



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 20, 2026 – 09:55 AM UTC

PDB ID : 5FEP / pdb_00005fep
Title : HydE from *T. maritima* in complex with (2R,4R)-MeTDA
Authors : Rohac, R.; Amara, P.; Benjdia, A.; Martin, L.; Ruffie, P.; Favier, A.; Berteau, O.; Mouesca, J.M.; Fontecilla-Camps, J.C.; Nicolet, Y.
Deposited on : 2015-12-17
Resolution : 1.45 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

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

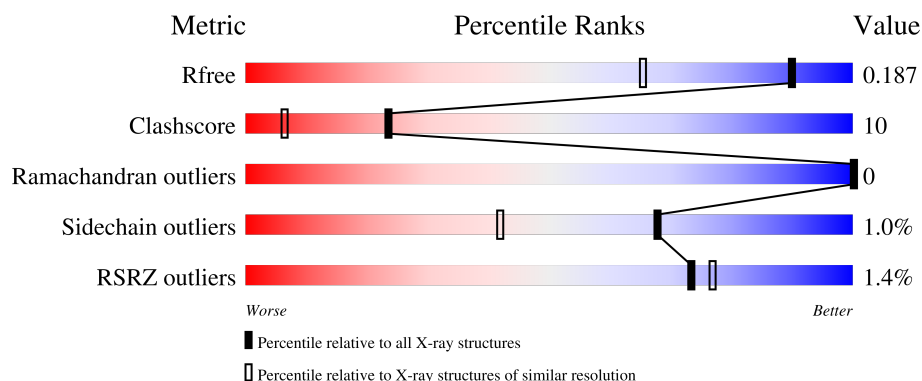
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

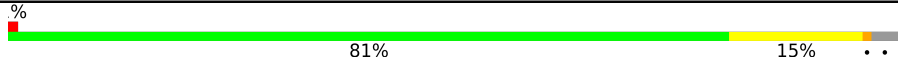
The reported resolution of this entry is 1.45 Å.

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



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	1756 (1.46-1.46)
Clashscore	190562	1795 (1.46-1.46)
Ramachandran outliers	187476	1776 (1.46-1.46)
Sidechain outliers	187428	1776 (1.46-1.46)
RSRZ outliers	180081	1756 (1.46-1.46)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 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	358	

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 3726 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.

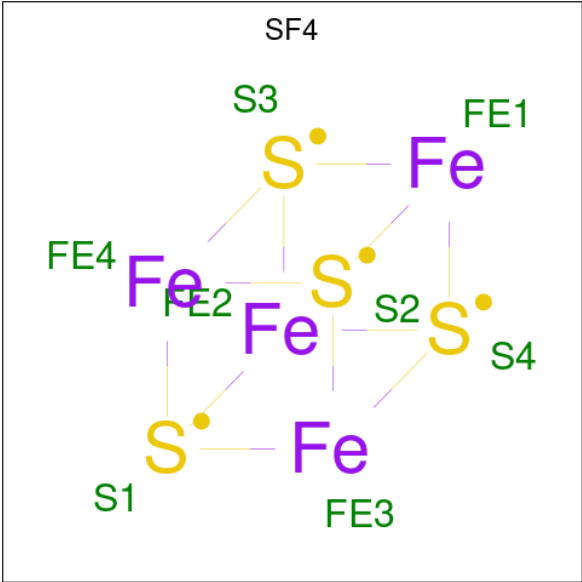
- Molecule 1 is a protein called [FeFe] hydrogenase maturase subunit HydE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	346	Total	C	N	O	S	0	35	0
			3000	1910	519	552	19			

There are 14 discrepancies between the modelled and reference sequences:

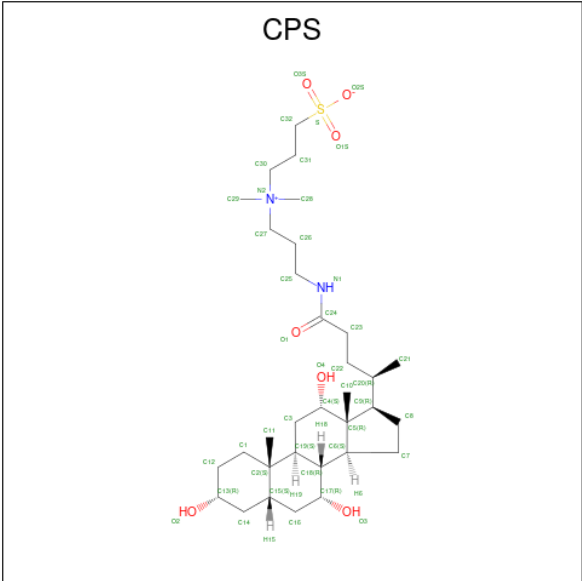
Chain	Residue	Modelled	Actual	Comment	Reference
A	-9	MET	-	initiating methionine	UNP Q9X0Z6
A	-8	TRP	-	expression tag	UNP Q9X0Z6
A	-7	SER	-	expression tag	UNP Q9X0Z6
A	-6	HIS	-	expression tag	UNP Q9X0Z6
A	-5	PRO	-	expression tag	UNP Q9X0Z6
A	-4	GLN	-	expression tag	UNP Q9X0Z6
A	-3	PHE	-	expression tag	UNP Q9X0Z6
A	-2	GLU	-	expression tag	UNP Q9X0Z6
A	-1	LYS	-	expression tag	UNP Q9X0Z6
A	0	ALA	-	expression tag	UNP Q9X0Z6
A	1	SER	-	expression tag	UNP Q9X0Z6
A	311	SER	CYS	engineered mutation	UNP Q9X0Z6
A	319	SER	CYS	engineered mutation	UNP Q9X0Z6
A	322	SER	CYS	engineered mutation	UNP Q9X0Z6

- Molecule 2 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe₄S₄).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	Fe	S		0	0
			8	4	4			

- Molecule 3 is 3-[(3-CHOLAMIDOPROPYL)DIMETHYLAMMONIO]-1-PROPANESULFO NATE (CCD ID: CPS) (formula: C₃₂H₅₈N₂O₇S).



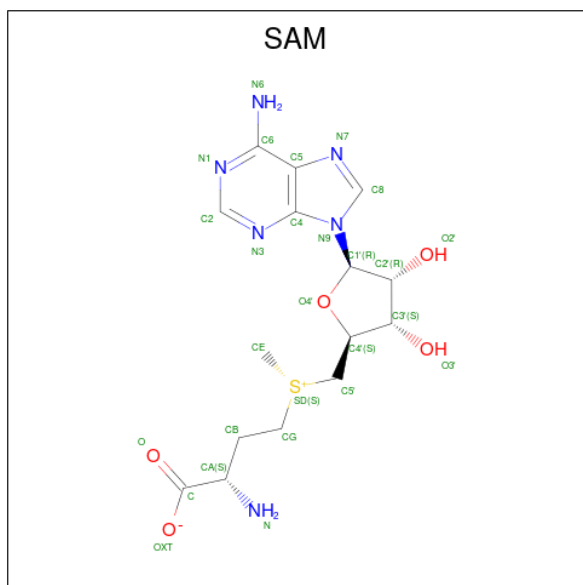
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	0	0
			42	32	2	7	1		
3	A	1	Total	C	N	O	S	0	0
			42	32	2	7	1		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			29	24	1	4		
3	A	1	Total	C	N	O	0	0
			29	24	1	4		
3	A	1	Total	C	O		0	1
			50	44	6			

- Molecule 4 is S-ADENOSYLMETHIONINE (CCD ID: SAM) (formula: $C_{15}H_{22}N_6O_5S$).

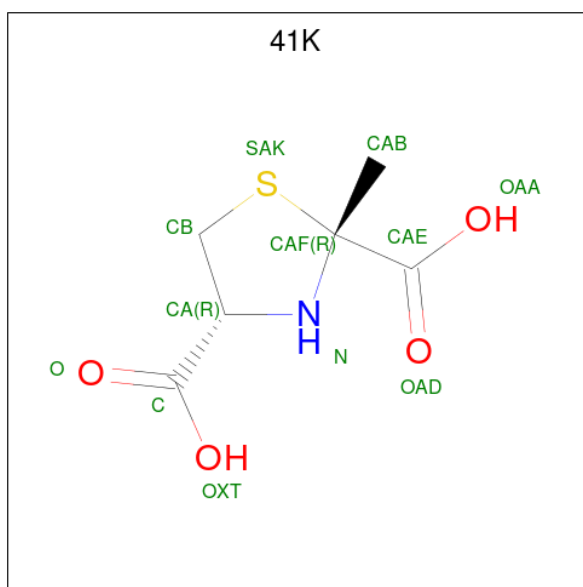


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	S	0	1
			27	15	6	5	1		

- Molecule 5 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total Cl	0	0
			1 1		

- Molecule 6 is (2R,4R)-2-methyl-1,3-thiazolidine-2,4-dicarboxylic acid (CCD ID: 41K) (formula: $C_6H_9NO_4S$).



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

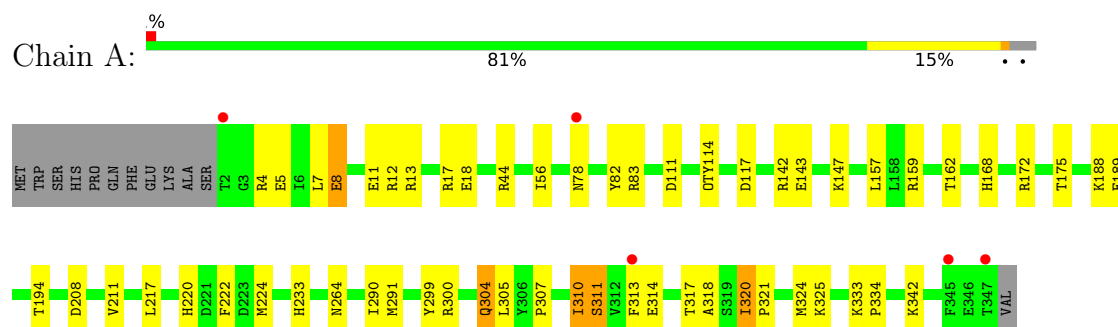
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	485	Total	O	0	10
			486	486		

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: [FeFe] hydrogenase maturase subunit HydE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	51.16Å 80.02Å 86.36Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	44.02 – 1.45 44.02 – 1.45	Depositor EDS
% Data completeness (in resolution range)	99.7 (44.02-1.45) 99.8 (44.02-1.45)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.91 (at 1.45Å)	Xtriage
Refinement program	REFMAC 5.8.0131	Depositor
R, R_{free}	0.162 , 0.188 0.162 , 0.187	Depositor DCC
R_{free} test set	3183 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	16.8	Xtriage
Anisotropy	0.456	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 49.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	3726	wwPDB-VP
Average B, all atoms (Å ²)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.47% 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: CL, SAM, 41K, OTY, SF4, CPS

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	1.39	11/3069 (0.4%)	1.17	3/4137 (0.1%)

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	304[A]	GLN	CA-CB	8.51	1.64	1.52
1	A	5	GLU	C-O	-6.87	1.16	1.24
1	A	208	ASP	C-O	-6.22	1.16	1.24
1	A	8	GLU	C-O	-6.18	1.16	1.24
1	A	314	GLU	C-O	-6.07	1.15	1.23
1	A	318	ALA	C-O	-5.38	1.17	1.24
1	A	18	GLU	N-CA	-5.24	1.40	1.46
1	A	320	ILE	CA-CB	5.13	1.57	1.54
1	A	310	ILE	C-O	-5.07	1.18	1.24
1	A	175	THR	CA-CB	5.07	1.61	1.54
1	A	300	ARG	C-O	-5.05	1.18	1.24

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	333	LYS	CA-C-N	-5.23	114.86	120.03
1	A	333	LYS	C-N-CA	-5.23	114.86	120.03
1	A	117	ASP	N-CA-C	5.12	117.77	111.82

There are no chirality outliers.

There are no planarity outliers.

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	3000	0	3001	59	1
2	A	8	0	0	0	0
3	A	192	0	264	15	1
4	A	27	0	21	6	0
5	A	1	0	0	0	0
6	A	12	0	7	0	0
7	A	486	0	0	20	1
All	All	3726	0	3293	67	2

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 10.

All (67) 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:334:PRO:HB3	7:A:904[A]:HOH:O	1.36	1.22
1:A:44:ARG:NH1	7:A:501:HOH:O	1.82	1.13
1:A:17:ARG:NH2	7:A:503:HOH:O	1.88	1.04
1:A:324[B]:MET:HE3	3:A:406[B]:CPS:C11	1.94	0.96
1:A:44:ARG:CZ	7:A:501:HOH:O	2.11	0.92
1:A:83[B]:ARG:HD3	1:A:111:ASP:OD2	1.68	0.91
1:A:13:ARG:NH2	7:A:502:HOH:O	1.85	0.84
1:A:147:LYS:NZ	7:A:505:HOH:O	2.13	0.80
1:A:321:PRO:HB3	3:A:406[A]:CPS:H11A	1.64	0.78
1:A:305:LEU:HD22	4:A:407[A]:SAM:CE	2.15	0.77
1:A:305:LEU:CD2	4:A:407[A]:SAM:CE	2.68	0.71
1:A:157:LEU:HD23	1:A:224[A]:MET:HE2	1.72	0.71
1:A:56[B]:ILE:HD11	1:A:291[B]:MET:HB3	1.72	0.70
1:A:305:LEU:HD21	4:A:407[A]:SAM:HE3	1.73	0.70
1:A:189:GLU:OE1	7:A:504:HOH:O	2.11	0.68
1:A:324[B]:MET:CE	3:A:406[B]:CPS:C11	2.70	0.67
1:A:324[B]:MET:HE3	3:A:406[B]:CPS:H11	1.77	0.66
1:A:305:LEU:CD2	4:A:407[A]:SAM:HE3	2.25	0.66
1:A:310:ILE:O	1:A:311[B]:SER:HB2	1.94	0.66
1:A:324[B]:MET:HE3	3:A:406[B]:CPS:H11B	1.78	0.66

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:188[B]:LYS:HD3	1:A:194[B]:THR:OG1	1.95	0.65
1:A:324[B]:MET:CE	3:A:406[B]:CPS:H11B	2.26	0.65
1:A:56[B]:ILE:HD11	1:A:291[B]:MET:SD	2.36	0.65
1:A:78[A]:ASN:OD1	7:A:506:HOH:O	2.15	0.65
1:A:168:HIS:HE1	1:A:172:ARG:HH11	1.46	0.62
1:A:194[A]:THR:HG21	7:A:616[A]:HOH:O	2.00	0.62
1:A:56[B]:ILE:CD1	1:A:291[B]:MET:HB3	2.30	0.61
1:A:157:LEU:CD2	1:A:224[A]:MET:HE2	2.31	0.61
1:A:8:GLU:O	1:A:12:ARG:HG3	2.02	0.60
1:A:313:PHE:O	7:A:507:HOH:O	2.16	0.59
1:A:325[B]:LYS:NZ	7:A:509:HOH:O	2.36	0.58
1:A:217:LEU:HD11	7:A:518:HOH:O	2.05	0.56
1:A:168:HIS:CE1	1:A:172:ARG:HH11	2.23	0.55
3:A:406[A]:CPS:H8	7:A:584:HOH:O	2.07	0.53
1:A:17:ARG:HG3	1:A:211:VAL:HG11	1.91	0.53
3:A:406[A]:CPS:H4	3:A:406[A]:CPS:H21A	1.90	0.52
3:A:406[B]:CPS:H21A	3:A:406[B]:CPS:H4	1.92	0.51
1:A:305:LEU:HD21	4:A:407[A]:SAM:CE	2.39	0.49
1:A:305:LEU:HD22	4:A:407[A]:SAM:HE1	1.90	0.49
1:A:334:PRO:HA	7:A:630:HOH:O	2.13	0.49
1:A:342:LYS:NZ	7:A:516:HOH:O	2.42	0.49
1:A:334:PRO:CA	7:A:630:HOH:O	2.60	0.49
1:A:334:PRO:CB	7:A:630:HOH:O	2.61	0.49
1:A:159[B]:ARG:HD2	7:A:527:HOH:O	2.13	0.47
1:A:168:HIS:CE1	1:A:172:ARG:HD3	2.50	0.47
1:A:56[B]:ILE:HD11	1:A:291[B]:MET:CB	2.42	0.47
1:A:157:LEU:HD23	1:A:224[A]:MET:CE	2.45	0.46
1:A:224[B]:MET:HA	1:A:264:ASN:O	2.16	0.46
3:A:406[A]:CPS:H3	3:A:406[A]:CPS:H1	1.78	0.46
1:A:159[B]:ARG:CD	7:A:527:HOH:O	2.64	0.46
1:A:7:LEU:O	1:A:11:GLU:HG3	2.16	0.45
1:A:310:ILE:O	1:A:311[A]:SER:CB	2.60	0.45
1:A:224[A]:MET:HA	1:A:264:ASN:O	2.17	0.45
1:A:320:ILE:HG23	1:A:324[A]:MET:HE3	1.99	0.44
1:A:220:HIS:HB2	1:A:222:PHE:CE1	2.52	0.44
1:A:324[B]:MET:HE2	3:A:406[B]:CPS:H11B	1.99	0.44
1:A:4:ARG:O	1:A:8:GLU:HG3	2.18	0.44
3:A:405:CPS:H14	3:A:405:CPS:O3	2.18	0.43
1:A:82:TYR:CE1	1:A:299:TYR:HB3	2.54	0.42
1:A:233:HIS:HA	1:A:307:PRO:HD3	2.01	0.42
3:A:404:CPS:H21A	3:A:404:CPS:H4	2.01	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:402:CPS:H4	3:A:402:CPS:H21A	2.01	0.41
3:A:405:CPS:H3	3:A:405:CPS:H1	1.79	0.41
1:A:142[A]:ARG:HH12	1:A:189:GLU:CD	2.29	0.41
1:A:162:THR:O	1:A:168:HIS:HD2	2.04	0.41
1:A:304[A]:GLN:NE2	7:A:517:HOH:O	2.42	0.41
1:A:320:ILE:CG2	1:A:324[A]:MET:HE3	2.50	0.40

All (2) 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)
7:A:696:HOH:O	7:A:773:HOH:O[4_455]	1.77	0.43
1:A:317:THR:OG1	3:A:403:CPS:O1[4_455]	2.17	0.03

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	375/358 (105%)	364 (97%)	11 (3%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	A	323/312 (104%)	319 (99%)	4 (1%)	63 33

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	143[A]	GLU
1	A	290	ILE
1	A	311[A]	SER
1	A	311[B]	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	107	GLN
1	A	168	HIS
1	A	304[A]	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
1	OTY	A	114[B]	1	11,12,14	1.11	0	10,15,19	1.88	4 (40%)
1	OTY	A	114[A]	1	12,13,14	1.35	1 (8%)	12,17,19	1.12	1 (8%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns.

'-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	OTY	A	114[B]	1	-	2/5/6/8	0/1/1/1
1	OTY	A	114[A]	1	-	0/5/6/8	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	114[A]	OTY	CD1-CG	-3.80	1.34	1.40

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	114[B]	OTY	CB-CG-CD2	-3.68	114.06	120.90
1	A	114[B]	OTY	CB-CG-CD1	2.52	125.60	120.90
1	A	114[B]	OTY	OH-CZ-CE1	-2.49	113.08	120.00
1	A	114[A]	OTY	CD2-CG-CD1	2.11	120.45	118.16
1	A	114[B]	OTY	OH-CZ-CE2	2.07	125.76	120.00

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	114[B]	OTY	CA-CB-CG-CD1
1	A	114[B]	OTY	CA-CB-CG-CD2

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 10 ligands modelled in this entry, 1 is monoatomic - leaving 9 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
6	41K	A	409	-	8,12,12	1.23	0	10,18,18	1.60	2 (20%)
3	CPS	A	403	-	45,45,45	1.59	7 (15%)	70,70,70	1.76	22 (31%)
3	CPS	A	406[B]	-	28,28,45	1.32	4 (14%)	46,46,70	1.77	14 (30%)
4	SAM	A	407[A]	2	27,29,29	1.76	7 (25%)	34,42,42	2.17	8 (23%)
3	CPS	A	406[A]	-	28,28,45	1.22	3 (10%)	46,46,70	2.23	18 (39%)
3	CPS	A	402	-	45,45,45	1.85	9 (20%)	70,70,70	1.41	10 (14%)
3	CPS	A	405	-	32,32,45	1.43	6 (18%)	51,51,70	1.74	15 (29%)
3	CPS	A	404	-	32,32,45	1.44	5 (15%)	51,51,70	1.30	6 (11%)
2	SF4	A	401	4,1	0,12,12	-	-	-	-	-

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
6	41K	A	409	-	-	0/6/21/21	0/1/1/1
3	CPS	A	403	-	-	1/25/90/90	0/4/4/4
3	CPS	A	406[B]	-	-	0/4/69/90	0/4/4/4
4	SAM	A	407[A]	2	-	2/17/33/33	0/3/3/3
3	CPS	A	406[A]	-	-	0/4/69/90	0/4/4/4
3	CPS	A	402	-	-	0/25/90/90	0/4/4/4
2	SF4	A	401	4,1	-	-	0/6/5/5
3	CPS	A	405	-	-	0/9/74/90	0/4/4/4
3	CPS	A	404	-	-	0/9/74/90	0/4/4/4

All (41) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	402	CPS	C32-S	-7.20	1.67	1.77
3	A	403	CPS	C32-S	-6.64	1.68	1.77
4	A	407[A]	SAM	C2-N1	4.79	1.42	1.33
3	A	404	CPS	C5-C4	-3.92	1.48	1.54
3	A	406[B]	CPS	C5-C6	-3.71	1.49	1.55
3	A	402	CPS	C1-C12	-3.68	1.46	1.53
3	A	405	CPS	O4-C4	3.65	1.49	1.43

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	402	CPS	C5-C9	-3.38	1.49	1.55
3	A	402	CPS	C5-C6	-3.33	1.49	1.55
3	A	404	CPS	C1-C2	-3.06	1.48	1.54
3	A	402	CPS	C16-C17	3.04	1.58	1.52
3	A	406[A]	CPS	C5-C4	-2.98	1.50	1.54
3	A	403	CPS	C5-C9	-2.97	1.50	1.55
4	A	407[A]	SAM	C5-N7	-2.89	1.33	1.39
4	A	407[A]	SAM	C5-C6	-2.88	1.33	1.41
3	A	402	CPS	C30-N2	-2.86	1.45	1.52
3	A	402	CPS	C11-C2	-2.77	1.49	1.54
3	A	402	CPS	C14-C15	-2.71	1.49	1.53
3	A	406[A]	CPS	C5-C9	-2.69	1.51	1.55
3	A	405	CPS	C2-C15	-2.58	1.51	1.55
3	A	403	CPS	C14-C15	-2.54	1.49	1.53
3	A	405	CPS	C20-C9	-2.40	1.50	1.54
4	A	407[A]	SAM	C4-N9	-2.40	1.32	1.37
3	A	406[A]	CPS	C18-C6	-2.39	1.49	1.53
4	A	407[A]	SAM	O4'-C4'	-2.36	1.39	1.45
3	A	406[B]	CPS	C18-C17	-2.36	1.49	1.53
3	A	403	CPS	C11-C2	-2.32	1.50	1.54
3	A	405	CPS	O3-C17	2.31	1.48	1.43
3	A	404	CPS	C20-C9	-2.30	1.50	1.54
4	A	407[A]	SAM	C2'-C1'	2.30	1.60	1.53
3	A	406[B]	CPS	C5-C4	-2.27	1.51	1.54
4	A	407[A]	SAM	C8-N7	2.25	1.36	1.31
3	A	402	CPS	C2-C15	-2.23	1.51	1.55
3	A	404	CPS	C1-C12	2.21	1.57	1.53
3	A	403	CPS	C2-C15	-2.18	1.52	1.55
3	A	406[B]	CPS	C18-C19	-2.17	1.49	1.53
3	A	405	CPS	C5-C4	-2.15	1.51	1.54
3	A	403	CPS	O1-C24	2.12	1.27	1.23
3	A	403	CPS	C22-C23	-2.12	1.46	1.52
3	A	404	CPS	O3-C17	2.04	1.47	1.43
3	A	405	CPS	C2-C19	-2.04	1.52	1.56

All (95) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	407[A]	SAM	N3-C2-N1	-7.15	117.75	128.58
3	A	406[A]	CPS	C7-C6-C5	-5.37	98.33	103.54
3	A	405	CPS	C3-C19-C2	-5.28	108.34	113.70
4	A	407[A]	SAM	C5-C4-N3	-4.93	119.93	126.72

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	403	CPS	O2S-S-C32	4.92	115.62	106.00
3	A	406[A]	CPS	C14-C15-C2	-4.32	108.06	112.66
3	A	406[A]	CPS	O4-C4-C5	-4.31	103.75	111.02
3	A	406[A]	CPS	C6-C5-C4	4.16	111.21	107.42
4	A	407[A]	SAM	C5-C4-N9	4.06	110.23	105.81
3	A	406[B]	CPS	C15-C14-C13	-3.98	106.70	112.71
3	A	403	CPS	C22-C23-C24	-3.90	104.37	113.06
4	A	407[A]	SAM	C2-N3-C4	3.89	121.33	111.83
3	A	402	CPS	O3S-S-C32	-3.86	100.89	106.73
3	A	406[B]	CPS	C16-C15-C14	-3.83	106.85	111.23
3	A	406[A]	CPS	C14-C13-C12	-3.82	105.96	110.62
3	A	406[A]	CPS	C15-C14-C13	-3.76	107.04	112.71
3	A	405	CPS	C19-C18-C17	-3.56	107.38	111.86
4	A	407[A]	SAM	N9-C8-N7	-3.52	108.94	113.94
4	A	407[A]	SAM	C4-C5-N7	-3.36	106.74	110.58
3	A	406[A]	CPS	C9-C5-C4	-3.33	114.67	117.67
3	A	406[A]	CPS	C1-C2-C15	3.32	112.52	107.75
3	A	402	CPS	C5-C9-C20	3.32	123.51	119.48
3	A	403	CPS	C25-N1-C24	-3.32	116.64	122.82
6	A	409	41K	CAB-CAF-N	-3.31	106.57	110.80
3	A	402	CPS	C7-C6-C5	-3.18	100.45	103.54
3	A	404	CPS	C23-C22-C20	-3.07	108.73	114.46
3	A	405	CPS	C15-C14-C13	-3.04	108.12	112.71
3	A	403	CPS	C5-C9-C20	-3.02	115.82	119.48
3	A	406[B]	CPS	C5-C9-C20	3.02	123.14	119.48
3	A	406[B]	CPS	C16-C17-C18	3.02	114.80	111.50
3	A	402	CPS	C16-C15-C2	-2.97	109.50	112.66
3	A	406[B]	CPS	C12-C1-C2	2.96	117.74	112.74
3	A	406[B]	CPS	C11-C2-C19	2.94	115.14	111.18
3	A	405	CPS	C11-C2-C15	-2.93	105.53	110.44
3	A	406[B]	CPS	C10-C5-C4	-2.91	106.14	109.06
4	A	407[A]	SAM	C5-N7-C8	2.90	108.00	103.45
3	A	403	CPS	C27-C26-C25	-2.88	105.33	110.95
3	A	405	CPS	C1-C2-C15	2.87	111.86	107.75
3	A	402	CPS	C23-C22-C20	2.85	119.78	114.46
3	A	403	CPS	O1S-S-C32	-2.84	102.43	106.73
3	A	402	CPS	C29-N2-C30	2.84	117.21	109.49
3	A	404	CPS	C7-C6-C5	2.82	106.28	103.54
3	A	402	CPS	C9-C5-C6	2.79	102.91	100.11
3	A	406[A]	CPS	C3-C4-C5	-2.73	108.49	111.26
3	A	402	CPS	C29-N2-C27	-2.67	102.22	109.49
3	A	405	CPS	C16-C15-C2	-2.67	109.82	112.66

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	404	CPS	C1-C2-C15	2.65	111.55	107.75
3	A	406[B]	CPS	C9-C5-C4	2.65	120.05	117.67
3	A	403	CPS	C31-C30-N2	-2.59	110.09	115.35
3	A	405	CPS	C22-C23-C24	-2.58	103.79	112.55
3	A	406[A]	CPS	C7-C6-C18	-2.57	114.83	118.36
3	A	403	CPS	O2S-S-O3S	-2.54	105.04	111.40
3	A	406[B]	CPS	C1-C12-C13	2.53	113.83	110.48
3	A	403	CPS	C23-C24-N1	2.51	120.93	116.34
3	A	403	CPS	C23-C22-C20	-2.51	109.77	114.46
3	A	403	CPS	C14-C15-C2	2.50	115.32	112.66
3	A	405	CPS	C19-C18-C6	-2.44	106.34	109.75
3	A	406[B]	CPS	C3-C4-C5	-2.44	108.79	111.26
3	A	403	CPS	C3-C4-C5	2.41	113.72	111.26
3	A	405	CPS	C10-C5-C4	-2.39	106.66	109.06
3	A	406[B]	CPS	C10-C5-C9	-2.39	107.46	111.20
3	A	403	CPS	O3S-S-C32	2.38	110.32	106.73
3	A	403	CPS	O1-C24-C23	-2.35	117.75	122.02
3	A	402	CPS	C19-C18-C6	-2.35	106.46	109.75
3	A	403	CPS	C10-C5-C6	2.34	114.87	111.20
3	A	405	CPS	C14-C13-C12	-2.33	107.78	110.62
3	A	403	CPS	C11-C2-C1	-2.28	104.68	108.31
4	A	407[A]	SAM	C6-C5-C4	2.28	120.29	117.18
3	A	405	CPS	C9-C5-C4	2.27	119.71	117.67
3	A	406[A]	CPS	C3-C19-C2	-2.26	111.41	113.70
3	A	403	CPS	C10-C5-C4	-2.24	106.81	109.06
3	A	403	CPS	C16-C17-C18	-2.24	109.05	111.50
3	A	406[A]	CPS	C19-C18-C6	-2.24	106.62	109.75
3	A	406[A]	CPS	C1-C2-C19	-2.22	107.89	111.34
3	A	402	CPS	C10-C5-C4	-2.21	106.84	109.06
3	A	404	CPS	C7-C8-C9	2.21	109.46	105.14
3	A	403	CPS	C16-C15-C2	-2.20	110.32	112.66
3	A	404	CPS	C5-C9-C20	-2.17	116.85	119.48
3	A	403	CPS	C28-N2-C27	-2.17	103.59	109.49
3	A	404	CPS	C8-C9-C5	-2.17	101.44	103.54
6	A	409	41K	CB-CA-C	2.15	114.38	111.32
3	A	405	CPS	C23-C22-C20	2.15	118.47	114.46
3	A	405	CPS	C8-C9-C20	-2.10	108.99	112.18
3	A	403	CPS	O2-C13-C14	2.09	114.01	109.84
3	A	406[A]	CPS	C5-C9-C20	-2.08	116.95	119.48
3	A	406[A]	CPS	C8-C9-C5	-2.07	101.53	103.54
3	A	403	CPS	C7-C6-C5	-2.07	101.53	103.54
3	A	405	CPS	C11-C2-C1	-2.07	105.02	108.31

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	406[B]	CPS	C11-C2-C1	-2.05	105.04	108.31
3	A	406[A]	CPS	C19-C3-C4	2.05	116.98	114.29
3	A	405	CPS	C7-C6-C18	-2.05	115.55	118.36
3	A	406[B]	CPS	C8-C9-C5	-2.04	101.56	103.54
3	A	406[A]	CPS	C11-C2-C1	2.03	111.53	108.31
3	A	406[A]	CPS	C19-C18-C17	2.01	114.39	111.86
3	A	406[B]	CPS	C19-C2-C15	-2.00	105.73	108.51

There are no chirality outliers.

All (3) torsion outliers are listed below:

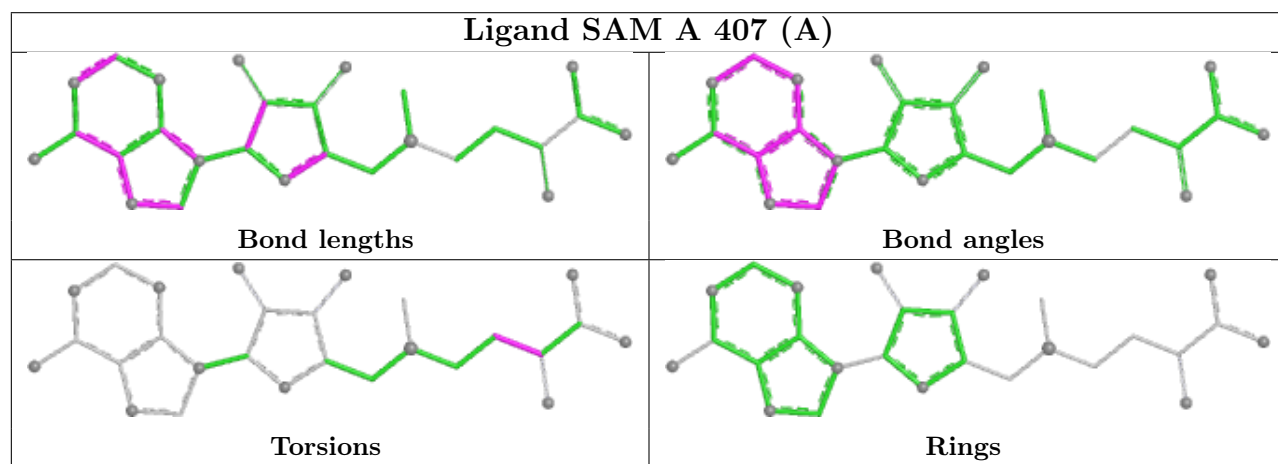
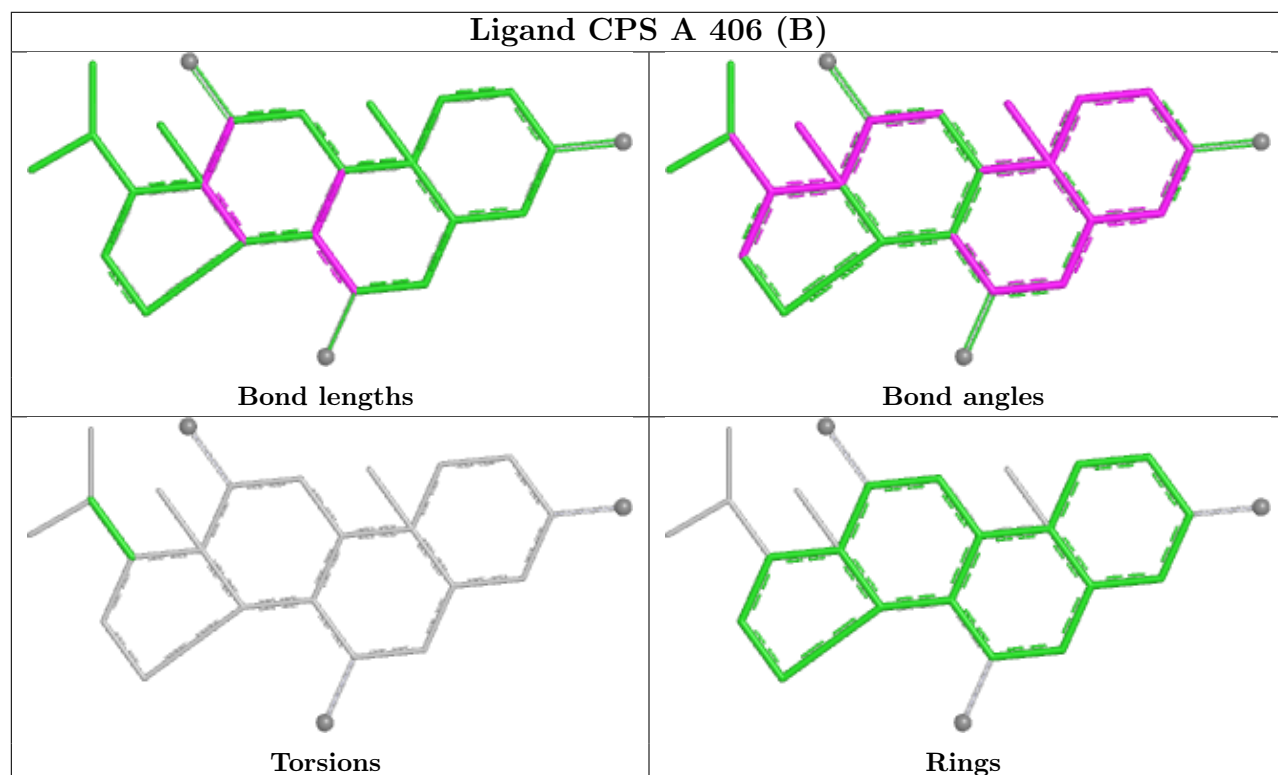
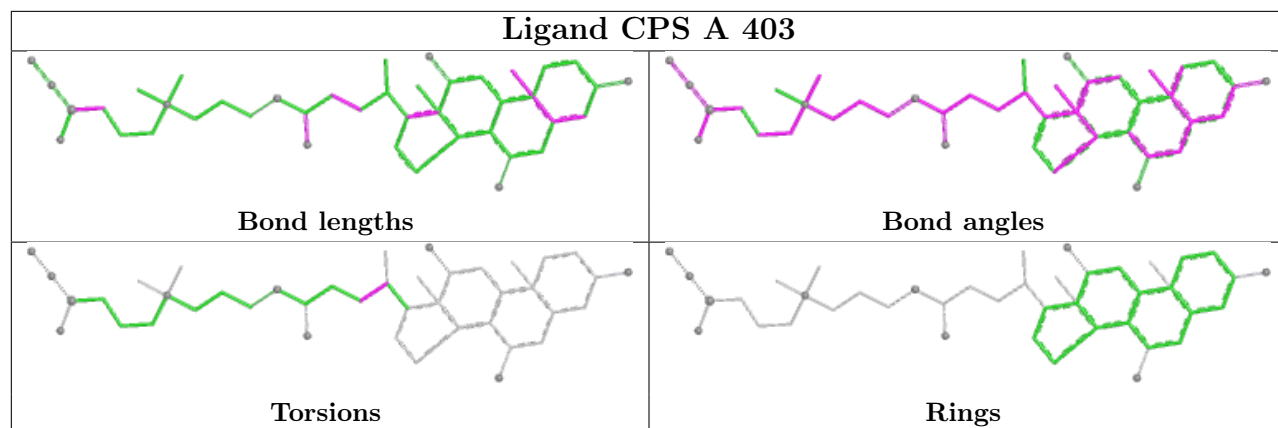
Mol	Chain	Res	Type	Atoms
4	A	407[A]	SAM	N-CA-CB-CG
4	A	407[A]	SAM	C-CA-CB-CG
3	A	403	CPS	C9-C20-C22-C23

There are no ring outliers.

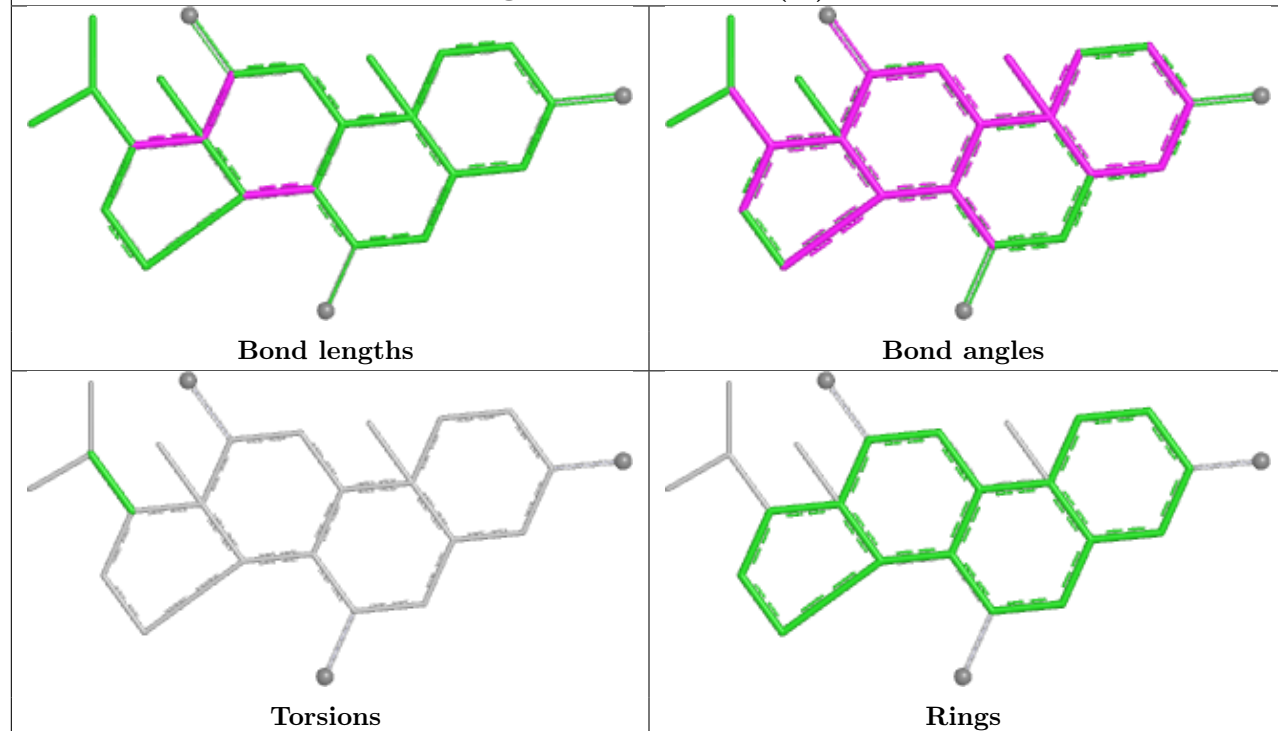
7 monomers are involved in 22 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	403	CPS	0	1
3	A	406[B]	CPS	7	0
4	A	407[A]	SAM	6	0
3	A	406[A]	CPS	4	0
3	A	402	CPS	1	0
3	A	405	CPS	2	0
3	A	404	CPS	1	0

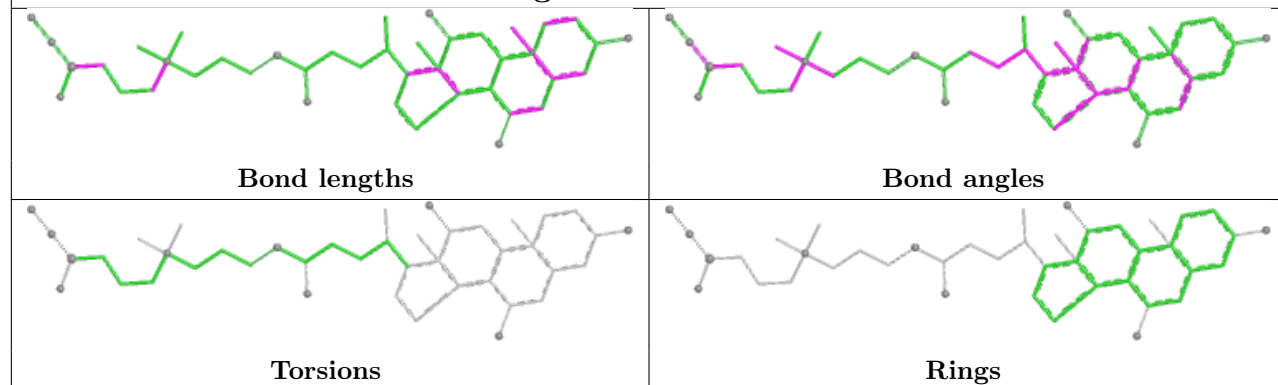
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

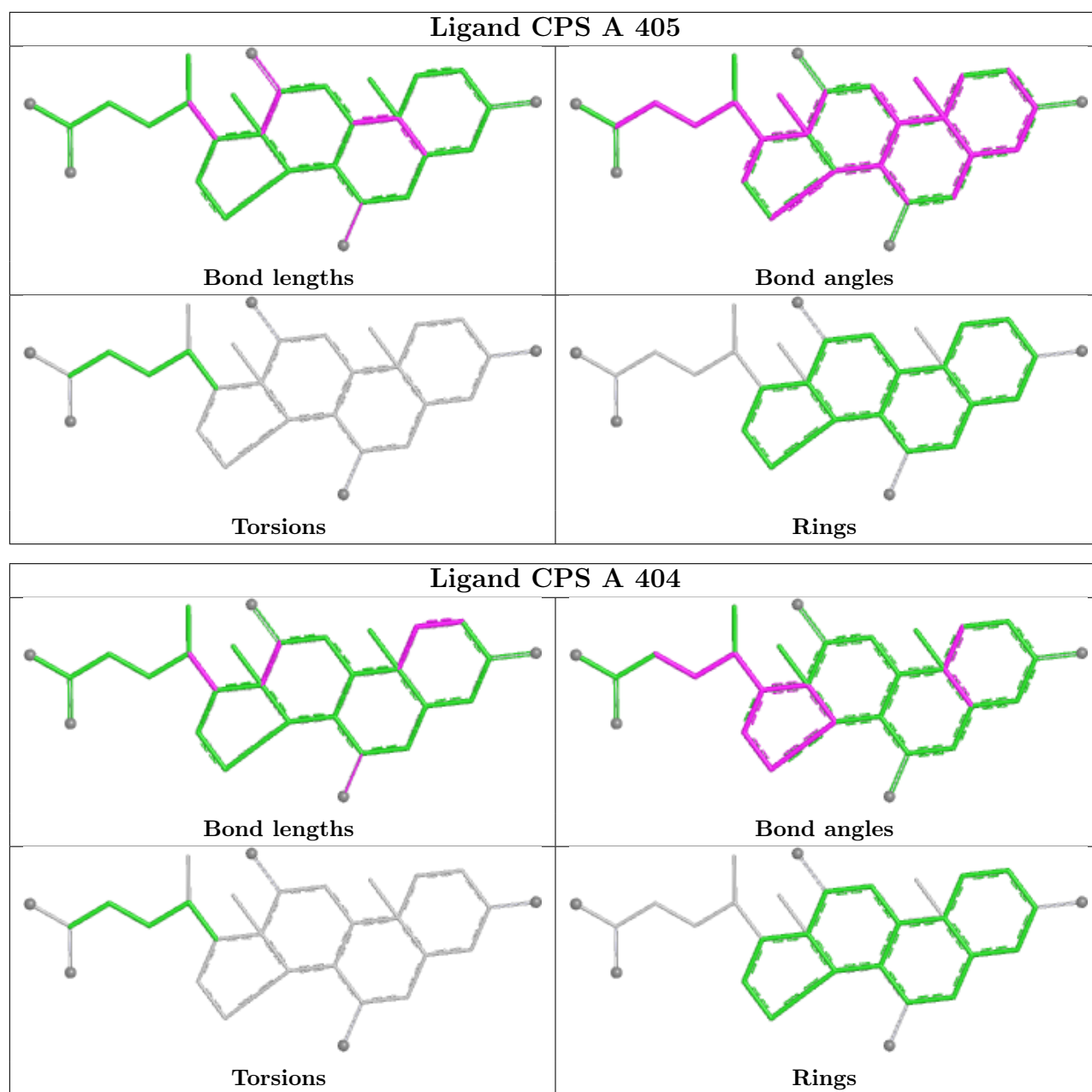


Ligand CPS A 406 (A)



Ligand CPS A 402





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	345/358 (96%)	0.08	5 (1%) 73 77	7, 17, 33, 51	38 (11%)

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	78[A]	ASN	3.0
1	A	2	THR	2.9
1	A	347	THR	2.5
1	A	313	PHE	2.2
1	A	345	PHE	2.2

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

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 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
1	OTY	A	114[A]	13/14	0.94	0.07	17,18,23,23	13
1	OTY	A	114[B]	12/14	0.94	0.07	11,12,16,17	12

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,

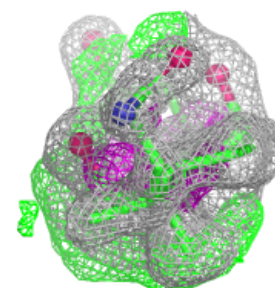
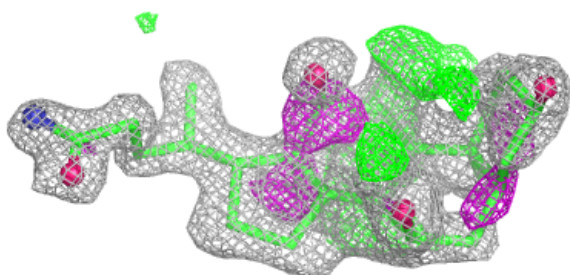
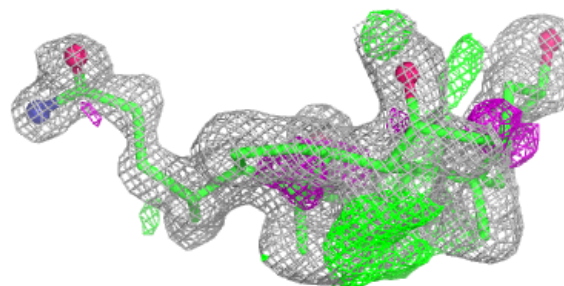
median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	CPS	A	405	29/42	0.69	0.15	25,31,36,45	0
3	CPS	A	406[A]	25/42	0.77	0.14	15,16,19,20	25
3	CPS	A	406[B]	25/42	0.77	0.14	22,25,30,32	25
3	CPS	A	403	42/42	0.88	0.12	15,22,42,45	5
4	SAM	A	407[A]	27/27	0.94	0.08	16,19,25,28	0
6	41K	A	409	12/12	0.95	0.07	16,21,29,33	0
3	CPS	A	404	29/42	0.96	0.06	15,18,36,41	0
3	CPS	A	402	42/42	0.96	0.07	12,15,27,36	5
2	SF4	A	401	8/8	0.99	0.04	16,17,18,20	0
5	CL	A	408	1/1	1.00	0.05	15,15,15,15	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.

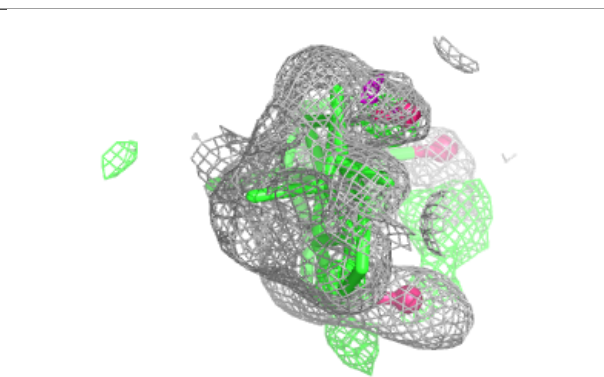
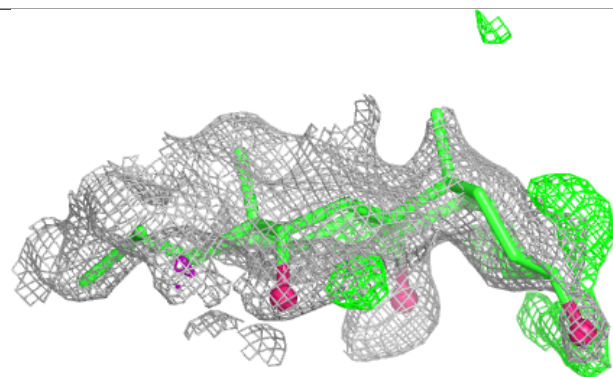
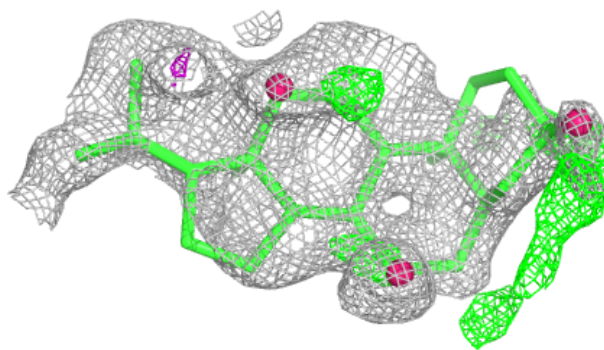
Electron density around CPS A 405:

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

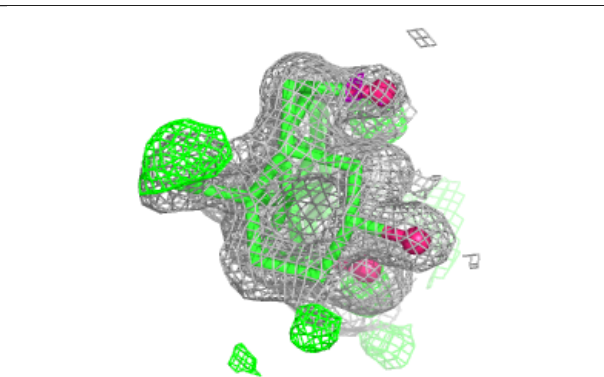
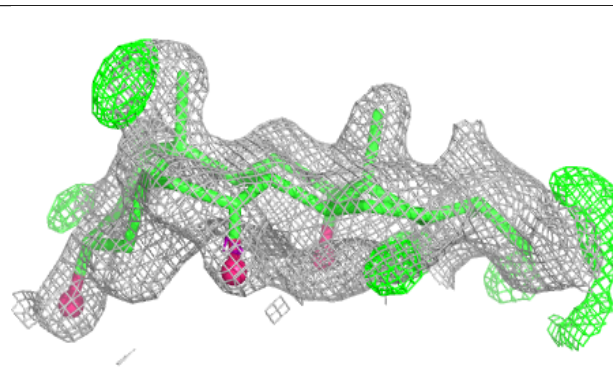
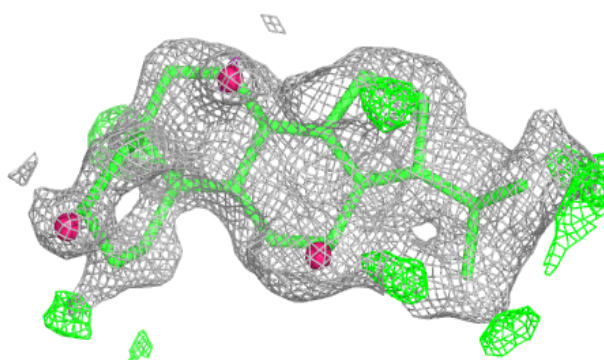


Electron density around CPS A 406 (A):

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

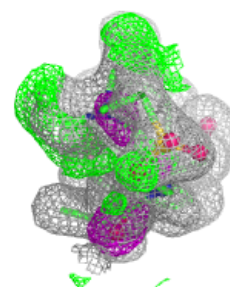
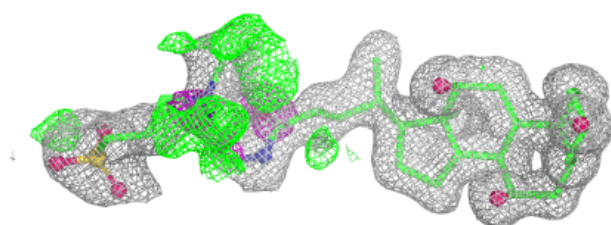
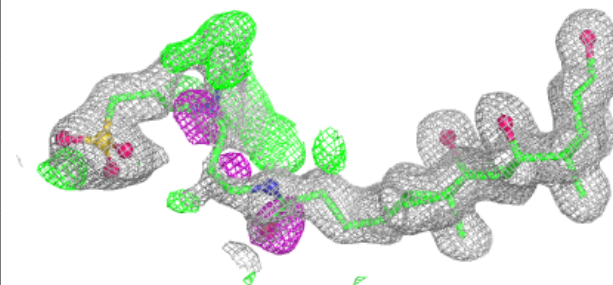
**Electron density around CPS A 406 (B):**

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

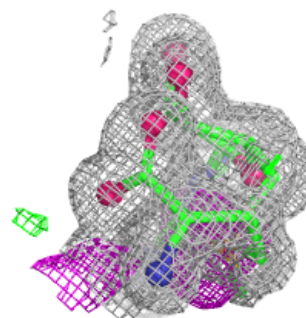
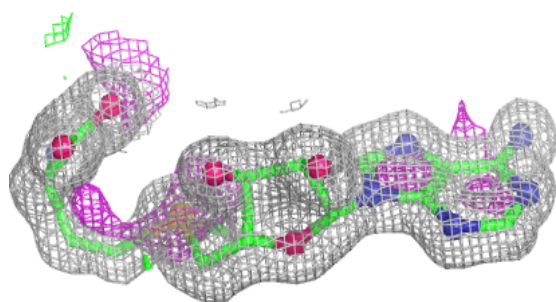
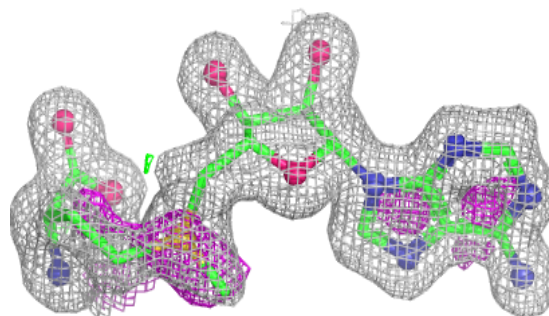


Electron density around CPS A 403:

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

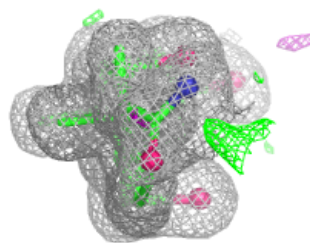
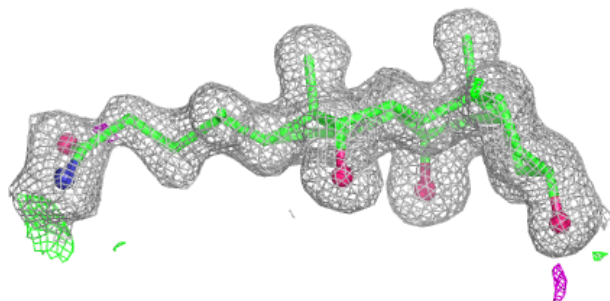
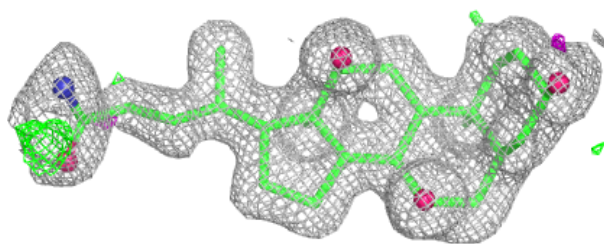
**Electron density around SAM A 407 (A):**

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



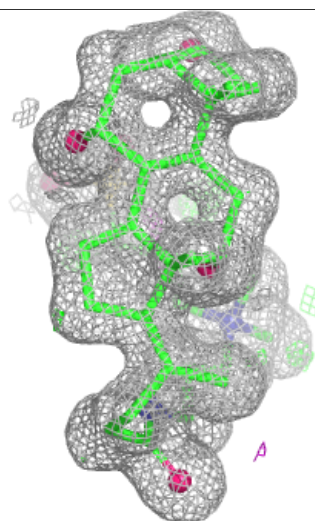
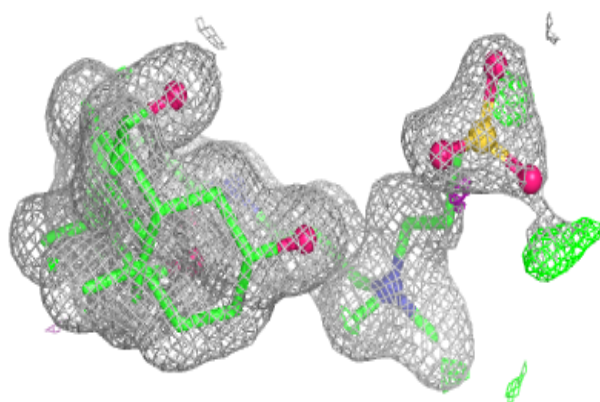
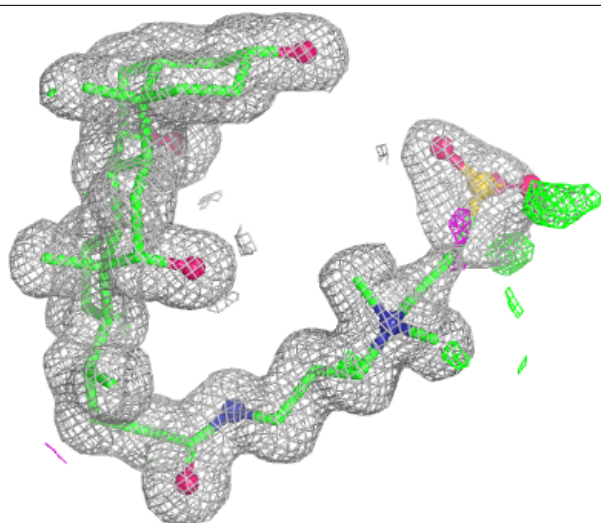
Electron density around CPS A 404:

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



Electron density around CPS A 402:

$2mF_o-DF_c$ (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.