



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 11:24 AM UTC

PDB ID : 8HUA / pdb_00008hua
Title : Serial synchrotron crystallography structure of ba3-type cytochrome c oxidase from *Thermus thermophilus* using a goniometer compatible flow-cell
Authors : Ghosh, S.; Zoric, D.; Bjelcic, M.; Johannesson, J.; Sandelin, E.; Branden, G.; Neutze, R.
Deposited on : 2022-12-22
Resolution : 2.12 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

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>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

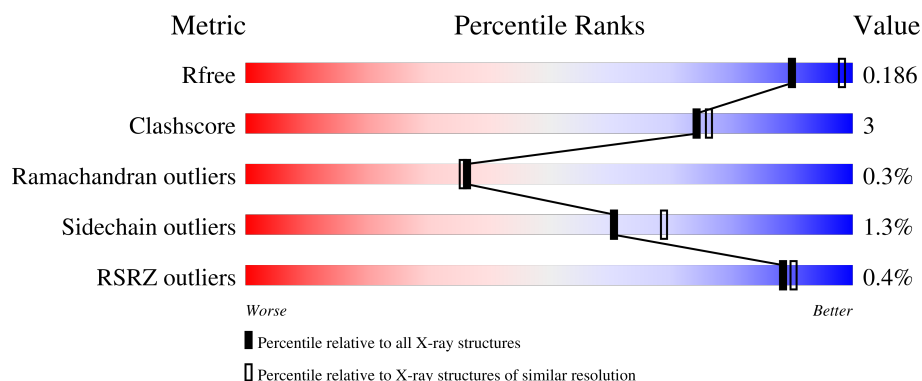
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

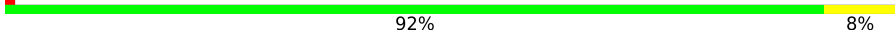
The reported resolution of this entry is 2.12 Å.

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}	180053	8290 (2.14-2.10)
Clashscore	190562	8817 (2.14-2.10)
Ramachandran outliers	187476	8738 (2.14-2.10)
Sidechain outliers	187428	8739 (2.14-2.10)
RSRZ outliers	180081	8294 (2.14-2.10)

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 of the lower bar indicate the fraction of residues that contain outliers for ≥ 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	569	
2	B	168	
3	C	34	

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
6	HAS	A	603	X	-	-	-

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 6398 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 Cytochrome c oxidase subunit 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	554	Total	C	N	O	S	0	0	0
			4368	2963	698	691	16			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	MET	-	initiating methionine	UNP Q5SJ79
A	-5	HIS	-	expression tag	UNP Q5SJ79
A	-4	HIS	-	expression tag	UNP Q5SJ79
A	-3	HIS	-	expression tag	UNP Q5SJ79
A	-2	HIS	-	expression tag	UNP Q5SJ79
A	-1	HIS	-	expression tag	UNP Q5SJ79
A	0	HIS	-	expression tag	UNP Q5SJ79
A	1	HIS	-	expression tag	UNP Q5SJ79

- Molecule 2 is a protein called Cytochrome c oxidase subunit 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	167	Total	C	N	O	S	0	0	0
			1301	846	216	235	4			

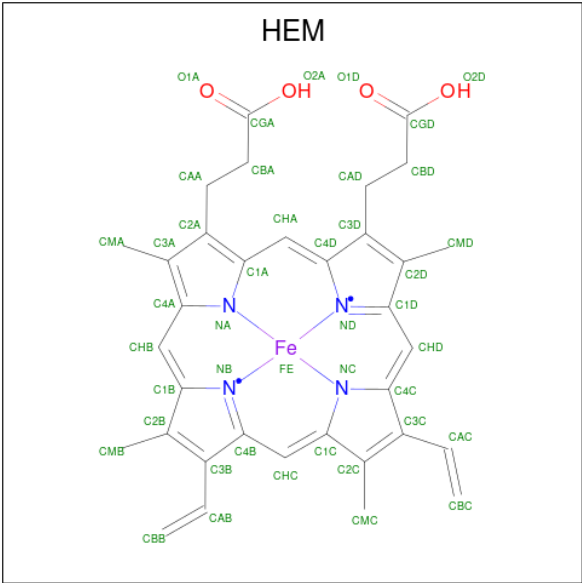
- Molecule 3 is a protein called Cytochrome c oxidase polypeptide 2A.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	31	Total	C	N	O	0	0	0
			241	169	37	35			

- Molecule 4 is COPPER (II) ION (CCD ID: CU) (formula: Cu) (labeled as "Ligand of Interest" by depositor).

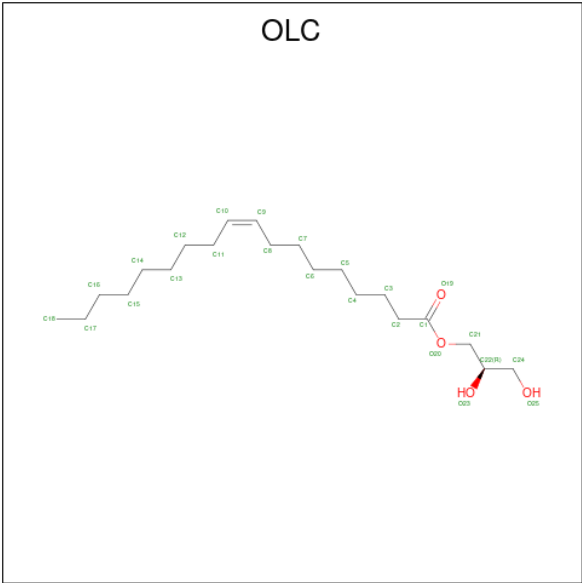
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Cu	0	0
			1	1		

- Molecule 5 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: HEM) (formula: $C_{34}H_{32}FeN_4O_4$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	A	1	Total	C	Fe	N	O	
			65	54	1	4	6	

- Molecule 7 is (2R)-2,3-dihydroxypropyl (9Z)-octadec-9-enoate (CCD ID: OLC) (formula: C₂₁H₄₀O₄) (labeled as "Ligand of Interest" by depositor).



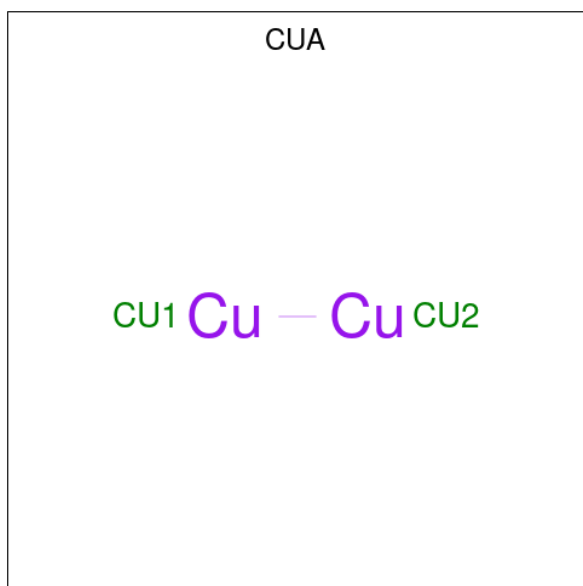
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	O	0	0
			23	19	4		
7	A	1	Total	C	O	0	0
			18	14	4		
7	A	1	Total	C	O	0	0
			17	13	4		
7	A	1	Total	C	O	0	0
			15	11	4		
7	A	1	Total	C	O	0	0
			18	14	4		
7	A	1	Total	C	O	0	0
			15	11	4		
7	A	1	Total	C	O	0	0
			20	16	4		
7	A	1	Total	C	O	0	0
			21	17	4		
7	A	1	Total	C		0	0
			9	9			
7	A	1	Total	C		0	0
			9	9			

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	B	1	Total	C	O	0	0
			20	18	2		
7	B	1	Total	C	O	0	0
			25	21	4		
7	C	1	Total	C	O	0	0
			24	20	4		
7	C	1	Total	C	O	0	0
			15	11	4		
7	C	1	Total	C	O	0	0
			24	20	4		

- Molecule 8 is DINUCLEAR COPPER ION (CCD ID: CUA) (formula: Cu₂) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	B	1	Total	Cu	0	0
			2	2		

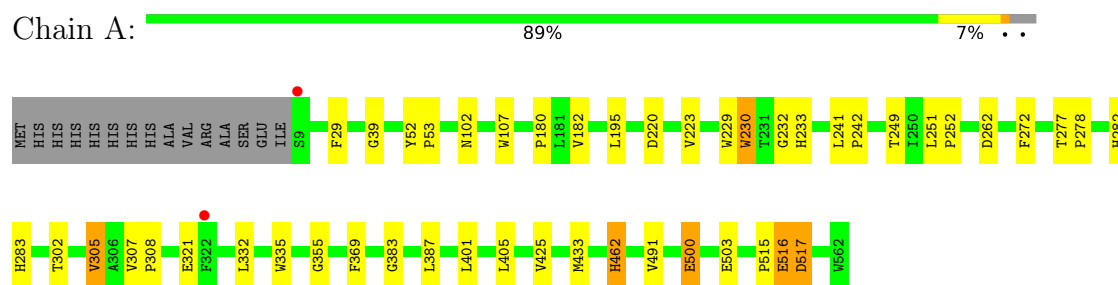
- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	62	Total	O	0	0
			62	62		
9	B	41	Total	O	0	0
			41	41		
9	C	1	Total	O	0	0
			1	1		

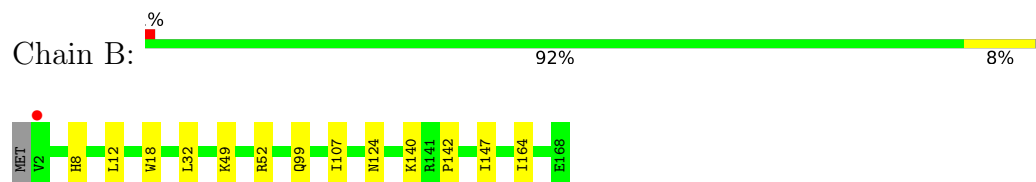
3 Residue-property plots

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.

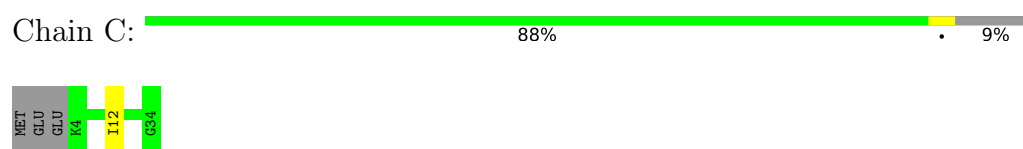
- Molecule 1: Cytochrome c oxidase subunit 1



- Molecule 2: Cytochrome c oxidase subunit 2



- Molecule 3: Cytochrome c oxidase polypeptide 2A



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	146.06Å 100.17Å 96.62Å 90.00° 126.76° 90.00°	Depositor
Resolution (Å)	25.80 – 2.12 25.80 – 2.12	Depositor EDS
% Data completeness (in resolution range)	99.9 (25.80-2.12) 99.9 (25.80-2.12)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.49 (at 2.12Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.152 , 0.184 0.161 , 0.186	Depositor DCC
R_{free} test set	3207 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	42.3	Xtriage
Anisotropy	0.110	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 71.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	6398	wwPDB-VP
Average B, all atoms (Å ²)	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.99% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: CUA, HEM, HAS, CU, OLC

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	1.03	0/4525	1.38	11/6213 (0.2%)
2	B	1.02	1/1338 (0.1%)	1.29	0/1828
3	C	0.99	0/247	1.43	0/335
All	All	1.03	1/6110 (0.0%)	1.36	11/8376 (0.1%)

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	A	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	124	ASN	C-O	5.31	1.28	1.23

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	233	HIS	CA-CB-CG	-9.29	104.51	113.80
1	A	517	ASP	CA-CB-CG	6.90	119.50	112.60
1	A	500	GLU	CB-CG-CD	6.29	123.29	112.60
1	A	195	LEU	CA-C-N	6.06	128.31	120.44
1	A	195	LEU	C-N-CA	6.06	128.31	120.44
1	A	515	PRO	CA-C-N	5.37	127.74	120.38
1	A	515	PRO	C-N-CA	5.37	127.74	120.38
1	A	180	PRO	CA-C-N	5.33	127.73	120.54
1	A	180	PRO	C-N-CA	5.33	127.73	120.54

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	383	GLY	CA-C-N	5.26	128.09	120.79
1	A	383	GLY	C-N-CA	5.26	128.09	120.79

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	516	GLU	Peptide

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	4368	0	4467	28	1
2	B	1301	0	1278	10	0
3	C	241	0	267	1	0
4	A	1	0	0	0	0
5	A	43	0	30	3	0
6	A	65	0	62	1	0
7	A	165	0	224	2	0
7	B	45	0	68	1	0
7	C	63	0	89	0	0
8	B	2	0	0	0	0
9	A	62	0	0	1	0
9	B	41	0	0	1	0
9	C	1	0	0	1	0
All	All	6398	0	6485	40	1

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 (40) 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:516:GLU:OE1	2:B:8:HIS:NE2	1.67	1.24

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:516:GLU:OE1	1:A:517:ASP:OD1	1.71	1.07
2:B:140:LYS:HE3	9:C:201:HOH:O	1.72	0.88
1:A:516:GLU:CD	2:B:8:HIS:HE2	1.89	0.77
1:A:516:GLU:CD	1:A:517:ASP:OD1	2.30	0.73
5:A:602:HEM:HBC2	5:A:602:HEM:HMC1	1.74	0.69
1:A:220:ASP:HB3	1:A:223:VAL:HG12	1.78	0.66
1:A:29:PHE:CE2	1:A:401:LEU:HD21	2.30	0.65
1:A:462:HIS:H	1:A:462:HIS:CD2	2.16	0.63
6:A:603:HAS:HBC1	6:A:603:HAS:HMC3	1.84	0.59
1:A:387:LEU:HD22	1:A:433:MET:HE1	1.85	0.59
2:B:99:GLN:HE22	2:B:142:PRO:HD3	1.72	0.54
2:B:18:TRP:CE3	3:C:12:ILE:HD13	2.44	0.53
2:B:52:ARG:NH2	9:B:303:HOH:O	2.40	0.52
2:B:99:GLN:NE2	2:B:142:PRO:HD3	2.25	0.51
1:A:387:LEU:HD22	1:A:433:MET:CE	2.42	0.50
1:A:307:VAL:N	1:A:308:PRO:HD2	2.27	0.49
1:A:229:TRP:CE3	1:A:232:GLY:HA3	2.48	0.48
1:A:405:LEU:HD23	1:A:491:VAL:HG11	1.96	0.48
1:A:282:HIS:CD2	1:A:283:HIS:CD2	3.01	0.47
1:A:355:GLY:CA	1:A:433:MET:HE1	2.44	0.47
5:A:602:HEM:HBC2	5:A:602:HEM:CMC	2.43	0.47
1:A:107:TRP:CZ3	7:A:606:OLC:H22	2.49	0.46
2:B:32:LEU:HD21	7:B:203:OLC:H7A	1.97	0.46
1:A:230:TRP:C	1:A:230:TRP:CD1	2.94	0.46
2:B:147:ILE:HD11	2:B:164:ILE:HG13	1.98	0.45
1:A:241:LEU:HD21	1:A:272:PHE:CD2	2.52	0.44
1:A:355:GLY:HA3	1:A:433:MET:HE1	2.00	0.43
1:A:500:GLU:OE2	1:A:503:GLU:OE1	2.35	0.43
1:A:251:LEU:HB3	1:A:252:PRO:HD3	2.01	0.43
1:A:241:LEU:N	1:A:242:PRO:CD	2.82	0.43
1:A:302:THR:HA	1:A:305:VAL:HG23	2.01	0.43
9:A:701:HOH:O	2:B:12:LEU:HD21	2.18	0.42
1:A:52:TYR:N	1:A:53:PRO:CD	2.83	0.42
7:A:605:OLC:H4	7:A:605:OLC:H7	1.79	0.42
1:A:182:VAL:HG22	1:A:249:THR:HG21	2.02	0.41
1:A:277:THR:N	1:A:278:PRO:CD	2.85	0.40
1:A:516:GLU:HG2	1:A:517:ASP:N	2.36	0.40
1:A:39:GLY:C	5:A:602:HEM:HMB3	2.47	0.40
1:A:321:GLU:HA	1:A:335:TRP:CE3	2.56	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:500:GLU:OE2	1:A:500:GLU:OE2[2_656]	1.63	0.57

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	552/569 (97%)	531 (96%)	19 (3%)	2 (0%)	30	28
2	B	165/168 (98%)	161 (98%)	4 (2%)	0	100	100
3	C	29/34 (85%)	29 (100%)	0	0	100	100
All	All	746/771 (97%)	721 (97%)	23 (3%)	2 (0%)	36	36

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	102	ASN
1	A	369	PHE

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	447/463 (96%)	441 (99%)	6 (1%)	61	69
2	B	136/138 (99%)	134 (98%)	2 (2%)	57	65
3	C	24/27 (89%)	24 (100%)	0	100	100
All	All	607/628 (97%)	599 (99%)	8 (1%)	61	69

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	230	TRP
1	A	262	ASP
1	A	305	VAL
1	A	332	LEU
1	A	425	VAL
1	A	462	HIS
2	B	49	LYS
2	B	107	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	174	ASN
1	A	254	GLN
1	A	455	GLN
1	A	462	HIS
2	B	60	GLN
2	B	69	GLN
2	B	99	GLN
2	B	159	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 19 ligands modelled in this entry, 1 is monoatomic - leaving 18 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and

the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
7	OLC	A	609	-	14,14,24	0.26	0	15,15,25	0.28	0
7	OLC	A	604	-	22,22,24	0.33	0	23,23,25	0.46	0
7	OLC	C	103	-	23,23,24	0.28	0	24,24,25	0.38	0
7	OLC	A	606	-	16,16,24	0.35	0	17,17,25	0.43	0
8	CUA	B	202	2	0,1,1	-	-	-	-	-
7	OLC	B	203	-	24,24,24	0.26	0	25,25,25	0.32	0
7	OLC	A	613	-	8,8,24	1.40	1 (12%)	7,7,25	0.85	0
7	OLC	C	102	-	14,14,24	0.29	0	15,15,25	0.44	0
7	OLC	A	610	-	19,19,24	0.29	0	20,20,25	0.37	0
7	OLC	A	612	-	8,8,24	0.17	0	7,7,25	0.17	0
7	OLC	A	608	-	17,17,24	0.33	0	18,18,25	0.41	0
7	OLC	A	605	-	17,17,24	0.33	0	18,18,25	0.51	0
5	HEM	A	602	1	50,50,50	1.59	8 (16%)	67,82,82	1.74	12 (17%)
6	HAS	A	603	1	72,72,72	2.22	25 (34%)	87,109,109	2.29	25 (28%)
7	OLC	C	101	-	23,23,24	0.29	0	24,24,25	0.26	0
7	OLC	A	607	-	14,14,24	0.25	0	15,15,25	0.37	0
7	OLC	A	611	-	20,20,24	0.27	0	21,21,25	0.47	0
7	OLC	B	201	-	19,19,24	0.32	0	19,19,25	0.24	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
7	OLC	A	609	-	-	4/14/14/24	-
7	OLC	A	604	-	-	9/22/22/24	-
7	OLC	C	103	-	-	11/23/23/24	-
7	OLC	A	606	-	-	8/16/16/24	-
7	OLC	B	203	-	-	9/24/24/24	-
7	OLC	A	613	-	-	2/6/6/24	-
7	OLC	C	102	-	-	3/14/14/24	-
7	OLC	A	610	-	-	10/19/19/24	-
7	OLC	A	612	-	-	2/6/6/24	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
7	OLC	A	608	-	-	9/17/17/24	-
7	OLC	A	605	-	-	11/17/17/24	-
5	HEM	A	602	1	-	2/14/54/54	-
6	HAS	A	603	1	1/1/8/18	7/42/82/82	-
7	OLC	C	101	-	-	10/23/23/24	-
7	OLC	A	607	-	-	7/14/14/24	-
7	OLC	A	611	-	-	7/20/20/24	-
7	OLC	B	201	-	-	13/18/18/24	-

All (34) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	603	HAS	FE-NA	5.00	2.11	1.95
6	A	603	HAS	CHB-C1D	4.72	1.47	1.38
6	A	603	HAS	FE-NB	4.67	2.09	1.94
5	A	602	HEM	FE-NB	4.59	2.09	1.94
6	A	603	HAS	FE-NC	4.54	2.10	1.95
6	A	603	HAS	C3B-C2B	4.53	1.45	1.34
5	A	602	HEM	C1B-NB	-4.40	1.32	1.40
6	A	603	HAS	CHD-C4A	4.32	1.46	1.38
6	A	603	HAS	C4B-NB	-4.21	1.33	1.40
6	A	603	HAS	C4A-NA	-4.15	1.31	1.39
6	A	603	HAS	FE-ND	4.15	2.07	1.94
6	A	603	HAS	C2D-C3D	3.93	1.46	1.37
7	A	613	OLC	C9-C10	3.83	1.53	1.31
6	A	603	HAS	CHA-C1A	3.66	1.45	1.38
6	A	603	HAS	C11-C3B	-3.65	1.46	1.51
6	A	603	HAS	CHB-C1B	3.50	1.47	1.39
5	A	602	HEM	C4D-ND	-3.49	1.34	1.40
5	A	602	HEM	C4B-NB	-3.46	1.32	1.38
5	A	602	HEM	FE-NC	3.25	2.05	1.95
6	A	603	HAS	CHC-C1C	3.08	1.46	1.39
6	A	603	HAS	C4B-C3B	3.05	1.50	1.44
5	A	602	HEM	C1C-NC	-2.98	1.34	1.39
6	A	603	HAS	C1A-NA	-2.97	1.34	1.39
6	A	603	HAS	C2A-C3A	2.91	1.43	1.36
5	A	602	HEM	C3C-C4C	-2.74	1.41	1.46
6	A	603	HAS	CHD-C4C	2.56	1.45	1.39
6	A	603	HAS	C1B-NB	-2.48	1.34	1.38
6	A	603	HAS	CHA-C4D	2.47	1.44	1.39

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	603	HAS	CHC-C4B	2.35	1.43	1.38
5	A	602	HEM	C1C-C2C	-2.32	1.40	1.45
6	A	603	HAS	C1B-C2B	2.15	1.48	1.44
6	A	603	HAS	C1D-ND	-2.15	1.36	1.40
6	A	603	HAS	O2A-CGA	-2.10	1.23	1.30
6	A	603	HAS	C4C-NC	-2.07	1.35	1.39

All (37) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	602	HEM	CHC-C4B-NB	7.17	132.14	124.42
6	A	603	HAS	C2D-C3D-C4D	-6.94	101.41	106.43
6	A	603	HAS	C2A-C1A-NA	5.94	116.06	110.32
6	A	603	HAS	C2B-C1B-NB	5.28	116.00	109.90
6	A	603	HAS	C3B-C4B-NB	5.05	115.64	109.84
6	A	603	HAS	C3C-C4C-NC	4.85	113.88	109.80
5	A	602	HEM	C1B-NB-C4B	4.58	110.62	105.21
6	A	603	HAS	C3C-C2C-C1C	-4.56	101.79	107.17
6	A	603	HAS	C3D-C4D-ND	4.48	114.68	110.35
6	A	603	HAS	CAA-CBA-CGA	-4.40	101.99	113.67
6	A	603	HAS	CAD-C3D-C4D	4.33	132.24	124.70
6	A	603	HAS	C1B-C2B-C3B	-3.81	102.39	106.80
5	A	602	HEM	CHD-C1D-ND	3.79	128.50	124.42
6	A	603	HAS	OMD-CMD-C2D	-3.72	117.22	125.62
5	A	602	HEM	O2A-CGA-CBA	3.59	125.36	114.00
6	A	603	HAS	C1A-C2A-C3A	-3.52	102.47	107.11
6	A	603	HAS	CHB-C1B-C2B	-3.31	119.80	125.03
6	A	603	HAS	CMA-C3A-C4A	3.27	130.49	124.73
5	A	602	HEM	C3B-C4B-NB	-3.24	107.14	109.47
6	A	603	HAS	C2C-C1C-NC	3.24	115.33	110.14
6	A	603	HAS	CAA-C2A-C1A	3.18	131.32	124.85
6	A	603	HAS	C3A-C4A-NA	3.18	115.52	109.64
6	A	603	HAS	C4B-C3B-C2B	-2.95	102.48	107.44
6	A	603	HAS	C25-C23-C24	2.80	120.08	115.23
6	A	603	HAS	C12-C11-C3B	-2.77	107.78	112.12
6	A	603	HAS	C4A-C3A-C2A	-2.77	102.86	106.97
5	A	602	HEM	C1A-CHA-C4D	-2.73	119.83	126.25
6	A	603	HAS	CHA-C1A-C2A	-2.66	120.67	124.86
5	A	602	HEM	CHD-C1D-C2D	-2.41	121.22	125.03
5	A	602	HEM	CHA-C4D-C3D	-2.40	120.80	125.23
5	A	602	HEM	CHD-C4C-NC	2.37	127.04	124.45
6	A	603	HAS	CHD-C4A-C3A	-2.30	120.71	125.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	602	HEM	CHA-C4D-ND	2.27	127.18	124.37
5	A	602	HEM	CHC-C4B-C3B	-2.21	120.67	125.07
6	A	603	HAS	C4C-C3C-C2C	-2.13	104.65	107.30
5	A	602	HEM	O1A-CGA-CBA	-2.11	116.40	123.09
6	A	603	HAS	O11-C11-C12	2.02	114.49	109.14

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
6	A	603	HAS	NA

All (124) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	603	HAS	C3D-C2D-CMD-OMD
7	A	605	OLC	C21-C22-C24-O25
7	A	605	OLC	O23-C22-C24-O25
7	A	606	OLC	O20-C21-C22-O23
7	A	608	OLC	C21-C22-C24-O25
7	A	611	OLC	O20-C21-C22-O23
7	B	203	OLC	O20-C21-C22-C24
7	C	101	OLC	C21-C22-C24-O25
7	C	102	OLC	C2-C1-O20-C21
7	C	102	OLC	O19-C1-O20-C21
7	A	605	OLC	O20-C21-C22-O23
7	A	605	OLC	C4-C5-C6-C7
7	A	606	OLC	C3-C4-C5-C6
7	A	606	OLC	C5-C6-C7-C8
7	C	103	OLC	C2-C1-O20-C21
7	C	103	OLC	C11-C12-C13-C14
7	C	103	OLC	O19-C1-O20-C21
7	C	101	OLC	C2-C1-O20-C21
7	C	101	OLC	O19-C1-O20-C21
7	A	604	OLC	C1-C2-C3-C4
7	A	605	OLC	C6-C7-C8-C9
7	A	610	OLC	O20-C21-C22-O23
7	B	203	OLC	O20-C21-C22-O23
7	A	606	OLC	O20-C21-C22-C24
7	A	610	OLC	O20-C21-C22-C24
7	B	201	OLC	C11-C10-C9-C8
7	A	610	OLC	C21-C22-C24-O25
7	A	611	OLC	C21-C22-C24-O25

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Mol	Chain	Res	Type	Atoms
7	B	203	OLC	C3-C4-C5-C6
7	C	101	OLC	C1-C2-C3-C4
7	A	604	OLC	C11-C12-C13-C14
7	A	608	OLC	O23-C22-C24-O25
7	B	201	OLC	C10-C11-C12-C13
7	A	604	OLC	C12-C13-C14-C15
7	B	201	OLC	C11-C12-C13-C14
7	A	608	OLC	C2-C1-O20-C21
7	A	605	OLC	C2-C3-C4-C5
7	B	203	OLC	C14-C15-C16-C17
7	A	608	OLC	O19-C1-O20-C21
7	A	607	OLC	C2-C3-C4-C5
7	B	201	OLC	C4-C5-C6-C7
7	A	613	OLC	C9-C10-C11-C12
7	B	201	OLC	C5-C6-C7-C8
7	C	103	OLC	C13-C14-C15-C16
7	A	604	OLC	C6-C7-C8-C9
7	B	201	OLC	C6-C7-C8-C9
7	A	605	OLC	C3-C4-C5-C6
7	A	611	OLC	C3-C4-C5-C6
7	B	201	OLC	C2-C1-O20-C21
7	A	605	OLC	C2-C1-O20-C21
7	C	103	OLC	C6-C7-C8-C9
7	A	605	OLC	O19-C1-O20-C21
7	A	610	OLC	C6-C7-C8-C9
7	B	203	OLC	C6-C7-C8-C9
7	B	201	OLC	C12-C13-C14-C15
7	C	103	OLC	C1-C2-C3-C4
7	B	203	OLC	C11-C12-C13-C14
7	A	608	OLC	C3-C4-C5-C6
7	C	101	OLC	C5-C6-C7-C8
7	A	606	OLC	C1-C2-C3-C4
7	A	604	OLC	O20-C21-C22-O23
7	A	606	OLC	O23-C22-C24-O25
7	A	610	OLC	O23-C22-C24-O25
7	C	101	OLC	O23-C22-C24-O25
7	A	609	OLC	C4-C5-C6-C7
7	A	608	OLC	C4-C5-C6-C7
7	A	604	OLC	C13-C14-C15-C16
7	A	604	OLC	C3-C4-C5-C6
7	A	607	OLC	C1-C2-C3-C4
7	A	610	OLC	C3-C4-C5-C6

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Mol	Chain	Res	Type	Atoms
7	C	101	OLC	C13-C14-C15-C16
7	A	607	OLC	O20-C21-C22-C24
7	C	103	OLC	C14-C15-C16-C17
7	A	607	OLC	O23-C22-C24-O25
7	C	102	OLC	C1-C2-C3-C4
7	B	201	OLC	C3-C4-C5-C6
7	A	611	OLC	O20-C21-C22-C24
7	A	612	OLC	C11-C12-C13-C14
6	A	603	HAS	C1D-C2D-CMD-OMD
7	B	201	OLC	O19-C1-O20-C21
7	A	610	OLC	C2-C3-C4-C5
7	A	611	OLC	O23-C22-C24-O25
7	A	611	OLC	C9-C10-C11-C12
7	B	201	OLC	C2-C3-C4-C5
7	A	611	OLC	C7-C8-C9-C10
7	A	604	OLC	C11-C10-C9-C8
6	A	603	HAS	CAA-CBA-CGA-O1A
7	A	610	OLC	C10-C11-C12-C13
7	A	607	OLC	C21-C22-C24-O25
7	A	612	OLC	C12-C13-C14-C15
7	A	610	OLC	C11-C10-C9-C8
6	A	603	HAS	CAA-CBA-CGA-O2A
7	C	103	OLC	C3-C4-C5-C6
6	A	603	HAS	CAD-CBD-CGD-O1D
7	A	607	OLC	O20-C21-C22-O23
7	A	608	OLC	O20-C1-C2-C3
7	C	103	OLC	C11-C10-C9-C8
7	B	203	OLC	C13-C14-C15-C16
7	A	604	OLC	O20-C21-C22-C24
7	A	608	OLC	C7-C8-C9-C10
7	A	610	OLC	C9-C10-C11-C12
7	C	103	OLC	C12-C13-C14-C15
7	B	201	OLC	C9-C10-C11-C12
7	A	608	OLC	C2-C3-C4-C5
7	B	201	OLC	C13-C14-C15-C16
7	A	606	OLC	O20-C1-C2-C3
7	B	203	OLC	C9-C10-C11-C12
6	A	603	HAS	C2C-C3C-CAC-CBC
7	C	101	OLC	C7-C8-C9-C10
7	C	103	OLC	C9-C10-C11-C12
7	C	101	OLC	O20-C21-C22-O23
7	A	605	OLC	C7-C8-C9-C10

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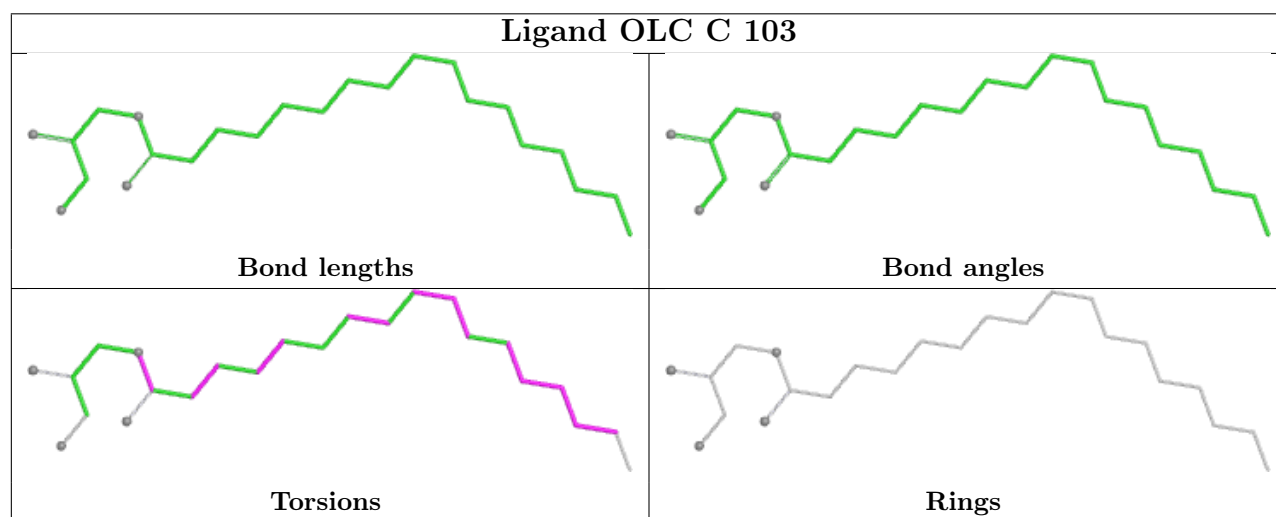
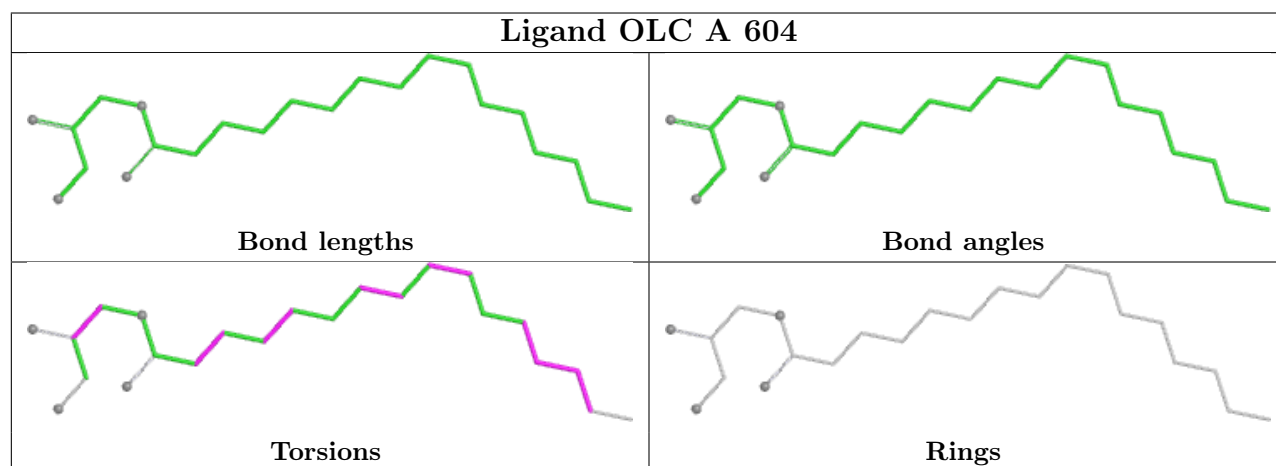
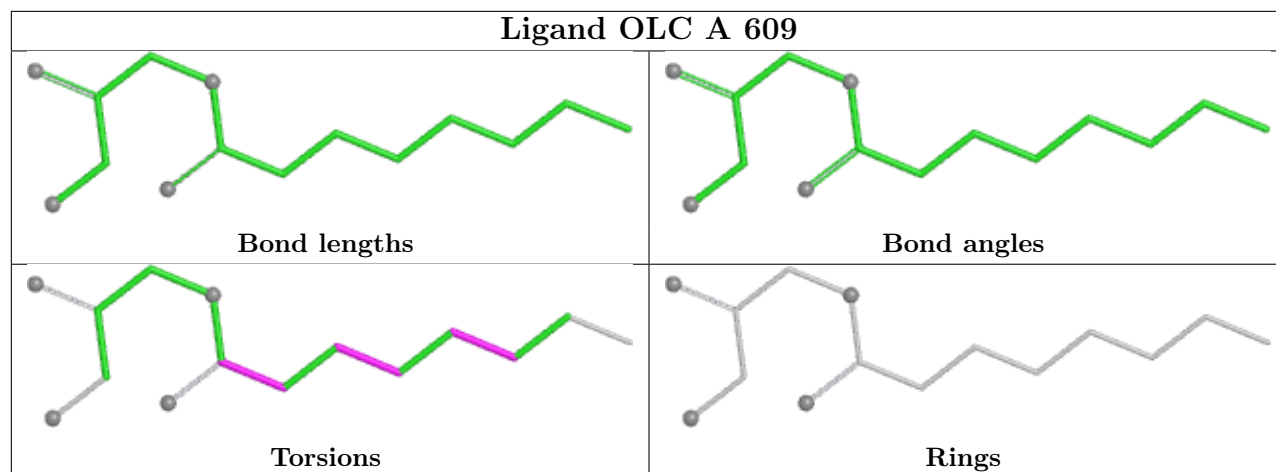
Mol	Chain	Res	Type	Atoms
7	A	609	OLC	O20-C1-C2-C3
7	A	613	OLC	C5-C6-C7-C8
7	B	203	OLC	C12-C13-C14-C15
6	A	603	HAS	CAD-CBD-CGD-O2D
7	A	605	OLC	C5-C6-C7-C8
7	A	609	OLC	O19-C1-C2-C3
7	C	101	OLC	C6-C7-C8-C9
7	A	609	OLC	C2-C3-C4-C5
7	A	607	OLC	O19-C1-O20-C21
7	A	606	OLC	O19-C1-C2-C3
5	A	602	HEM	CAD-CBD-CGD-O2D
5	A	602	HEM	CAD-CBD-CGD-O1D

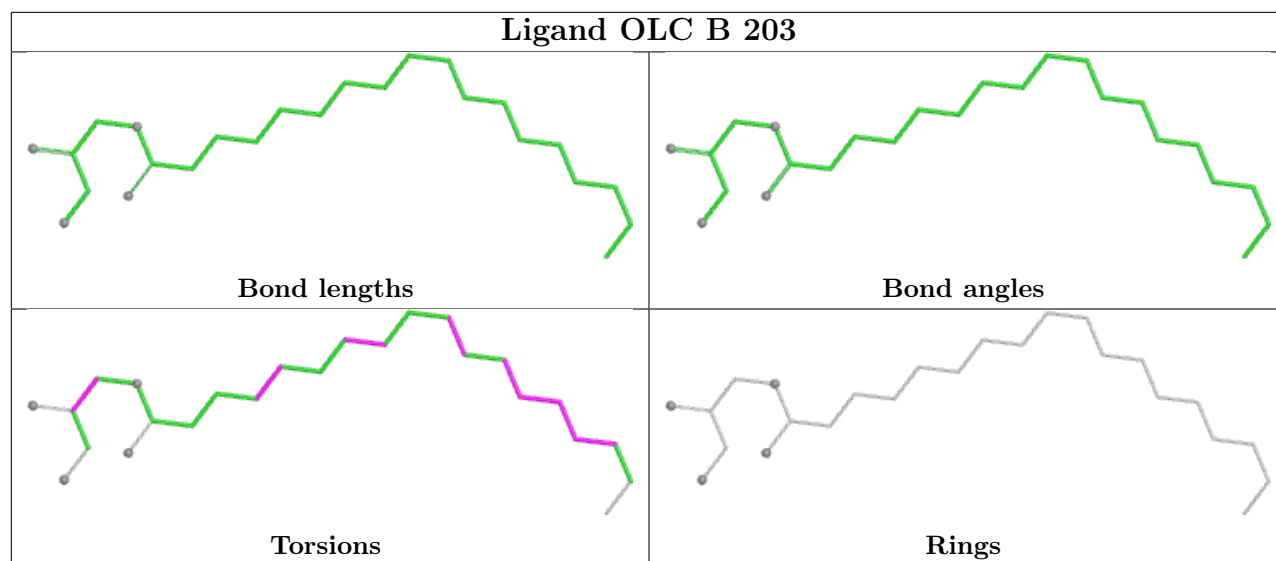
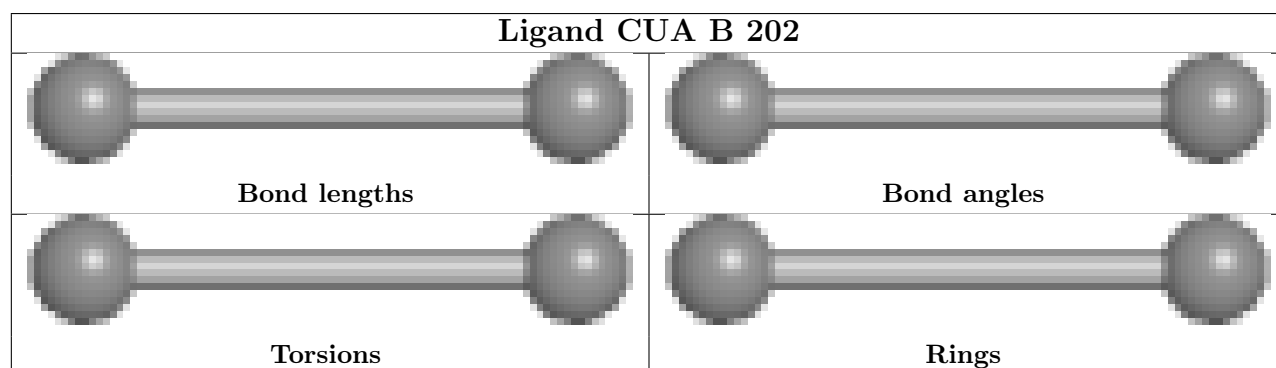
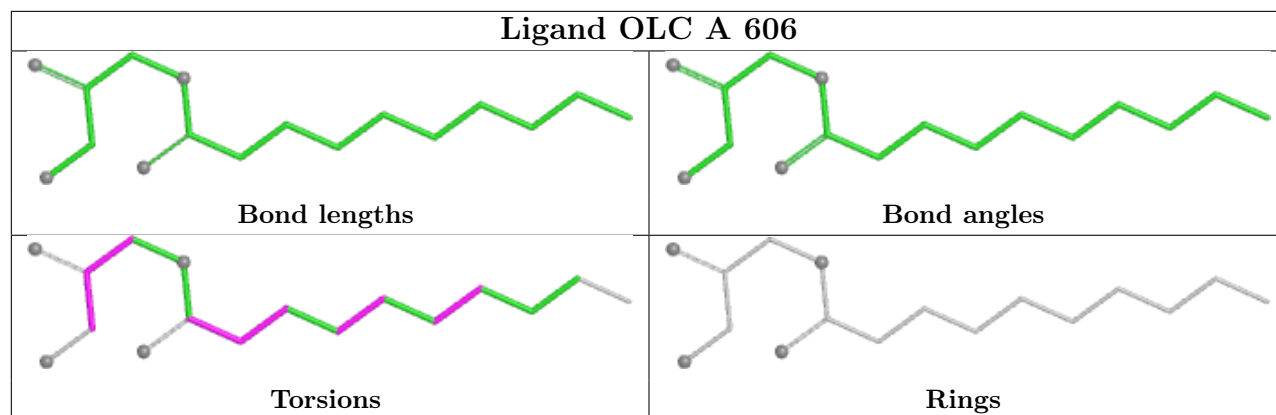
There are no ring outliers.

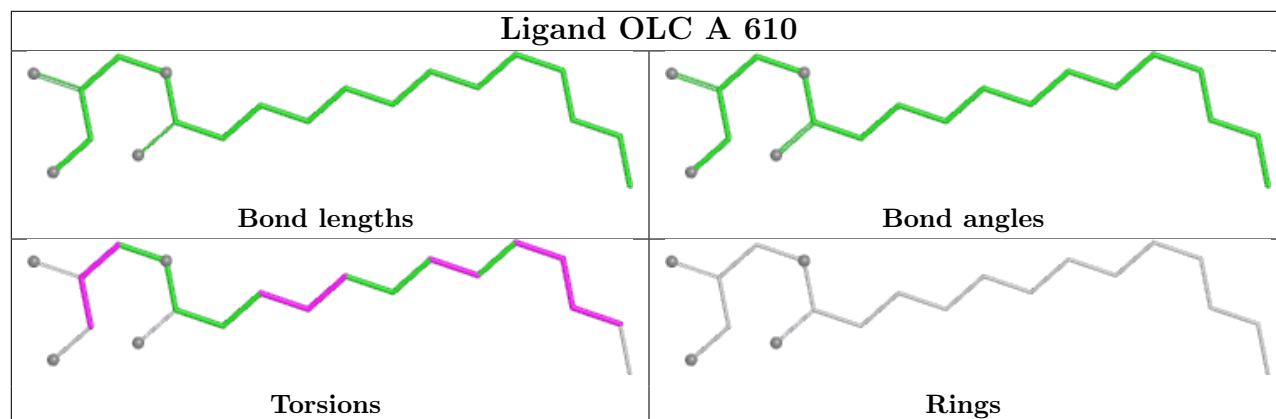
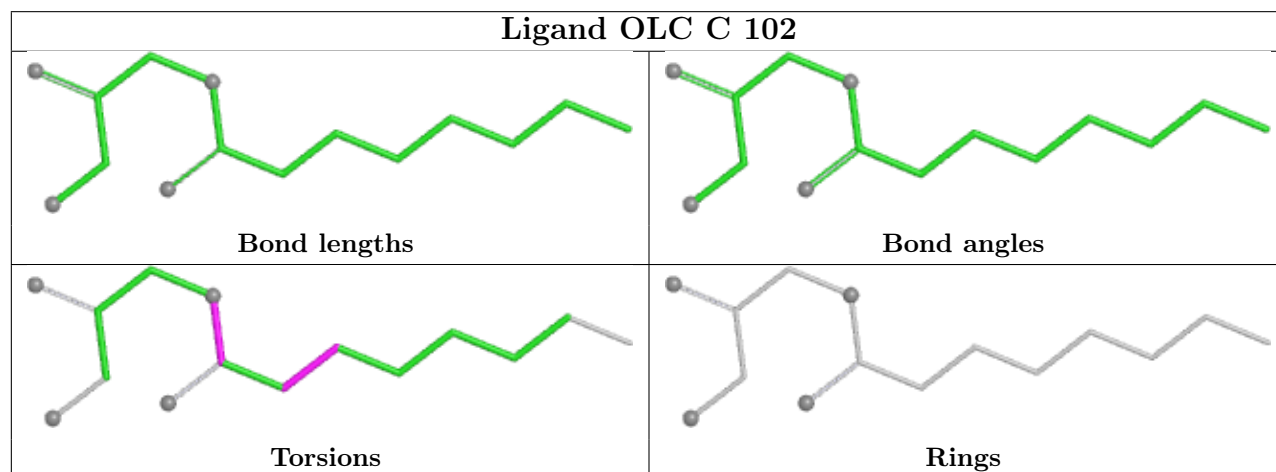
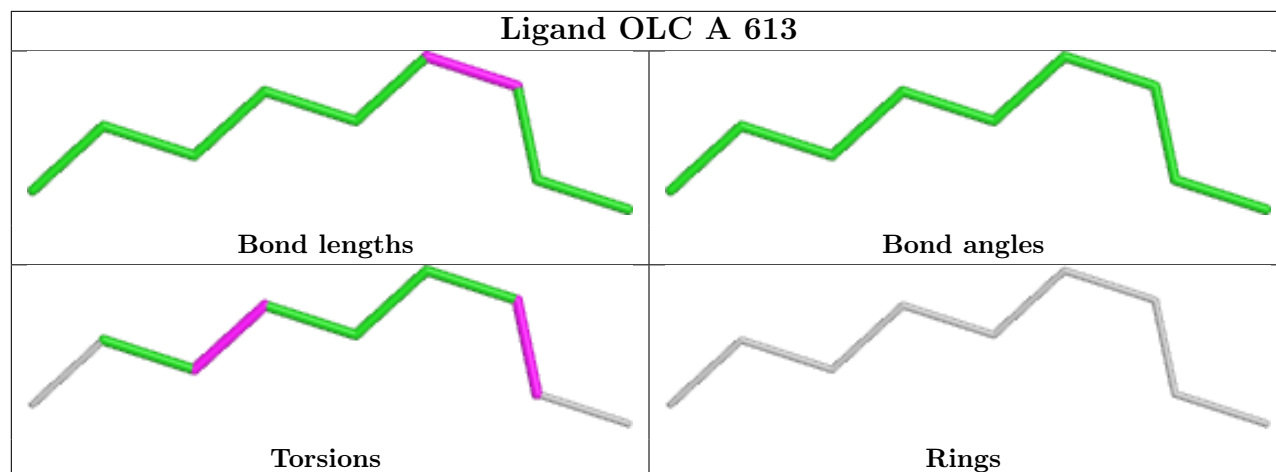
5 monomers are involved in 7 short contacts:

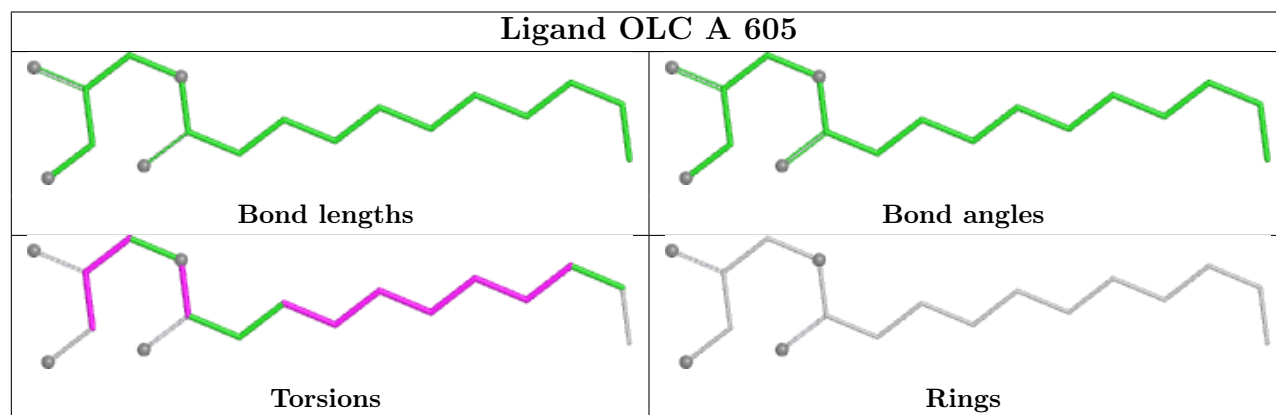
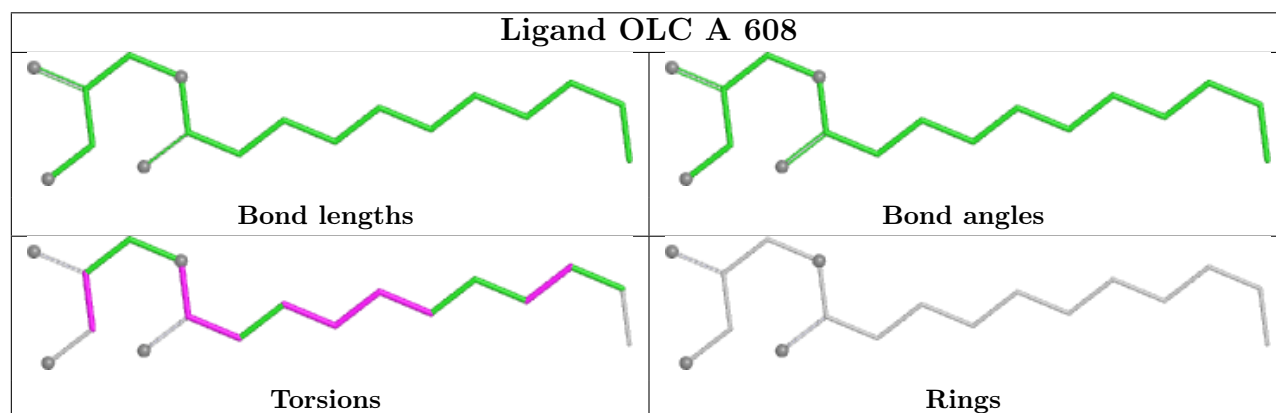
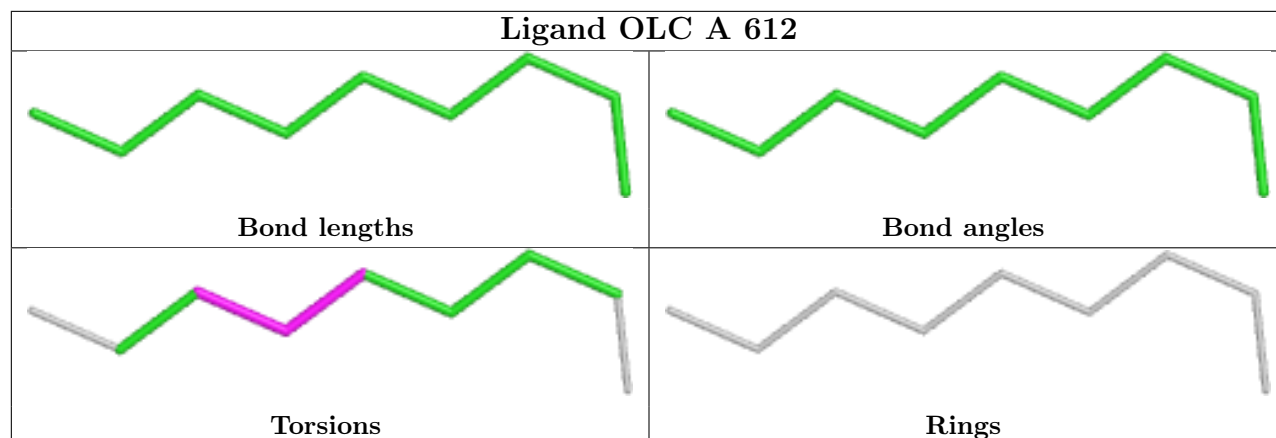
Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	A	606	OLC	1	0
7	B	203	OLC	1	0
7	A	605	OLC	1	0
5	A	602	HEM	3	0
6	A	603	HAS	1	0

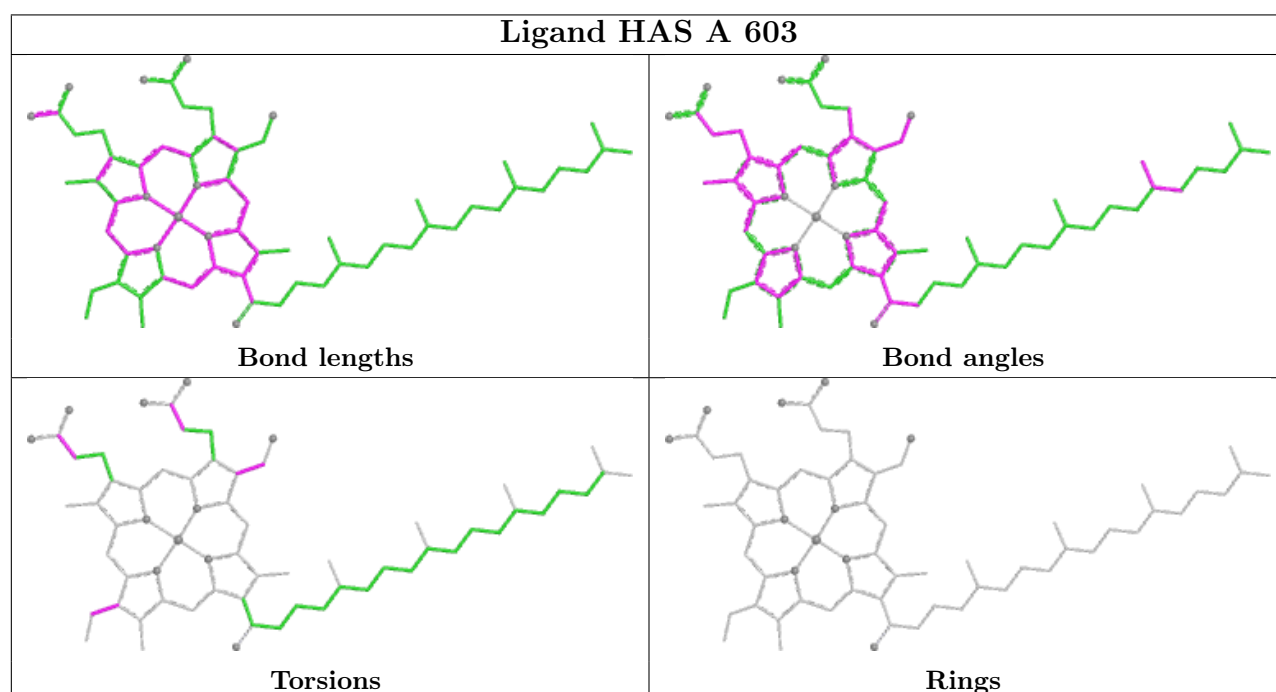
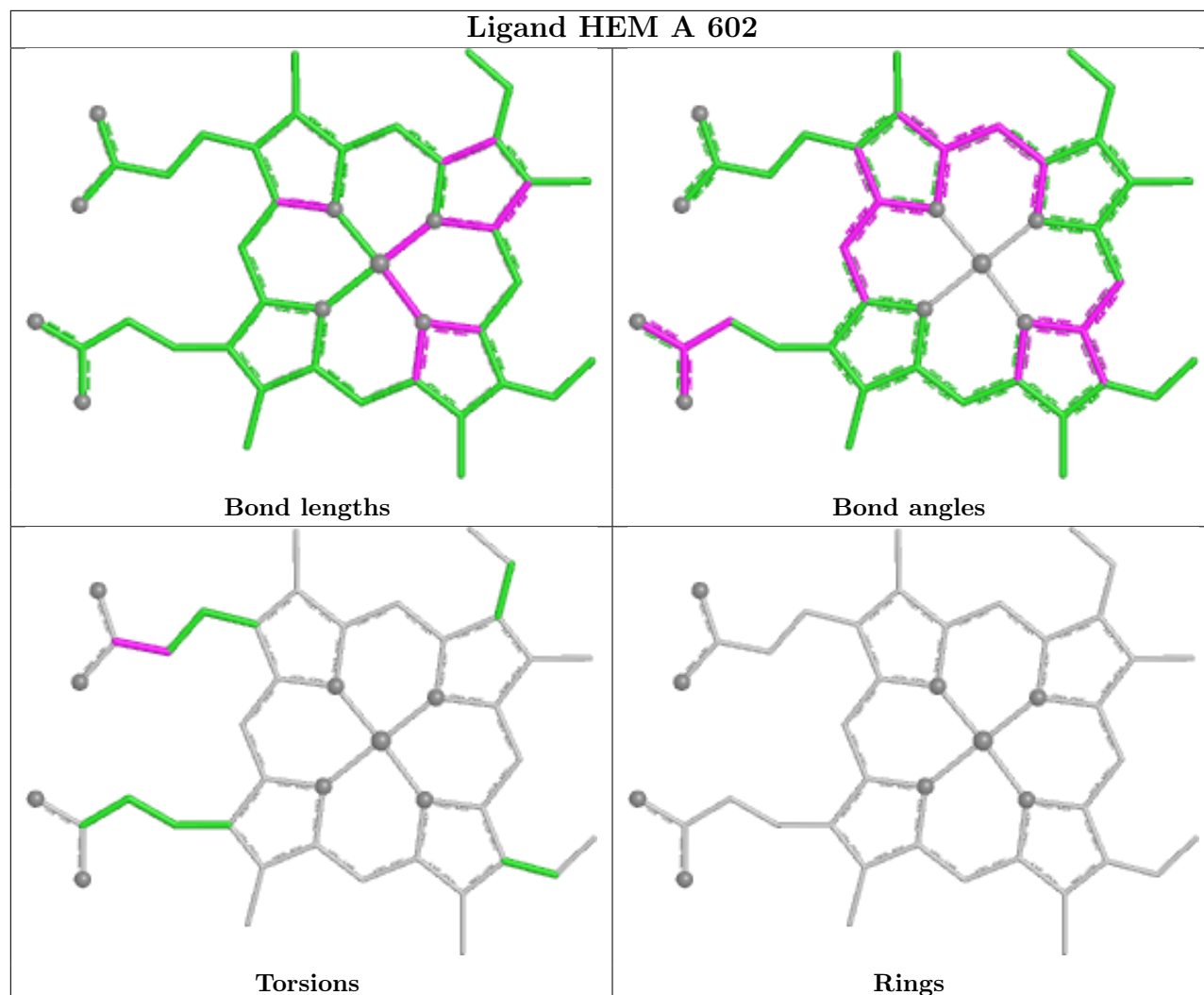
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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.

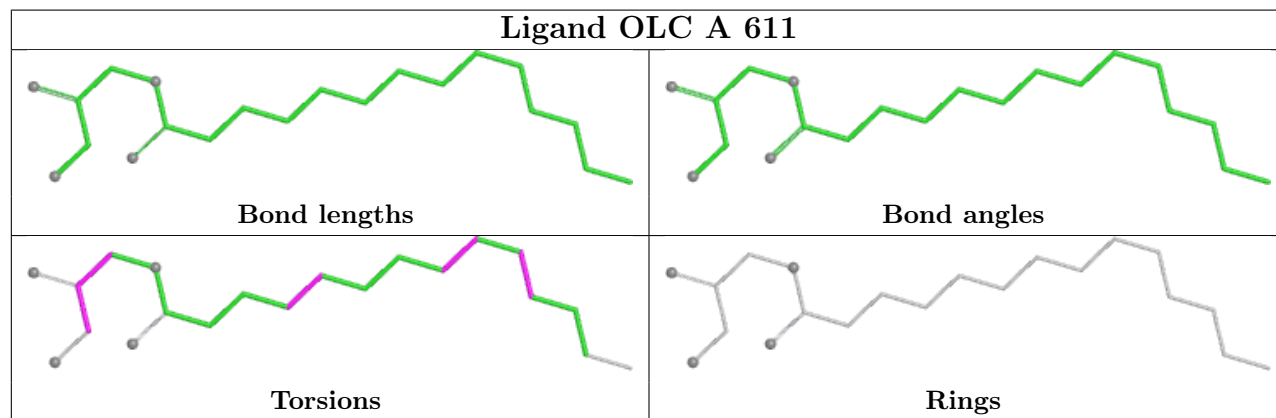
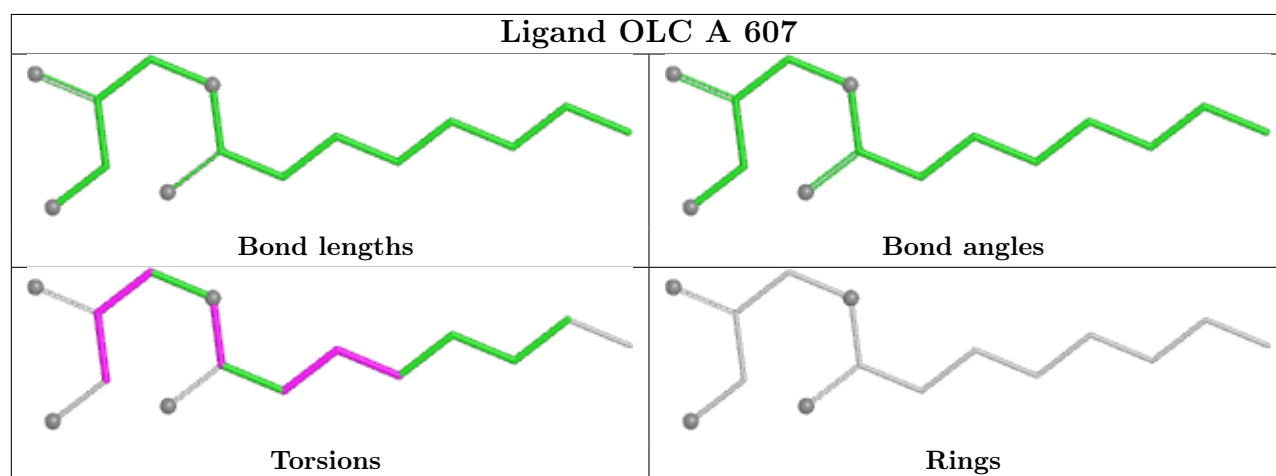
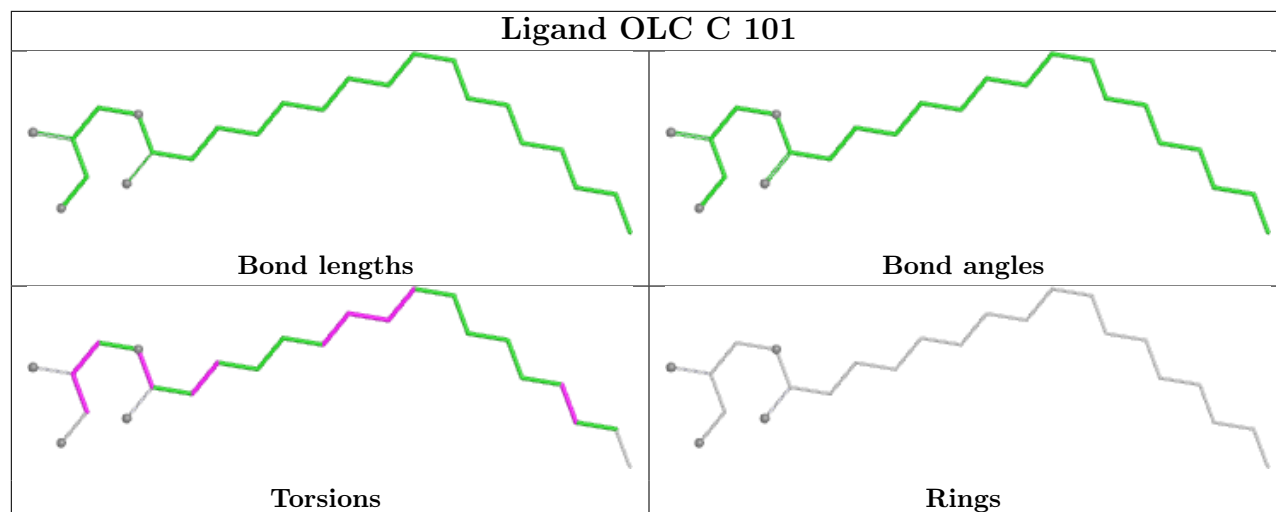


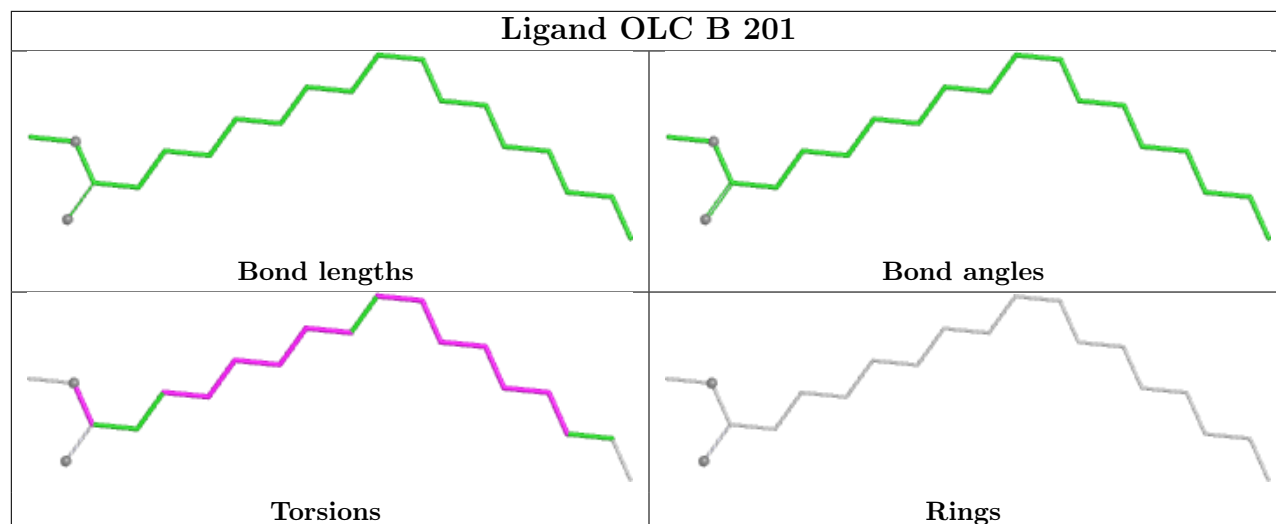












5.7 Other polymers [i](#)

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, 95th 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 ²)	Q<0.9
1	A	554/569 (97%)	-0.23	2 (0%) 88 90	32, 46, 77, 122	0
2	B	167/168 (99%)	-0.33	1 (0%) 85 87	33, 46, 79, 122	0
3	C	31/34 (91%)	-0.38	0 100 100	39, 45, 59, 86	0
All	All	752/771 (97%)	-0.26	3 (0%) 88 90	32, 46, 78, 122	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	2	VAL	3.3
1	A	9	SER	3.2
1	A	322	PHE	2.2

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

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides 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, 95th 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 ²)	Q<0.9
7	OLC	A	607	15/25	0.70	0.24	78,93,120,131	0

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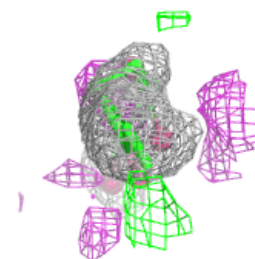
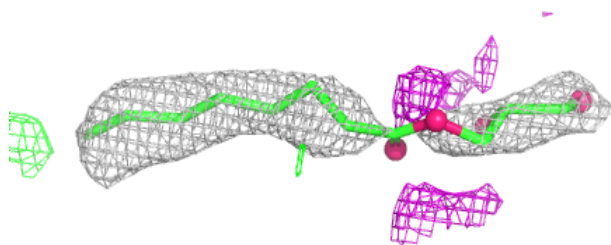
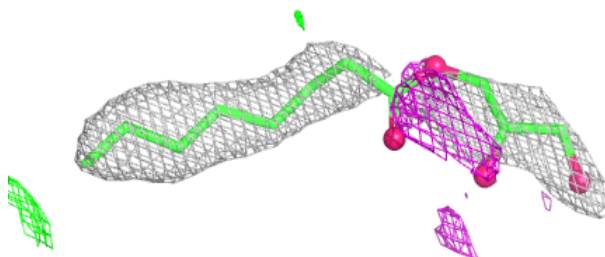
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
7	OLC	A	606	17/25	0.77	0.18	87,98,103,112	0
7	OLC	C	102	15/25	0.79	0.17	85,99,113,124	0
7	OLC	A	605	18/25	0.82	0.18	80,89,107,109	0
7	OLC	A	611	21/25	0.83	0.17	79,96,102,103	0
7	OLC	B	201	20/25	0.83	0.18	76,90,113,120	0
7	OLC	A	610	20/25	0.83	0.17	75,95,107,108	0
7	OLC	C	101	24/25	0.85	0.17	77,94,113,118	0
7	OLC	B	203	25/25	0.85	0.15	82,90,99,107	0
7	OLC	C	103	24/25	0.85	0.18	79,96,115,124	0
7	OLC	A	613	9/25	0.86	0.16	70,72,82,82	0
7	OLC	A	608	18/25	0.86	0.18	73,94,111,112	0
7	OLC	A	604	23/25	0.88	0.17	57,75,115,117	0
7	OLC	A	609	15/25	0.89	0.17	84,96,109,111	0
7	OLC	A	612	9/25	0.92	0.17	83,84,91,92	0
6	HAS	A	603	65/65	0.99	0.05	29,35,58,68	0
5	HEM	A	602	43/43	0.99	0.05	31,34,37,44	0
4	CU	A	601	1/1	1.00	0.01	36,36,36,36	0
8	CUA	B	202	2/2	1.00	0.02	34,34,34,35	0

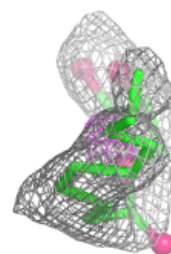
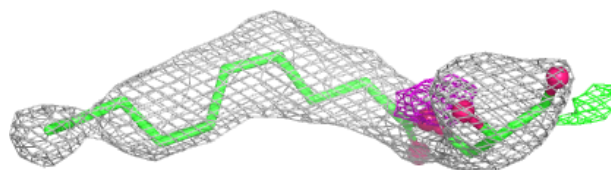
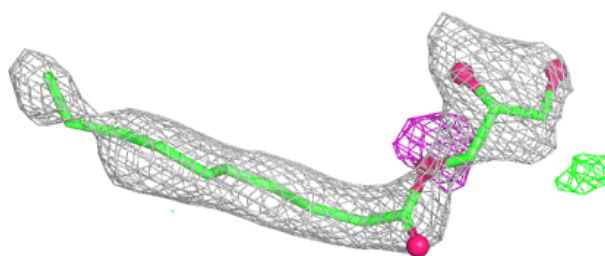
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around OLC A 607:

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

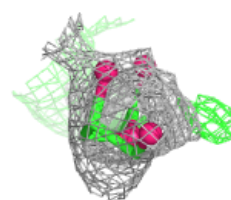
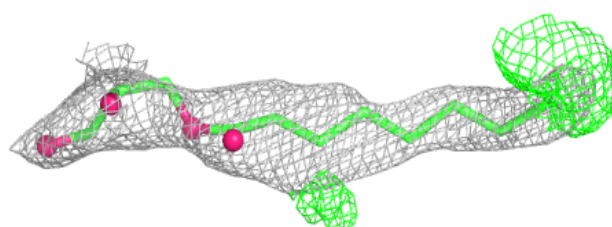
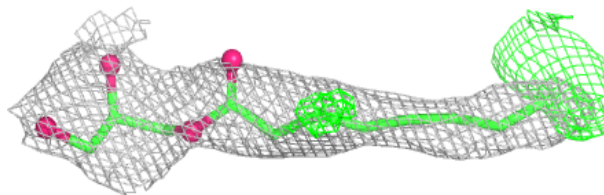
**Electron density around OLC A 606:**

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

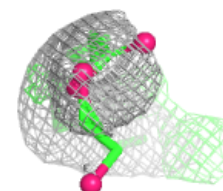
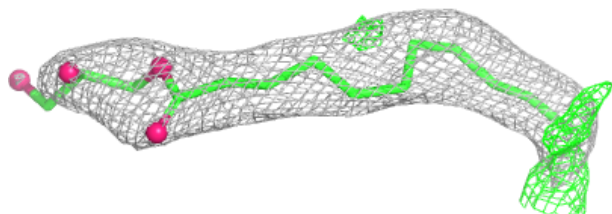
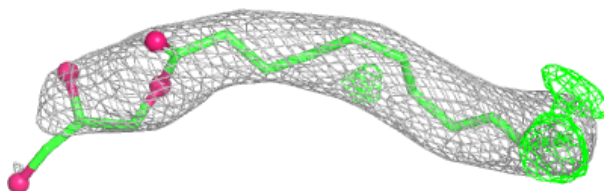


Electron density around OLC C 102:

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

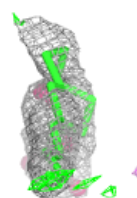
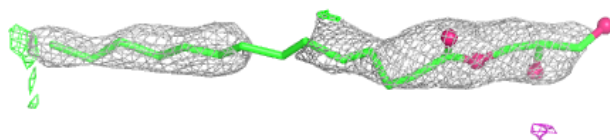
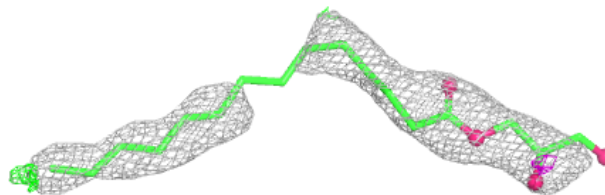
**Electron density around OLC A 605:**

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

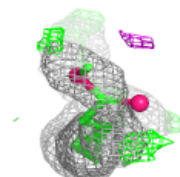
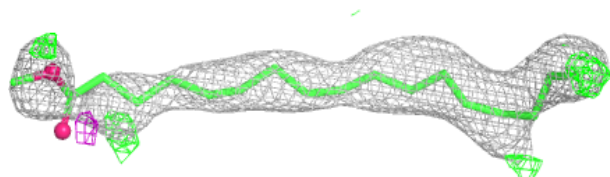
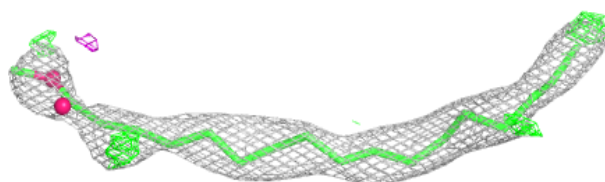


Electron density around OLC A 611:

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

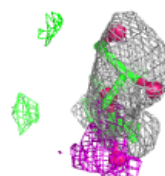
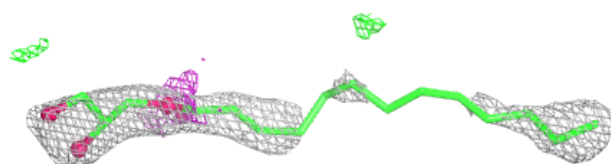
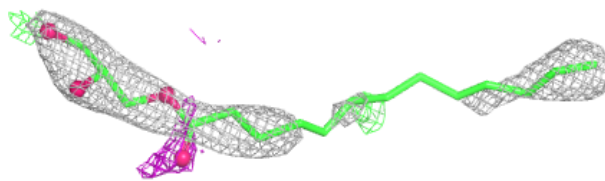
**Electron density around OLC B 201:**

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

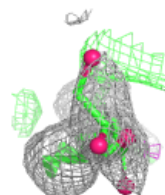
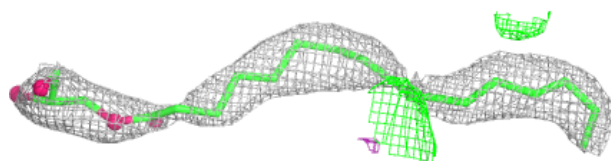
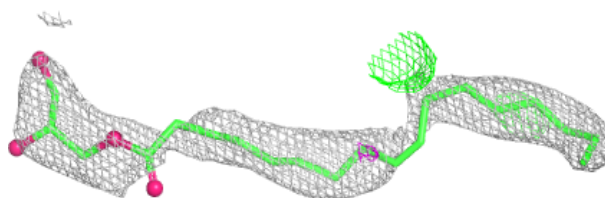


Electron density around OLC A 610:

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

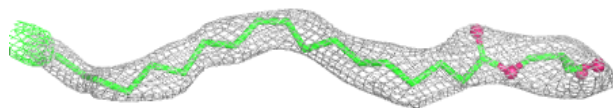
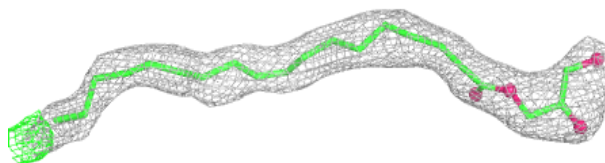
**Electron density around OLC C 101:**

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

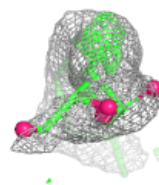
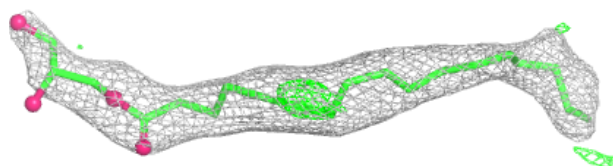
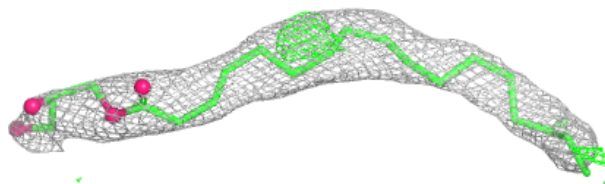


Electron density around OLC B 203:

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

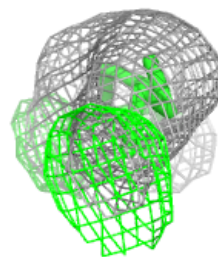
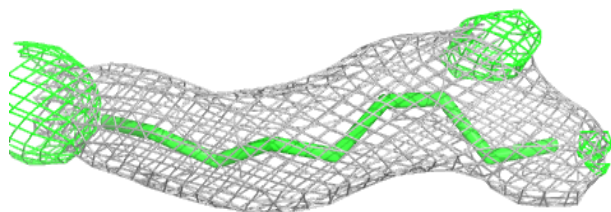
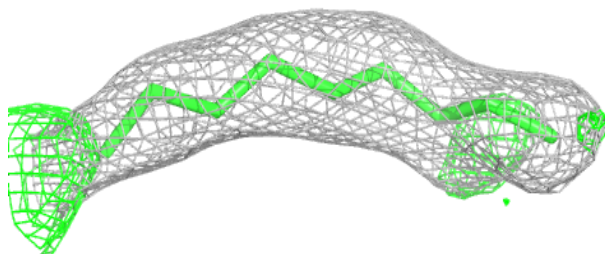
**Electron density around OLC C 103:**

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

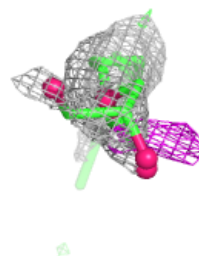
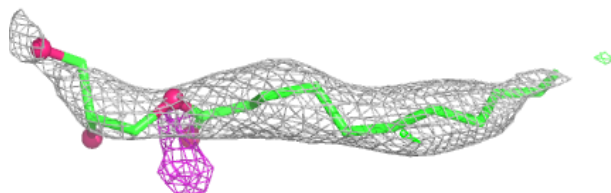
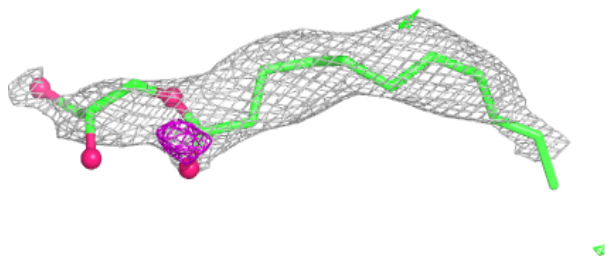


Electron density around OLC A 613:

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

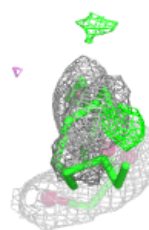
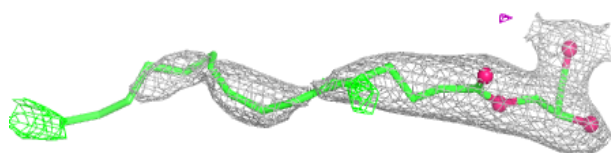
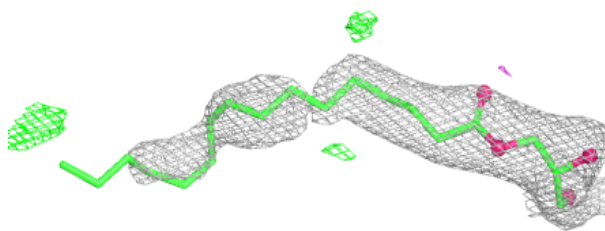
**Electron density around OLC A 608:**

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

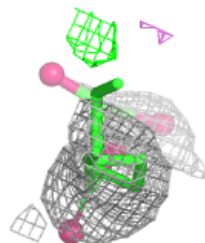
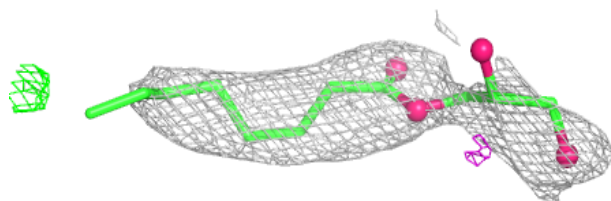
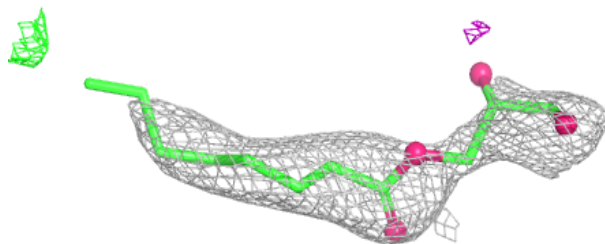


Electron density around OLC A 604:

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

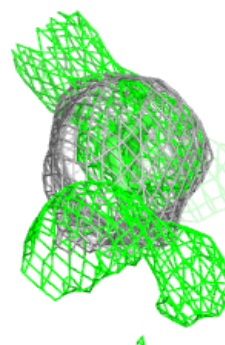
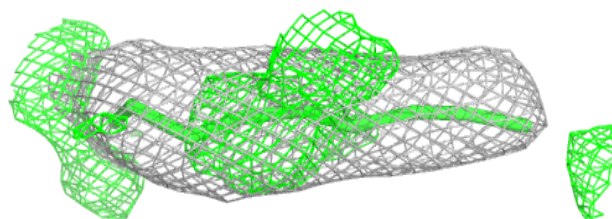
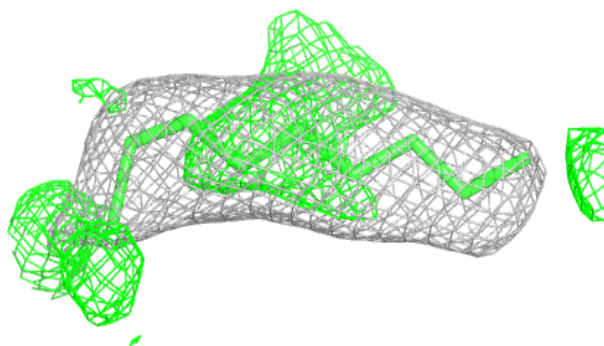
**Electron density around OLC A 609:**

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

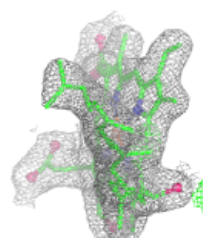
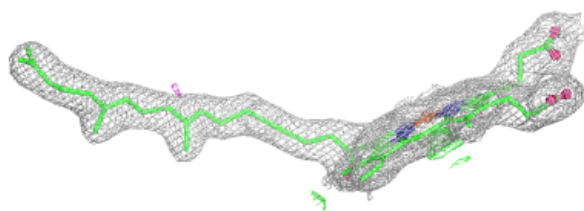
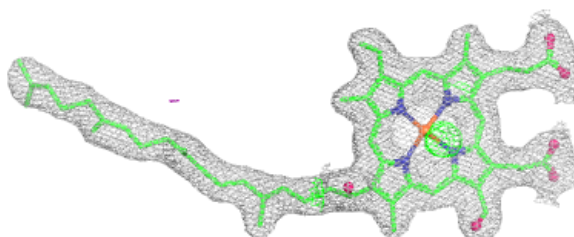


Electron density around OLC A 612:

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

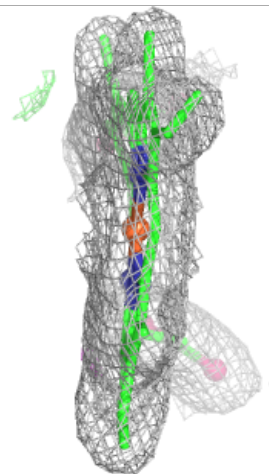
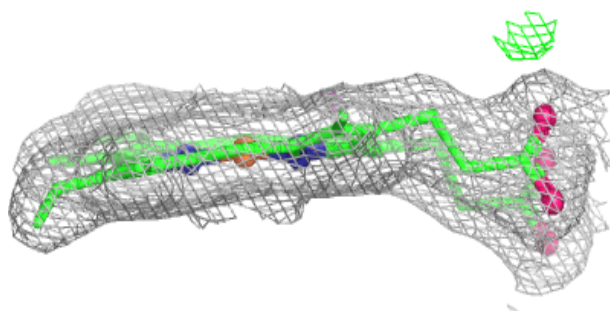
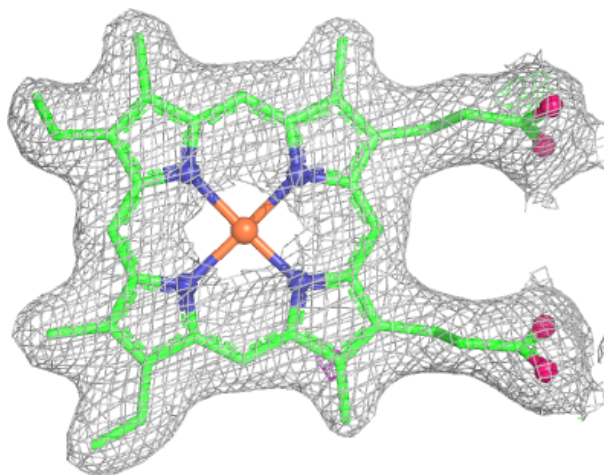
**Electron density around HAS A 603:**

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



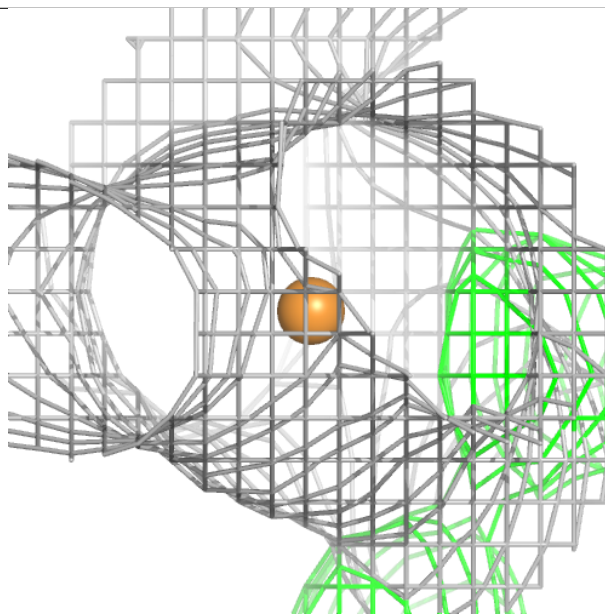
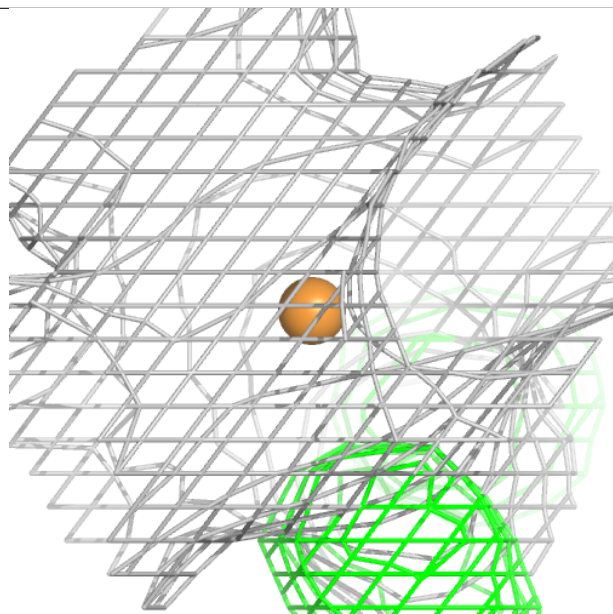
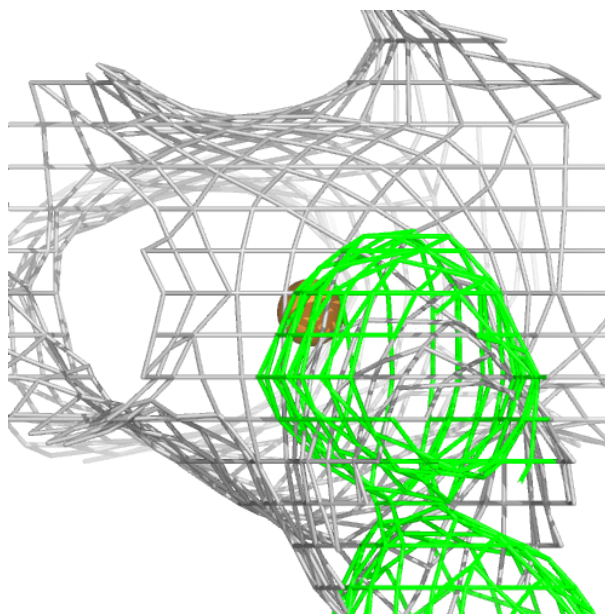
Electron density around HEM A 602:

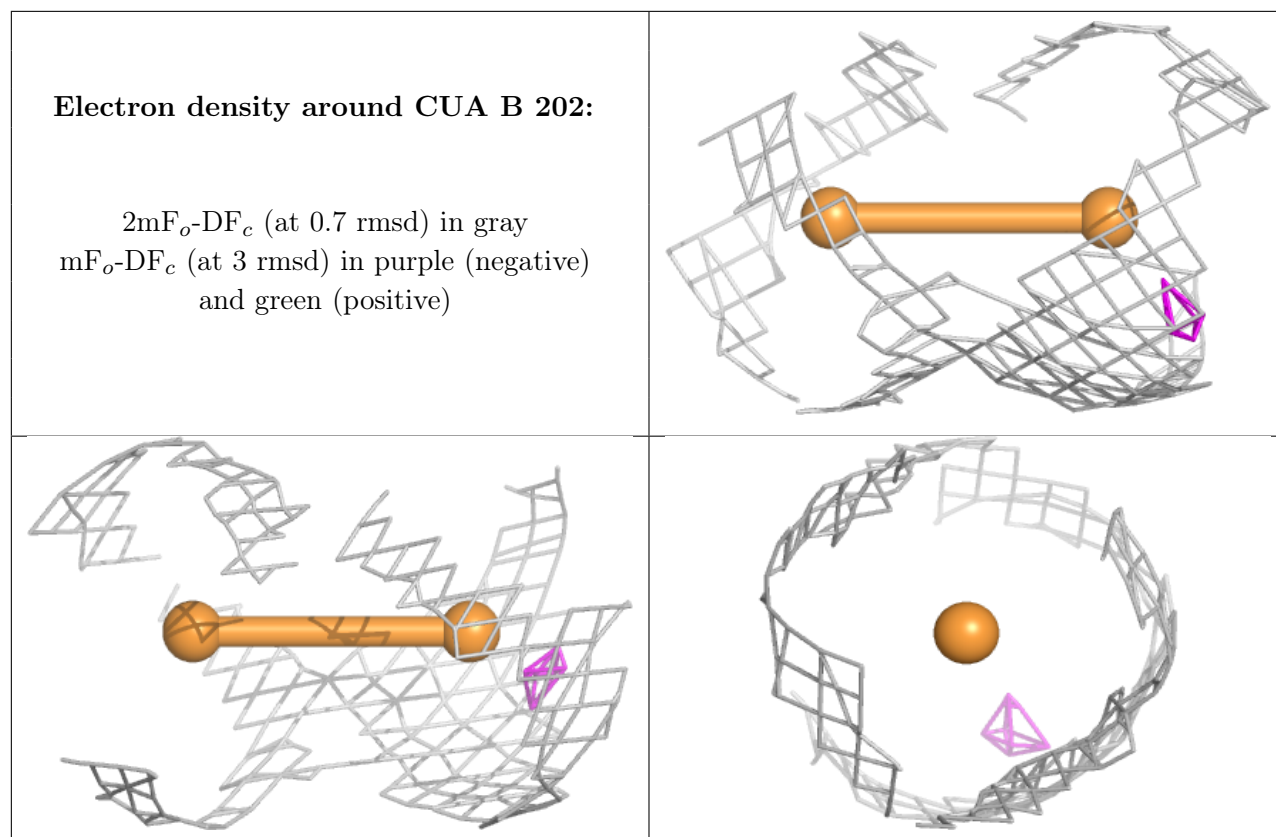
$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around CU A 601:

$2mF_o-DF_c$ (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.