wwPDB X-ray Structure Validation Summary Report (i)

Jun 18, 2024 – 10:19 PM EDT

PDB ID	:	4LKO
Title	:	Crystal structure of human DPP-IV in complex with BMS-744891
Authors	:	Klei, H.E.
Deposited on	:	2013-07-08
Resolution	:	2.43 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 (i) 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 (i)) were used in the production of this report:

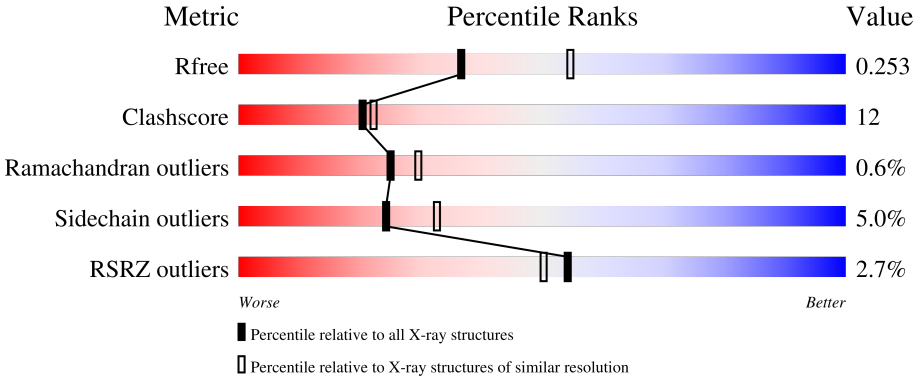
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.37.1
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.37.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.43 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}	130704	1564 (2.46-2.42)
Clashscore	141614	1631 (2.46-2.42)
Ramachandran outliers	138981	1617 (2.46-2.42)
Sidechain outliers	138945	1617 (2.46-2.42)
RSRZ outliers	127900	1547 (2.46-2.42)

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.

Mol	Chain	Length	Quality of chain
1	A	728	2% 75% 22% •
1	B	728	3% 72% 25% •

2 Entry composition (i)

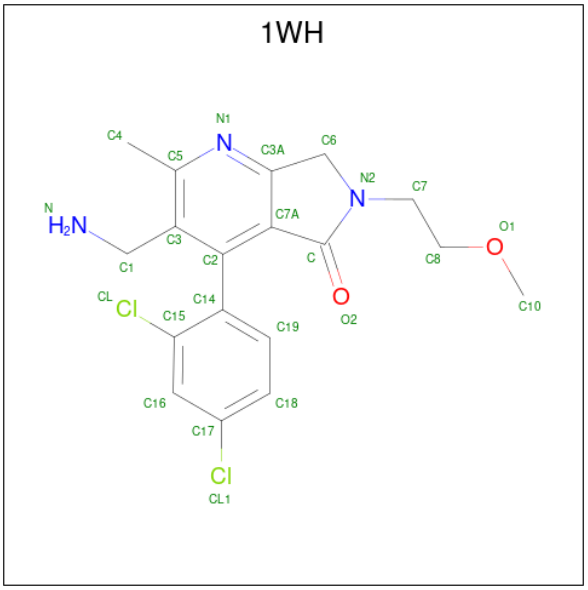
There are 3 unique types of molecules in this entry. The entry contains 12074 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Dipeptidyl peptidase 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	728	5963	3827	982	1128	26	0	0	0
1	B	728	5963	3827	982	1128	26	0	0	0

- Molecule 2 is 3-(aminomethyl)-4-(2,4-dichlorophenyl)-6-(2-methoxyethyl)-2-methyl-6,7-dihydro-5H-pyrrolo[3,4-b]pyridin-5-one (three-letter code: 1WH) (formula: $C_{18}H_{19}Cl_2N_3O_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	Cl	N	O		
2	A	1	25	18	2	3	2	0	0
2	B	1	25	18	2	3	2	0	0

- Molecule 3 is water.

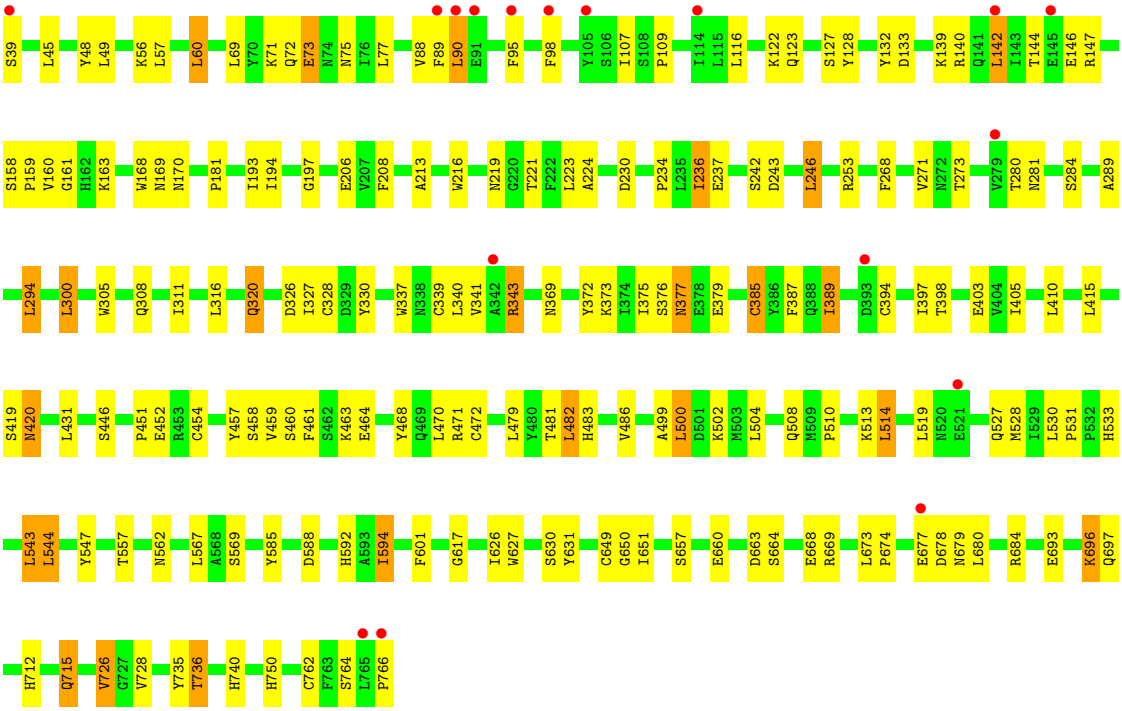
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	63	63	63	0	0
			Total	O		
3	B	35	35	35	0	0

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.

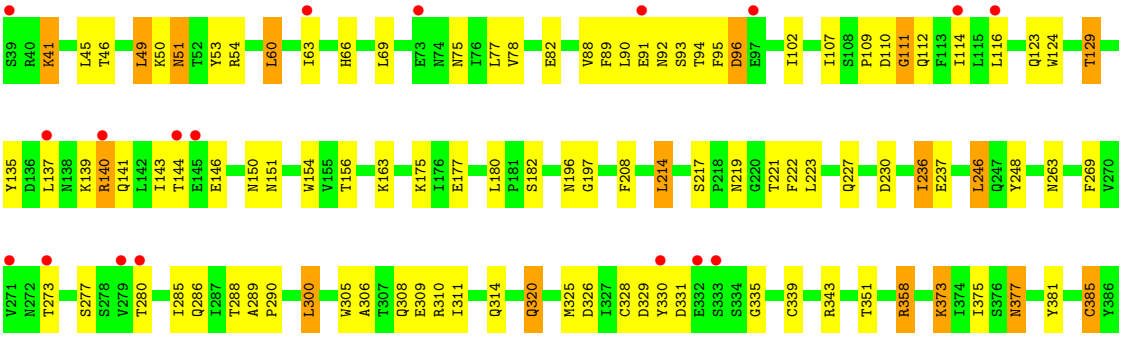
• Molecule 1: Dipeptidyl peptidase 4

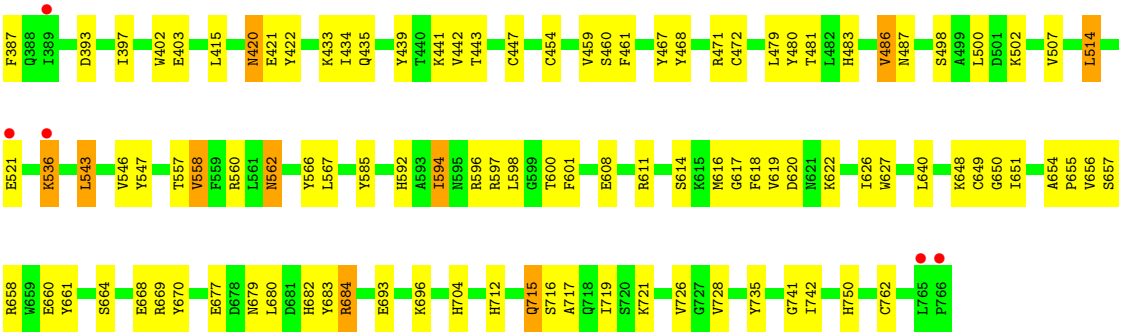
Chain A:



• Molecule 1: Dipeptidyl peptidase 4

Chain B:




F387 Q388 I389 D393 I397 W402 E403 L415 N420 E421 Y422 K433 I434 Q435 Y439 T440 K441 V442 T443 C447 C454 V459 S460 F461 Y467 Y468 R471 C472 L479 Y480 T481 L482 H483 V486 N487 S498 A499 L500 D501 K502 V507 L514
E521 K536 L543 V546 Y547 T557 V558 F559 R560 L561 N562 Y566 L567 Y585 H592 A593 I594 N595 R596 R597 L598 G599 T600 F601 E608 R611 S614 K615 M616 G617 F618 V619 D620 N621 K622 I626 W627 L640 K648 C649 G650 I651 A654 P655 V656 S657
R658 W659 E660 Y661 S664 E668 R669 Y670 E677 D678 N679 L680 D681 H682 Y683 R684 E693 K696 H704 H712 Q715 S716 A717 Q718 I719 S720 K721 V726 G727 V728 Y735 G741 I742 H750 C762 L765 P766

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	65.90Å 68.30Å 421.50Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.43 – 2.43 47.42 – 2.43	Depositor EDS
% Data completeness (in resolution range)	96.4 (47.43-2.43) 96.5 (47.42-2.43)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.63 (at 2.42Å)	Xtriage
Refinement program	CNS, CNX 2002	Depositor
R, R_{free}	0.226 , 0.263 0.217 , 0.253	Depositor DCC
R_{free} test set	4996 reflections (7.12%)	wwPDB-VP
Wilson B-factor (Å^2)	50.5	Xtriage
Anisotropy	0.543	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 30.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	0.064 for k,h,-l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	12074	wwPDB-VP
Average B, all atoms (Å^2)	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.07% of the height of the origin peak. No significant pseudotranslation is detected.*

[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 (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: 1WH

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	0.40	0/6135	0.67	0/8344
1	B	0.36	0/6135	0.66	1/8344 (0.0%)
All	All	0.38	0/12270	0.66	1/16688 (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	A	0	1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	300	LEU	N-CA-C	-5.00	97.49	111.00

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	547	TYR	Sidechain

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	5963	0	5695	135	0
1	B	5963	0	5695	157	0
2	A	25	0	19	0	0
2	B	25	0	19	0	0
3	A	63	0	0	1	0
3	B	35	0	0	0	0
All	All	12074	0	11428	285	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 12.

The worst 5 of 285 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:508:GLN:HE21	1:A:533:HIS:CE1	1.76	1.04
1:B:600:THR:HG23	1:B:601:PHE:H	1.22	0.99
1:B:51:ASN:HD22	1:B:54:ARG:HG2	1.32	0.95
1:B:177:GLU:HB2	1:B:180:LEU:HD23	1.49	0.95
1:A:508:GLN:HE21	1:A:533:HIS:HE1	0.99	0.93

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	726/728 (100%)	675 (93%)	47 (6%)	4 (1%)	25	29
1	B	726/728 (100%)	682 (94%)	39 (5%)	5 (1%)	22	26
All	All	1452/1456 (100%)	1357 (94%)	86 (6%)	9 (1%)	25	29

5 of 9 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	389	ILE
1	B	111	GLY
1	B	320	GLN
1	A	320	GLN
1	A	617	GLY

5.3.2 Protein sidechains (i)

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	653/653 (100%)	619 (95%)	34 (5%)	23	31
1	B	653/653 (100%)	622 (95%)	31 (5%)	26	35
All	All	1306/1306 (100%)	1241 (95%)	65 (5%)	24	33

5 of 65 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	543	LEU
1	B	562	ASN
1	A	514	LEU
1	A	500	LEU
1	B	566	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 35 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	483	HIS
1	B	533	HIS
1	B	679	ASN
1	A	592	HIS
1	A	586	GLN

5.3.3 RNA (i)

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 monosaccharides in this entry.

5.6 Ligand geometry (i)

2 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	$\#\|Z\| > 2$
2	1WH	B	801	-	25,27,27	1.77	9 (36%)	33,39,39	2.24	10 (30%)
2	1WH	A	801	-	25,27,27	1.95	6 (24%)	33,39,39	3.20	12 (36%)

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	1WH	B	801	-	-	1/9/22/22	0/3/3/3
2	1WH	A	801	-	-	1/9/22/22	0/3/3/3

The worst 5 of 15 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	801	1WH	C15-CL	-4.33	1.63	1.73
2	A	801	1WH	C17-CL1	-4.30	1.64	1.74
2	B	801	1WH	C18-C17	4.15	1.45	1.38
2	A	801	1WH	C18-C17	3.68	1.44	1.38
2	A	801	1WH	C19-C18	3.16	1.43	1.38

The worst 5 of 22 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	801	1WH	C16-C17-CL1	-7.50	109.77	119.17
2	A	801	1WH	C16-C15-C14	7.09	127.48	121.97
2	A	801	1WH	C16-C15-CL	-6.77	107.37	118.45
2	A	801	1WH	C8-C7-N2	-5.43	101.90	113.41
2	A	801	1WH	C15-C16-C17	-5.41	112.61	118.72

There are no chirality outliers.

All (2) torsion outliers are listed below:

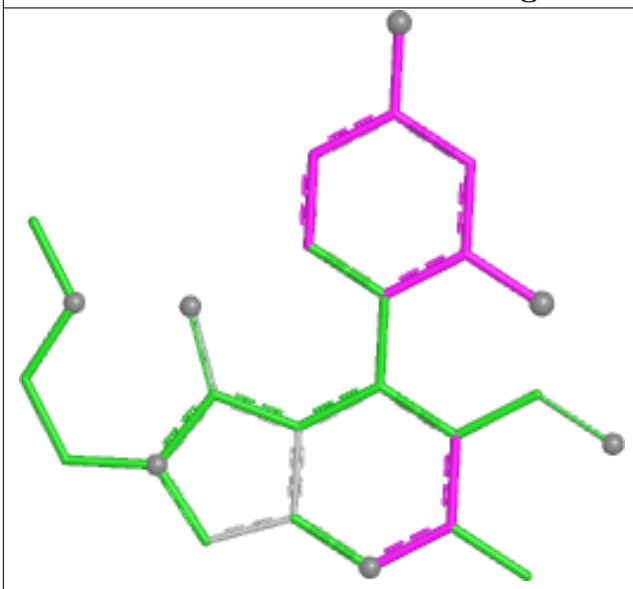
Mol	Chain	Res	Type	Atoms
2	A	801	1WH	C7-C8-O1-C10
2	B	801	1WH	C7-C8-O1-C10

There are no ring outliers.

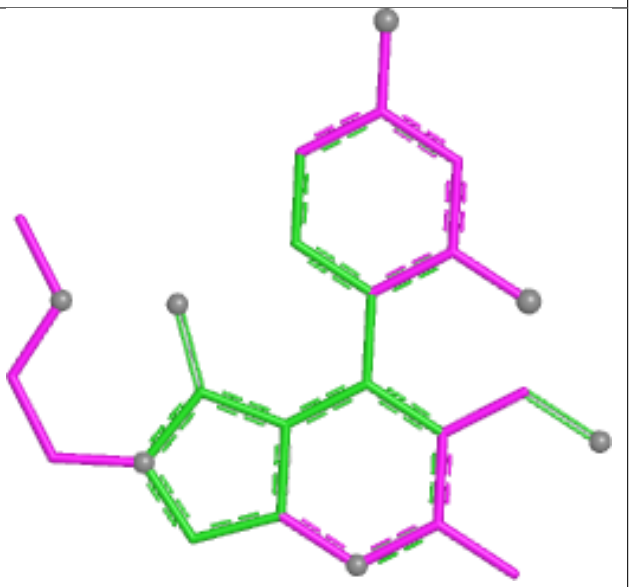
No monomer is involved in short contacts.

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.

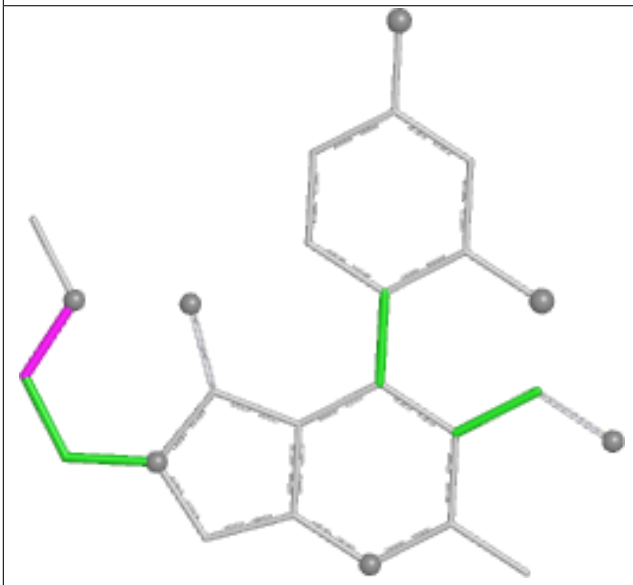
Ligand 1WH B 801



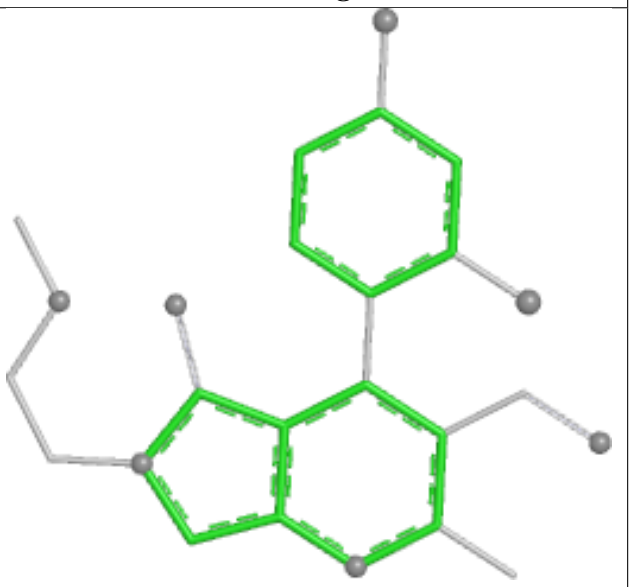
Bond lengths



Bond angles

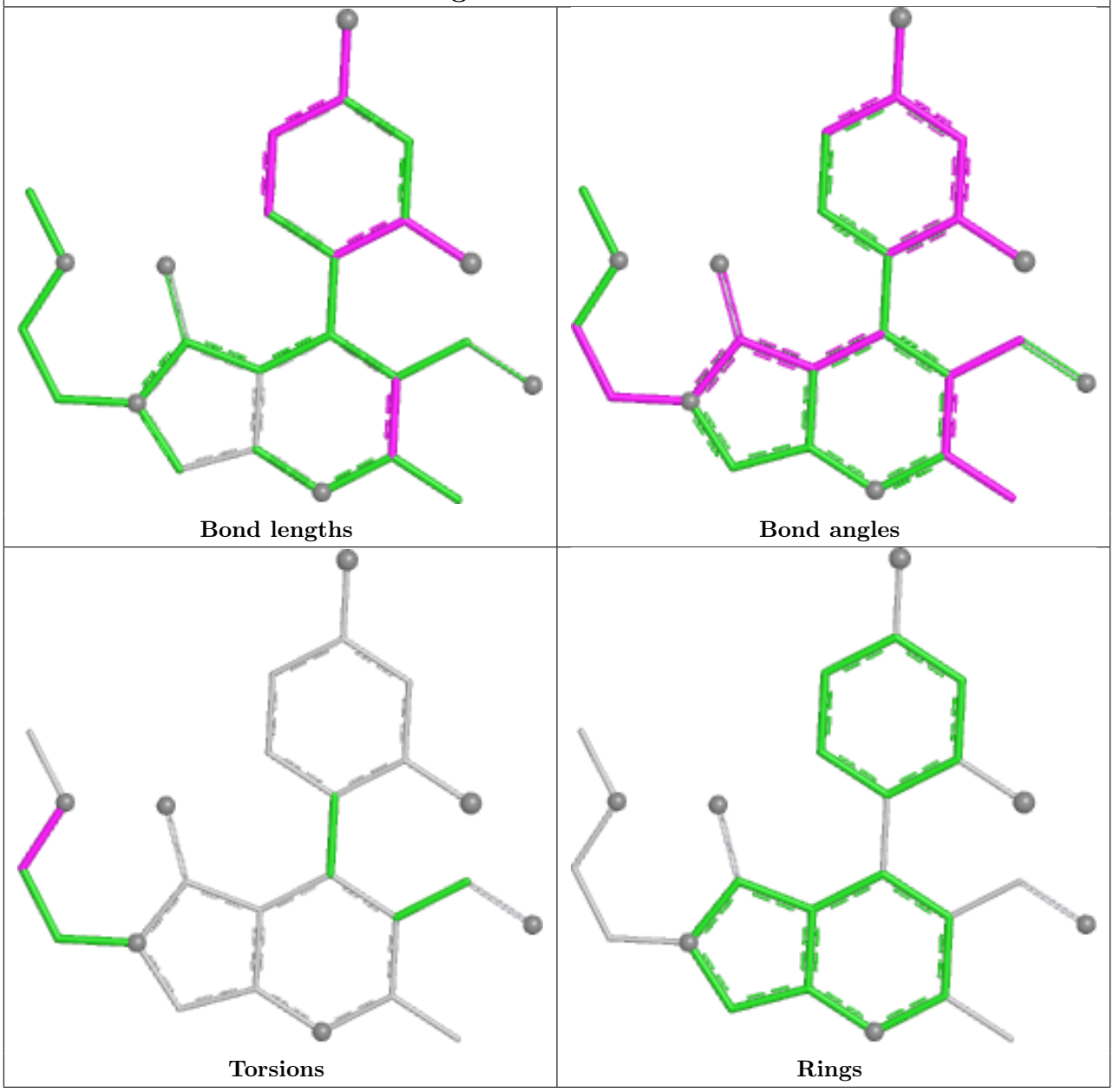


Torsions



Rings

Ligand 1WH A 801



5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data (i)

6.1 Protein, DNA and RNA chains (i)

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2			OWAB(Å^2)	Q<0.9
1	A	728/728 (100%)	0.03	17 (2%)	60	56	34, 47, 69, 84	0
1	B	728/728 (100%)	0.14	23 (3%)	47	44	33, 54, 75, 84	0
All	All	1456/1456 (100%)	0.08	40 (2%)	54	50	33, 50, 73, 84	0

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	39	SER	11.2
1	A	766	PRO	10.8
1	B	333	SER	4.8
1	B	279	VAL	4.7
1	A	765	LEU	4.6

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 monosaccharides in this entry.

6.4 Ligands (i)

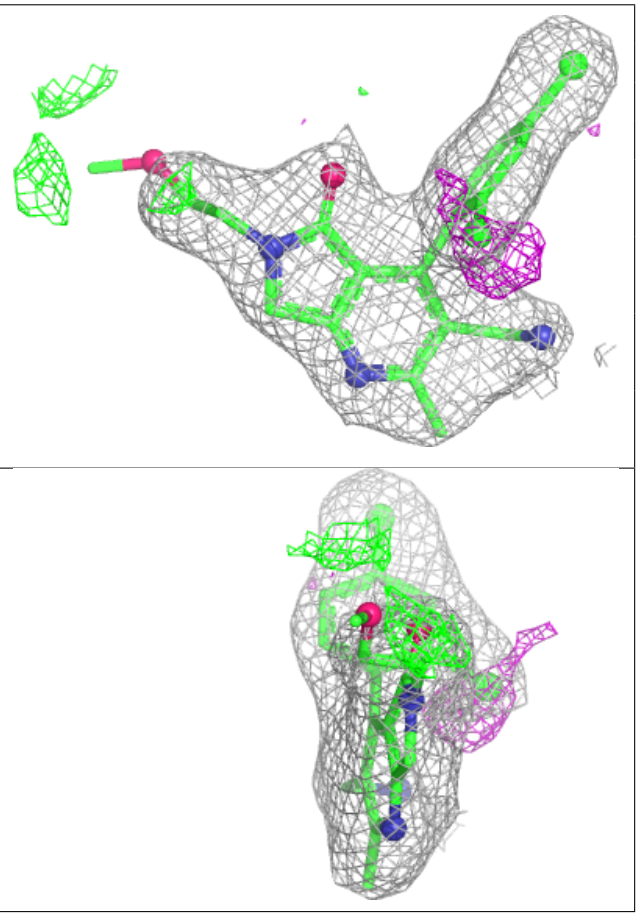
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	1WH	B	801	25/25	0.90	0.26	55,58,67,74	0
2	1WH	A	801	25/25	0.91	0.24	52,56,63,68	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.

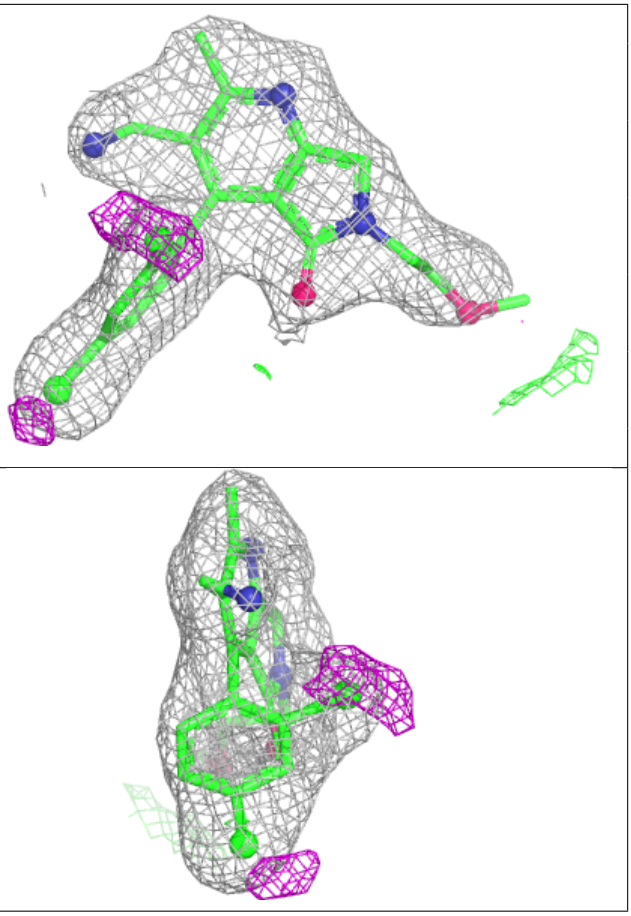
Electron density around 1WH B 801:

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 1WH A 801:

$2mF_o$-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.