



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 4, 2025 – 07:55 pm BST

PDB ID : 9I31 / pdb\_00009i31  
Title : Alpha-Methylacyl-CoA racemase from Mycobacterium tuberculosis in complex with acetyl-CoA  
Authors : Mojanaga, O.O.; Acharya, K.R.; Lloyd, M.D.  
Deposited on : 2025-01-22  
Resolution : 1.88 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 4-5-2 with Phenix2.0rc1  
Mogul : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 2.0rc1  
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) : 2.43.1

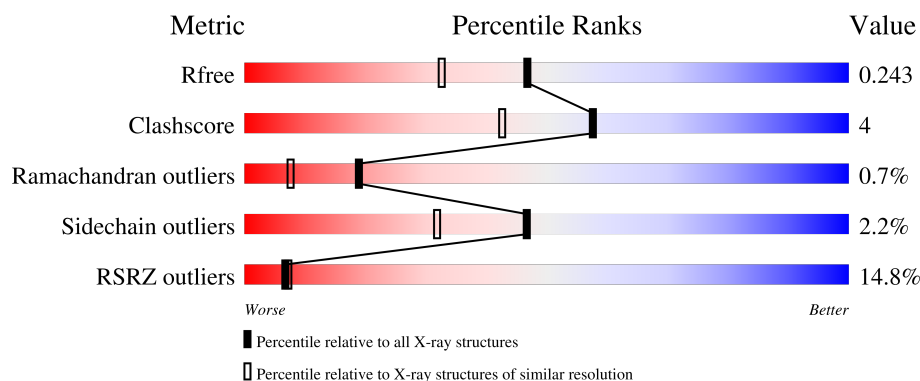
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.88 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	1090 (1.88-1.88)
Clashscore	180529	1144 (1.88-1.88)
Ramachandran outliers	177936	1135 (1.88-1.88)
Sidechain outliers	177891	1135 (1.88-1.88)
RSRZ outliers	164620	1090 (1.88-1.88)

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	364	<div> <div>18%</div> <div> <div></div> <div>87%</div> <div>12%</div> <div>..</div> </div> </div>
1	B	364	<div> <div>12%</div> <div> <div></div> <div>89%</div> <div>8%</div> <div>...</div> </div> </div>
1	C	364	<div> <div>15%</div> <div> <div></div> <div>86%</div> <div>12%</div> <div>.</div> </div> </div>
1	D	364	<div> <div>17%</div> <div> <div></div> <div>88%</div> <div>9%</div> <div>...</div> </div> </div>
1	E	364	<div> <div>12%</div> <div> <div></div> <div>86%</div> <div>12%</div> <div>..</div> </div> </div>

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Mol	Chain	Length	Quality of chain
1	F	364	
1	G	364	
1	H	364	
1	I	364	
1	J	364	
1	K	364	
1	L	364	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 35726 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 Alpha-methylacyl-CoA racemase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	359	Total	C	N	O	S	0	2	0
			2718	1704	486	512	16			
1	B	359	Total	C	N	O	S	0	1	0
			2715	1703	486	510	16			
1	C	359	Total	C	N	O	S	0	2	0
			2718	1704	486	512	16			
1	D	359	Total	C	N	O	S	0	1	0
			2715	1703	486	510	16			
1	E	359	Total	C	N	O	S	0	2	0
			2718	1704	486	512	16			
1	F	359	Total	C	N	O	S	0	1	0
			2715	1703	486	510	16			
1	G	359	Total	C	N	O	S	0	2	0
			2718	1704	486	512	16			
1	H	359	Total	C	N	O	S	0	1	0
			2715	1703	486	510	16			
1	I	359	Total	C	N	O	S	0	2	0
			2718	1704	486	512	16			
1	J	359	Total	C	N	O	S	0	1	0
			2715	1703	486	510	16			
1	K	360	Total	C	N	O	S	0	3	0
			2728	1710	488	514	16			
1	L	359	Total	C	N	O	S	0	1	0
			2715	1703	486	510	16			

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	361	GLY	-	expression tag	UNP O06543
A	362	SER	-	expression tag	UNP O06543
A	363	GLY	-	expression tag	UNP O06543
A	364	CYS	-	expression tag	UNP O06543
B	361	GLY	-	expression tag	UNP O06543

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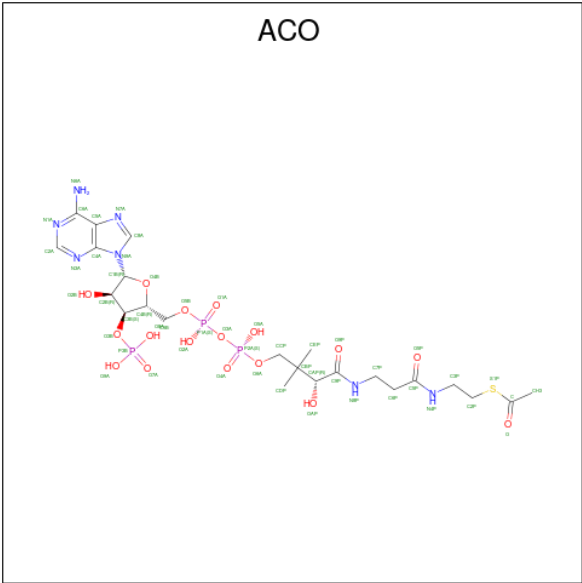
Chain	Residue	Modelled	Actual	Comment	Reference
B	362	SER	-	expression tag	UNP O06543
B	363	GLY	-	expression tag	UNP O06543
B	364	CYS	-	expression tag	UNP O06543
C	361	GLY	-	expression tag	UNP O06543
C	362	SER	-	expression tag	UNP O06543
C	363	GLY	-	expression tag	UNP O06543
C	364	CYS	-	expression tag	UNP O06543
D	361	GLY	-	expression tag	UNP O06543
D	362	SER	-	expression tag	UNP O06543
D	363	GLY	-	expression tag	UNP O06543
D	364	CYS	-	expression tag	UNP O06543
E	361	GLY	-	expression tag	UNP O06543
E	362	SER	-	expression tag	UNP O06543
E	363	GLY	-	expression tag	UNP O06543
E	364	CYS	-	expression tag	UNP O06543
F	361	GLY	-	expression tag	UNP O06543
F	362	SER	-	expression tag	UNP O06543
F	363	GLY	-	expression tag	UNP O06543
F	364	CYS	-	expression tag	UNP O06543
G	361	GLY	-	expression tag	UNP O06543
G	362	SER	-	expression tag	UNP O06543
G	363	GLY	-	expression tag	UNP O06543
G	364	CYS	-	expression tag	UNP O06543
H	361	GLY	-	expression tag	UNP O06543
H	362	SER	-	expression tag	UNP O06543
H	363	GLY	-	expression tag	UNP O06543
H	364	CYS	-	expression tag	UNP O06543
I	361	GLY	-	expression tag	UNP O06543
I	362	SER	-	expression tag	UNP O06543
I	363	GLY	-	expression tag	UNP O06543
I	364	CYS	-	expression tag	UNP O06543
J	361	GLY	-	expression tag	UNP O06543
J	362	SER	-	expression tag	UNP O06543
J	363	GLY	-	expression tag	UNP O06543
J	364	CYS	-	expression tag	UNP O06543
K	361	GLY	-	expression tag	UNP O06543
K	362	SER	-	expression tag	UNP O06543
K	363	GLY	-	expression tag	UNP O06543
K	364	CYS	-	expression tag	UNP O06543
L	361	GLY	-	expression tag	UNP O06543
L	362	SER	-	expression tag	UNP O06543
L	363	GLY	-	expression tag	UNP O06543

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Chain	Residue	Modelled	Actual	Comment	Reference
L	364	CYS	-	expression tag	UNP O06543

- Molecule 2 is ACETYL COENZYME \*A (CCD ID: ACO) (formula: C<sub>23</sub>H<sub>38</sub>N<sub>7</sub>O<sub>17</sub>P<sub>3</sub>S) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	B	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	C	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	D	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	E	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	F	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	G	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	H	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	I	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		
2	J	1	Total	C	N	O	P	S	0	1
			102	46	14	34	6	2		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	K	1	Total	C	N	O	P	S	
			102	46	14	34	6	2	
2	L	1	Total	C	N	O	P	S	
			102	46	14	34	6	2	

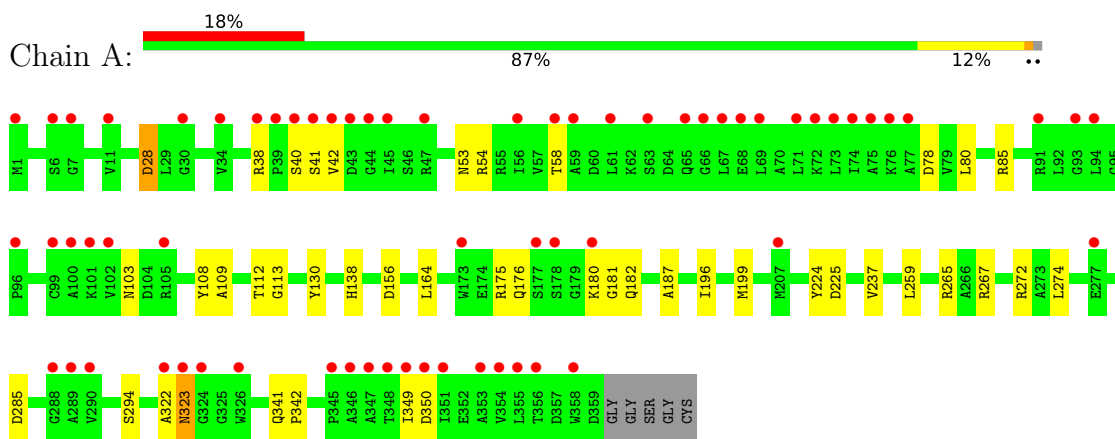
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	166	Total	O		
			166	166	0	0
3	B	150	Total	O		
			150	150	0	0
3	C	152	Total	O		
			152	152	0	0
3	D	162	Total	O		
			162	162	0	0
3	E	154	Total	O		
			154	154	0	0
3	F	143	Total	O		
			143	143	0	0
3	G	135	Total	O		
			135	135	0	0
3	H	144	Total	O		
			144	144	0	0
3	I	170	Total	O		
			170	170	0	0
3	J	180	Total	O		
			180	180	0	0
3	K	172	Total	O		
			172	172	0	0
3	L	166	Total	O		
			166	166	0	0

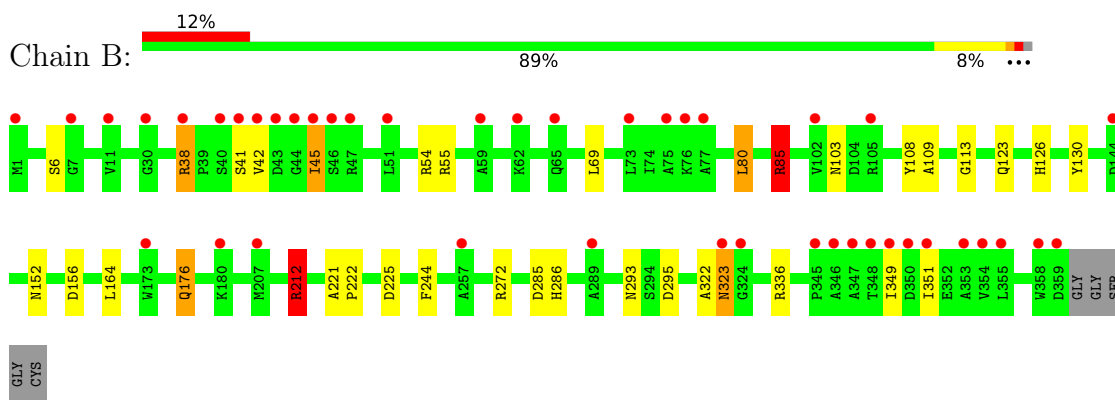
### 3 Residue-property plots [i](#)

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.

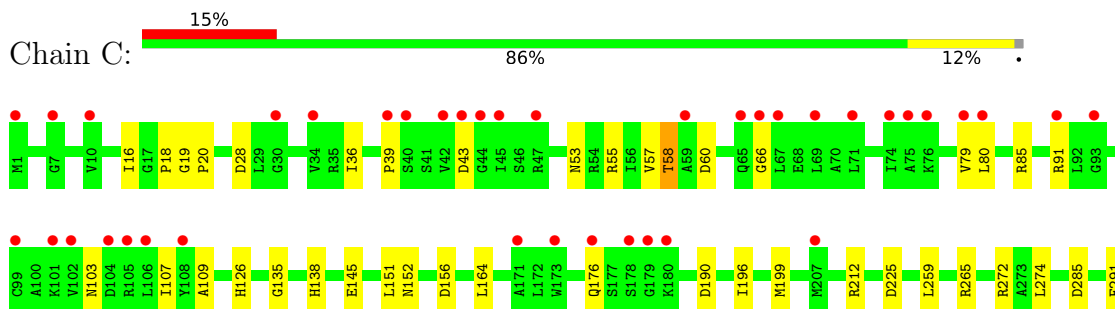
#### • Molecule 1: Alpha-methylacyl-CoA racemase



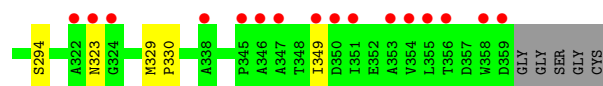
#### • Molecule 1: Alpha-methylacyl-CoA racemase



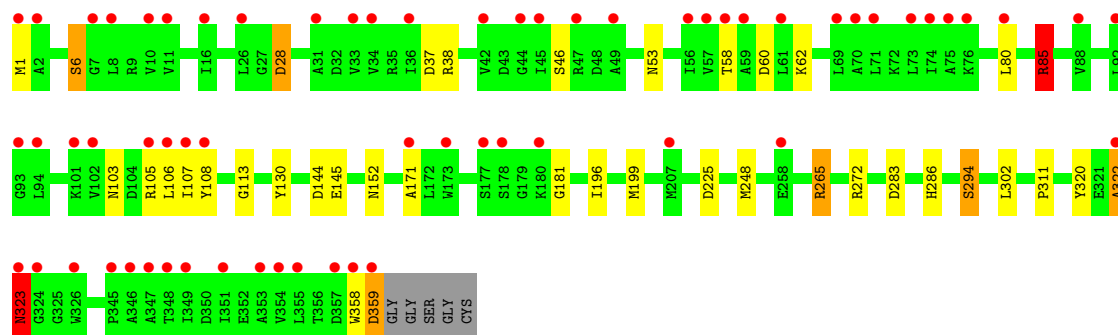
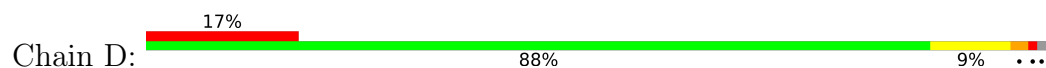
#### • Molecule 1: Alpha-methylacyl-CoA racemase



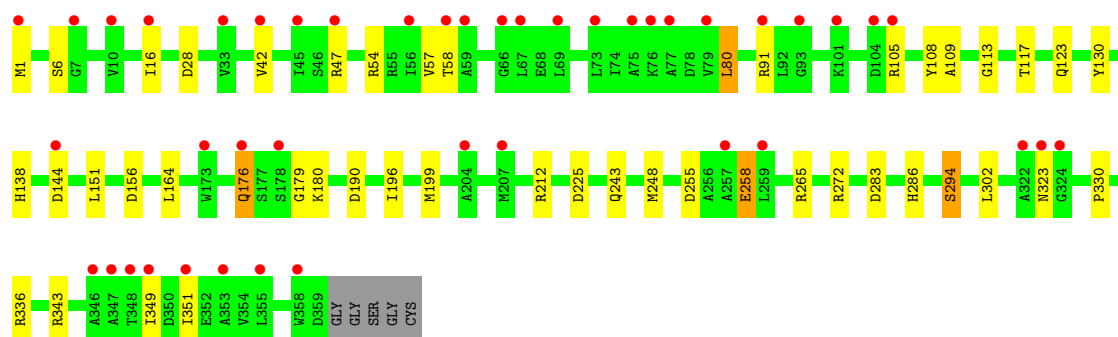
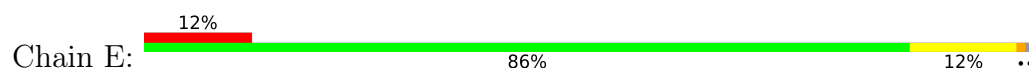




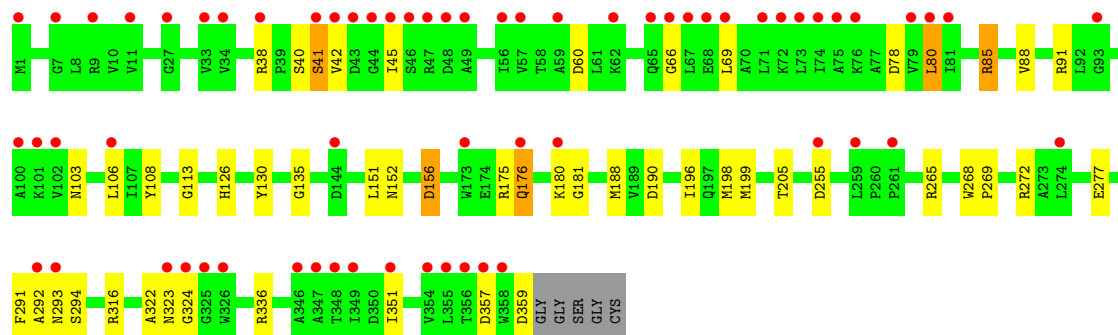
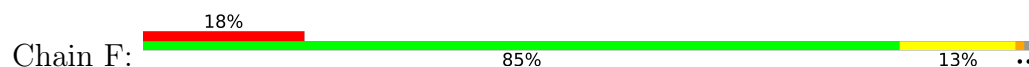
• Molecule 1: Alpha-methylacyl-CoA racemase



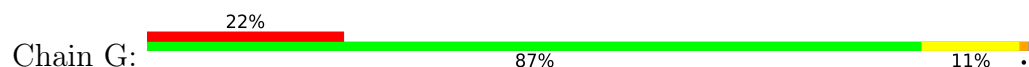
• Molecule 1: Alpha-methylacyl-CoA racemase

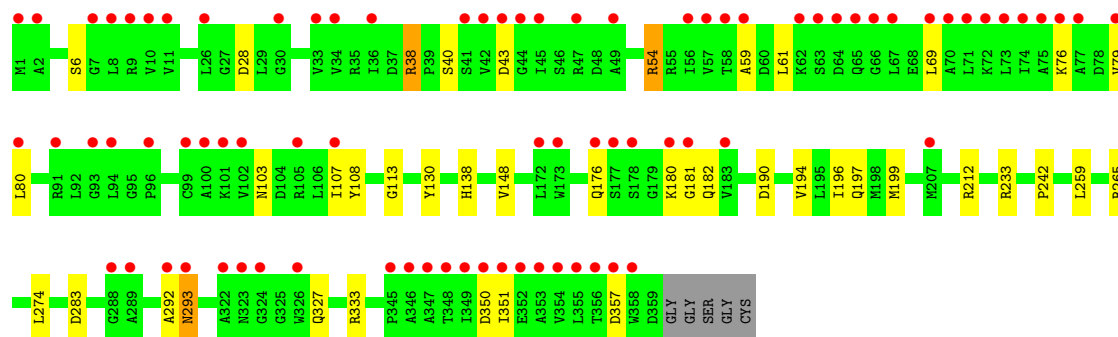


• Molecule 1: Alpha-methylacyl-CoA racemase

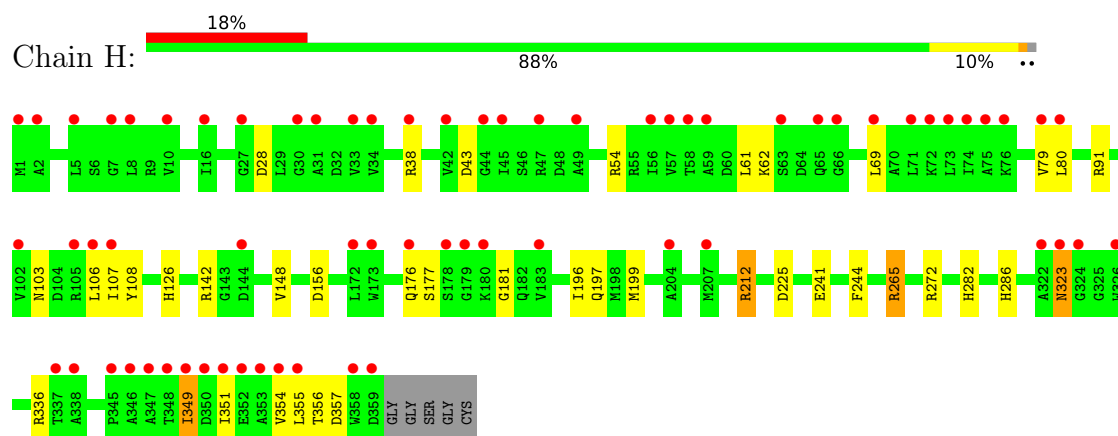


• Molecule 1: Alpha-methylacyl-CoA racemase

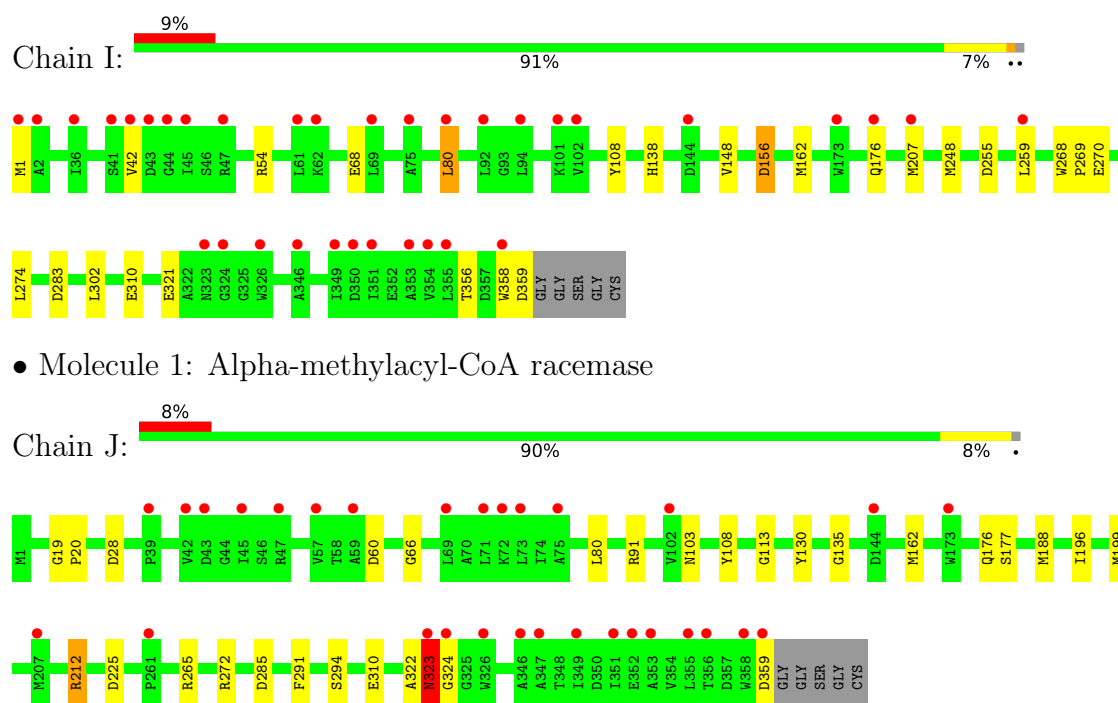




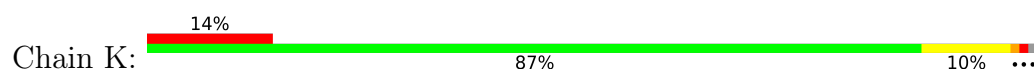
• Molecule 1: Alpha-methylacyl-CoA racemase

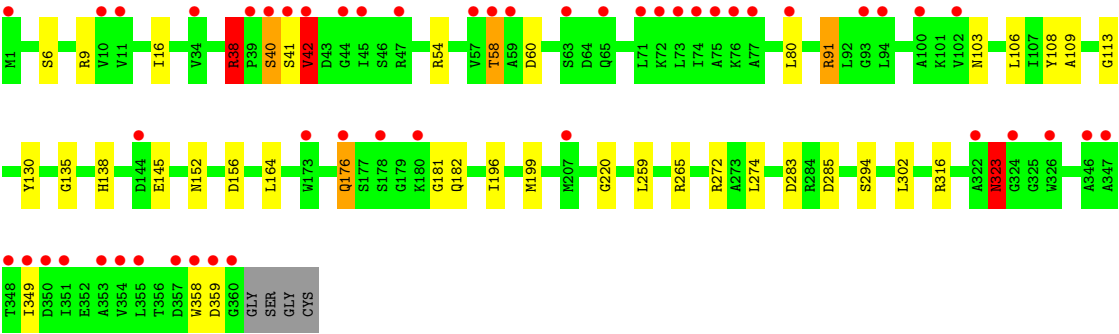


• Molecule 1: Alpha-methylacyl-CoA racemase

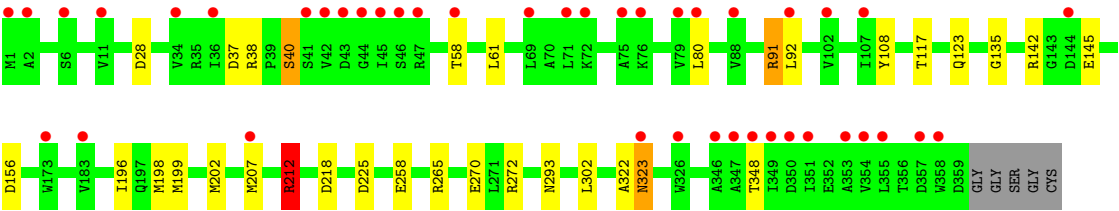
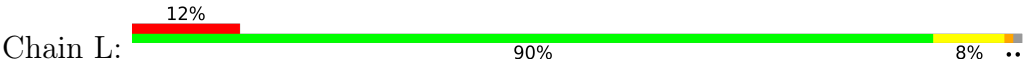


• Molecule 1: Alpha-methylacyl-CoA racemase





● Molecule 1: Alpha-methylacyl-CoA racemase



## 4 Data and refinement statistics

Property	Value	Source
Space group	I 4 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	276.63Å 276.63Å 390.30Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	225.69 – 1.88 225.69 – 1.88	Depositor EDS
% Data completeness (in resolution range)	100.0 (225.69-1.88) 99.9 (225.69-1.88)	Depositor EDS
$R_{merge}$	0.21	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.29 (at 1.88Å)	Xtriage
Refinement program	REFMAC 5.8.0415	Depositor
R, $R_{free}$	0.203 , 0.234 0.213 , 0.243	Depositor DCC
$R_{free}$ test set	30188 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	34.1	Xtriage
Anisotropy	0.016	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 36.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.009 for -1/2*h+1/2*k-1/2*l, 1/2*h-1/2*k-1/2*l, -h-k 0.009 for -1/2*h-1/2*k+1/2*l, -1/2*h-1/2*k-1/2*l, h-k	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	35726	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	41.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.92% 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 ⓘ

### 5.1 Standard geometry ⓘ

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

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	0.66	0/2791	1.02	2/3797 (0.1%)
1	B	0.67	0/2782	1.02	1/3785 (0.0%)
1	C	0.65	0/2791	1.05	1/3797 (0.0%)
1	D	0.68	0/2782	1.08	7/3785 (0.2%)
1	E	0.68	0/2791	1.06	5/3797 (0.1%)
1	F	0.66	0/2782	1.02	3/3785 (0.1%)
1	G	0.65	0/2791	1.06	4/3797 (0.1%)
1	H	0.68	0/2782	1.07	5/3785 (0.1%)
1	I	0.67	0/2791	1.07	6/3797 (0.2%)
1	J	0.68	1/2782 (0.0%)	1.05	3/3785 (0.1%)
1	K	0.66	1/2804 (0.0%)	1.04	3/3814 (0.1%)
1	L	0.67	0/2782	1.03	2/3785 (0.1%)
All	All	0.67	2/33451 (0.0%)	1.05	42/45509 (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	3
1	B	0	4
1	D	0	3
1	E	0	2
1	G	0	5
1	H	0	4
1	I	0	1
1	J	0	2
1	K	0	2
1	L	0	4
All	All	0	30

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	J	285	ASP	CG-OD1	6.46	1.37	1.25
1	K	285	ASP	CG-OD1	5.28	1.35	1.25

The worst 5 of 42 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	283	ASP	CA-CB-CG	6.97	119.57	112.60
1	G	283	ASP	CA-CB-CG	6.96	119.56	112.60
1	E	28	ASP	CA-CB-CG	6.82	119.42	112.60
1	D	265	ARG	NE-CZ-NH2	6.54	125.08	119.20
1	H	148	VAL	CA-C-O	6.44	123.76	119.38

There are no chirality outliers.

5 of 30 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	265	ARG	Sidechain
1	A	38	ARG	Sidechain
1	A	54	ARG	Peptide
1	B	54	ARG	Peptide
1	B	85	ARG	Sidechain

## 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	2718	0	2658	21	0
1	B	2715	0	2660	27	0
1	C	2718	0	2658	29	0
1	D	2715	0	2660	25	0
1	E	2718	0	2658	27	0
1	F	2715	0	2660	40	0
1	G	2718	0	2658	20	0
1	H	2715	0	2660	25	0
1	I	2718	0	2658	14	0
1	J	2715	0	2660	16	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	K	2728	0	2669	30	0
1	L	2715	0	2660	20	0
2	A	102	0	68	9	0
2	B	102	0	68	15	0
2	C	102	0	68	8	0
2	D	102	0	68	5	0
2	E	102	0	68	13	0
2	F	102	0	68	15	0
2	G	102	0	68	4	0
2	H	102	0	68	10	0
2	I	102	0	68	1	0
2	J	102	0	68	2	0
2	K	102	0	68	8	0
2	L	102	0	68	6	0
3	A	166	0	0	4	0
3	B	150	0	0	3	0
3	C	152	0	0	2	0
3	D	162	0	0	3	0
3	E	154	0	0	3	0
3	F	143	0	0	4	0
3	G	135	0	0	1	0
3	H	144	0	0	3	0
3	I	170	0	0	4	0
3	J	180	0	0	1	0
3	K	172	0	0	2	0
3	L	166	0	0	3	0
All	All	35726	0	32735	295	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

The worst 5 of 295 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)
2:A:401[B]:ACO:H71	2:A:401[B]:ACO:CDP	2.00	0.90
2:A:401[B]:ACO:H71	2:A:401[B]:ACO:H131	1.50	0.89
1:D:85:ARG:HD3	2:D:401[A]:ACO:O2A	1.71	0.89
1:B:85:ARG:HD3	2:B:401[A]:ACO:O2A	1.77	0.83
1:H:62:LYS:NZ	2:H:401[B]:ACO:O8A	2.10	0.83

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	359/364 (99%)	339 (94%)	16 (4%)	4 (1%)	12	3
1	B	358/364 (98%)	344 (96%)	12 (3%)	2 (1%)	22	10
1	C	359/364 (99%)	347 (97%)	8 (2%)	4 (1%)	12	3
1	D	358/364 (98%)	342 (96%)	15 (4%)	1 (0%)	37	26
1	E	359/364 (99%)	348 (97%)	9 (2%)	2 (1%)	22	10
1	F	358/364 (98%)	341 (95%)	12 (3%)	5 (1%)	9	1
1	G	359/364 (99%)	337 (94%)	18 (5%)	4 (1%)	12	3
1	H	358/364 (98%)	343 (96%)	13 (4%)	2 (1%)	22	10
1	I	359/364 (99%)	347 (97%)	12 (3%)	0	100	100
1	J	358/364 (98%)	345 (96%)	11 (3%)	2 (1%)	22	10
1	K	361/364 (99%)	345 (96%)	12 (3%)	4 (1%)	12	3
1	L	358/364 (98%)	344 (96%)	13 (4%)	1 (0%)	37	26
All	All	4304/4368 (98%)	4122 (96%)	151 (4%)	31 (1%)	19	7

5 of 31 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	41	SER
1	B	323	ASN
1	F	41	SER
1	F	323	ASN
1	G	103	ASN

### 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	277/277 (100%)	274 (99%)	3 (1%)	70	62
1	B	276/277 (100%)	267 (97%)	9 (3%)	33	17
1	C	277/277 (100%)	274 (99%)	3 (1%)	70	62
1	D	276/277 (100%)	269 (98%)	7 (2%)	42	26
1	E	277/277 (100%)	267 (96%)	10 (4%)	30	14
1	F	276/277 (100%)	268 (97%)	8 (3%)	37	20
1	G	277/277 (100%)	271 (98%)	6 (2%)	47	32
1	H	276/277 (100%)	274 (99%)	2 (1%)	81	77
1	I	277/277 (100%)	272 (98%)	5 (2%)	54	40
1	J	276/277 (100%)	272 (99%)	4 (1%)	62	52
1	K	278/277 (100%)	268 (96%)	10 (4%)	30	14
1	L	276/277 (100%)	270 (98%)	6 (2%)	47	32
All	All	3319/3324 (100%)	3246 (98%)	73 (2%)	47	32

5 of 73 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	K	6	SER
1	L	323	ASN
1	K	40	SER
1	K	323	ASN
1	E	58	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 49 such sidechains are listed below:

Mol	Chain	Res	Type
1	G	308	HIS
1	I	263	ASN
1	G	327	GLN
1	I	116	GLN
1	I	293	ASN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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

## 5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry ⓘ

24 ligands are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	ACO	C	401[A]	-	45,53,53	0.72	1 (2%)	56,79,79	1.39	7 (12%)
2	ACO	I	401[B]	-	45,53,53	0.68	1 (2%)	56,79,79	0.90	2 (3%)
2	ACO	K	401[B]	-	45,53,53	0.64	0	56,79,79	1.08	4 (7%)
2	ACO	I	401[A]	-	45,53,53	0.62	0	56,79,79	1.01	4 (7%)
2	ACO	H	401[B]	-	45,53,53	0.65	0	56,79,79	1.25	5 (8%)
2	ACO	H	401[A]	-	45,53,53	0.73	1 (2%)	56,79,79	1.19	3 (5%)
2	ACO	K	401[A]	-	45,53,53	0.69	1 (2%)	56,79,79	1.03	3 (5%)
2	ACO	G	401[B]	-	45,53,53	0.72	1 (2%)	56,79,79	1.09	2 (3%)
2	ACO	F	401[B]	-	45,53,53	0.72	1 (2%)	56,79,79	1.14	4 (7%)
2	ACO	A	401[B]	-	45,53,53	0.71	1 (2%)	56,79,79	1.06	3 (5%)
2	ACO	B	401[B]	-	45,53,53	0.73	1 (2%)	56,79,79	1.05	2 (3%)
2	ACO	G	401[A]	-	45,53,53	0.71	1 (2%)	56,79,79	1.29	4 (7%)
2	ACO	B	401[A]	-	45,53,53	0.73	0	56,79,79	1.38	5 (8%)
2	ACO	D	401[B]	-	45,53,53	0.60	0	56,79,79	1.01	2 (3%)
2	ACO	A	401[A]	-	45,53,53	0.72	1 (2%)	56,79,79	1.15	4 (7%)
2	ACO	F	401[A]	-	45,53,53	0.65	0	56,79,79	1.09	2 (3%)
2	ACO	E	401[B]	-	45,53,53	0.78	1 (2%)	56,79,79	1.23	3 (5%)
2	ACO	D	401[A]	-	45,53,53	0.70	0	56,79,79	1.23	6 (10%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	ACO	E	401[A]	-	45,53,53	0.67	0	56,79,79	1.27	4 (7%)
2	ACO	L	401[B]	-	45,53,53	0.73	1 (2%)	56,79,79	0.93	1 (1%)
2	ACO	L	401[A]	-	45,53,53	0.70	1 (2%)	56,79,79	1.65	4 (7%)
2	ACO	J	401[B]	-	45,53,53	0.68	0	56,79,79	1.09	5 (8%)
2	ACO	J	401[A]	-	45,53,53	0.77	0	56,79,79	1.24	7 (12%)
2	ACO	C	401[B]	-	45,53,53	0.66	0	56,79,79	0.89	2 (3%)

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	ACO	C	401[A]	-	-	11/47/67/67	0/3/3/3
2	ACO	I	401[B]	-	-	10/47/67/67	0/3/3/3
2	ACO	K	401[B]	-	-	4/47/67/67	0/3/3/3
2	ACO	I	401[A]	-	-	6/47/67/67	0/3/3/3
2	ACO	H	401[B]	-	-	6/47/67/67	0/3/3/3
2	ACO	H	401[A]	-	-	12/47/67/67	0/3/3/3
2	ACO	K	401[A]	-	-	9/47/67/67	0/3/3/3
2	ACO	G	401[B]	-	-	6/47/67/67	0/3/3/3
2	ACO	F	401[B]	-	-	6/47/67/67	0/3/3/3
2	ACO	A	401[B]	-	-	9/47/67/67	0/3/3/3
2	ACO	B	401[B]	-	-	12/47/67/67	0/3/3/3
2	ACO	G	401[A]	-	-	8/47/67/67	0/3/3/3
2	ACO	B	401[A]	-	-	5/47/67/67	0/3/3/3
2	ACO	D	401[B]	-	-	14/47/67/67	0/3/3/3
2	ACO	A	401[A]	-	-	15/47/67/67	0/3/3/3
2	ACO	F	401[A]	-	-	5/47/67/67	0/3/3/3
2	ACO	E	401[B]	-	-	16/47/67/67	0/3/3/3
2	ACO	D	401[A]	-	-	7/47/67/67	0/3/3/3
2	ACO	E	401[A]	-	-	9/47/67/67	0/3/3/3
2	ACO	L	401[B]	-	-	7/47/67/67	0/3/3/3
2	ACO	L	401[A]	-	-	10/47/67/67	0/3/3/3
2	ACO	J	401[B]	-	-	7/47/67/67	0/3/3/3
2	ACO	J	401[A]	-	-	10/47/67/67	0/3/3/3

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	ACO	C	401[B]	-	-	16/47/67/67	0/3/3/3

The worst 5 of 13 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	401[B]	ACO	P3B-O3B	2.99	1.65	1.59
2	F	401[B]	ACO	P3B-O3B	2.85	1.64	1.59
2	A	401[A]	ACO	P3B-O3B	2.80	1.64	1.59
2	K	401[A]	ACO	P3B-O3B	2.53	1.64	1.59
2	C	401[A]	ACO	P3B-O3B	2.51	1.64	1.59

The worst 5 of 88 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	L	401[A]	ACO	C2P-S1P-C	9.96	154.10	101.68
2	B	401[A]	ACO	C2P-S1P-C	6.81	137.51	101.68
2	C	401[A]	ACO	C2P-S1P-C	6.70	136.93	101.68
2	G	401[A]	ACO	C2P-S1P-C	6.66	136.74	101.68
2	E	401[B]	ACO	C2P-S1P-C	6.14	133.98	101.68

There are no chirality outliers.

5 of 220 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401[A]	ACO	C3B-O3B-P3B-O7A
2	A	401[A]	ACO	C9P-CAP-CBP-CCP
2	A	401[A]	ACO	C9P-CAP-CBP-CEP
2	A	401[A]	ACO	CAP-C9P-N8P-C7P
2	A	401[A]	ACO	O9P-C9P-N8P-C7P

There are no ring outliers.

23 monomers are involved in 96 short contacts:

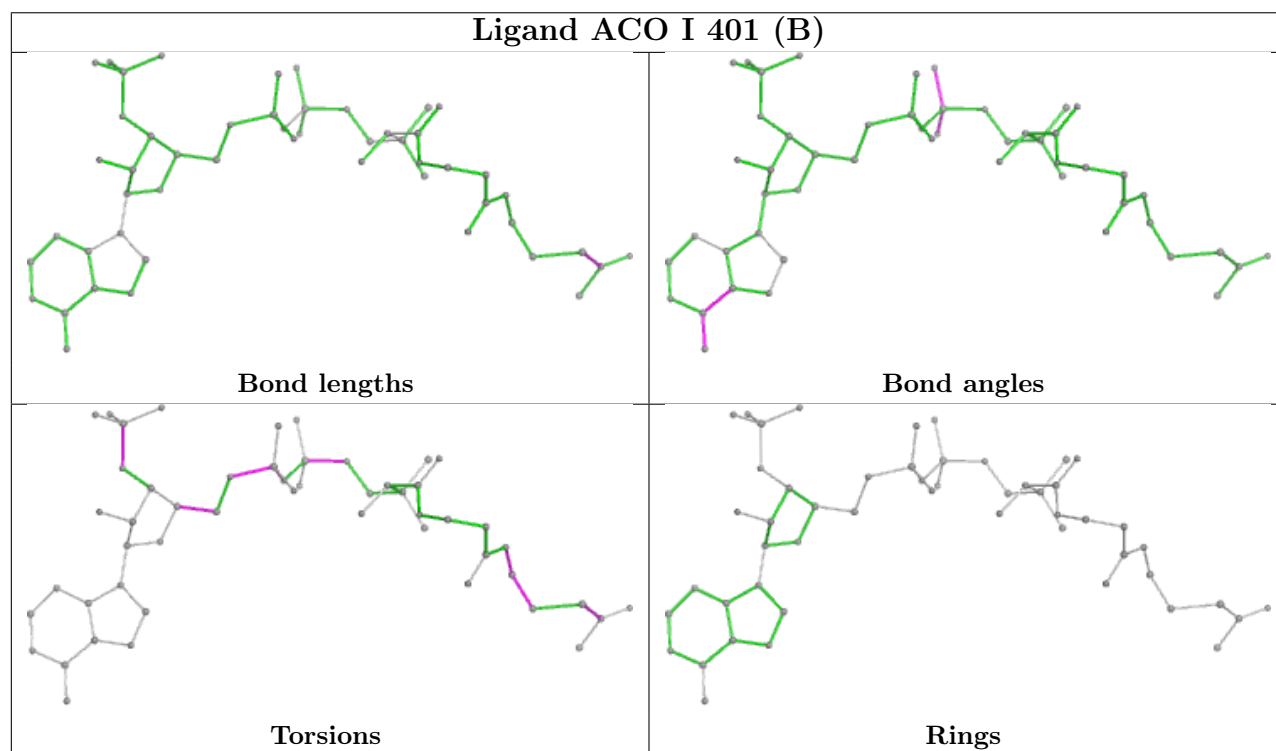
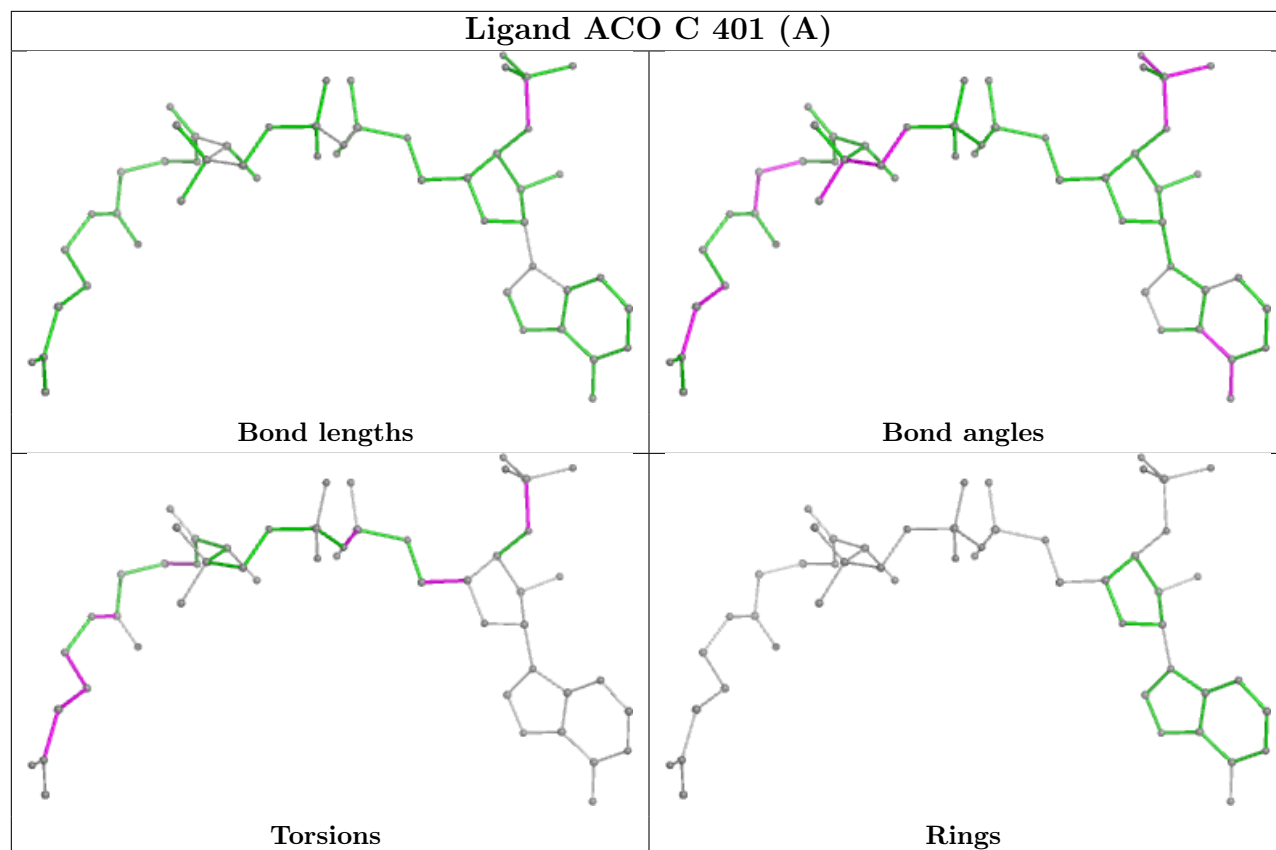
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	401[A]	ACO	4	0
2	I	401[B]	ACO	1	0
2	K	401[B]	ACO	3	0
2	H	401[B]	ACO	4	0
2	H	401[A]	ACO	6	0
2	K	401[A]	ACO	5	0
2	G	401[B]	ACO	1	0

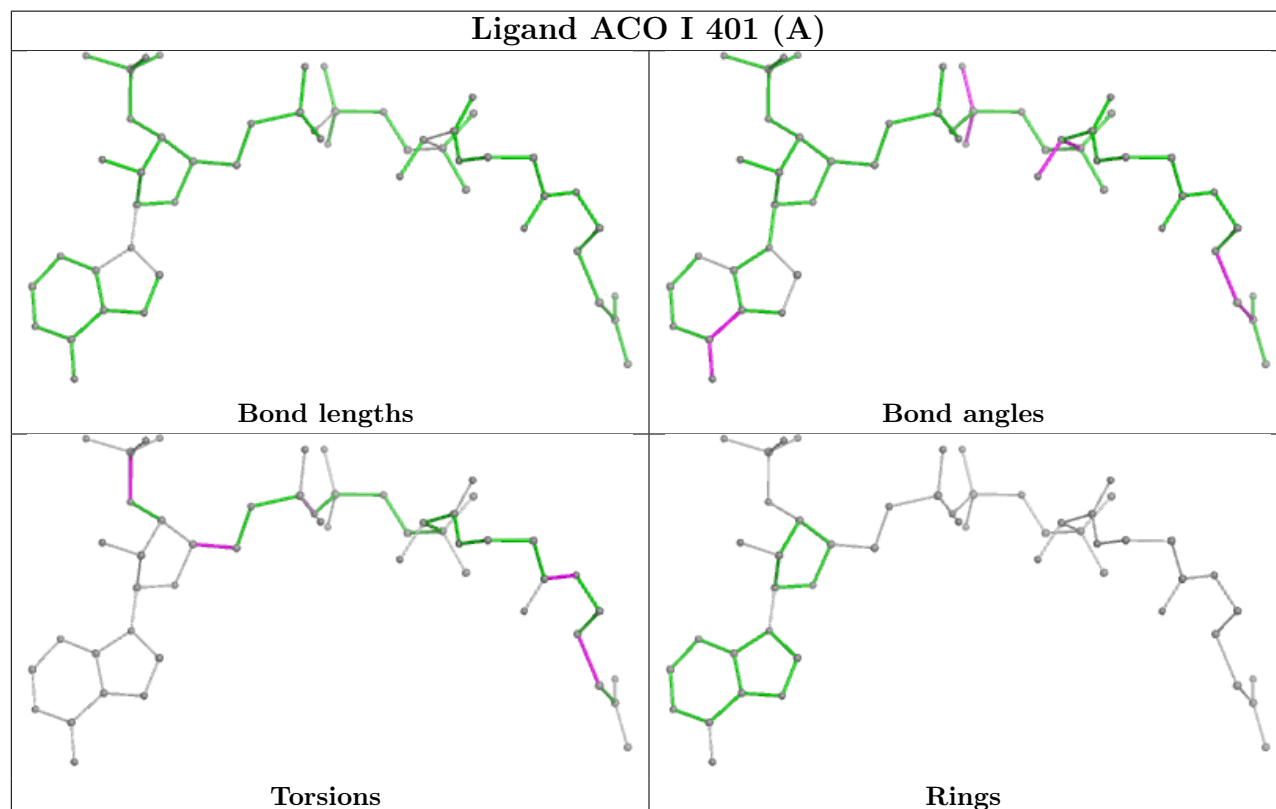
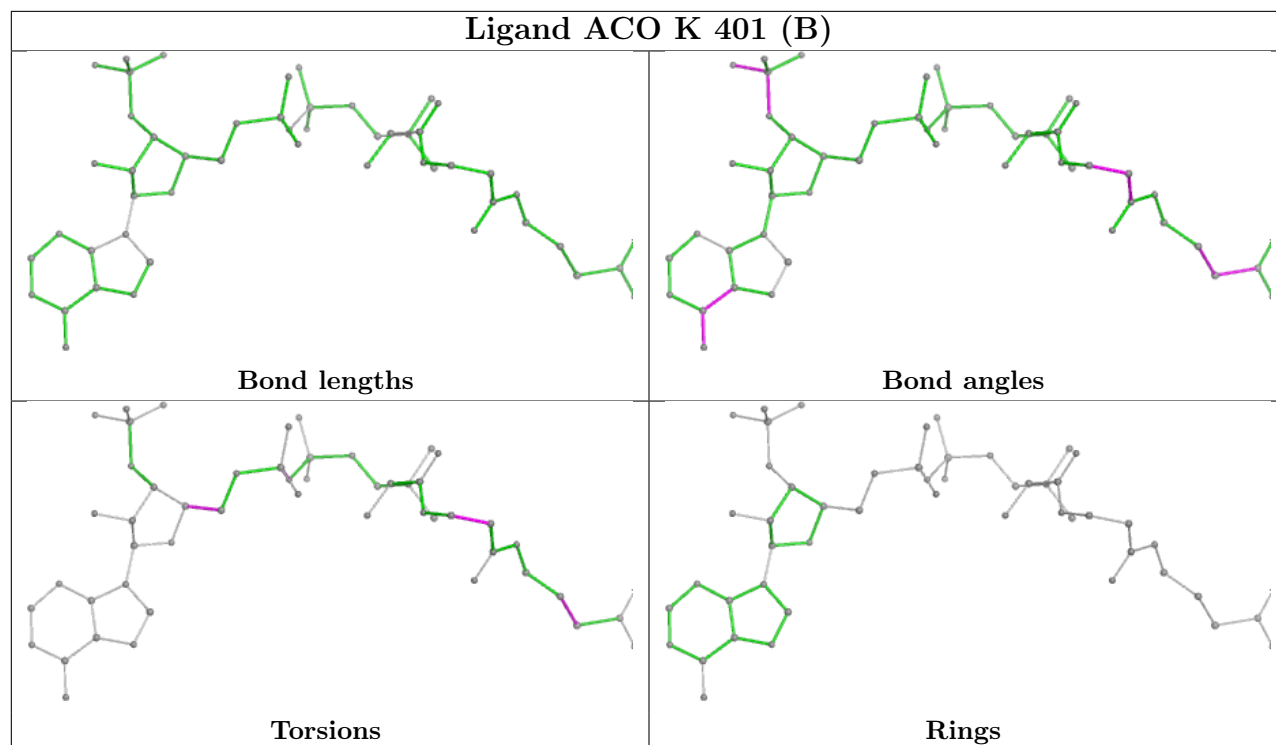
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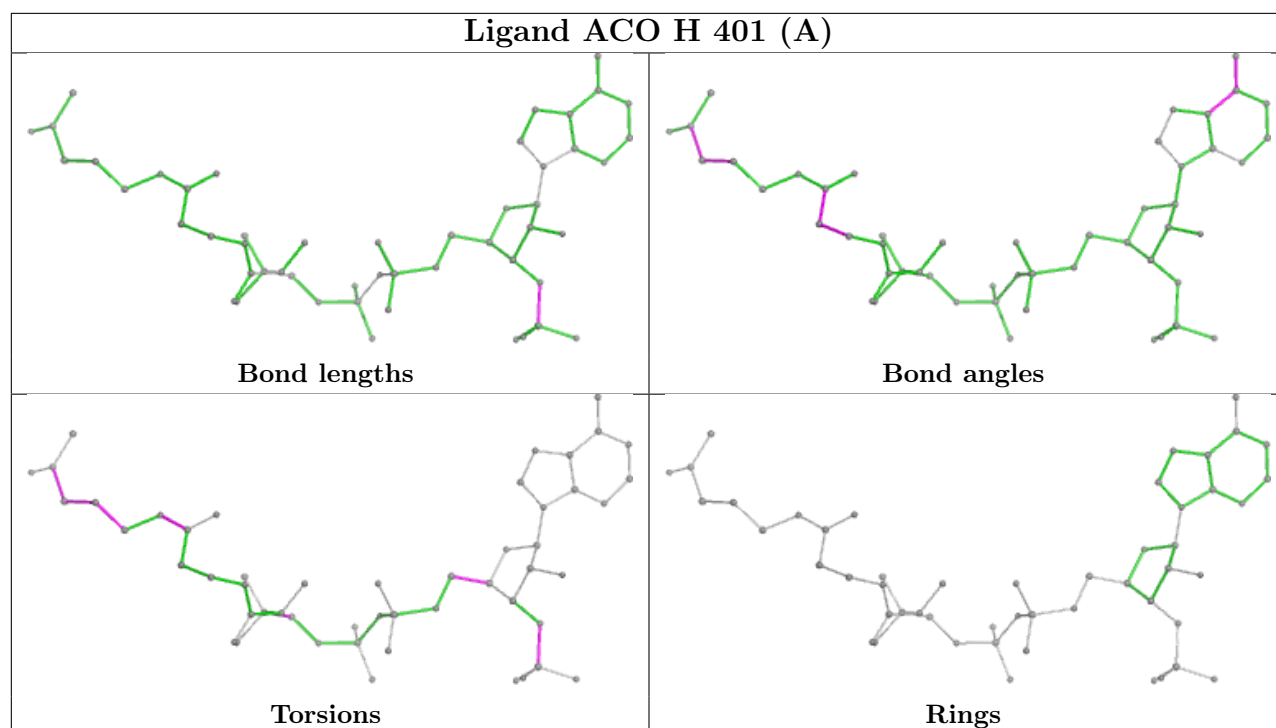
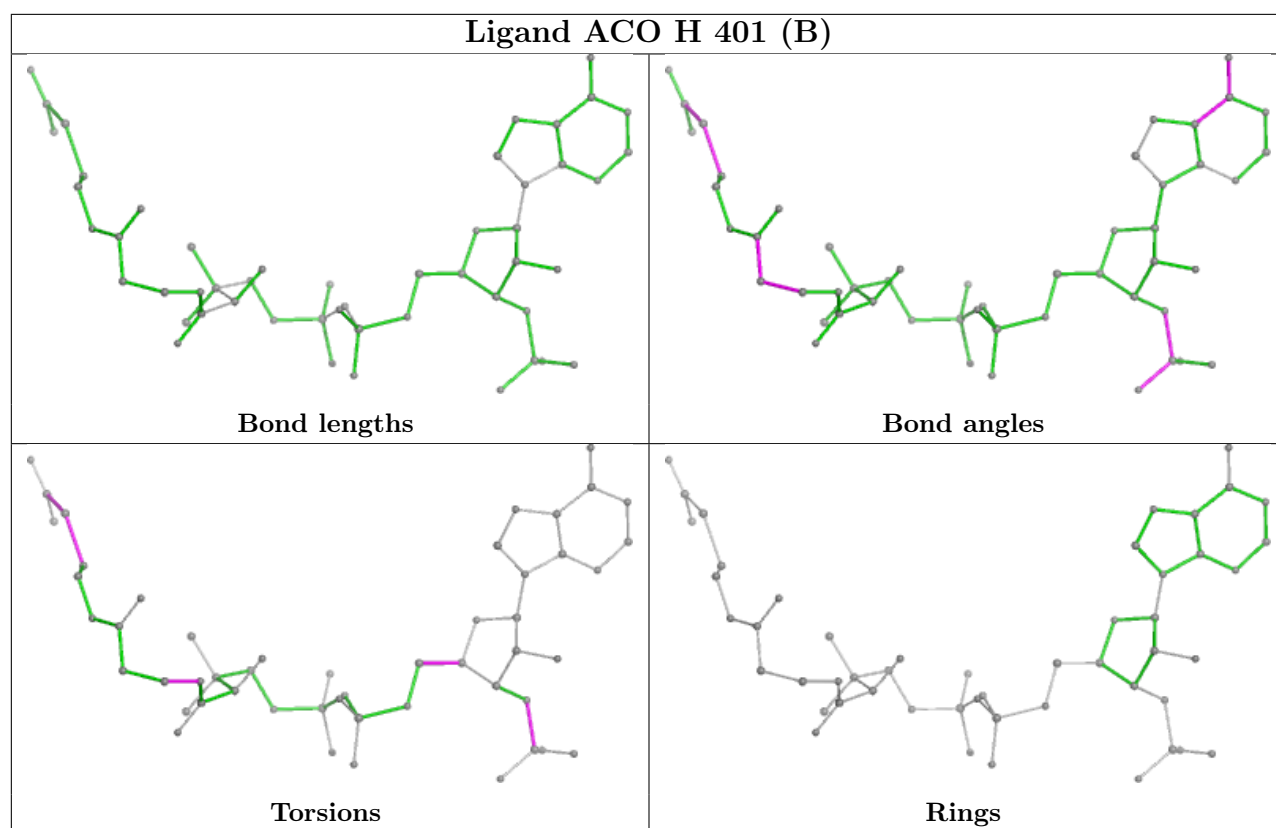
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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	F	401[B]	ACO	7	0
2	A	401[B]	ACO	5	0
2	B	401[B]	ACO	10	0
2	G	401[A]	ACO	3	0
2	B	401[A]	ACO	5	0
2	D	401[B]	ACO	1	0
2	A	401[A]	ACO	4	0
2	F	401[A]	ACO	8	0
2	E	401[B]	ACO	5	0
2	D	401[A]	ACO	4	0
2	E	401[A]	ACO	8	0
2	L	401[B]	ACO	4	0
2	L	401[A]	ACO	2	0
2	J	401[B]	ACO	1	0
2	J	401[A]	ACO	1	0
2	C	401[B]	ACO	4	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

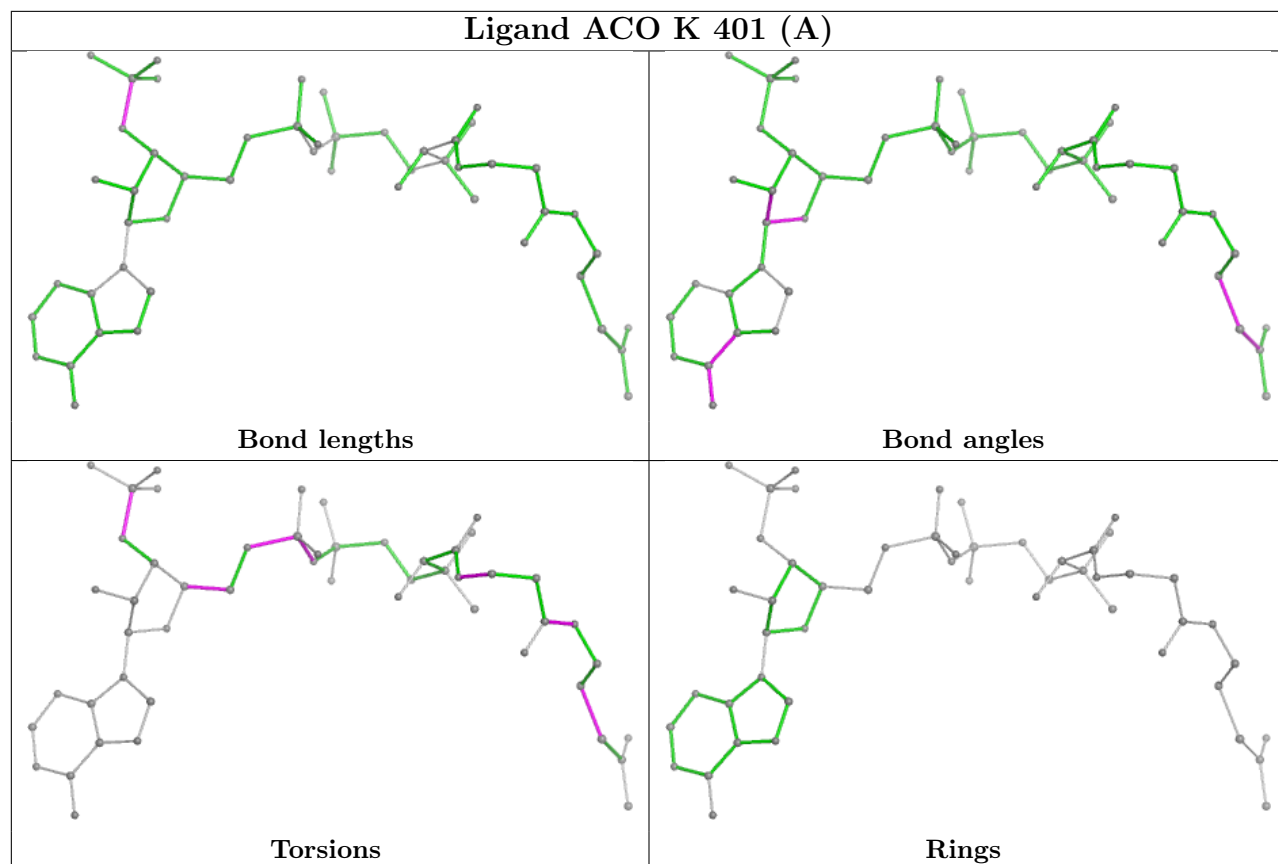




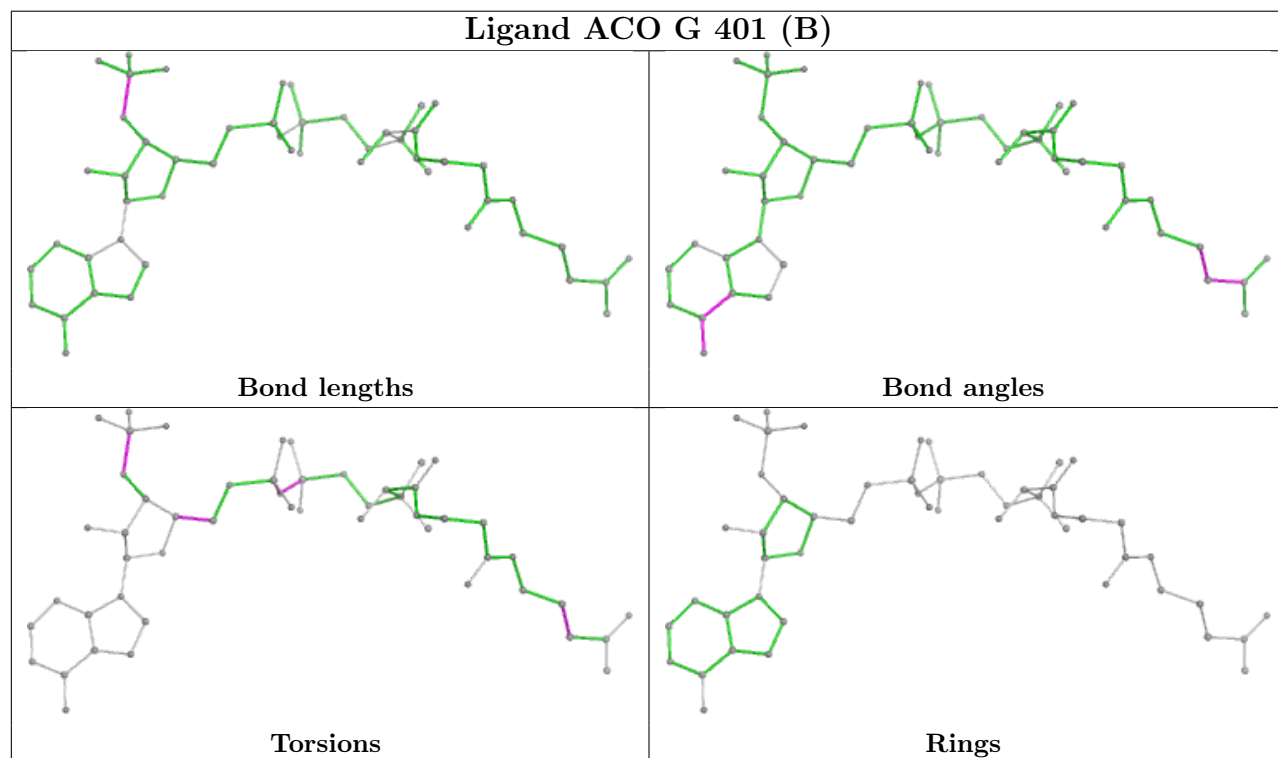




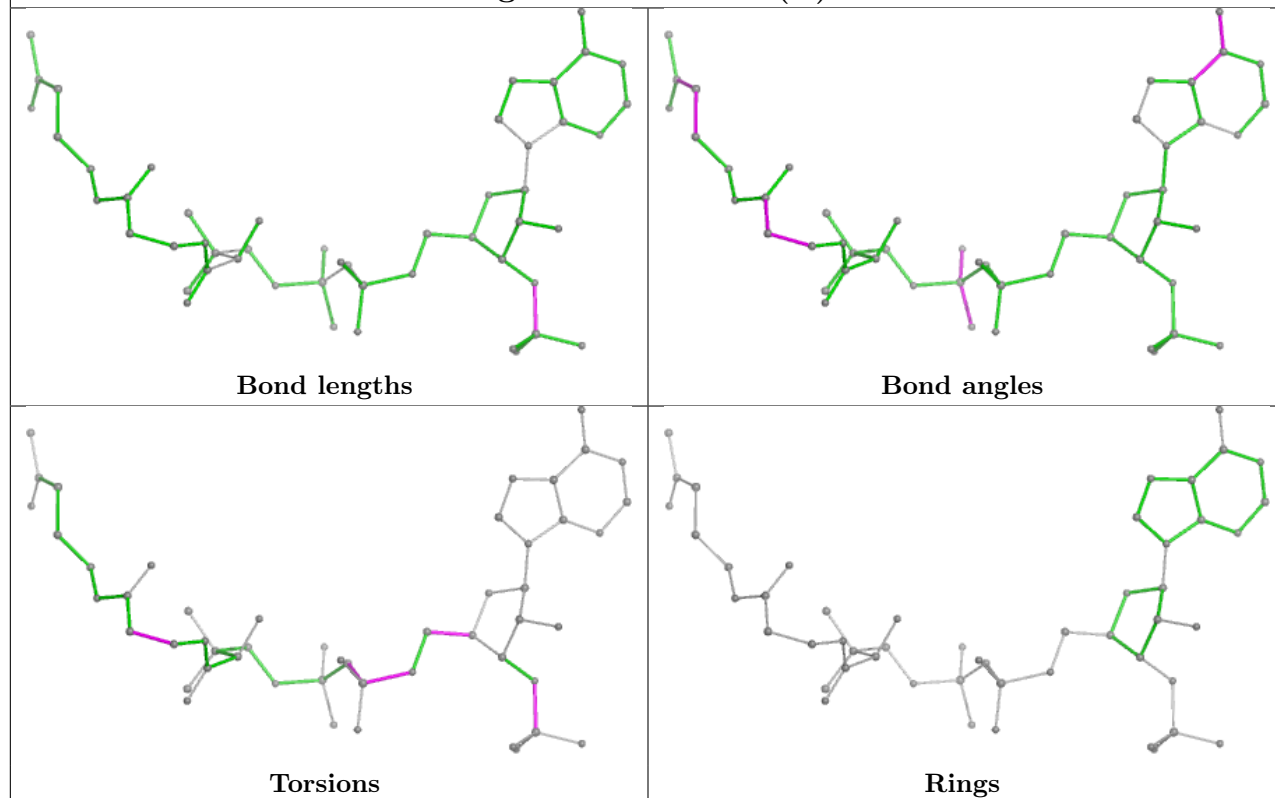
## Ligand ACO K 401 (A)



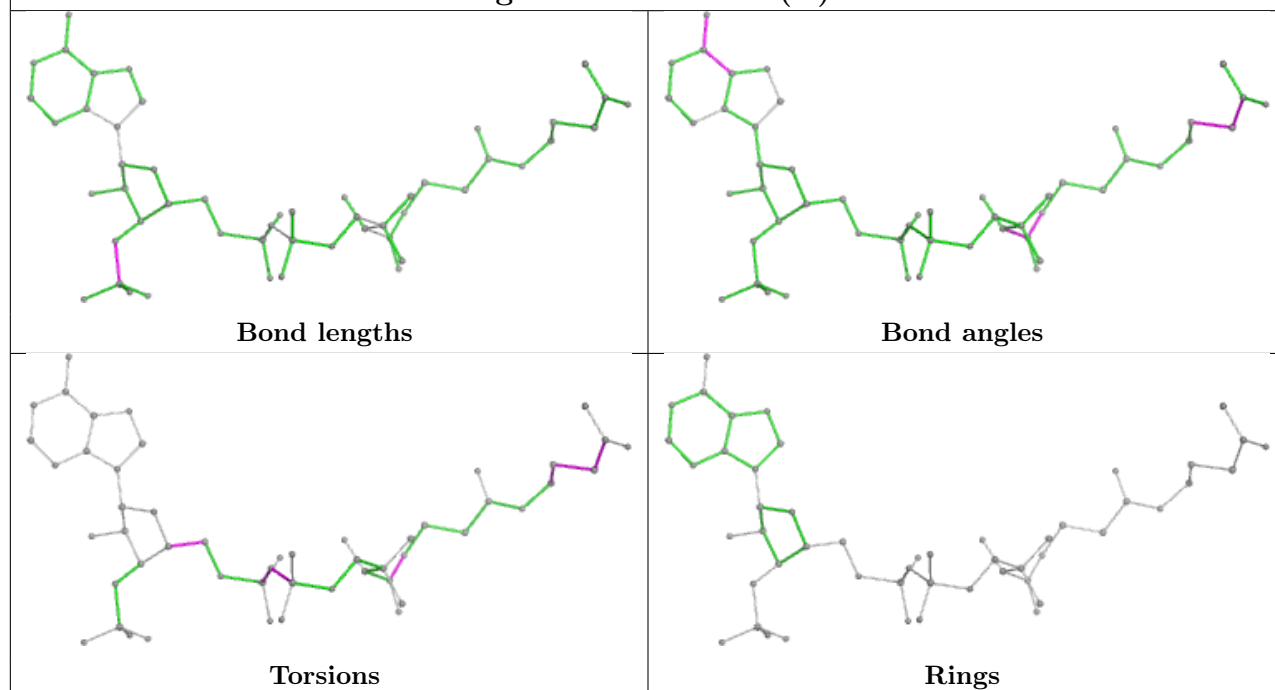
## Ligand ACO G 401 (B)

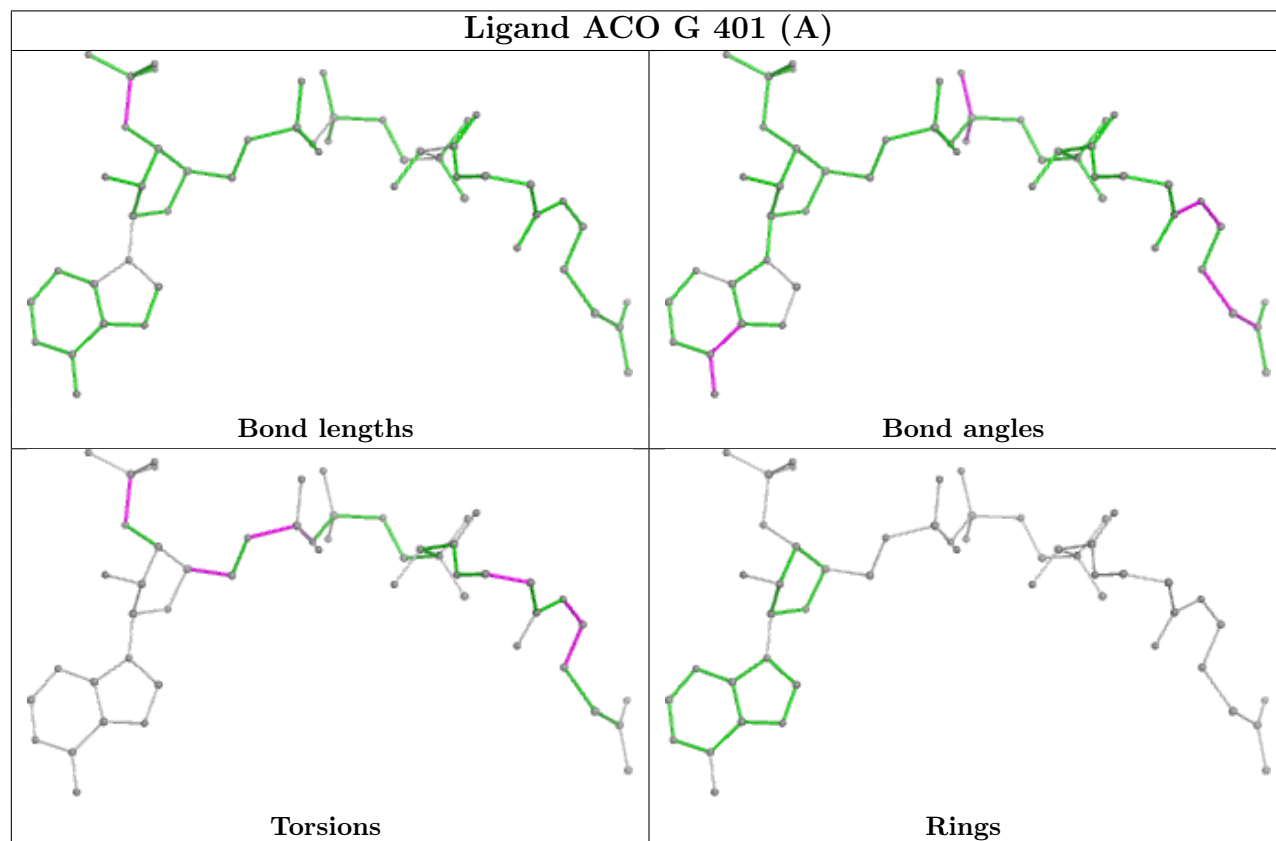
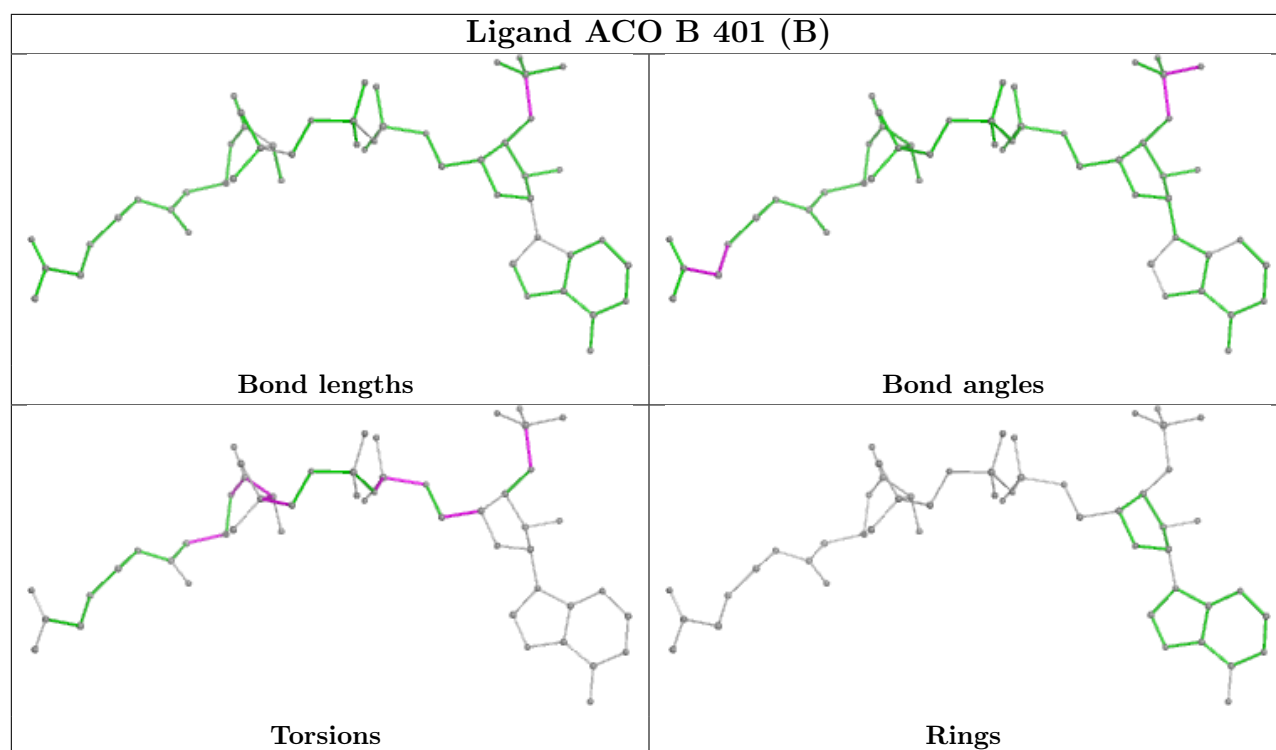


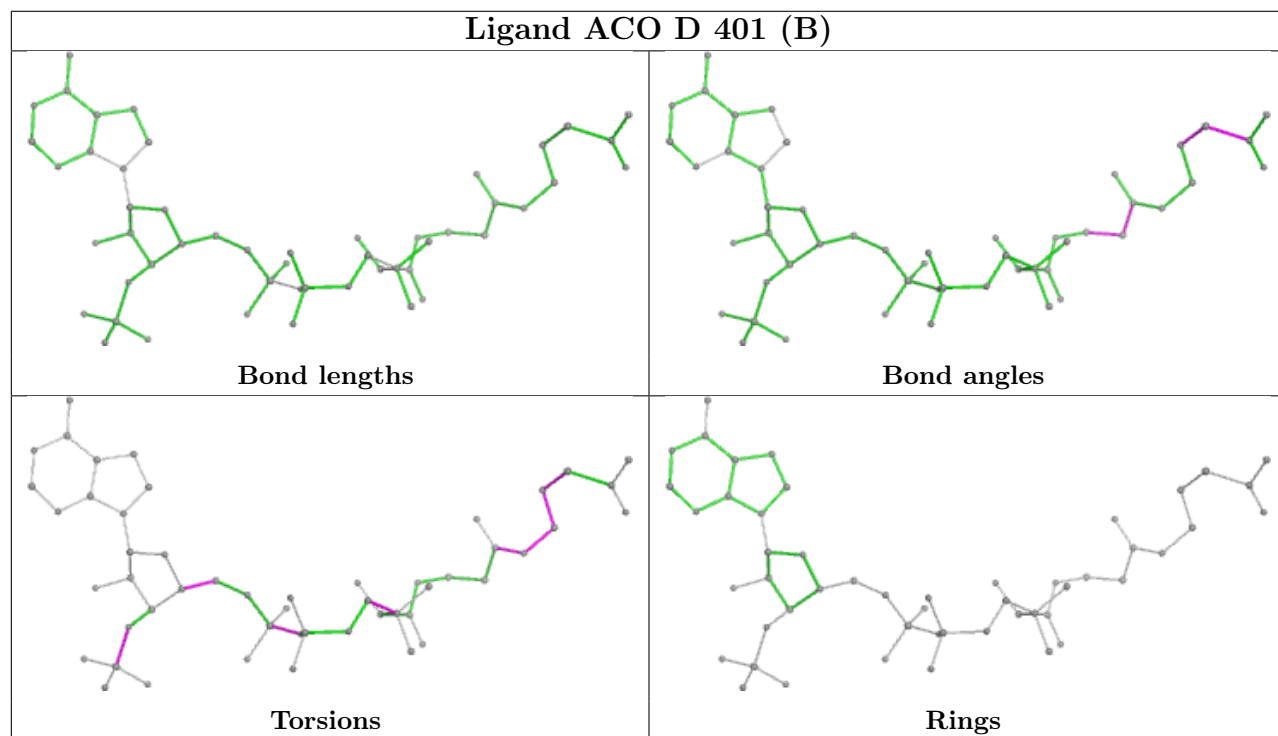
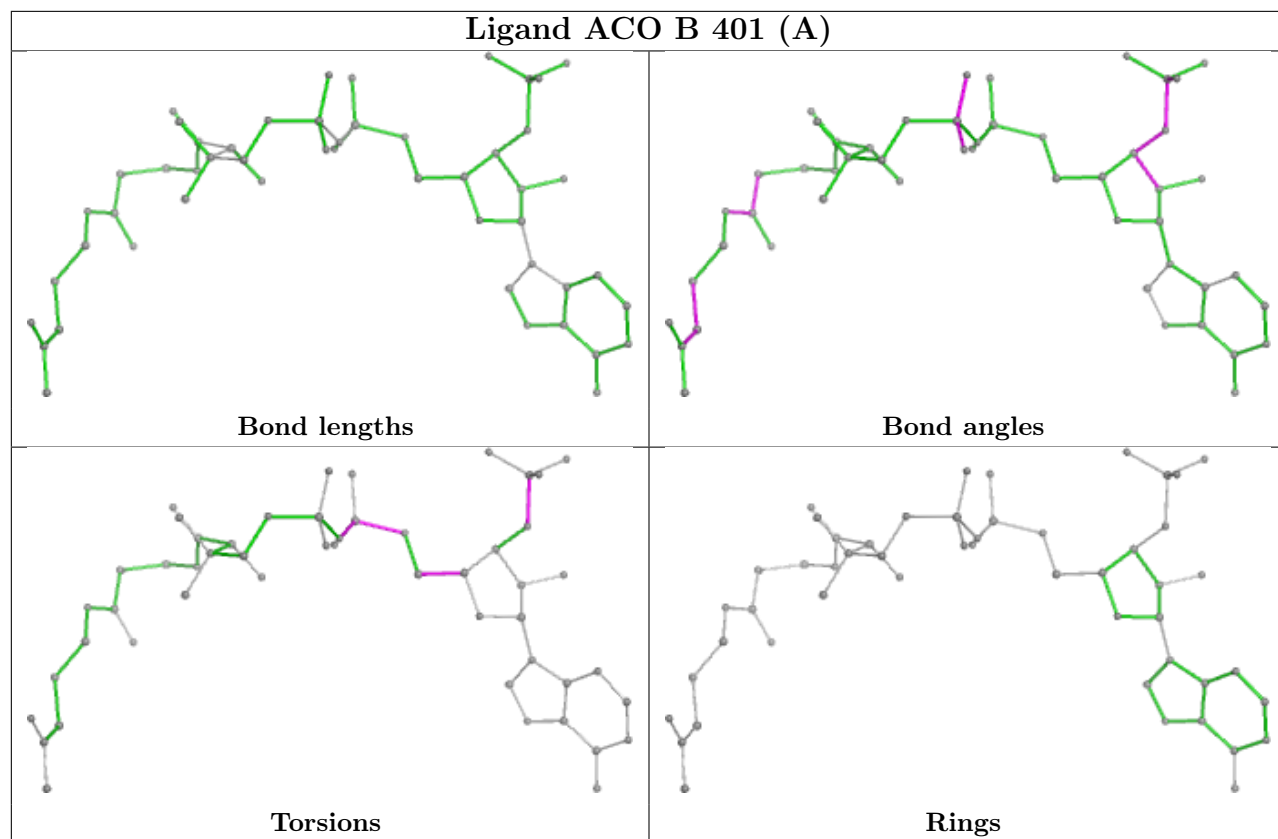
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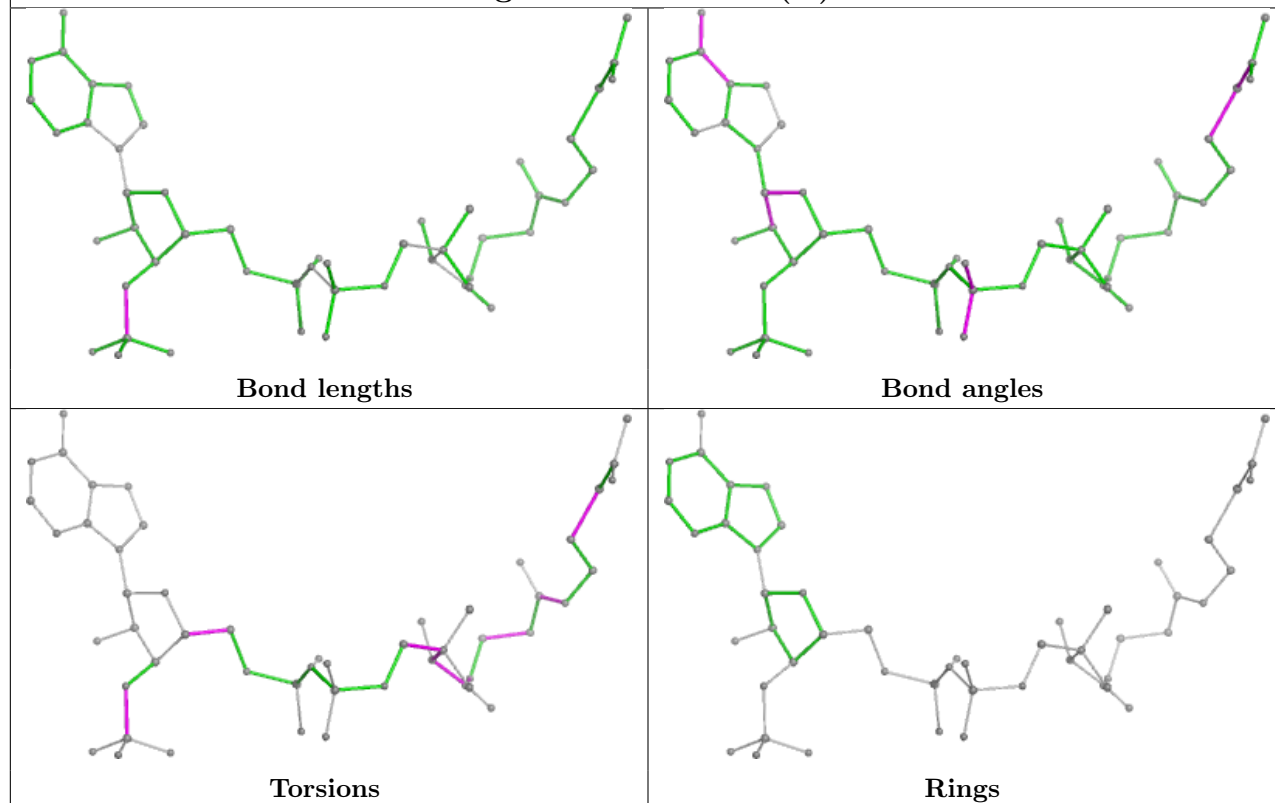
## Ligand ACO A 401 (B)



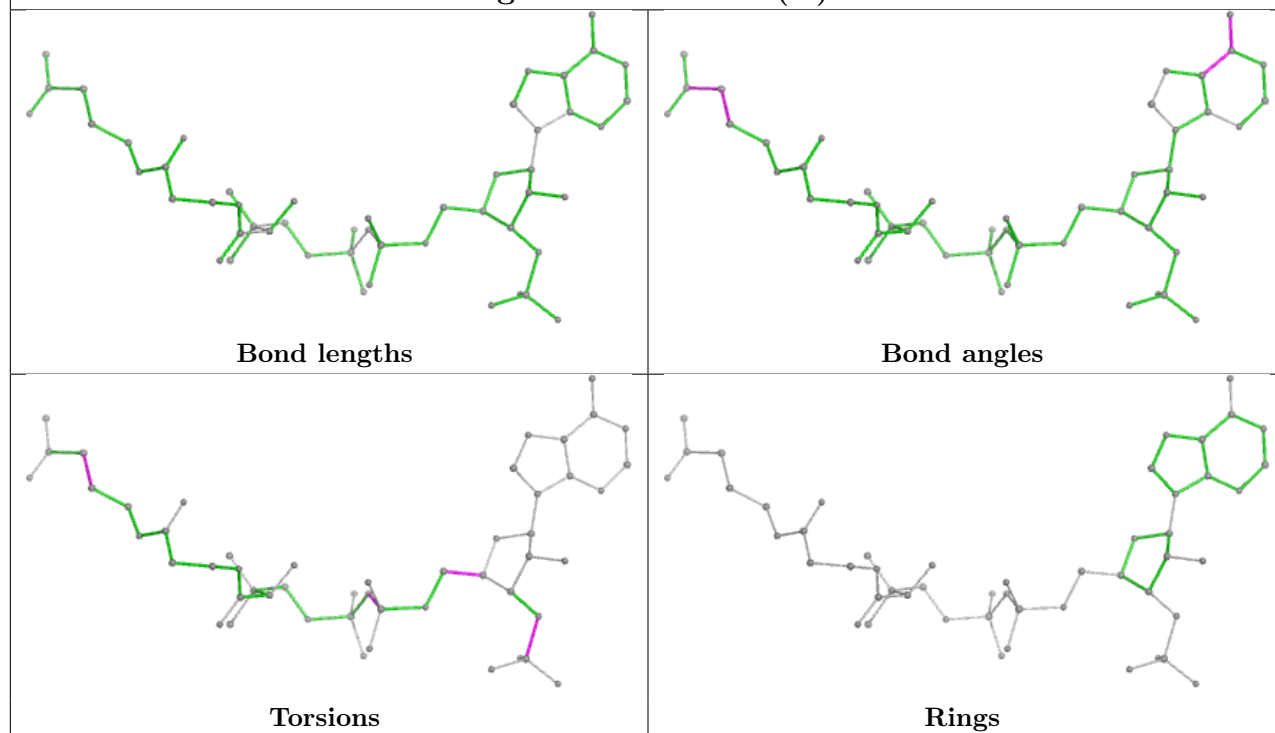


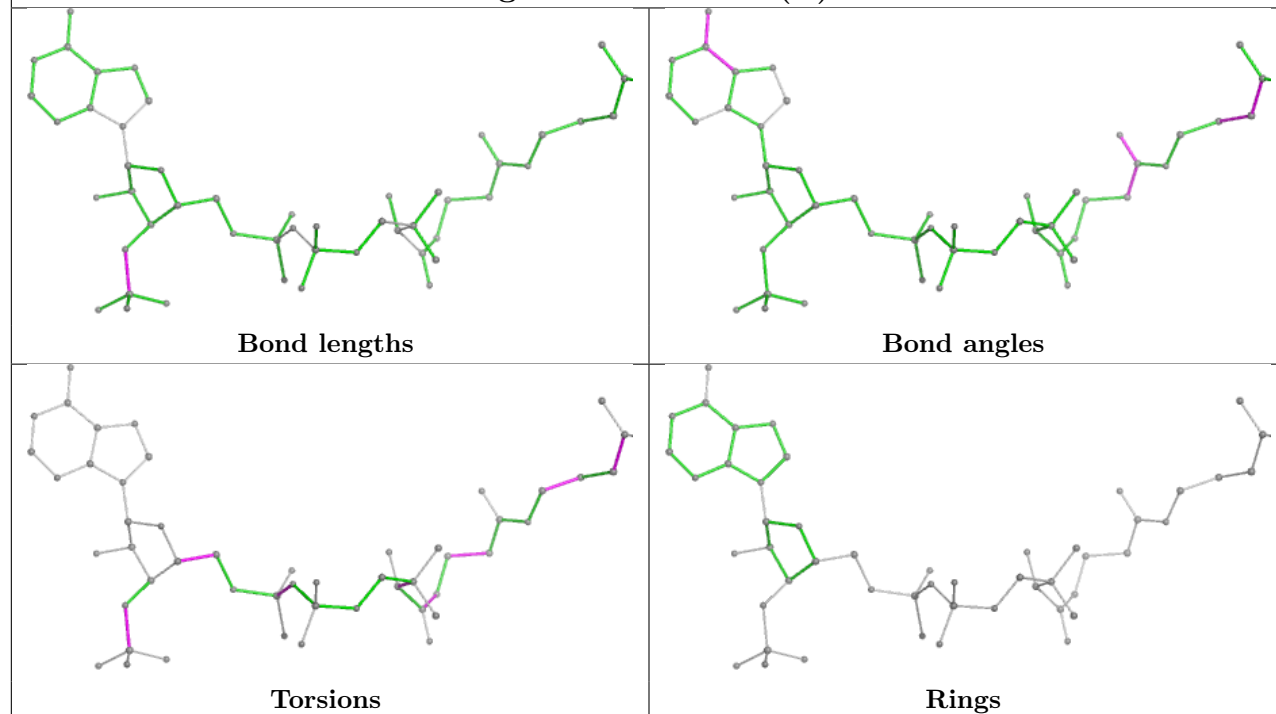
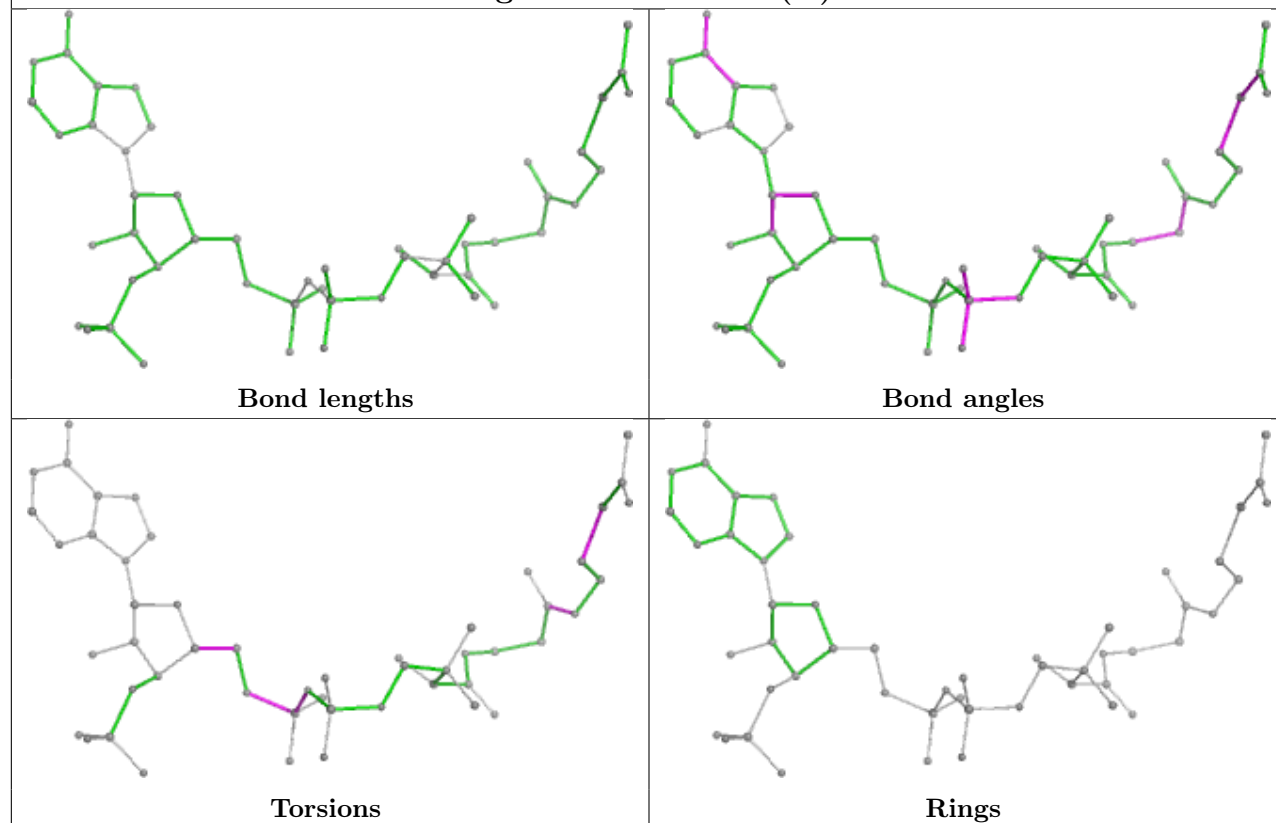


## Ligand ACO A 401 (A)

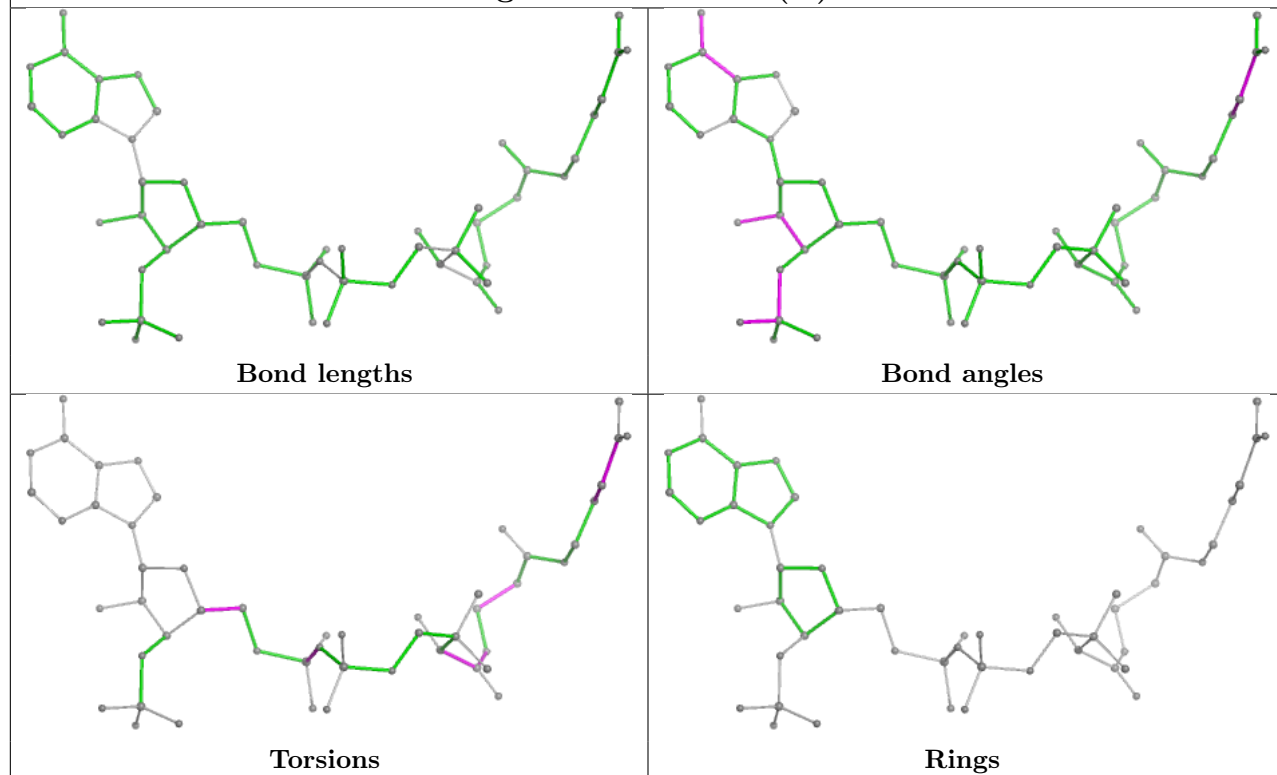


## Ligand ACO F 401 (A)

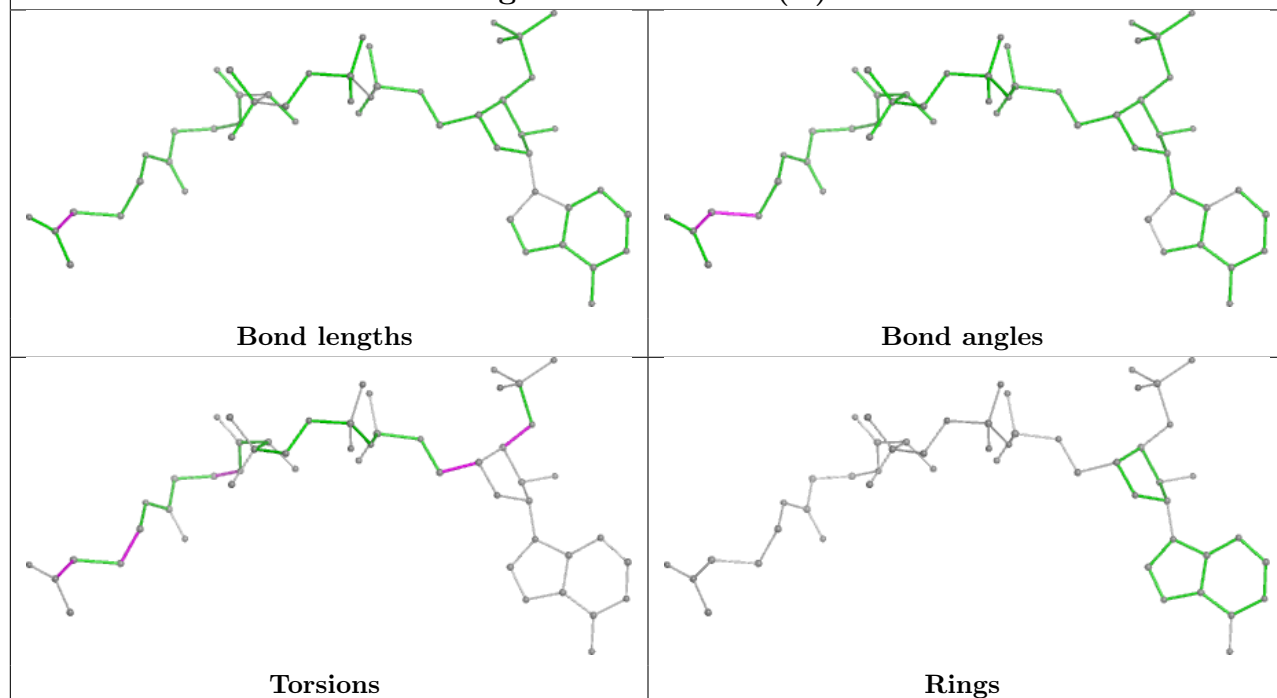


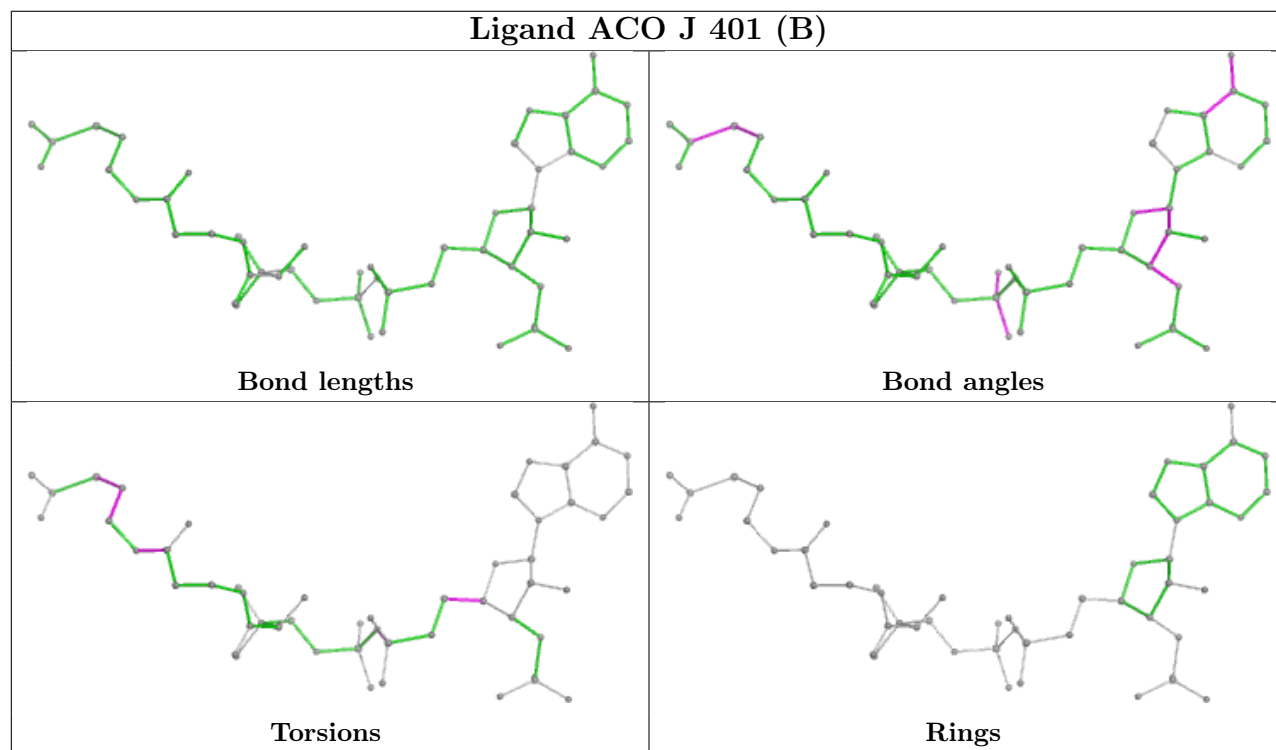
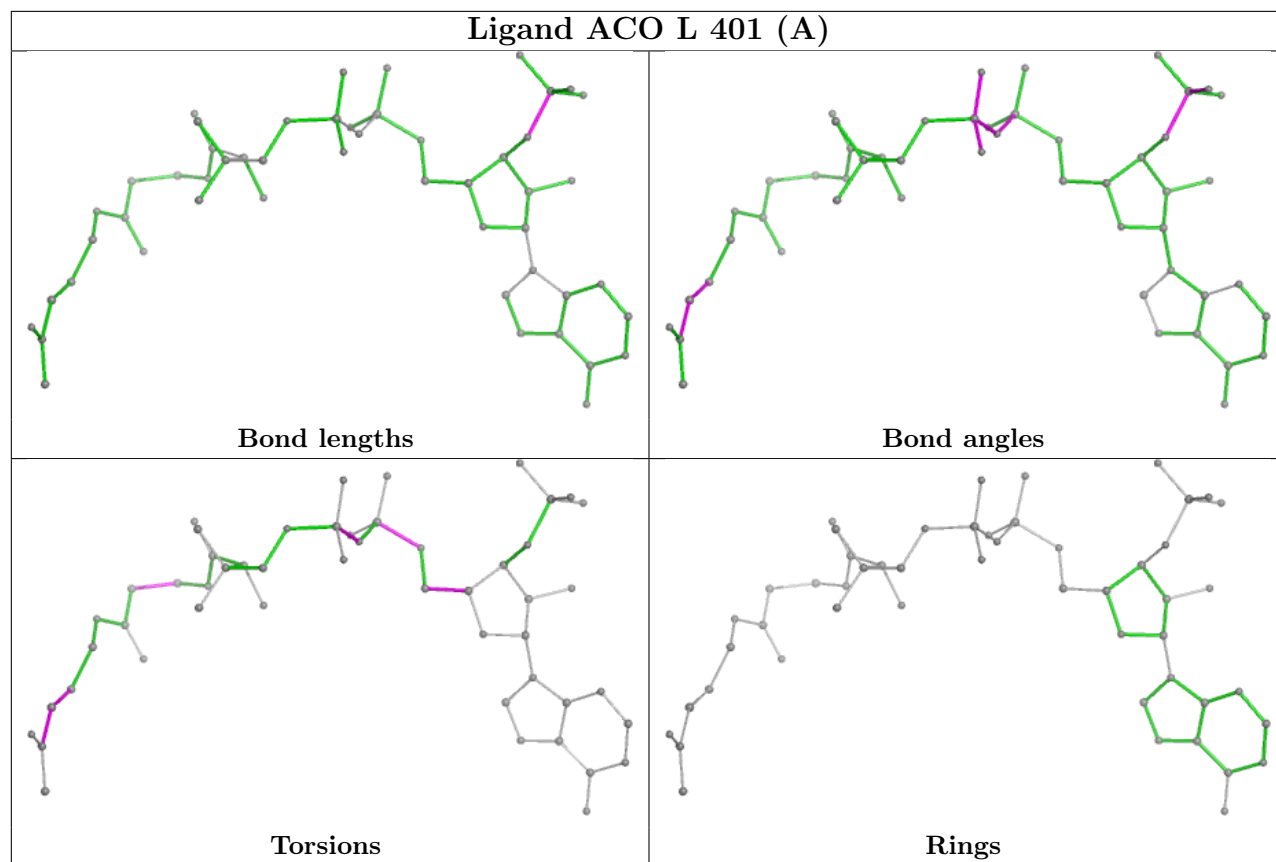
**Ligand ACO E 401 (B)****Ligand ACO D 401 (A)**

## Ligand ACO E 401 (A)

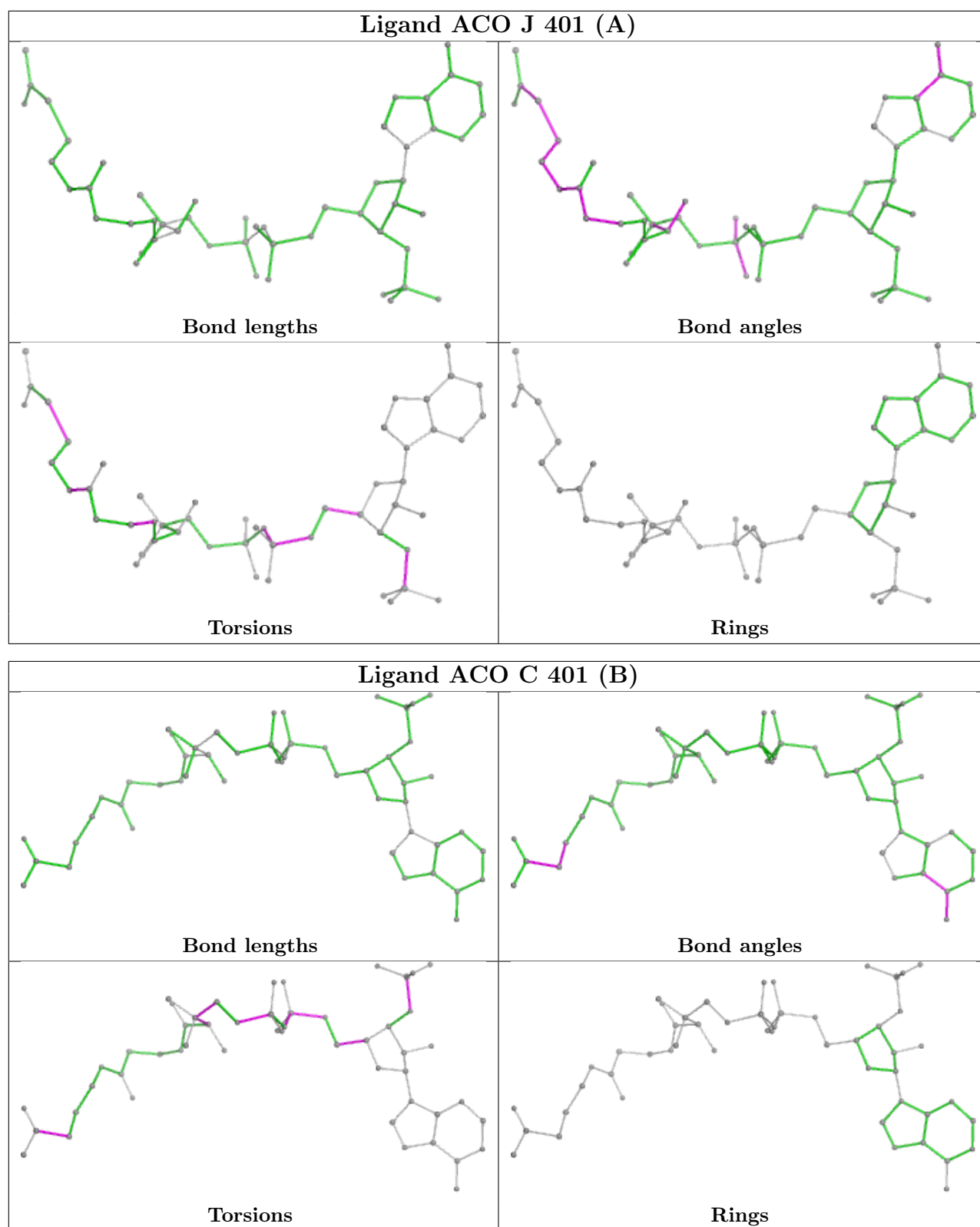


## Ligand ACO L 401 (B)









## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

## 6 Fit of model and data [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	359/364 (98%)	0.82	66 (18%) 4 4	24, 36, 75, 108	2 (0%)
1	B	359/364 (98%)	0.68	43 (11%) 10 11	22, 37, 73, 110	1 (0%)
1	C	359/364 (98%)	0.80	55 (15%) 6 7	22, 37, 73, 111	2 (0%)
1	D	359/364 (98%)	0.86	63 (17%) 5 4	23, 38, 69, 101	1 (0%)
1	E	359/364 (98%)	0.69	43 (11%) 10 11	23, 37, 68, 104	2 (0%)
1	F	359/364 (98%)	0.84	64 (17%) 4 4	23, 38, 72, 119	1 (0%)
1	G	359/364 (98%)	1.03	81 (22%) 3 2	23, 39, 77, 114	2 (0%)
1	H	359/364 (98%)	0.84	67 (18%) 4 3	23, 38, 75, 106	1 (0%)
1	I	359/364 (98%)	0.63	34 (9%) 15 18	23, 35, 64, 99	2 (0%)
1	J	359/364 (98%)	0.52	30 (8%) 18 20	23, 35, 66, 113	1 (0%)
1	K	360/364 (98%)	0.66	50 (13%) 7 8	18, 36, 70, 106	3 (0%)
1	L	359/364 (98%)	0.67	42 (11%) 10 11	23, 37, 67, 101	1 (0%)
All	All	4309/4368 (98%)	0.75	638 (14%) 7 7	18, 37, 72, 119	19 (0%)

The worst 5 of 638 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	42	VAL	6.8
1	C	42	VAL	6.7
1	B	45	ILE	6.4
1	G	351	ILE	5.5
1	E	324	GLY	5.3

### 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 ⓘ

There are no monosaccharides in this entry.

## 6.4 Ligands ⓘ

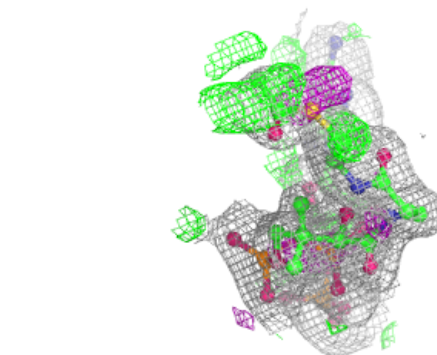
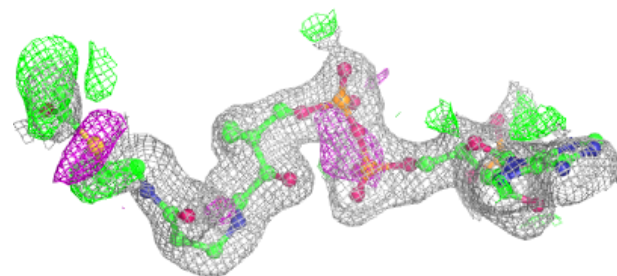
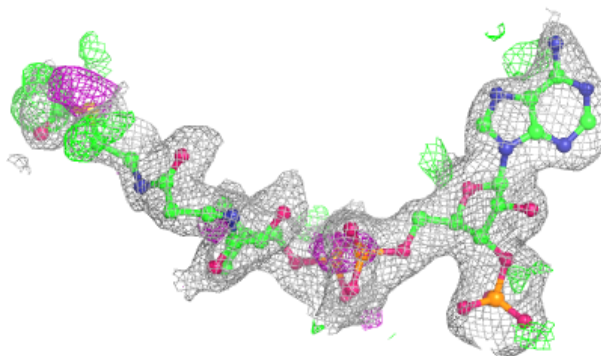
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 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
2	ACO	F	401[A]	51/51	0.83	0.16	26,40,50,65	51
2	ACO	F	401[B]	51/51	0.83	0.16	31,42,49,56	51
2	ACO	H	401[A]	51/51	0.84	0.19	33,50,70,74	51
2	ACO	H	401[B]	51/51	0.84	0.19	36,45,62,64	51
2	ACO	E	401[A]	51/51	0.86	0.18	35,50,76,81	51
2	ACO	E	401[B]	51/51	0.86	0.18	31,54,88,92	51
2	ACO	A	401[A]	51/51	0.87	0.17	21,46,76,78	51
2	ACO	A	401[B]	51/51	0.87	0.17	31,45,62,78	51
2	ACO	G	401[A]	51/51	0.89	0.14	35,46,60,66	51
2	ACO	G	401[B]	51/51	0.89	0.14	30,43,63,66	51
2	ACO	C	401[A]	51/51	0.89	0.13	30,42,51,58	51
2	ACO	C	401[B]	51/51	0.89	0.13	26,51,59,65	51
2	ACO	J	401[A]	51/51	0.89	0.12	23,37,43,50	51
2	ACO	J	401[B]	51/51	0.89	0.12	25,40,53,63	51
2	ACO	B	401[A]	51/51	0.90	0.12	19,39,49,56	51
2	ACO	B	401[B]	51/51	0.90	0.12	33,46,66,75	51
2	ACO	L	401[A]	51/51	0.90	0.12	27,39,45,48	51
2	ACO	L	401[B]	51/51	0.90	0.12	31,41,50,60	51
2	ACO	K	401[A]	51/51	0.91	0.13	32,42,51,55	51
2	ACO	K	401[B]	51/51	0.91	0.13	29,39,53,66	51
2	ACO	I	401[A]	51/51	0.91	0.12	27,40,49,54	51
2	ACO	I	401[B]	51/51	0.91	0.12	26,42,53,58	51
2	ACO	D	401[A]	51/51	0.94	0.11	20,34,54,59	51
2	ACO	D	401[B]	51/51	0.94	0.11	35,54,68,80	51

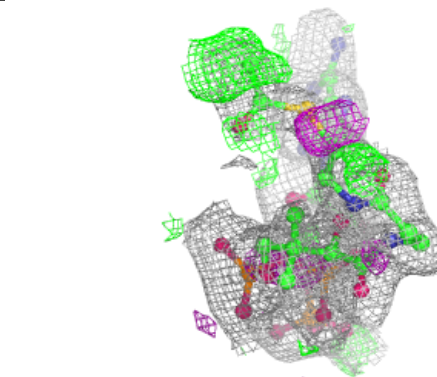
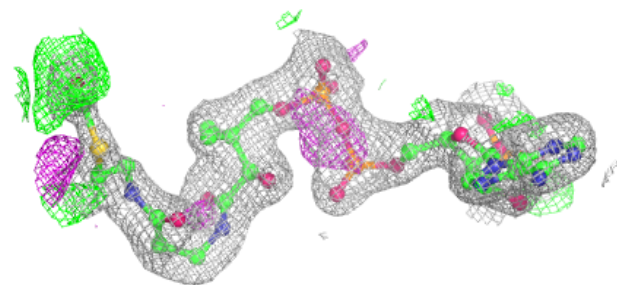
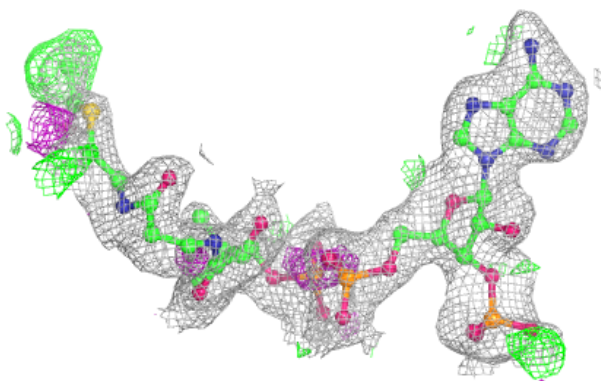
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

**Electron density around ACO F 401 (A):**

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

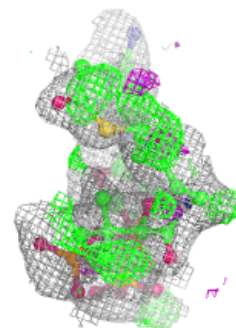
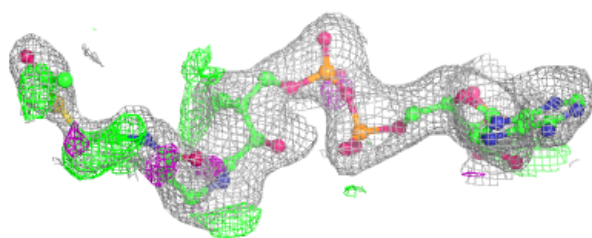
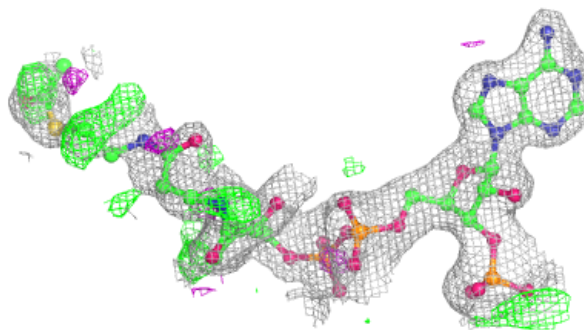
**Electron density around ACO F 401 (B):**

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and green (positive)

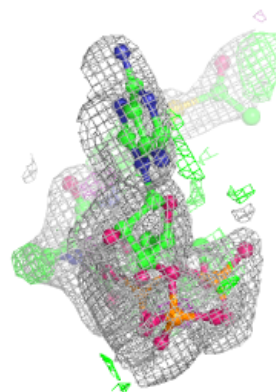
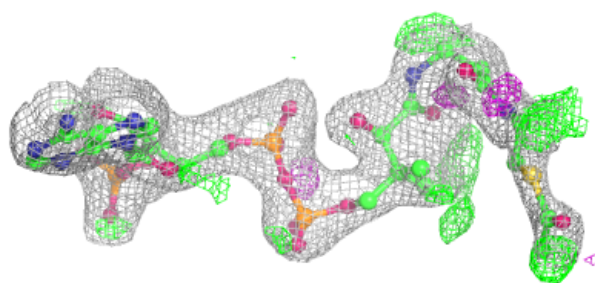
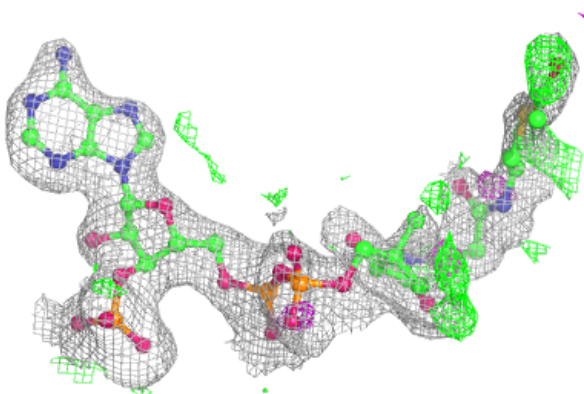


**Electron density around ACO H 401 (A):**

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and green (positive)

**Electron density around ACO H 401 (B):**

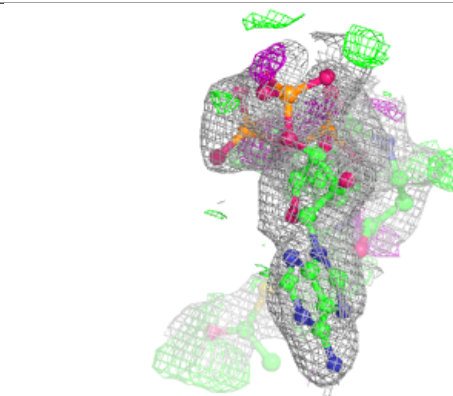
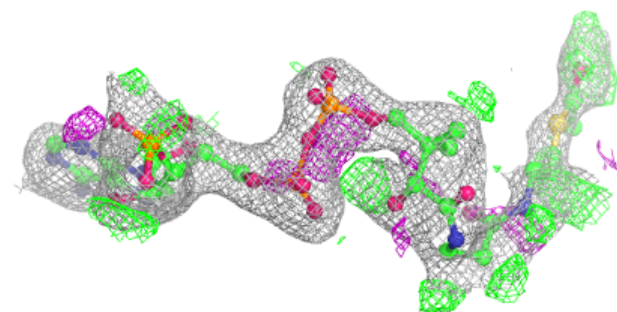
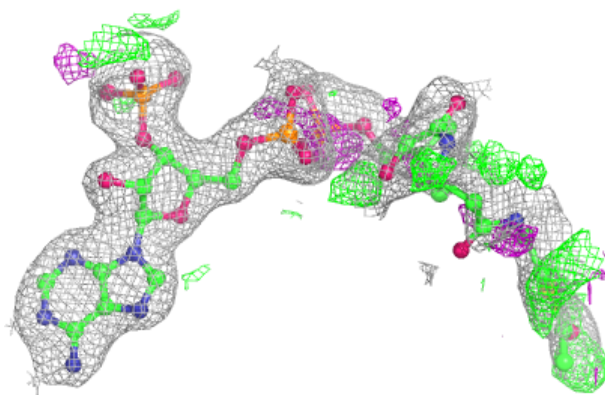
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



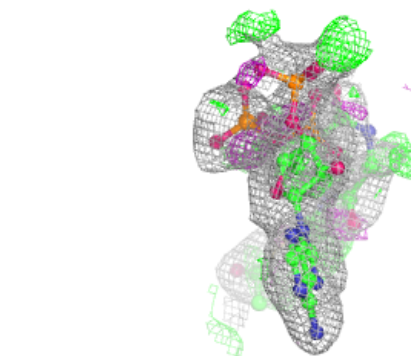
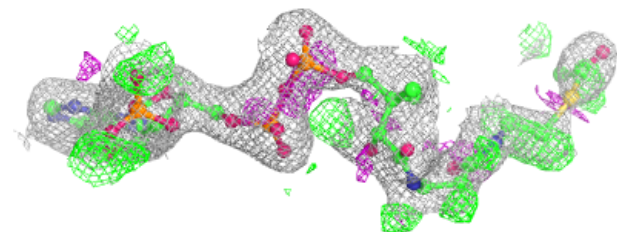
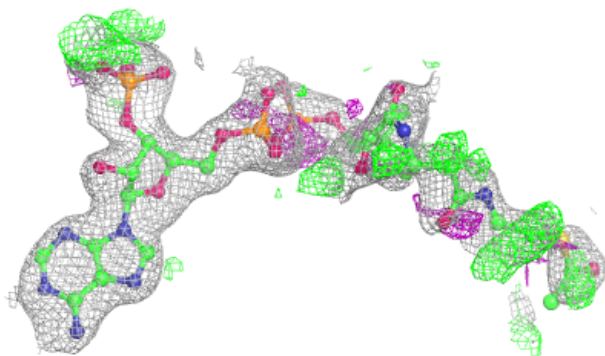


**Electron density around ACO E 401 (A):**

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and green (positive)

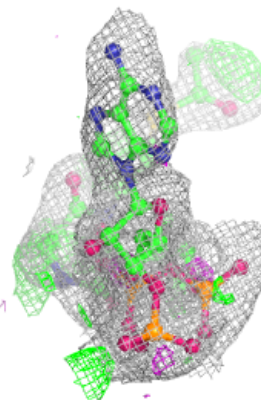
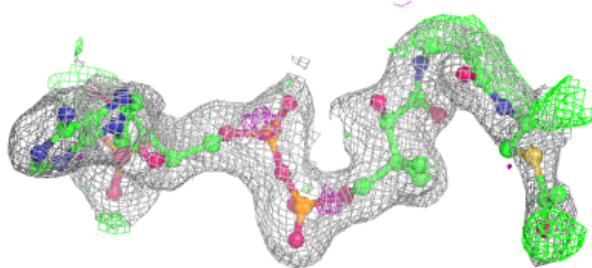
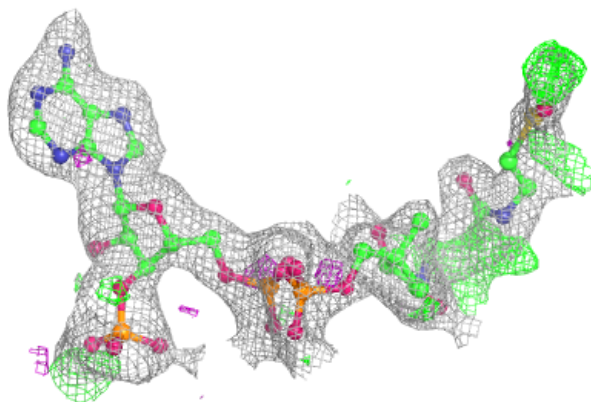
**Electron density around ACO E 401 (B):**

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and green (positive)

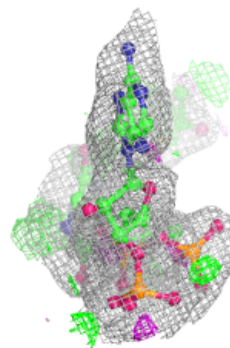
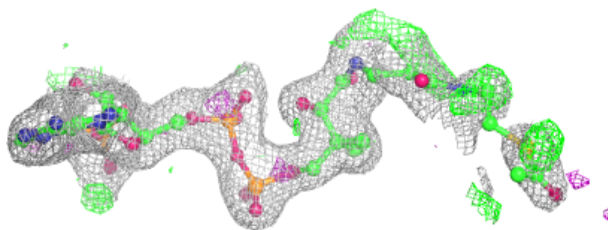
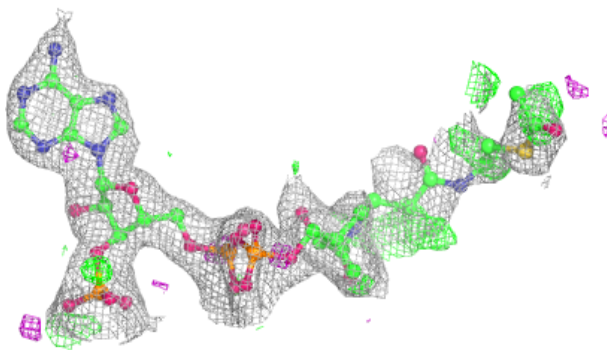


**Electron density around ACO A 401 (A):**

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

**Electron density around ACO A 401 (B):**

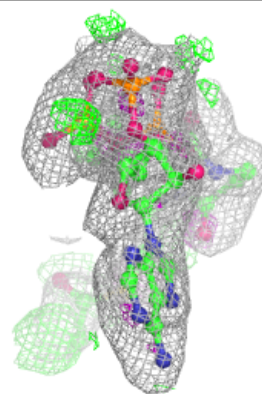
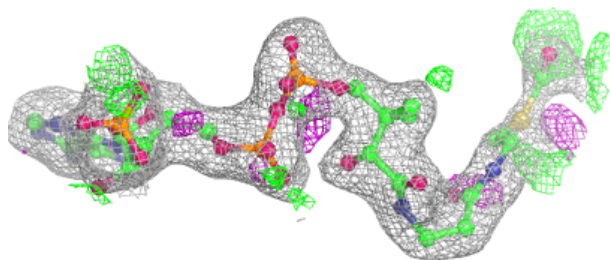
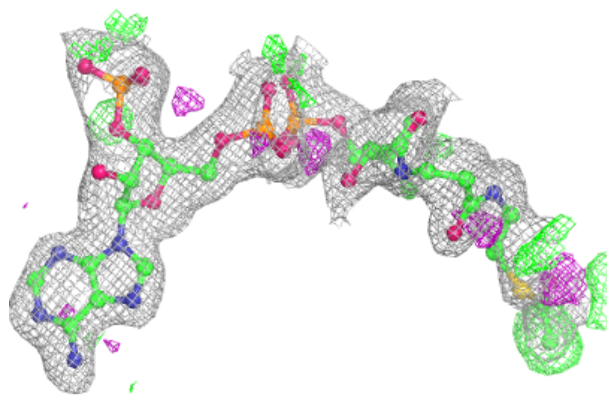
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 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



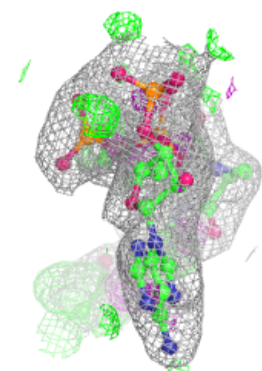
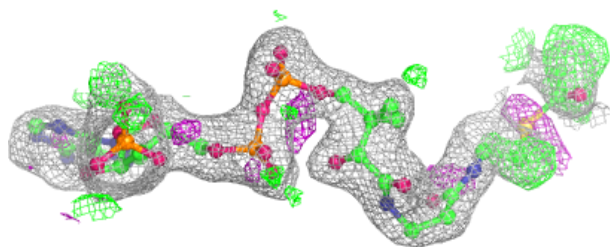
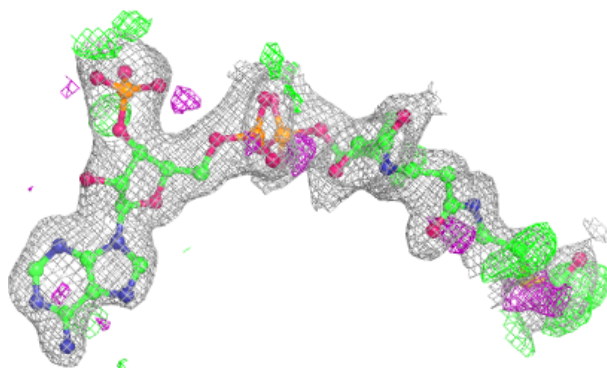


**Electron density around ACO G 401 (A):**

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and green (positive)

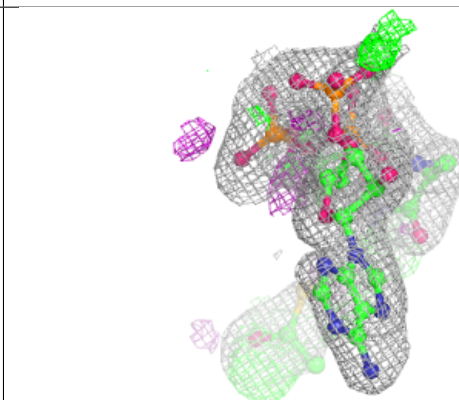
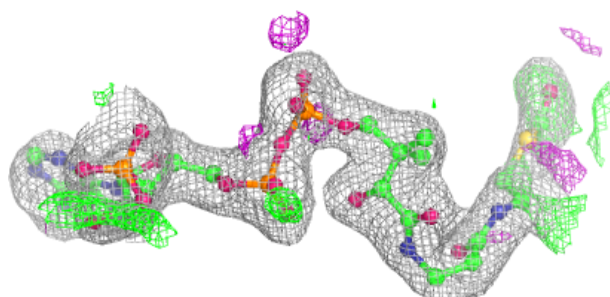
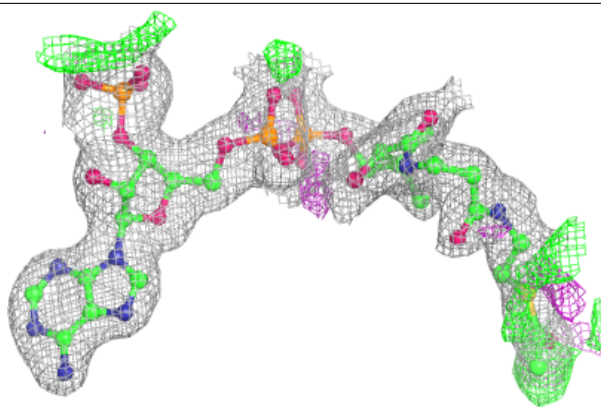
**Electron density around ACO G 401 (B):**

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

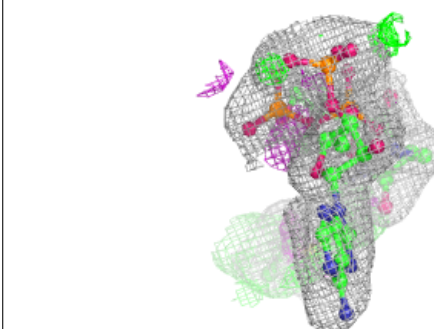
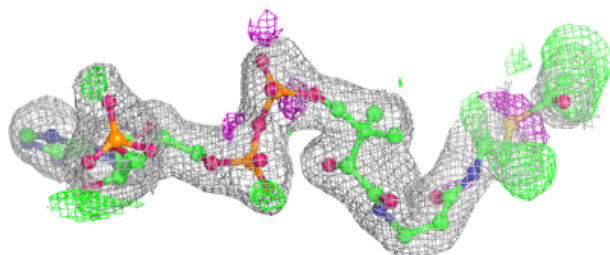
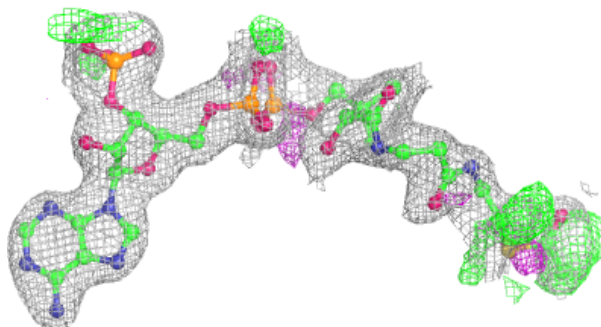


**Electron density around ACO C 401 (A):**

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and green (positive)

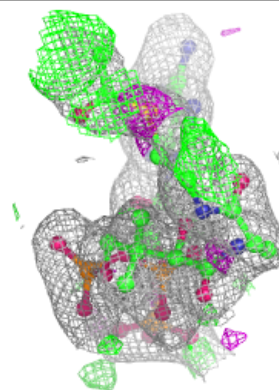
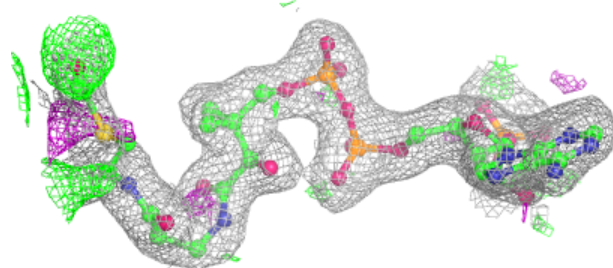
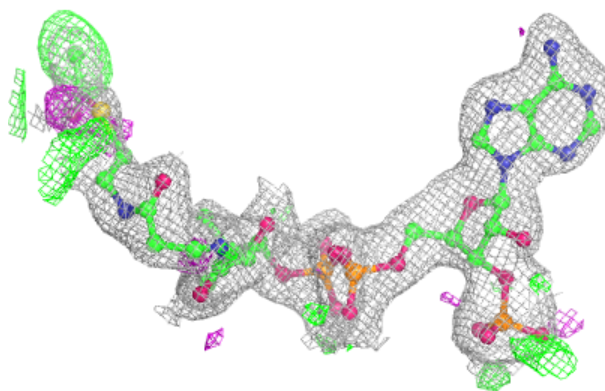
**Electron density around ACO C 401 (B):**

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

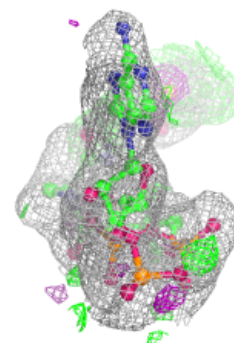
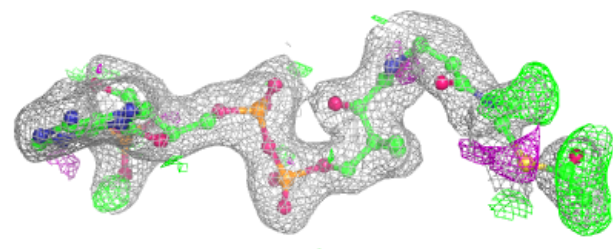
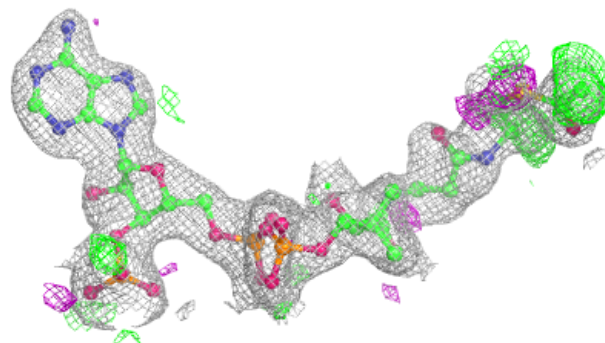


**Electron density around ACO J 401 (A):**

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

**Electron density around ACO J 401 (B):**

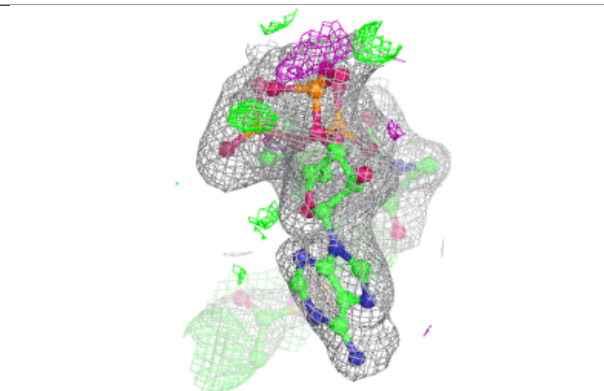
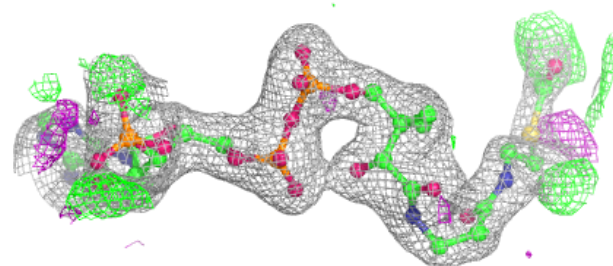
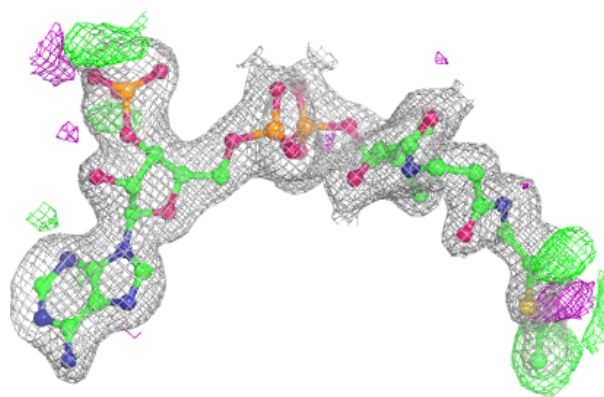
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 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



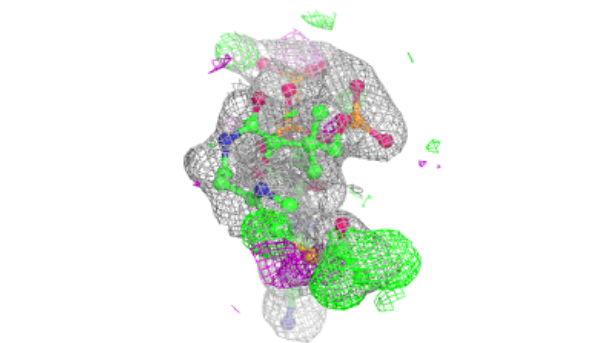
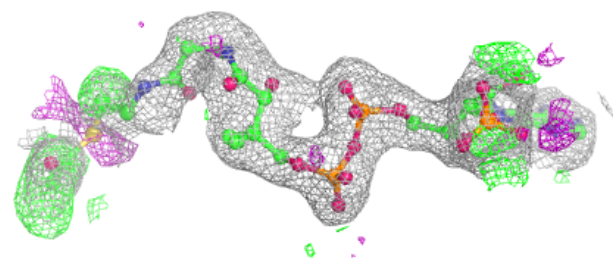
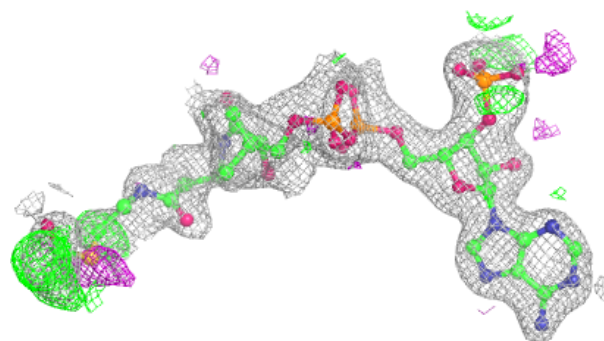


**Electron density around ACO B 401 (A):**

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and green (positive)

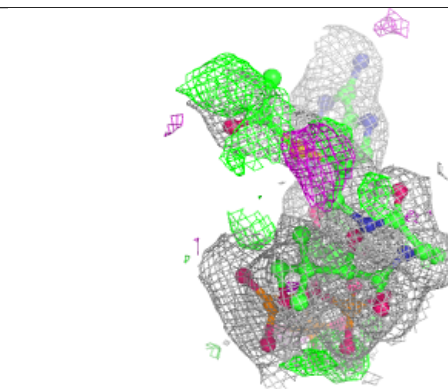
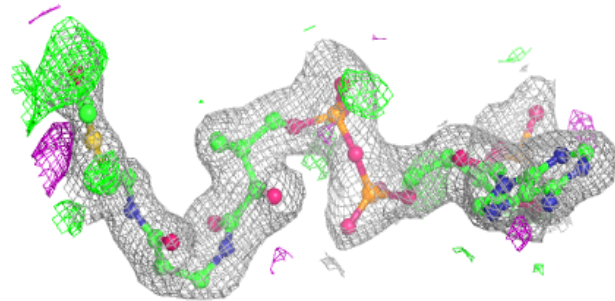
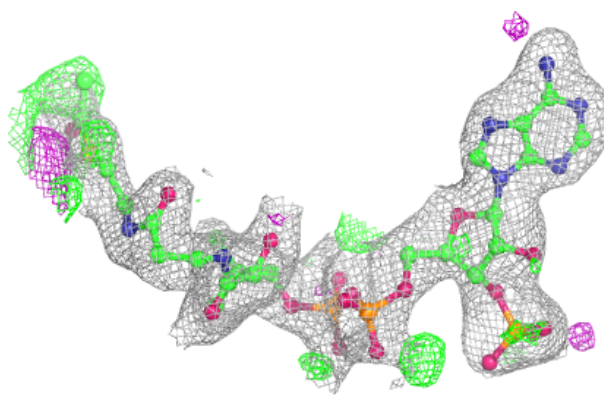
**Electron density around ACO B 401 (B):**

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and green (positive)

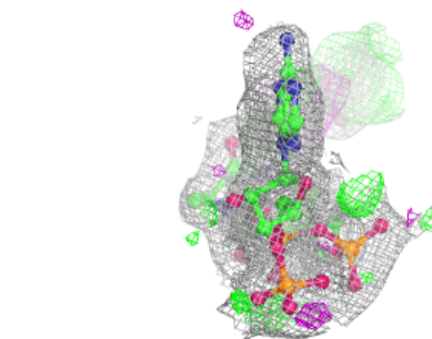
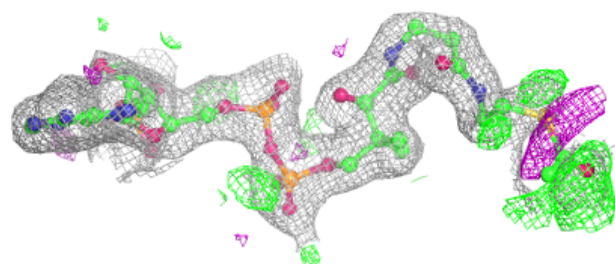
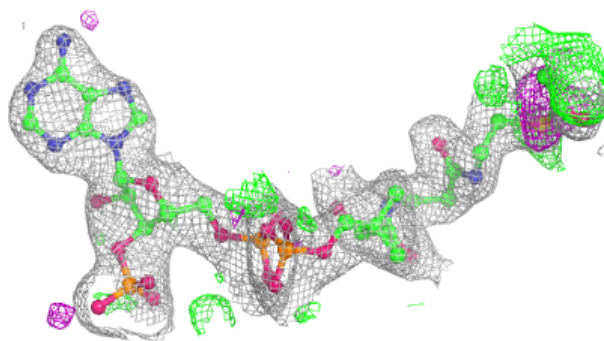


**Electron density around ACO L 401 (A):**

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

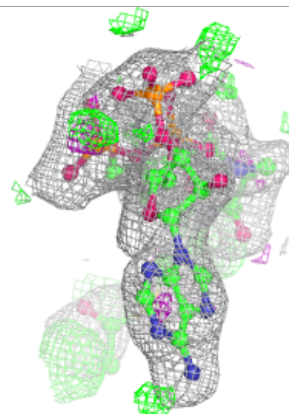
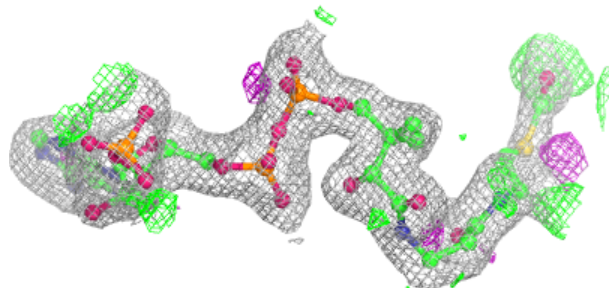
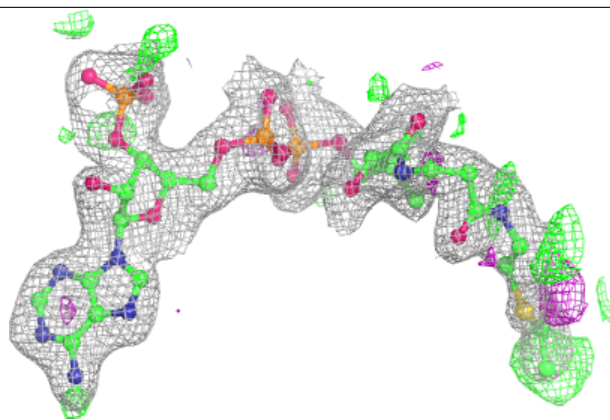
**Electron density around ACO L 401 (B):**

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and green (positive)

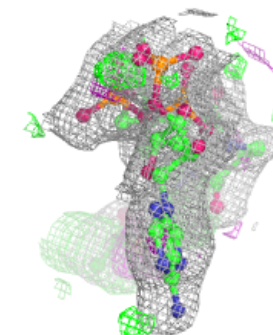
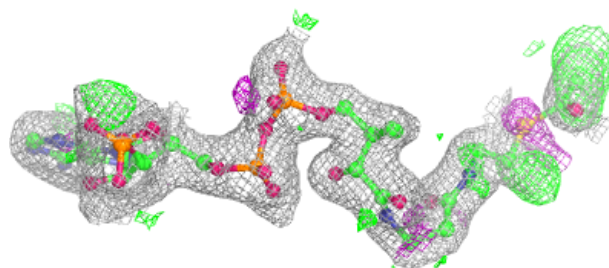
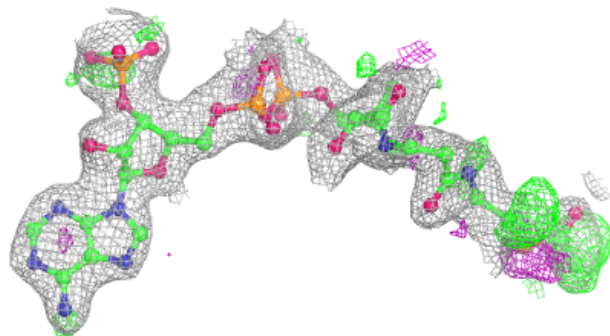


**Electron density around ACO K 401 (A):**

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and green (positive)

**Electron density around ACO K 401 (B):**

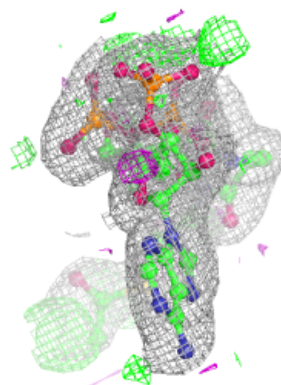
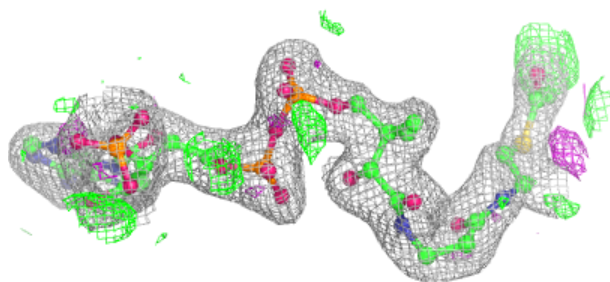
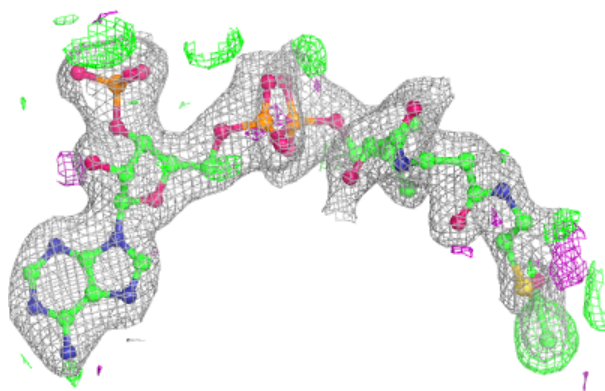
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and green (positive)



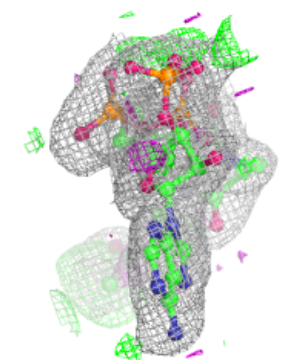
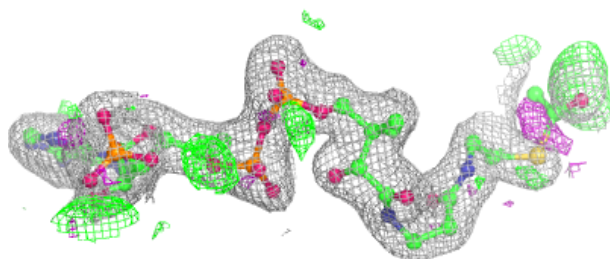
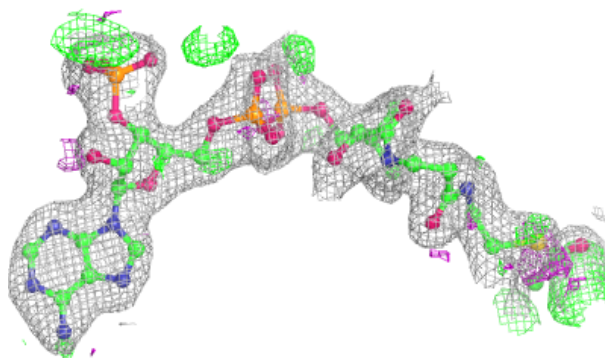


**Electron density around ACO I 401 (A):**

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

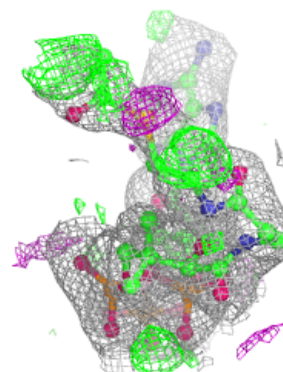
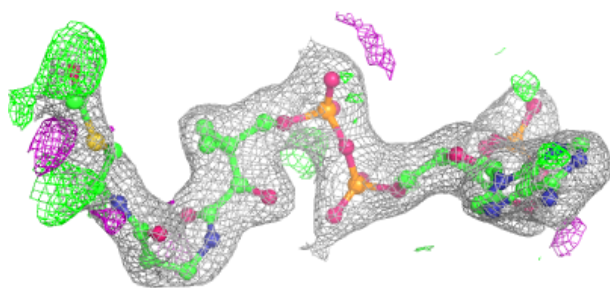
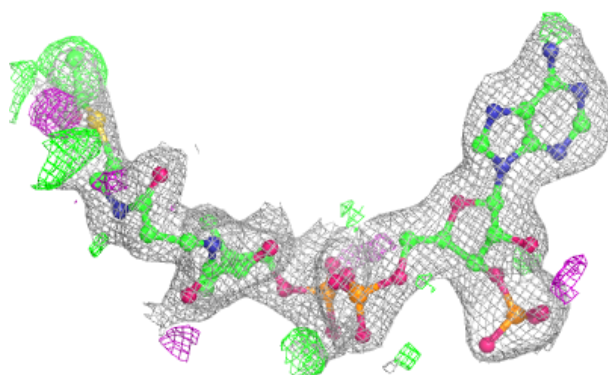
**Electron density around ACO I 401 (B):**

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

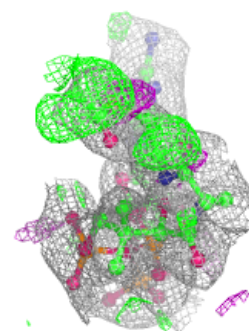
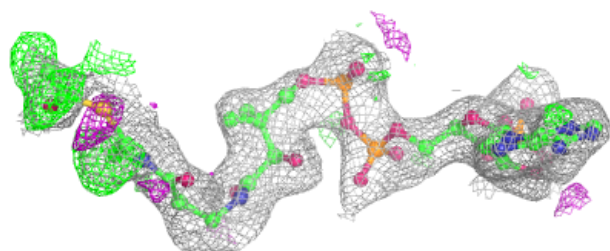
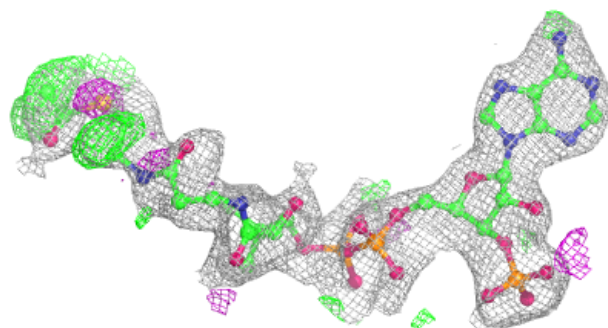


**Electron density around ACO D 401 (A):**

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

**Electron density around ACO D 401 (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.