



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 01:21 PM UTC

PDB ID : 4RA4 / pdb_00004ra4
Title : Crystal Structure of Human Protein Kinase C Alpha in Complex with Compound 28 ((R)-6-((3S,4S)-1,3-Dimethyl-piperidin-4-yl)-7-(2-fluoro-phenyl)-4-methyl-2,10-dihydro-9-oxa-1,2,4a-triaza-phenanthren-3-one)
Authors : Argiriadi, M.A.; George, D.M.
Deposited on : 2014-09-09
Resolution : 2.63 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

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>.

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	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
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)	:	2.49

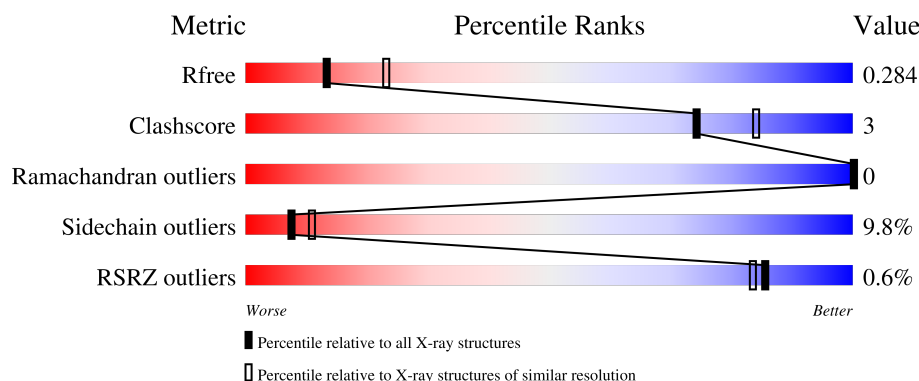
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.63 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}	180053	2053 (2.66-2.62)
Clashscore	190562	2097 (2.66-2.62)
Ramachandran outliers	187476	2066 (2.66-2.62)
Sidechain outliers	187428	2066 (2.66-2.62)
RSRZ outliers	180081	2052 (2.66-2.62)

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 $\leq 5\%$. 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	355	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 2650 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.

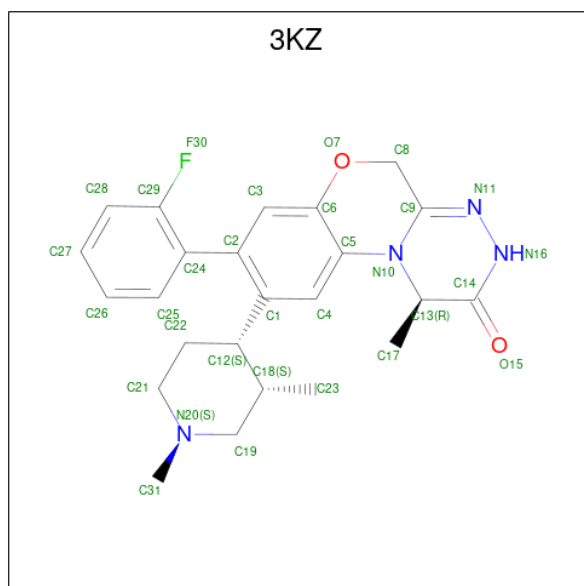
- Molecule 1 is a protein called Protein kinase C.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	320	2579	1656	420	482	3	18	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	568	ILE	VAL	SEE REMARK 999	UNP L7RSM7
A	619	SER	CYS	engineered mutation	UNP L7RSM7

- Molecule 2 is (1R)-9-[(3S,4S)-1,3-dimethylpiperidin-4-yl]-8-(2-fluorophenyl)-1-methyl-1,3,5-dihydro[1,2,4]triazino[3,4-c][1,4]benzoxazin-2(1H)-one (CCD ID: 3KZ) (formula: C₂₄H₂₇FN₄O₂).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	F	N	O		
2	A	1	31	24	1	4	2	0	0

- Molecule 3 is water.

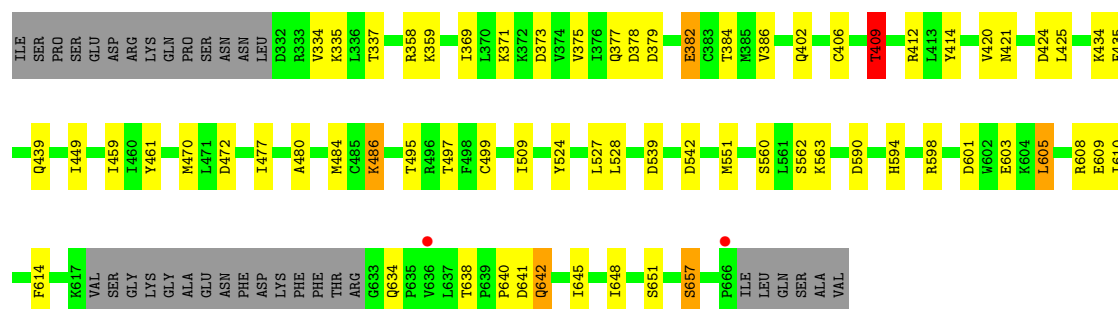
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	40	Total	O	0	0
			40	40		

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: Protein kinase C

Chain A: 



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	112.41 Å 44.47 Å 85.50 Å 90.00° 114.72° 90.00°	Depositor
Resolution (Å)	40.77 – 2.63 40.77 – 2.63	Depositor EDS
% Data completeness (in resolution range)	99.6 (40.77-2.63) 99.6 (40.77-2.63)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.70 (at 2.65 Å)	Xtriage
Refinement program	BUSTER 2.9.7	Depositor
R, R_{free}	0.186 , 0.264 0.196 , 0.284	Depositor DCC
R_{free} test set	553 reflections (4.76%)	wwPDB-VP
Wilson B-factor (Å ²)	56.3	Xtriage
Anisotropy	0.158	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 39.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2650	wwPDB-VP
Average B, all atoms (Å ²)	60.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.84% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: 3KZ, TPO, SEP

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	0.86	0/2609	1.45	24/3520 (0.7%)

There are no bond length outliers.

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	563	LYS	CA-C-N	7.00	129.90	120.65
1	A	563	LYS	C-N-CA	7.00	129.90	120.65
1	A	509	ILE	N-CA-C	-6.98	104.05	110.82
1	A	472	ASP	CA-CB-CG	6.86	119.46	112.60
1	A	594	HIS	CA-C-N	6.06	129.23	120.38
1	A	594	HIS	C-N-CA	6.06	129.23	120.38
1	A	527	LEU	CA-C-N	5.88	128.08	120.44
1	A	527	LEU	C-N-CA	5.88	128.08	120.44
1	A	421	ASN	N-CA-C	5.88	119.71	112.54
1	A	420	VAL	CA-C-N	5.87	130.52	120.72
1	A	420	VAL	C-N-CA	5.87	130.52	120.72
1	A	435	PHE	CA-CB-CG	5.79	119.59	113.80
1	A	590	ASP	CA-CB-CG	5.50	118.09	112.60
1	A	562	SER	CA-C-N	5.39	128.28	120.79
1	A	562	SER	C-N-CA	5.39	128.28	120.79
1	A	524	TYR	N-CA-C	-5.29	105.60	111.36
1	A	614	PHE	CA-CB-CG	5.23	119.03	113.80
1	A	542	ASP	CA-C-N	5.20	128.02	120.79
1	A	542	ASP	C-N-CA	5.20	128.02	120.79
1	A	409	THR	CB-CA-C	5.12	121.57	111.22
1	A	601	ASP	CA-CB-CG	5.11	117.71	112.60
1	A	641	ASP	CA-CB-CG	5.03	117.63	112.60
1	A	539	ASP	CA-CB-CG	5.01	117.61	112.60
1	A	378	ASP	CA-CB-CG	5.01	117.61	112.60

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	2579	0	2510	16	0
2	A	31	0	27	0	0
3	A	40	0	0	0	0
All	All	2650	0	2537	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 3.

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:A:645:ILE:HA	1:A:648:ILE:HD12	1.80	0.63
1:A:640:PRO:HB2	1:A:645:ILE:HD11	1.83	0.61
1:A:424:ASP:HA	1:A:470:MET:HA	1.90	0.54
1:A:409:THR:HG22	1:A:412:ARG:H	1.78	0.49
1:A:459:ILE:HA	1:A:486:LYS:O	2.12	0.49
1:A:382:GLU:O	1:A:386:VAL:HG23	2.16	0.46
1:A:484:MET:HE3	1:A:499:CYS:HB2	1.98	0.44
1:A:642:GLN:HA	1:A:645:ILE:HD12	2.00	0.44
1:A:337:THR:O	1:A:359:LYS:HD2	2.19	0.43
1:A:461:TYR:OH	1:A:480:ALA:O	2.29	0.42
1:A:369:ILE:HG12	1:A:414:TYR:CD2	2.53	0.42
1:A:486:LYS:HA	1:A:486:LYS:HD3	1.88	0.42
1:A:335:LYS:NZ	1:A:337:THR:HB	2.34	0.42
1:A:371:LYS:O	1:A:375:VAL:HG23	2.20	0.42
1:A:406:CYS:O	1:A:657:SEP:HA	2.21	0.41
1:A:605:LEU:HB2	1:A:610:ILE:HD12	2.03	0.41

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	313/355 (88%)	297 (95%)	16 (5%)	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	276/310 (89%)	249 (90%)	27 (10%)	7	11

All (27) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	334	VAL
1	A	358	ARG
1	A	373	ASP
1	A	377	GLN
1	A	379	ASP
1	A	382	GLU
1	A	384	THR
1	A	402	GLN
1	A	409	THR
1	A	425	LEU
1	A	434	LYS
1	A	439	GLN
1	A	449	ILE

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	477	ILE
1	A	486	LYS
1	A	495	THR
1	A	528	LEU
1	A	551	MET
1	A	560	SER
1	A	598	ARG
1	A	603	GLU
1	A	605	LEU
1	A	608	ARG
1	A	609	GLU
1	A	634	GLN
1	A	642	GLN
1	A	651	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	421	ASN
1	A	430	GLN
1	A	431	GLN
1	A	439	GLN
1	A	488	HIS
1	A	611	GLN
1	A	634	GLN
1	A	647	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	SEP	A	657	1	8,9,10	1.08	1 (12%)	7,12,14	2.55	1 (14%)
1	TPO	A	638	1	8,10,11	1.08	0	10,14,16	1.55	2 (20%)
1	TPO	A	497	1	8,10,11	1.32	2 (25%)	10,14,16	1.75	3 (30%)

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	SEP	A	657	1	-	1/6/8/10	-
1	TPO	A	638	1	-	3/9/11/13	-
1	TPO	A	497	1	-	2/9/11/13	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	657	SEP	P-O1P	2.29	1.57	1.50
1	A	497	TPO	P-O3P	-2.27	1.46	1.54
1	A	497	TPO	P-OG1	-2.04	1.56	1.59

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	657	SEP	OG-CB-CA	5.95	113.93	108.14
1	A	497	TPO	P-OG1-CB	-3.34	114.24	123.33
1	A	638	TPO	P-OG1-CB	-3.27	114.43	123.33
1	A	638	TPO	O-C-CA	-2.49	118.36	124.77
1	A	497	TPO	O2P-P-O1P	-2.49	101.12	110.83
1	A	497	TPO	O3P-P-O2P	2.24	116.19	107.80

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	497	TPO	O-C-CA-CB
1	A	638	TPO	O-C-CA-CB

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms
1	A	497	TPO	CB-OG1-P-O2P
1	A	638	TPO	CB-OG1-P-O1P
1	A	638	TPO	C-CA-CB-CG2
1	A	657	SEP	C-CA-CB-OG

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	657	SEP	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	3KZ	A	701	-	35,35,35	1.71	7 (20%)	41,52,52	2.02	6 (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	3KZ	A	701	-	-	2/8/47/47	0/5/5/5

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	701	3KZ	C14-N16	5.32	1.38	1.34
2	A	701	3KZ	C9-N11	4.98	1.32	1.28
2	A	701	3KZ	C5-N10	-3.22	1.37	1.42
2	A	701	3KZ	N16-N11	2.95	1.46	1.38
2	A	701	3KZ	C19-N20	2.55	1.50	1.46
2	A	701	3KZ	C2-C24	-2.48	1.44	1.49
2	A	701	3KZ	C9-N10	-2.43	1.33	1.37

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	701	3KZ	C14-N16-N11	-8.41	119.88	126.95
2	A	701	3KZ	C21-N20-C19	5.56	115.62	110.06
2	A	701	3KZ	C23-C18-C12	3.58	116.23	112.40
2	A	701	3KZ	C8-O7-C6	-3.17	106.27	115.65
2	A	701	3KZ	C6-C5-N10	2.80	120.33	118.24
2	A	701	3KZ	C22-C21-N20	-2.63	107.80	111.20

There are no chirality outliers.

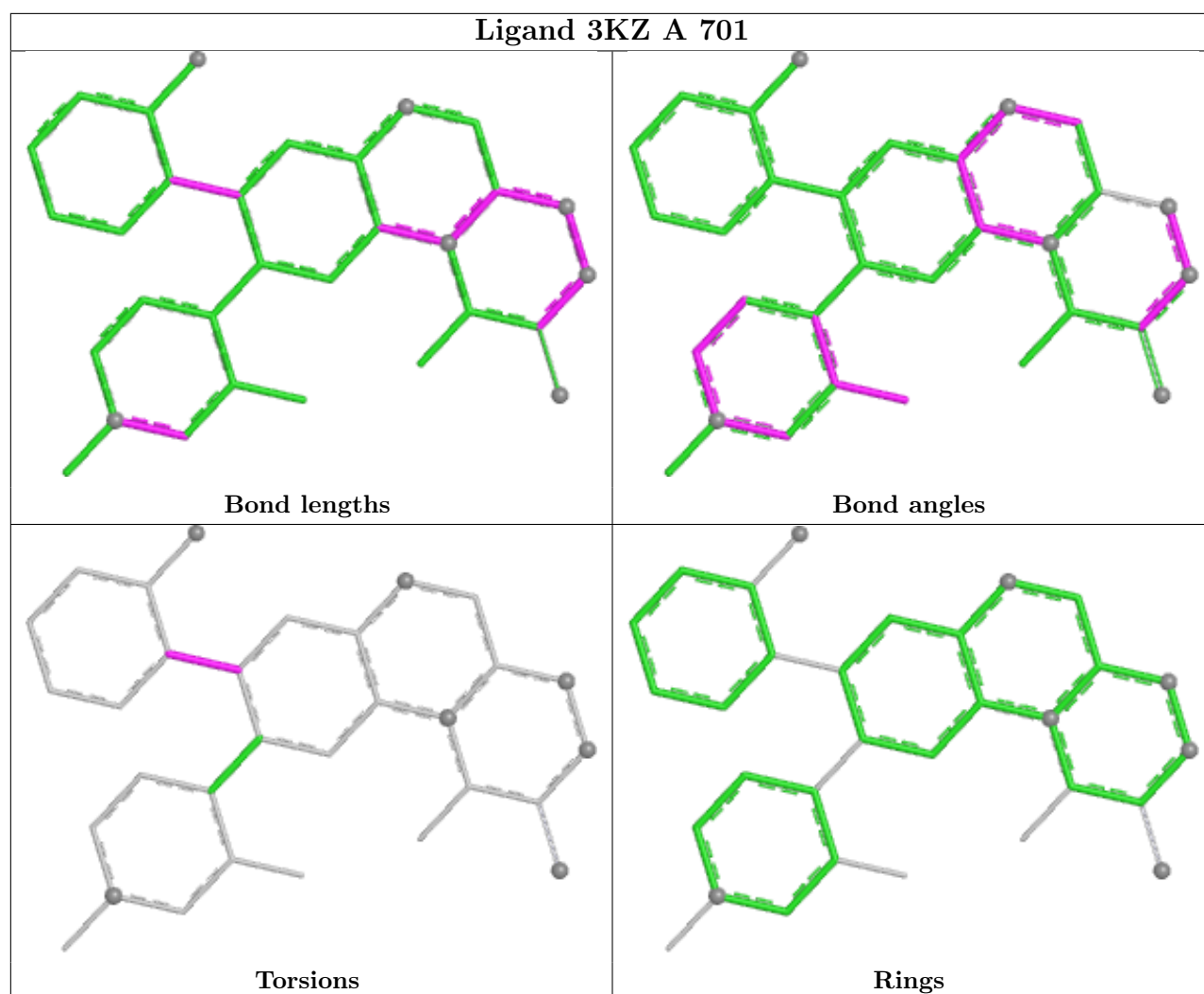
All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	701	3KZ	C1-C2-C24-C29
2	A	701	3KZ	C3-C2-C24-C29

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, 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(Å ²)	Q<0.9
1	A	317/355 (89%)	-0.10	2 (0%) 85 83	36, 58, 86, 104	0

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	636	VAL	3.2
1	A	666	PRO	2.4

6.2 Non-standard residues in protein, DNA, RNA chains [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, 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(Å ²)	Q<0.9
1	TPO	A	638	11/12	0.84	0.12	82,84,89,89	0
1	SEP	A	657	10/11	0.93	0.07	55,59,65,66	0
1	TPO	A	497	11/12	0.96	0.06	52,54,57,57	0

6.3 Carbohydrates [i](#)

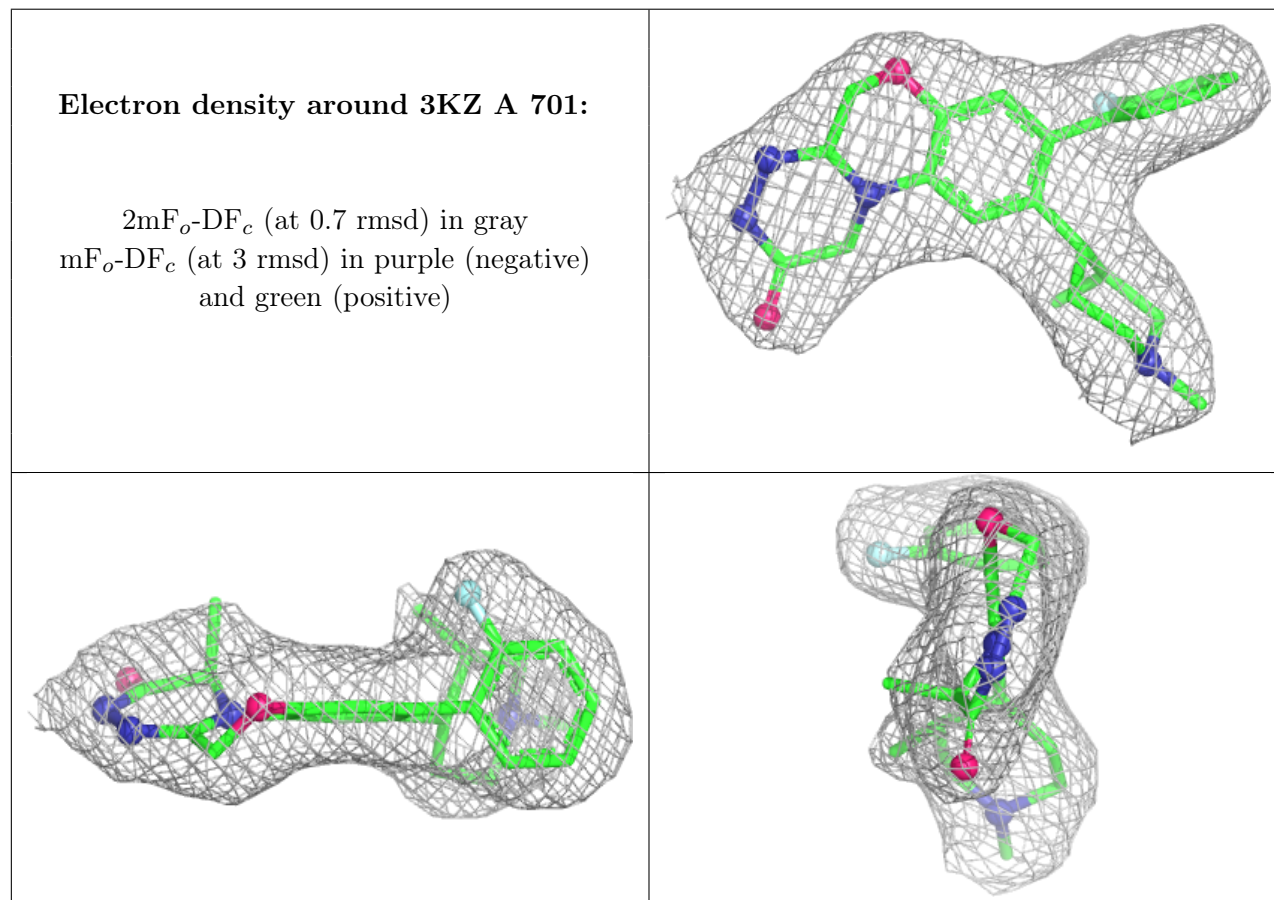
There are no oligosaccharides in this entry.

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, 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($\text{\AA}^2$)	Q<0.9
2	3KZ	A	701	31/31	0.96	0.07	49,52,57,57	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 ⓘ

There are no such residues in this entry.