



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 20, 2020 – 05:15 PM BST

PDB ID : 6XVA  
Title : Crystal structure of the kinase domain of human c-KIT in complex with a type-II inhibitor bearing an acrylamide  
Authors : Schimpl, M.; McAuley, K.; Hoyt, E.A.; Thomas, M.; Bodnarchuk, M.S.; Lewis, H.J.; Barratt, D.; Deery, M.J.; Ogg, D.J.; Bernardes, G.J.L.; Ward, R.A.; Kettle, J.G.; Waring, M.J.  
Deposited on : 2020-01-21  
Resolution : 2.30 Å(reported)

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

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

A user guide is available at

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

with specific help available everywhere you see the ⓘ symbol.

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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 : 2.13.1  
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) : 2.13.1

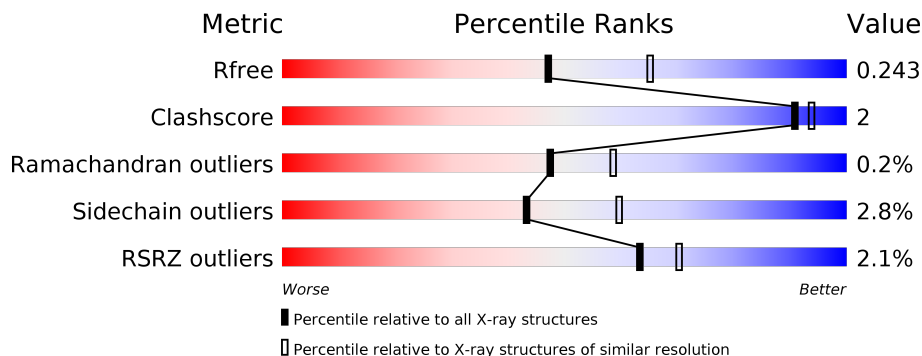
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 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	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (2.30-2.30)

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	328	 % 83% 6% 10%
1	B	328	 3% 81% 7% 12%

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4751 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 Mast/stem cell growth factor receptor Kit, Mast/stem cell growth factor receptor Kit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	294	2332	1497	387	432	16	0	0	0
1	B	288	2268	1457	376	419	16	0	0	0

There are 72 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	547	GLY	-	expression tag	UNP P10721
A	548	SER	-	expression tag	UNP P10721
A	549	HIS	-	expression tag	UNP P10721
A	550	MET	-	expression tag	UNP P10721
A	563	SER	ILE	engineered mutation	UNP P10721
A	569	SER	VAL	engineered mutation	UNP P10721
A	609	GLN	TYR	engineered mutation	UNP P10721
A	631	SER	LEU	engineered mutation	UNP P10721
A	651	GLU	MET	engineered mutation	UNP P10721
A	662	HIS	ILE	engineered mutation	UNP P10721
A	688	GLU	-	linker	UNP P10721
A	689	PHE	-	linker	UNP P10721
A	690	VAL	-	linker	UNP P10721
A	691	PRO	-	linker	UNP P10721
A	692	TYR	-	linker	UNP P10721
A	753	LYS	-	linker	UNP P10721
A	754	VAL	-	linker	UNP P10721
A	755	ALA	-	linker	UNP P10721
A	756	PRO	-	linker	UNP P10721
A	757	GLU	-	linker	UNP P10721
A	758	ASP	-	linker	UNP P10721
A	759	LEU	-	linker	UNP P10721
A	760	TYR	-	linker	UNP P10721
A	761	LYS	-	linker	UNP P10721

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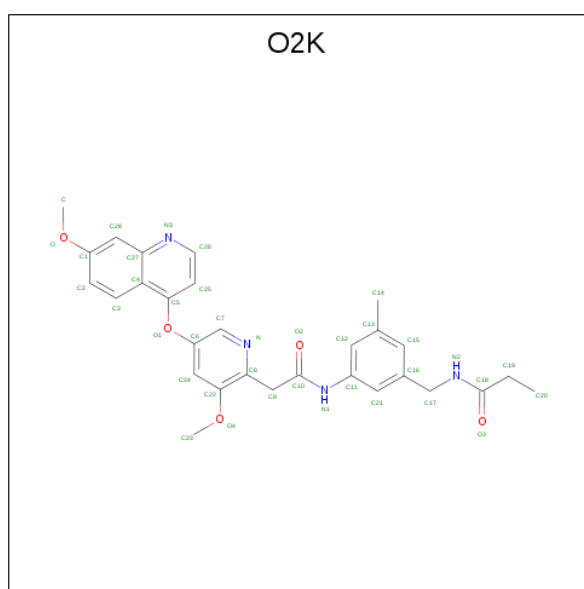
Chain	Residue	Modelled	Actual	Comment	Reference
A	762	ASP	-	linker	UNP P10721
A	763	PHE	-	linker	UNP P10721
A	764	LEU	-	linker	UNP P10721
A	765	THR	-	linker	UNP P10721
A	768	HIS	ASP	engineered mutation	UNP P10721
A	804	ASN	ARG	engineered mutation	UNP P10721
A	825	ASP	VAL	engineered mutation	UNP P10721
A	844	SER	CYS	engineered mutation	UNP P10721
A	890	SER	LEU	engineered mutation	UNP P10721
A	894	TYR	HIS	engineered mutation	UNP P10721
A	912	ASP	LEU	engineered mutation	UNP P10721
A	923	ASP	LEU	engineered mutation	UNP P10721
B	547	GLY	-	expression tag	UNP P10721
B	548	SER	-	expression tag	UNP P10721
B	549	HIS	-	expression tag	UNP P10721
B	550	MET	-	expression tag	UNP P10721
B	563	SER	ILE	engineered mutation	UNP P10721
B	569	SER	VAL	engineered mutation	UNP P10721
B	609	GLN	TYR	engineered mutation	UNP P10721
B	631	SER	LEU	engineered mutation	UNP P10721
B	651	GLU	MET	engineered mutation	UNP P10721
B	662	HIS	ILE	engineered mutation	UNP P10721
B	688	GLU	-	linker	UNP P10721
B	689	PHE	-	linker	UNP P10721
B	690	VAL	-	linker	UNP P10721
B	691	PRO	-	linker	UNP P10721
B	692	TYR	-	linker	UNP P10721
B	693	LYS	-	linker	UNP P10721
B	754	VAL	-	linker	UNP P10721
B	755	ALA	-	linker	UNP P10721
B	756	PRO	-	linker	UNP P10721
B	757	GLU	-	linker	UNP P10721
B	758	ASP	-	linker	UNP P10721
B	759	LEU	-	linker	UNP P10721
B	760	TYR	-	linker	UNP P10721
B	761	LYS	-	linker	UNP P10721
B	762	ASP	-	linker	UNP P10721
B	763	PHE	-	linker	UNP P10721
B	764	LEU	-	linker	UNP P10721
B	765	THR	-	linker	UNP P10721
B	768	HIS	ASP	engineered mutation	UNP P10721
B	804	ASN	ARG	engineered mutation	UNP P10721

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Chain	Residue	Modelled	Actual	Comment	Reference
B	825	ASP	VAL	engineered mutation	UNP P10721
B	844	SER	CYS	engineered mutation	UNP P10721
B	890	SER	LEU	engineered mutation	UNP P10721
B	894	TYR	HIS	engineered mutation	UNP P10721
B	912	ASP	LEU	engineered mutation	UNP P10721
B	923	ASP	LEU	engineered mutation	UNP P10721

- Molecule 2 is {N}-[[3-[2-[3-methoxy-5-(7-methoxyquinolin-4-yl)oxy-pyridin-2-yl]ethanoylamino]-5-methyl-phenyl]methyl]propanamide (three-letter code: O2K) (formula: C<sub>29</sub>H<sub>30</sub>N<sub>4</sub>O<sub>5</sub>) (labeled as "Ligand of Interest" by author).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	38	29	4	5	0	0
2	B	1	38	29	4	5	0	0

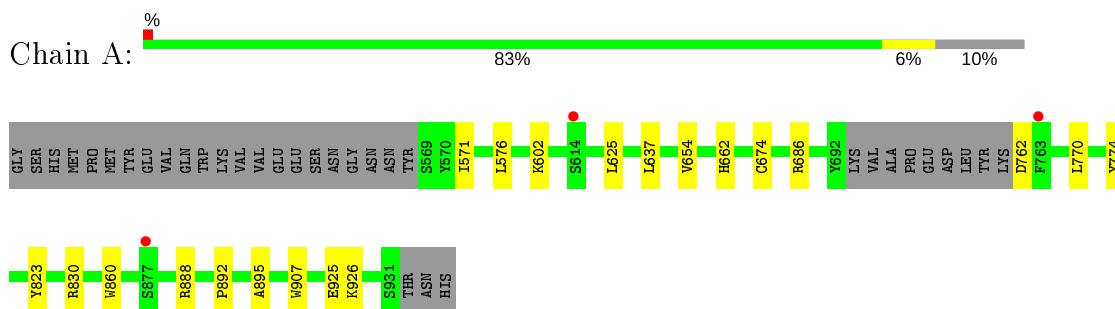
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	50	50	50	0	0
3	B	25	25	25	0	0

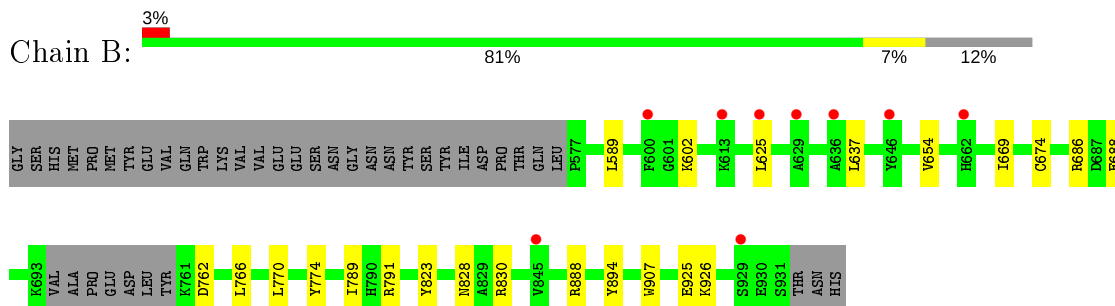
### 3 Residue-property plots [i](#)

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: Mast/stem cell growth factor receptor Kit,Mast/stem cell growth factor receptor Kit



- Molecule 1: Mast/stem cell growth factor receptor Kit,Mast/stem cell growth factor receptor Kit



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	88.14Å 90.05Å 90.75Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	44.07 – 2.30 45.37 – 2.30	Depositor EDS
% Data completeness (in resolution range)	67.3 (44.07-2.30) 67.4 (45.37-2.30)	Depositor EDS
$R_{merge}$	0.13	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.42 (at 2.29Å)	Xtriage
Refinement program	BUSTER	Depositor
R, $R_{free}$	0.196 , 0.245 0.200 , 0.243	Depositor DCC
$R_{free}$ test set	1144 reflections (5.17%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	44.2	Xtriage
Anisotropy	0.093	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 46.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.007 for -h,l,k 0.010 for -l,-k,-h 0.000 for k,h,-l 0.000 for k,l,h 0.000 for l,h,k	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	4751	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.47% of the height of the origin peak. No significant pseudotranslation is detected.*

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

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

## 5 Model quality [i](#)

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

Bond lengths and bond angles in the following residue types are not validated in this section: O2K

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	0.54	0/2391	0.71	0/3235
1	B	0.50	0/2324	0.70	0/3142
All	All	0.52	0/4715	0.71	0/6377

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 [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	2332	0	2288	9	0
1	B	2268	0	2224	9	0
2	A	38	0	0	0	0
2	B	38	0	0	0	0
3	A	50	0	0	0	0
3	B	25	0	0	0	0
All	All	4751	0	4512	16	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.

All (16) 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:789:ILE:HG22	1:B:791:ARG:HG3	1.83	0.59
1:A:674:CYS:SG	1:B:674:CYS:HB2	2.44	0.58
1:A:674:CYS:SG	1:B:674:CYS:CB	2.93	0.56
1:B:589:LEU:HD11	1:B:669:ILE:HD11	1.94	0.49
1:B:766:LEU:HD21	1:B:894:TYR:O	2.13	0.48
1:A:892:PRO:HG2	1:A:895:ALA:HB2	1.95	0.47
1:B:625:LEU:HG	1:B:637:LEU:HD22	1.96	0.47
1:A:571:ILE:HD12	1:A:576:LEU:HD11	1.97	0.45
1:B:774:TYR:CE1	1:B:925:GLU:HG3	2.51	0.45
1:A:625:LEU:HG	1:A:637:LEU:HD22	1.99	0.44
1:B:888:ARG:HD2	1:B:907:TRP:HB3	1.99	0.44
1:A:888:ARG:HD2	1:A:907:TRP:HB3	2.00	0.43
1:A:774:TYR:CE1	1:A:925:GLU:HG3	2.54	0.42
1:B:823:TYR:HB3	1:B:830:ARG:HG3	2.01	0.41
1:A:823:TYR:HB3	1:A:830:ARG:HG3	2.01	0.41
1:A:860:TRP:CD1	1:A:892:PRO:HD3	2.55	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	290/328 (88%)	280 (97%)	10 (3%)	0	100	100
1	B	284/328 (87%)	273 (96%)	10 (4%)	1 (0%)	34	42
All	All	574/656 (88%)	553 (96%)	20 (4%)	1 (0%)	47	58

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	762	ASP

### 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	253/286 (88%)	246 (97%)	7 (3%)	43	60
1	B	243/286 (85%)	236 (97%)	7 (3%)	42	58
All	All	496/572 (87%)	482 (97%)	14 (3%)	43	60

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	602	LYS
1	A	654	VAL
1	A	662	HIS
1	A	686	ARG
1	A	762	ASP
1	A	770	LEU
1	A	926	LYS
1	B	602	LYS
1	B	654	VAL
1	B	686	ARG
1	B	688	GLU
1	B	770	LEU
1	B	828	ASN
1	B	926	LYS

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	580	HIS
1	A	655	ASN
1	A	662	HIS
1	A	922	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	O2K	A	1001	-	39,41,41	0.79	1 (2%)	51,56,56	0.73	2 (3%)
2	O2K	B	1001	-	39,41,41	0.77	1 (2%)	51,56,56	0.43	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	O2K	A	1001	-	-	2/23/23/23	0/4/4/4
2	O2K	B	1001	-	-	1/23/23/23	0/4/4/4

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1001	O2K	C20-C19	-4.43	1.31	1.51
2	A	1001	O2K	C20-C19	-4.39	1.31	1.51

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
2	A	1001	O2K	C17-N2-C18	3.04	127.07	122.34
2	A	1001	O2K	C16-C17-N2	-2.09	108.58	113.05

There are no chirality outliers.

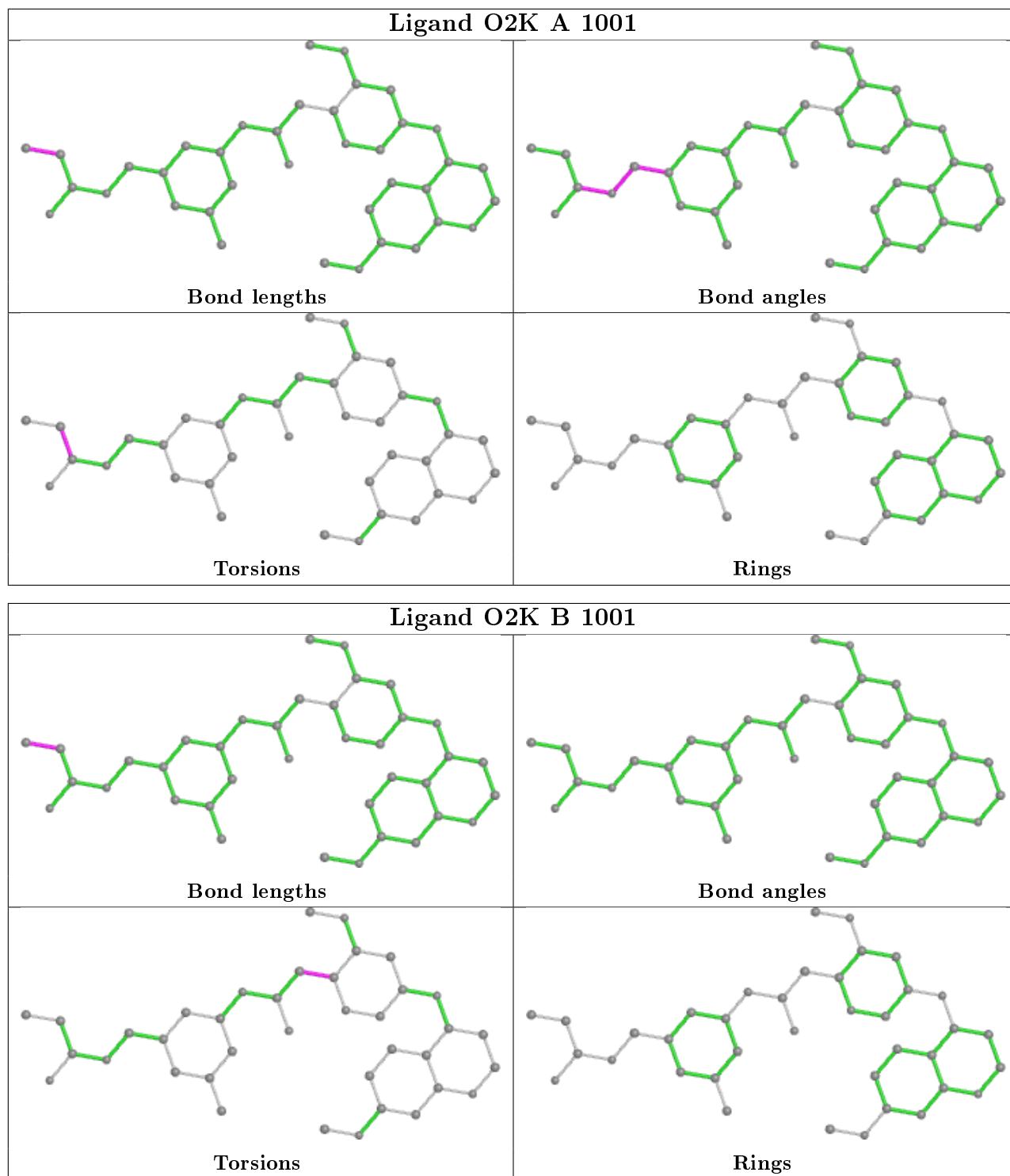
All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1001	O2K	O3-C18-C19-C20
2	A	1001	O2K	N2-C18-C19-C20
2	B	1001	O2K	C22-C8-C9-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 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

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	294/328 (89%)	0.15	3 (1%) 82 86	27, 42, 72, 106	0
1	B	288/328 (87%)	0.28	9 (3%) 49 56	33, 56, 87, 105	0
All	All	582/656 (88%)	0.22	12 (2%) 63 70	27, 49, 82, 106	0

All (12) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	845	VAL	3.6
1	B	625	LEU	3.2
1	B	600	PHE	2.9
1	B	613	LYS	2.6
1	A	763	PHE	2.6
1	B	646	TYR	2.5
1	B	929	SER	2.5
1	B	636	ALA	2.4
1	B	662	HIS	2.4
1	B	629	ALA	2.3
1	A	614	SER	2.3
1	A	877	SER	2.1

### 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](#)

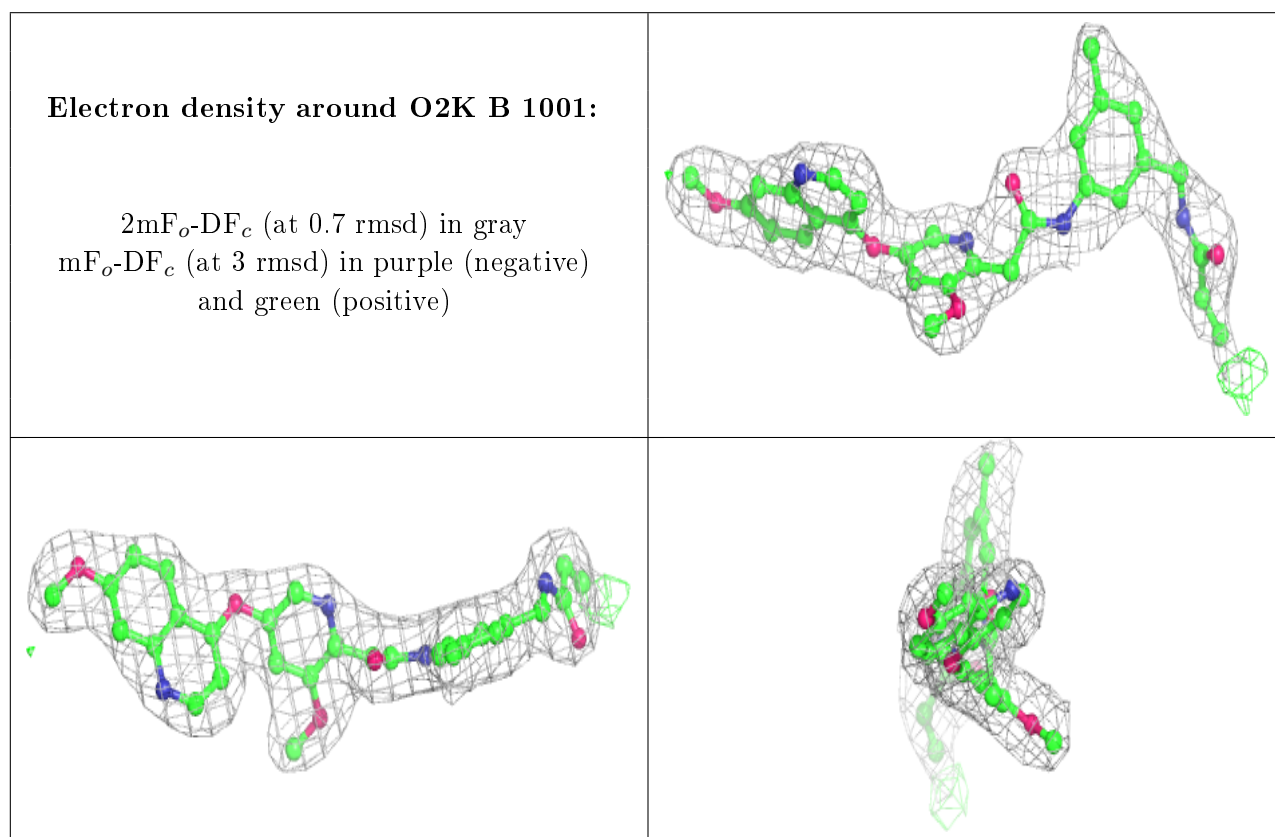
There are no monosaccharides in this entry.

## 6.4 Ligands [i](#)

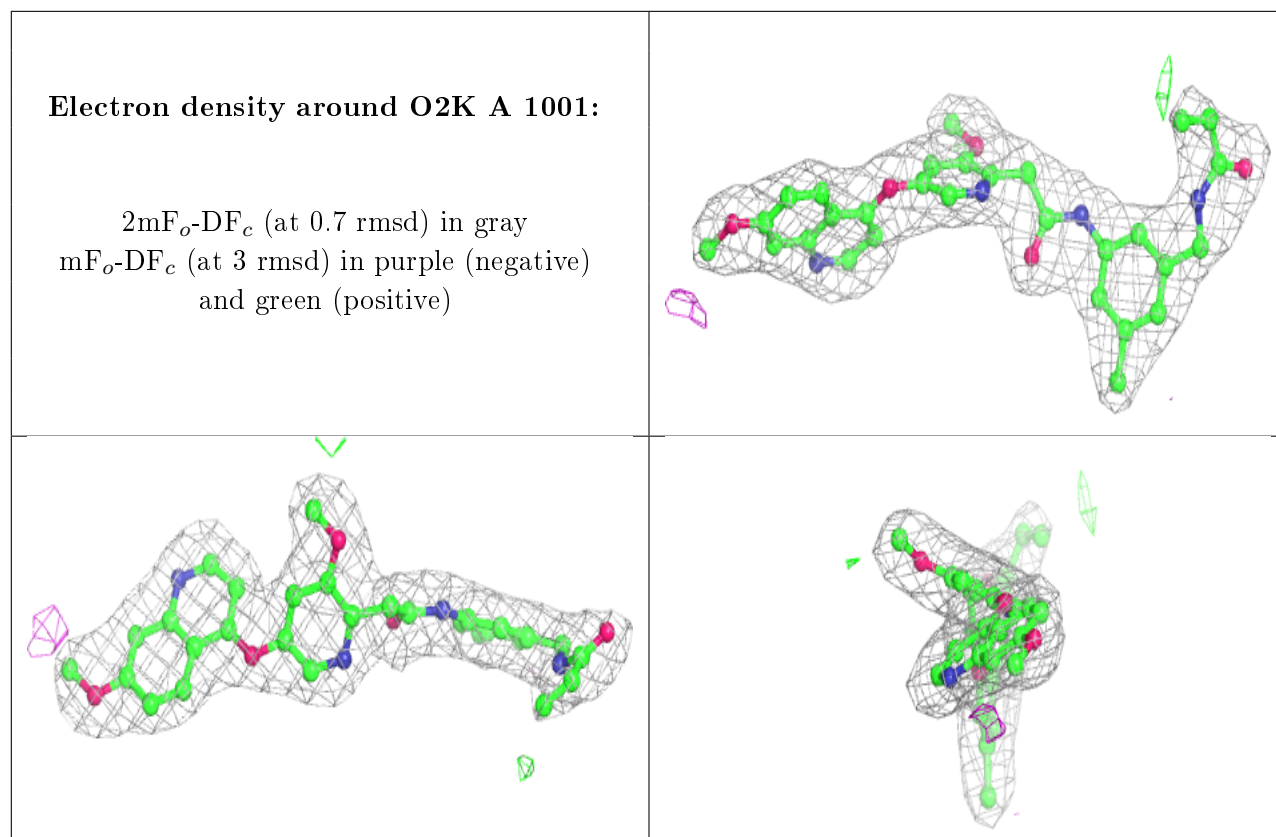
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	O2K	B	1001	38/38	0.95	0.14	32,45,72,74	0
2	O2K	A	1001	38/38	0.98	0.15	21,29,55,57	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.







## 6.5 Other polymers [i](#)

There are no such residues in this entry.