



# wwPDB X-ray Structure Validation Summary Report ⓘ

May 25, 2020 – 07:15 am BST

PDB ID : 5ITA  
Title : Crystal Structure of BRAF Kinase Domain Bound to AZ-VEM  
Authors : Wu, Y.; Gavathiotis, E.  
Deposited on : 2016-03-16  
Resolution : 1.95 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](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.

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

MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
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)	:	2.11

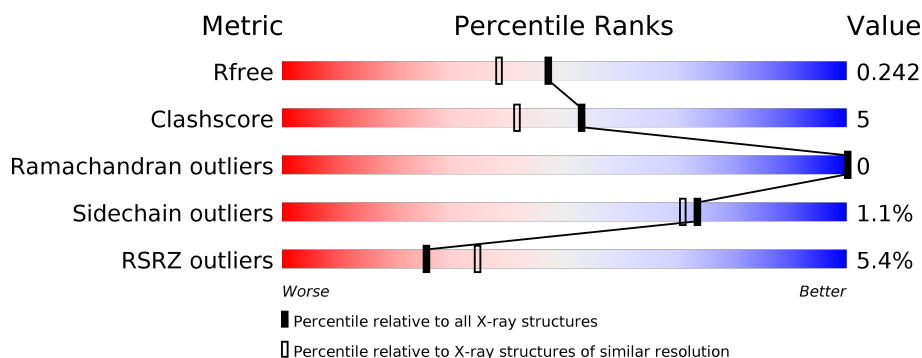
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.95 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	2580 (1.96-1.96)
Clashscore	141614	2705 (1.96-1.96)
Ramachandran outliers	138981	2678 (1.96-1.96)
Sidechain outliers	138945	2678 (1.96-1.96)
RSRZ outliers	127900	2539 (1.96-1.96)

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 on 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  $\leq 5\%$ . 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	297	<div> <div>5%</div> <div> <div></div> <div>74%</div> <div>9%</div> <div>16%</div> </div> </div>
1	B	297	<div> <div>4%</div> <div> <div></div> <div>73%</div> <div>10%</div> <div>15%</div> </div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4177 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 Serine/threonine-protein kinase B-raf.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	250	Total	C	N	O	S	0	0	0
			2003	1273	355	362	13			
1	B	252	Total	C	N	O	S	0	0	0
			2019	1278	360	368	13			

There are 74 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	427	MET	-	initiating methionine	UNP P15056
A	428	GLY	-	expression tag	UNP P15056
A	429	SER	-	expression tag	UNP P15056
A	430	SER	-	expression tag	UNP P15056
A	431	HIS	-	expression tag	UNP P15056
A	432	HIS	-	expression tag	UNP P15056
A	433	HIS	-	expression tag	UNP P15056
A	434	HIS	-	expression tag	UNP P15056
A	435	HIS	-	expression tag	UNP P15056
A	436	HIS	-	expression tag	UNP P15056
A	437	SER	-	expression tag	UNP P15056
A	438	SER	-	expression tag	UNP P15056
A	439	GLY	-	expression tag	UNP P15056
A	440	LEU	-	expression tag	UNP P15056
A	441	VAL	-	expression tag	UNP P15056
A	442	PRO	-	expression tag	UNP P15056
A	443	ARG	-	expression tag	UNP P15056
A	444	GLY	-	expression tag	UNP P15056
A	445	SER	-	expression tag	UNP P15056
A	446	HIS	-	expression tag	UNP P15056
A	447	MET	-	expression tag	UNP P15056
A	543	ALA	ILE	engineered mutation	UNP P15056
A	544	SER	ILE	engineered mutation	UNP P15056
A	551	LYS	ILE	engineered mutation	UNP P15056
A	562	ARG	GLN	engineered mutation	UNP P15056

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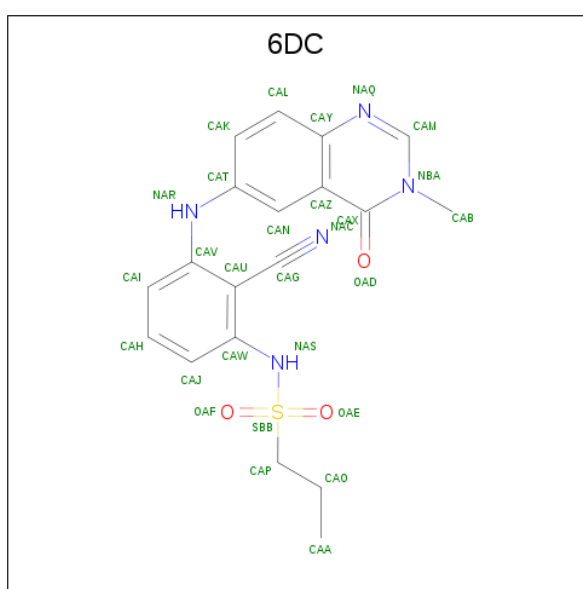
Chain	Residue	Modelled	Actual	Comment	Reference
A	588	ASN	LEU	engineered mutation	UNP P15056
A	630	SER	LYS	engineered mutation	UNP P15056
A	667	GLU	PHE	engineered mutation	UNP P15056
A	673	SER	TYR	engineered mutation	UNP P15056
A	688	ARG	ALA	engineered mutation	UNP P15056
A	706	SER	LEU	engineered mutation	UNP P15056
A	709	ARG	GLN	engineered mutation	UNP P15056
A	713	GLU	SER	engineered mutation	UNP P15056
A	716	GLU	LEU	engineered mutation	UNP P15056
A	720	GLU	SER	engineered mutation	UNP P15056
A	722	SER	PRO	engineered mutation	UNP P15056
A	723	GLY	LYS	engineered mutation	UNP P15056
B	427	MET	-	initiating methionine	UNP P15056
B	428	GLY	-	expression tag	UNP P15056
B	429	SER	-	expression tag	UNP P15056
B	430	SER	-	expression tag	UNP P15056
B	431	HIS	-	expression tag	UNP P15056
B	432	HIS	-	expression tag	UNP P15056
B	433	HIS	-	expression tag	UNP P15056
B	434	HIS	-	expression tag	UNP P15056
B	435	HIS	-	expression tag	UNP P15056
B	436	HIS	-	expression tag	UNP P15056
B	437	SER	-	expression tag	UNP P15056
B	438	SER	-	expression tag	UNP P15056
B	439	GLY	-	expression tag	UNP P15056
B	440	LEU	-	expression tag	UNP P15056
B	441	VAL	-	expression tag	UNP P15056
B	442	PRO	-	expression tag	UNP P15056
B	443	ARG	-	expression tag	UNP P15056
B	444	GLY	-	expression tag	UNP P15056
B	445	SER	-	expression tag	UNP P15056
B	446	HIS	-	expression tag	UNP P15056
B	447	MET	-	expression tag	UNP P15056
B	543	ALA	ILE	engineered mutation	UNP P15056
B	544	SER	ILE	engineered mutation	UNP P15056
B	551	LYS	ILE	engineered mutation	UNP P15056
B	562	ARG	GLN	engineered mutation	UNP P15056
B	588	ASN	LEU	engineered mutation	UNP P15056
B	630	SER	LYS	engineered mutation	UNP P15056
B	667	GLU	PHE	engineered mutation	UNP P15056
B	673	SER	TYR	engineered mutation	UNP P15056
B	688	ARG	ALA	engineered mutation	UNP P15056

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Chain	Residue	Modelled	Actual	Comment	Reference
B	706	SER	LEU	engineered mutation	UNP P15056
B	709	ARG	GLN	engineered mutation	UNP P15056
B	713	GLU	SER	engineered mutation	UNP P15056
B	716	GLU	LEU	engineered mutation	UNP P15056
B	720	GLU	SER	engineered mutation	UNP P15056
B	722	SER	PRO	engineered mutation	UNP P15056
B	723	GLY	LYS	engineered mutation	UNP P15056

- Molecule 2 is N-{2-cyano-3-[(3-methyl-4-oxo-3,4-dihydroquinazolin-6-yl)amino]phenyl}propane-1-sulfonamide (three-letter code: 6DC) (formula: C<sub>19</sub>H<sub>19</sub>N<sub>5</sub>O<sub>3</sub>S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	S	0	0
			28	19	5	3	1		
2	B	1	Total	C	N	O	S	0	0
			28	19	5	3	1		

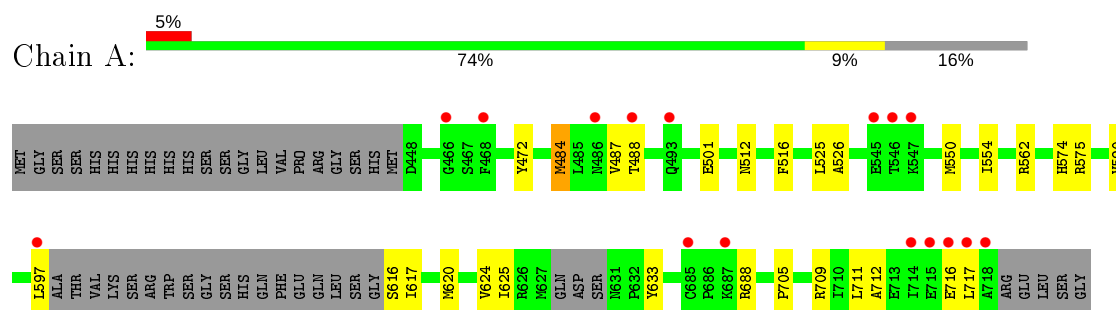
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	63	Total	O	0	0
			63	63		
3	B	36	Total	O	0	0
			36	36		

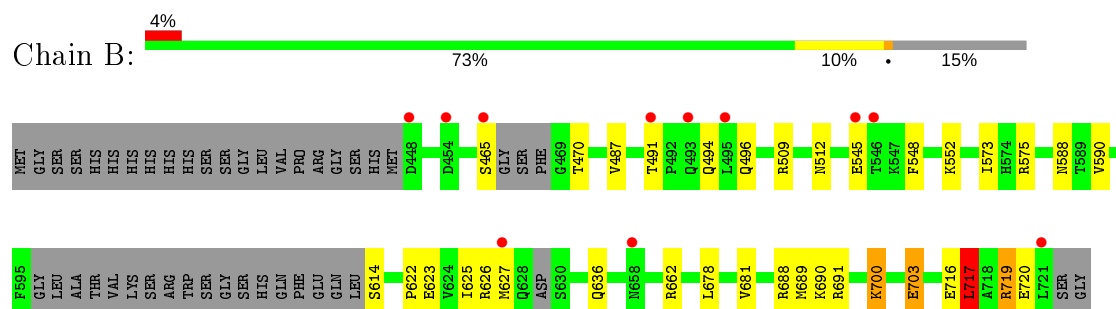
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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 B-raf



- Molecule 1: Serine/threonine-protein kinase B-raf



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	52.10Å 103.82Å 110.57Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.73 – 1.95 48.80 – 1.95	Depositor EDS
% Data completeness (in resolution range)	99.6 (34.73-1.95) 99.6 (48.80-1.95)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.78 (at 1.95Å)	Xtriage
Refinement program	PHENIX (1.10_2155)	Depositor
R, $R_{free}$	0.195 , 0.244 0.195 , 0.242	Depositor DCC
$R_{free}$ test set	2302 reflections (5.18%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	30.1	Xtriage
Anisotropy	0.780	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 51.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	4177	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.01% 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 6DC

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	0.44	0/2044	0.60	1/2753 (0.0%)
1	B	0.56	4/2058 (0.2%)	0.57	2/2771 (0.1%)
All	All	0.50	4/4102 (0.1%)	0.59	3/5524 (0.1%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	703	GLU	CD-OE1	-12.55	1.11	1.25
1	B	703	GLU	CB-CG	-10.19	1.32	1.52
1	B	700	LYS	CB-CG	6.44	1.70	1.52
1	B	700	LYS	CD-CE	5.05	1.63	1.51

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	717	LEU	CA-CB-CG	6.20	129.57	115.30
1	B	700	LYS	CA-CB-CG	5.44	125.36	113.40
1	A	574	HIS	C-N-CA	5.05	134.33	121.70

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	2003	0	2022	20	0
1	B	2019	0	2030	25	0
2	A	28	0	0	0	0
2	B	28	0	0	0	0
3	A	63	0	0	0	0
3	B	36	0	0	0	0
All	All	4177	0	4052	44	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 5.

The worst 5 of 44 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:B:700:LYS:NZ	1:B:703:GLU:OE1	1.84	1.10
1:A:550:MET:O	1:A:554:ILE:HD12	1.74	0.87
1:B:491:THR:H	1:B:494:GLN:NE2	1.80	0.79
1:A:501:GLU:OE1	1:A:597:LEU:HD22	1.81	0.79
1:A:712:ALA:O	1:A:716:GLU:HG3	1.87	0.75

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	244/297 (82%)	234 (96%)	10 (4%)	0	100	100
1	B	244/297 (82%)	239 (98%)	5 (2%)	0	100	100
All	All	488/594 (82%)	473 (97%)	15 (3%)	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	220/260 (85%)	218 (99%)	2 (1%)	78	77
1	B	222/260 (85%)	219 (99%)	3 (1%)	67	62
All	All	442/520 (85%)	437 (99%)	5 (1%)	73	71

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	484	MET
1	A	488	THR
1	B	636	GLN
1	B	717	LEU
1	B	719	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	486	ASN
1	B	494	GLN
1	B	496	GLN
1	B	628	GLN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

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	6DC	A	801	-	29,30,30	2.33	7 (24%)	35,43,43	2.31	8 (22%)
2	6DC	B	801	-	29,30,30	2.54	8 (27%)	35,43,43	2.38	5 (14%)

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	6DC	A	801	-	-	0/15/15/15	0/3/3/3
2	6DC	B	801	-	-	1/15/15/15	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	B	801	6DC	OAE-SBB	6.52	1.52	1.43
2	A	801	6DC	OAF-SBB	6.36	1.52	1.43
2	B	801	6DC	OAF-SBB	6.21	1.52	1.43
2	B	801	6DC	CAM-NAQ	5.55	1.40	1.30
2	A	801	6DC	CAM-NAQ	5.36	1.40	1.30

The worst 5 of 13 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	801	6DC	CAU-CAW-NAS	-8.58	114.22	120.59
2	A	801	6DC	CAU-CAW-NAS	-7.27	115.19	120.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	801	6DC	OAF-SBB-OAE	-6.37	110.12	119.35
2	B	801	6DC	CAZ-CAX-NBA	5.96	120.22	116.15
2	B	801	6DC	OAF-SBB-OAE	-5.87	110.84	119.35

There are no chirality outliers.

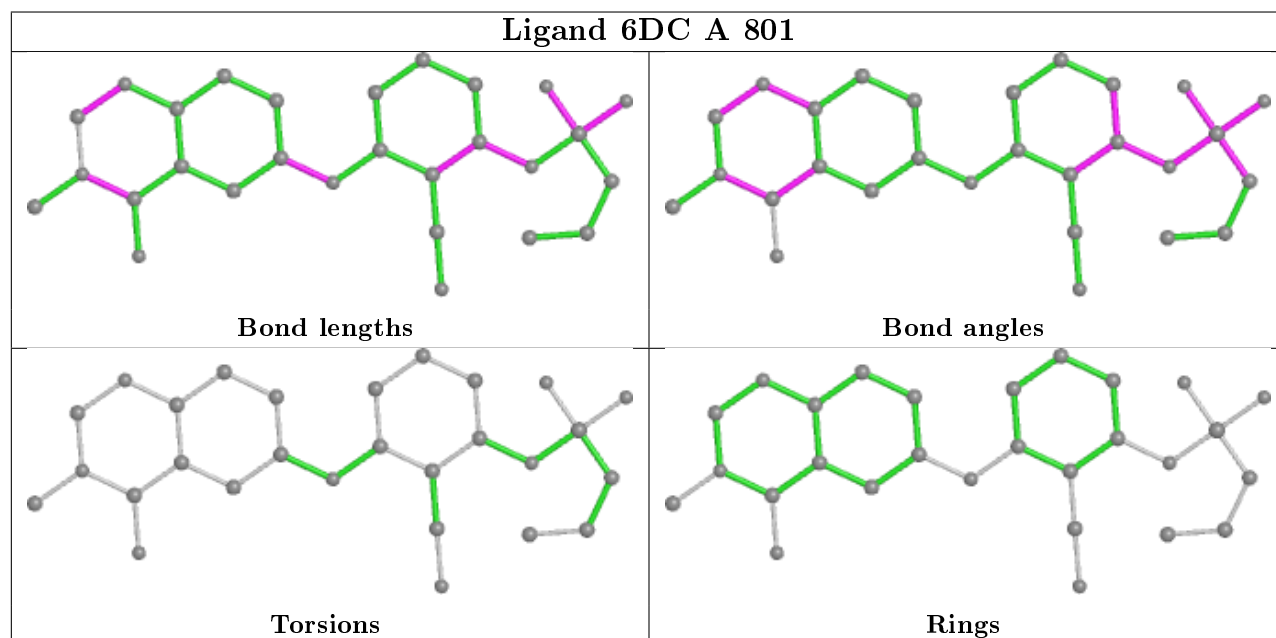
All (1) torsion outliers are listed below:

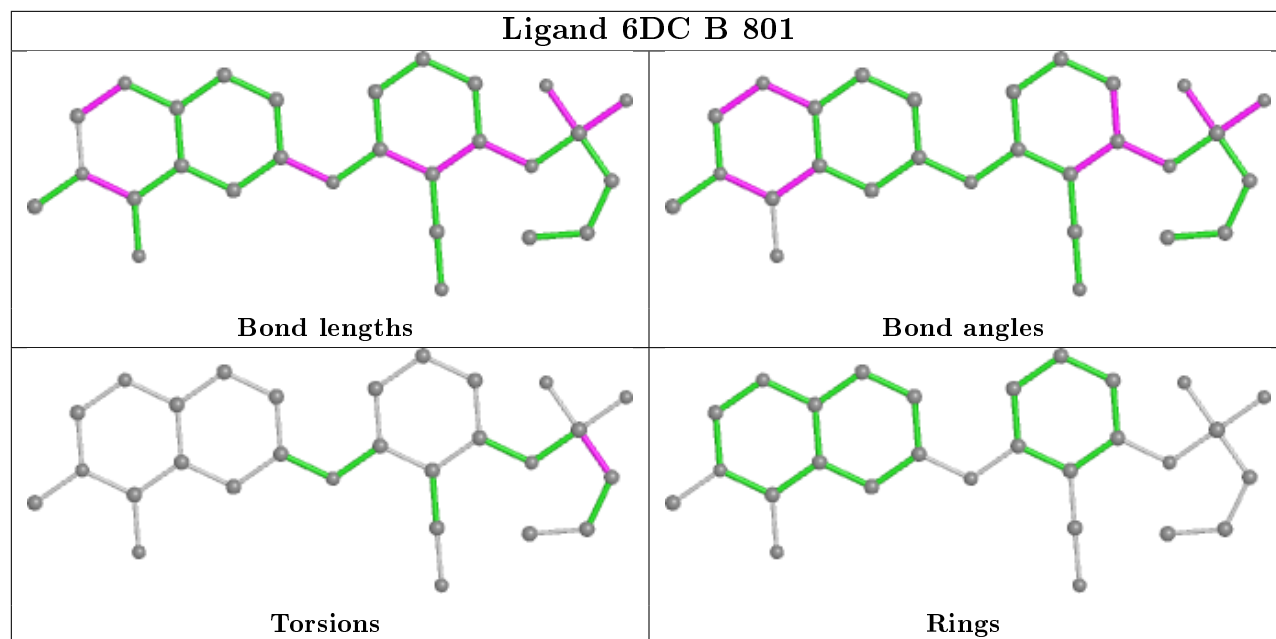
Mol	Chain	Res	Type	Atoms
2	B	801	6DC	CAO-CAP-SBB-OAE

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 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 [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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	250/297 (84%)	0.36	16 (6%) 19 28	21, 39, 83, 108	0
1	B	252/297 (84%)	0.38	11 (4%) 34 44	21, 44, 88, 107	0
All	All	502/594 (84%)	0.37	27 (5%) 25 34	21, 41, 86, 108	0

The worst 5 of 27 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	468	PHE	9.4
1	A	493	GLN	4.5
1	A	597	LEU	3.7
1	A	547	LYS	3.7
1	B	721	LEU	3.6

### 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 carbohydrates in this entry.

### 6.4 Ligands [i](#)

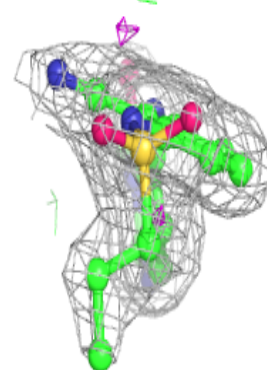
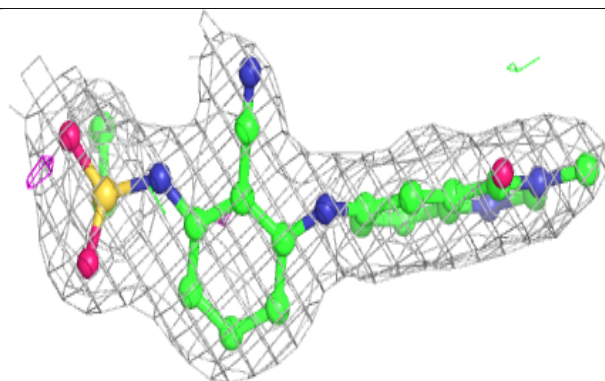
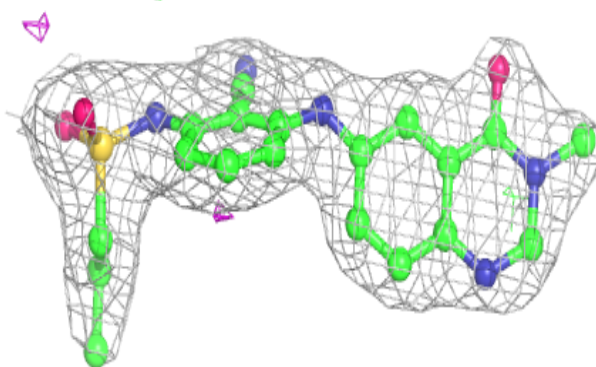
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	6DC	B	801	28/28	0.97	0.12	32,40,49,53	0
2	6DC	A	801	28/28	0.98	0.11	19,24,28,30	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.

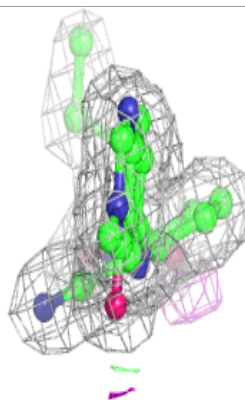
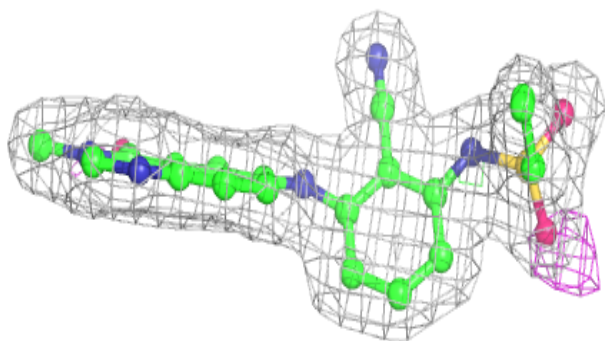
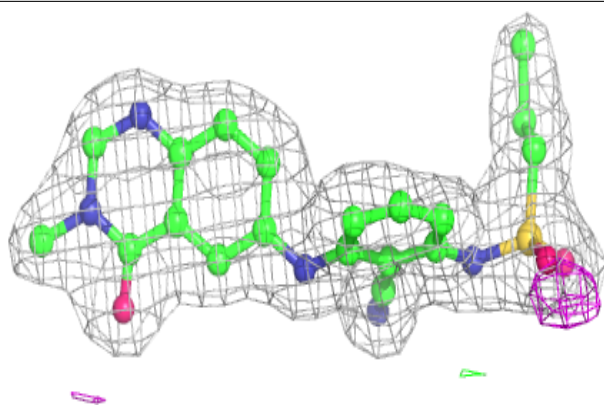
**Electron density around 6DC B 801:**

2mF<sub>o</sub>-DF<sub>c</sub> (at 0.7 rmsd) in gray  
mF<sub>o</sub>-DF<sub>c</sub> (at 3 rmsd) in purple (negative)  
and green (positive)



**Electron density around 6DC 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.