5	5.43	119.47	112.19
3	C	1	NAG	C2-N2-C7	4.41	128.81	122.90
3	C	5	MAN	C1-C2-C3	4.17	115.72	109.64
3	C	3	BMA	C3-C4-C5	3.72	116.98	110.23
3	C	1	NAG	O5-C1-C2	3.42	116.59	111.29
3	C	4	MAN	C1-O5-C5	3.40	116.75	112.19
3	C	1	NAG	O7-C7-C8	-3.19	116.38	122.05
3	C	5	MAN	O5-C5-C6	3.12	113.74	107.66
3	C	1	NAG	O7-C7-N2	2.99	127.27	121.98
3	C	2	NAG	O5-C5-C6	2.93	113.37	107.66
3	C	3	BMA	C2-C3-C4	2.77	115.74	110.86

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	3	BMA	O5-C1-C2	-2.53	104.75	110.79
3	C	5	MAN	C3-C4-C5	-2.26	106.14	110.23
3	C	1	NAG	C4-C3-C2	2.21	114.25	111.02

There are no chirality outliers.

All (8) torsion outliers are listed below:

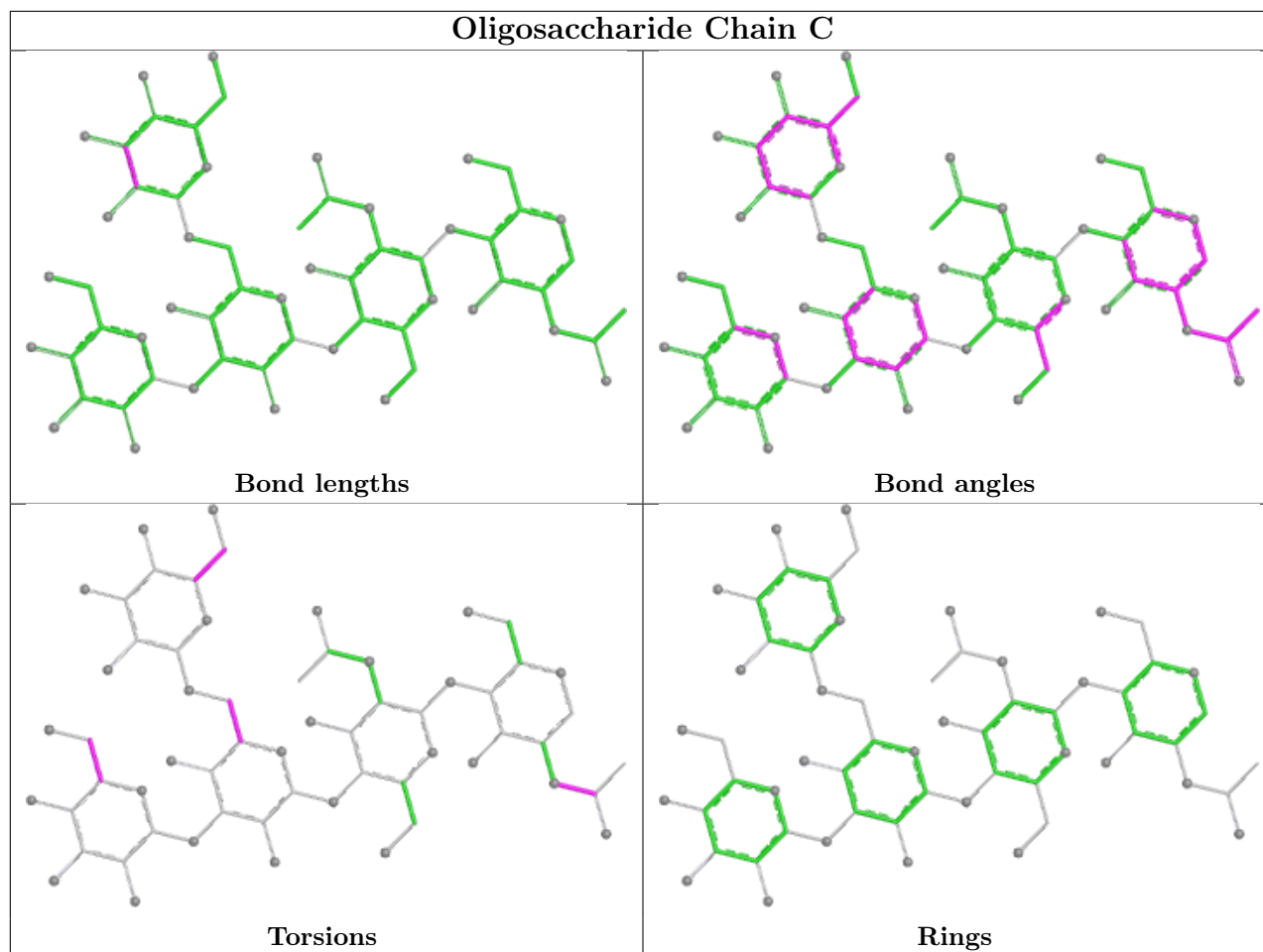
Mol	Chain	Res	Type	Atoms
3	C	3	BMA	O5-C5-C6-O6
3	C	3	BMA	C4-C5-C6-O6
3	C	5	MAN	C4-C5-C6-O6
3	C	5	MAN	O5-C5-C6-O6
3	C	1	NAG	C8-C7-N2-C2
3	C	4	MAN	C4-C5-C6-O6
3	C	1	NAG	O7-C7-N2-C2
3	C	4	MAN	O5-C5-C6-O6

There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	3	BMA	1	0
3	C	1	NAG	2	0
3	C	5	MAN	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 oligosaccharide.



## 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	$\# Z  > 2$
6	PLM	A	404	1	15,16,17	0.67	0	14,15,17	1.19	1 (7%)
7	RET	A	410	-	21,21,21	0.94	1 (4%)	27,28,28	1.86	8 (29%)
9	ACT	A	412	-	3,3,3	0.96	0	3,3,3	1.33	0
5	BOG	A	402	-	20,20,20	0.80	1 (5%)	25,25,25	1.21	1 (4%)
4	PEF	A	401	-	46,46,46	0.95	3 (6%)	49,51,51	1.13	4 (8%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
8	LPP	A	411	-	36,36,43	1.17	2 (5%)	39,41,48	1.24	4 (10%)
6	PLM	A	403	1	15,16,17	0.69	0	14,15,17	0.96	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
6	PLM	A	404	1	-	0/14/14/15	-
7	RET	A	410	-	-	3/14/31/31	0/1/1/1
5	BOG	A	402	-	-	2/11/31/31	0/1/1/1
4	PEF	A	401	-	-	7/50/50/50	-
8	LPP	A	411	-	-	23/38/38/45	-
6	PLM	A	403	1	-	0/14/14/15	-

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
8	A	411	LPP	O9-C11	4.67	1.47	1.34
8	A	411	LPP	O27-C29	4.27	1.45	1.33
7	A	410	RET	C1-C6	-3.36	1.49	1.53
5	A	402	BOG	O1-C1	2.27	1.44	1.40
4	A	401	PEF	P-O2P	2.24	1.65	1.55
4	A	401	PEF	P-O4P	2.19	1.68	1.59
4	A	401	PEF	C31-C30	2.00	1.56	1.50

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	A	411	LPP	O9-C11-C12	4.90	122.08	111.48
7	A	410	RET	C11-C10-C9	-4.21	121.38	127.28
5	A	402	BOG	C1'-O1-C1	3.66	119.94	113.68
7	A	410	RET	C3-C4-C5	-3.37	108.05	114.06
7	A	410	RET	C16-C1-C6	-3.31	105.06	110.24
8	A	411	LPP	O9-C11-O10	-2.97	116.76	123.70
7	A	410	RET	C7-C6-C5	2.91	128.27	121.56
6	A	404	PLM	CB-CA-C9	-2.78	100.30	114.37
4	A	401	PEF	C22-C21-C20	-2.75	100.45	114.37
7	A	410	RET	C1-C6-C7	-2.60	108.60	115.65
7	A	410	RET	C7-C8-C9	-2.53	122.48	126.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
7	A	410	RET	C12-C13-C14	2.40	122.79	119.01
7	A	410	RET	C11-C12-C13	-2.37	119.87	126.36
4	A	401	PEF	C32-C31-C30	2.31	122.17	113.69
8	A	411	LPP	O27-C29-O28	-2.28	117.93	123.63
4	A	401	PEF	O2-C2-C3	-2.12	100.72	108.34
4	A	401	PEF	C13-C12-C11	-2.02	105.71	113.13
8	A	411	LPP	O27-C29-C30	2.01	117.97	111.83

There are no chirality outliers.

All (35) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	402	BOG	O5-C1-O1-C1'
8	A	411	LPP	C6-O5-P1-O2
8	A	411	LPP	C6-O5-P1-O3
8	A	411	LPP	C6-O5-P1-O4
8	A	411	LPP	O10-C11-O9-C7
8	A	411	LPP	O28-C29-O27-C8
8	A	411	LPP	C30-C29-O27-C8
8	A	411	LPP	C12-C11-O9-C7
8	A	411	LPP	C11-C12-C13-C14
8	A	411	LPP	C8-C7-O9-C11
8	A	411	LPP	C33-C34-C35-C36
7	A	410	RET	C1-C6-C7-C8
7	A	410	RET	C5-C6-C7-C8
8	A	411	LPP	C18-C19-C20-C21
8	A	411	LPP	C21-C22-C23-C24
4	A	401	PEF	C11-C10-O2-C2
8	A	411	LPP	C12-C13-C14-C15
4	A	401	PEF	O4-C10-O2-C2
8	A	411	LPP	C29-C30-C31-C32
8	A	411	LPP	C19-C20-C21-C22
5	A	402	BOG	C2-C1-O1-C1'
8	A	411	LPP	O9-C7-C8-O27
8	A	411	LPP	C23-C24-C25-C26
8	A	411	LPP	C6-C7-C8-O27
8	A	411	LPP	C17-C18-C19-C20
4	A	401	PEF	C3-C2-O2-C10
8	A	411	LPP	C22-C23-C24-C25
4	A	401	PEF	C1-C2-O2-C10
4	A	401	PEF	O5-C30-O3-C3
8	A	411	LPP	C7-C6-O5-P1

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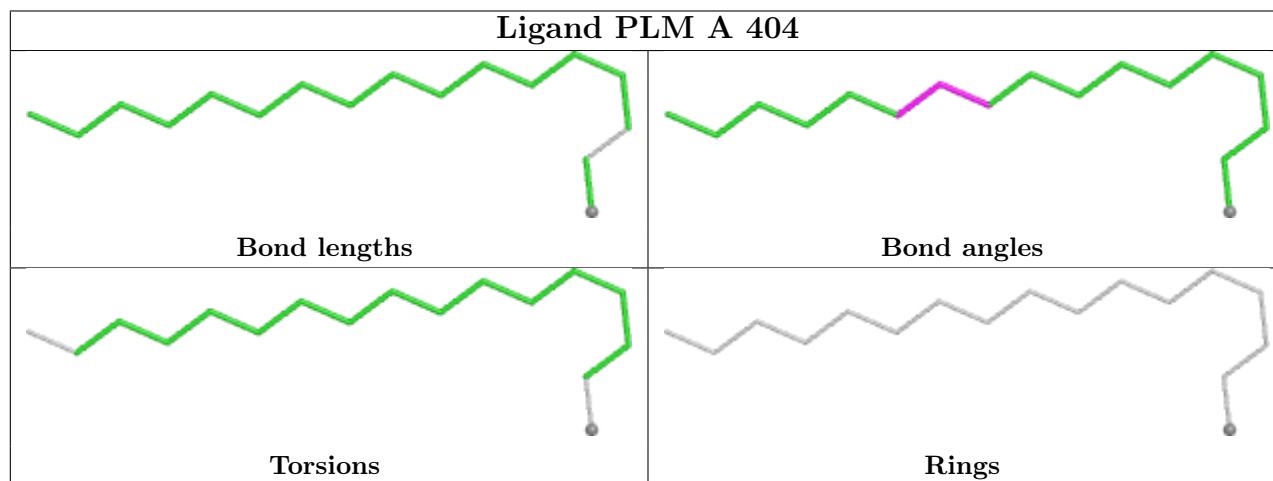
Mol	Chain	Res	Type	Atoms
7	A	410	RET	C11-C12-C13-C14
4	A	401	PEF	O2-C10-C11-C12
4	A	401	PEF	O4-C10-C11-C12
8	A	411	LPP	C13-C14-C15-C16
8	A	411	LPP	C32-C33-C34-C35

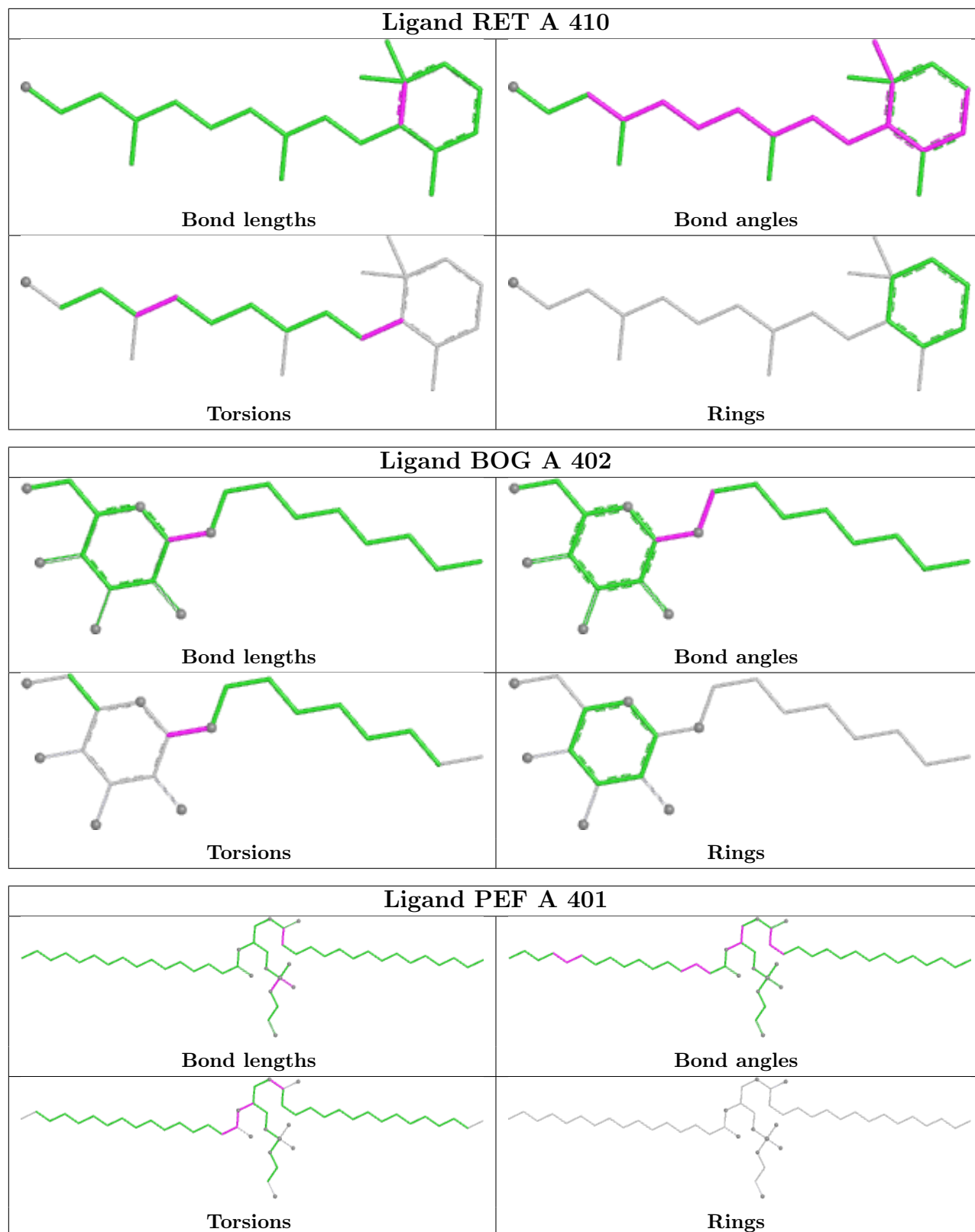
There are no ring outliers.

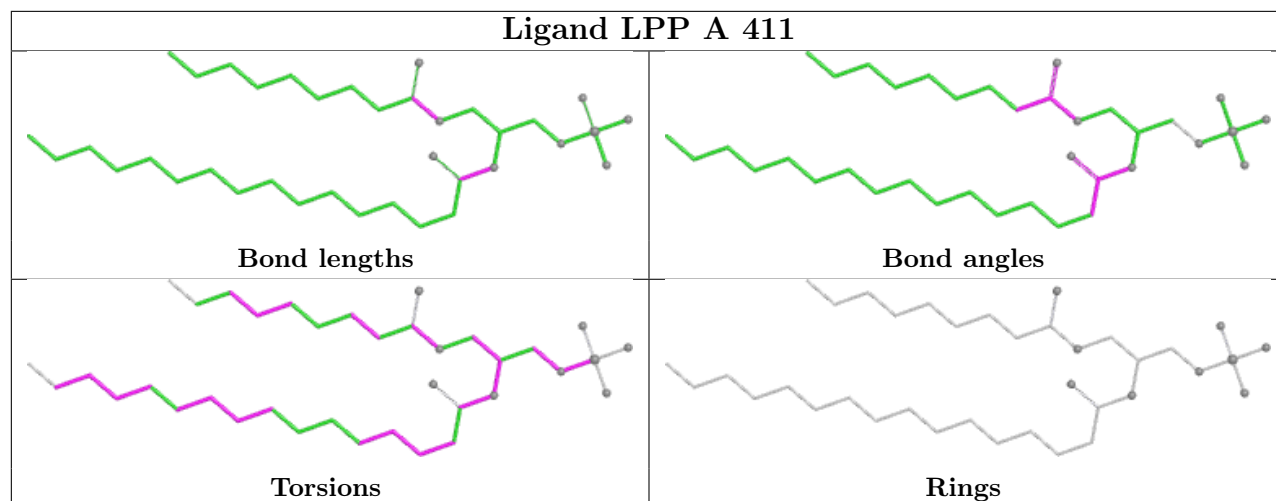
5 monomers are involved in 25 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	A	410	RET	9	0
5	A	402	BOG	2	0
4	A	401	PEF	6	0
8	A	411	LPP	8	0
6	A	403	PLM	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	326/349 (93%)	-0.87	0 100 100	59, 74, 98, 135	0
2	B	11/11 (100%)	-0.89	0 100 100	83, 90, 97, 100	0
All	All	337/360 (93%)	-0.87	0 100 100	59, 75, 99, 135	0

There are no RSRZ outliers to report.

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

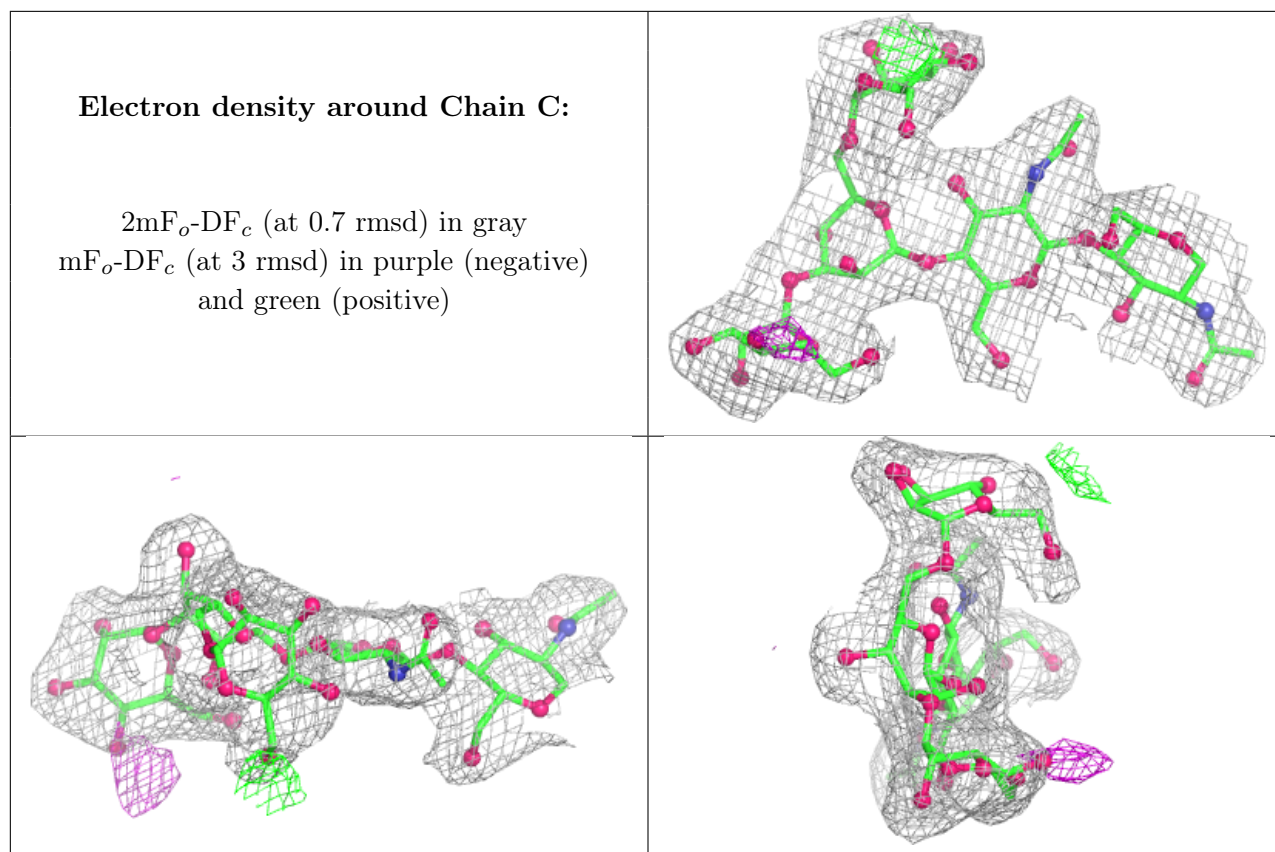
There are no non-standard protein/DNA/RNA residues in this entry.

### 6.3 Carbohydrates [i](#)

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
3	MAN	C	5	11/12	0.91	0.25	104,112,118,118	0
3	MAN	C	4	11/12	0.94	0.25	81,89,94,100	0
3	BMA	C	3	11/12	0.95	0.14	78,92,103,111	0
3	NAG	C	2	14/15	0.98	0.12	51,59,73,77	0
3	NAG	C	1	14/15	0.98	0.10	55,59,66,70	0

The following is a graphical depiction of the model fit to experimental electron density for oligosaccharide. Each fit is shown from different orientation to approximate a three-dimensional view.

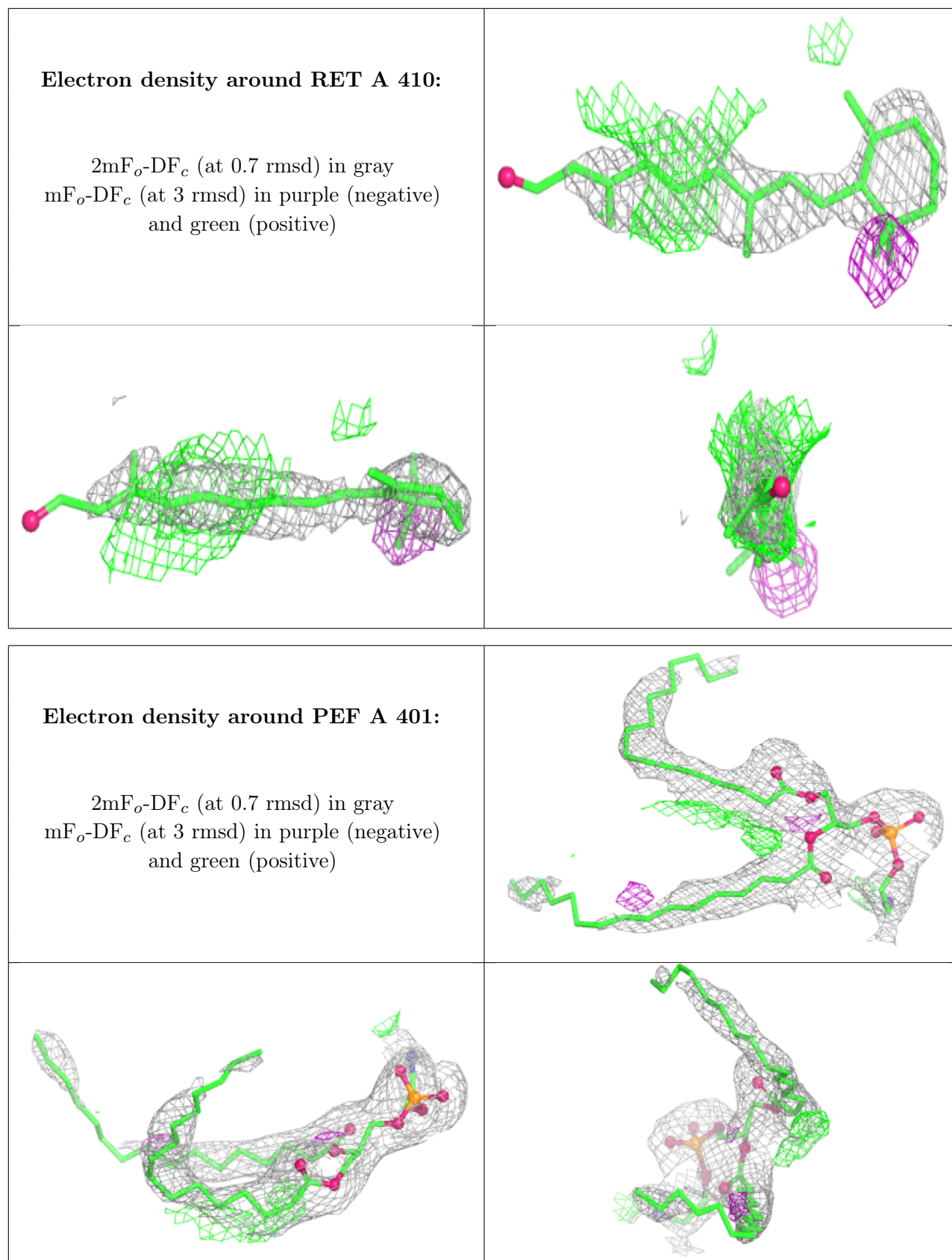


## 6.4 Ligands [i](#)

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.

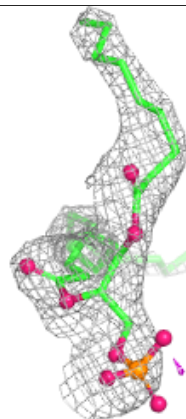
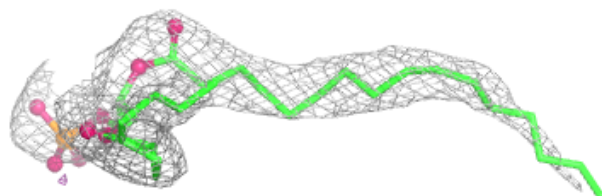
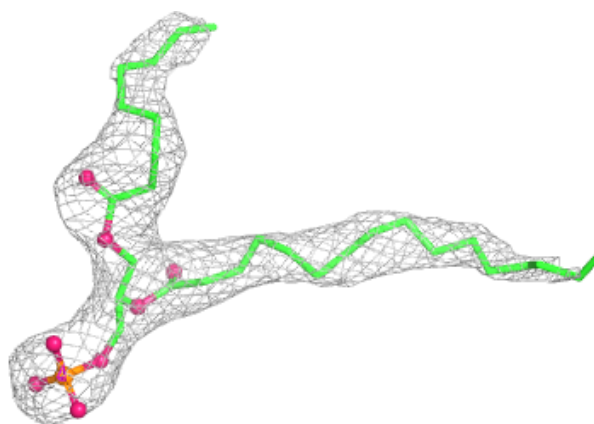
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
7	RET	A	410	21/21	0.80	0.38	73,84,87,90	21
4	PEF	A	401	47/47	0.87	0.36	63,105,124,147	0
8	LPP	A	411	37/44	0.90	0.32	79,117,175,186	0
6	PLM	A	404	17/18	0.92	0.26	84,100,114,117	0
5	BOG	A	402	20/20	0.93	0.31	78,116,134,137	0
6	PLM	A	403	17/18	0.95	0.20	79,88,112,116	0
9	ACT	A	412	4/4	0.96	0.41	83,88,96,98	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.

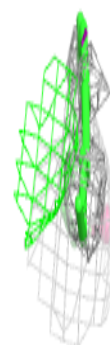
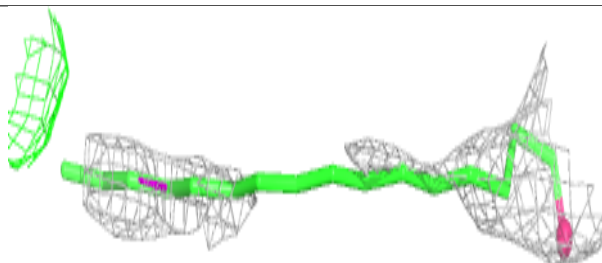
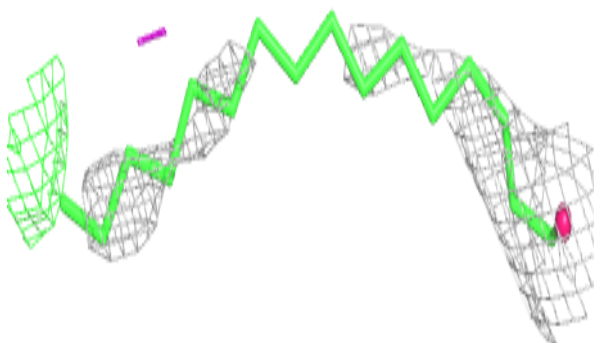


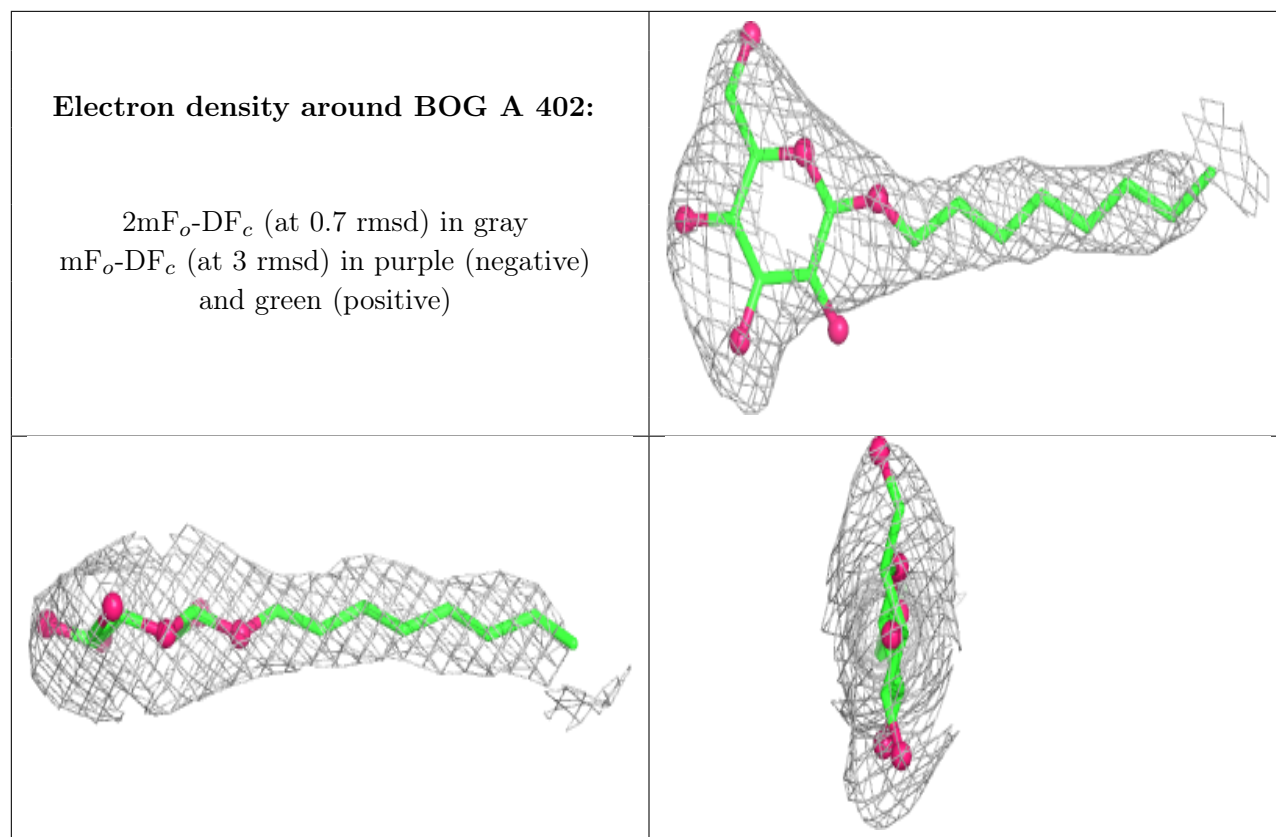
**Electron density around LPP A 411:**

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

**Electron density around PLM A 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 [i](#)

There are no such residues in this entry.