



# Full wwPDB X-ray Structure Validation Report ⓘ

May 15, 2020 – 10:11 am BST

PDB ID : 4Y2B  
Title : Co-crystal structure of 3-ethyl-2-(isopropylamino)-7-(pyridin-3-yl)thieno[3,2-d]pyrimidin-4(3H)-one bound to PDE7A  
Authors : Endo, Y.; Kawai, K.; Asano, T.; Amano, S.; Asanuma, Y.; Sawada, K.; Onodera, Y.; Ueo, N.; Takahashi, N.; Sonoda, Y.; Kamei, N.; Irie, T.  
Deposited on : 2015-02-09  
Resolution : 2.20 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 : 2.11  
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

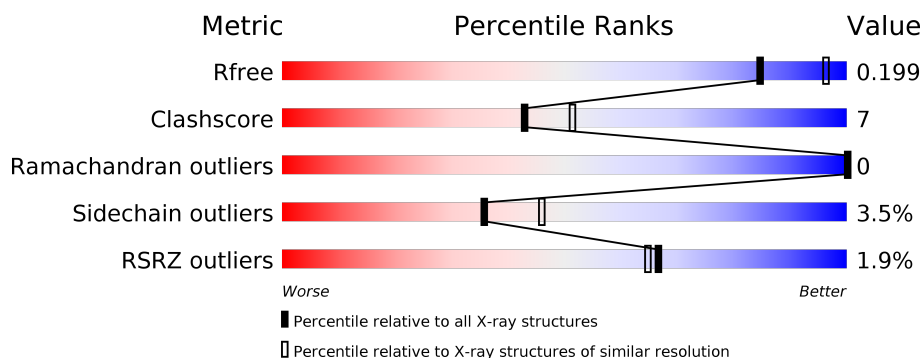
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (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 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	389	<div> <div>2%</div> <div>68%</div> <div>12%</div> <div>•</div> <div>18%</div> </div>

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 2903 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 High affinity cAMP-specific 3',5'-cyclic phosphodiesterase 7A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	318	2595	1653	459	467	16	0	0	0

There are 36 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	94	GLY	-	expression tag	UNP Q13946
A	95	SER	-	expression tag	UNP Q13946
A	96	GLY	-	expression tag	UNP Q13946
A	97	MET	-	expression tag	UNP Q13946
A	98	LYS	-	expression tag	UNP Q13946
A	99	GLU	-	expression tag	UNP Q13946
A	100	THR	-	expression tag	UNP Q13946
A	101	ALA	-	expression tag	UNP Q13946
A	102	ALA	-	expression tag	UNP Q13946
A	103	ALA	-	expression tag	UNP Q13946
A	104	LYS	-	expression tag	UNP Q13946
A	105	PHE	-	expression tag	UNP Q13946
A	106	GLU	-	expression tag	UNP Q13946
A	107	ARG	-	expression tag	UNP Q13946
A	108	GLN	-	expression tag	UNP Q13946
A	109	HIS	-	expression tag	UNP Q13946
A	110	MET	-	expression tag	UNP Q13946
A	111	ASP	-	expression tag	UNP Q13946
A	112	SER	-	expression tag	UNP Q13946
A	113	PRO	-	expression tag	UNP Q13946
A	114	ASP	-	expression tag	UNP Q13946
A	115	LEU	-	expression tag	UNP Q13946
A	116	GLY	-	expression tag	UNP Q13946
A	117	THR	-	expression tag	UNP Q13946
A	118	ASP	-	expression tag	UNP Q13946
A	119	ASP	-	expression tag	UNP Q13946
A	120	ASP	-	expression tag	UNP Q13946

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Chain	Residue	Modelled	Actual	Comment	Reference
A	121	ASP	-	expression tag	UNP Q13946
A	122	LYS	-	expression tag	UNP Q13946
A	123	ALA	-	expression tag	UNP Q13946
A	124	MET	-	expression tag	UNP Q13946
A	125	ALA	-	expression tag	UNP Q13946
A	126	ASP	-	expression tag	UNP Q13946
A	127	ILE	-	expression tag	UNP Q13946
A	128	GLY	-	expression tag	UNP Q13946
A	129	SER	-	expression tag	UNP Q13946

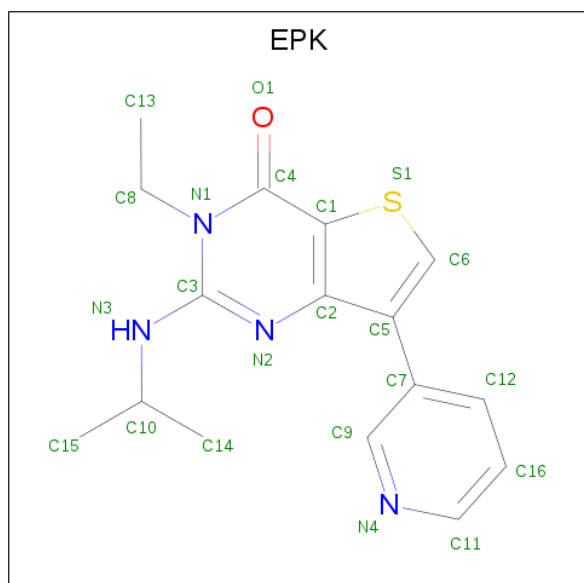
- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Zn 1 1	0	0

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Mg 1 1	0	0

- Molecule 4 is 3-ethyl-2-(propan-2-ylamino)-7-(pyridin-3-yl)thieno[3,2-d]pyrimidin-4(3H)-one (three-letter code: EPK) (formula: C<sub>16</sub>H<sub>18</sub>N<sub>4</sub>OS).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	S	0	0
			22	16	4	1	1		

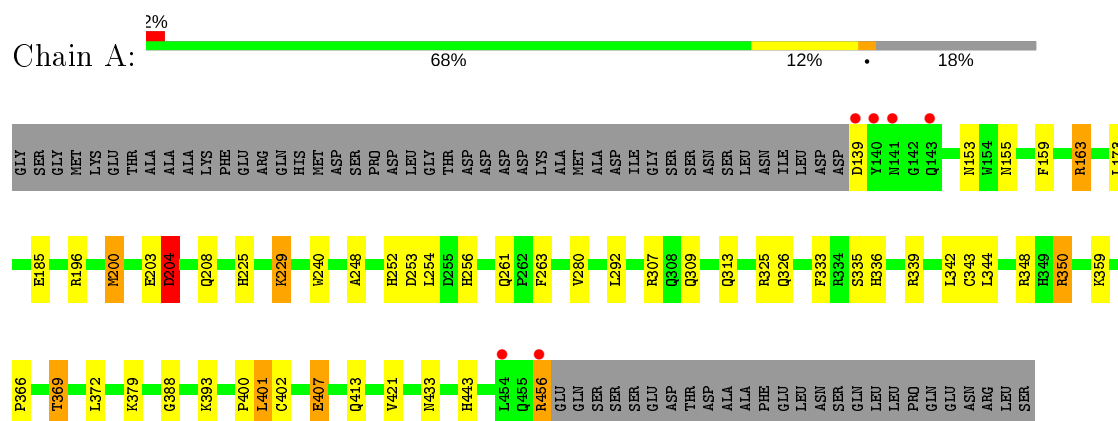
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	284	Total	O	0	0
			284	284		

### 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: High affinity cAMP-specific 3',5'-cyclic phosphodiesterase 7A



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	115.96 Å   115.96 Å   64.41 Å 90.00°   90.00°   120.00°	Depositor
Resolution (Å)	30.67 – 2.20 30.67 – 2.20	Depositor EDS
% Data completeness (in resolution range)	99.6 (30.67-2.20) 99.6 (30.67-2.20)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.39 (at 2.20 Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, $R_{free}$	0.158 , 0.196 0.158 , 0.199	Depositor DCC
$R_{free}$ test set	1294 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	26.0	Xtriage
Anisotropy	0.015	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 51.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.034 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	2903	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.12% 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: MG, ZN, EPK

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	1.15	6/2662 (0.2%)	0.95	8/3607 (0.2%)

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	185	GLU	CD-OE1	6.43	1.32	1.25
1	A	343	CYS	CB-SG	-5.95	1.72	1.81
1	A	407	GLU	CB-CG	5.94	1.63	1.52
1	A	203	GLU	CB-CG	5.29	1.62	1.52
1	A	333	PHE	CE1-CZ	5.19	1.47	1.37
1	A	263	PHE	CE1-CZ	5.07	1.47	1.37

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	163	ARG	NE-CZ-NH2	-9.34	115.63	120.30
1	A	163	ARG	NE-CZ-NH1	6.53	123.56	120.30
1	A	350	ARG	NE-CZ-NH1	6.50	123.55	120.30
1	A	200	MET	CG-SD-CE	6.35	110.36	100.20
1	A	204	ASP	CB-CG-OD2	-5.67	113.20	118.30
1	A	307	ARG	NE-CZ-NH1	5.44	123.02	120.30
1	A	229	LYS	CD-CE-NZ	5.31	123.92	111.70
1	A	163	ARG	CG-CD-NE	-5.10	101.09	111.80

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	2595	0	2538	35	0
2	A	1	0	0	0	0
3	A	1	0	0	0	0
4	A	22	0	18	0	0
5	A	284	0	0	13	0
All	All	2903	0	2556	35	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 7.

All (35) 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:309:GLN:HG2	1:A:313:GLN:HE21	1.33	0.93
1:A:229:LYS:CE	5:A:871:HOH:O	2.29	0.80
1:A:208:GLN:OE1	5:A:826:HOH:O	2.01	0.79
1:A:309:GLN:HG2	1:A:313:GLN:NE2	1.96	0.79
1:A:369:THR:HG21	5:A:811:HOH:O	1.86	0.76
1:A:326:GLN:HE21	1:A:359:LYS:HZ1	1.33	0.73
1:A:163:ARG:NH2	5:A:741:HOH:O	2.22	0.70
1:A:204:ASP:OD2	5:A:746:HOH:O	2.10	0.70
1:A:155:ASN:OD1	5:A:761:HOH:O	2.14	0.66
1:A:400:PRO:O	1:A:401:LEU:HB2	1.97	0.63
1:A:229:LYS:HE3	5:A:871:HOH:O	1.94	0.59
1:A:240:TRP:HE1	1:A:313:GLN:HE22	1.51	0.57
1:A:326:GLN:HE21	1:A:359:LYS:NZ	2.03	0.57
1:A:335:SER:HB3	1:A:339:ARG:NH2	2.22	0.55
1:A:261:GLN:NE2	1:A:280:VAL:H	2.04	0.55
1:A:456:ARG:C	1:A:456:ARG:HD2	2.27	0.55
1:A:344:LEU:O	1:A:350:ARG:HD3	2.10	0.52
1:A:366:PRO:HG2	1:A:421:VAL:HG21	1.91	0.52
1:A:196:ARG:NH1	5:A:601:HOH:O	2.38	0.51
1:A:369:THR:CG2	1:A:372:LEU:H	2.24	0.51
1:A:196:ARG:O	1:A:200:MET:HG3	2.11	0.50
1:A:254:LEU:HD21	1:A:292:LEU:HD12	1.93	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:388:GLY:HA3	1:A:402:CYS:O	2.13	0.49
1:A:309:GLN:CG	1:A:313:GLN:NE2	2.73	0.48
1:A:336:HIS:HB3	1:A:342:LEU:HG	1.95	0.47
1:A:253:ASP:O	1:A:256:HIS:HB2	2.17	0.45
1:A:335:SER:HB3	1:A:339:ARG:HH21	1.82	0.44
1:A:229:LYS:HE2	5:A:871:HOH:O	2.08	0.43
1:A:225:HIS:NE2	1:A:229:LYS:HE2	2.33	0.43
1:A:159:PHE:CE1	1:A:379:LYS:HE3	2.55	0.42
1:A:248:ALA:O	1:A:252:HIS:HB3	2.19	0.42
1:A:413:GLN:HG2	5:A:790:HOH:O	2.20	0.41
1:A:443:HIS:HE1	5:A:761:HOH:O	2.02	0.41
1:A:325:ARG:HD3	5:A:796:HOH:O	2.19	0.41
1:A:393:LYS:NZ	5:A:605:HOH:O	2.53	0.41

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	316/389 (81%)	310 (98%)	6 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	285/345 (83%)	275 (96%)	10 (4%)	36	46

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	139	ASP
1	A	153	ASN
1	A	173	LEU
1	A	204	ASP
1	A	348	ARG
1	A	369	THR
1	A	401	LEU
1	A	407	GLU
1	A	433	ASN
1	A	456	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	168	ASN
1	A	176	HIS
1	A	202	GLN
1	A	261	GLN
1	A	308	GLN
1	A	313	GLN
1	A	326	GLN
1	A	433	ASN
1	A	443	HIS

### 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

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 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
4	EPK	A	503	-	19,24,24	3.12	7 (36%)	18,34,34	4.27	10 (55%)

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
4	EPK	A	503	-	-	0/10/10/10	0/3/3/3

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	503	EPK	C3-N2	7.96	1.45	1.33
4	A	503	EPK	C9-N4	6.35	1.48	1.34
4	A	503	EPK	O1-C4	5.23	1.37	1.24
4	A	503	EPK	C16-C11	4.05	1.49	1.37
4	A	503	EPK	C12-C7	3.37	1.46	1.39
4	A	503	EPK	C16-C12	-2.90	1.32	1.38
4	A	503	EPK	C6-C5	2.85	1.38	1.37

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	503	EPK	C5-C6-S1	-14.18	108.57	112.53
4	A	503	EPK	C12-C7-C5	-6.51	109.90	120.86
4	A	503	EPK	C4-C1-C2	4.68	122.96	119.96
4	A	503	EPK	C6-S1-C1	3.49	95.42	91.24
4	A	503	EPK	C12-C7-C9	3.23	124.75	116.76
4	A	503	EPK	C7-C9-N4	-3.19	114.92	123.48
4	A	503	EPK	C16-C12-C7	-2.17	117.84	120.56

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	503	EPK	C9-C7-C5	2.15	125.25	121.72
4	A	503	EPK	C14-C10-N3	-2.11	105.35	109.94
4	A	503	EPK	C11-N4-C9	2.10	120.49	116.85

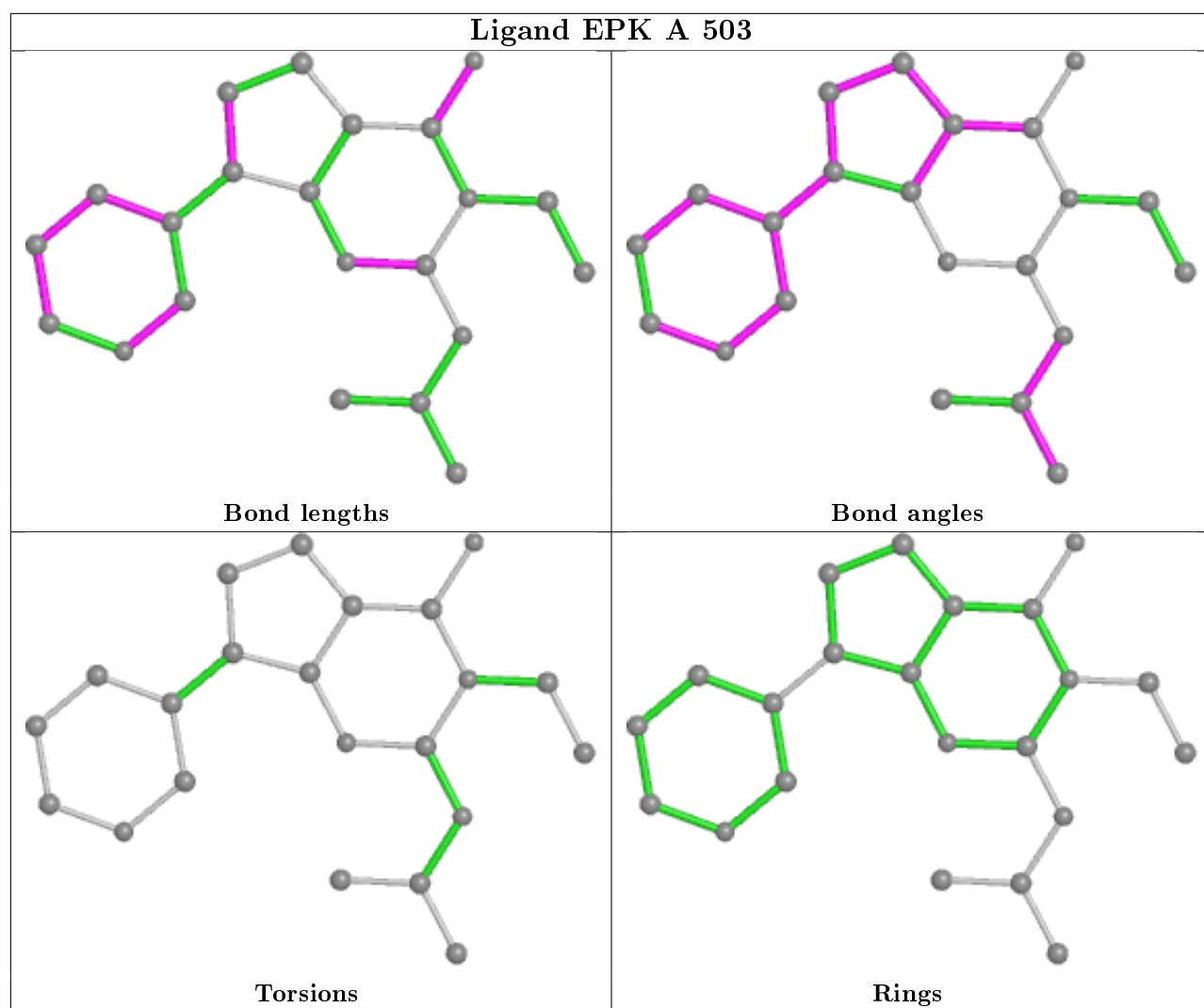
There are no chirality outliers.

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 [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	318/389 (81%)	-0.53	6 (1%) 66 65	15, 24, 42, 86	0

All (6) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	139	ASP	4.1
1	A	456	ARG	3.8
1	A	141	ASN	3.3
1	A	140	TYR	2.5
1	A	454	LEU	2.2
1	A	143	GLN	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 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.

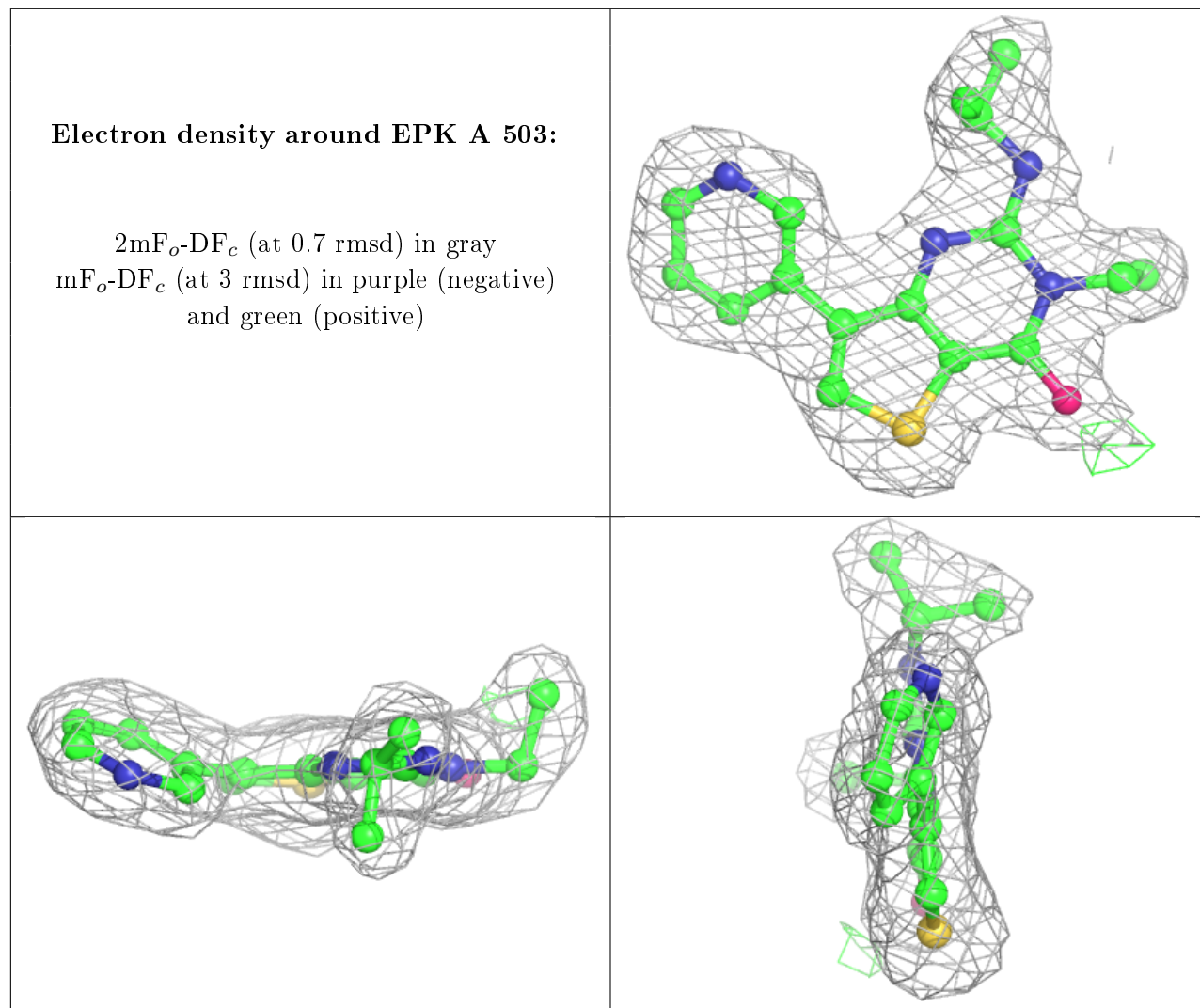
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
4	EPK	A	503	22/22	0.98	0.16	13,18,21,21	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	MG	A	502	1/1	0.99	0.08	18,18,18,18	0
2	ZN	A	501	1/1	1.00	0.06	26,26,26,26	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 ⓘ

There are no such residues in this entry.