



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 02:57 PM UTC

PDB ID : 4D96 / pdb_00004d96
Title : D-Cysteine desulfhydrase from Salmonella typhimurium complexed with 1-amino-1-carboxycyclopropane (ACC)
Authors : Bharath, S.R.; Shveta, B.; Rajesh, K.H.; Savithri, H.S.; Murthy, M.R.N.
Deposited on : 2012-01-11
Resolution : 2.09 Å(reported)

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

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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

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

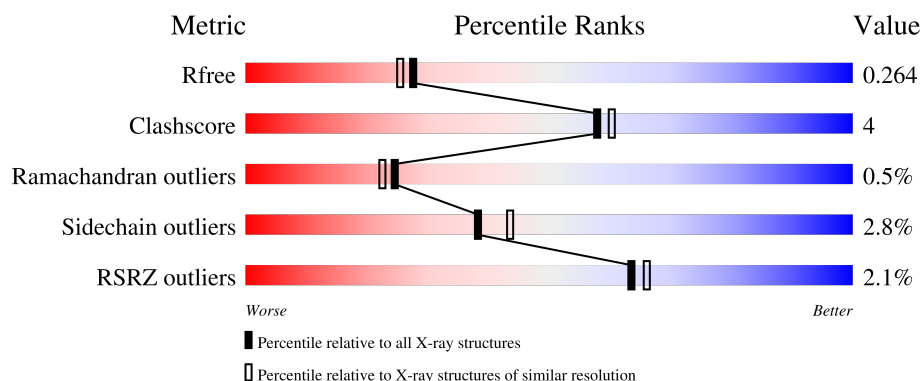
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.09 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	6658 (2.10-2.10)
Clashscore	190562	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)
RSRZ outliers	180081	6662 (2.10-2.10)

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

Mol	Chain	Length	Quality of chain
1	A	342	0% 86% 10% .
1	B	342	3% 82% 11% 6%
1	C	342	3% 83% 10% 6%
1	D	342	2% 84% 11% .

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 10469 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 D-cysteine desulphydrase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	328	Total	C	N	O	S	4	3	0
			2466	1572	416	466	12			
1	B	322	Total	C	N	O	S	14	1	0
			2384	1520	403	452	9			
1	C	322	Total	C	N	O	S	1	2	0
			2398	1527	406	456	9			
1	D	328	Total	C	N	O	S	8	1	0
			2457	1566	419	462	10			

There are 56 discrepancies between the modelled and reference sequences:

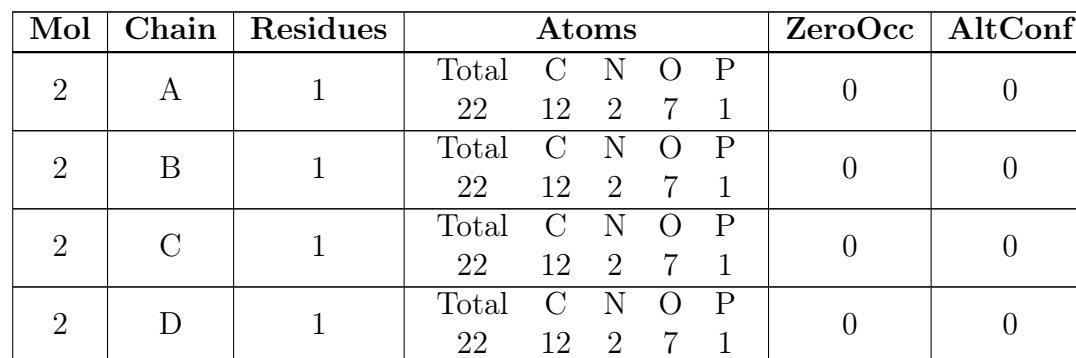
Chain	Residue	Modelled	Actual	Comment	Reference
A	-13	MET	-	expression tag	UNP Q8ZNT7
A	-12	ARG	-	expression tag	UNP Q8ZNT7
A	-11	GLY	-	expression tag	UNP Q8ZNT7
A	-10	SER	-	expression tag	UNP Q8ZNT7
A	-9	HIS	-	expression tag	UNP Q8ZNT7
A	-8	HIS	-	expression tag	UNP Q8ZNT7
A	-7	HIS	-	expression tag	UNP Q8ZNT7
A	-6	HIS	-	expression tag	UNP Q8ZNT7
A	-5	HIS	-	expression tag	UNP Q8ZNT7
A	-4	HIS	-	expression tag	UNP Q8ZNT7
A	-3	GLY	-	expression tag	UNP Q8ZNT7
A	-2	MET	-	expression tag	UNP Q8ZNT7
A	-1	ALA	-	expression tag	UNP Q8ZNT7
A	0	SER	-	expression tag	UNP Q8ZNT7
B	-13	MET	-	expression tag	UNP Q8ZNT7
B	-12	ARG	-	expression tag	UNP Q8ZNT7
B	-11	GLY	-	expression tag	UNP Q8ZNT7
B	-10	SER	-	expression tag	UNP Q8ZNT7
B	-9	HIS	-	expression tag	UNP Q8ZNT7
B	-8	HIS	-	expression tag	UNP Q8ZNT7
B	-7	HIS	-	expression tag	UNP Q8ZNT7

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-6	HIS	-	expression tag	UNP Q8ZNT7
B	-5	HIS	-	expression tag	UNP Q8ZNT7
B	-4	HIS	-	expression tag	UNP Q8ZNT7
B	-3	GLY	-	expression tag	UNP Q8ZNT7
B	-2	MET	-	expression tag	UNP Q8ZNT7
B	-1	ALA	-	expression tag	UNP Q8ZNT7
B	0	SER	-	expression tag	UNP Q8ZNT7
C	-13	MET	-	expression tag	UNP Q8ZNT7
C	-12	ARG	-	expression tag	UNP Q8ZNT7
C	-11	GLY	-	expression tag	UNP Q8ZNT7
C	-10	SER	-	expression tag	UNP Q8ZNT7
C	-9	HIS	-	expression tag	UNP Q8ZNT7
C	-8	HIS	-	expression tag	UNP Q8ZNT7
C	-7	HIS	-	expression tag	UNP Q8ZNT7
C	-6	HIS	-	expression tag	UNP Q8ZNT7
C	-5	HIS	-	expression tag	UNP Q8ZNT7
C	-4	HIS	-	expression tag	UNP Q8ZNT7
C	-3	GLY	-	expression tag	UNP Q8ZNT7
C	-2	MET	-	expression tag	UNP Q8ZNT7
C	-1	ALA	-	expression tag	UNP Q8ZNT7
C	0	SER	-	expression tag	UNP Q8ZNT7
D	-13	MET	-	expression tag	UNP Q8ZNT7
D	-12	ARG	-	expression tag	UNP Q8ZNT7
D	-11	GLY	-	expression tag	UNP Q8ZNT7
D	-10	SER	-	expression tag	UNP Q8ZNT7
D	-9	HIS	-	expression tag	UNP Q8ZNT7
D	-8	HIS	-	expression tag	UNP Q8ZNT7
D	-7	HIS	-	expression tag	UNP Q8ZNT7
D	-6	HIS	-	expression tag	UNP Q8ZNT7
D	-5	HIS	-	expression tag	UNP Q8ZNT7
D	-4	HIS	-	expression tag	UNP Q8ZNT7
D	-3	GLY	-	expression tag	UNP Q8ZNT7
D	-2	MET	-	expression tag	UNP Q8ZNT7
D	-1	ALA	-	expression tag	UNP Q8ZNT7
D	0	SER	-	expression tag	UNP Q8ZNT7

- Molecule 2 is N-[3-HYDROXY-2-METHYL-5-PHOSPHONOOXYMETHYL-PYRIDIN-4-Y-LMETHYL]-1-AMINO-CYCLOPROPANECARBOXYLIC ACID (CCD ID: 5PA) (formula: C₁₂H₁₇N₂O₇P).



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- Chemical structure of BEN (Benzamide) showing the benzene ring (C1-C6) and the amide group (C=O, N1, H1, N2, H2).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C N 9 7 2	0	0
3	C	1	Total C N 9 7 2	0	0
3	D	1	Total C N 9 7 2	0	0

- Molecule 4 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



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

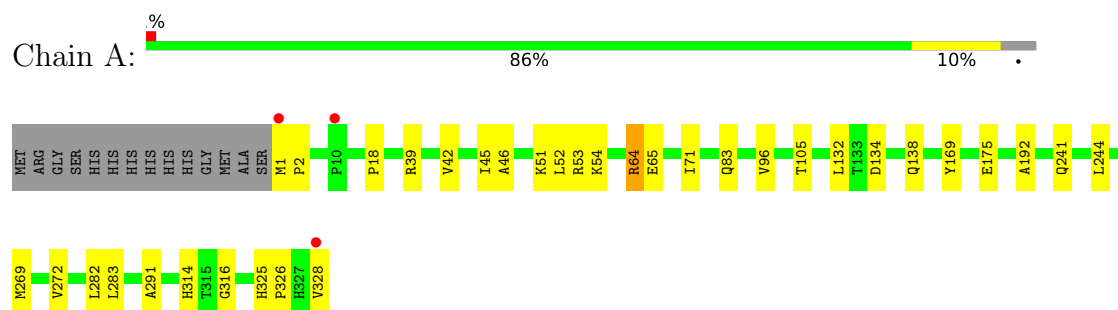
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	205	Total O 205 205	0	0
5	B	128	Total O 128 128	0	0
5	C	118	Total O 118 118	0	0
5	D	188	Total O 188 188	0	0

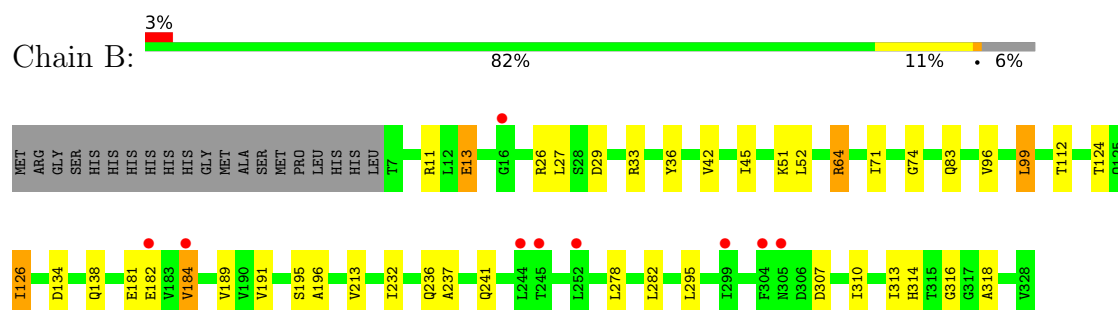
3 Residue-property plots [i](#)

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.

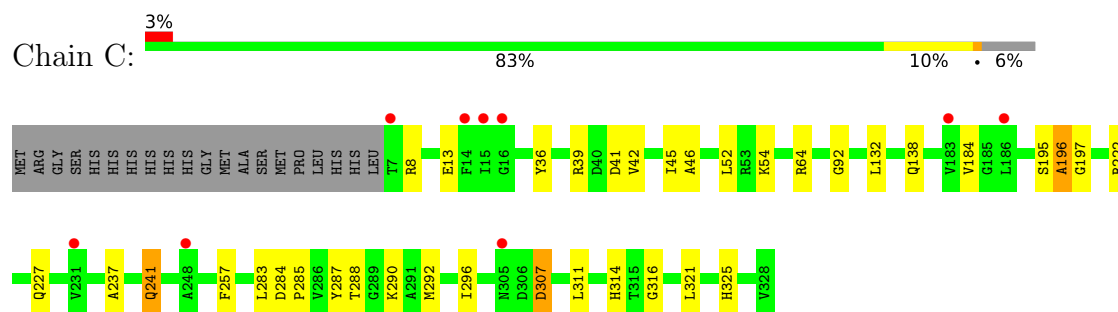
- Molecule 1: D-cysteine desulfhydrase



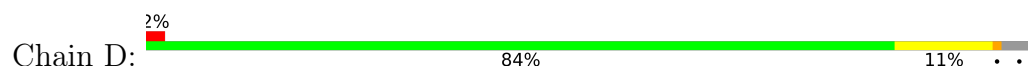
- Molecule 1: D-cysteine desulfhydrase

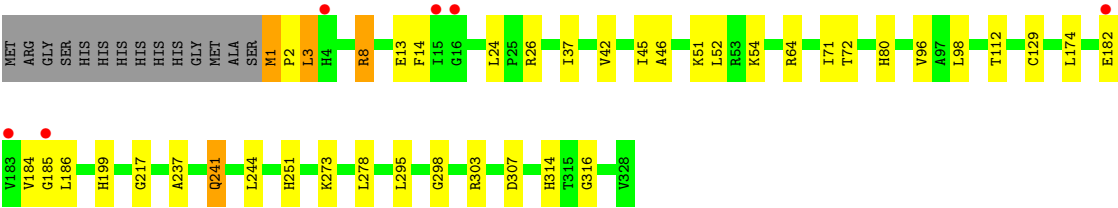


- Molecule 1: D-cysteine desulfhydrase



- Molecule 1: D-cysteine desulfhydrase





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	66.59Å 165.35Å 68.92Å 90.00° 119.01° 90.00°	Depositor
Resolution (Å)	48.70 – 2.09 48.70 – 2.09	Depositor EDS
% Data completeness (in resolution range)	91.4 (48.70-2.09) 89.7 (48.70-2.09)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.09 (at 2.08Å)	Xtriage
Refinement program	REFMAC 5.6.0117	Depositor
R, R_{free}	0.215 , 0.264 0.215 , 0.264	Depositor DCC
R_{free} test set	3858 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	22.0	Xtriage
Anisotropy	0.128	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 43.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.40$, $\langle L^2 \rangle = 0.23$	Xtriage
Estimated twinning fraction	0.076 for l,k,-h-l 0.076 for -h-l,k,h 0.208 for h,-k,-h-l 0.076 for l,-k,h 0.106 for -h-l,-k,l	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	10469	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.42% 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: BEN, 5PA, SO4

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	0.65	0/2523	0.85	0/3438
1	B	0.85	4/2432 (0.2%)	0.87	4/3316 (0.1%)
1	C	0.61	1/2449 (0.0%)	0.84	1/3338 (0.0%)
1	D	0.66	1/2508 (0.0%)	0.93	2/3418 (0.1%)
All	All	0.70	6/9912 (0.1%)	0.87	7/13510 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	181	GLU	CA-CB	-25.55	1.12	1.53
1	B	182	GLU	CA-CB	-9.57	1.34	1.53
1	B	64	ARG	CA-CB	-8.11	1.40	1.53
1	D	8	ARG	CA-CB	-8.02	1.40	1.53
1	B	13	GLU	CA-CB	-6.46	1.45	1.53
1	C	8	ARG	CA-CB	6.41	1.65	1.53

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	182	GLU	N-CA-CB	-16.93	97.17	114.10
1	D	182	GLU	CB-CA-C	-13.32	96.64	109.83
1	B	181	GLU	CB-CA-C	10.14	125.76	110.14

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	8	ARG	CB-CA-C	-7.19	95.92	109.72
1	B	182	GLU	N-CA-CB	6.68	121.86	110.50
1	B	318	ALA	CA-C-N	-5.18	114.28	119.56
1	B	318	ALA	C-N-CA	-5.18	114.28	119.56

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	64	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	2466	0	2490	26	0
1	B	2384	0	2393	22	0
1	C	2398	0	2407	19	0
1	D	2457	0	2482	24	0
2	A	22	0	14	0	0
2	B	22	0	14	0	0
2	C	22	0	13	1	0
2	D	22	0	13	1	0
3	A	9	0	7	0	0
3	C	9	0	7	0	0
3	D	9	0	7	0	0
4	A	5	0	0	0	0
4	D	5	0	0	0	0
5	A	205	0	0	3	0
5	B	128	0	0	0	0
5	C	118	0	0	2	0
5	D	188	0	0	1	0
All	All	10469	0	9847	88	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.

All (88) 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:D:1:MET:HG3	1:D:2:PRO:HD3	1.38	1.01
1:A:52:LEU:HG	1:A:83:GLN:HE21	1.35	0.90
1:A:328:VAL:HA	5:A:786:HOH:O	1.73	0.87
1:A:105:THR:OG1	1:A:328:VAL:HG12	1.93	0.68
1:D:3[B]:LEU:HD11	1:D:174:LEU:HD22	1.75	0.67
1:C:39[A]:ARG:NH1	5:C:596:HOH:O	2.27	0.66
1:D:314:HIS:HD2	1:D:316:GLY:H	1.44	0.64
1:B:52:LEU:HG	1:B:83:GLN:HE21	1.64	0.61
1:D:251:HIS:HD2	5:D:774:HOH:O	1.82	0.61
1:B:33:ARG:HH21	1:B:310:ILE:HD11	1.67	0.60
1:B:42:VAL:HG12	1:B:42:VAL:O	2.02	0.60
1:C:325:HIS:HD2	5:C:610:HOH:O	1.83	0.60
1:C:314:HIS:HD2	1:C:316:GLY:H	1.50	0.59
1:A:52:LEU:HG	1:A:83:GLN:NE2	2.13	0.57
1:D:14:PHE:HB3	1:D:45:ILE:HD12	1.84	0.57
1:C:237:ALA:O	1:C:241:GLN:HG2	2.05	0.56
1:D:42:VAL:HG12	1:D:42:VAL:O	2.08	0.54
1:D:98:LEU:HD11	1:D:129:CYS:HB3	1.89	0.54
1:D:51:LYS:HZ2	1:D:54:LYS:HZ2	1.56	0.54
1:B:26:ARG:HD3	1:B:278:LEU:O	2.07	0.54
1:C:283:LEU:HD22	1:C:288:THR:HB	1.90	0.54
1:B:33:ARG:NH2	1:B:310:ILE:HD11	2.24	0.53
1:A:1[A]:MET:HG3	1:A:2:PRO:HD3	1.91	0.53
1:C:45:ILE:HB	1:C:52:LEU:HD11	1.90	0.53
1:D:51:LYS:HE3	2:D:501:5PA:H101	1.89	0.53
1:D:237:ALA:O	1:D:241:GLN:HG2	2.08	0.53
1:A:325:HIS:HE1	1:B:112:THR:OG1	1.92	0.52
1:B:36:TYR:CE1	1:B:184:VAL:HG11	2.44	0.52
1:A:272:VAL:HG22	1:A:283:LEU:HB2	1.90	0.52
1:B:189:VAL:HG23	1:B:213:VAL:HG11	1.90	0.52
1:C:257:PHE:HA	1:C:290:LYS:HD3	1.92	0.52
1:A:134:ASP:H	1:A:138:GLN:NE2	2.08	0.52
1:A:53:ARG:HD2	1:A:169:TYR:CE1	2.44	0.52
1:A:325:HIS:CD2	1:A:326:PRO:HA	2.45	0.52
1:B:237:ALA:O	1:B:241:GLN:HG3	2.10	0.51
1:A:51:LYS:NZ	1:A:54:LYS:HE2	2.27	0.50
1:B:124:THR:O	1:B:126:ILE:HD12	2.12	0.49
1:D:51:LYS:HZ2	1:D:54:LYS:NZ	2.10	0.49
1:A:39:ARG:O	1:A:42:VAL:HG12	2.12	0.49
1:C:325:HIS:HE1	1:D:112:THR:OG1	1.95	0.49
1:A:51:LYS:HZ2	1:A:54:LYS:HE2	1.78	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:71:ILE:HG12	1:A:96:VAL:HB	1.95	0.48
1:A:314:HIS:CD2	1:A:316:GLY:H	2.32	0.48
1:C:195:SER:O	1:C:196:ALA:HB3	2.14	0.48
1:B:282:LEU:O	1:B:314:HIS:CE1	2.67	0.47
1:D:71:ILE:HG12	1:D:96:VAL:HB	1.96	0.47
1:C:287:TYR:OH	2:C:402:5PA:C10	2.63	0.47
1:A:241:GLN:HG2	5:A:695:HOH:O	2.15	0.47
1:B:282:LEU:O	1:B:314:HIS:HE1	1.98	0.46
1:C:222:ARG:HD2	1:C:227:GLN:OE1	2.16	0.46
1:A:2:PRO:O	1:A:244:LEU:HD21	2.16	0.46
1:A:132:LEU:HA	1:A:138:GLN:HE22	1.80	0.45
1:D:72:THR:OG1	1:D:80:HIS:HE1	1.99	0.45
1:B:314:HIS:HD2	1:B:316:GLY:H	1.64	0.45
1:B:51:LYS:HA	1:B:51:LYS:HD3	1.85	0.45
1:B:232:ILE:O	1:B:236:GLN:HG2	2.17	0.45
1:B:191:VAL:HG23	1:B:313:ILE:HB	1.99	0.44
1:A:105:THR:CB	1:A:328:VAL:HG12	2.46	0.44
1:C:292:MET:O	1:C:296:ILE:HG13	2.17	0.44
1:D:298:GLY:HA2	1:D:303:ARG:HB2	2.00	0.44
1:A:325:HIS:HD2	5:A:777:HOH:O	2.00	0.44
1:B:295:LEU:C	1:B:295:LEU:HD23	2.42	0.44
1:D:26:ARG:HD3	1:D:278:LEU:O	2.18	0.44
1:B:74:GLY:O	1:B:99:LEU:HA	2.18	0.43
1:D:3[B]:LEU:HD21	1:D:174:LEU:HD13	2.00	0.43
1:D:199:HIS:CE1	1:D:217:GLY:HA3	2.54	0.43
1:C:54:LYS:HE2	1:C:197:GLY:HA3	2.00	0.43
1:C:307:ASP:OD1	1:C:307:ASP:N	2.52	0.43
1:D:51:LYS:NZ	1:D:54:LYS:NZ	2.67	0.43
1:B:71:ILE:HG12	1:B:96:VAL:HB	2.00	0.43
1:A:269[A]:MET:HE3	1:A:269[A]:MET:HA	2.00	0.42
1:C:36:TYR:CE1	1:C:184:VAL:HG21	2.55	0.42
1:C:132:LEU:HA	1:C:138:GLN:HE22	1.84	0.42
1:A:314:HIS:HD2	1:A:316:GLY:H	1.66	0.42
1:A:192:ALA:HB2	1:A:291:ALA:HB2	2.02	0.42
1:B:195:SER:O	1:B:196:ALA:HB3	2.19	0.42
1:C:92:GLY:HA2	1:D:26:ARG:CZ	2.49	0.42
1:B:134:ASP:C	1:B:138:GLN:HE21	2.28	0.41
1:D:2:PRO:O	1:D:244:LEU:HD21	2.19	0.41
1:A:18:PRO:HB3	1:A:175:GLU:HG2	2.01	0.41
1:D:24:LEU:HD11	1:D:37:ILE:HB	2.03	0.41
1:B:45:ILE:HB	1:B:52:LEU:HD11	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:285:PRO:HD3	1:C:321:LEU:HD23	2.03	0.41
1:C:39[A]:ARG:HD2	1:C:41:ASP:OD1	2.21	0.41
1:D:295:LEU:HD23	1:D:295:LEU:C	2.45	0.41
1:A:45:ILE:HB	1:A:52:LEU:HD11	2.03	0.40
1:A:282:LEU:O	1:A:314:HIS:HE1	2.04	0.40
1:D:42:VAL:O	1:D:42:VAL:CG1	2.69	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	328/342 (96%)	319 (97%)	8 (2%)	1 (0%)	36	36
1	B	321/342 (94%)	310 (97%)	11 (3%)	0	100	100
1	C	322/342 (94%)	313 (97%)	7 (2%)	2 (1%)	21	18
1	D	327/342 (96%)	316 (97%)	8 (2%)	3 (1%)	14	10
All	All	1298/1368 (95%)	1258 (97%)	34 (3%)	6 (0%)	24	22

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	46	ALA
1	D	184	VAL
1	A	46	ALA
1	C	196	ALA
1	C	46	ALA
1	D	185	GLY

5.3.2 Protein sidechains ⓘ

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	258/267 (97%)	256 (99%)	2 (1%)	73	81
1	B	245/267 (92%)	236 (96%)	9 (4%)	30	33
1	C	248/267 (93%)	241 (97%)	7 (3%)	38	43
1	D	256/267 (96%)	245 (96%)	11 (4%)	26	27
All	All	1007/1068 (94%)	978 (97%)	29 (3%)	38	42

All (29) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	64	ARG
1	A	65	GLU
1	B	11	ARG
1	B	13	GLU
1	B	27	LEU
1	B	29	ASP
1	B	64	ARG
1	B	99	LEU
1	B	126	ILE
1	B	184	VAL
1	B	307	ASP
1	C	13	GLU
1	C	42	VAL
1	C	64	ARG
1	C	241	GLN
1	C	284	ASP
1	C	307	ASP
1	C	311	LEU
1	D	1	MET
1	D	3[A]	LEU
1	D	3[B]	LEU
1	D	8	ARG
1	D	13	GLU
1	D	52	LEU

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Mol	Chain	Res	Type
1	D	64	ARG
1	D	186	LEU
1	D	241	GLN
1	D	273	LYS
1	D	307	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (26) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	83	GLN
1	A	94	HIS
1	A	125	GLN
1	A	138	GLN
1	A	251	HIS
1	A	314	HIS
1	A	325	HIS
1	B	80	HIS
1	B	83	GLN
1	B	125	GLN
1	B	138	GLN
1	B	251	HIS
1	B	301	GLN
1	B	314	HIS
1	C	80	HIS
1	C	138	GLN
1	C	251	HIS
1	C	305	ASN
1	C	314	HIS
1	C	325	HIS
1	D	80	HIS
1	D	125	GLN
1	D	241	GLN
1	D	251	HIS
1	D	314	HIS
1	D	325	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

9 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
4	SO4	D	503	-	4,4,4	0.43	0	6,6,6	0.29	0
2	5PA	B	501	-	22,23,23	2.73	5 (22%)	33,35,35	4.90	8 (24%)
2	5PA	A	501	-	22,23,23	2.53	3 (13%)	33,35,35	2.01	10 (30%)
2	5PA	C	402	-	22,23,23	2.65	4 (18%)	33,35,35	1.67	8 (24%)
3	BEN	C	401	-	9,9,9	0.85	0	7,11,11	0.68	0
4	SO4	A	503	-	4,4,4	0.46	0	6,6,6	0.23	0
2	5PA	D	501	-	22,23,23	2.58	5 (22%)	33,35,35	4.53	9 (27%)
3	BEN	A	502	-	9,9,9	0.98	1 (11%)	7,11,11	1.00	1 (14%)
3	BEN	D	502	-	9,9,9	0.96	1 (11%)	7,11,11	0.38	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	5PA	B	501	-	-	4/15/22/22	0/2/2/2
2	5PA	A	501	-	-	4/15/22/22	0/2/2/2
2	5PA	C	402	-	-	2/15/22/22	0/2/2/2
3	BEN	C	401	-	-	0/4/4/4	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	5PA	D	501	-	-	5/15/22/22	0/2/2/2
3	BEN	A	502	-	-	0/4/4/4	0/1/1/1
3	BEN	D	502	-	-	0/4/4/4	0/1/1/1

All (19) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	501	5PA	C3-C2	7.82	1.49	1.41
2	C	402	5PA	C3-C2	7.46	1.48	1.41
2	A	501	5PA	C3-C2	6.94	1.48	1.41
2	D	501	5PA	C3-C2	6.89	1.48	1.41
2	A	501	5PA	C3-C4	6.52	1.49	1.40
2	C	402	5PA	C3-C4	6.48	1.49	1.40
2	B	501	5PA	C3-C4	6.37	1.49	1.40
2	B	501	5PA	C5-C4	6.23	1.49	1.40
2	C	402	5PA	C5-C4	6.22	1.49	1.40
2	A	501	5PA	C5-C4	5.96	1.48	1.40
2	D	501	5PA	C3-C4	5.95	1.48	1.40
2	D	501	5PA	C5-C4	5.95	1.48	1.40
2	D	501	5PA	C9-C8	3.29	1.55	1.51
2	B	501	5PA	C9-C8	3.26	1.55	1.51
2	D	501	5PA	C10-C8	3.06	1.54	1.51
2	C	402	5PA	C9-C8	2.42	1.54	1.51
3	A	502	BEN	C1-C	2.31	1.51	1.47
3	D	502	BEN	C1-C	2.18	1.51	1.47
2	B	501	5PA	C10-C8	2.15	1.53	1.51

All (36) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	501	5PA	C10-C8-N	-24.59	93.97	117.30
2	D	501	5PA	C10-C8-N	-20.69	97.67	117.30
2	D	501	5PA	C10-C8-C7	-11.01	94.59	117.11
2	B	501	5PA	C10-C8-C7	-9.26	98.18	117.11
2	B	501	5PA	C9-C8-N	6.66	123.63	117.30
2	A	501	5PA	C9-C8-N	-5.98	111.62	117.30
2	D	501	5PA	C9-C8-N	5.68	122.69	117.30
2	C	402	5PA	C10-C8-N	4.57	121.64	117.30
2	D	501	5PA	O8-C7-C8	3.75	123.02	113.59
2	A	501	5PA	C4A-N-C8	3.63	123.64	116.47
2	C	402	5PA	C4A-N-C8	3.54	123.47	116.47
2	D	501	5PA	O7-C7-C8	-3.52	114.22	122.93

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	501	5PA	C4A-N-C8	3.51	123.41	116.47
2	D	501	5PA	C4A-C4-C3	3.32	124.39	119.98
2	C	402	5PA	C4A-C4-C3	3.14	124.16	119.98
2	A	501	5PA	C10-C8-N	3.10	120.24	117.30
2	A	501	5PA	C4-C3-C2	-2.83	115.63	119.91
2	B	501	5PA	C4A-C4-C3	2.83	123.74	119.98
2	A	501	5PA	O8-C7-C8	2.81	120.65	113.59
2	C	402	5PA	C3-C4-C5	-2.78	116.21	118.73
2	A	501	5PA	C4A-C4-C3	2.73	123.60	119.98
2	D	501	5PA	C4A-N-C8	2.60	121.62	116.47
2	A	501	5PA	C6-N1-C2	2.60	123.92	119.20
2	A	501	5PA	O7-C7-C8	-2.58	116.55	122.93
2	D	501	5PA	C4-C3-C2	-2.41	116.27	119.91
2	D	501	5PA	C6-N1-C2	2.35	123.47	119.20
2	C	402	5PA	C6-C5-C4	2.29	119.79	118.06
2	A	501	5PA	O3P-P-O2P	2.28	116.34	107.80
2	B	501	5PA	C6-N1-C2	2.26	123.29	119.20
2	C	402	5PA	C6-N1-C2	2.22	123.22	119.20
2	B	501	5PA	C4-C3-C2	-2.19	116.60	119.91
2	B	501	5PA	C6-C5-C4	2.13	119.67	118.06
3	A	502	BEN	C1-C-N2	2.12	121.23	118.01
2	C	402	5PA	O3P-P-O2P	2.07	115.57	107.80
2	C	402	5PA	C9-C8-C7	-2.05	112.91	117.11
2	A	501	5PA	C6-C5-C4	2.04	119.60	118.06

There are no chirality outliers.

All (15) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	501	5PA	C5-C4-C4A-N
2	C	402	5PA	C5-C4-C4A-N
2	D	501	5PA	C5-C4-C4A-N
2	D	501	5PA	C3-C4-C4A-N
2	A	501	5PA	C5-C4-C4A-N
2	A	501	5PA	C3-C4-C4A-N
2	D	501	5PA	O7-C7-C8-C10
2	B	501	5PA	C4-C4A-N-C8
2	B	501	5PA	C3-C4-C4A-N
2	C	402	5PA	C3-C4-C4A-N
2	A	501	5PA	O7-C7-C8-C9
2	A	501	5PA	O8-C7-C8-C9
2	B	501	5PA	O7-C7-C8-C10

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Mol	Chain	Res	Type	Atoms
2	D	501	5PA	O8-C7-C8-C9
2	D	501	5PA	O8-C7-C8-C10

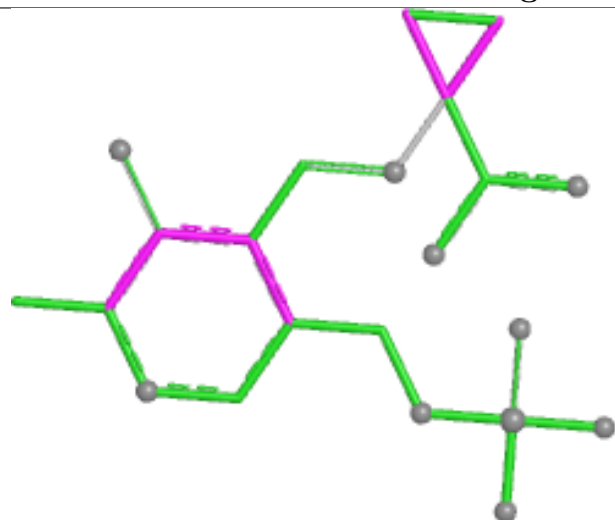
There are no ring outliers.

2 monomers are involved in 2 short contacts:

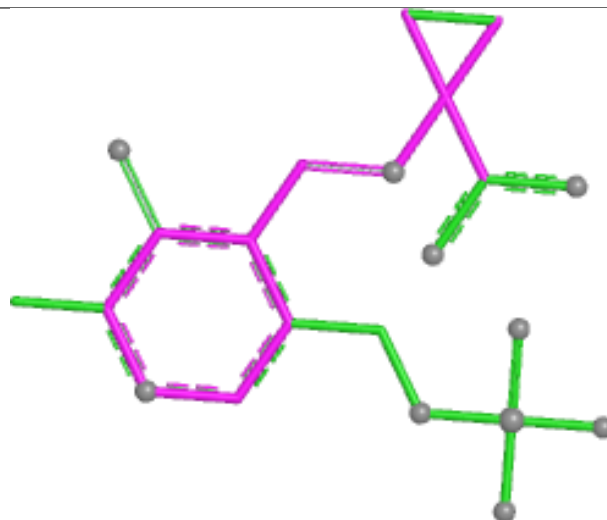
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	402	5PA	1	0
2	D	501	5PA	1	0

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.

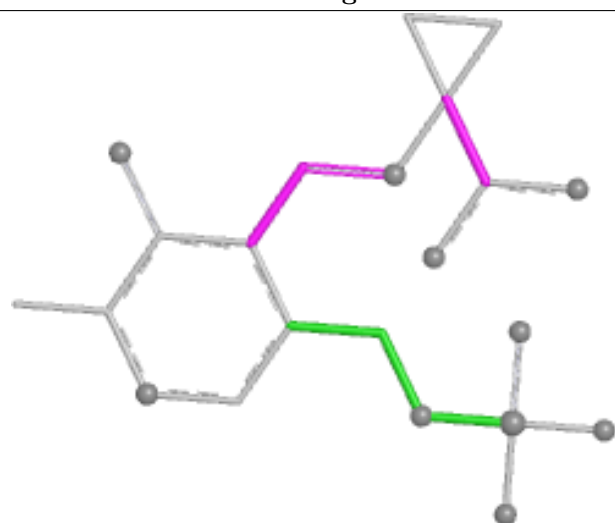
Ligand 5PA B 501



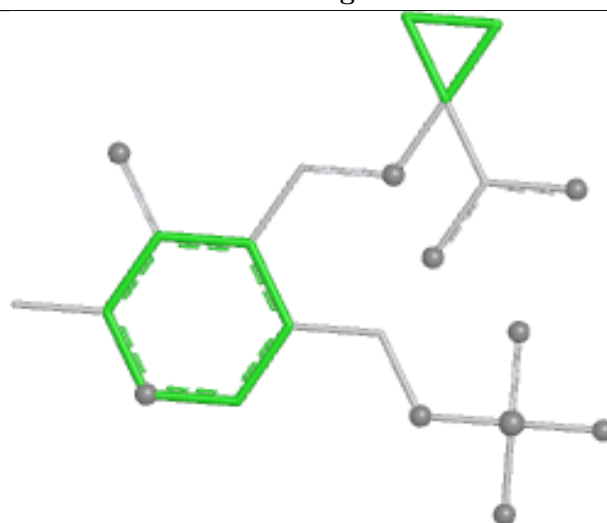
Bond lengths



Bond angles

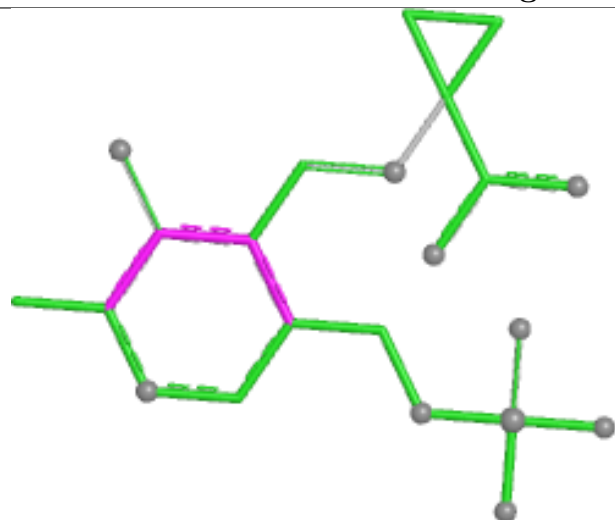


Torsions

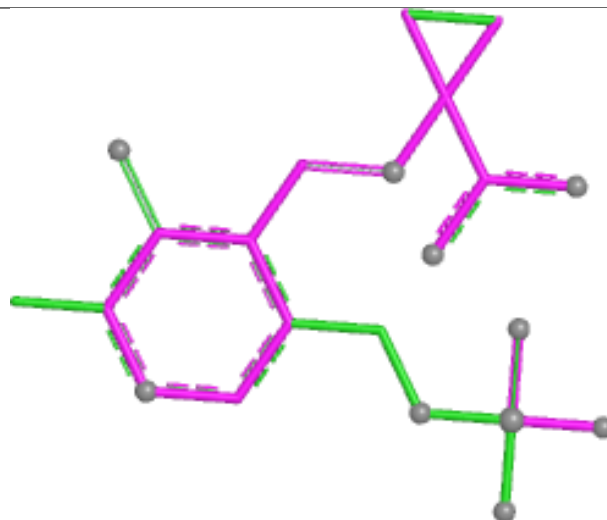


Rings

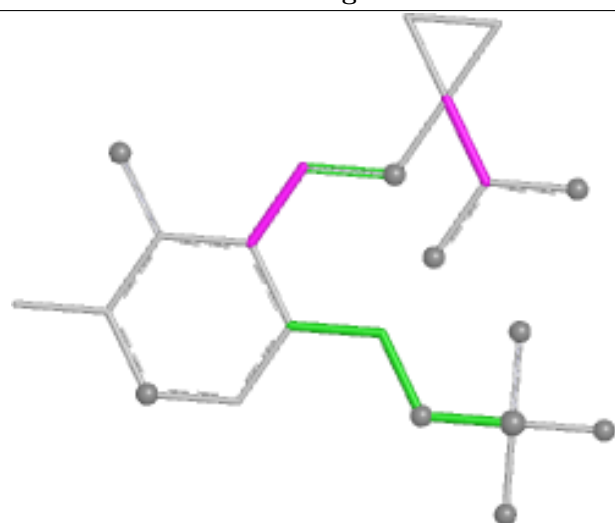
Ligand 5PA A 501



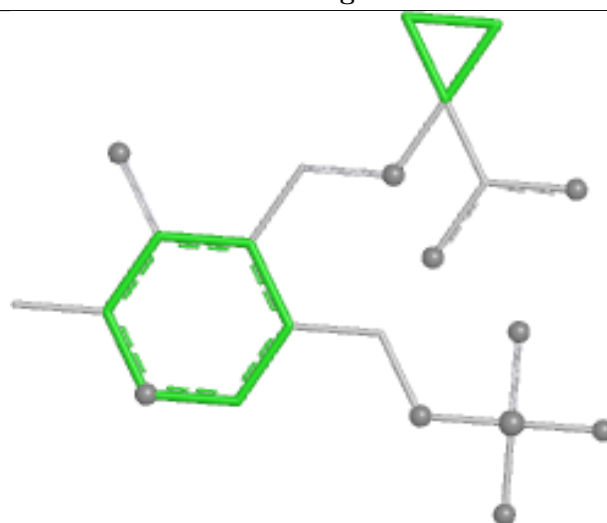
Bond lengths



Bond angles

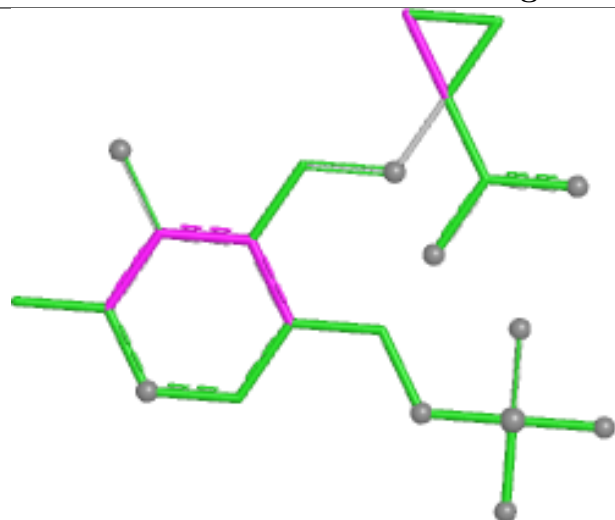


Torsions

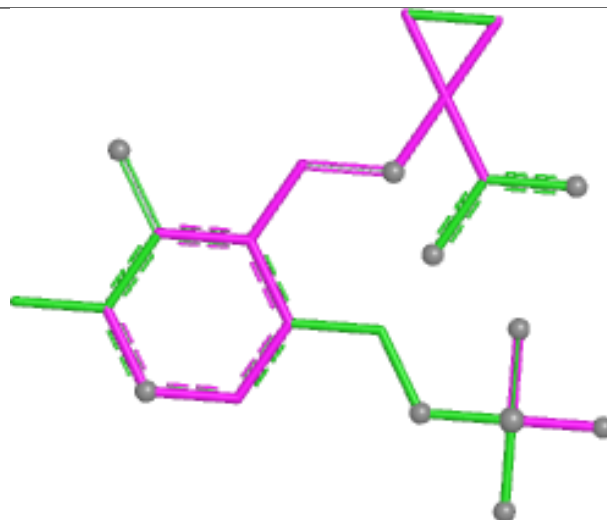


Rings

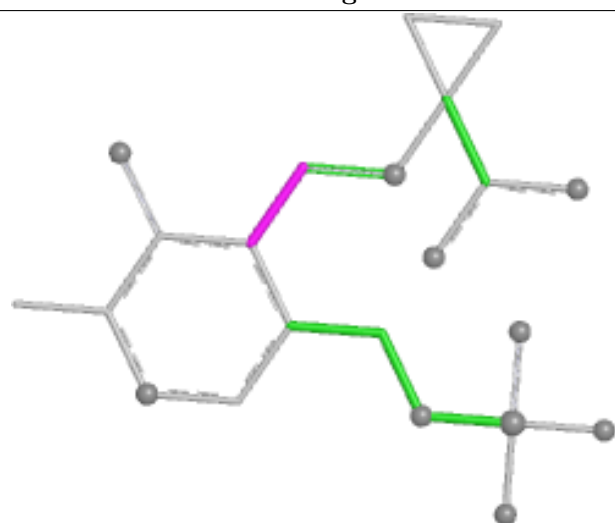
Ligand 5PA C 402



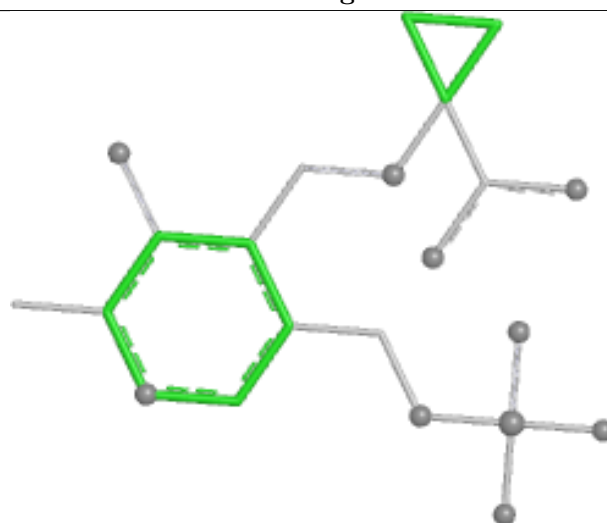
Bond lengths



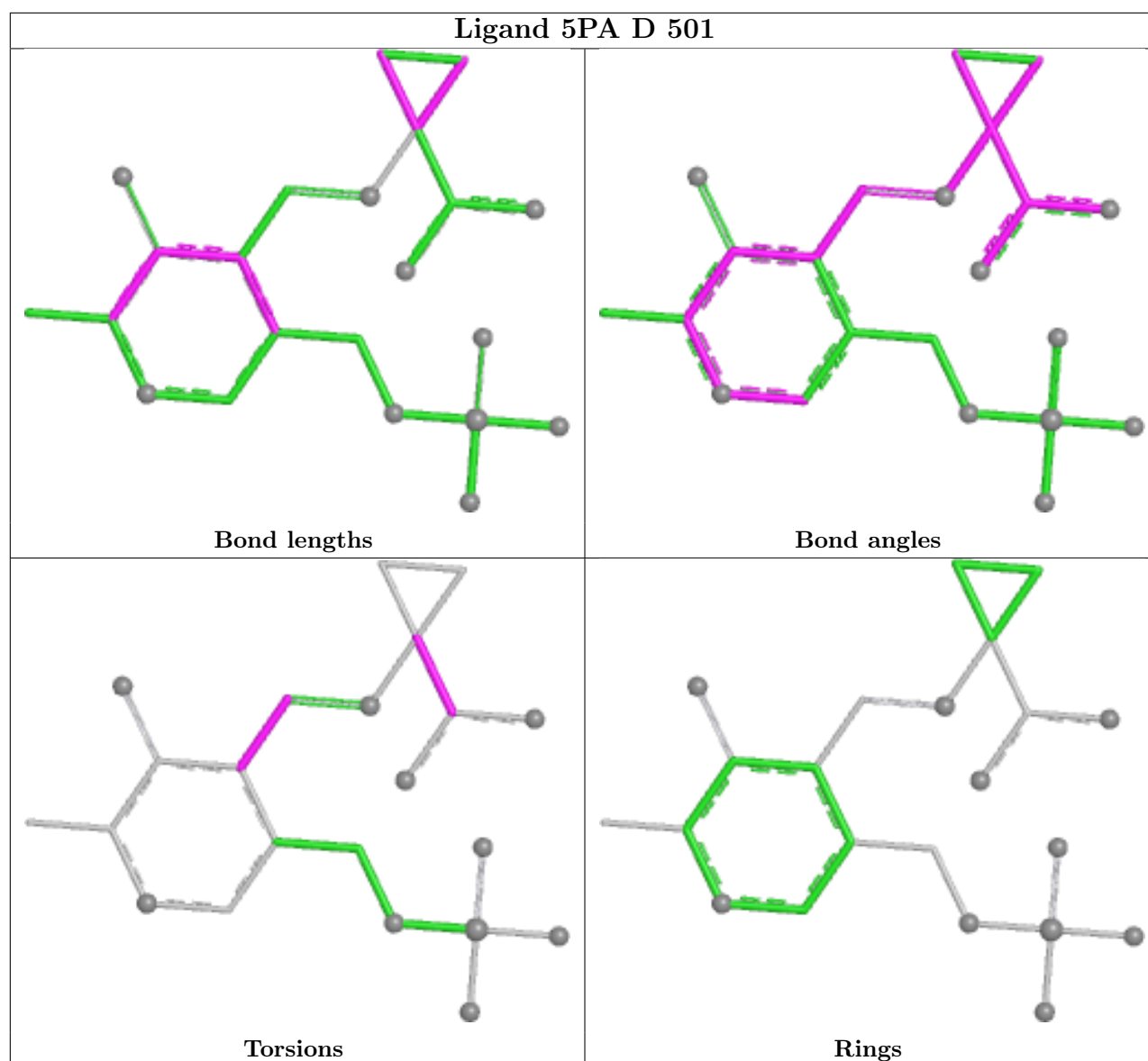
Bond angles



Torsions



Rings



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

6.1 Protein, DNA and RNA chains

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	328/342 (95%)	0.03	3 (0%) 81 83	10, 17, 31, 39	4 (1%)
1	B	322/342 (94%)	0.46	9 (2%) 55 57	10, 25, 38, 52	5 (1%)
1	C	322/342 (94%)	0.44	9 (2%) 55 57	11, 25, 39, 47	3 (0%)
1	D	328/342 (95%)	0.02	6 (1%) 67 70	11, 18, 34, 45	3 (0%)
All	All	1300/1368 (95%)	0.24	27 (2%) 63 66	10, 21, 37, 52	15 (1%)

All (27) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	7	THR	3.9
1	A	1[A]	MET	3.2
1	D	16	GLY	2.9
1	C	14	PHE	2.7
1	D	15	ILE	2.7
1	B	184	VAL	2.7
1	B	244	LEU	2.6
1	B	299	ILE	2.5
1	C	16	GLY	2.5
1	B	245	THR	2.5
1	C	231	VAL	2.4
1	D	183	VAL	2.4
1	C	15	ILE	2.4
1	C	186	LEU	2.4
1	B	182	GLU	2.4
1	B	252	LEU	2.3
1	C	248	ALA	2.3
1	D	185	GLY	2.3
1	B	16	GLY	2.2
1	B	305	ASN	2.2
1	B	304	PHE	2.1

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Mol	Chain	Res	Type	RSRZ
1	D	182	GLU	2.1
1	D	4	HIS	2.1
1	A	328	VAL	2.1
1	A	10	PRO	2.0
1	C	183	VAL	2.0
1	C	305	ASN	2.0

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

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

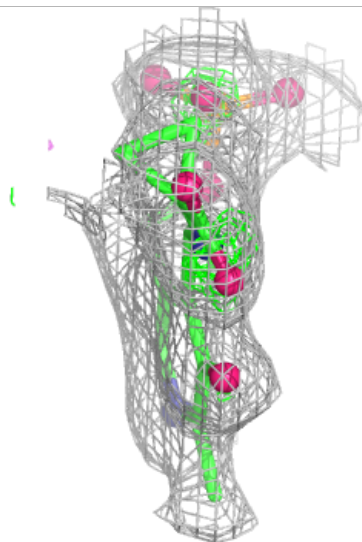
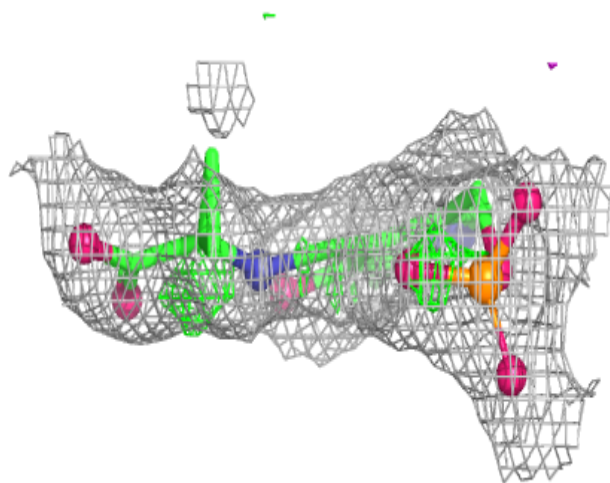
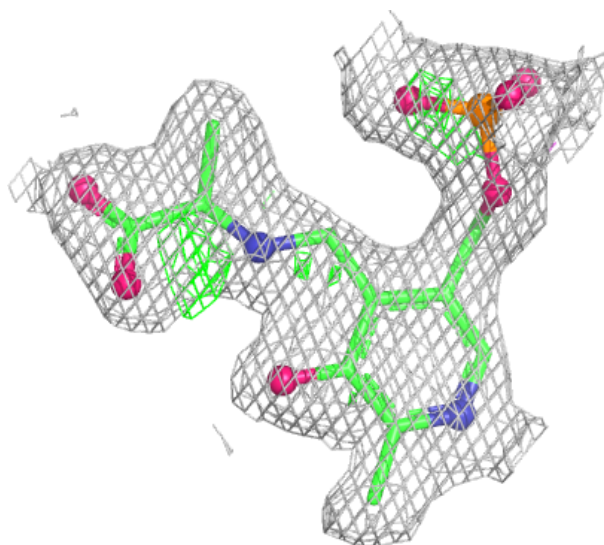
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	BEN	C	401	9/9	0.90	0.12	43,44,44,44	0
2	5PA	C	402	22/22	0.93	0.12	15,15,15,16	22
3	BEN	A	502	9/9	0.94	0.08	12,13,13,13	0
4	SO4	A	503	5/5	0.94	0.13	33,34,35,35	0
2	5PA	B	501	22/22	0.95	0.07	18,20,21,22	0
3	BEN	D	502	9/9	0.96	0.06	12,12,13,13	0
2	5PA	A	501	22/22	0.96	0.07	13,14,16,17	0
4	SO4	D	503	5/5	0.96	0.15	31,32,33,34	0
2	5PA	D	501	22/22	0.97	0.07	12,13,15,16	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.

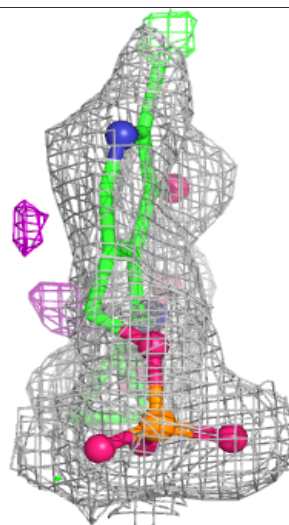
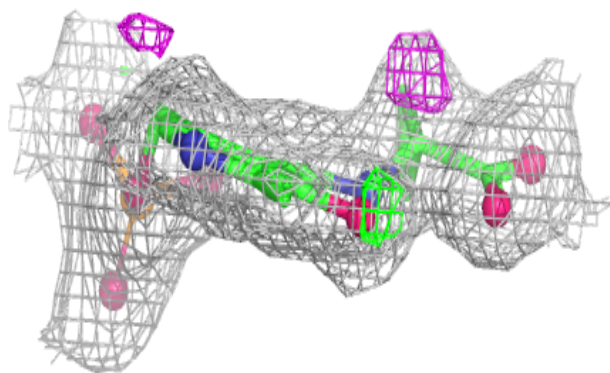
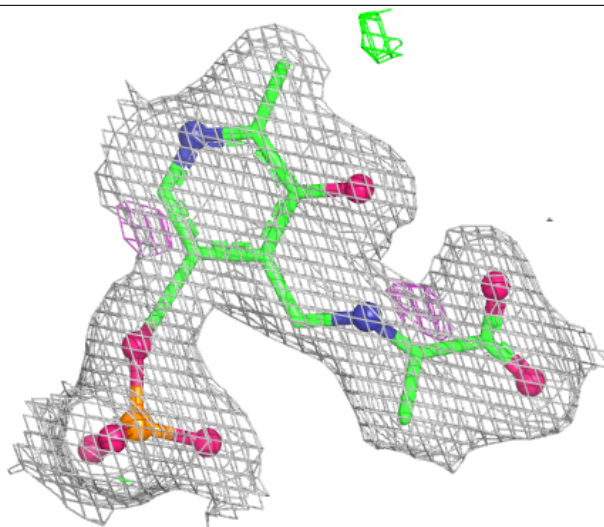
Electron density around 5PA C 402:

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



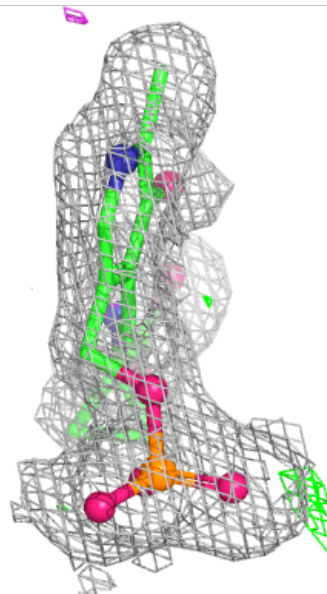
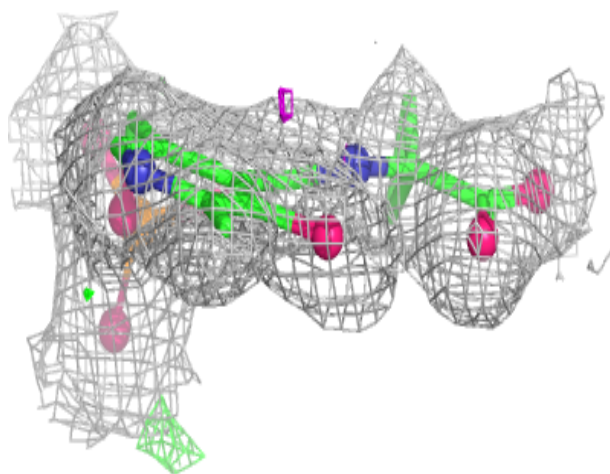
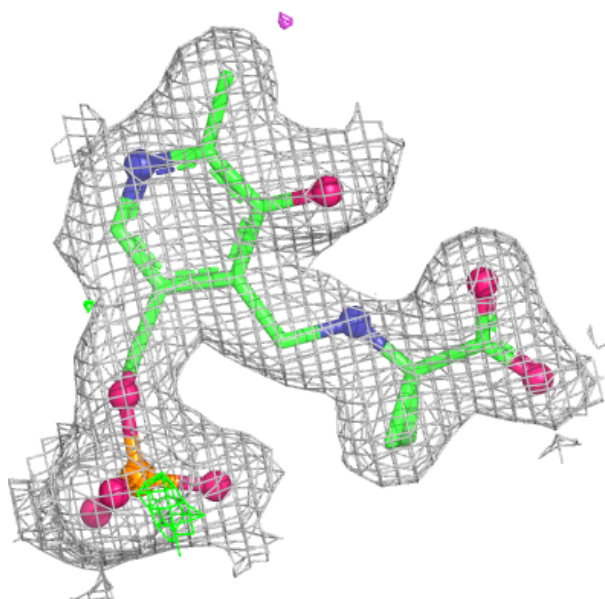
Electron density around 5PA B 501:

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



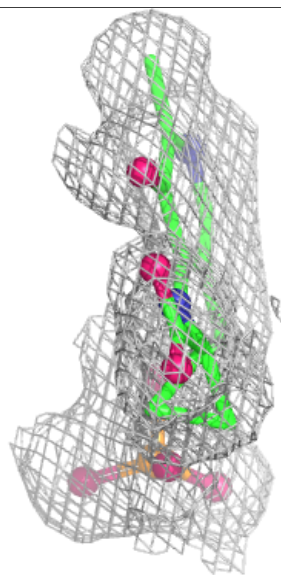
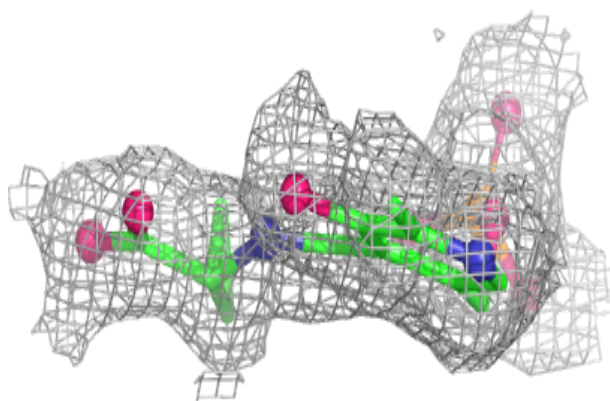
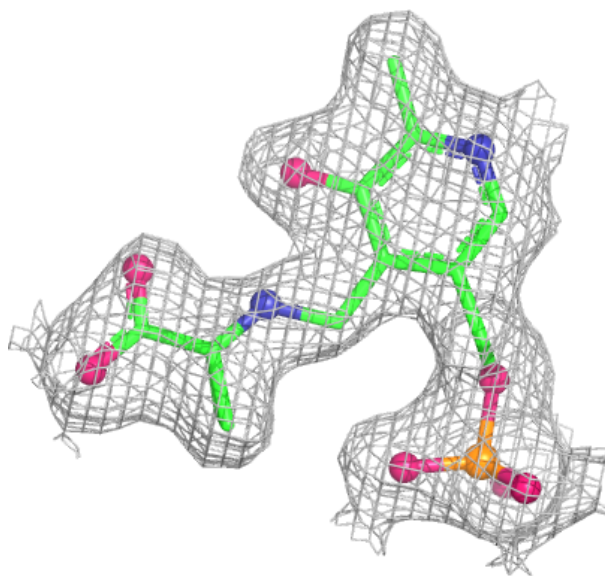
Electron density around 5PA A 501:

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



Electron density around 5PA D 501:

$2mF_o-DF_c$ (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.