



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 5, 2026 – 04:24 pm GMT

PDB ID : 9FR7 / pdb\_00009fr7  
Title : Crystal structure of human GSK3B in complex with ARN25507  
Authors : Dalle Vedove, A.; Demuro, S.; Di Martino, R.M.C.; Balboni, B.; Tripathi, S.K.; Storici, P.; Girotto, S.; Cavalli, A.  
Deposited on : 2024-06-18  
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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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 : ?? (??), CSD ??CSD?? (????)  
Xtriage (Phenix) : 2.0  
EDS : 3.0  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
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) : 2.47

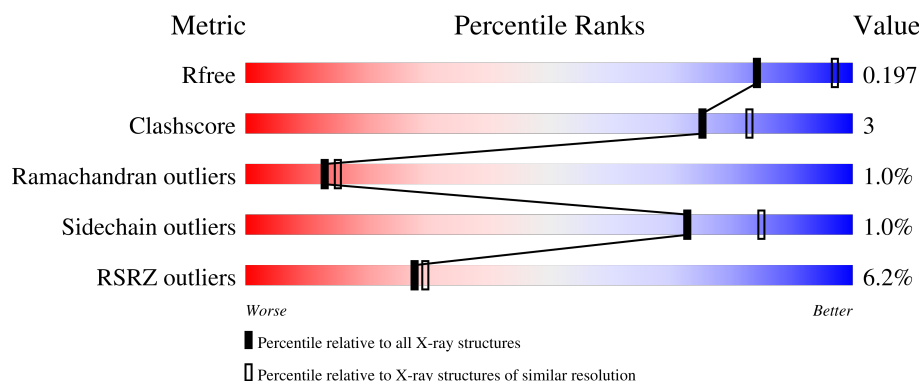
# 1 Overall quality at a glance

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))
$R_{free}$	164625	5963 (2.30-2.30)
Clashscore	180529	6698 (2.30-2.30)
Ramachandran outliers	177936	6640 (2.30-2.30)
Sidechain outliers	177891	6640 (2.30-2.30)
RSRZ outliers	164620	5963 (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 of 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	442	<div> <div>6%</div> <div>74%</div> <div>7%</div> <div>18%</div> </div>
1	B	442	<div> <div>4%</div> <div>74%</div> <div>5%</div> <div>21%</div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 6094 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 Glycogen synthase kinase-3 beta.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	361	Total	C	N	O	S	0	0	0
			2889	1853	498	526	12			
1	B	347	Total	C	N	O	S	0	0	0
			2779	1789	475	504	11			

There are 46 discrepancies between the modelled and reference sequences:

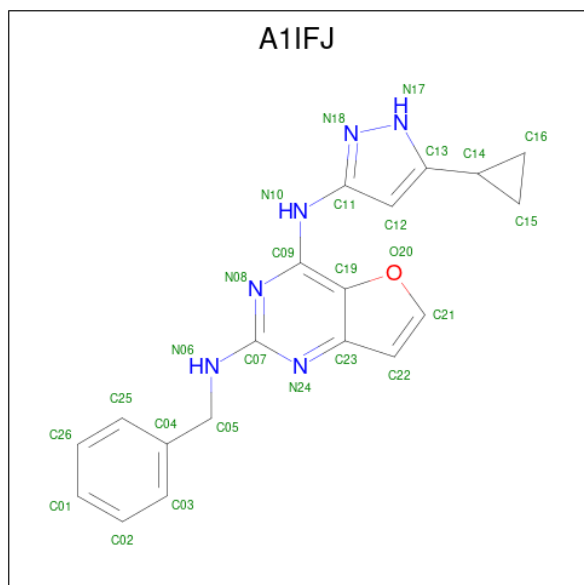
Chain	Residue	Modelled	Actual	Comment	Reference
A	-21	MET	-	initiating methionine	UNP P49841
A	-20	GLY	-	expression tag	UNP P49841
A	-19	HIS	-	expression tag	UNP P49841
A	-18	HIS	-	expression tag	UNP P49841
A	-17	HIS	-	expression tag	UNP P49841
A	-16	HIS	-	expression tag	UNP P49841
A	-15	HIS	-	expression tag	UNP P49841
A	-14	HIS	-	expression tag	UNP P49841
A	-13	SER	-	expression tag	UNP P49841
A	-12	SER	-	expression tag	UNP P49841
A	-11	GLY	-	expression tag	UNP P49841
A	-10	VAL	-	expression tag	UNP P49841
A	-9	ASP	-	expression tag	UNP P49841
A	-8	LEU	-	expression tag	UNP P49841
A	-7	GLY	-	expression tag	UNP P49841
A	-6	THR	-	expression tag	UNP P49841
A	-5	GLU	-	expression tag	UNP P49841
A	-4	ASN	-	expression tag	UNP P49841
A	-3	LEU	-	expression tag	UNP P49841
A	-2	TYR	-	expression tag	UNP P49841
A	-1	PHE	-	expression tag	UNP P49841
A	0	GLN	-	expression tag	UNP P49841
A	1	SER	-	expression tag	UNP P49841
B	-21	MET	-	initiating methionine	UNP P49841
B	-20	GLY	-	expression tag	UNP P49841

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-19	HIS	-	expression tag	UNP P49841
B	-18	HIS	-	expression tag	UNP P49841
B	-17	HIS	-	expression tag	UNP P49841
B	-16	HIS	-	expression tag	UNP P49841
B	-15	HIS	-	expression tag	UNP P49841
B	-14	HIS	-	expression tag	UNP P49841
B	-13	SER	-	expression tag	UNP P49841
B	-12	SER	-	expression tag	UNP P49841
B	-11	GLY	-	expression tag	UNP P49841
B	-10	VAL	-	expression tag	UNP P49841
B	-9	ASP	-	expression tag	UNP P49841
B	-8	LEU	-	expression tag	UNP P49841
B	-7	GLY	-	expression tag	UNP P49841
B	-6	THR	-	expression tag	UNP P49841
B	-5	GLU	-	expression tag	UNP P49841
B	-4	ASN	-	expression tag	UNP P49841
B	-3	LEU	-	expression tag	UNP P49841
B	-2	TYR	-	expression tag	UNP P49841
B	-1	PHE	-	expression tag	UNP P49841
B	0	GLN	-	expression tag	UNP P49841
B	1	SER	-	expression tag	UNP P49841

- Molecule 2 is {N}4-(5-cyclopropyl-1 {H}-pyrazol-3-yl)- {N}2-(phenylmethyl)furo[3,2-d]pyrimidine-2,4-diamine (CCD ID: A1IFJ) (formula: C<sub>19</sub>H<sub>18</sub>N<sub>6</sub>O) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			26	19	6	1		
2	B	1	Total	C	N	O	0	0
			26	19	6	1		

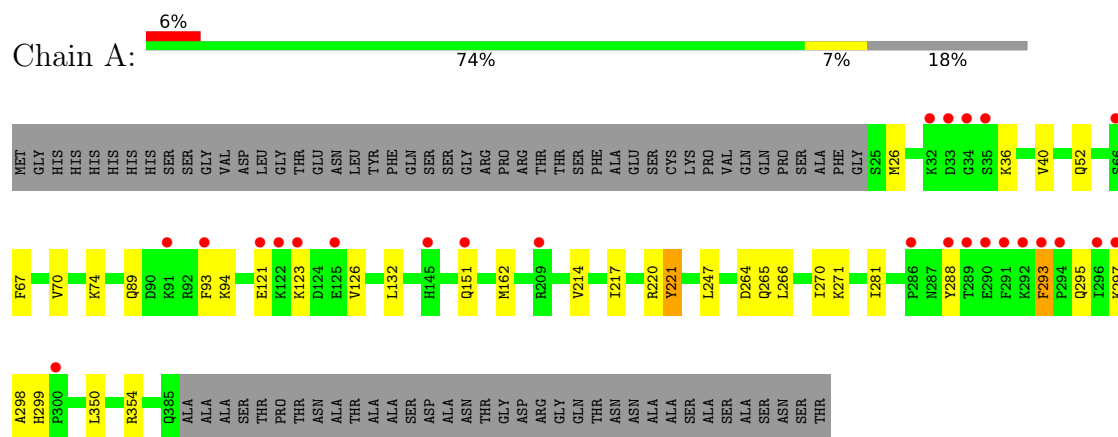
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	174	Total	O	0	0
			174	174		
3	B	200	Total	O	0	0
			200	200		

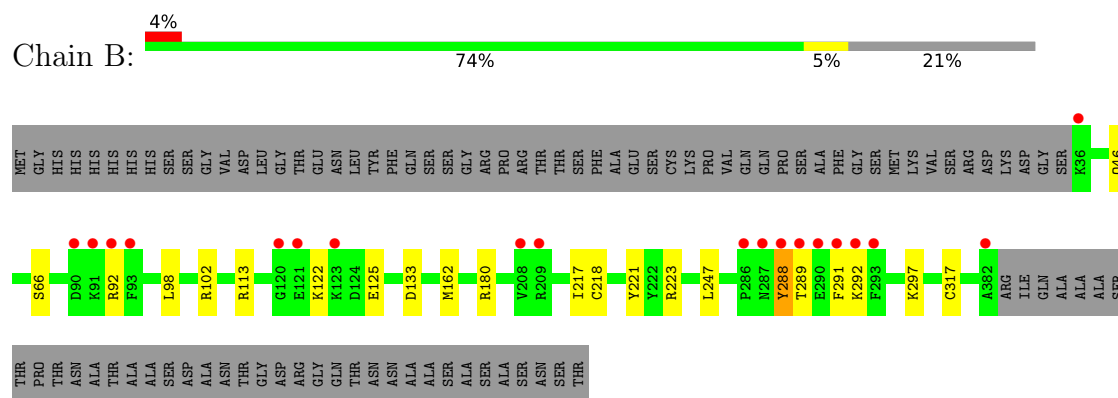
### 3 Residue-property plots [i](#)

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: Glycogen synthase kinase-3 beta



- Molecule 1: Glycogen synthase kinase-3 beta



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	82.32Å 85.25Å 178.42Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	56.20 – 2.30 56.20 – 2.30	Depositor EDS
% Data completeness (in resolution range)	97.6 (56.20-2.30) 100.0 (56.20-2.30)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.56 (at 2.25Å)	Xtriage
Refinement program	PHENIX (1.19.2_4158: ???)	Depositor
R, $R_{free}$	0.197 , 0.229 0.200 , 0.197	Depositor DCC
$R_{free}$ test set	2997 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	45.0	Xtriage
Anisotropy	0.521	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 35.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.015 for k,h,-l	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	6094	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.48% 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: A1IFJ

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	0.10	0/2960	0.27	0/4022
1	B	0.09	0/2850	0.27	0/3878
All	All	0.10	0/5810	0.27	0/7900

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2889	0	2919	22	0
1	B	2779	0	2804	15	0
2	A	26	0	0	0	0
2	B	26	0	0	0	0
3	A	174	0	0	1	0
3	B	200	0	0	3	0
All	All	6094	0	5723	33	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 3.

All (33) 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:162:MET:HE2	1:A:247:LEU:HB2	1.76	0.67
1:A:52:GLN:NE2	3:A:605:HOH:O	2.30	0.63
1:A:26:MET:HB3	1:A:40:VAL:HG12	1.80	0.61
1:A:293:PHE:O	1:A:295:GLN:NE2	2.34	0.61
1:A:297:LYS:NZ	1:A:298:ALA:O	2.33	0.60
1:A:266:LEU:O	1:A:270:ILE:HG12	2.02	0.58
1:B:46:GLN:NE2	3:B:606:HOH:O	2.36	0.58
1:B:180:ARG:HB3	1:B:217:ILE:HD13	1.86	0.57
1:B:162:MET:HE2	1:B:247:LEU:HB2	1.87	0.56
1:A:281:ILE:HD11	1:A:293:PHE:HE2	1.73	0.52
1:A:214:VAL:HG11	1:B:291:PHE:HB2	1.93	0.51
1:B:288:TYR:OH	3:B:601:HOH:O	2.20	0.50
1:B:122:LYS:HB2	1:B:125:GLU:HB2	1.94	0.49
1:A:220:ARG:HG2	1:A:221:TYR:CD1	2.49	0.47
1:A:74:LYS:HB2	1:A:74:LYS:HE2	1.76	0.47
1:B:102:ARG:NH2	3:B:609:HOH:O	2.43	0.47
1:A:67:PHE:HE1	1:A:70:VAL:HG23	1.80	0.46
1:B:297:LYS:HD3	1:B:297:LYS:HA	1.67	0.45
1:B:113:ARG:NE	1:B:133:ASP:OD1	2.45	0.45
1:B:218:CYS:HB3	1:B:223:ARG:HG2	1.98	0.45
1:A:121:GLU:OE1	1:A:121:GLU:N	2.43	0.44
1:A:350:LEU:HD12	1:A:354:ARG:HB2	2.00	0.43
1:A:271:LYS:O	1:A:299:HIS:HB2	2.18	0.43
1:A:162:MET:HG3	1:A:247:LEU:HD13	2.00	0.43
1:A:281:ILE:HD11	1:A:293:PHE:CE2	2.54	0.42
1:A:214:VAL:HG12	1:B:289:THR:HB	2.00	0.42
1:A:220:ARG:HG3	1:A:265:GLN:NE2	2.34	0.42
1:B:98:LEU:O	1:B:102:ARG:HG3	2.20	0.42
1:A:121:GLU:H	1:A:121:GLU:CD	2.27	0.42
1:A:264:ASP:OD1	1:B:66:SER:OG	2.34	0.41
1:A:89:GLN:HB3	1:A:126:VAL:HG13	2.03	0.41
1:A:93:PHE:CZ	1:B:292:LYS:HD3	2.56	0.40
1:B:217:ILE:H	1:B:217:ILE:HG13	1.67	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	359/442 (81%)	343 (96%)	12 (3%)	4 (1%)	12	13
1	B	345/442 (78%)	330 (96%)	12 (4%)	3 (1%)	14	17
All	All	704/884 (80%)	673 (96%)	24 (3%)	7 (1%)	13	15

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	92	ARG
1	A	36	LYS
1	A	221	TYR
1	B	288	TYR
1	A	288	TYR
1	A	123	LYS
1	B	221	TYR

### 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	322/383 (84%)	317 (98%)	5 (2%)	58	74
1	B	309/383 (81%)	308 (100%)	1 (0%)	91	96
All	All	631/766 (82%)	625 (99%)	6 (1%)	73	85

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	94	LYS
1	A	132	LEU
1	A	151	GLN
1	A	217	ILE
1	A	293	PHE
1	B	317	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	108	ASN
1	A	151	GLN
1	A	265	GLN
1	A	381	HIS
1	B	46	GLN
1	B	265	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 oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

2 ligands are modelled in this entry.

There are no bond length outliers.

There are no bond angle outliers.

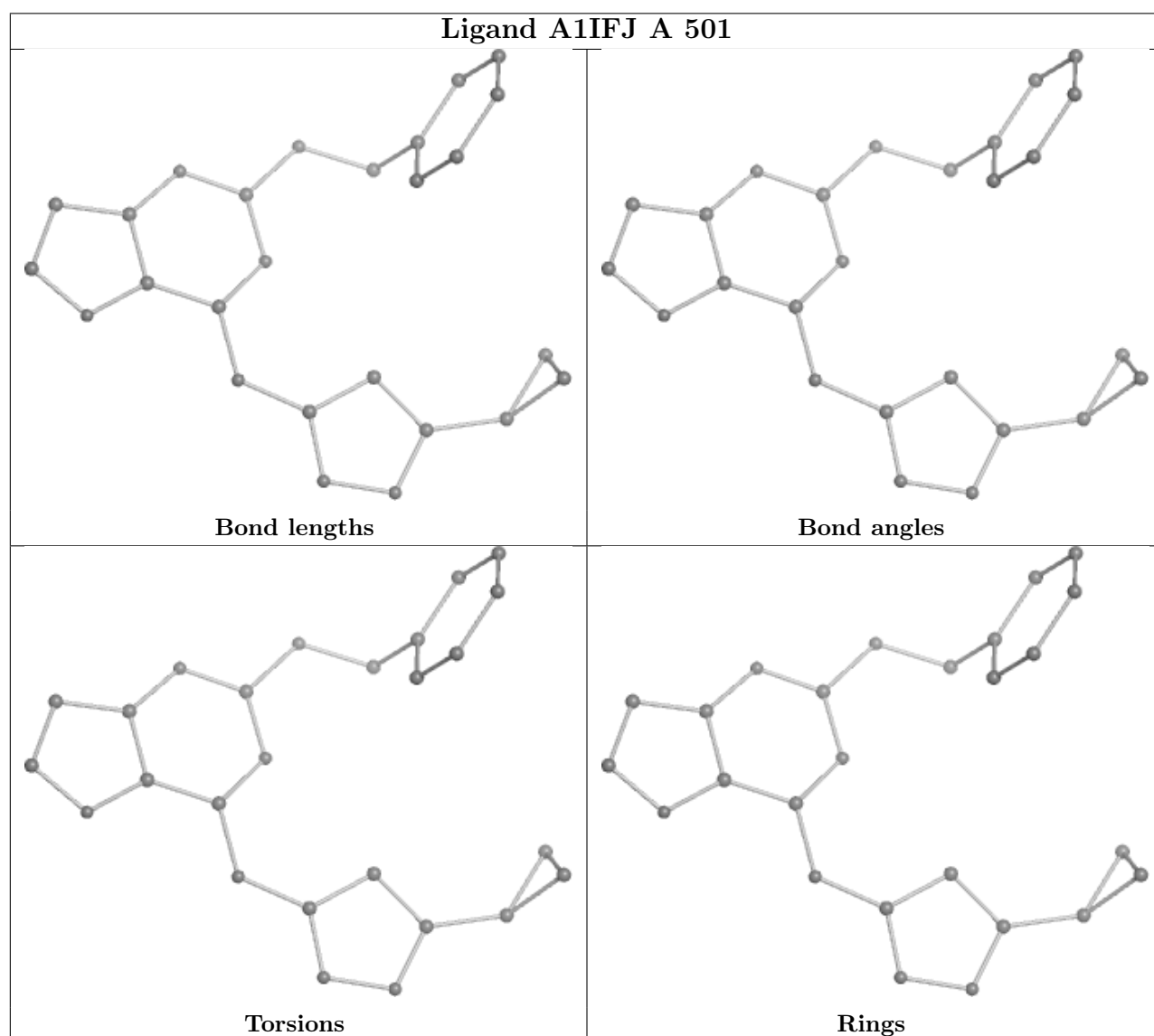
There are no chirality outliers.

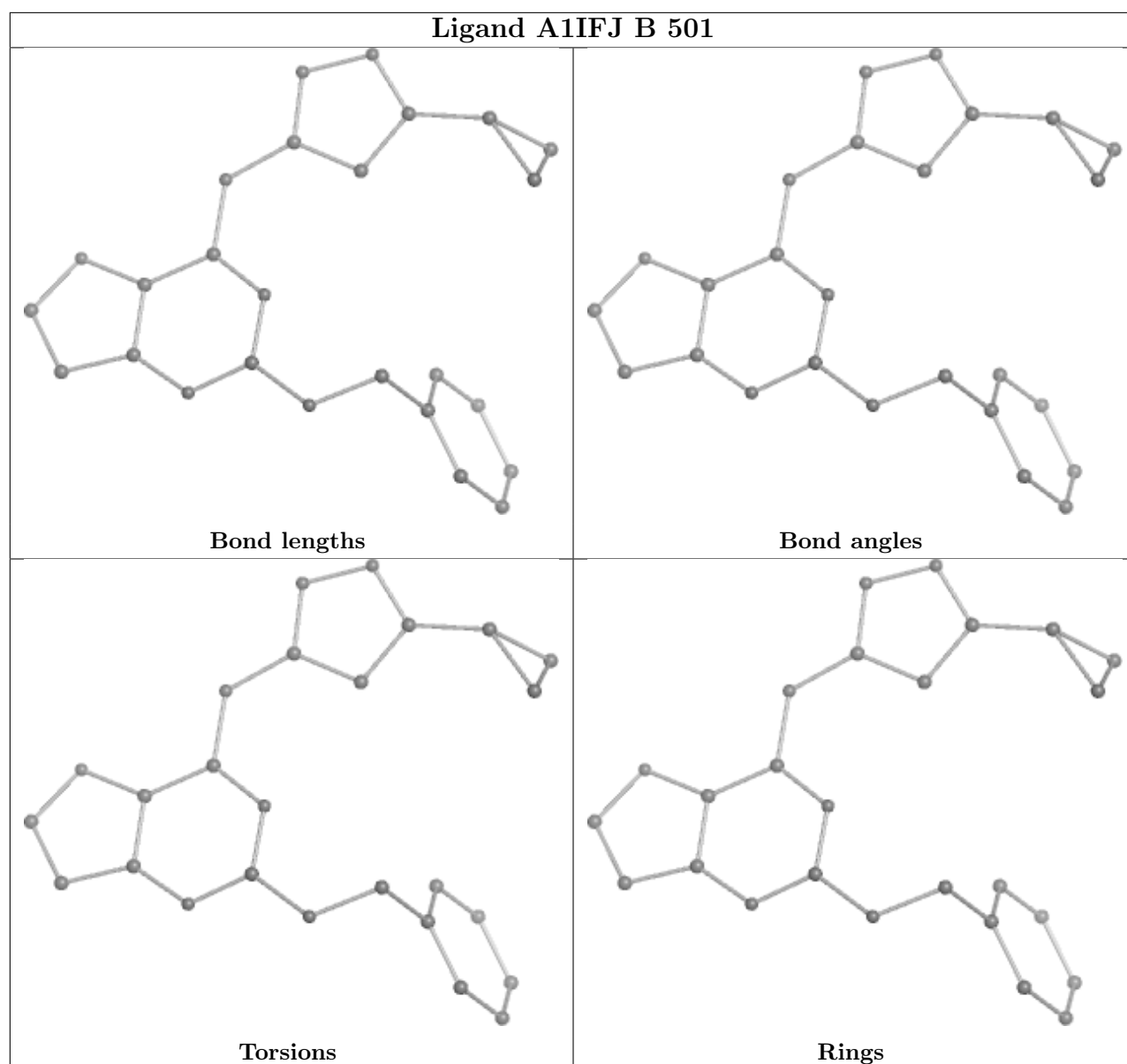
There are no torsion outliers.

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

### 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, 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	361/442 (81%)	0.17	25 (6%) 24 26	20, 37, 80, 98	0
1	B	347/442 (78%)	0.03	19 (5%) 32 33	18, 34, 72, 98	0
All	All	708/884 (80%)	0.10	44 (6%) 28 29	18, 35, 76, 98	0

All (44) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	291	PHE	9.5
1	B	291	PHE	8.1
1	B	289	THR	7.1
1	B	93	PHE	6.4
1	A	286	PRO	5.8
1	A	289	THR	5.7
1	B	288	TYR	4.8
1	A	292	LYS	4.7
1	A	293	PHE	4.5
1	A	288	TYR	4.4
1	A	290	GLU	4.3
1	B	290	GLU	4.1
1	A	93	PHE	3.8
1	B	286	PRO	3.5
1	B	91	LYS	3.5
1	A	294	PRO	3.4
1	B	292	LYS	3.3
1	A	34	GLY	3.2
1	A	125	GLU	3.0
1	B	287	ASN	3.0
1	A	123	LYS	2.9
1	A	297	LYS	2.8
1	A	296	ILE	2.8
1	B	123	LYS	2.7

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Mol	Chain	Res	Type	RSRZ
1	A	121	GLU	2.7
1	A	32	LYS	2.7
1	B	121	GLU	2.7
1	A	35	SER	2.7
1	B	92	ARG	2.6
1	A	300	PRO	2.6
1	A	122	LYS	2.6
1	B	36	LYS	2.5
1	A	33	ASP	2.5
1	B	209	ARG	2.4
1	B	293	PHE	2.4
1	B	90	ASP	2.3
1	B	382	ALA	2.3
1	B	208	VAL	2.3
1	A	151	GLN	2.1
1	B	120	GLY	2.1
1	A	91	LYS	2.1
1	A	66	SER	2.1
1	A	145	HIS	2.0
1	A	209	ARG	2.0

## 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 oligosaccharides in this entry.

## 6.4 Ligands [i](#)

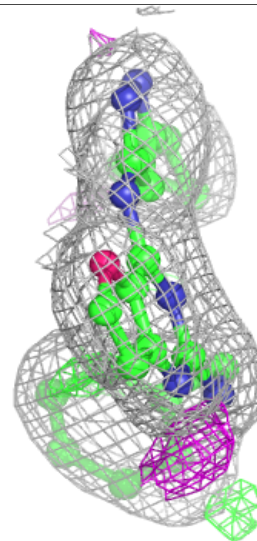
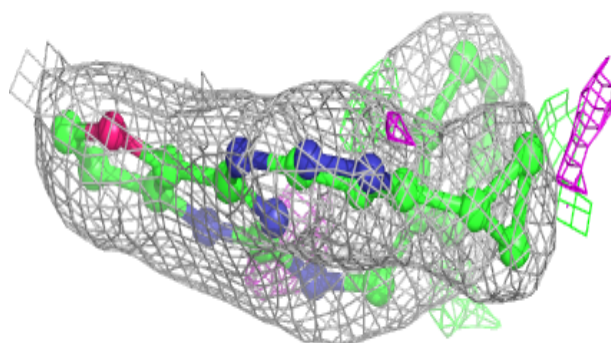
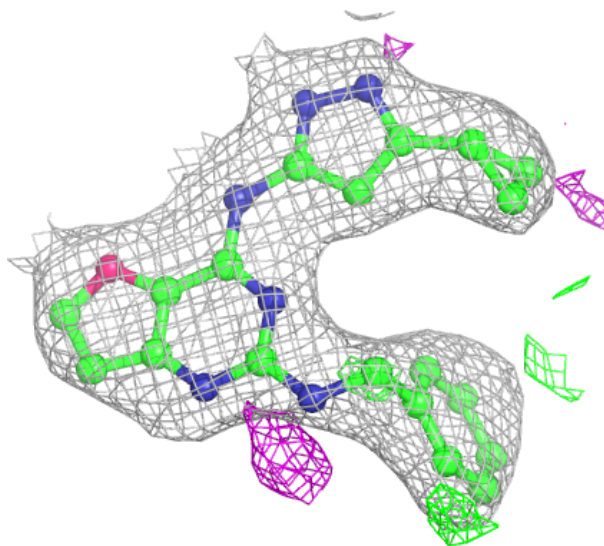
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 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	A1IFJ	B	501	26/26	0.94	0.08	17,30,35,37	0
2	A1IFJ	A	501	26/26	0.96	0.07	23,33,37,45	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 A1IFJ B 501:**

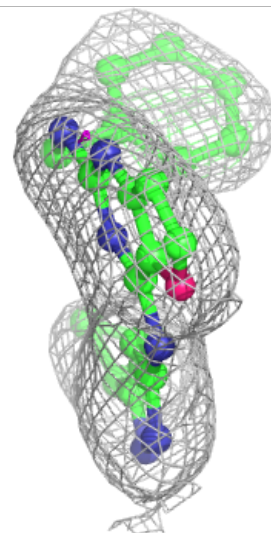
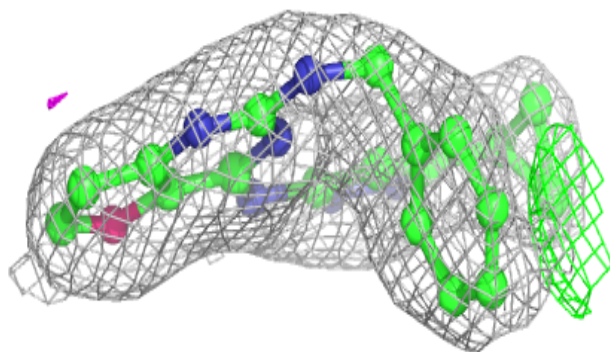
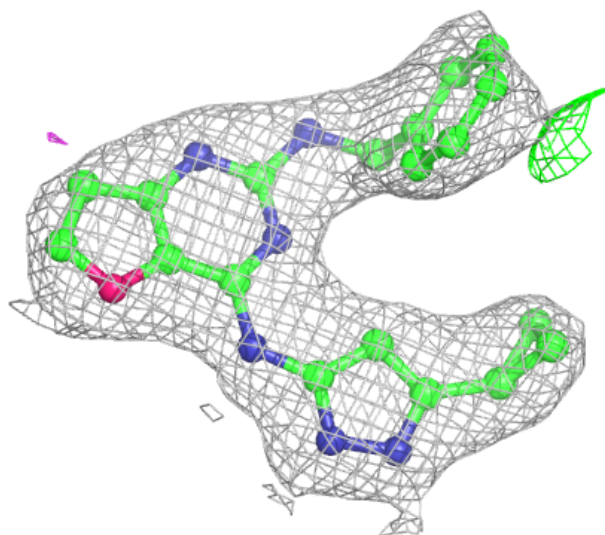
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





**Electron density around A1IFJ A 501:**

$2mF_o-DF_c$  (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.