



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:14 PM UTC

PDB ID : 8P5K / pdb_00008p5k
Title : Kinase domain of mutant human ULK1 in complex with compound MRT68921
Authors : Battista, T.; Semrau, M.S.; Heroux, A.; Lolli, G.; Storici, P.
Deposited on : 2023-05-24
Resolution : 2.21 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

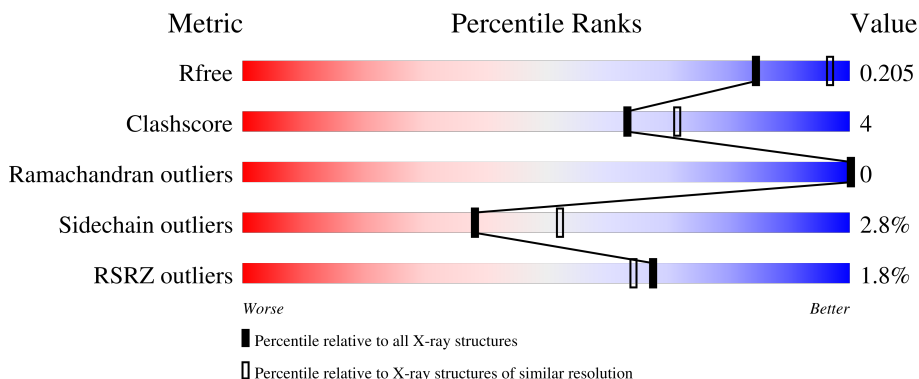
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.21 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	6164 (2.20-2.20)
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (2.20-2.20)

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 $\leq 5\%$. 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	284	2% 86% 9% 5%
1	B	284	0% 88% 7% ...
1	C	284	2% 82% 11% 6%
1	D	284	0% 85% 10% ...

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 18727 atoms, of which 9161 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.

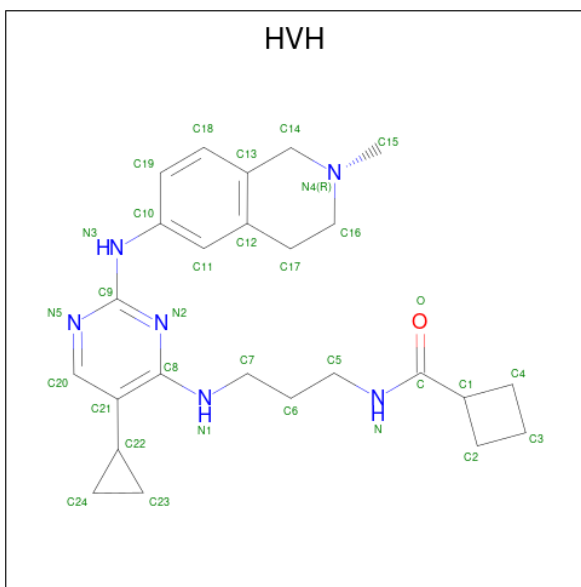
- Molecule 1 is a protein called Serine/threonine-protein kinase ULK1.

Mol	Chain	Residues	Atoms								ZeroOcc	AltConf	Trace
1	A	269	Total	C	H	N	O	P	S				
			4432	1404	2242	380	389	1	16	62	8	0	
1	B	273	Total	C	H	N	O	P	S				
			4470	1413	2264	385	391	1	16	60	6	0	
1	C	268	Total	C	H	N	O	P	S				
			4409	1397	2229	377	389	1	16	64	8	0	
1	D	273	Total	C	H	N	O	P	S				
			4475	1413	2266	388	391	1	16	60	6	0	

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	SER	-	expression tag	UNP O75385
A	245	ALA	ARG	engineered mutation	UNP O75385
A	246	ALA	GLU	engineered mutation	UNP O75385
B	0	SER	-	expression tag	UNP O75385
B	245	ALA	ARG	engineered mutation	UNP O75385
B	246	ALA	GLU	engineered mutation	UNP O75385
C	0	SER	-	expression tag	UNP O75385
C	245	ALA	ARG	engineered mutation	UNP O75385
C	246	ALA	GLU	engineered mutation	UNP O75385
D	0	SER	-	expression tag	UNP O75385
D	245	ALA	ARG	engineered mutation	UNP O75385
D	246	ALA	GLU	engineered mutation	UNP O75385

- Molecule 2 is {N}-[3-[[5-cyclopropyl-2-[(2-methyl-3,4-dihydro-1 {H}-isoquinolin-6-yl) amino]pyrimidin-4-yl]amino]propyl]cyclobutanecarboxamide (CCD ID: HVH) (formula: C₂₅H₃₄N₆O) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	H	N	O	0	0
			66	25	34	6	1		
2	B	1	Total	C	H	N	O	0	0
			66	25	34	6	1		
2	C	1	Total	C	H	N	O	0	0
			66	25	34	6	1		
2	D	1	Total	C	H	N	O	0	0
			66	25	34	6	1		

- Molecule 3 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).

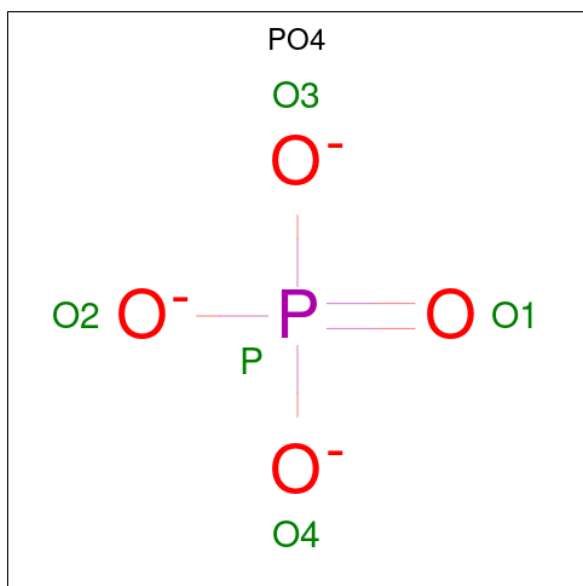


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	H	O	2	0
			14	3	8	3		
3	B	1	Total	C	H	O	2	0
			14	3	8	3		
3	C	1	Total	C	H	O	2	0
			14	3	8	3		

- Molecule 4 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total	Mg	0	0
			2	2		
4	B	2	Total	Mg	0	0
			2	2		
4	C	2	Total	Mg	0	0
			2	2		
4	D	2	Total	Mg	0	0
			2	2		

- Molecule 5 is PHOSPHATE ION (CCD ID: PO4) (formula: O₄P).



Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	O P	0	0
			5	4 1		
5	C	1	Total	O P	0	0
			5	4 1		

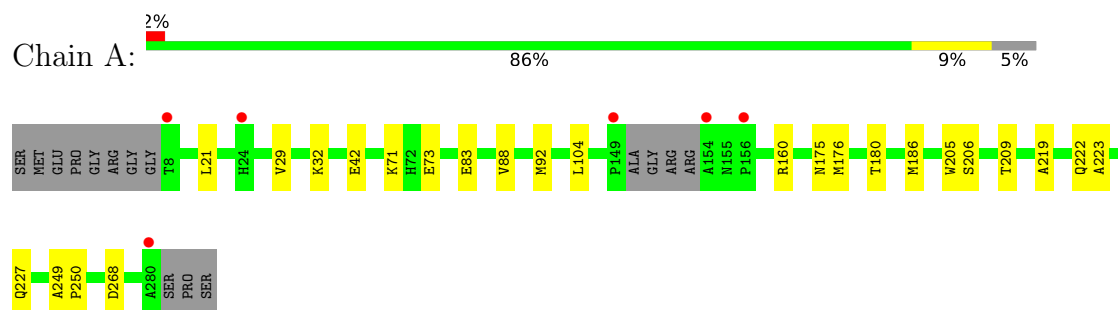
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	148	Total 148	O 148	0	0
6	B	155	Total 155	O 155	0	0
6	C	147	Total 147	O 147	0	0
6	D	167	Total 167	O 167	0	0

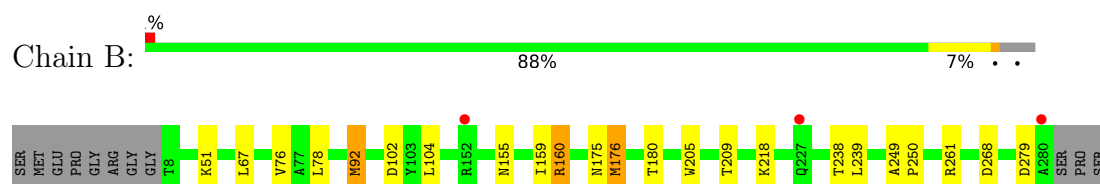
3 Residue-property plots [i](#)

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.

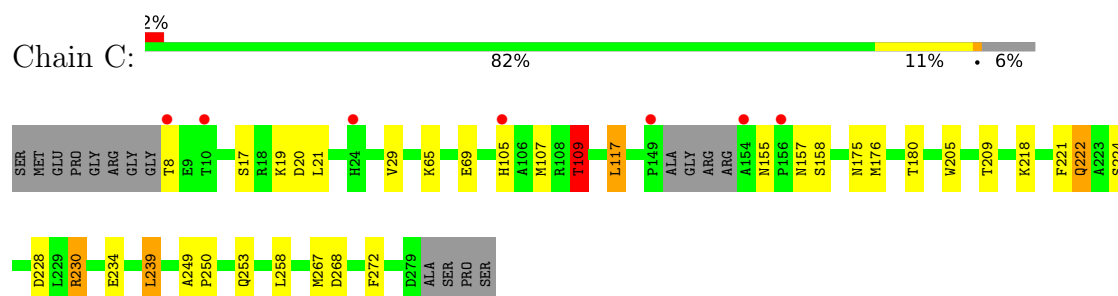
- Molecule 1: Serine/threonine-protein kinase ULK1



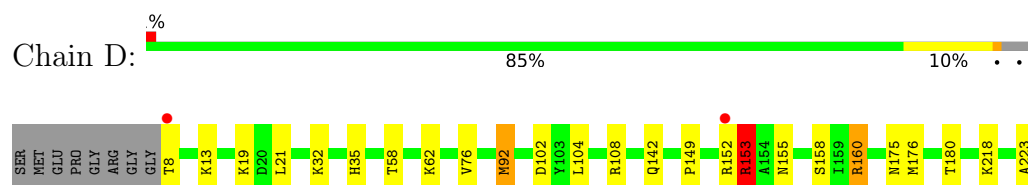
- Molecule 1: Serine/threonine-protein kinase ULK1

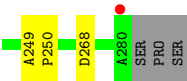


- Molecule 1: Serine/threonine-protein kinase ULK1



- Molecule 1: Serine/threonine-protein kinase ULK1





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	85.26Å 109.94Å 96.22Å 90.00° 93.78° 90.00°	Depositor
Resolution (Å)	85.08 – 2.21 85.08 – 2.21	Depositor EDS
% Data completeness (in resolution range)	99.6 (85.08-2.21) 99.7 (85.08-2.21)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.36 (at 2.20Å)	Xtriage
Refinement program	REFMAC 5.8.0405	Depositor
R, R_{free}	0.177 , 0.204 0.178 , 0.205	Depositor DCC
R_{free} test set	4466 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å ²)	37.2	Xtriage
Anisotropy	0.072	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 36.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	18727	wwPDB-VP
Average B, all atoms (Å ²)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.73% 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: MG, PO4, TPO, GOL, HVH

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	0.61	0/2248	0.92	0/3027
1	B	0.61	0/2258	0.93	1/3042 (0.0%)
1	C	0.61	0/2238	0.95	2/3013 (0.1%)
1	D	0.60	0/2261	0.95	3/3043 (0.1%)
All	All	0.61	0/9005	0.94	6/12125 (0.0%)

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	B	0	2
1	C	0	1
1	D	0	3
All	All	0	6

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	228	ASP	CA-CB-CG	6.79	119.39	112.60
1	C	109	THR	CA-CB-OG1	-5.78	100.93	109.60
1	D	155	ASN	CB-CA-C	5.65	117.57	109.26
1	B	155	ASN	CB-CA-C	5.56	117.44	109.26
1	C	8	THR	CA-CB-OG1	-5.02	102.06	109.60
1	D	92	MET	CA-CB-CG	-5.01	104.08	114.10

There are no chirality outliers.

All (6) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	160	ARG	Sidechain
1	B	279	ASP	Peptide
1	C	230	ARG	Sidechain
1	D	108	ARG	Sidechain
1	D	152	ARG	Sidechain
1	D	153	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	2190	2242	2236	17	0
1	B	2206	2264	2258	12	0
1	C	2180	2229	2223	27	0
1	D	2209	2266	2260	15	0
2	A	32	34	0	1	0
2	B	32	34	0	1	0
2	C	32	34	0	0	0
2	D	32	34	0	2	0
3	A	6	8	8	2	0
3	B	6	8	8	0	0
3	C	6	8	8	0	0
4	A	2	0	0	0	0
4	B	2	0	0	0	0
4	C	2	0	0	0	0
4	D	2	0	0	0	0
5	A	5	0	0	0	0
5	C	5	0	0	0	0
6	A	148	0	0	3	0
6	B	155	0	0	4	0
6	C	147	0	0	10	0
6	D	167	0	0	5	0
All	All	9566	9161	9001	71	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 (71) 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:142:GLN:HG2	6:D:541:HOH:O	1.38	1.20
1:C:258:LEU:CD2	1:C:267:MET:HE2	1.81	1.10
1:C:258:LEU:HD21	1:C:267:MET:HE2	1.41	0.98
1:C:230:ARG:NH1	1:C:234:GLU:OE2	1.97	0.96
1:C:258:LEU:HD21	1:C:267:MET:CE	1.98	0.94
1:C:222:GLN:HG3	6:C:518:HOH:O	1.69	0.92
1:D:102:ASP:OD2	6:D:401:HOH:O	1.92	0.85
1:A:268:ASP:HB2	6:A:504:HOH:O	1.81	0.81
1:D:268:ASP:HB2	6:D:491:HOH:O	1.82	0.80
1:B:268:ASP:HB2	6:B:489:HOH:O	1.84	0.77
1:A:175:ASN:O	1:A:176[B]:MET:HE2	1.90	0.71
1:C:268:ASP:HB2	6:C:515:HOH:O	1.90	0.71
1:C:267:MET:HE3	1:C:272:PHE:HB2	1.73	0.69
1:C:17:SER:OG	1:C:19:LYS:HG2	1.93	0.69
1:D:13:LYS:HE2	1:D:35:HIS:HE2	1.59	0.67
1:B:175:ASN:O	1:B:176[B]:MET:HE2	1.94	0.67
1:C:65:LYS:HE3	6:C:409:HOH:O	1.96	0.65
1:C:175:ASN:O	1:C:176[B]:MET:HE2	1.95	0.65
1:C:253[A]:GLN:HG2	6:C:482:HOH:O	1.97	0.64
1:C:224[B]:SER:OG	1:C:228:ASP:OD2	2.14	0.64
1:A:32:LYS:NZ	1:A:42:GLU:OE2	2.37	0.57
1:C:205:TRP:O	1:C:209[B]:THR:HG22	2.04	0.57
1:B:176[A]:MET:HE2	6:B:499:HOH:O	2.04	0.57
1:C:107:MET:HE2	6:C:462:HOH:O	2.05	0.56
1:C:258:LEU:CG	1:C:267:MET:HE2	2.36	0.56
1:D:223:ALA:HB1	1:D:228:ASP:HB3	1.89	0.55
1:C:258:LEU:HD23	1:C:267:MET:HE2	1.81	0.55
1:D:92:MET:HE3	2:D:301:HVH:C23	2.38	0.54
1:A:219:ALA:HB3	1:A:222:GLN:HG3	1.89	0.54
1:A:73:GLU:OE2	1:A:160:ARG:NH2	2.41	0.54
1:B:78:LEU:HD12	1:B:92:MET:HE3	1.89	0.53
1:D:21:LEU:C	1:D:21:LEU:HD13	2.34	0.53
1:C:69:GLU:OE2	6:C:401:HOH:O	2.18	0.52
1:C:21:LEU:CD1	1:C:29:VAL:HG13	2.40	0.52
1:D:76[A]:VAL:HG11	2:D:301:HVH:C24	2.40	0.51
1:B:102:ASP:OD2	6:B:401:HOH:O	2.19	0.50
1:D:58:THR:HG22	1:D:62:LYS:HE2	1.93	0.50
1:A:21:LEU:CD1	1:A:29:VAL:HG13	2.41	0.50
1:A:186:MET:HB2	3:A:302:GOL:O2	2.13	0.49
1:A:83:GLU:HG3	1:A:88[B]:VAL:CG1	2.42	0.49
1:B:67:LEU:HD13	1:B:92:MET:HE1	1.93	0.49
1:A:223:ALA:H	3:A:302:GOL:H31	1.79	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:78:LEU:HA	1:B:92:MET:CE	2.44	0.47
1:C:253[B]:GLN:HG2	6:C:440:HOH:O	2.14	0.47
1:C:221:PHE:CE1	1:C:239:LEU:HD22	2.50	0.47
1:C:105[B]:HIS:CE1	6:C:417:HOH:O	2.67	0.47
1:B:76:VAL:HG11	2:B:301:HVH:C24	2.46	0.46
1:A:71:LYS:HE2	6:A:533:HOH:O	2.16	0.45
1:D:32:LYS:HE2	6:D:532:HOH:O	2.17	0.44
1:C:117:LEU:HD23	1:C:157:ASN:HA	2.00	0.44
1:C:176[A]:MET:HE2	6:C:476:HOH:O	2.16	0.44
1:C:109:THR:HG23	6:C:435:HOH:O	2.18	0.44
1:B:209[A]:THR:HG21	6:B:471:HOH:O	2.17	0.44
1:C:267:MET:HE3	1:C:272:PHE:CB	2.46	0.43
1:A:92:MET:HE3	2:A:301:HVH:C23	2.48	0.42
1:C:249:ALA:HB3	1:C:250:PRO:HD3	2.01	0.42
1:A:83:GLU:HG3	1:A:88[B]:VAL:HG12	2.00	0.42
1:D:175:ASN:O	1:D:176[B]:MET:HE2	2.19	0.42
1:B:249:ALA:N	1:B:250:PRO:CD	2.83	0.42
1:A:205:TRP:O	1:A:209[A]:THR:HG23	2.20	0.41
1:D:62:LYS:HE3	6:D:432:HOH:O	2.19	0.41
1:A:209[A]:THR:HG21	6:A:454:HOH:O	2.21	0.41
1:A:249:ALA:HB3	1:A:250:PRO:HD3	2.02	0.41
1:B:239:LEU:HD12	1:B:261:ARG:HB2	2.02	0.41
1:C:258:LEU:CD2	1:C:267:MET:CE	2.65	0.41
1:D:149:PRO:O	1:D:153:ARG:HD2	2.21	0.41
1:D:249:ALA:N	1:D:250:PRO:CD	2.84	0.41
1:A:206:SER:O	1:A:209[A]:THR:OG1	2.36	0.40
1:D:160[B]:ARG:HD2	1:D:160[B]:ARG:HA	1.92	0.40
1:A:227:GLN:H	1:A:227:GLN:CD	2.29	0.40
1:B:205:TRP:O	1:B:209[A]:THR:HG23	2.20	0.40

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	272/284 (96%)	261 (96%)	11 (4%)	0	100	100
1	B	276/284 (97%)	265 (96%)	11 (4%)	0	100	100
1	C	271/284 (95%)	262 (97%)	9 (3%)	0	100	100
1	D	276/284 (97%)	264 (96%)	12 (4%)	0	100	100
All	All	1095/1136 (96%)	1052 (96%)	43 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	238/240 (99%)	237 (100%)	1 (0%)	84	92
1	B	238/240 (99%)	229 (96%)	9 (4%)	29	40
1	C	238/240 (99%)	229 (96%)	9 (4%)	29	40
1	D	238/240 (99%)	226 (95%)	12 (5%)	22	28
All	All	952/960 (99%)	921 (97%)	31 (3%)	38	45

All (31) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	104	LEU
1	B	51	LYS
1	B	92	MET
1	B	104	LEU
1	B	159	ILE
1	B	160	ARG
1	B	176[A]	MET
1	B	176[B]	MET
1	B	218	LYS
1	B	238	THR
1	C	20	ASP
1	C	109	THR
1	C	117	LEU

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Mol	Chain	Res	Type
1	C	155	ASN
1	C	158[A]	SER
1	C	158[B]	SER
1	C	218	LYS
1	C	222	GLN
1	C	239	LEU
1	D	8	THR
1	D	19	LYS
1	D	104[A]	LEU
1	D	104[B]	LEU
1	D	153	ARG
1	D	158[A]	SER
1	D	158[B]	SER
1	D	160[A]	ARG
1	D	160[B]	ARG
1	D	218	LYS
1	D	237	LYS
1	D	238	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	130	HIS
1	B	130	HIS
1	B	157	ASN
1	B	173	GLN
1	B	263	HIS
1	C	148	ASN
1	C	222	GLN
1	D	130	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

4 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	TPO	A	180	1	8,10,11	1.19	1 (12%)	10,14,16	1.31	0
1	TPO	D	180	1	8,10,11	1.27	2 (25%)	10,14,16	1.27	2 (20%)
1	TPO	B	180	1	8,10,11	1.05	1 (12%)	10,14,16	1.25	1 (10%)
1	TPO	C	180	1	8,10,11	1.05	0	10,14,16	1.20	1 (10%)

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	TPO	A	180	1	-	0/9/11/13	-
1	TPO	D	180	1	-	1/9/11/13	-
1	TPO	B	180	1	-	1/9/11/13	-
1	TPO	C	180	1	-	0/9/11/13	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	180	TPO	P-OG1	2.27	1.63	1.59
1	B	180	TPO	P-OG1	2.16	1.63	1.59
1	D	180	TPO	P-O2P	-2.12	1.46	1.54
1	A	180	TPO	P-O2P	-2.09	1.47	1.54

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	180	TPO	O3P-P-O2P	2.65	117.73	107.80
1	D	180	TPO	O3P-P-O2P	2.11	115.72	107.80
1	C	180	TPO	O3P-P-O2P	2.06	115.53	107.80
1	D	180	TPO	O3P-P-O1P	2.03	118.75	110.83

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	B	180	TPO	CB-OG1-P-O3P
1	D	180	TPO	CB-OG1-P-O3P

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 17 ligands modelled in this entry, 8 are 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	$\# Z > 2$
2	HVH	A	301	-	36,36,36	0.67	1 (2%)	44,50,50	0.94	3 (6%)
2	HVH	B	301	-	36,36,36	0.56	1 (2%)	44,50,50	1.04	2 (4%)
3	GOL	C	302	-	5,5,5	0.18	0	5,5,5	0.39	0
5	PO4	C	305	-	4,4,4	1.09	0	6,6,6	0.43	0
3	GOL	A	302	-	5,5,5	0.15	0	5,5,5	0.34	0
3	GOL	B	302	-	5,5,5	0.25	0	5,5,5	0.50	0
2	HVH	D	301	-	36,36,36	0.57	0	44,50,50	1.05	2 (4%)
2	HVH	C	301	-	36,36,36	0.56	0	44,50,50	1.07	3 (6%)
5	PO4	A	305	-	4,4,4	0.73	0	6,6,6	0.49	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	HVH	A	301	-	-	2/20/37/37	0/5/5/5

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	HVH	B	301	-	-	0/20/37/37	0/5/5/5
3	GOL	C	302	-	-	2/4/4/4	-
3	GOL	A	302	-	-	2/4/4/4	-
3	GOL	B	302	-	-	0/4/4/4	-
2	HVH	D	301	-	-	0/20/37/37	0/5/5/5
2	HVH	C	301	-	-	0/20/37/37	0/5/5/5

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	301	HVH	C14-N4	2.75	1.51	1.47
2	B	301	HVH	C14-N4	2.19	1.50	1.47

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	301	HVH	C14-N4-C16	4.57	113.56	109.75
2	D	301	HVH	C14-N4-C16	4.14	113.21	109.75
2	A	301	HVH	C14-N4-C16	2.84	112.12	109.75
2	C	301	HVH	C5-N-C	2.65	127.31	122.55
2	C	301	HVH	C17-C16-N4	2.64	113.04	110.61
2	B	301	HVH	C17-C16-N4	2.60	113.01	110.61
2	D	301	HVH	N5-C9-N2	-2.58	123.92	126.42
2	C	301	HVH	C14-N4-C16	2.55	111.88	109.75
2	A	301	HVH	N5-C9-N2	-2.36	124.14	126.42
2	A	301	HVH	C21-C20-N5	-2.06	121.92	124.42

There are no chirality outliers.

All (6) torsion outliers are listed below:

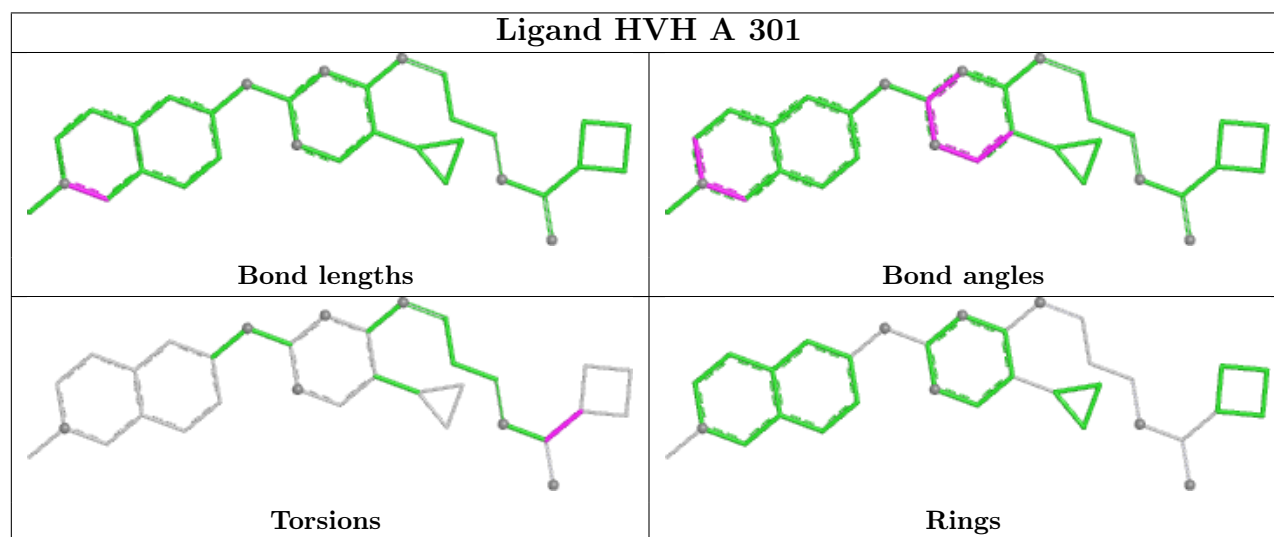
Mol	Chain	Res	Type	Atoms
3	A	302	GOL	O1-C1-C2-C3
3	C	302	GOL	C1-C2-C3-O3
3	A	302	GOL	O1-C1-C2-O2
3	C	302	GOL	O2-C2-C3-O3
2	A	301	HVH	O-C-C1-C2
2	A	301	HVH	N-C-C1-C2

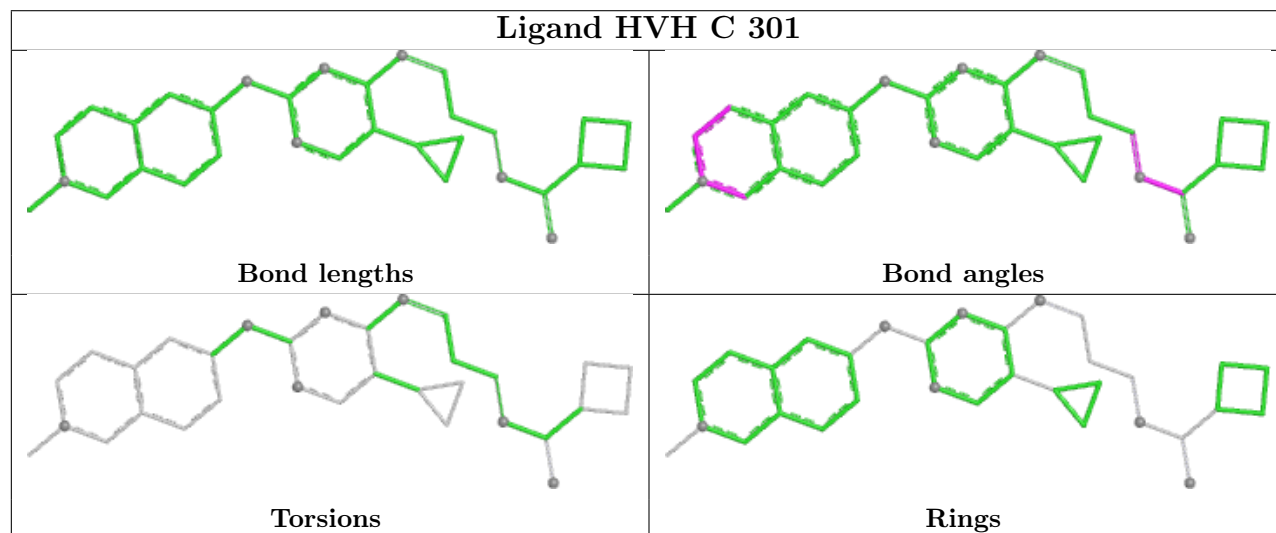
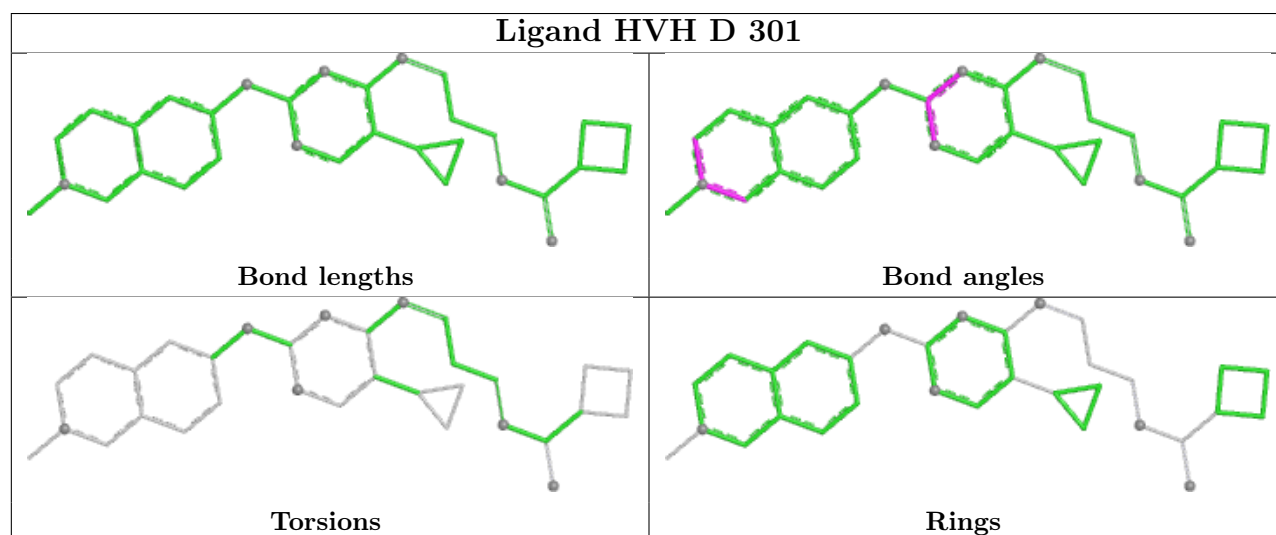
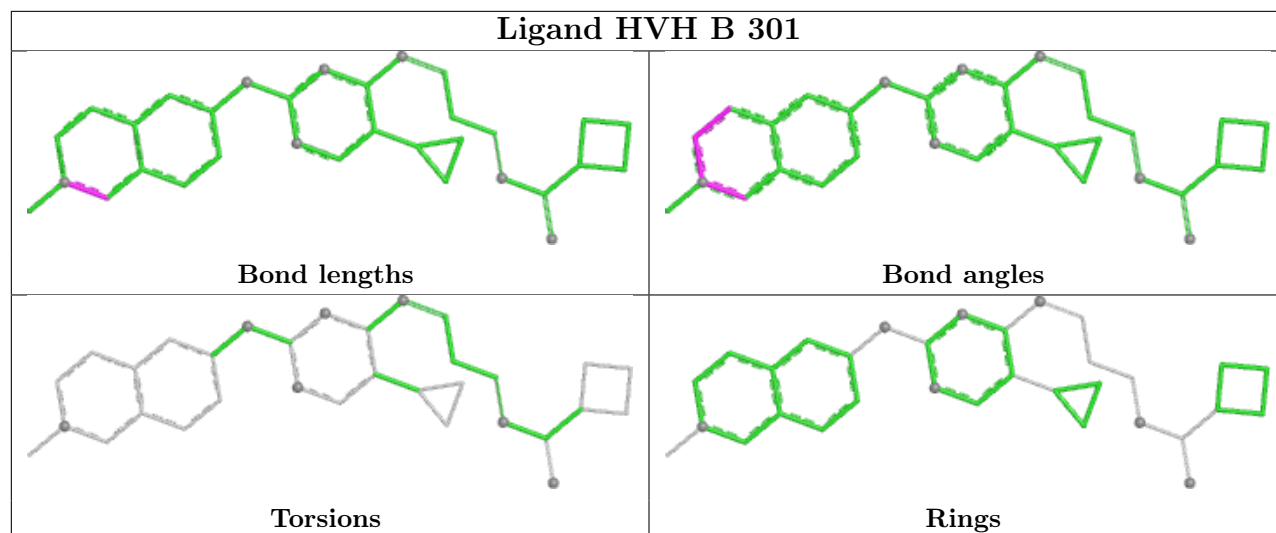
There are no ring outliers.

4 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	301	HVH	1	0
2	B	301	HVH	1	0
3	A	302	GOL	2	0
2	D	301	HVH	2	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.





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	268/284 (94%)	-0.26	6 (2%) 62 59	16, 38, 67, 108	8 (2%)
1	B	272/284 (95%)	-0.43	3 (1%) 78 76	17, 36, 70, 112	6 (2%)
1	C	267/284 (94%)	-0.16	7 (2%) 57 54	15, 39, 80, 104	8 (2%)
1	D	272/284 (95%)	-0.22	3 (1%) 78 76	18, 38, 76, 125	6 (2%)
All	All	1079/1136 (94%)	-0.26	19 (1%) 67 64	15, 38, 73, 125	28 (2%)

All (19) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	149	PRO	6.1
1	A	149	PRO	5.6
1	B	280	ALA	5.2
1	A	154	ALA	5.0
1	A	24[A]	HIS	4.2
1	A	280	ALA	4.2
1	C	154	ALA	4.1
1	D	280	ALA	4.0
1	D	8	THR	3.9
1	A	8	THR	2.9
1	A	156	PRO	2.8
1	C	105[A]	HIS	2.7
1	D	152	ARG	2.6
1	C	8	THR	2.6
1	B	152	ARG	2.5
1	C	10	THR	2.2
1	B	227	GLN	2.2
1	C	24	HIS	2.0
1	C	156	PRO	2.0

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

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	TPO	C	180	11/12	0.98	0.06	27,31,37,46	0
1	TPO	D	180	11/12	0.98	0.06	25,31,35,39	0
1	TPO	A	180	11/12	0.99	0.04	24,28,33,39	0
1	TPO	B	180	11/12	0.99	0.04	26,29,32,35	0

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 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.

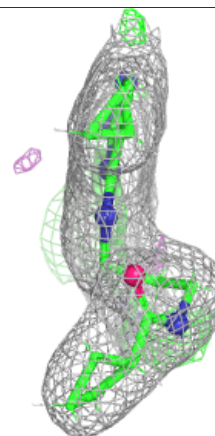
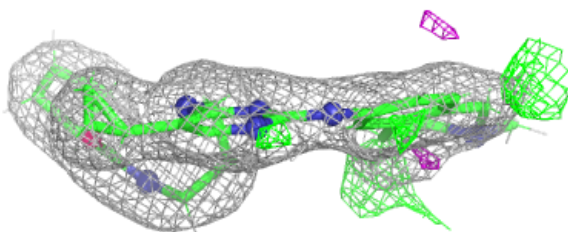
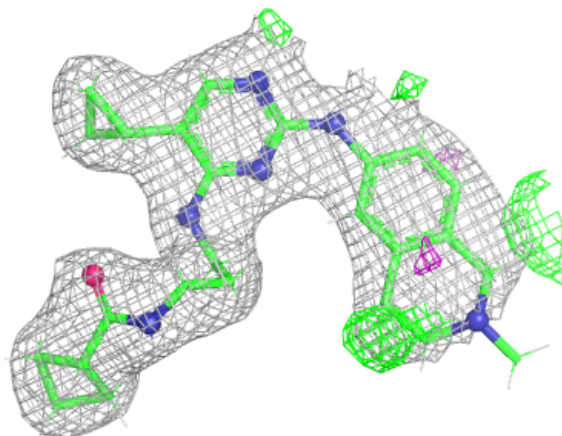
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
5	PO4	C	305	5/5	0.86	0.09	79,81,94,95	0
5	PO4	A	305	5/5	0.90	0.08	72,79,87,91	0
3	GOL	C	302	6/6	0.91	0.14	70,74,82,84	2
3	GOL	A	302	6/6	0.92	0.15	71,76,78,79	2
3	GOL	B	302	6/6	0.93	0.11	48,54,56,57	2
2	HVH	C	301	32/32	0.94	0.11	37,46,92,94	0
2	HVH	A	301	32/32	0.95	0.10	34,44,82,90	0
2	HVH	D	301	32/32	0.97	0.06	28,34,43,44	0
4	MG	C	303	1/1	0.97	0.08	40,40,40,40	0
2	HVH	B	301	32/32	0.98	0.05	24,30,38,38	0
4	MG	A	303	1/1	0.98	0.18	40,40,40,40	0
4	MG	B	303	1/1	0.98	0.08	49,49,49,49	0
4	MG	D	302	1/1	0.99	0.09	46,46,46,46	0
4	MG	D	303	1/1	0.99	0.17	41,41,41,41	0
4	MG	A	304	1/1	0.99	0.11	37,37,37,37	0
4	MG	C	304	1/1	0.99	0.14	38,38,38,38	0
4	MG	B	304	1/1	1.00	0.13	40,40,40,40	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.

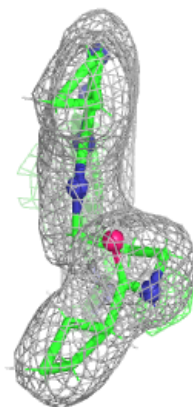
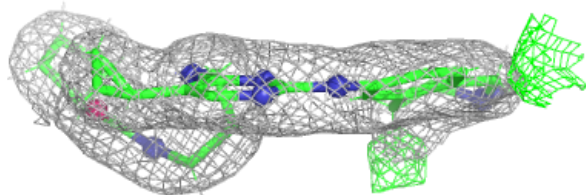
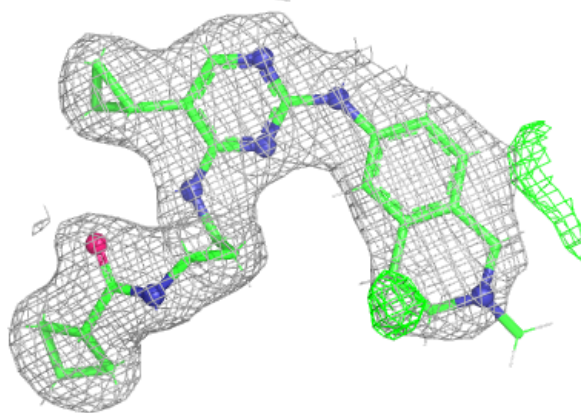
Electron density around HVH C 301:

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



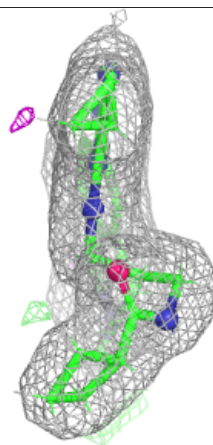
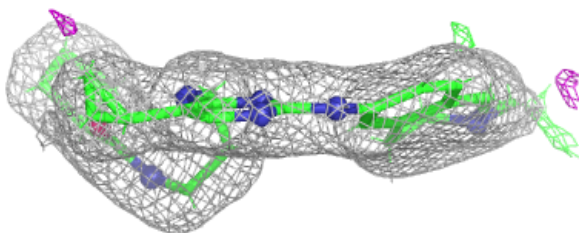
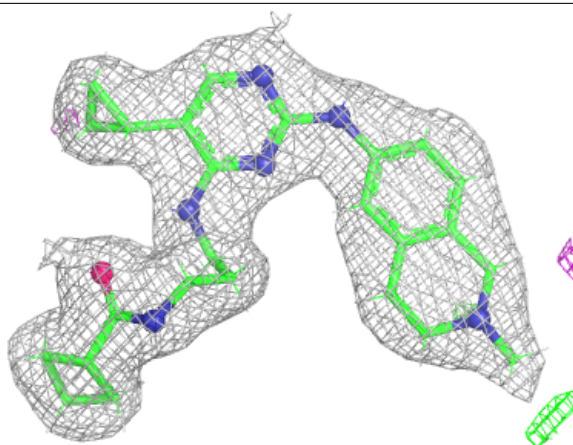
Electron density around HVH A 301:

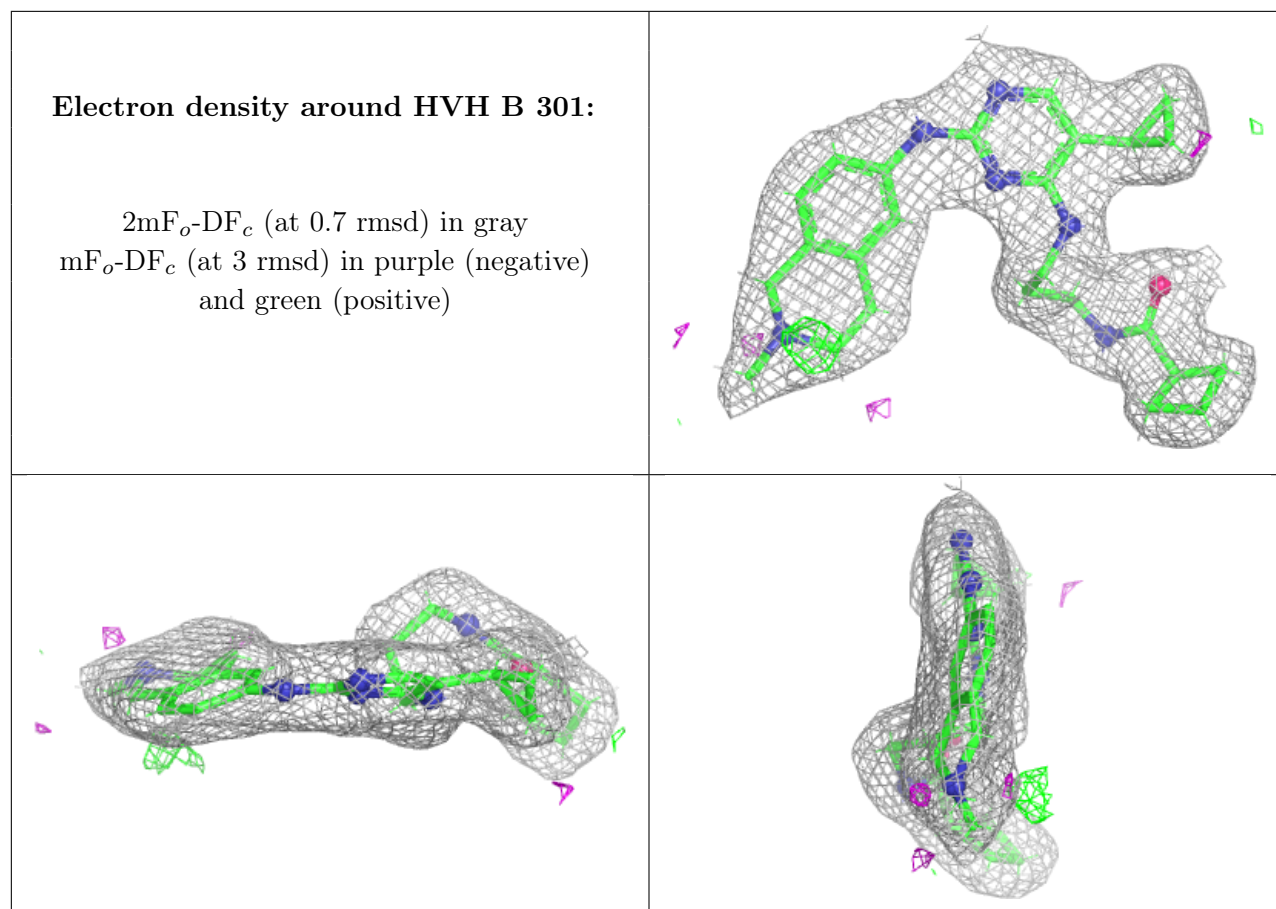
$2mF_o - DF_c$ (at 0.7 rmsd) in gray
 $mF_o - DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around HVH D 301:

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





6.5 Other polymers ⓘ

There are no such residues in this entry.