Full wwPDB X-ray Structure Validation Report ⓘ

Oct 13, 2025 – 04:35 PM EDT

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PDB ID	:	3MWU / pdb_00003mwu
Title	:	Activated Calcium-Dependent Protein Kinase 1 from Cryptosporidium parvum (CpCDPK1) in complex with bumped kinase inhibitor RM-1-95
Authors	:	Larson, E.T.; Merritt, E.A.; Medical Structural Genomics of Pathogenic Protozoa (MSGPP)
Deposited on	:	2010-05-06
Resolution	:	1.98 Å(reported)

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 1.98 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.
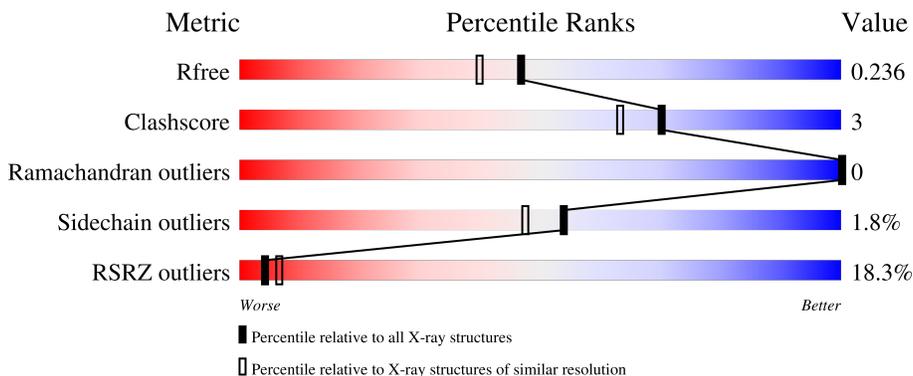
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	164625	1356 (1.98-1.98)
Clashscore	180529	1437 (1.98-1.98)
Ramachandran outliers	177936	1426 (1.98-1.98)
Sidechain outliers	177891	1426 (1.98-1.98)
RSRZ outliers	164620	1356 (1.98-1.98)

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	486	

2 Entry composition ⓘ

There are 4 unique types of molecules in this entry. The entry contains 3822 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 Calmodulin-domain protein kinase 1.

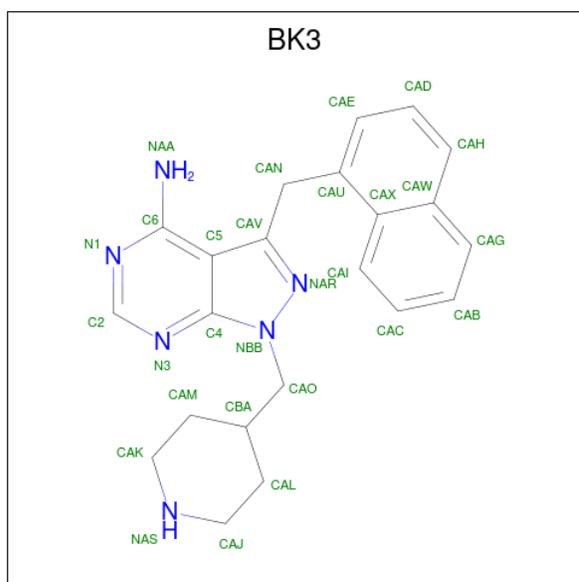| Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	447	3661	2325	613	702	21	0	8	0

There are 17 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-16	MET	-	expression tag	UNP A3FQ16
A	-15	HIS	-	expression tag	UNP A3FQ16
A	-14	HIS	-	expression tag	UNP A3FQ16
A	-13	HIS	-	expression tag	UNP A3FQ16
A	-12	HIS	-	expression tag	UNP A3FQ16
A	-11	HIS	-	expression tag	UNP A3FQ16
A	-10	HIS	-	expression tag	UNP A3FQ16
A	-9	SER	-	expression tag	UNP A3FQ16
A	-8	SER	-	expression tag	UNP A3FQ16
A	-7	GLY	-	expression tag	UNP A3FQ16
A	-6	ARG	-	expression tag	UNP A3FQ16
A	-5	GLU	-	expression tag	UNP A3FQ16
A	-4	ASN	-	expression tag	UNP A3FQ16
A	-3	LEU	-	expression tag	UNP A3FQ16
A	-2	TYR	-	expression tag	UNP A3FQ16
A	-1	PHE	-	expression tag	UNP A3FQ16
A	0	GLN	-	expression tag	UNP A3FQ16

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Ca		
2	A	4	4	4	0	0

- Molecule 3 is 3-(naphthalen-1-ylmethyl)-1-(piperidin-4-ylmethyl)-1H-pyrazolo[3,4-d]pyrimid in-4-amine (CCD ID: BK3) (formula: $C_{22}H_{24}N_6$).

BK3

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total 28	C 22	N 6	0	0

• Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	125	Total 129	O 129	0	4

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: Calmodulin-domain protein kinase 1
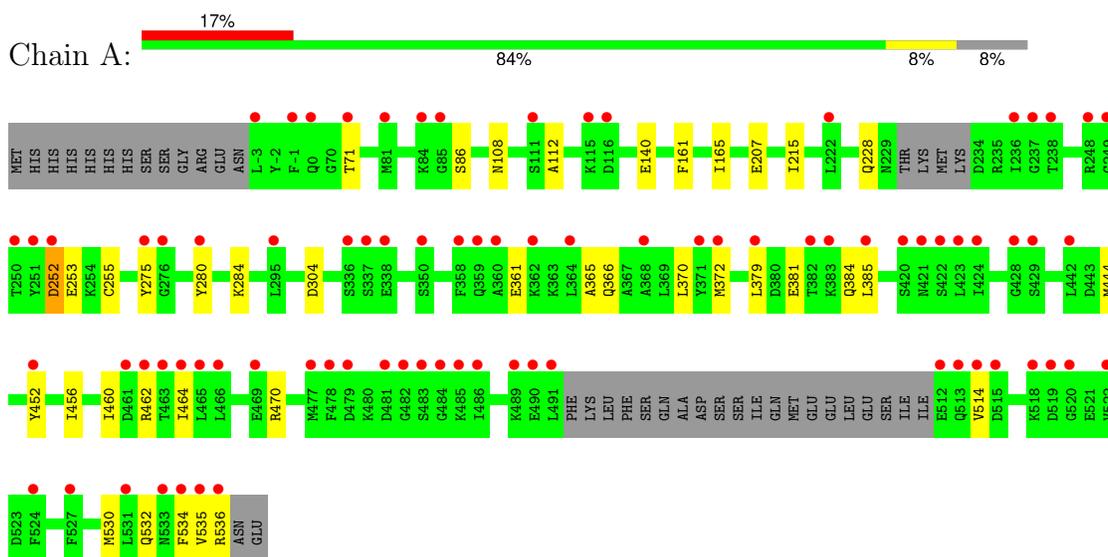
4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	60.02Å 55.97Å 82.21Å 90.00° 104.79° 90.00°	Depositor
Resolution (Å)	42.04 – 1.98 42.04 – 1.99	Depositor EDS
% Data completeness (in resolution range)	99.8 (42.04-1.98) 99.8 (42.04-1.99)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.07 (at 2.00Å)	Xtriage
Refinement program	REFMAC refmac_5.5.0106	Depositor
R, R_{free}	0.194 , 0.229 0.200 , 0.236	Depositor DCC
R_{free} test set	1808 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å^2)	36.5	Xtriage
Anisotropy	0.147	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 46.2	EDS
L-test for twinning[2]	$< |L| > = 0.49, < L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	3822	wwPDB-VP
Average B, all atoms (Å^2)	66.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.55% 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: BK3, CA

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	0.67	0/3744	0.79	1/5033 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	140	GLU	N-CA-C	5.24	116.80	108.79

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	3661	0	3664	24	0
2	A	4	0	0	0	0
3	A	28	0	24	0	0
4	A	129	0	0	0	0
All	All	3822	0	3688	24	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 (24) 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:275[B]:TYR:N	1:A:275[B]:TYR:CD2	2.57	0.71
1:A:370:LEU:HD22	1:A:444:MET:HE3	1.78	0.65
1:A:462:ARG:HG2	1:A:535:VAL:HG23	1.85	0.59
1:A:530:MET:HE2	1:A:534:PHE:CZ	2.37	0.59
1:A:108:ASN:O	1:A:112:ALA:HB3	2.04	0.58
1:A:161:PHE:CZ	1:A:165:ILE:HD11	2.43	0.54
1:A:161:PHE:CE2	1:A:165:ILE:HD11	2.42	0.54
1:A:365:ALA:HB2	1:A:534:PHE:CD1	2.44	0.53
1:A:361:GLU:O	1:A:366:GLN:NE2	2.44	0.51
1:A:275[B]:TYR:N	1:A:275[B]:TYR:HD2	2.07	0.51
1:A:280:TYR:O	1:A:284:LYS:HG2	2.13	0.49
1:A:532:GLN:O	1:A:536:ARG:NH1	2.47	0.47
1:A:252:ASP:O	1:A:255[A]:CYS:SG	2.66	0.46
1:A:462:ARG:CG	1:A:535:VAL:HG23	2.44	0.46
1:A:86:SER:HA	1:A:228[A]:GLN:HE22	1.82	0.45
1:A:532:GLN:O	1:A:535:VAL:HG12	2.17	0.45
1:A:215:ILE:C	1:A:215:ILE:HD12	2.43	0.44
1:A:532:GLN:C	1:A:535:VAL:HG12	2.42	0.44
1:A:452:TYR:CE2	1:A:456:ILE:HG13	2.54	0.43
1:A:372:MET:HE3	1:A:372:MET:HB3	1.96	0.41
1:A:385:LEU:HD11	1:A:460:ILE:HA	2.02	0.41
1:A:207:GLU:HG2	1:A:379:LEU:HD22	2.03	0.40
1:A:381:GLU:CD	1:A:470:ARG:HH22	2.28	0.40
1:A:207:GLU:CG	1:A:379:LEU:HD22	2.52	0.40

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	449/486 (92%)	431 (96%)	18 (4%)	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	408/439 (93%)	400 (98%)	8 (2%)	50	43

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	71	THR
1	A	252	ASP
1	A	253[A]	GLU
1	A	253[B]	GLU
1	A	304	ASP
1	A	384	GLN
1	A	464	ILE
1	A	514	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	396	ASN

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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 5 ligands modelled in this entry, 4 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	#$|Z| > 2$
3	BK3	A	561	-	29,32,32	2.23	1 (3%)	31,45,45	1.67	4 (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
3	BK3	A	561	-	-	1/6/16/16	0/5/5/5

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	561	BK3	NAR-NBB	-10.76	1.25	1.37

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	561	BK3	CAV-NAR-NBB	5.27	109.03	104.48
3	A	561	BK3	N3-C2-N1	-4.38	122.73	128.67
3	A	561	BK3	CAO-NBB-NAR	4.00	124.11	117.25
3	A	561	BK3	CAJ-CAL-CBA	-2.16	108.80	112.14

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	561	BK3	NBB-CAO-CBA-CAM

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 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 BK3 A 561

Bond lengths

Bond angles

Torsions

Rings
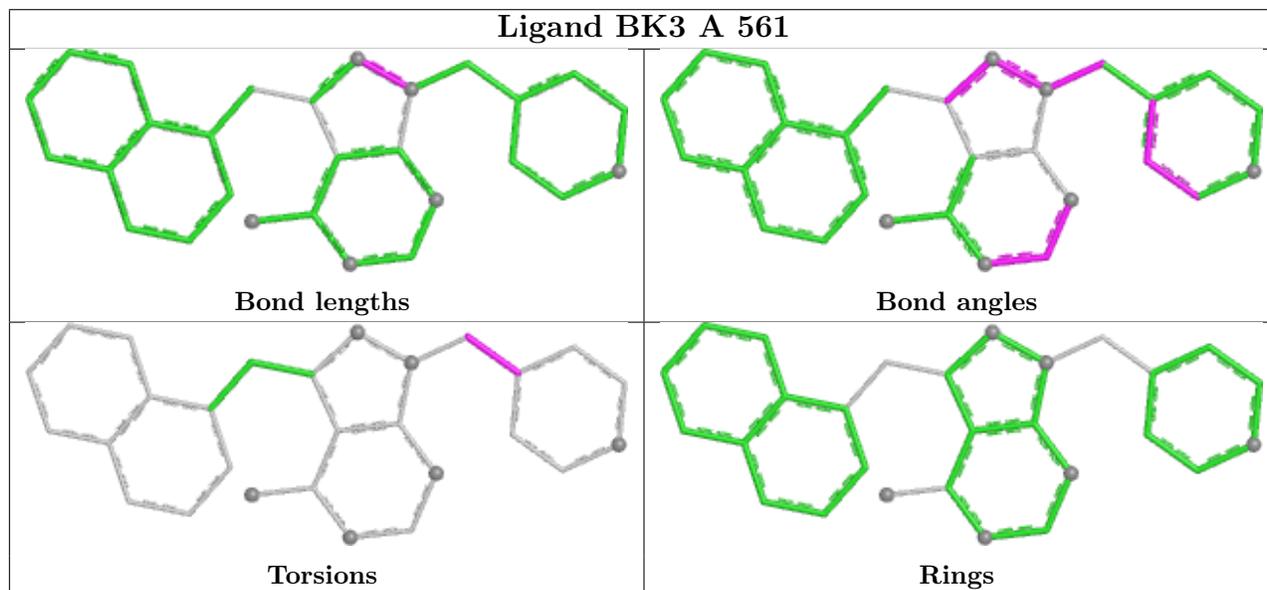
5.7 Other polymers ⓘ

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(Å^2)	Q<0.9
1	A	447/486 (91%)	0.98	82 (18%)	4	6	24, 59, 123, 216	8 (1%)

All (82) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	514	VAL	7.1
1	A	483	SER	7.0
1	A	275[A]	TYR	5.8
1	A	491	LEU	5.7
1	A	512	GLU	5.6
1	A	236	ILE	5.1
1	A	484	GLY	5.0
1	A	250	THR	4.9
1	A	535	VAL	4.7
1	A	424	ILE	4.4
1	A	464	ILE	4.2
1	A	513	GLN	4.2
1	A	251	TYR	4.0
1	A	520	GLY	3.7
1	A	534	PHE	3.7
1	A	519	ASP	3.6
1	A	337	SER	3.6
1	A	115	LYS	3.5
1	A	422	SER	3.5
1	A	111	SER	3.4
1	A	518	LYS	3.4
1	A	360	ALA	3.4
1	A	465	LEU	3.4
1	A	420	SER	3.4
1	A	338	GLU	3.3
1	A	428	GLY	3.3
1	A	452	TYR	3.0

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Mol	Chain	Res	Type	RSRZ
1	A	522	VAL	3.0
1	A	478	PHE	2.9
1	A	531	LEU	2.9
1	A	486	ILE	2.8
1	A	515	ASP	2.8
1	A	81	MET	2.8
1	A	429	SER	2.8
1	A	371	TYR	2.8
1	A	116	ASP	2.7
1	A	0	GLN	2.7
1	A	527	PHE	2.7
1	A	479	ASP	2.7
1	A	249	GLY	2.6
1	A	490	GLU	2.6
1	A	222	LEU	2.6
1	A	-3	LEU	2.5
1	A	466	LEU	2.5
1	A	524	PHE	2.5
1	A	85	GLY	2.5
1	A	368	ALA	2.5
1	A	533	ASN	2.5
1	A	276	GLY	2.4
1	A	238	THR	2.4
1	A	379	LEU	2.4
1	A	382	THR	2.4
1	A	248	ARG	2.3
1	A	489	LYS	2.3
1	A	463	THR	2.3
1	A	362	LYS	2.3
1	A	383	LYS	2.3
1	A	364	LEU	2.3
1	A	350	SER	2.3
1	A	237	GLY	2.3
1	A	482	GLY	2.3
1	A	359	GLN	2.3
1	A	423	LEU	2.3
1	A	336	SER	2.2
1	A	385	LEU	2.2
1	A	461	ASP	2.2
1	A	358	PHE	2.2
1	A	252	ASP	2.1
1	A	481	ASP	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	421	ASN	2.1
1	A	-1	PHE	2.1
1	A	536	ARG	2.1
1	A	295	LEU	2.1
1	A	280	TYR	2.1
1	A	71	THR	2.1
1	A	442	LEU	2.1
1	A	469	GLU	2.1
1	A	372	MET	2.0
1	A	462	ARG	2.0
1	A	84	LYS	2.0
1	A	485	LYS	2.0
1	A	477	MET	2.0

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

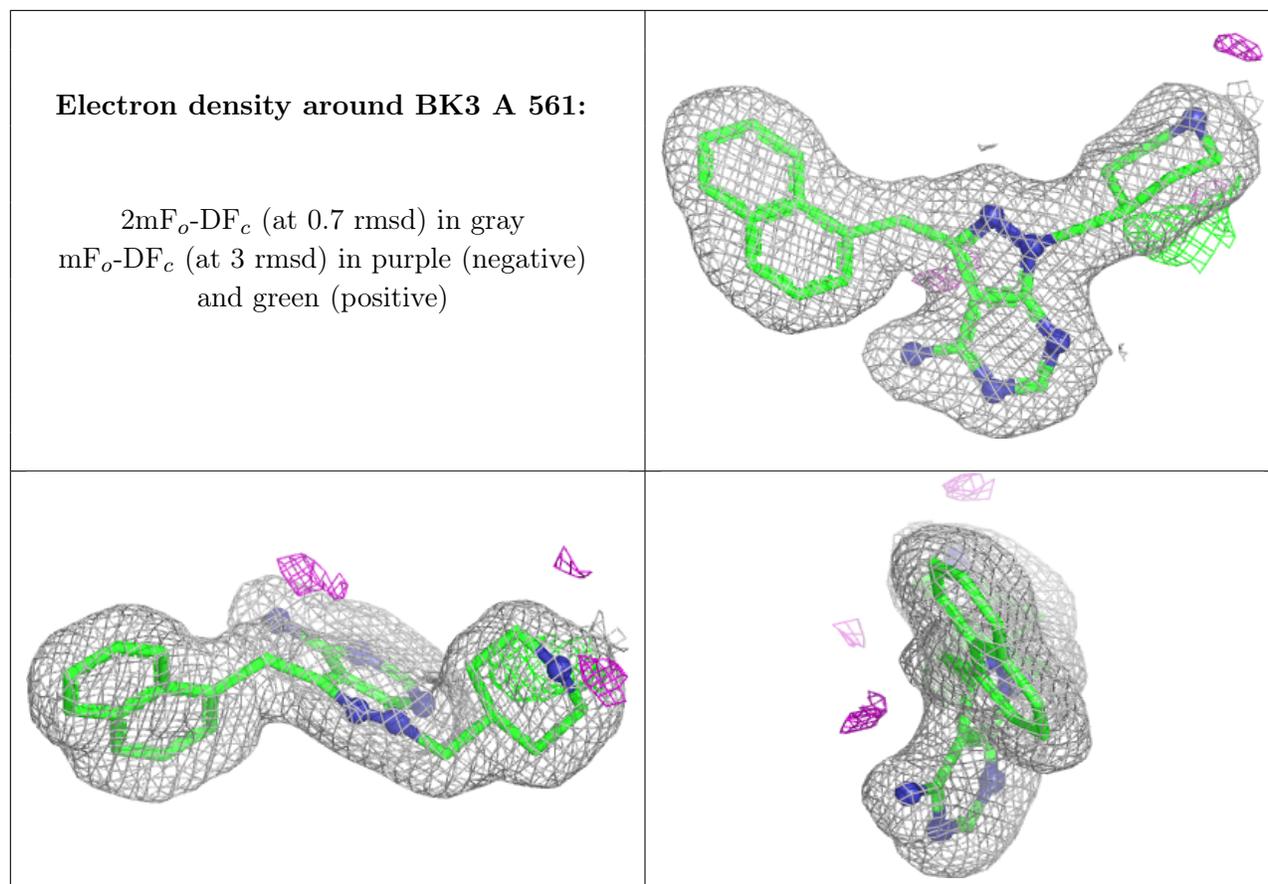There are no oligosaccharides in this entry.

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(Å^2)	Q<0.9
2	CA	A	554	1/1	0.91	0.14	106,106,106,106	0
2	CA	A	553	1/1	0.92	0.13	91,91,91,91	0
3	BK3	A	561	28/28	0.96	0.07	33,38,51,53	0
2	CA	A	552	1/1	0.99	0.04	49,49,49,49	0
2	CA	A	551	1/1	0.99	0.03	43,43,43,43	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 BK3 A 561:

$2mF_o$-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.