



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 27, 2025 – 01:27 pm GMT

PDB ID : 9EWU  
Title : Crystal structure of human butyrylcholinesterase in complex with (2R,3S)-1-[(cyclopropylmethyl)amino]-3-[(9H-fluoren-9-yl)amino]-4-phenylbutan-2-ol  
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Deposited on : 2024-04-04  
Resolution : 2.45 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)  
Xtrriage (Phenix) : 1.13  
EDS : 3.0  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.003 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.40

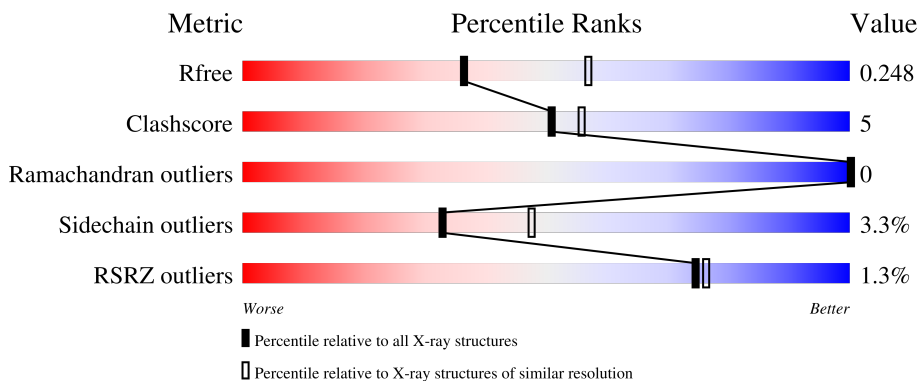
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.45 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	164625	1096 (2.46-2.46)
Clashscore	180529	1178 (2.46-2.46)
Ramachandran outliers	177936	1170 (2.46-2.46)
Sidechain outliers	177891	1170 (2.46-2.46)
RSRZ outliers	164620	1096 (2.46-2.46)

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	529	
2	B	2	
3	C	3	
3	D	3	
3	E	3	

## 2 Entry composition i

There are 10 unique types of molecules in this entry. The entry contains 4587 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 Cholinesterase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	526	4220	2725	711	769	15	0	4	0

There are 4 discrepancies between the modelled and reference sequences:

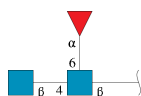
Chain	Residue	Modelled	Actual	Comment	Reference
A	17	GLN	ASN	engineered mutation	UNP P06276
A	455	GLN	ASN	engineered mutation	UNP P06276
A	481	GLN	ASN	engineered mutation	UNP P06276
A	486	GLN	ASN	engineered mutation	UNP P06276

- Molecule 2 is an oligosaccharide called alpha-L-fucopyranose-(1-6)-2-acetamido-2-deoxy-beta-D-glucopyranose.



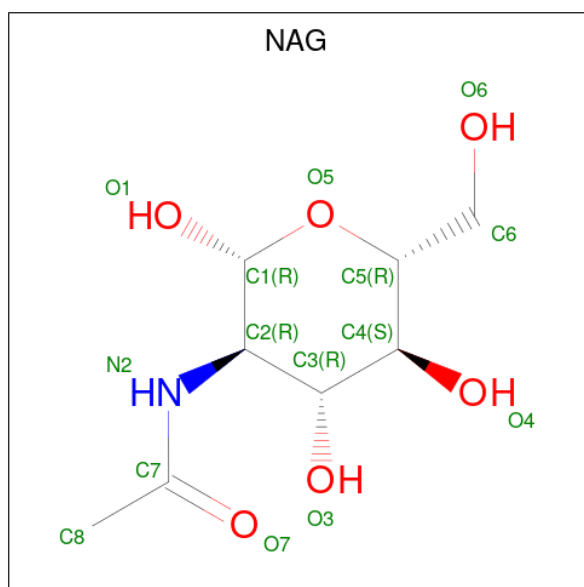
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	B	2	24	14	1	9	0	0	0

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



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	3	Total	C	N	O	0	0	0
			38	22	2	14			
3	D	3	Total	C	N	O	0	0	0
			38	22	2	14			
3	E	3	Total	C	N	O	0	0	0
			38	22	2	14			

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula:  $C_8H_{15}NO_6$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			14	8	1	5		
4	A	1	Total	C	N	O	0	0
			14	8	1	5		

- Molecule 5 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES) (formula:  $C_6H_{13}NO_4S$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
5	A	1	12	6	1	4	1	0	0

- Molecule 6 is SULFATE ION (three-letter code: SO<sub>4</sub>) (formula: O<sub>4</sub>S).



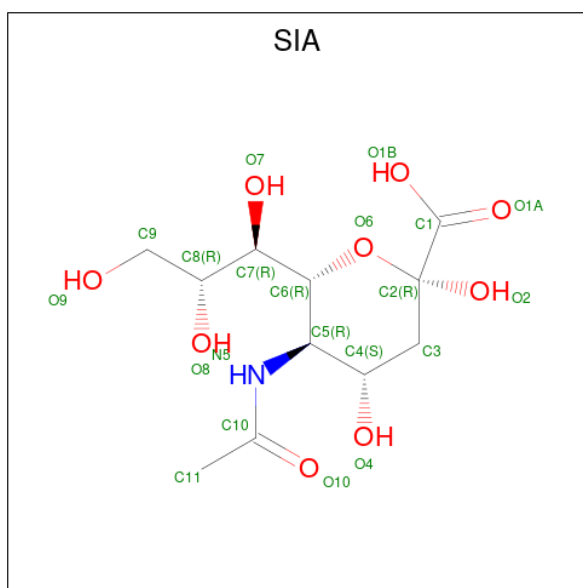
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
6	A	1	5	4	1	0	0
6	A	1	5	4	1	0	0
6	A	1	5	4	1	0	0

- Molecule 7 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	O	0	0
			6	3	3		

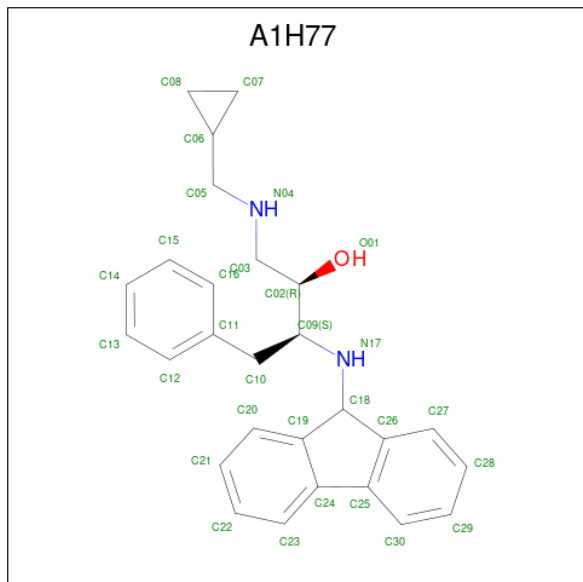
- Molecule 8 is N-acetyl-alpha-neuraminic acid (three-letter code: SIA) (formula:  $C_{11}H_{19}NO_9$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
8	A	1	Total	C	N	O	0	0
			21	11	1	9		

- Molecule 9 is (2 {R},3 {S})-1-(cyclopropylmethylamino)-3-(9 {H}-fluoren-9-ylamino)-4-p

henyl-butan-2-ol (three-letter code: A1H77) (formula:  $C_{27}H_{30}N_2O$ ) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
9	A	1	60	54	4	2	0	1

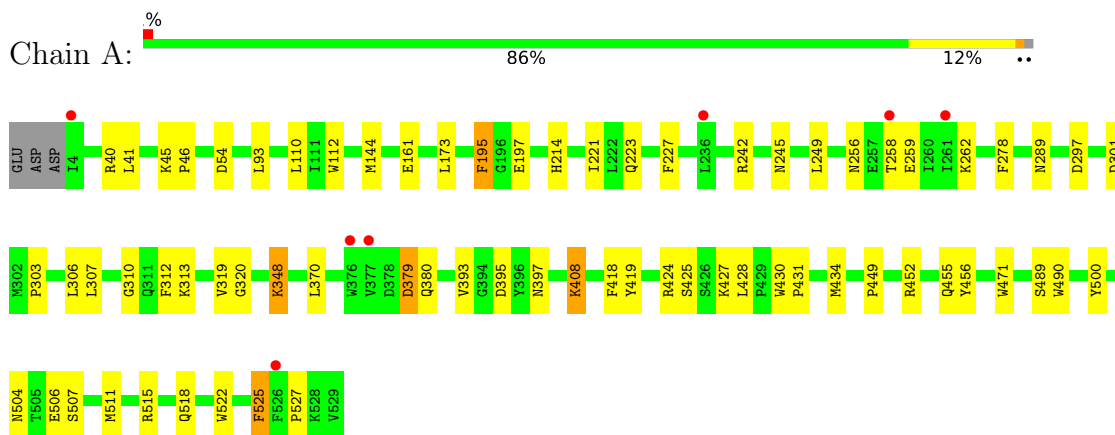
- Molecule 10 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
10	A	87	87	87	0	0

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

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

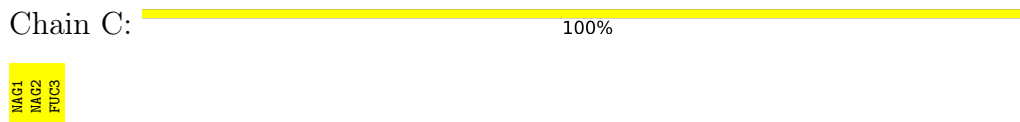
- Molecule 1: Cholinesterase



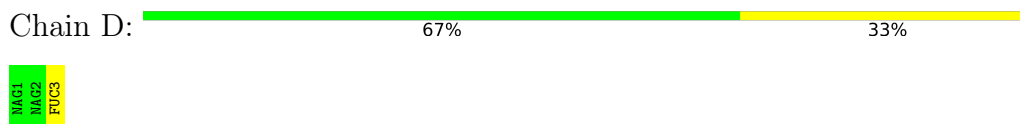
- Molecule 2: alpha-L-fucopyranose-(1-6)-2-acetamido-2-deoxy-beta-D-glucopyranose



- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose



- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose



- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose



Chain E:

100%

MAG1  
MAG2  
FUC3

## 4 Data and refinement statistics

Property	Value	Source
Space group	I 4 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	154.60Å 154.60Å 128.52Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.91 – 2.45 38.91 – 2.45	Depositor EDS
% Data completeness (in resolution range)	100.0 (38.91-2.45) 99.9 (38.91-2.45)	Depositor EDS
$R_{merge}$	0.20	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.68 (at 2.45Å)	Xtrriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, $R_{free}$	0.188 , 0.244 0.188 , 0.248	Depositor DCC
$R_{free}$ test set	1164 reflections (4.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	61.9	Xtrriage
Anisotropy	0.344	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 45.6	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	0.96	EDS
Total number of atoms	4587	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	71.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.71% 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: A1H77, SO4, MES, GOL, NAG, FUC, SIA

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	0.46	0/4346	0.62	0/5899

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4220	0	4124	44	0
2	B	24	0	22	0	0
3	C	38	0	34	0	0
3	D	38	0	34	0	0
3	E	38	0	34	0	0
4	A	28	0	26	0	0
5	A	12	0	12	5	0
6	A	15	0	0	0	0
7	A	6	0	8	1	0
8	A	21	0	18	0	0
9	A	60	0	0	0	0
10	A	87	0	0	3	0
All	All	4587	0	4312	45	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 5.

All (45) 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:515[B]:ARG:HD2	5:A:603:MES:H32	1.59	0.84
1:A:348:LYS:HD2	1:A:348:LYS:H	1.55	0.70
1:A:515[A]:ARG:H	5:A:603:MES:H52	1.59	0.65
1:A:515[B]:ARG:H	5:A:603:MES:H52	1.60	0.64
1:A:242:ARG:HH22	7:A:607:GOL:H11	1.64	0.63
1:A:500:TYR:CZ	1:A:511:MET:HB2	2.37	0.60
1:A:348:LYS:H	1:A:348:LYS:CD	2.14	0.58
1:A:45:LYS:NZ	1:A:297:ASP:OD2	2.35	0.57
1:A:522:TRP:O	1:A:527:PRO:HD3	2.07	0.55
1:A:227:PHE:HZ	1:A:307:LEU:HB2	1.72	0.54
1:A:395:ASP:OD1	1:A:515[A]:ARG:HD2	2.09	0.53
1:A:256:ASN:HB3	1:A:259:GLU:HB2	1.92	0.51
1:A:319:VAL:O	1:A:418:PHE:HA	2.11	0.51
1:A:379:ASP:OD1	1:A:380:GLN:HG2	2.11	0.50
1:A:507:SER:HA	10:A:730:HOH:O	2.12	0.48
1:A:525:PHE:C	1:A:525:PHE:CD2	2.86	0.48
1:A:504:ASN:OD1	1:A:506:GLU:HG2	2.13	0.48
1:A:449:PRO:HA	1:A:456:TYR:CD2	2.49	0.48
1:A:427:LYS:HD2	1:A:455:GLN:HB2	1.96	0.48
1:A:214:HIS:O	1:A:313:LYS:NZ	2.45	0.47
1:A:227:PHE:CE1	1:A:303:PRO:HB2	2.50	0.47
1:A:430:TRP:HB3	1:A:431:PRO:HD2	1.95	0.47
1:A:393:VAL:O	1:A:397:ASN:HB2	2.16	0.45
1:A:310:GLY:HA2	1:A:312:PHE:CE2	2.51	0.45
1:A:197:GLU:HA	1:A:223:GLN:O	2.18	0.44
1:A:301:ASP:HB3	1:A:306:LEU:HD21	2.00	0.44
1:A:245:ASN:O	1:A:249:LEU:HD12	2.18	0.44
1:A:242:ARG:HD3	1:A:289:ASN:O	2.17	0.44
1:A:227:PHE:CD1	1:A:303:PRO:HB2	2.53	0.43
1:A:452:ARG:NH2	10:A:713:HOH:O	2.51	0.43
1:A:161:GLU:HG3	1:A:258:THR:HG23	2.01	0.43
1:A:518:GLN:HE22	5:A:603:MES:H22	1.83	0.43
1:A:425:SER:HB3	1:A:428:LEU:HB2	2.00	0.42
1:A:320:GLY:HA3	1:A:419:TYR:CE2	2.55	0.42
5:A:603:MES:H72	10:A:756:HOH:O	2.18	0.42
1:A:408:LYS:HA	1:A:408:LYS:HD2	1.79	0.42
1:A:195:PHE:HB3	1:A:221:ILE:HB	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:112:TRP:HA	1:A:195:PHE:O	2.20	0.41
1:A:431:PRO:HD2	1:A:434:MET:SD	2.61	0.41
1:A:506:GLU:HG2	1:A:507:SER:H	1.85	0.41
1:A:46:PRO:HB2	1:A:173:LEU:HD22	2.02	0.41
1:A:419:TYR:HB3	1:A:490:TRP:CZ2	2.56	0.41
1:A:93:LEU:HD23	1:A:93:LEU:HA	1.83	0.40
1:A:424:ARG:NH2	1:A:430:TRP:O	2.55	0.40
1:A:500:TYR:CE1	1:A:511:MET:HB2	2.56	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	528/529 (100%)	498 (94%)	30 (6%)	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	454/454 (100%)	438 (96%)	16 (4%)	31   45

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	40	ARG
1	A	41	LEU
1	A	54	ASP
1	A	110[A]	LEU
1	A	110[B]	LEU
1	A	144	MET
1	A	195	PHE
1	A	262	LYS
1	A	278	PHE
1	A	348	LYS
1	A	370	LEU
1	A	379	ASP
1	A	408	LYS
1	A	471	TRP
1	A	489	SER
1	A	525	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	35	GLN

### 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](#)

11 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
2	NAG	B	1	1,2	14,14,15	0.30	0	17,19,21	0.50	0
2	FUC	B	2	2	10,10,11	1.49	3 (30%)	14,14,16	0.70	0
3	NAG	C	1	3,1	14,14,15	0.86	1 (7%)	17,19,21	0.97	2 (11%)
3	NAG	C	2	3	14,14,15	0.30	0	17,19,21	0.58	1 (5%)
3	FUC	C	3	3	10,10,11	1.93	3 (30%)	14,14,16	1.60	4 (28%)
3	NAG	D	1	3,1	14,14,15	0.44	0	17,19,21	0.53	0
3	NAG	D	2	3	14,14,15	0.27	0	17,19,21	0.55	0
3	FUC	D	3	3	10,10,11	1.17	0	14,14,16	0.91	2 (14%)
3	NAG	E	1	3,1	14,14,15	0.53	0	17,19,21	1.26	2 (11%)
3	NAG	E	2	3	14,14,15	0.47	0	17,19,21	0.65	1 (5%)
3	FUC	E	3	3	10,10,11	1.39	2 (20%)	14,14,16	1.37	3 (21%)

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	NAG	B	1	1,2	-	2/6/23/26	0/1/1/1
2	FUC	B	2	2	-	-	0/1/1/1
3	NAG	C	1	3,1	-	2/6/23/26	0/1/1/1
3	NAG	C	2	3	-	0/6/23/26	0/1/1/1
3	FUC	C	3	3	-	-	0/1/1/1
3	NAG	D	1	3,1	-	0/6/23/26	0/1/1/1
3	NAG	D	2	3	-	4/6/23/26	0/1/1/1
3	FUC	D	3	3	-	-	0/1/1/1
3	NAG	E	1	3,1	-	1/6/23/26	0/1/1/1
3	NAG	E	2	3	-	2/6/23/26	0/1/1/1
3	FUC	E	3	3	-	-	0/1/1/1

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	3	FUC	C2-C3	3.45	1.57	1.52
3	C	3	FUC	C1-C2	3.37	1.59	1.52
3	E	3	FUC	C1-C2	2.58	1.58	1.52
3	C	1	NAG	O5-C1	-2.50	1.39	1.43
2	B	2	FUC	C2-C3	2.46	1.56	1.52
2	B	2	FUC	C4-C3	2.24	1.58	1.52

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	3	FUC	O5-C5	2.23	1.48	1.43
3	E	3	FUC	C4-C5	2.09	1.57	1.52
2	B	2	FUC	O5-C1	-2.00	1.40	1.43

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	E	1	NAG	C1-O5-C5	3.70	117.21	112.19
3	C	3	FUC	C1-C2-C3	3.07	113.44	109.67
3	E	3	FUC	O5-C5-C4	2.70	114.36	109.52
3	C	3	FUC	O2-C2-C1	2.62	114.50	109.15
3	C	3	FUC	C1-O5-C5	2.60	118.66	112.78
3	C	3	FUC	O5-C5-C4	2.49	113.98	109.52
3	C	1	NAG	C3-C4-C5	2.41	114.54	110.24
3	E	3	FUC	C1-O5-C5	2.26	117.90	112.78
3	D	3	FUC	O2-C2-C1	2.12	113.49	109.15
3	E	2	NAG	C1-O5-C5	2.10	115.04	112.19
3	E	1	NAG	C1-C2-N2	2.10	114.07	110.49
3	E	3	FUC	O2-C2-C1	2.09	113.42	109.15
3	C	2	NAG	C1-O5-C5	2.02	114.93	112.19
3	C	1	NAG	C1-O5-C5	-2.02	109.46	112.19
3	D	3	FUC	C1-O5-C5	2.00	117.32	112.78

There are no chirality outliers.

All (11) torsion outliers are listed below:

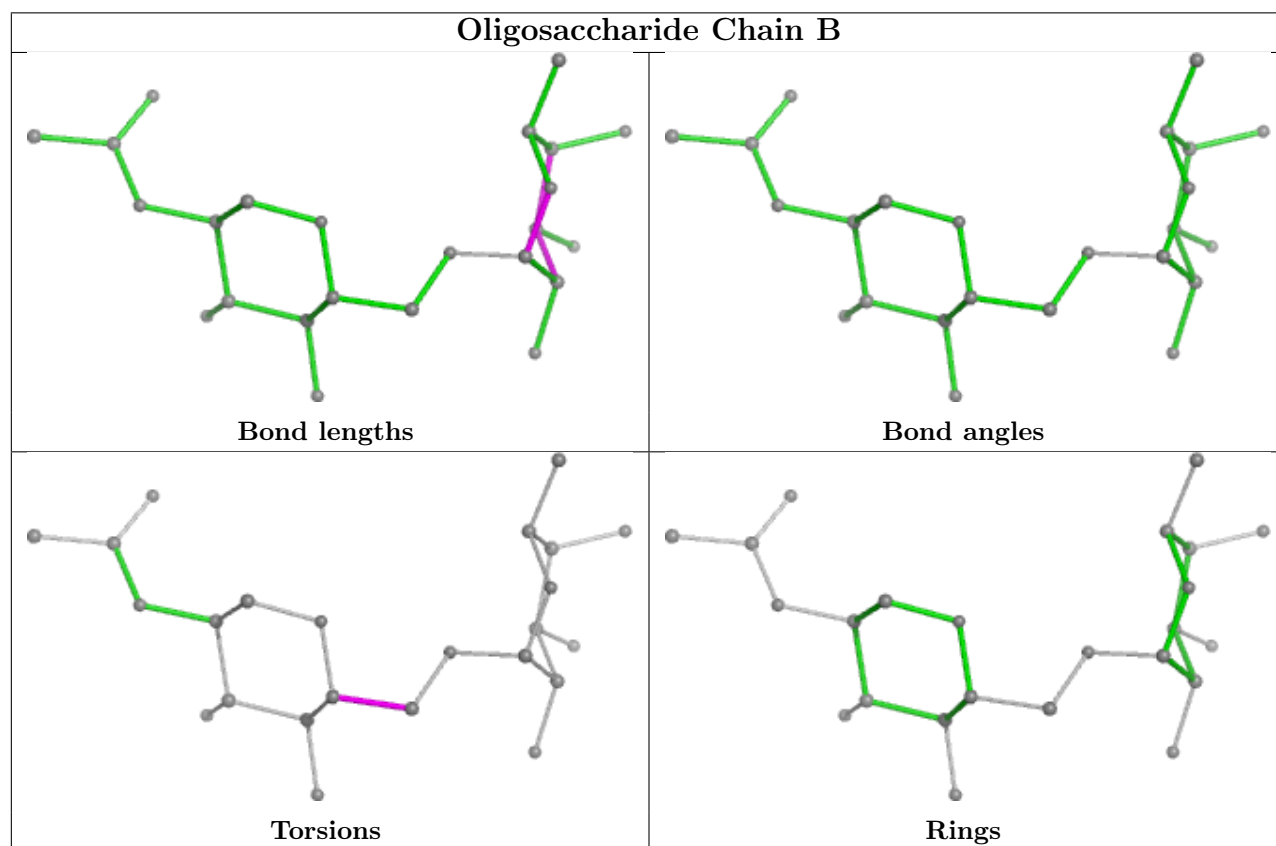
Mol	Chain	Res	Type	Atoms
3	E	2	NAG	O5-C5-C6-O6
3	D	2	NAG	O5-C5-C6-O6
3	E	2	NAG	C4-C5-C6-O6
3	D	2	NAG	C4-C5-C6-O6
3	C	1	NAG	C8-C7-N2-C2
3	C	1	NAG	O7-C7-N2-C2
3	D	2	NAG	C8-C7-N2-C2
3	D	2	NAG	O7-C7-N2-C2
2	B	1	NAG	O5-C5-C6-O6
2	B	1	NAG	C4-C5-C6-O6
3	E	1	NAG	C3-C2-N2-C7

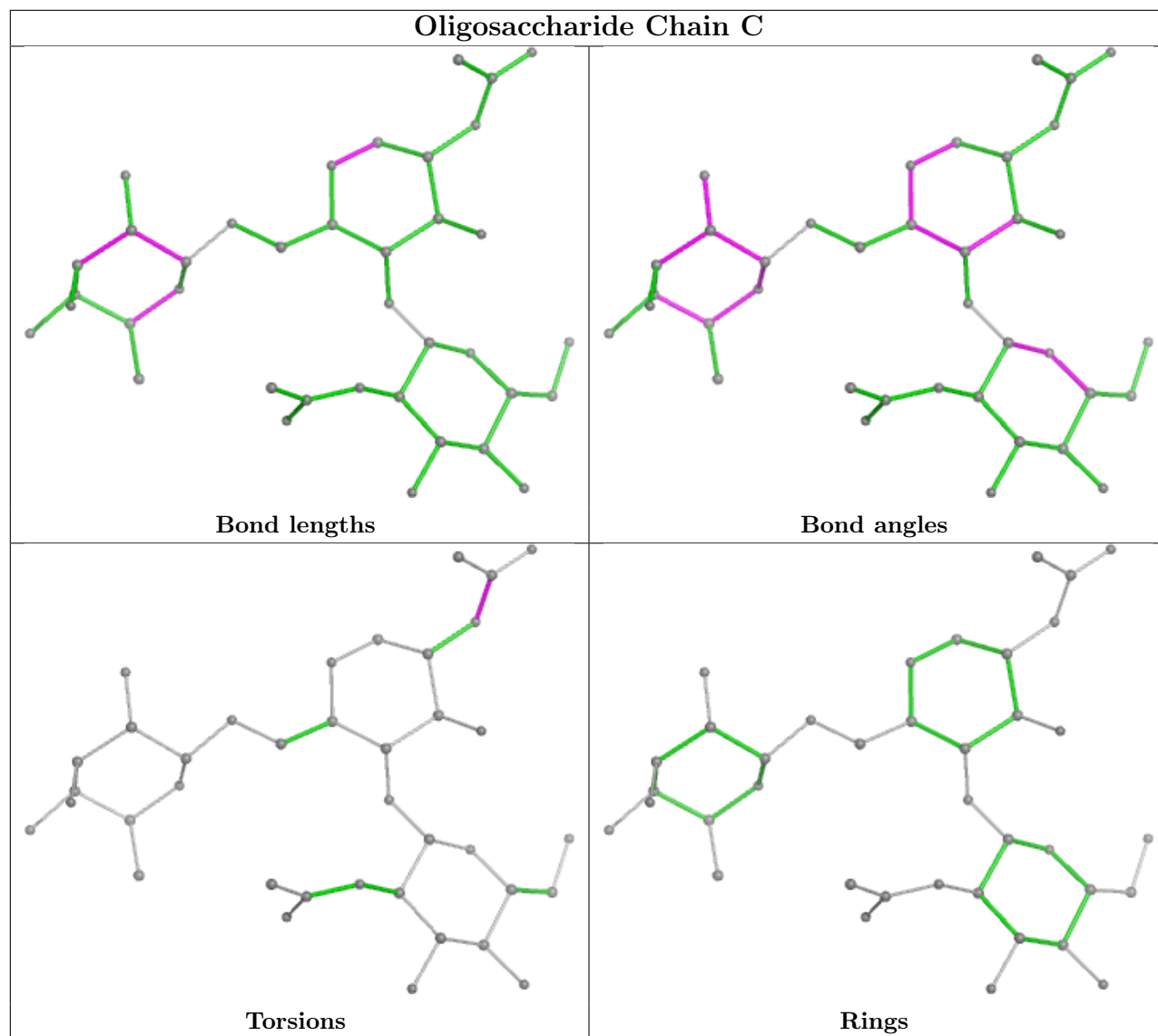
There are no ring outliers.

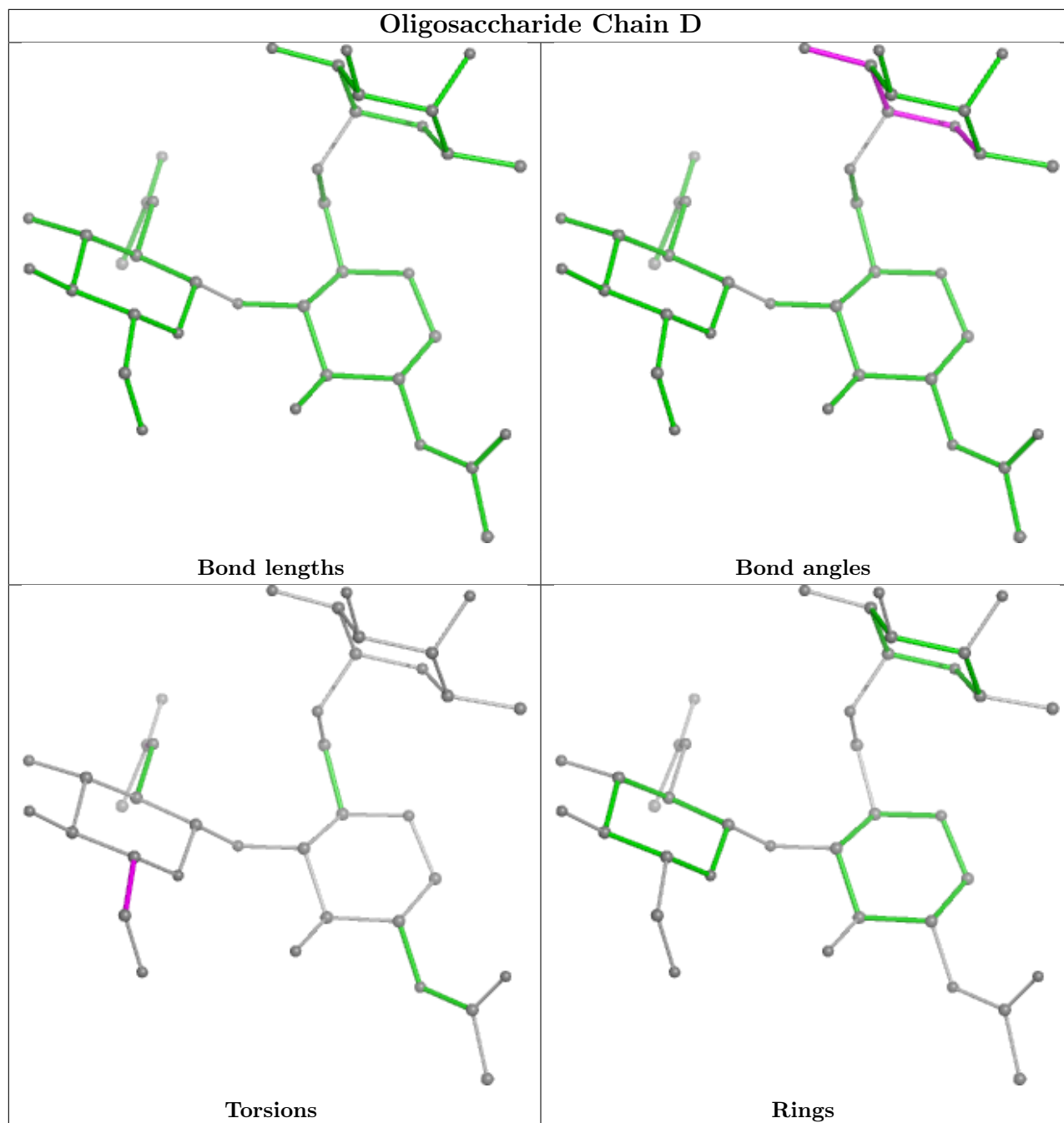
No monomer is involved in short contacts.

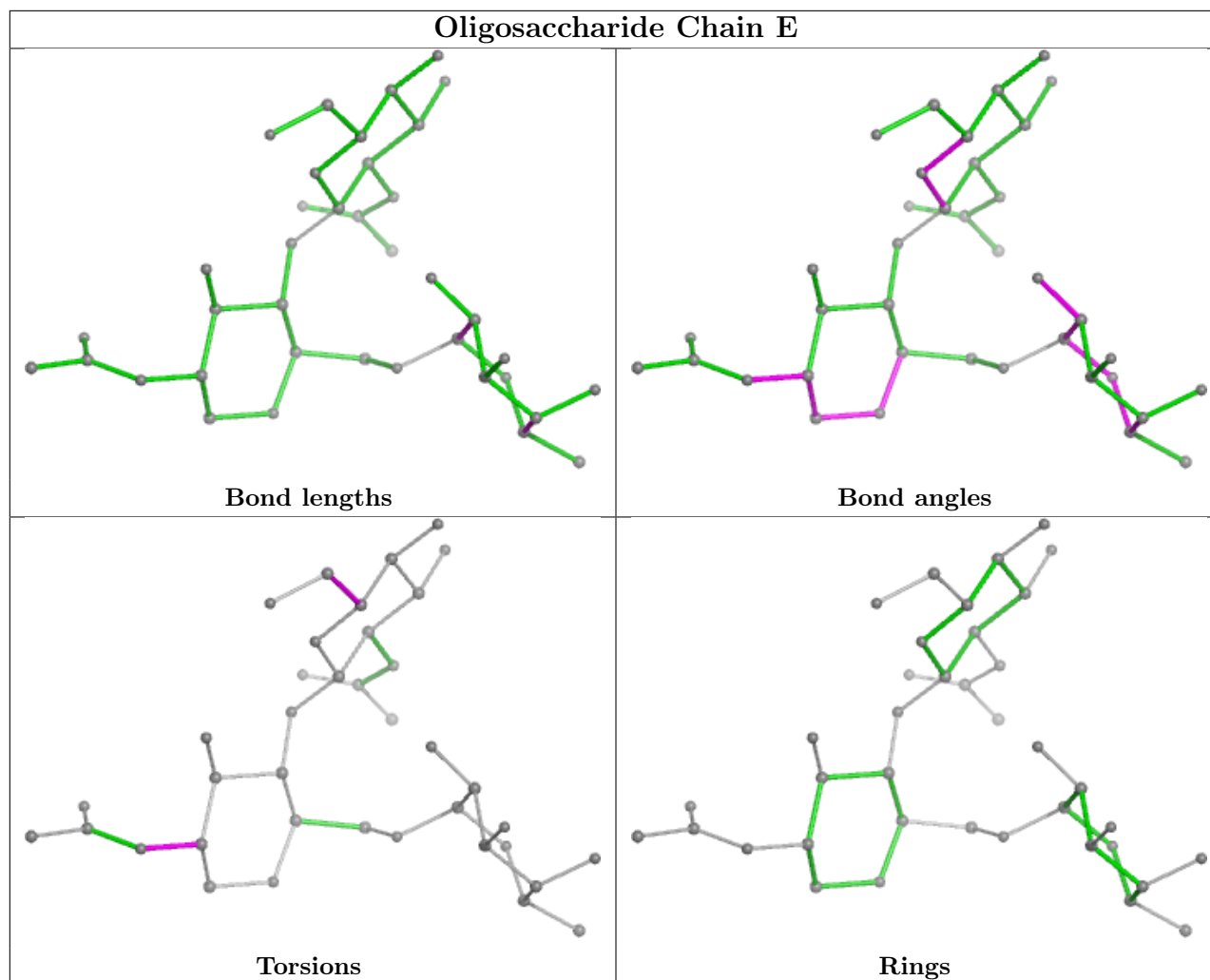


The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.









## 5.6 Ligand geometry [i](#)

10 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	$\# Z  > 2$
8	SIA	A	608	-	21,21,21	1.91	4 (19%)	25,31,31	2.41	6 (24%)
6	SO4	A	604	-	4,4,4	0.17	0	6,6,6	0.30	0
4	NAG	A	602	1	14,14,15	1.03	1 (7%)	17,19,21	0.86	1 (5%)
7	GOL	A	607	-	5,5,5	0.68	0	5,5,5	1.08	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
6	SO4	A	606	-	4,4,4	0.19	0	6,6,6	0.12	0
4	NAG	A	601	1	14,14,15	0.47	0	17,19,21	0.59	0
9	A1H77	A	609[B]	-	32,34,34	2.52	22 (68%)	37,47,47	1.32	5 (13%)
6	SO4	A	605	-	4,4,4	0.19	0	6,6,6	0.16	0
5	MES	A	603	-	12,12,12	2.15	1 (8%)	14,16,16	2.26	4 (28%)
9	A1H77	A	609[A]	-	32,34,34	3.17	24 (75%)	37,47,47	1.30	4 (10%)

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
8	SIA	A	608	-	-	10/20/38/38	0/1/1/1
4	NAG	A	602	1	-	0/6/23/26	0/1/1/1
7	GOL	A	607	-	-	2/4/4/4	-
4	NAG	A	601	1	-	2/6/23/26	0/1/1/1
9	A1H77	A	609[B]	-	-	8/18/32/32	0/5/5/5
5	MES	A	603	-	-	2/6/14/14	0/1/1/1
9	A1H77	A	609[A]	-	-	11/18/32/32	0/5/5/5

All (52) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	603	MES	C8-S	-7.01	1.67	1.77
9	A	609[A]	A1H77	C18-N17	6.69	1.64	1.48
8	A	608	SIA	O6-C2	5.79	1.49	1.43
9	A	609[A]	A1H77	C05-N04	5.55	1.56	1.47
9	A	609[A]	A1H77	C03-C02	5.42	1.59	1.52
9	A	609[A]	A1H77	C10-C09	5.03	1.64	1.53
9	A	609[B]	A1H77	C03-C02	4.39	1.58	1.52
9	A	609[A]	A1H77	C27-C26	3.81	1.44	1.39
9	A	609[B]	A1H77	C02-C09	3.77	1.60	1.53
9	A	609[B]	A1H77	C25-C24	3.74	1.55	1.46
9	A	609[A]	A1H77	C24-C19	3.73	1.47	1.40
9	A	609[A]	A1H77	C25-C24	3.69	1.54	1.46
9	A	609[B]	A1H77	C27-C26	3.61	1.44	1.39
9	A	609[B]	A1H77	C03-N04	3.55	1.53	1.47
4	A	602	NAG	O5-C1	3.49	1.49	1.43
9	A	609[A]	A1H77	C25-C26	3.25	1.46	1.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
9	A	609[A]	A1H77	C03-N04	3.23	1.52	1.47
9	A	609[A]	A1H77	C30-C25	3.20	1.45	1.40
9	A	609[B]	A1H77	C10-C09	3.18	1.60	1.53
9	A	609[A]	A1H77	C09-N17	3.17	1.53	1.47
9	A	609[B]	A1H77	C05-N04	3.14	1.52	1.47
9	A	609[A]	A1H77	C08-C07	3.07	1.60	1.48
8	A	608	SIA	C2-C1	3.04	1.58	1.53
8	A	608	SIA	C3-C2	3.01	1.55	1.51
9	A	609[A]	A1H77	C05-C06	2.94	1.57	1.51
9	A	609[B]	A1H77	C08-C07	2.94	1.59	1.48
9	A	609[A]	A1H77	C28-C27	2.84	1.44	1.38
9	A	609[A]	A1H77	C29-C28	2.79	1.45	1.38
9	A	609[B]	A1H77	C18-N17	2.76	1.54	1.48
9	A	609[B]	A1H77	C20-C19	2.76	1.43	1.39
9	A	609[A]	A1H77	C07-C06	2.69	1.63	1.48
9	A	609[A]	A1H77	C20-C19	2.65	1.43	1.39
9	A	609[A]	A1H77	C29-C30	2.59	1.44	1.38
9	A	609[B]	A1H77	C07-C06	2.50	1.62	1.48
9	A	609[B]	A1H77	C29-C30	2.50	1.44	1.38
8	A	608	SIA	C7-C6	2.50	1.56	1.53
9	A	609[A]	A1H77	C10-C11	2.49	1.57	1.51
9	A	609[A]	A1H77	C22-C21	2.47	1.44	1.38
9	A	609[A]	A1H77	C22-C23	2.44	1.44	1.38
9	A	609[B]	A1H77	C22-C23	2.41	1.44	1.38
9	A	609[A]	A1H77	C08-C06	2.41	1.61	1.48
9	A	609[B]	A1H77	C24-C19	2.28	1.44	1.40
9	A	609[B]	A1H77	C08-C06	2.25	1.60	1.48
9	A	609[B]	A1H77	C25-C26	2.25	1.44	1.40
9	A	609[B]	A1H77	C30-C25	2.23	1.43	1.40
9	A	609[B]	A1H77	C22-C21	2.21	1.43	1.38
9	A	609[B]	A1H77	C29-C28	2.15	1.43	1.38
9	A	609[A]	A1H77	C13-C12	2.12	1.43	1.38
9	A	609[A]	A1H77	C12-C11	2.10	1.43	1.38
9	A	609[B]	A1H77	C13-C12	2.05	1.43	1.38
9	A	609[B]	A1H77	C28-C27	2.03	1.43	1.38
9	A	609[B]	A1H77	C10-C11	2.00	1.56	1.51

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	A	608	SIA	O1A-C1-C2	-8.91	110.10	123.59
5	A	603	MES	C5-N4-C3	5.48	121.17	108.83

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
9	A	609[B]	A1H77	C26-C18-C19	4.81	105.54	102.08
9	A	609[A]	A1H77	C26-C18-C19	4.33	105.20	102.08
5	A	603	MES	O3S-S-C8	3.74	111.82	105.77
8	A	608	SIA	C5-N5-C10	3.57	131.86	123.18
9	A	609[B]	A1H77	O01-C02-C09	-3.51	102.77	109.85
8	A	608	SIA	O2-C2-C1	-3.16	104.34	110.76
4	A	602	NAG	C1-O5-C5	3.04	116.32	112.19
9	A	609[A]	A1H77	O01-C02-C09	-2.99	103.82	109.85
8	A	608	SIA	C4-C5-N5	2.93	116.18	110.38
9	A	609[A]	A1H77	C25-C26-C18	-2.64	107.05	109.78
9	A	609[B]	A1H77	C23-C24-C19	-2.64	117.16	120.33
5	A	603	MES	C7-N4-C3	2.55	117.76	111.23
8	A	608	SIA	C6-C5-N5	2.50	115.06	110.91
8	A	608	SIA	O1B-C1-O1A	2.49	131.74	123.82
5	A	603	MES	C7-N4-C5	2.38	117.33	111.23
9	A	609[A]	A1H77	C23-C24-C19	-2.34	117.53	120.33
9	A	609[B]	A1H77	C25-C26-C18	-2.25	107.46	109.78
9	A	609[B]	A1H77	C30-C25-C26	-2.01	117.92	120.33

There are no chirality outliers.

All (35) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	603	MES	N4-C7-C8-S
8	A	608	SIA	O1B-C1-C2-O6
8	A	608	SIA	C5-C6-C7-O7
8	A	608	SIA	O6-C6-C7-C8
8	A	608	SIA	O6-C6-C7-O7
9	A	609[A]	A1H77	C09-C02-C03-N04
9	A	609[A]	A1H77	O01-C02-C03-N04
9	A	609[A]	A1H77	C03-C02-C09-C10
9	A	609[A]	A1H77	C03-C02-C09-N17
9	A	609[A]	A1H77	O01-C02-C09-C10
9	A	609[A]	A1H77	O01-C02-C09-N17
9	A	609[A]	A1H77	C02-C09-C10-C11
9	A	609[A]	A1H77	N17-C09-C10-C11
9	A	609[B]	A1H77	C09-C02-C03-N04
9	A	609[B]	A1H77	N04-C05-C06-C08
9	A	609[B]	A1H77	C02-C09-N17-C18
9	A	609[B]	A1H77	C10-C09-N17-C18
9	A	609[B]	A1H77	C26-C18-N17-C09
8	A	608	SIA	O8-C8-C9-O9

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Mol	Chain	Res	Type	Atoms
8	A	608	SIA	C7-C8-C9-O9
7	A	607	GOL	O1-C1-C2-C3
8	A	608	SIA	C6-C5-N5-C10
5	A	603	MES	C8-C7-N4-C5
7	A	607	GOL	O1-C1-C2-O2
4	A	601	NAG	C1-C2-N2-C7
8	A	608	SIA	O1A-C1-C2-O6
9	A	609[B]	A1H77	C02-C03-N04-C05
9	A	609[B]	A1H77	C02-C09-C10-C11
9	A	609[A]	A1H77	C02-C09-N17-C18
8	A	608	SIA	C5-C6-C7-C8
8	A	608	SIA	C4-C5-N5-C10
9	A	609[A]	A1H77	C02-C03-N04-C05
9	A	609[A]	A1H77	C06-C05-N04-C03
4	A	601	NAG	C3-C2-N2-C7
9	A	609[B]	A1H77	O01-C02-C03-N04

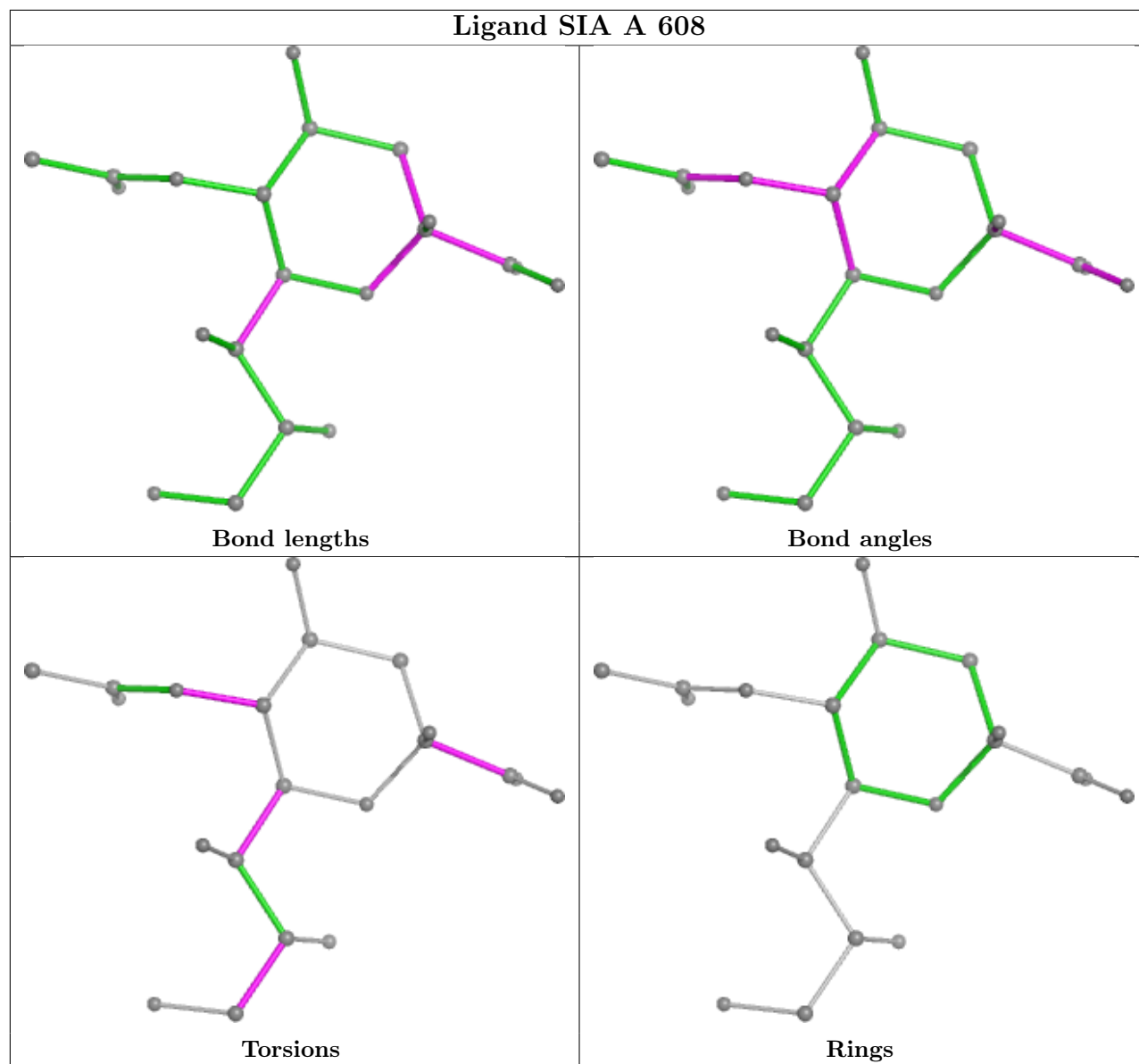
There are no ring outliers.

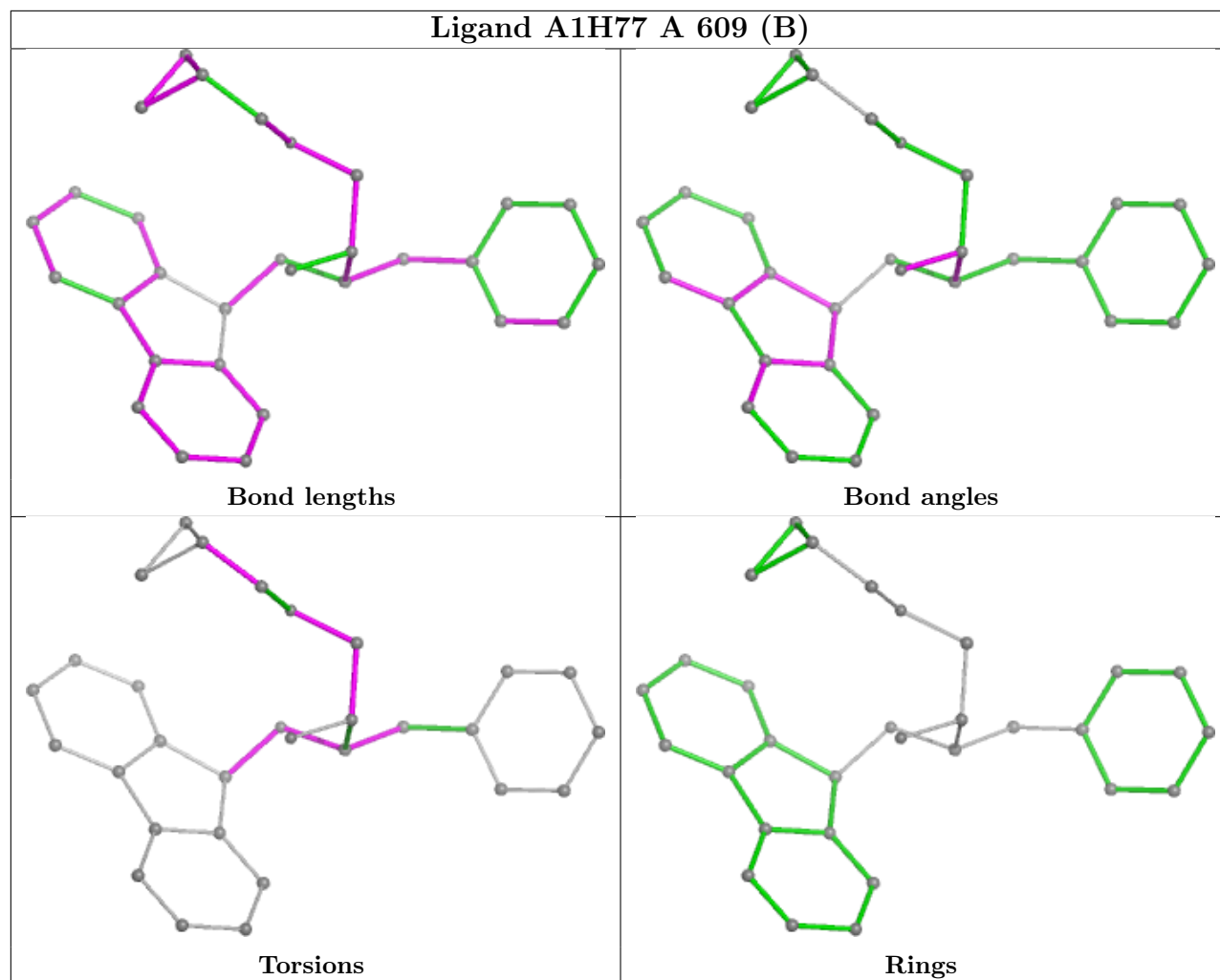
2 monomers are involved in 6 short contacts:

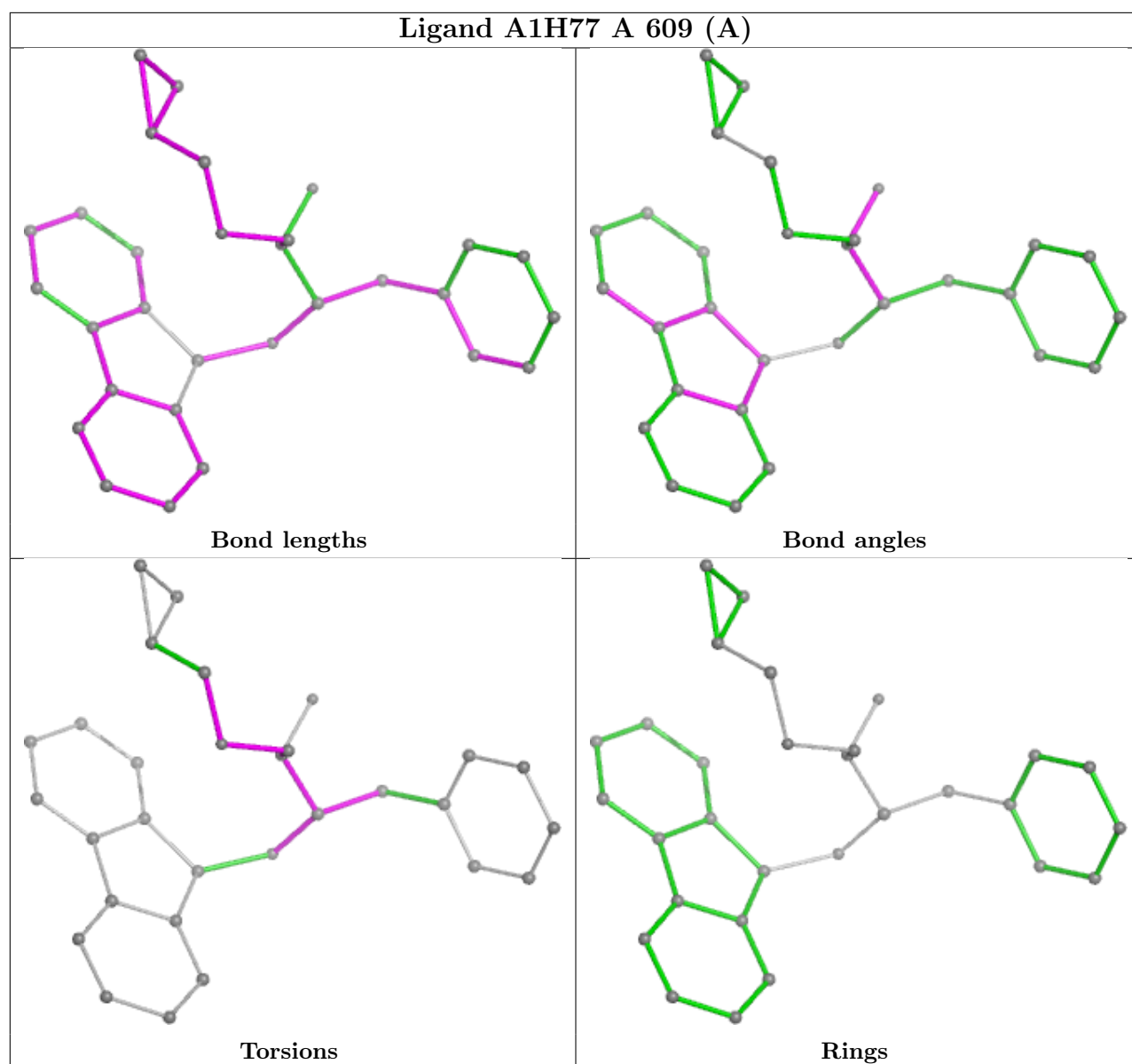
Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	A	607	GOL	1	0
5	A	603	MES	5	0

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	526/529 (99%)	0.16	7 (1%) 74 76	28, 66, 96, 144	4 (0%)

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	261	ILE	3.2
1	A	526	PHE	3.2
1	A	377	VAL	2.9
1	A	4	ILE	2.4
1	A	258	THR	2.3
1	A	376	TRP	2.3
1	A	236	LEU	2.1

### 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.

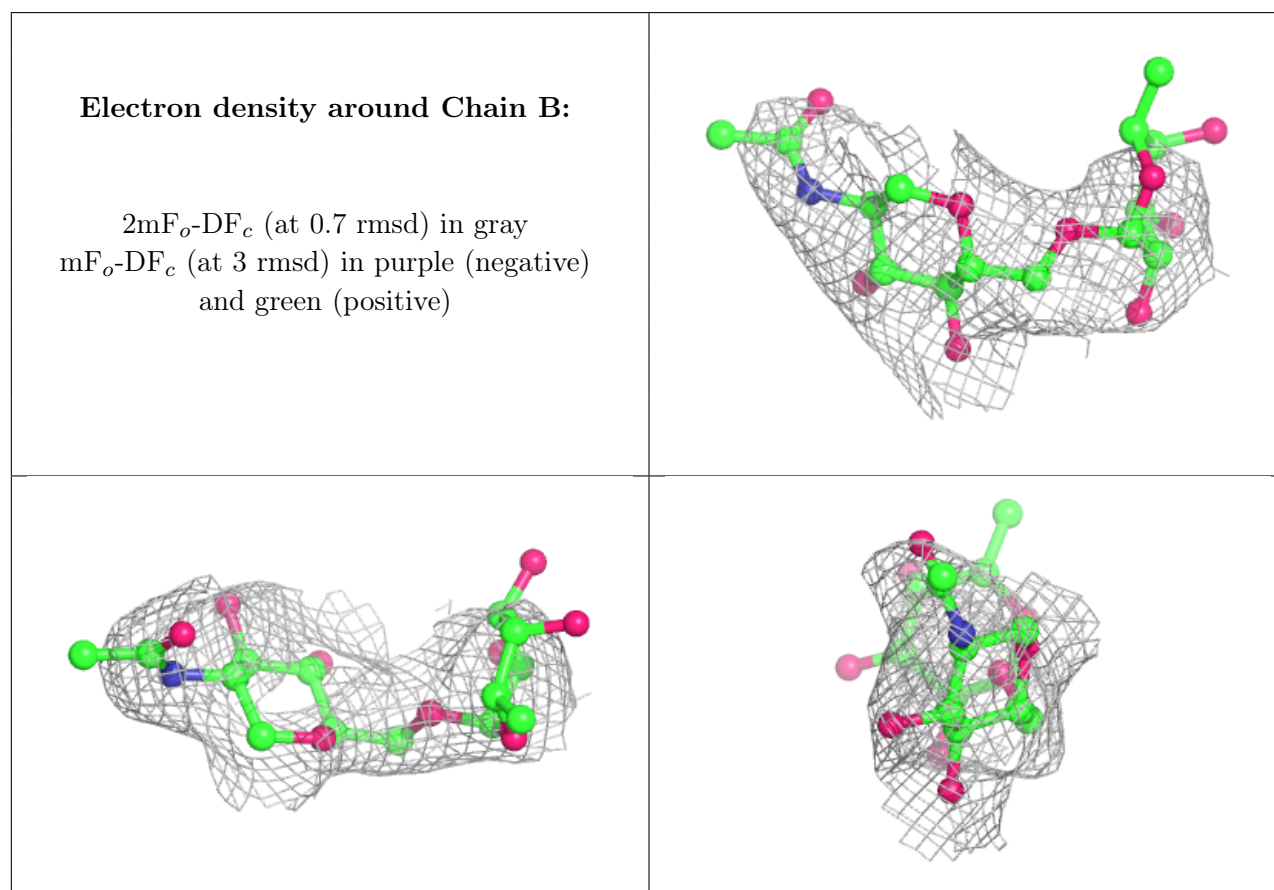
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
3	NAG	E	2	14/15	0.49	0.14	119,128,135,135	0
2	FUC	B	2	10/11	0.56	0.15	122,134,136,137	0
3	NAG	C	2	14/15	0.61	0.14	117,126,132,133	0
3	NAG	E	1	14/15	0.73	0.10	112,117,126,127	0
3	FUC	D	3	10/11	0.74	0.16	79,94,101,102	0

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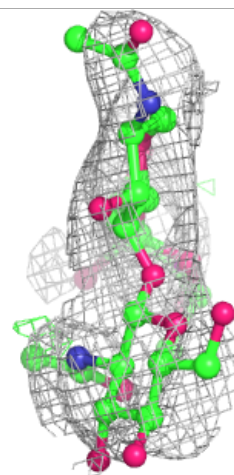
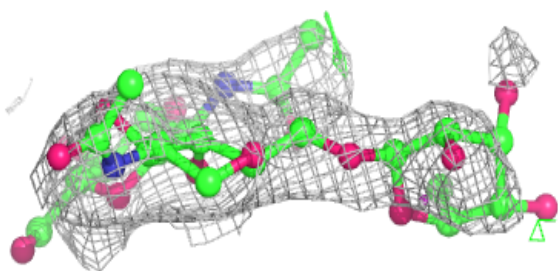
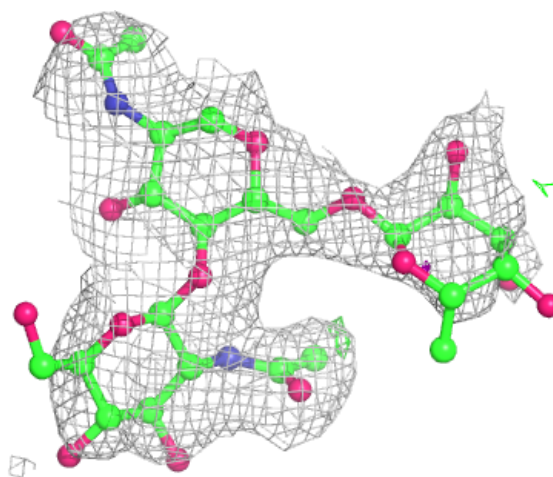
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	FUC	C	3	10/11	0.74	0.16	96,116,123,124	0
3	NAG	D	2	14/15	0.74	0.12	91,101,111,122	0
2	NAG	B	1	14/15	0.75	0.11	93,107,118,123	0
3	NAG	C	1	14/15	0.75	0.12	99,108,116,116	0
3	FUC	E	3	10/11	0.81	0.09	92,105,113,120	0
3	NAG	D	1	14/15	0.93	0.08	74,79,87,94	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.



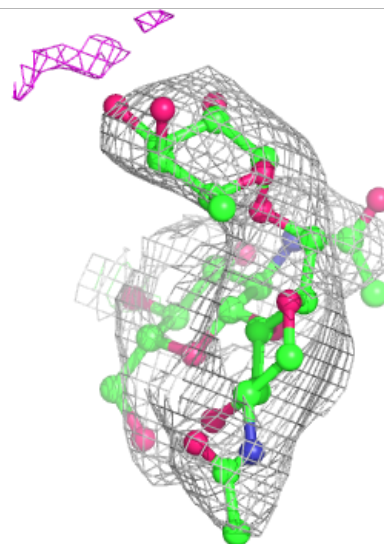
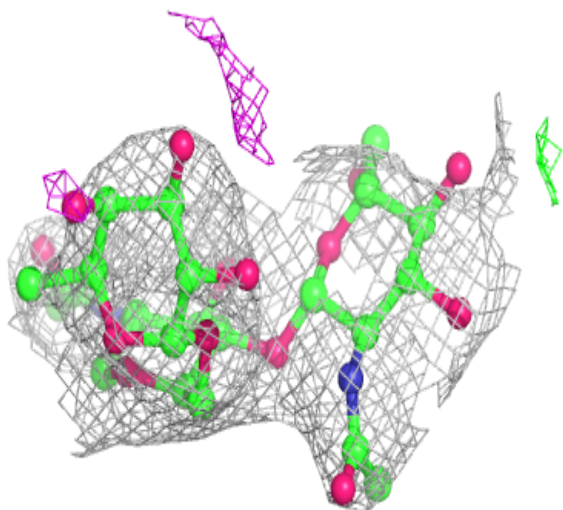
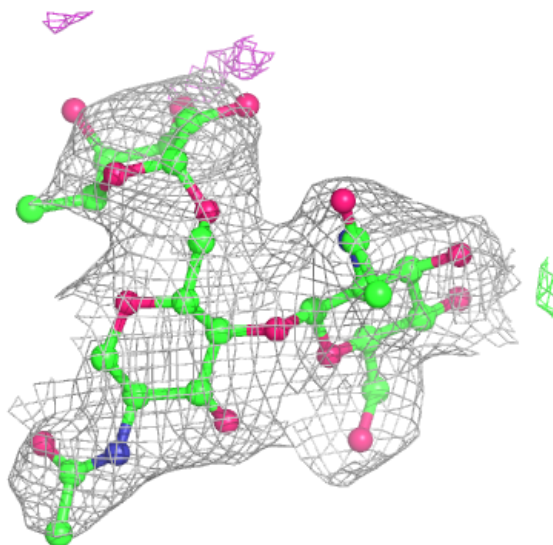
**Electron density around Chain C:**

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

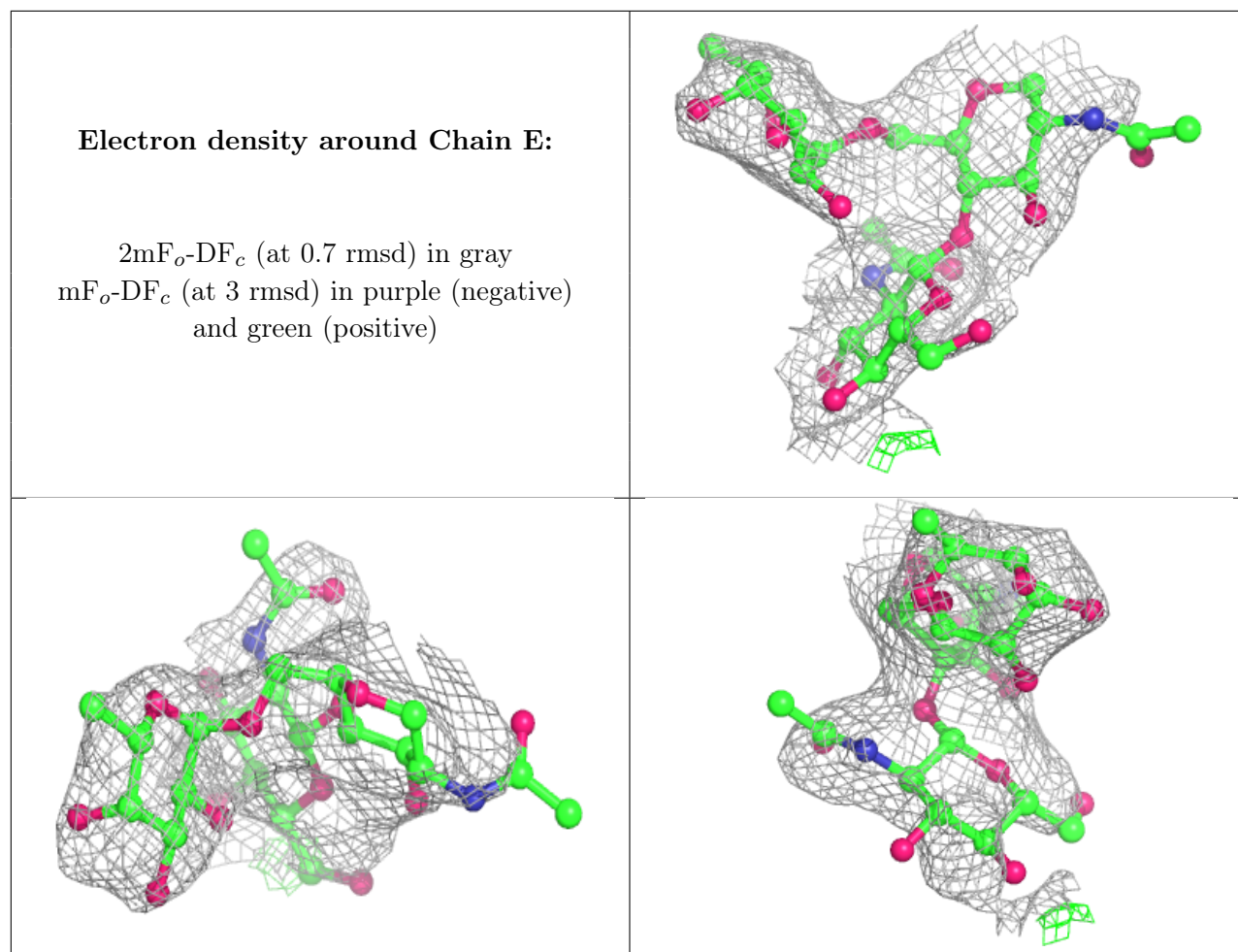


**Electron density around Chain D:**

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







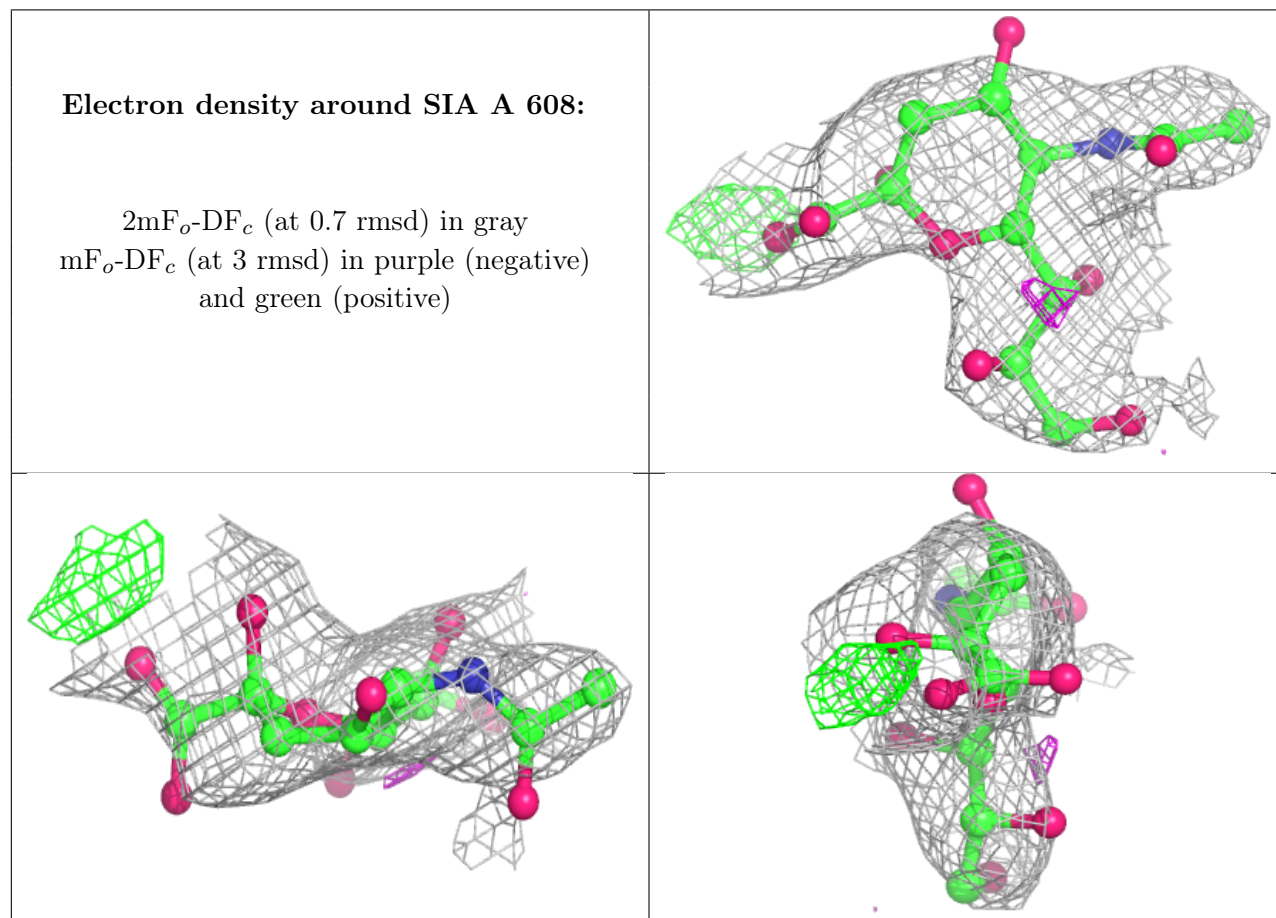
## 6.4 Ligands [i](#)

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	NAG	A	601	14/15	0.30	0.13	128,134,142,142	0
8	SIA	A	608	21/21	0.64	0.13	70,94,104,106	0
4	NAG	A	602	14/15	0.70	0.14	76,100,106,107	0
6	SO4	A	606	5/5	0.73	0.08	101,106,117,124	0
5	MES	A	603	12/12	0.78	0.18	68,74,85,96	12
6	SO4	A	605	5/5	0.78	0.09	87,89,98,102	0
6	SO4	A	604	5/5	0.85	0.07	75,84,97,98	0
9	A1H77	A	609[A]	30/30	0.85	0.23	61,72,80,83	30
9	A1H77	A	609[B]	30/30	0.85	0.23	62,71,79,81	30
7	GOL	A	607	6/6	0.87	0.12	76,78,85,87	0

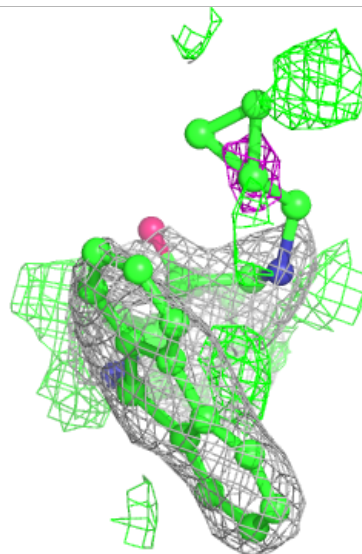
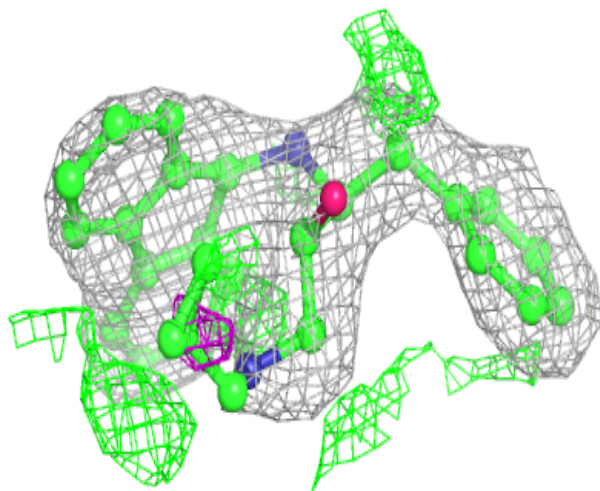
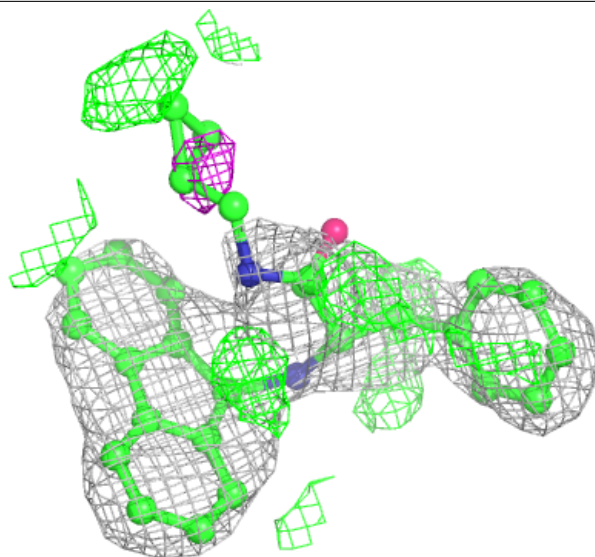


The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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



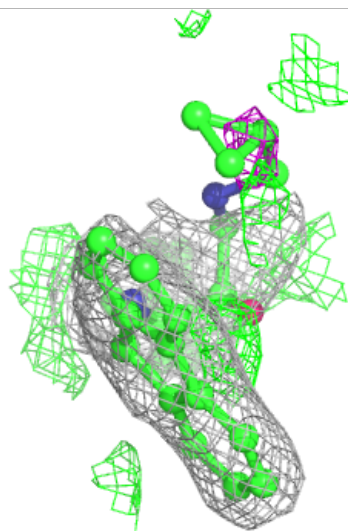
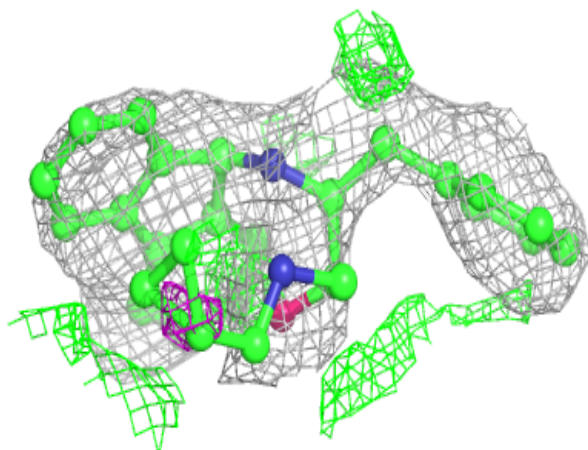
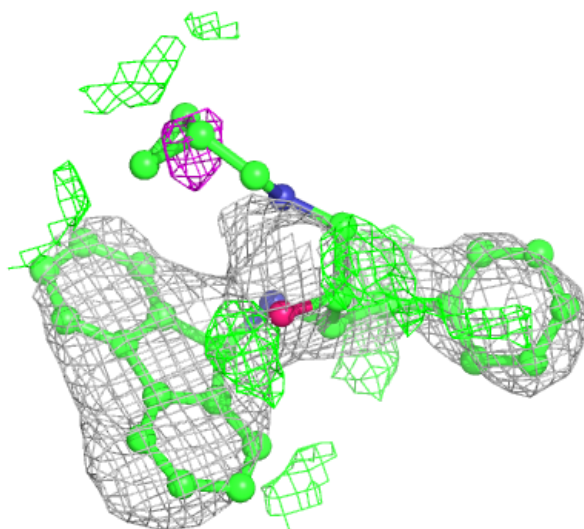
**Electron density around A1H77 A 609 (A):**

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



**Electron density around A1H77 A 609 (B):**

$2mF_o-DF_c$  (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.