



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 02:13 PM UTC

PDB ID : 4OW0 / pdb\_00004ow0  
Title : X-Ray Structural and Biological Evaluation of a Series of Potent and Highly Selective Inhibitors of Human Coronavirus Papain-Like Proteases  
Authors : Baez-Santos, Y.M.; Mesecar, A.  
Deposited on : 2014-01-28  
Resolution : 2.10 Å(reported)

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

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

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

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

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

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

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	NOT EXECUTED
Xtriage (Phenix)	:	2.0
EDS	:	NOT EXECUTED
Buster-report	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

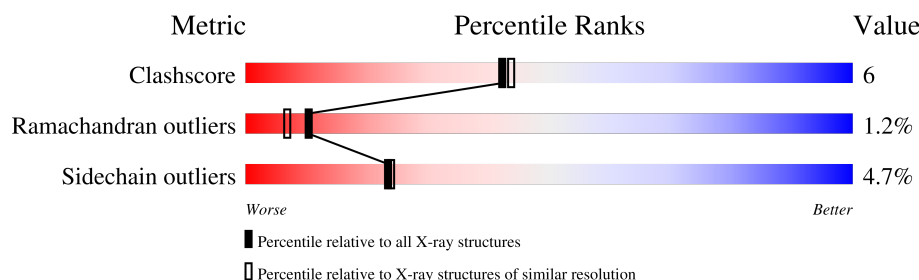
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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))
Clashscore	190562	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (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  $\geq 3$ , 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  $\leq 5\%$ .

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	316	 81% 14% . .
1	B	316	 74% 8% . 18%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	DMS	A	903	-	-	X	-
4	DMS	A	905	-	-	X	-

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 9187 atoms, of which 4414 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 papain-like protease.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	312	Total	C	H	N	O	S	0	0	0
			4853	1559	2393	409	475	17			
1	B	260	Total	C	H	N	O	S	0	0	0
			4046	1299	1995	341	396	15			

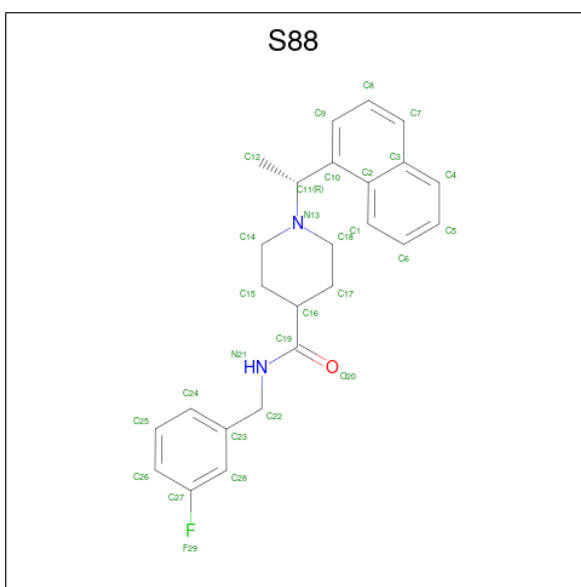
There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	initiating methionine	UNP P0C6U8
B	1	MET	-	initiating methionine	UNP P0C6U8

- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Zn	0	0
			1	1		
2	B	1	Total	Zn	0	0
			1	1		

- Molecule 3 is N-[(3-fluorophenyl)methyl]-1-[(1R)-1-naphthalen-1-ylethyl]piperidine-4-carboxamide (CCD ID: S88) (formula: C<sub>25</sub>H<sub>27</sub>FN<sub>2</sub>O).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	F	N	O	0	0
			29	25	1	2	1		
3	B	1	Total	C	F	N	O	0	0
			29	25	1	2	1		

- Molecule 4 is DIMETHYL SULFOXIDE (CCD ID: DMS) (formula:  $C_2H_6OS$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	H	O	S	0	0
			10	2	6	1	1		
4	A	1	Total	C	H	O	S	0	0
			10	2	6	1	1		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	B	1	Total	C	H	O	S	0	0
			10	2	6	1	1		

- Molecule 5 is GLYCEROL (CCD ID: GOL) (formula:  $C_3H_8O_3$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	H	O	0	0
			14	3	8	3		

- Molecule 6 is water.


Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	85	Total	O	0	0
			85	85		
6	B	99	Total	O	0	0
			99	99		

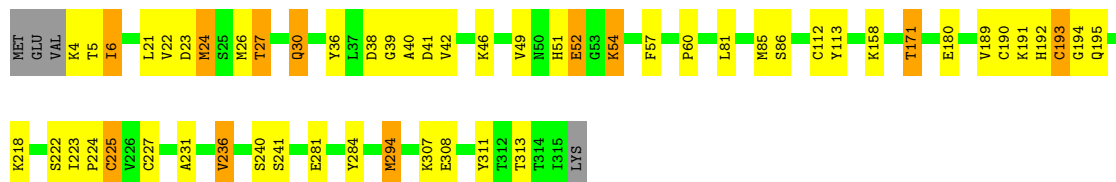
### 3 Residue-property plots [i](#)

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. 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. 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.

Note EDS was not executed.

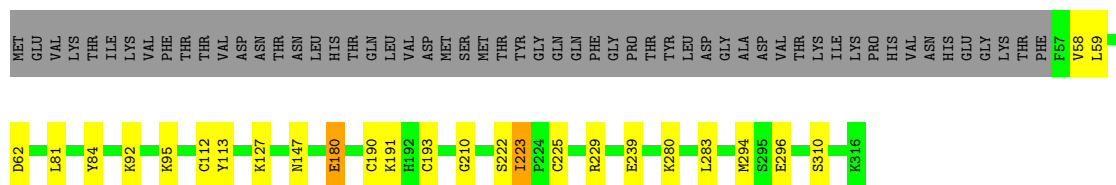
- Molecule 1: papain-like protease

Chain A:  81% 14% . .



- Molecule 1: papain-like protease

Chain B:  74% 8% . 18%



## 4 Data and refinement statistics

EDS was not executed - this section is therefore incomplete.

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	119.42Å 74.39Å 98.33Å 90.00° 104.11° 90.00°	Depositor
Resolution (Å)	31.79 – 2.10	Depositor
% Data completeness (in resolution range)	85.8 (31.79-2.10)	Depositor
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.50 (at 2.10Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8_1069)	Depositor
R, $R_{free}$	0.176 , 0.204	Depositor
Wilson B-factor (Å <sup>2</sup> )	25.2	Xtriage
Anisotropy	0.257	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	9187	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	42.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.98% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: S88, GOL, OCS, ZN, DMS

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	0.73	0/2505	0.79	1/3398 (0.0%)
1	B	0.78	0/2086	0.83	0/2826
All	All	0.75	0/4591	0.81	1/6224 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	225	CYS	N-CA-C	5.37	117.25	110.33

There are no chirality outliers.

There are no planarity outliers.

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

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2460	2393	2398	39	0
1	B	2051	1995	2001	14	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	29	0	27	4	0
3	B	29	0	27	0	0
4	A	8	12	12	11	0
4	B	4	6	6	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	6	8	8	0	0
6	A	85	0	0	2	0
6	B	99	0	0	4	0
All	All	4773	4414	4479	57	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 6.

All (57) 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:4:LYS:N	1:A:24:MET:SD	2.29	1.05
1:A:192:HIS:NE2	6:A:1001:HOH:O	2.07	0.87
3:A:902:S88:O20	4:A:903:DMS:H22	1.88	0.73
1:A:241:SER:H	4:A:905:DMS:H23	1.53	0.71
1:A:171:THR:HG21	6:B:1089:HOH:O	1.95	0.66
1:A:192:HIS:O	1:A:194:GLY:N	2.30	0.65
1:A:40:ALA:O	1:A:42:VAL:N	2.34	0.61
1:A:240:SER:HA	4:A:905:DMS:C2	2.33	0.58
1:A:6:ILE:HG23	1:A:22:VAL:HG23	1.85	0.58
3:A:902:S88:H6	4:A:903:DMS:C2	2.33	0.57
1:A:294:MET:N	1:A:294:MET:HE2	2.19	0.56
1:A:240:SER:HB2	4:A:905:DMS:H22	1.86	0.56
1:A:241:SER:N	4:A:905:DMS:H23	2.21	0.56
1:A:307:LYS:HD3	1:A:308:GLU:N	2.21	0.56
1:A:218:LYS:HE2	1:A:311:TYR:CE1	2.41	0.55
1:B:84:TYR:OH	1:B:147:ASN:OD1	2.25	0.54
1:A:192:HIS:CD2	6:A:1001:HOH:O	2.54	0.54
1:B:239:GLU:OE2	1:B:310:SER:OG	2.25	0.54
3:A:902:S88:H6	4:A:903:DMS:H22	1.90	0.52
1:A:4:LYS:HD2	1:A:4:LYS:C	2.34	0.52
1:A:27:THR:HG22	1:A:30:GLN:OE1	2.11	0.51
1:A:225:CYS:SG	1:A:231:ALA:HB2	2.52	0.50
1:A:36:TYR:CE2	1:A:85:MET:HG3	2.46	0.50
1:B:280:LYS:HD2	6:B:1015:HOH:O	2.11	0.49
1:B:225:CYS:HB2	1:B:229:ARG:O	2.13	0.49
1:B:294:MET:HG3	1:B:296:GLU:O	2.13	0.48
1:B:190:CYS:SG	1:B:193:CYS:HB2	2.53	0.48
1:A:192:HIS:O	1:A:193:CYS:C	2.56	0.48
1:A:190:CYS:CB	1:A:193:CYS:HB3	2.45	0.47
1:B:62:ASP:OD1	1:B:62:ASP:C	2.58	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:283:LEU:HB2	1:B:294:MET:O	2.15	0.47
1:B:180:GLU:H	1:B:180:GLU:CD	2.24	0.46
1:A:51:HIS:O	1:A:52:GLU:C	2.59	0.46
1:A:4:LYS:HZ1	1:A:49:VAL:HG22	1.82	0.45
1:B:112:OCS:OD2	1:B:113:TYR:N	2.50	0.45
1:B:222:SER:C	1:B:223:ILE:HG23	2.42	0.44
1:A:218:LYS:HE2	1:A:311:TYR:CD1	2.53	0.44
1:A:240:SER:CA	4:A:905:DMS:C2	2.96	0.44
1:A:57:PHE:CD2	1:A:85:MET:HE3	2.52	0.44
1:B:280:LYS:CD	6:B:1015:HOH:O	2.65	0.44
1:A:4:LYS:NZ	1:A:49:VAL:HG22	2.31	0.44
1:A:281:GLU:OE2	1:A:284:TYR:OH	2.30	0.44
1:A:40:ALA:O	1:A:42:VAL:HG13	2.18	0.43
1:A:54:LYS:HA	1:A:54:LYS:HD2	1.84	0.43
4:B:903:DMS:H21	6:B:1022:HOH:O	2.18	0.43
1:A:158:LYS:NZ	4:A:903:DMS:H21	2.33	0.43
1:A:38:ASP:O	1:A:39:GLY:C	2.61	0.43
3:A:902:S88:H1	1:B:210:GLY:HA2	1.99	0.43
1:A:240:SER:CB	4:A:905:DMS:H22	2.49	0.43
1:A:241:SER:H	4:A:905:DMS:C2	2.28	0.42
1:B:95:LYS:N	1:B:95:LYS:HD2	2.34	0.42
1:A:23:ASP:O	1:A:24:MET:C	2.62	0.42
1:A:112:OCS:OD2	1:A:113:TYR:N	2.53	0.42
1:A:193:CYS:HB2	1:A:227:CYS:SG	2.60	0.42
1:A:189:VAL:HG22	1:A:195:GLN:OE1	2.21	0.40
1:A:236:VAL:HA	1:A:313:THR:HB	2.03	0.40
1:A:27:THR:HA	1:A:46:LYS:HA	2.03	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	309/316 (98%)	284 (92%)	19 (6%)	6 (2%)	6	3
1	B	257/316 (81%)	248 (96%)	8 (3%)	1 (0%)	30	28
All	All	566/632 (90%)	532 (94%)	27 (5%)	7 (1%)	10	7

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	24	MET
1	A	41	ASP
1	A	193	CYS
1	A	27	THR
1	B	191	LYS
1	A	60	PRO
1	A	224	PRO

### 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	268/272 (98%)	252 (94%)	16 (6%)	17	15
1	B	221/272 (81%)	214 (97%)	7 (3%)	34	38
All	All	489/544 (90%)	466 (95%)	23 (5%)	23	24

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	5	THR
1	A	6	ILE
1	A	21	LEU
1	A	26	MET
1	A	30	GLN
1	A	52	GLU
1	A	54	LYS
1	A	81	LEU
1	A	86	SER

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Mol	Chain	Res	Type
1	A	171	THR
1	A	180	GLU
1	A	191	LYS
1	A	222	SER
1	A	223	ILE
1	A	236	VAL
1	A	294	MET
1	B	58	VAL
1	B	59	LEU
1	B	81	LEU
1	B	92	LYS
1	B	127	LYS
1	B	180	GLU
1	B	223	ILE

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

Mol	Chain	Res	Type
1	B	90	HIS

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

Mogul was not executed - this section is therefore empty.

## 5.5 Carbohydrates [i](#)

Mogul was not executed - this section is therefore empty.

## 5.6 Ligand geometry [i](#)

Mogul was not executed - this section is therefore empty.

## 5.7 Other polymers [i](#)

Mogul was not executed - this section is therefore empty.

## 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

EDS was not executed - this section is therefore empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

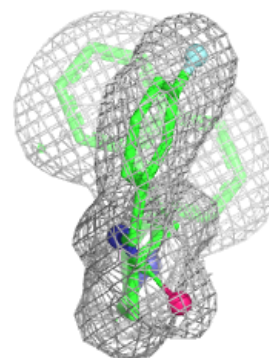
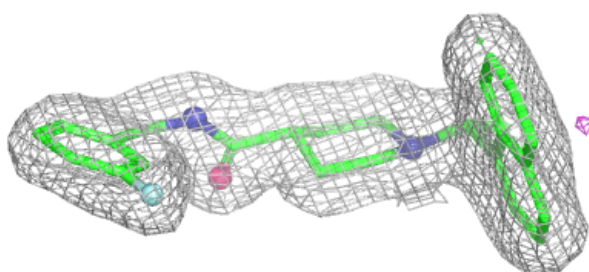
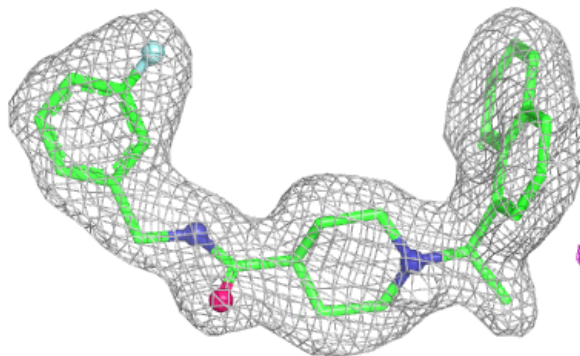
### 6.4 Ligands

EDS was not executed - this section is therefore empty.

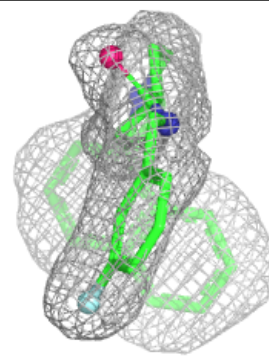
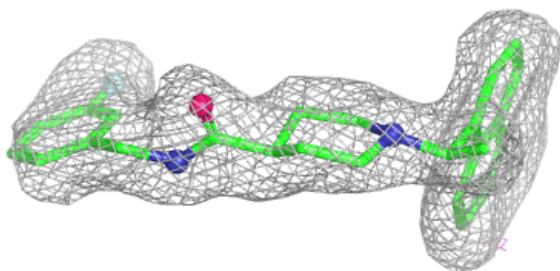
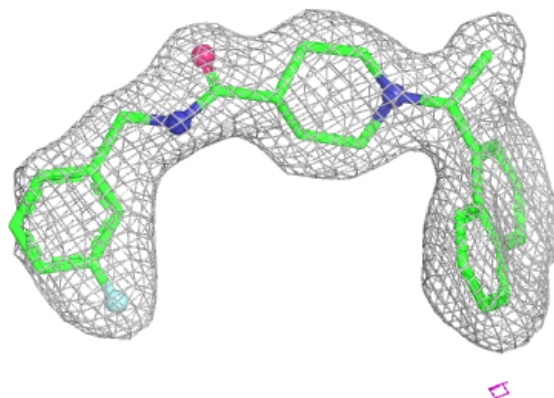
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

**Electron density around S88 A 902:**

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

**Electron density around S88 B 902:**

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



## 6.5 Other polymers

EDS was not executed - this section is therefore empty.