Full wwPDB X-ray Structure Validation Report ⓘ

Oct 28, 2025 – 06:19 pm GMT

PDB ID	:	9S9T / pdb_00009s9t
Title	:	Structure of human PKCBeta Kinase domain with Ruboxistaurin, D427N mutant
Authors	:	Briggs, D.C.; Parker, P.J.; McDonald, N.Q.; Brown, S.J.
Deposited on	:	2025-08-06
Resolution	:	3.42 Å(reported)

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

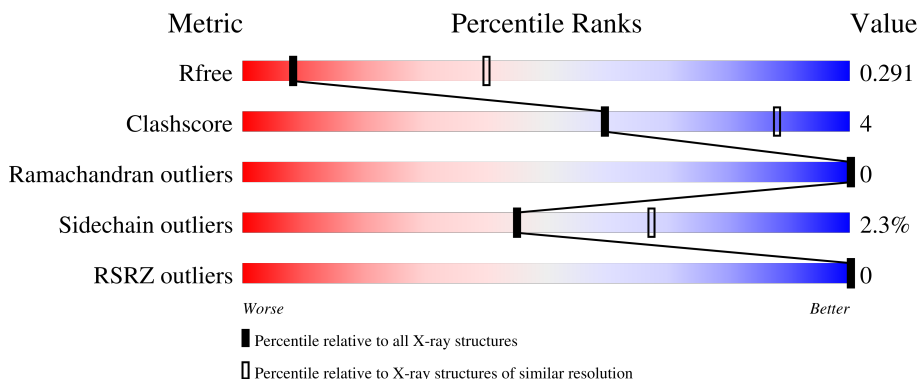|		
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.46

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 3.42 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 | Percentile Ranks | Value

Rfree — 0.291
Clashscore — 4
Ramachandran outliers — 0
Sidechain outliers — 2.3%
RSRZ outliers — 0

Worse   *Better*

▐ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	164625	1112 (3.48-3.36)
Clashscore	180529	1144 (3.48-3.36)
Ramachandran outliers	177936	1146 (3.48-3.36)
Sidechain outliers	177891	1146 (3.48-3.36)
RSRZ outliers	164620	1112 (3.48-3.36)

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	353	71% 16% · 11%

2 Entry composition ⓘ

There are 2 unique types of molecules in this entry. The entry contains 5001 atoms, of which 2437 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 Isoform Beta-II of Protein kinase C beta type.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
			Total	C	H	N	O	P	S			
1	A	315	4938	1626	2409	410	471	3	19	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	321	GLY	-	expression tag	UNP P05771
A	427	ASN	ASP	engineered mutation	UNP P05771

- Molecule 2 is (9R)-9-[(DIMETHYLAMINO)METHYL]-6,7,10,11-TETRAHYDRO-9H,18H-5,21:12,17-DIMETHENODIBENZO[E,K]PYRROLO[3,4-H][1,4,13]OXADIA ZACYCLOH EXADECINE-18,20-DIONE (CCD ID: LY4) (formula: $C_{28}H_{28}N_4O_3$) (labeled as "Ligand of Interest" by depositor).
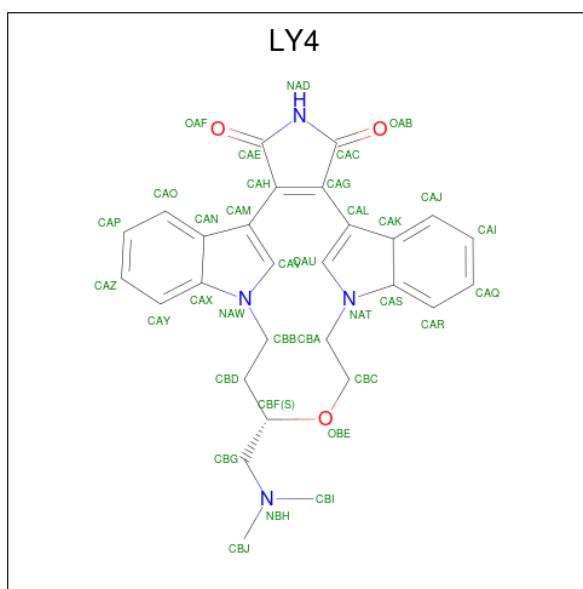

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	H	N	O		
2	A	1	63	28	28	4	3	0	0

3 Residue-property plots ⓘ

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: Isoform Beta-II of Protein kinase C beta type
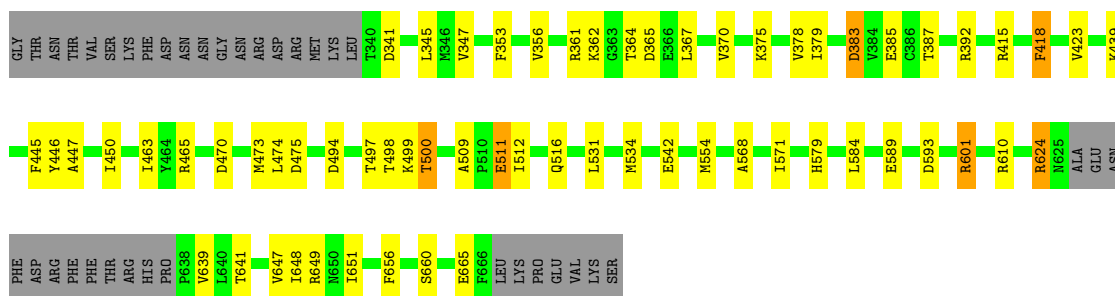
4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α, β, γ	102.33Å 102.33Å 82.83Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	60.51 – 3.42 60.51 – 3.42	Depositor EDS
% Data completeness (in resolution range)	99.8 (60.51-3.42) 99.8 (60.51-3.42)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	0.97 (at 3.40Å)	Xtriage
Refinement program	REFMAC 5.8.0430 (refmacat 0.4.105)	Depositor
R, R_{free}	0.214 , 0.290 0.215 , 0.291	Depositor DCC
R_{free} test set	364 reflections (5.20%)	wwPDB-VP
Wilson B-factor (Å^2)	123.4	Xtriage
Anisotropy	0.055	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.41 , 128.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.35, < L^2 > = 0.19$	Xtriage
Estimated twinning fraction	0.229 for -h,-k,l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	5001	wwPDB-VP
Average B, all atoms (Å^2)	145.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.99% of the height of the origin peak. No significant pseudotranslation is detected.*

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[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: SEP, LY4, TPO

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	0.73	0/2558	1.54	21/3445 (0.6%)

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	7

There are no bond length outliers.

All (21) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	418	PHE	CA-CB-CG	7.68	121.48	113.80
1	A	341	ASP	CA-CB-CG	7.60	120.20	112.60
1	A	511	GLU	CB-CA-C	-7.01	97.46	109.65
1	A	554	MET	CG-SD-CE	6.83	115.92	100.90
1	A	624	ARG	NE-CZ-NH2	6.56	125.10	119.20
1	A	365	ASP	CB-CA-C	6.47	121.24	111.80
1	A	475	ASP	CA-CB-CG	6.25	118.85	112.60
1	A	542	GLU	CB-CG-CD	5.96	122.72	112.60
1	A	347	VAL	N-CA-CB	5.69	117.82	110.99
1	A	579	HIS	CB-CA-C	5.60	115.71	110.17
1	A	353	PHE	CA-CB-CG	5.52	119.32	113.80
1	A	445	PHE	CA-CB-CG	5.48	119.28	113.80
1	A	385	GLU	CB-CG-CD	5.37	121.73	112.60
1	A	494	ASP	CA-CB-CG	5.36	117.96	112.60
1	A	497	THR	CA-CB-OG1	-5.24	101.74	109.60
1	A	624	ARG	NE-CZ-NH1	-5.24	116.26	121.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	445	PHE	N-CA-CB	5.20	117.52	109.98
1	A	439	LYS	CB-CG-CD	5.10	123.02	111.30
1	A	450	ILE	N-CA-C	-5.08	105.37	110.30
1	A	383	ASP	CA-CB-CG	5.08	117.68	112.60
1	A	665	GLU	CB-CG-CD	5.01	121.13	112.60

There are no chirality outliers.

All (7) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	361	ARG	Sidechain
1	A	392	ARG	Sidechain
1	A	415	ARG	Sidechain
1	A	601	ARG	Sidechain
1	A	610	ARG	Sidechain
1	A	624	ARG	Sidechain
1	A	649	ARG	Sidechain

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	2529	2409	2455	21	0
2	A	35	28	28	3	0
All	All	2564	2437	2483	21	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 4.

All (21) 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:446:TYR:HB2	1:A:534:MET:HE1	1.67	0.76
1:A:345:LEU:HD12	1:A:367:LEU:HD11	1.85	0.58
1:A:379:ILE:HD11	1:A:656:PHE:CE2	2.44	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:345:LEU:CD1	1:A:367:LEU:HD11	2.41	0.51
1:A:356:VAL:HG11	2:A:701:LY4:CAU	2.42	0.50
1:A:584:LEU:HD11	1:A:593:ASP:HB3	1.95	0.49
1:A:375:LYS:HA	1:A:378:VAL:HG22	1.93	0.49
1:A:509:ALA:HB3	1:A:512:ILE:HG22	1.96	0.48
1:A:601:ARG:HG2	1:A:601:ARG:HH11	1.80	0.47
1:A:447:ALA:HB2	1:A:531:LEU:HD21	1.97	0.46
1:A:648:ILE:HA	1:A:651:ILE:HD12	1.96	0.46
1:A:423:VAL:HG12	1:A:474:LEU:O	2.17	0.44
1:A:511:GLU:O	1:A:516:GLN:HB2	2.18	0.44
1:A:383:ASP:O	1:A:387:THR:HG23	2.19	0.43
1:A:465:ARG:NH2	1:A:498:THR:HG21	2.35	0.42
1:A:470:ASP:HB3	2:A:701:LY4:HBI3	2.02	0.41
1:A:473:MET:HE1	2:A:701:LY4:CAG	2.50	0.41
1:A:568:ALA:O	1:A:571:ILE:HG22	2.21	0.41
1:A:568:ALA:HA	1:A:571:ILE:HG22	2.02	0.41
1:A:370:VAL:HG13	1:A:418:PHE:O	2.21	0.41
1:A:499:LYS:O	1:A:500:TPO:C	2.69	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	308/353 (87%)	289 (94%)	19 (6%)	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	266/305 (87%)	260 (98%)	6 (2%)	45　67

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

Mol	Chain	Res	Type
1	A	362	LYS
1	A	364	THR
1	A	463	ILE
1	A	589	GLU
1	A	639	VAL
1	A	647	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	471	ASN
1	A	557	ASN
1	A	650	ASN

5.3.3　RNA ⓘ

There are no RNA molecules in this entry.

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

3 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	TPO	A	500	1	8,10,11	1.03	1 (12%)	10,14,16	1.14	1 (10%)
1	TPO	A	641	1	8,10,11	0.71	0	10,14,16	1.17	1 (10%)
1	SEP	A	660	1	8,9,10	0.97	0	8,12,14	1.17	1 (12%)

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
1	TPO	A	500	1	-	0/9/11/13	-
1	TPO	A	641	1	-	3/9/11/13	-
1	SEP	A	660	1	-	2/5/8/10	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	500	TPO	P-O3P	-2.00	1.47	1.54

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	641	TPO	O-C-CA	-2.88	117.24	124.78
1	A	500	TPO	O-C-CA	-2.40	118.49	124.78
1	A	660	SEP	OG-CB-CA	2.25	110.33	108.14

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	641	TPO	C-CA-CB-CG2
1	A	641	TPO	CB-OG1-P-O1P
1	A	660	SEP	N-CA-CB-OG
1	A	641	TPO	CB-OG1-P-O2P
1	A	660	SEP	CA-CB-OG-P

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	500	TPO	1	0

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

1 ligand is 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	LY4	A	701	-	37,40,40	1.26	2 (5%)	37,59,59	1.05	1 (2%)

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	LY4	A	701	-	-	6/15/39/39	0/5/6/6

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	701	LY4	CAU-NAT	-4.34	1.32	1.38
2	A	701	LY4	CAV-NAW	-2.74	1.35	1.38

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	701	LY4	CBB-NAW-CAV	2.03	127.52	123.90

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	701	LY4	CBB-CBD-CBF-OBE
2	A	701	LY4	CBD-CBB-NAW-CAV
2	A	701	LY4	CBD-CBB-NAW-CAX
2	A	701	LY4	CBD-CBF-CBG-NBH
2	A	701	LY4	OBE-CBF-CBG-NBH
2	A	701	LY4	CBB-CBD-CBF-CBG

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	701	LY4	3	0

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 LY4 A 701

Bond lengths

Bond angles

Torsions

Rings
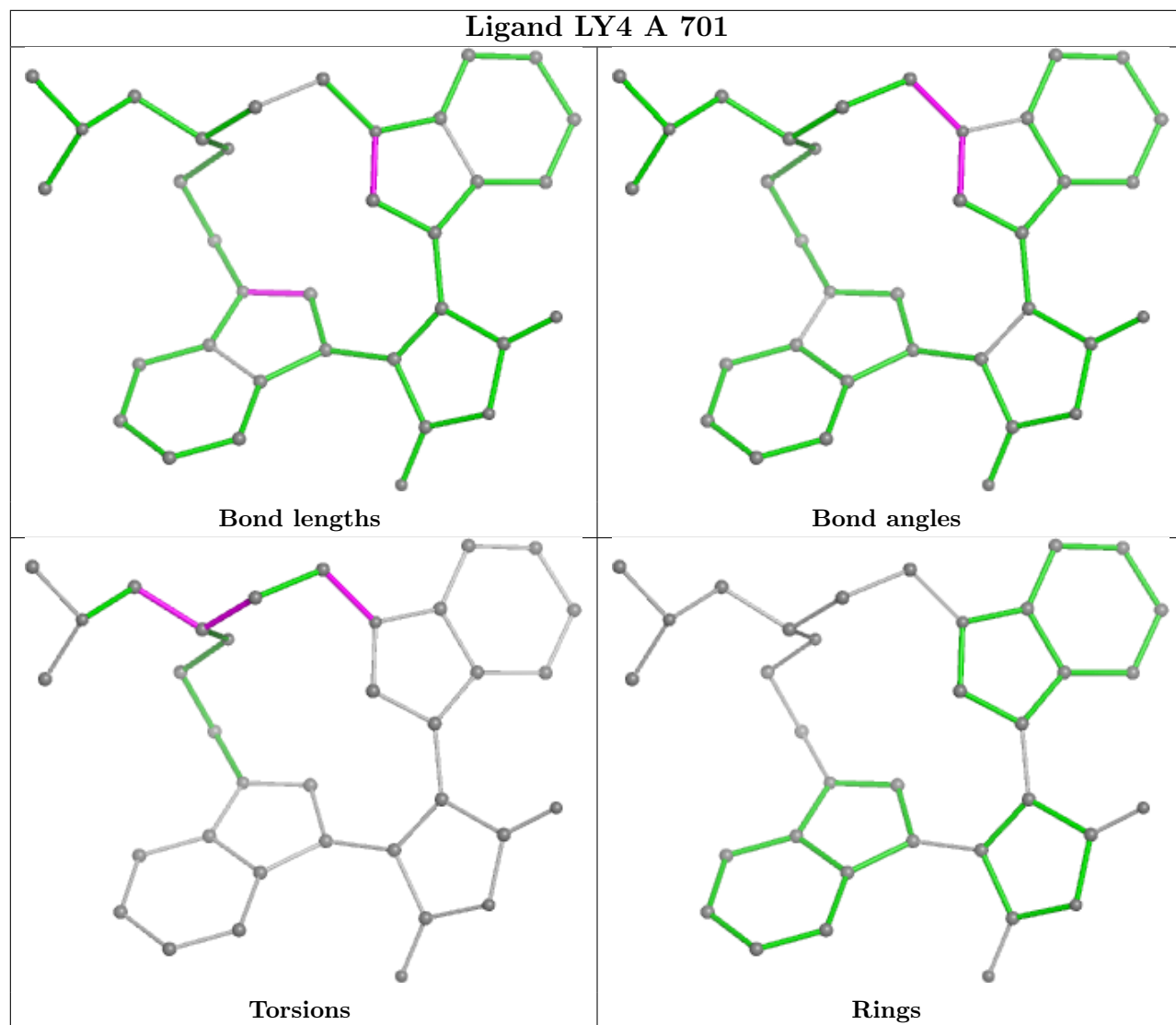
5.7 Other polymers ⓘ

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 ⓘ

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, 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(Å²)	Q<0.9
1	A	312/353 (88%)	-0.96	0	100	100	93, 142, 198, 231	0

There are no RSRZ outliers to report.

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

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.

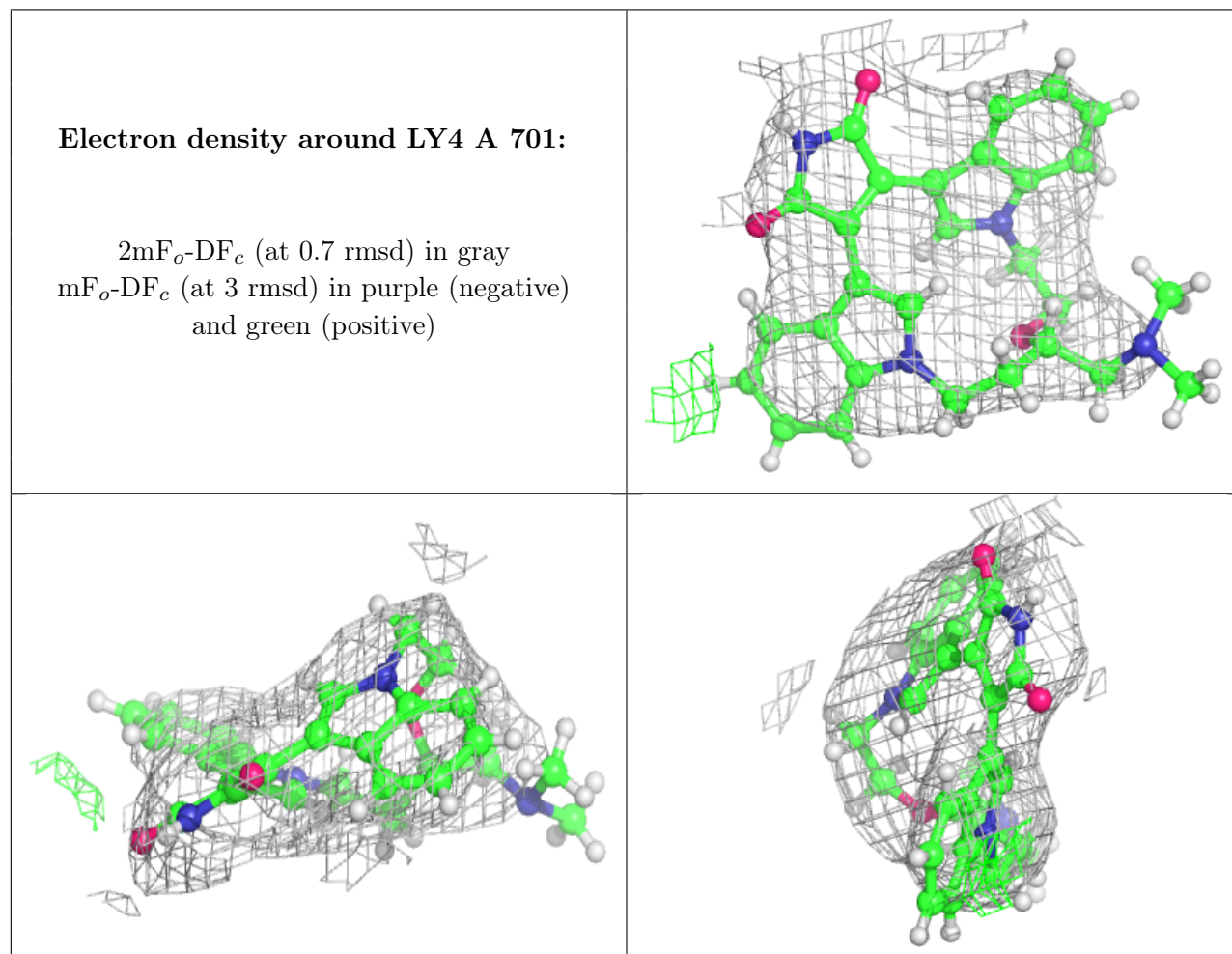| Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å²)	Q<0.9
1	TPO	A	641	11/12	0.76	0.06	169,198,214,256	0
1	SEP	A	660	10/11	0.89	0.10	143,150,165,170	0
1	TPO	A	500	11/12	0.97	0.04	95,110,140,161	0

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

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(Å²)	Q<0.9
2	LY4	A	701	35/35	0.97	0.06	107,129,159,169	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 LY4 A 701:

$2mF_o$-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 ⓘ

There are no such residues in this entry.