WORLDWIDE wwPDB PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 27, 2024 – 04:08 PM EST

PDB ID	:	9AY9
Title	:	Co-crystal structure of human PRMT9 in complex with MRK-990 inhibitor
Authors	:	Zeng, H.; Dong, A.; Li, Y.; Hutchinson, A.; Seitova, A.; Li, Y.; Gao, Y.D.; Schneider, S.; Siliphaivanh, P.; Sloman, D.; Nicholson, B.; Fischer, C.; Hicks, J.; Brown, P.J.; Arrowsmith, C.H.; Edwards, A.M.; Halabelian, L.; Structural Genomics Consortium (SGC)
Deposited on	:	2024-03-07
Resolution	:	2.22 Å(reported)

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

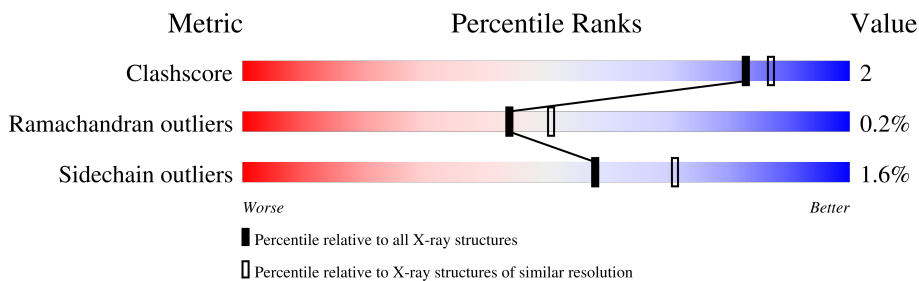|		
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.21
EDS	:	FAILED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.40

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 2.22 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	Percentile Ranks	Value
Clashscore		2
Ramachandran outliers		0.2%
Sidechain outliers		1.6%

Worse   *Better*

∎ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	180529	8096 (2.24-2.20)
Ramachandran outliers	177936	8010 (2.24-2.20)
Sidechain outliers	177891	8011 (2.24-2.20)

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 <=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.

Note EDS failed to run properly.

Mol	Chain	Length	Quality of chain
1	A	720	80% 6% 14%
1	B	720	81% 5% 14%
1	C	720	80% 6% 14%
1	D	720	80% 6% 14%

2 Entry composition ⓘ

There are 4 unique types of molecules in this entry. The entry contains 19473 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 Protein arginine N-methyltransferase 9.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	616	Total	C	N	O	S	0	4	0
			4718	3044	775	870	29			
1	B	621	Total	C	N	O	S	0	3	0
			4767	3074	782	880	31			
1	C	617	Total	C	N	O	S	0	3	1
			4640	2981	755	874	30			
1	D	618	Total	C	N	O	S	0	3	1
			4600	2953	761	857	29			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	126	GLY	-	expression tag	UNP Q6P2P2
B	126	GLY	-	expression tag	UNP Q6P2P2
C	126	GLY	-	expression tag	UNP Q6P2P2
D	126	GLY	-	expression tag	UNP Q6P2P2

- Molecule 2 is 7-[5-S-(4-{[(2-tert-butylpyridin-3-yl)methyl]amino}butyl)-5-thio-beta-D-ribofuranosyl]-5-methyl-7H-pyrrolo[2,3-d]pyrimidin-4-amine (three-letter code: A1AHM) (formula: $C_{26}H_{38}N_6O_3S$) (labeled as "Ligand of Interest" by depositor).
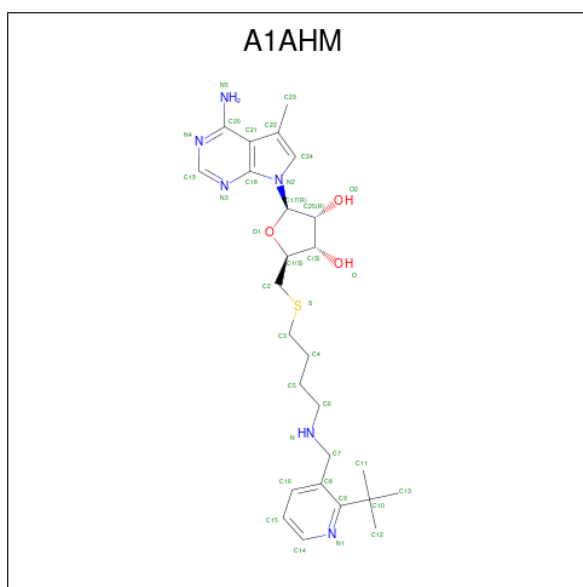
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	S	0	0
			36	26	6	3	1		
2	B	1	Total	C	N	O	S	0	0
			36	26	6	3	1		
2	C	1	Total	C	N	O	S	0	0
			36	26	6	3	1		
2	D	1	Total	C	N	O	S	0	0
			36	26	6	3	1		

- Molecule 3 is UNKNOWN ATOM OR ION (three-letter code: UNX) (formula: X).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	C	1	Total	X	0	0
			1	1		
3	D	1	Total	X	0	0
			1	1		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	176	Total	O	0	3
			179	179		
4	B	165	Total	O	0	1
			166	166		
4	C	137	Total	O	0	0
			137	137		

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| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	D	120	Total 120	O 120	0	0

3 Residue-property plots ⓘ

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

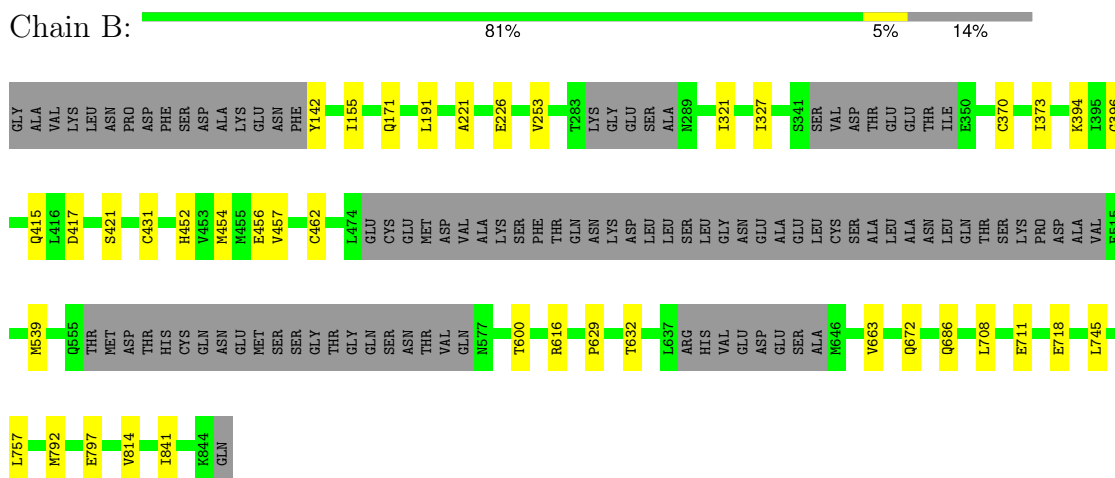Note EDS failed to run properly.

- Molecule 1: Protein arginine N-methyltransferase 9
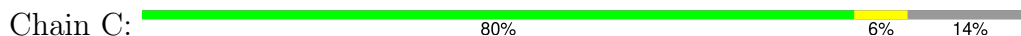
Chain A:
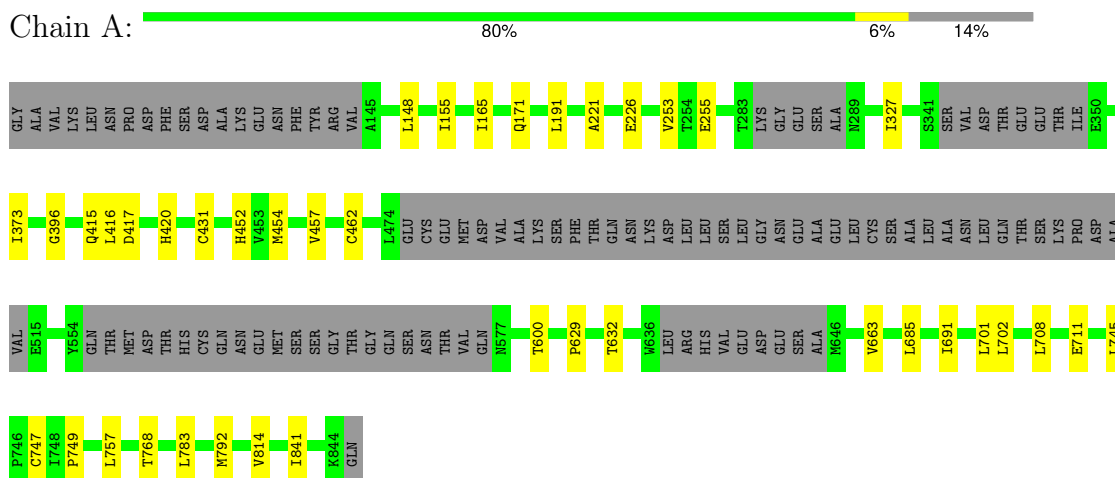
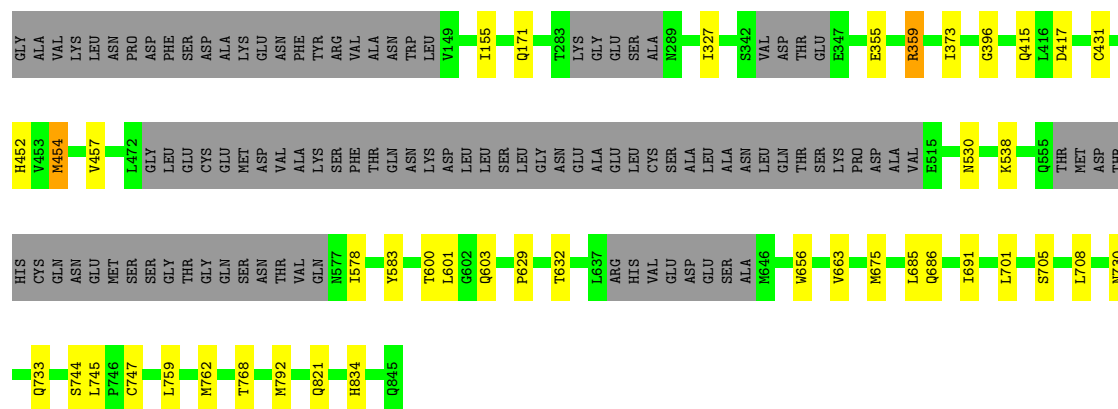- Molecule 1: Protein arginine N-methyltransferase 9

Chain B:
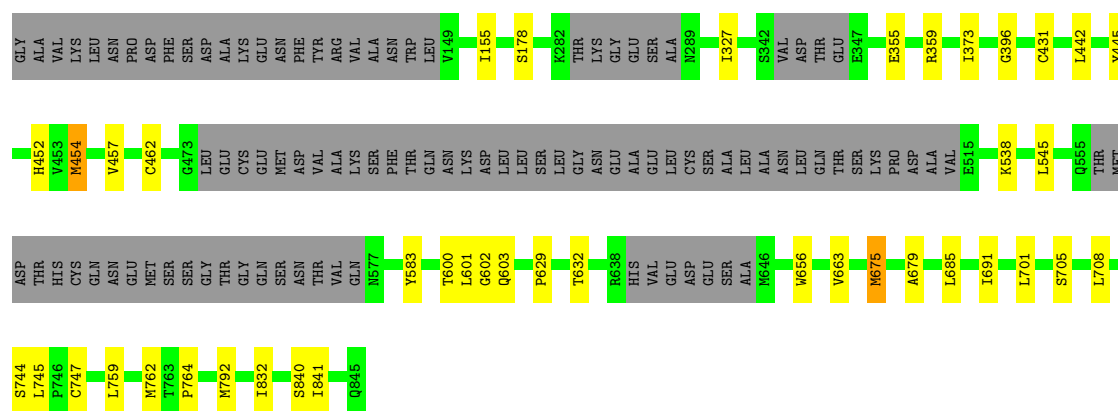

- Molecule 1: Protein arginine N-methyltransferase 9

Chain C:

• Molecule 1: Protein arginine N-methyltransferase 9

Chain D:

80%   6%   14%

4   Data and refinement statistics   ⓘ

EDS failed to run properly - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	84.37Å 223.08Å 84.70Å 90.00° 90.23° 90.00°	Depositor
Resolution (Å)	46.58 – 2.22	Depositor
% Data completeness (in resolution range)	97.4 (46.58-2.22)	Depositor
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.42 (at 2.20Å)	Xtriage
Refinement program	BUSTER 2.10.3	Depositor
R, R_{free}	0.208 , 0.235	Depositor
Wilson B-factor (Å^2)	41.1	Xtriage
Anisotropy	0.255	Xtriage
L-test for twinning[2]	$< |L| > = 0.43, < L^2 > = 0.25$	Xtriage
Estimated twinning fraction	0.418 for l,k,-h 0.239 for h,-k,-l 0.240 for l,-k,h	Xtriage
Total number of atoms	19473	wwPDB-VP
Average B, all atoms (Å^2)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.21% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: A1AHM, UNX

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	0.52	0/4818	0.66	0/6564
1	B	0.51	0/4867	0.66	0/6628
1	C	0.50	0/4737	0.65	0/6461
1	D	0.50	0/4695	0.66	0/6412
All	All	0.51	0/19117	0.66	0/26065

There are no bond length outliers.

There are no bond angle outliers.

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	4718	0	4579	24	0
1	B	4767	0	4629	18	0
1	C	4640	0	4357	22	0
1	D	4600	0	4291	20	0
2	A	36	0	0	0	0
2	B	36	0	0	1	0
2	C	36	0	0	1	0
2	D	36	0	0	0	0
3	C	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	D	1	0	0	0	0
4	A	179	0	0	1	0
4	B	166	0	0	0	0
4	C	137	0	0	1	0
4	D	120	0	0	0	0
All	All	19473	0	17856	84	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 2.

The worst 5 of 84 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:452:HIS:HB3	1:A:454:MET:HE3	1.64	0.79
1:C:452:HIS:HB3	1:C:454:MET:HE3	1.65	0.79
1:B:221:ALA:HA	1:B:226:GLU:HG3	1.65	0.78
1:A:221:ALA:HA	1:A:226:GLU:HG3	1.64	0.77
1:B:452:HIS:HB3	1:B:454:MET:HE3	1.67	0.76

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	608/720 (84%)	592 (97%)	15 (2%)	1 (0%)	44	51
1	B	612/720 (85%)	597 (98%)	14 (2%)	1 (0%)	44	51
1	C	608/720 (84%)	590 (97%)	18 (3%)	0	100	100
1	D	609/720 (85%)	588 (97%)	19 (3%)	2 (0%)	37	41
All	All	2437/2880 (85%)	2367 (97%)	66 (3%)	4 (0%)	44	51

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	178	SER
1	A	462	CYS
1	B	462	CYS
1	D	462	CYS

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	489/636 (77%)	485 (99%)	4 (1%)	79	87
1	B	494/636 (78%)	483 (98%)	11 (2%)	47	59
1	C	462/636 (73%)	452 (98%)	10 (2%)	47	59
1	D	447/636 (70%)	439 (98%)	8 (2%)	54	67
All	All	1892/2544 (74%)	1859 (98%)	33 (2%)	58	69

5 of 33 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	603[B]	GLN
1	D	675	MET
1	D	840	SER
1	B	718	GLU
1	B	686	GLN

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

Mol	Chain	Res	Type
1	C	530	ASN

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)

Of 6 ligands modelled in this entry, 2 are unknown - leaving 4 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	$\#|Z| > 2$
2	A1AHM	B	901	-	35,39,39	0.50	0	40,56,56	0.81	1 (2%)
2	A1AHM	C	901	-	35,39,39	0.48	0	40,56,56	0.83	1 (2%)
2	A1AHM	D	901	-	35,39,39	0.48	0	40,56,56	0.83	1 (2%)
2	A1AHM	A	901	-	35,39,39	0.49	0	40,56,56	0.81	1 (2%)

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	A1AHM	B	901	-	-	6/17/37/37	0/4/4/4
2	A1AHM	C	901	-	-	6/17/37/37	0/4/4/4
2	A1AHM	D	901	-	-	6/17/37/37	0/4/4/4
2	A1AHM	A	901	-	-	6/17/37/37	0/4/4/4

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	D	901	A1AHM	C22-C24-N2	2.85	111.00	107.49
2	C	901	A1AHM	C22-C24-N2	2.78	110.92	107.49
2	B	901	A1AHM	C22-C24-N2	2.77	110.90	107.49
2	A	901	A1AHM	C22-C24-N2	2.75	110.88	107.49

There are no chirality outliers.
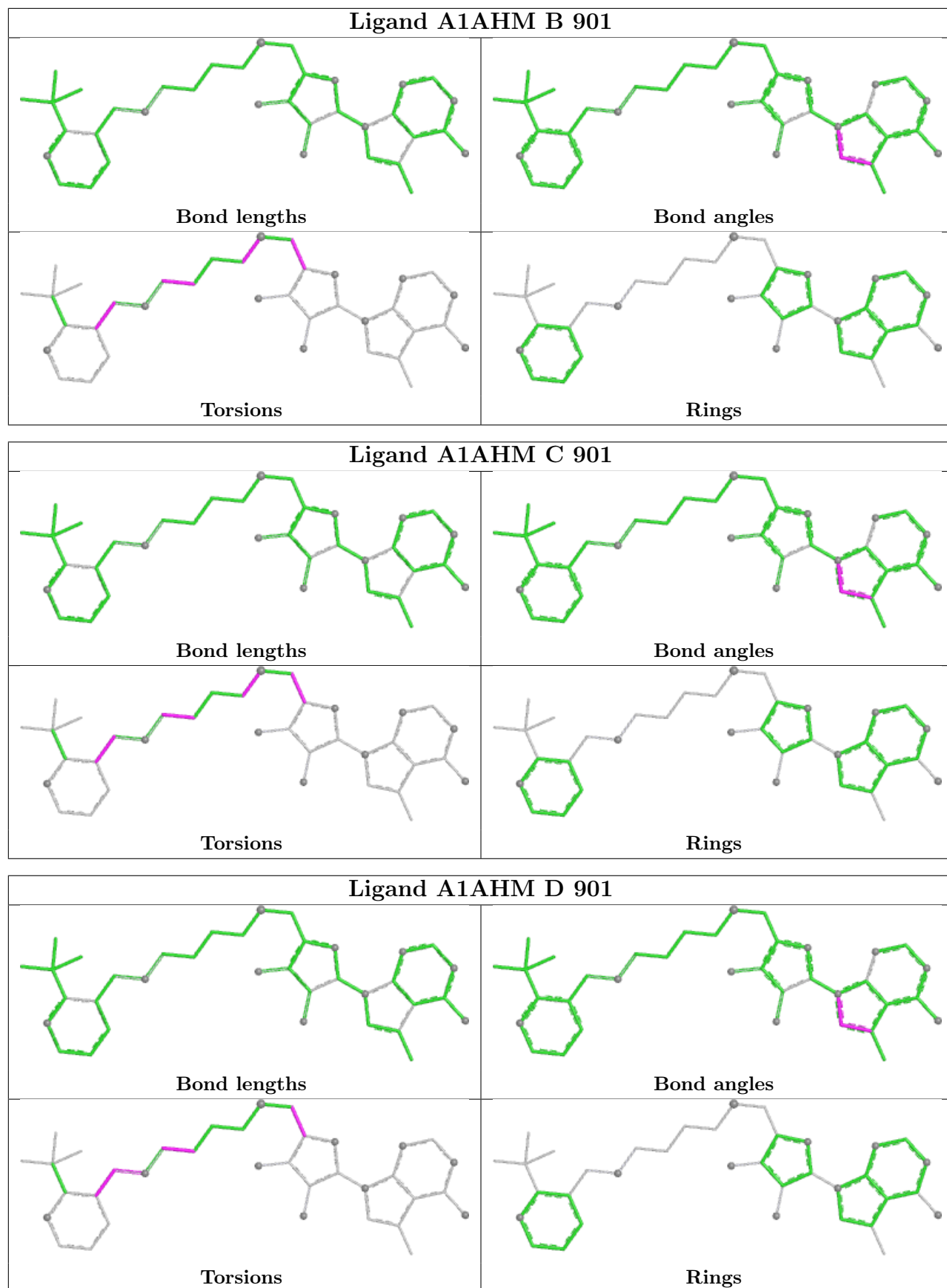
5 of 24 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	901	A1AHM	N-C7-C8-C9
2	A	901	A1AHM	C-C1-C2-S
2	A	901	A1AHM	O1-C1-C2-S
2	B	901	A1AHM	N-C7-C8-C9
2	B	901	A1AHM	C-C1-C2-S

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	901	A1AHM	1	0
2	C	901	A1AHM	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 then 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 A1AHM B 901

Bond lengths

Bond angles

Torsions

Rings

Ligand A1AHM C 901

Bond lengths

Bond angles

Torsions

Rings

Ligand A1AHM D 901

Bond lengths

Bond angles

Torsions

Rings

Ligand A1AHM A 901	
Bond lengths	Bond angles
Torsions	Rings
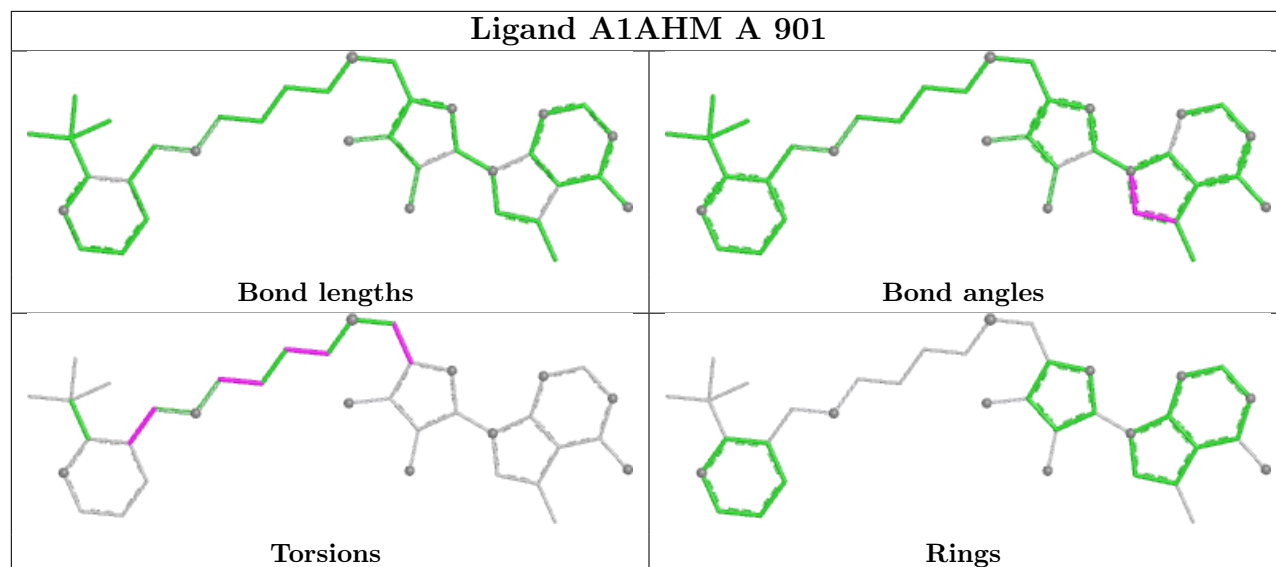
5.7 Other polymers ⓘ

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 ⓘ

6.1 Protein, DNA and RNA chains ⓘ

EDS failed to run properly - this section is therefore empty.

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

EDS failed to run properly - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS failed to run properly - this section is therefore empty.

6.4 Ligands ⓘ

EDS failed to run properly - 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.
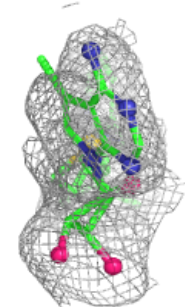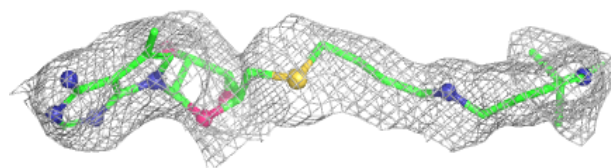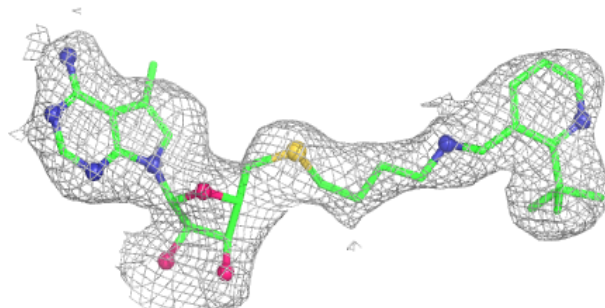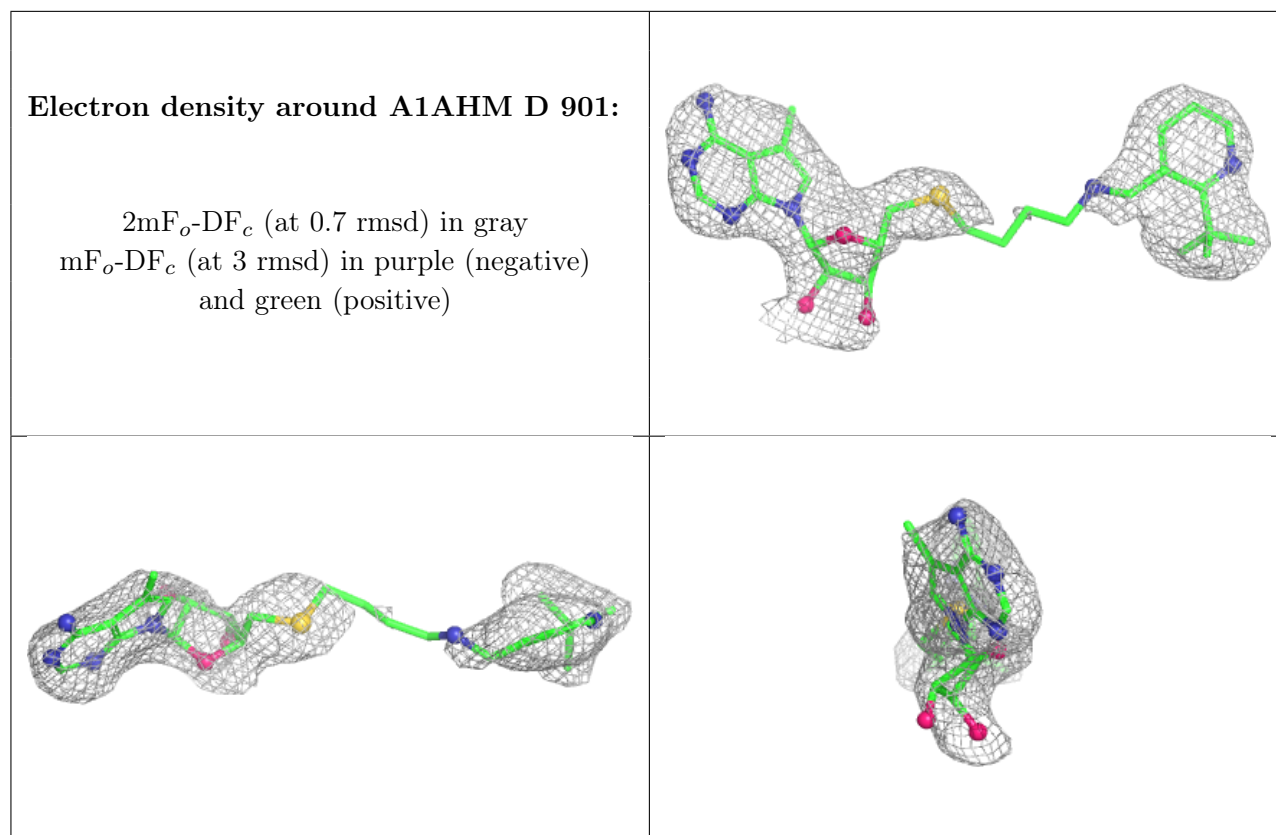
Electron density around A1AHM A 901:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative) and green (positive)
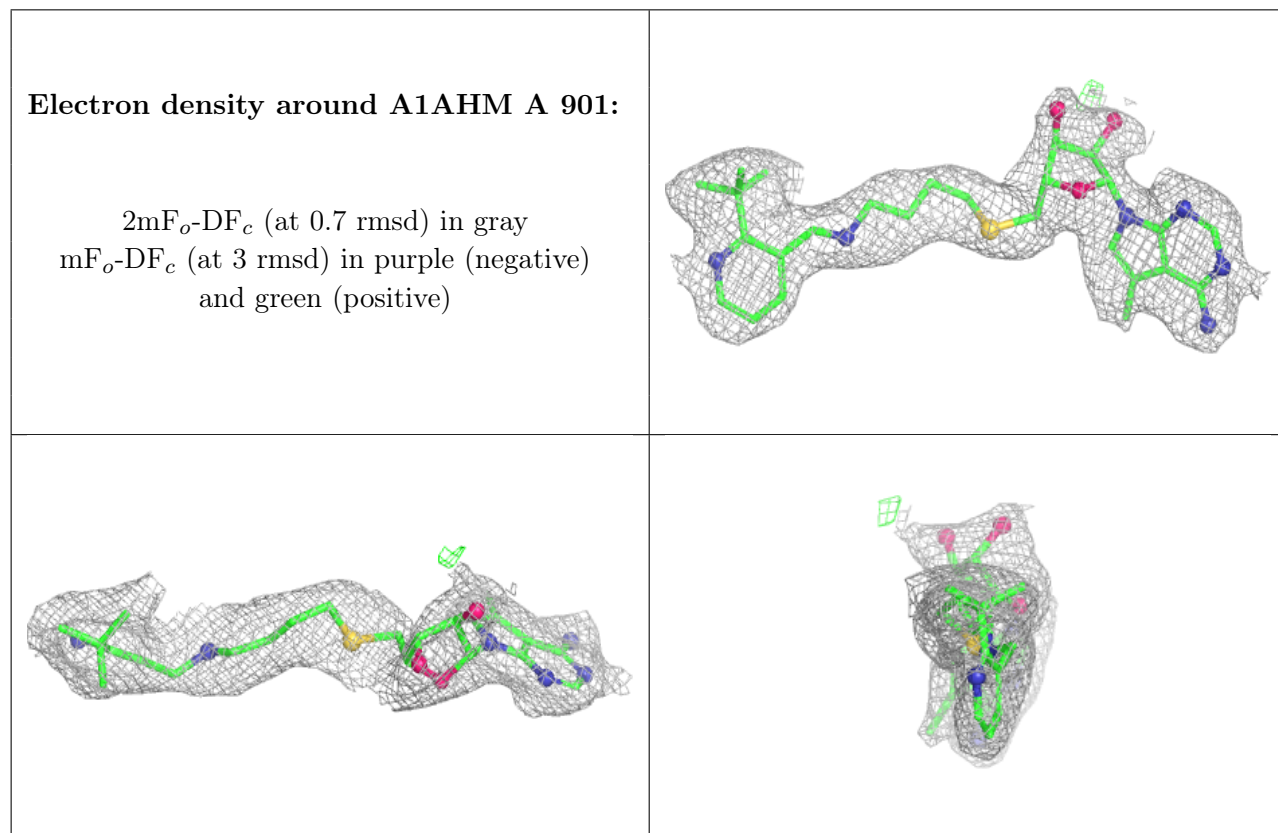
Electron density around A1AHM B 901:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)
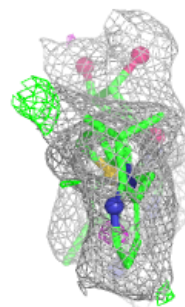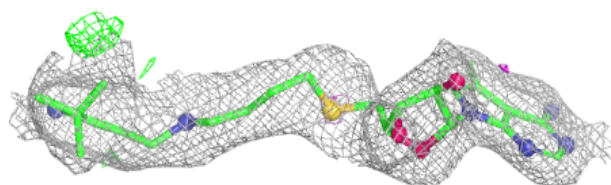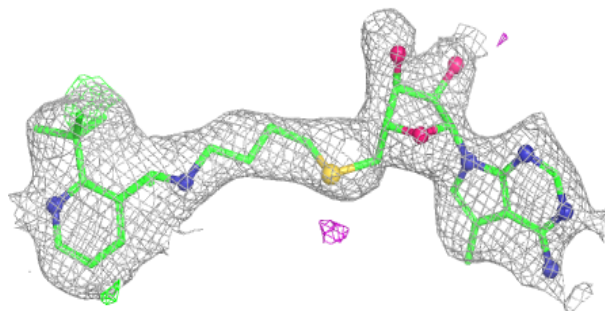
Electron density around A1AHM C 901:

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 A1AHM D 901:

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

6.5 Other polymers ⓘ

EDS failed to run properly - this section is therefore empty.