



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 20, 2026 – 06:45 PM EST

PDB ID : 9PSU / pdb\_00009psu  
Title : IRAK4 in Complex with Compound 12  
Authors : Ferrao, R.  
Deposited on : 2025-07-26  
Resolution : 2.43 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 : 2022.3.0, CSD as543be (2022)  
Xtrriage (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

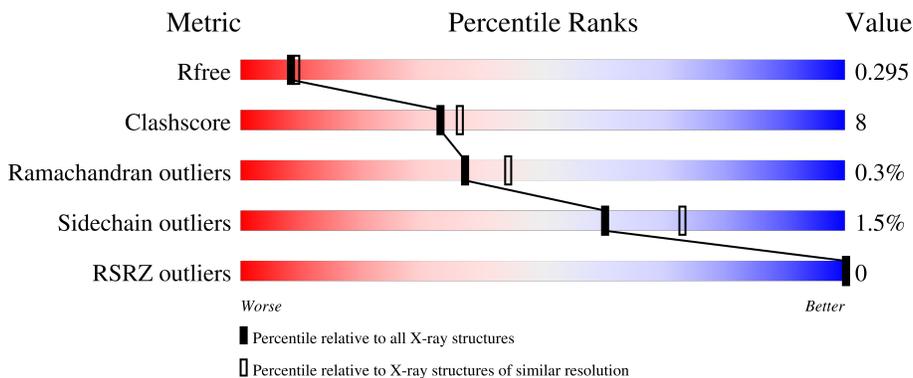
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.43 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	2124 (2.46-2.42)
Clashscore	180529	2259 (2.46-2.42)
Ramachandran outliers	177936	2244 (2.46-2.42)
Sidechain outliers	177891	2244 (2.46-2.42)
RSRZ outliers	164620	2124 (2.46-2.42)

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	304	 71% 21% • 7%
1	B	304	 77% 16% • 6%
1	C	304	 75% 17% • 8%
1	D	304	 77% 14% • 7%

## 2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 9257 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.

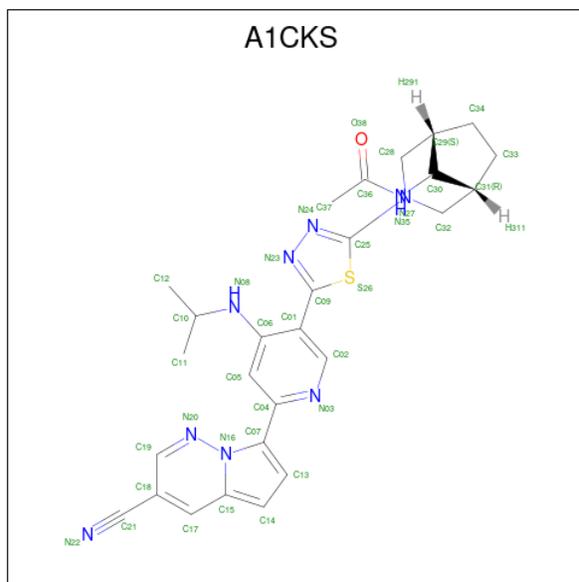
- Molecule 1 is a protein called Interleukin-1 receptor-associated kinase 4.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	282	2208	1387	370	435	2	14	0	0	0
1	B	286	2249	1410	376	447	2	14	0	0	0
1	C	281	2219	1392	372	439	2	14	0	0	0
1	D	282	2226	1397	375	438	2	14	0	0	0

There are 12 discrepancies between the modelled and reference sequences:

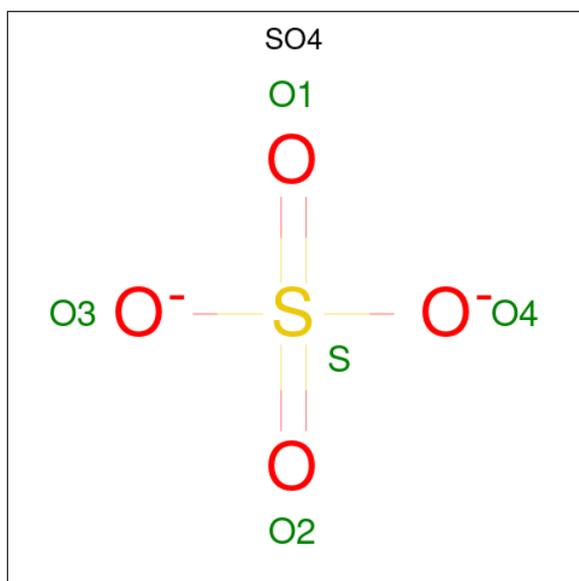
Chain	Residue	Modelled	Actual	Comment	Reference
A	157	GLY	-	expression tag	UNP Q9NWZ3
A	158	ALA	-	expression tag	UNP Q9NWZ3
A	159	MET	-	expression tag	UNP Q9NWZ3
B	157	GLY	-	expression tag	UNP Q9NWZ3
B	158	ALA	-	expression tag	UNP Q9NWZ3
B	159	MET	-	expression tag	UNP Q9NWZ3
C	157	GLY	-	expression tag	UNP Q9NWZ3
C	158	ALA	-	expression tag	UNP Q9NWZ3
C	159	MET	-	expression tag	UNP Q9NWZ3
D	157	GLY	-	expression tag	UNP Q9NWZ3
D	158	ALA	-	expression tag	UNP Q9NWZ3
D	159	MET	-	expression tag	UNP Q9NWZ3

- Molecule 2 is N-[(1R,5S,8R)-3-(5-{{(6P)-6-[(8S)-3-cyanopyrrolo[1,2-b]pyridazin-7-yl]-4-[(propan-2-yl)amino]pyridin-3-yl}-1,3,4-thiadiazol-2-yl)-3-azabicyclo[3.2.1]octan-8-yl]acetamide (CCD ID: A1CKS) (formula: C<sub>27</sub>H<sub>29</sub>N<sub>9</sub>OS) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
2	A	1	38	27	9	1	1	0	0
2	B	1	38	27	9	1	1	0	0
2	C	1	38	27	9	1	1	0	0
2	D	1	38	27	9	1	1	0	0

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0
3	C	1	Total O S 5 4 1	0	0

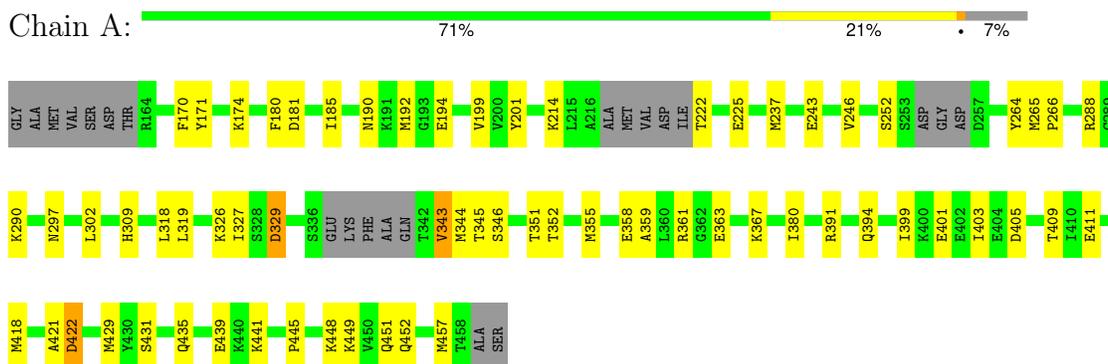
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	43	Total O 43 43	0	0
4	B	44	Total O 44 44	0	0
4	C	42	Total O 42 42	0	0
4	D	59	Total O 59 59	0	0

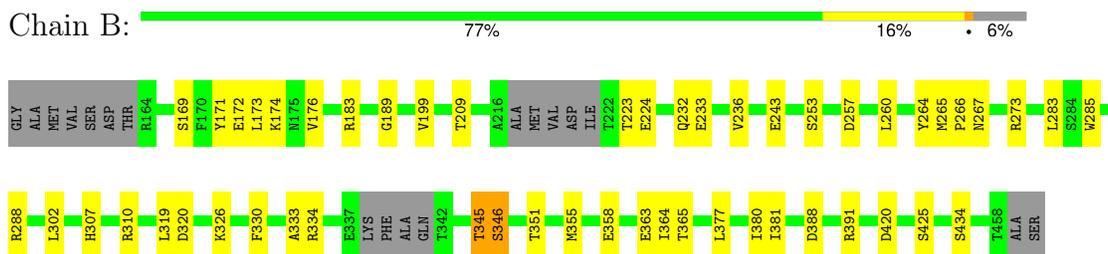
### 3 Residue-property plots [i](#)

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.

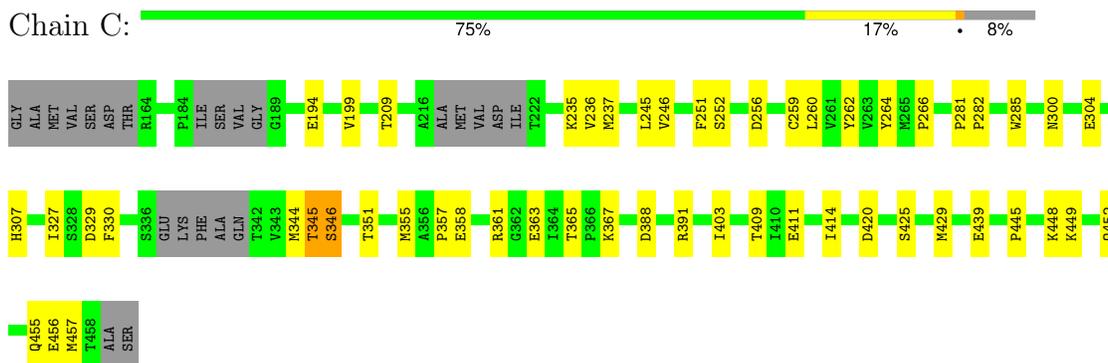
- Molecule 1: Interleukin-1 receptor-associated kinase 4



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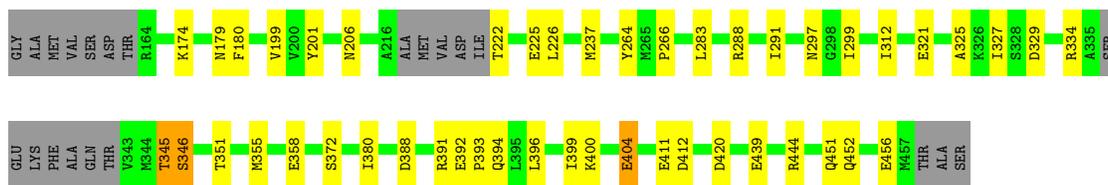


- Molecule 1: Interleukin-1 receptor-associated kinase 4



- Molecule 1: Interleukin-1 receptor-associated kinase 4

Chain D:  77% 14% 7%



## 4 Data and refinement statistics i

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	136.61Å 141.25Å 87.35Å 90.00° 126.72° 90.00°	Depositor
Resolution (Å)	49.72 – 2.43 49.72 – 2.43	Depositor EDS
% Data completeness (in resolution range)	99.5 (49.72-2.43) 88.7 (49.72-2.43)	Depositor EDS
$R_{merge}$	0.19	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.08 (at 2.42Å)	Xtrriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, $R_{free}$	0.245 , 0.295 0.245 , 0.295	Depositor DCC
$R_{free}$ test set	2368 reflections (4.73%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	27.0	Xtrriage
Anisotropy	0.678	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 41.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.126 for -h-2*1,-k,l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	9257	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	50.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 29.62 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.5022e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: A1CKS, SO4, 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	0.10	0/2222	0.30	0/2997
1	B	0.12	0/2264	0.30	0/3052
1	C	0.10	0/2233	0.31	0/3007
1	D	0.12	0/2241	0.32	0/3019
All	All	0.11	0/8960	0.31	0/12075

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 [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	2208	0	2154	41	0
1	B	2249	0	2198	28	0
1	C	2219	0	2174	36	0
1	D	2226	0	2184	36	0
2	A	38	0	0	0	0
2	B	38	0	0	0	0
2	C	38	0	0	0	0
2	D	38	0	0	0	0
3	B	10	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	5	0	0	0	0
4	A	43	0	0	1	0
4	B	44	0	0	0	0
4	C	42	0	0	1	0
4	D	59	0	0	4	0
All	All	9257	0	8710	137	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 8.

All (137) 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:D:266:PRO:HG3	1:D:321:GLU:HG2	1.62	0.81
1:C:237:MET:HE1	1:C:246:VAL:HG23	1.67	0.76
1:D:411:GLU:N	1:D:411:GLU:OE2	2.22	0.70
1:B:267:ASN:ND2	1:B:320:ASP:O	2.23	0.69
1:C:252:SER:HB3	1:C:259:CYS:HB2	1.74	0.69
1:A:422:ASP:OD2	1:A:422:ASP:N	2.25	0.65
1:D:222:THR:HB	1:D:225:GLU:HG2	1.79	0.64
1:A:429:MET:HB2	1:A:457:MET:HE1	1.79	0.64
1:A:297:ASN:ND2	1:A:451:GLN:OE1	2.31	0.62
1:A:411:GLU:OE1	1:A:411:GLU:N	2.34	0.61
1:C:345:TPO:OG1	1:C:346:SEP:N	2.29	0.61
1:D:297:ASN:HA	1:D:451:GLN:HE21	1.67	0.58
1:A:361:ARG:HH22	1:C:357:PRO:HD3	1.67	0.58
1:A:355:MET:O	1:C:361:ARG:NH1	2.32	0.56
1:C:388:ASP:HB3	1:C:391:ARG:HB3	1.87	0.56
1:C:367:LYS:NZ	4:C:605:HOH:O	2.38	0.56
1:B:285:TRP:NE1	1:B:425:SER:OG	2.40	0.55
1:B:351:THR:O	1:B:355:MET:HG3	2.07	0.55
1:B:183:ARG:HB2	1:B:189:GLY:HA3	1.88	0.55
1:B:288:ARG:HB3	1:B:380:ILE:HG23	1.89	0.55
1:A:401:GLU:O	1:A:405:ASP:N	2.41	0.54
1:A:403:ILE:HG23	1:A:409:THR:HA	1.89	0.54
1:B:243:GLU:O	1:B:326:LYS:NZ	2.41	0.54
1:C:351:THR:O	1:C:355:MET:HG3	2.09	0.53
1:D:345:TPO:OG1	1:D:346:SEP:N	2.40	0.53
1:A:222:THR:HB	1:A:225:GLU:HG3	1.91	0.53
1:B:209:THR:HG23	1:B:264:TYR:HB3	1.90	0.53
1:C:251:PHE:HB3	1:C:260:LEU:HD23	1.91	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:264:TYR:CE1	1:C:266:PRO:HA	2.43	0.53
1:D:174:LYS:HD2	1:D:179:ASN:HA	1.90	0.53
1:B:264:TYR:CE1	1:B:266:PRO:HA	2.44	0.52
1:C:445:PRO:HB3	1:C:449:LYS:NZ	2.25	0.52
1:C:256:ASP:OD1	1:C:256:ASP:N	2.43	0.51
1:A:194:GLU:HG2	1:A:199:VAL:HG22	1.93	0.51
1:C:209:THR:HG23	1:C:264:TYR:HB3	1.93	0.51
1:C:237:MET:HE3	1:C:262:TYR:HE1	1.76	0.51
1:D:334:ARG:NH1	4:D:608:HOH:O	2.40	0.50
1:C:365:THR:OG1	1:C:367:LYS:HD2	2.10	0.50
1:D:393:PRO:HG2	1:D:399:ILE:HG13	1.93	0.50
1:A:214:LYS:NZ	4:A:605:HOH:O	2.43	0.50
1:A:288:ARG:HB3	1:A:380:ILE:HG23	1.93	0.50
1:D:174:LYS:NZ	4:D:611:HOH:O	2.44	0.50
1:B:232:GLN:O	1:B:236:VAL:HG23	2.12	0.50
1:C:300:ASN:O	1:C:304:GLU:HG3	2.12	0.50
1:B:236:VAL:HG13	1:B:307:HIS:CD2	2.47	0.50
1:D:206:ASN:ND2	4:D:612:HOH:O	2.45	0.50
1:D:283:LEU:HB2	1:D:288:ARG:HE	1.77	0.50
1:A:181:ASP:HB3	1:A:190:ASN:HB2	1.95	0.49
1:D:291:ILE:HG23	1:D:325:ALA:HB2	1.94	0.49
1:B:169:SER:HB3	1:B:172:GLU:HG3	1.93	0.49
1:D:358:GLU:OE2	1:D:444:ARG:NH1	2.40	0.48
1:A:343:VAL:HG12	1:A:344:MET:H	1.78	0.48
1:A:418:MET:HE2	1:A:421:ALA:HB2	1.95	0.48
1:D:391:ARG:O	1:D:394:GLN:HG2	2.13	0.48
1:D:388:ASP:HB3	1:D:391:ARG:HB3	1.95	0.48
1:A:391:ARG:O	1:A:394:GLN:HG2	2.13	0.48
1:D:452:GLN:NE2	1:D:456:GLU:OE2	2.47	0.48
1:A:399:ILE:O	1:A:403:ILE:HG13	2.12	0.48
1:D:264:TYR:CE1	1:D:266:PRO:HA	2.49	0.47
1:B:171:TYR:HA	1:B:174:LYS:HD3	1.97	0.47
1:D:299:ILE:HG13	1:D:327:ILE:HD11	1.97	0.47
1:B:345:TPO:OG1	1:B:346:SEP:N	2.47	0.47
1:A:171:TYR:HA	1:A:174:LYS:HD3	1.95	0.47
1:D:351:THR:O	1:D:355:MET:HG3	2.15	0.46
1:C:194:GLU:HB3	1:C:199:VAL:HG13	1.97	0.46
1:A:265:MET:HE3	1:A:319:LEU:C	2.41	0.46
1:D:297:ASN:OD1	1:D:451:GLN:NE2	2.47	0.46
1:D:391:ARG:HG2	1:D:392:GLU:N	2.31	0.46
1:D:400:LYS:O	1:D:404:GLU:HG2	2.16	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:420:ASP:OD1	1:C:420:ASP:N	2.48	0.46
1:D:180:PHE:HD2	1:D:201:TYR:CD1	2.34	0.46
1:D:297:ASN:HA	1:D:451:GLN:NE2	2.30	0.46
1:B:358:GLU:HB2	1:B:363:GLU:CD	2.41	0.46
1:C:285:TRP:NE1	1:C:425:SER:OG	2.46	0.46
1:C:246:VAL:HG22	1:C:327:ILE:O	2.16	0.46
1:B:388:ASP:HB3	1:B:391:ARG:HB2	1.98	0.46
1:A:180:PHE:HD2	1:A:201:TYR:CD1	2.34	0.46
1:C:388:ASP:HB3	1:C:391:ARG:HE	1.81	0.46
1:C:448:LYS:O	1:C:452:GLN:HG3	2.17	0.45
1:A:448:LYS:O	1:A:452:GLN:HG3	2.17	0.45
1:B:273:ARG:NE	1:B:273:ARG:HA	2.32	0.45
1:C:403:ILE:HG13	1:C:409:THR:HA	1.99	0.45
1:B:283:LEU:HB2	1:B:288:ARG:HE	1.83	0.44
1:B:265:MET:HE2	1:B:326:LYS:HB2	2.00	0.44
1:A:290:LYS:HA	1:A:290:LYS:HD2	1.73	0.44
1:D:420:ASP:OD1	1:D:420:ASP:N	2.48	0.44
1:A:185:ILE:HG21	1:A:192:MET:HG2	2.00	0.44
1:D:237:MET:HA	1:D:237:MET:HE2	2.00	0.43
1:C:455:GLN:HE21	1:C:455:GLN:HB2	1.61	0.43
1:D:180:PHE:HB3	1:D:201:TYR:CZ	2.53	0.43
1:D:396:LEU:HA	1:D:399:ILE:HD12	1.99	0.43
1:C:358:GLU:HB2	1:C:363:GLU:CD	2.44	0.43
1:B:333:ALA:O	1:B:334:ARG:HD3	2.19	0.43
1:A:246:VAL:HG11	1:A:318:LEU:HD12	2.01	0.43
1:D:312:ILE:HB	1:D:372:SER:HB2	2.01	0.43
1:A:237:MET:HA	1:A:237:MET:HE2	2.00	0.42
1:A:264:TYR:CE1	1:A:266:PRO:HA	2.54	0.42
1:A:435:GLN:O	1:A:445:PRO:HD3	2.19	0.42
1:D:404:GLU:HG2	1:D:404:GLU:H	1.59	0.42
1:A:302:LEU:HD23	1:A:302:LEU:HA	1.87	0.42
1:A:344:MET:HB2	1:A:344:MET:HE2	1.71	0.42
1:B:377:LEU:O	1:B:381:ILE:HG13	2.19	0.42
1:D:288:ARG:HB3	1:D:380:ILE:HG23	2.02	0.42
1:A:309:HIS:NE2	1:A:329:ASP:O	2.53	0.42
1:A:439:GLU:CB	1:C:439:GLU:HG3	2.50	0.42
1:A:448:LYS:HE2	1:A:448:LYS:HB2	1.83	0.41
1:B:265:MET:HE3	1:B:319:LEU:C	2.45	0.41
1:D:396:LEU:HD12	1:D:399:ILE:HD13	2.01	0.41
1:A:361:ARG:NH2	1:C:357:PRO:HD3	2.32	0.41
1:B:173:LEU:HA	1:B:176:VAL:HB	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:236:VAL:HG22	1:C:307:HIS:CD2	2.56	0.41
1:C:245:LEU:HD22	1:C:330:PHE:CZ	2.54	0.41
1:A:352:THR:HA	1:A:355:MET:HG3	2.02	0.41
1:B:223:THR:OG1	1:B:224:GLU:N	2.52	0.41
1:C:411:GLU:HA	1:C:414:ILE:HG13	2.02	0.41
1:A:170:PHE:O	1:A:174:LYS:HG3	2.21	0.41
1:A:358:GLU:HG2	1:A:359:ALA:N	2.35	0.41
1:B:310:ARG:HD3	1:B:364:ILE:HG23	2.02	0.41
1:A:403:ILE:HG13	1:A:403:ILE:H	1.67	0.41
1:D:226:LEU:HD23	1:D:226:LEU:HA	1.89	0.41
1:A:367:LYS:HE2	1:A:441:LYS:O	2.21	0.41
1:B:243:GLU:CD	1:B:243:GLU:H	2.27	0.41
1:C:452:GLN:O	1:C:456:GLU:HG3	2.21	0.41
1:D:225:GLU:HG2	1:D:225:GLU:H	1.69	0.41
1:C:439:GLU:H	1:C:439:GLU:CD	2.29	0.41
1:D:174:LYS:NZ	1:D:180:PHE:HD1	2.18	0.41
1:B:233:GLU:HG2	1:B:260:LEU:HD13	2.01	0.40
1:B:420:ASP:OD1	1:B:420:ASP:N	2.54	0.40
1:A:243:GLU:O	1:A:326:LYS:NZ	2.36	0.40
1:A:246:VAL:HG22	1:A:327:ILE:O	2.21	0.40
1:B:302:LEU:HD11	1:B:330:PHE:CE1	2.56	0.40
1:C:281:PRO:HA	1:C:282:PRO:HD3	1.97	0.40
1:D:439:GLU:HA	4:D:601:HOH:O	2.21	0.40
1:C:300:ASN:ND2	1:C:304:GLU:OE2	2.54	0.40
1:A:363:GLU:OE1	1:A:441:LYS:NZ	2.52	0.40
1:C:344:MET:HB3	1:C:344:MET:HE2	1.70	0.40
1:C:429:MET:HE2	1:C:457:MET:HE1	2.04	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	272/304 (90%)	260 (96%)	11 (4%)	1 (0%)	30	36
1	B	278/304 (91%)	272 (98%)	6 (2%)	0	100	100
1	C	271/304 (89%)	265 (98%)	5 (2%)	1 (0%)	30	36
1	D	274/304 (90%)	268 (98%)	5 (2%)	1 (0%)	30	36
All	All	1095/1216 (90%)	1065 (97%)	27 (2%)	3 (0%)	37	44

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	329	ASP
1	C	329	ASP
1	D	329	ASP

### 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	240/261 (92%)	234 (98%)	6 (2%)	42	55
1	B	246/261 (94%)	241 (98%)	5 (2%)	50	63
1	C	243/261 (93%)	242 (100%)	1 (0%)	89	94
1	D	243/261 (93%)	240 (99%)	3 (1%)	67	79
All	All	972/1044 (93%)	957 (98%)	15 (2%)	60	73

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	252	SER
1	A	343	VAL
1	A	351	THR
1	A	422	ASP
1	A	431	SER
1	A	449	LYS
1	B	199	VAL
1	B	253	SER

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Mol	Chain	Res	Type
1	B	257	ASP
1	B	365	THR
1	B	434	SER
1	C	235	LYS
1	D	199	VAL
1	D	404	GLU
1	D	412	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (19) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	190	ASN
1	A	306	HIS
1	B	241	GLN
1	B	293	GLN
1	B	305	ASN
1	B	306	HIS
1	B	435	GLN
1	B	455	GLN
1	C	178	ASN
1	C	293	GLN
1	C	394	GLN
1	C	452	GLN
1	C	455	GLN
1	D	178	ASN
1	D	229	GLN
1	D	297	ASN
1	D	390	HIS
1	D	438	HIS
1	D	451	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](#)

8 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	C	346	1	8,9,10	1.62	1 (12%)	7,12,14	0.71	0
1	SEP	D	346	1	8,9,10	1.62	1 (12%)	7,12,14	1.19	1 (14%)
1	SEP	A	346	1	8,9,10	1.63	1 (12%)	7,12,14	1.26	1 (14%)
1	TPO	B	345	1	8,10,11	1.11	0	10,14,16	1.85	1 (10%)
1	TPO	C	345	1	8,10,11	1.10	0	10,14,16	1.79	1 (10%)
1	SEP	B	346	1	8,9,10	1.62	1 (12%)	7,12,14	1.06	0
1	TPO	A	345	1	8,10,11	1.12	0	10,14,16	2.05	1 (10%)
1	TPO	D	345	1	8,10,11	1.12	0	10,14,16	1.86	1 (10%)

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	C	346	1	-	2/6/8/10	-
1	SEP	D	346	1	-	3/6/8/10	-
1	SEP	A	346	1	-	3/6/8/10	-
1	TPO	B	345	1	-	2/9/11/13	-
1	TPO	C	345	1	-	2/9/11/13	-
1	SEP	B	346	1	-	2/6/8/10	-
1	TPO	A	345	1	-	3/9/11/13	-
1	TPO	D	345	1	-	1/9/11/13	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	346	SEP	P-O1P	3.56	1.61	1.50
1	B	346	SEP	P-O1P	3.54	1.61	1.50
1	D	346	SEP	P-O1P	3.52	1.61	1.50
1	C	346	SEP	P-O1P	3.52	1.61	1.50

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	345	TPO	P-OG1-CB	-5.76	107.68	123.33
1	D	345	TPO	P-OG1-CB	-5.23	109.12	123.33
1	B	345	TPO	P-OG1-CB	-5.16	109.32	123.33
1	C	345	TPO	P-OG1-CB	-5.07	109.56	123.33
1	A	346	SEP	OG-CB-CA	2.66	110.73	108.14
1	D	346	SEP	OG-CB-CA	2.43	110.51	108.14

There are no chirality outliers.

All (18) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	345	TPO	N-CA-CB-OG1
1	A	346	SEP	CB-OG-P-O2P
1	A	346	SEP	CB-OG-P-O3P
1	B	345	TPO	N-CA-CB-OG1
1	B	346	SEP	C-CA-CB-OG
1	C	345	TPO	N-CA-CB-OG1
1	C	346	SEP	N-CA-CB-OG
1	C	346	SEP	C-CA-CB-OG
1	D	345	TPO	N-CA-CB-OG1
1	D	346	SEP	CB-OG-P-O2P
1	D	346	SEP	CB-OG-P-O3P
1	A	346	SEP	CB-OG-P-O1P
1	D	346	SEP	CB-OG-P-O1P
1	B	346	SEP	N-CA-CB-OG
1	B	345	TPO	CB-OG1-P-O1P
1	C	345	TPO	CB-OG1-P-O1P
1	A	345	TPO	CB-OG1-P-O3P
1	A	345	TPO	O-C-CA-CB

There are no ring outliers.

6 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	C	346	SEP	1	0
1	D	346	SEP	1	0
1	B	345	TPO	1	0
1	C	345	TPO	1	0
1	B	346	SEP	1	0
1	D	345	TPO	1	0

## 5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

7 ligands 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
2	A1CKS	A	501	-	36,43,43	0.80	0	43,63,63	1.25	2 (4%)
2	A1CKS	D	501	-	36,43,43	0.83	0	43,63,63	1.30	2 (4%)
3	SO4	C	502	-	4,4,4	0.23	0	6,6,6	0.07	0
2	A1CKS	B	501	-	36,43,43	0.82	0	43,63,63	1.33	2 (4%)
2	A1CKS	C	501	-	36,43,43	0.84	0	43,63,63	1.29	2 (4%)
3	SO4	B	503	-	4,4,4	0.24	0	6,6,6	0.08	0
3	SO4	B	502	-	4,4,4	0.24	0	6,6,6	0.09	0

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	A1CKS	A	501	-	-	2/16/43/43	0/7/6/6
2	A1CKS	D	501	-	-	0/16/43/43	0/7/6/6
2	A1CKS	C	501	-	-	4/16/43/43	0/7/6/6
2	A1CKS	B	501	-	-	2/16/43/43	0/7/6/6

There are no bond length outliers.

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	501	A1CKS	C14-C13-C07	5.32	111.11	107.61

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	501	A1CKS	C14-C13-C07	5.20	111.03	107.61
2	C	501	A1CKS	C14-C13-C07	5.13	110.98	107.61
2	A	501	A1CKS	C14-C13-C07	4.70	110.70	107.61
2	C	501	A1CKS	C09-N23-N24	3.66	113.11	105.12
2	D	501	A1CKS	C09-N23-N24	3.66	113.09	105.12
2	B	501	A1CKS	C09-N23-N24	3.61	113.01	105.12
2	A	501	A1CKS	C09-N23-N24	3.58	112.93	105.12

There are no chirality outliers.

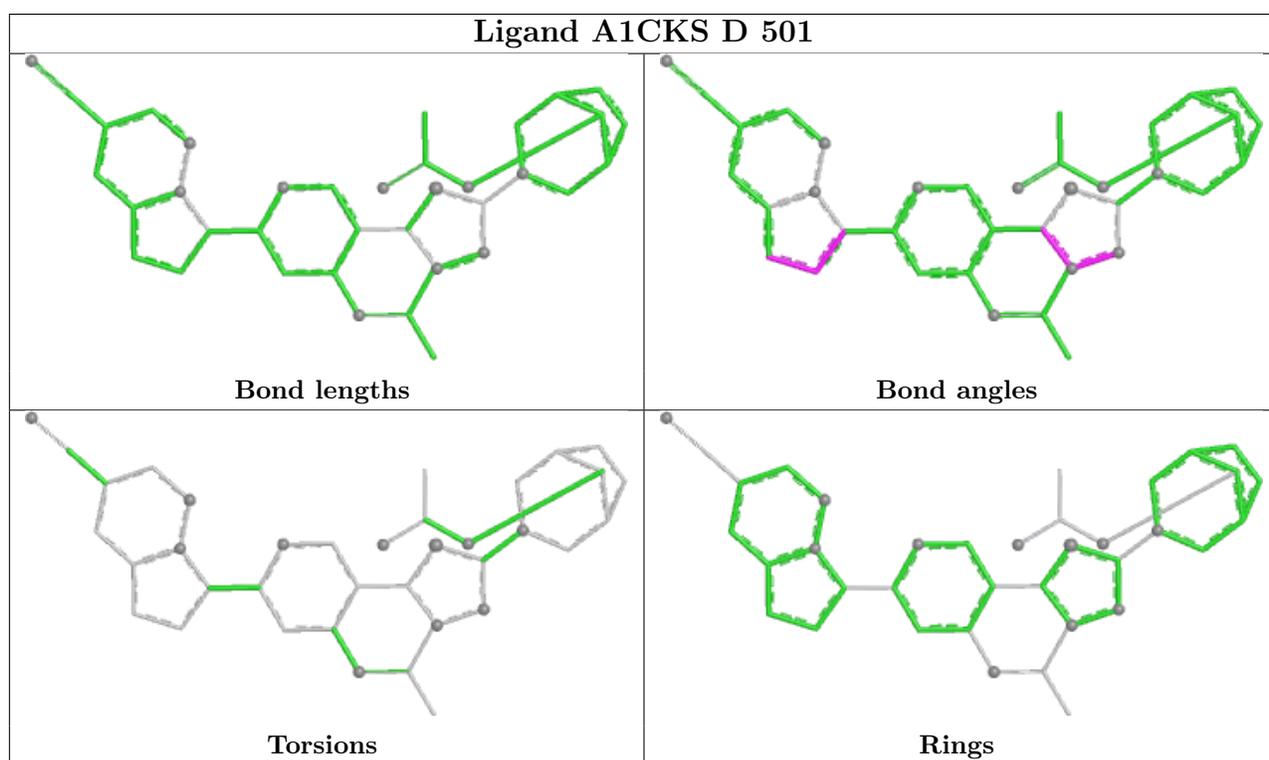
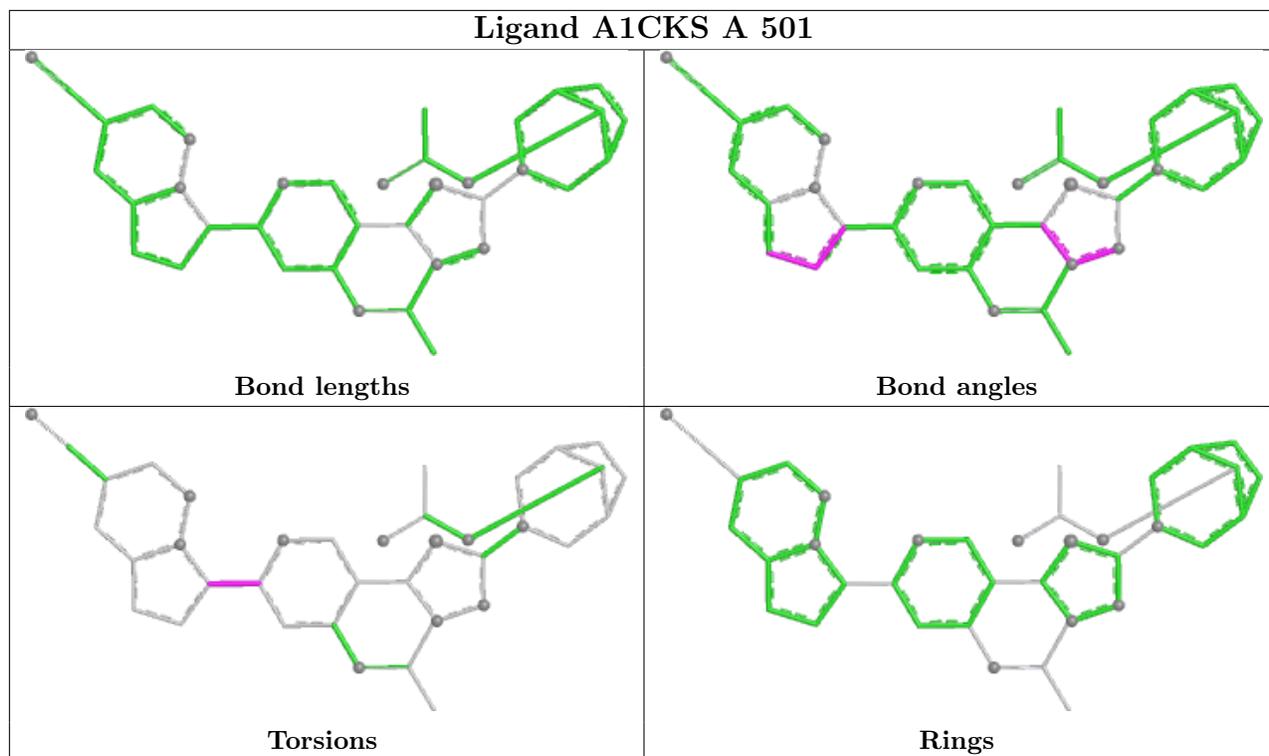
All (8) torsion outliers are listed below:

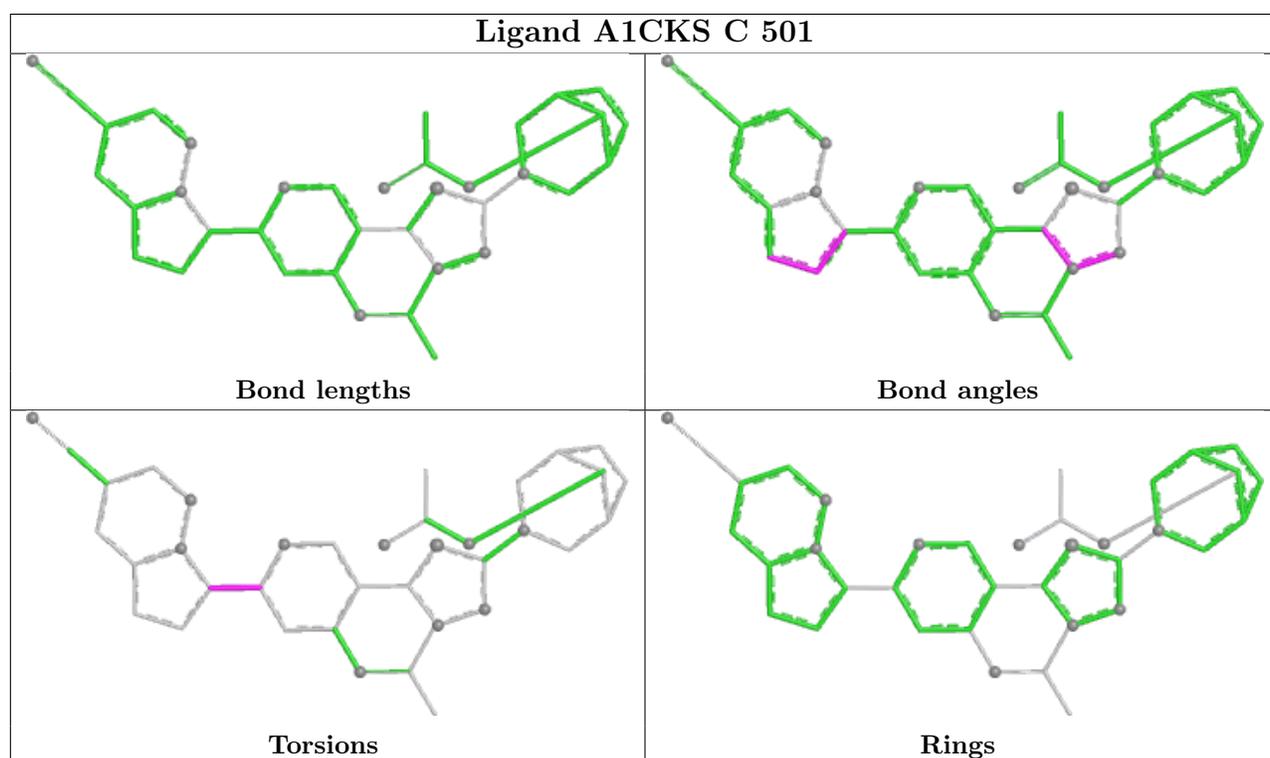
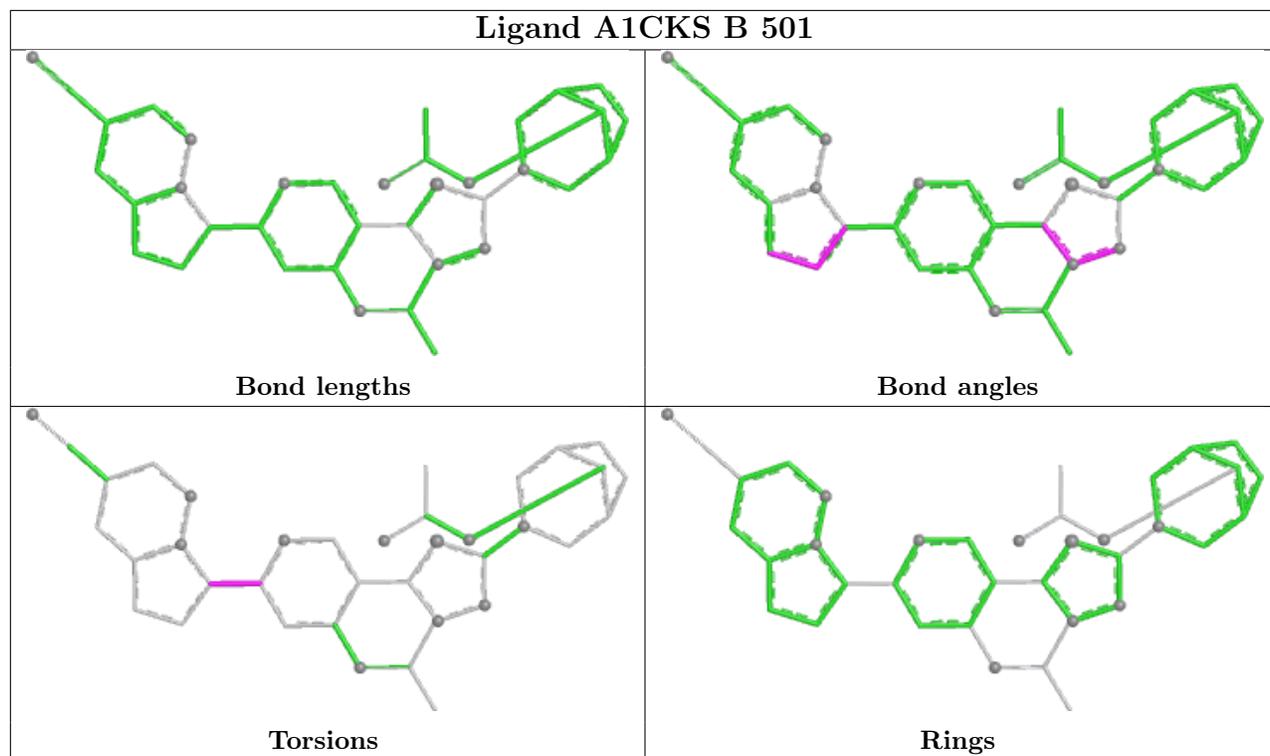
Mol	Chain	Res	Type	Atoms
2	C	501	A1CKS	N03-C04-C07-C13
2	C	501	A1CKS	N03-C04-C07-N16
2	C	501	A1CKS	C05-C04-C07-C13
2	C	501	A1CKS	C05-C04-C07-N16
2	A	501	A1CKS	N03-C04-C07-C13
2	B	501	A1CKS	N03-C04-C07-C13
2	A	501	A1CKS	C05-C04-C07-C13
2	B	501	A1CKS	C05-C04-C07-C13

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

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	280/304 (92%)	-1.43	0 100 100	30, 48, 74, 89	0
1	B	284/304 (93%)	-1.45	0 100 100	25, 48, 74, 92	0
1	C	279/304 (91%)	-1.44	0 100 100	34, 51, 73, 86	0
1	D	280/304 (92%)	-1.45	0 100 100	27, 46, 72, 89	0
All	All	1123/1216 (92%)	-1.44	0 100 100	25, 49, 73, 92	0

There are no RSRZ outliers to report.

### 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, 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
1	SEP	B	346	10/11	0.97	0.06	71,83,96,114	0
1	SEP	A	346	10/11	0.98	0.04	77,86,103,106	0
1	TPO	A	345	11/12	0.98	0.05	72,79,84,84	0
1	SEP	C	346	10/11	0.98	0.04	66,76,95,105	0
1	TPO	D	345	11/12	0.98	0.04	67,76,89,95	0
1	SEP	D	346	10/11	0.98	0.04	77,83,91,97	0
1	TPO	C	345	11/12	0.99	0.04	59,64,73,77	0
1	TPO	B	345	11/12	0.99	0.03	61,71,83,85	0

### 6.3 Carbohydrates [i](#)

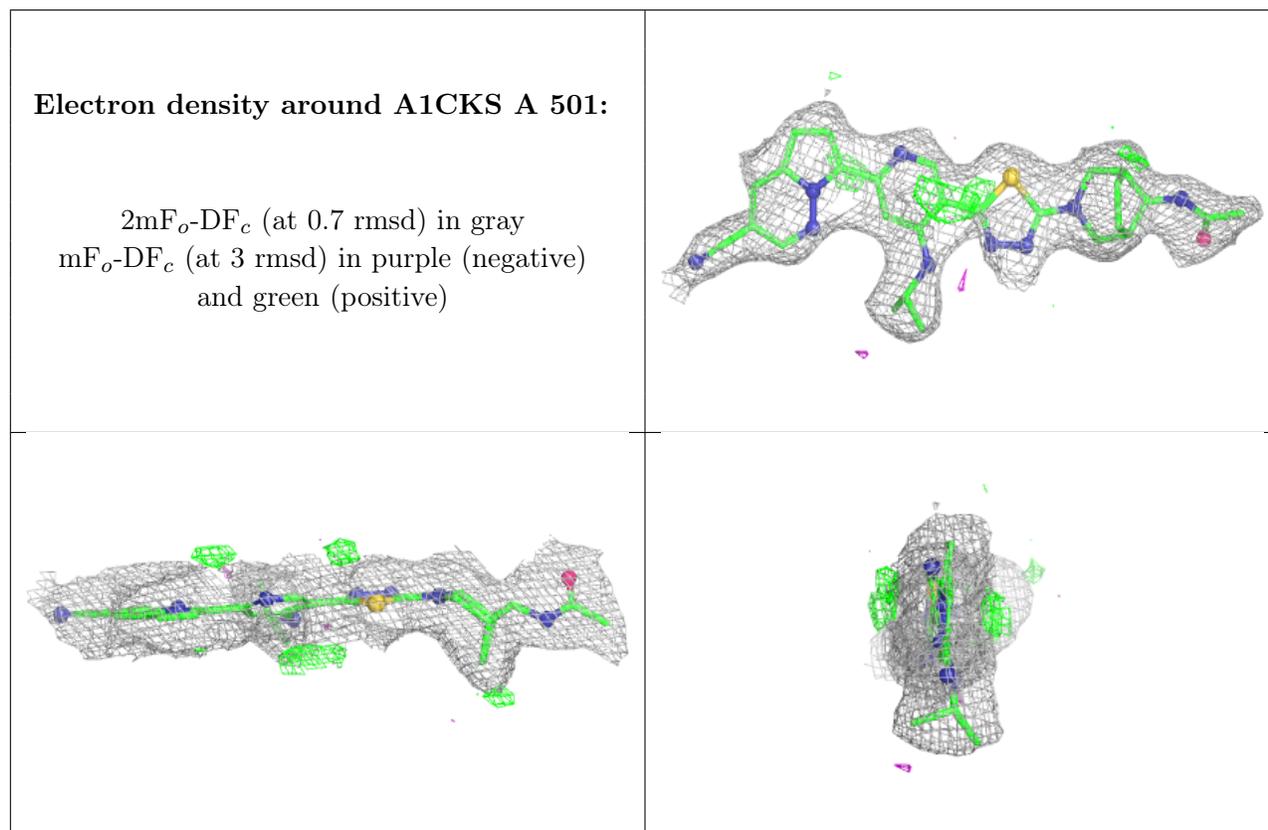
There are no oligosaccharides in this entry.

## 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, 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.

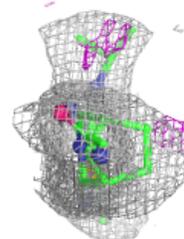
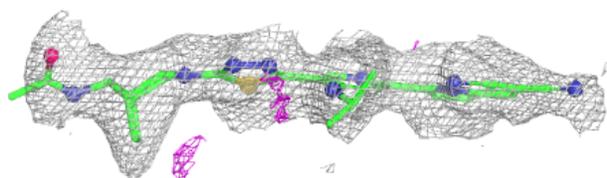
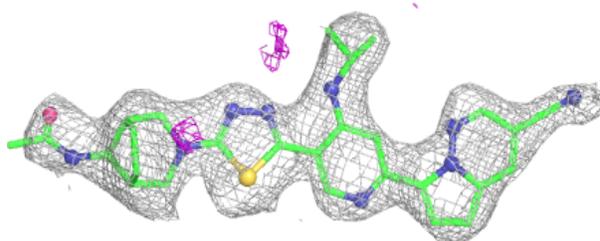
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	A1CKS	A	501	38/38	0.99	0.04	25,33,43,45	0
2	A1CKS	B	501	38/38	0.99	0.04	26,37,48,52	0
2	A1CKS	C	501	38/38	0.99	0.04	27,41,49,59	0
2	A1CKS	D	501	38/38	0.99	0.04	20,34,45,46	0
3	SO4	B	502	5/5	0.99	0.04	45,56,73,75	0
3	SO4	B	503	5/5	0.99	0.05	62,65,72,83	0
3	SO4	C	502	5/5	0.99	0.03	46,49,61,63	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.

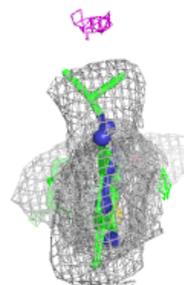
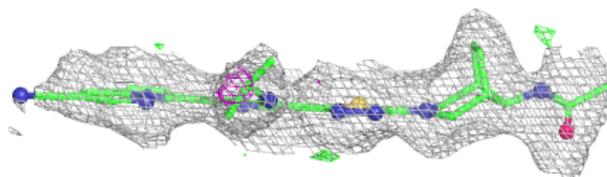
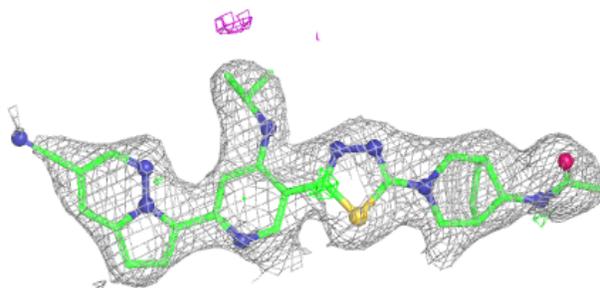


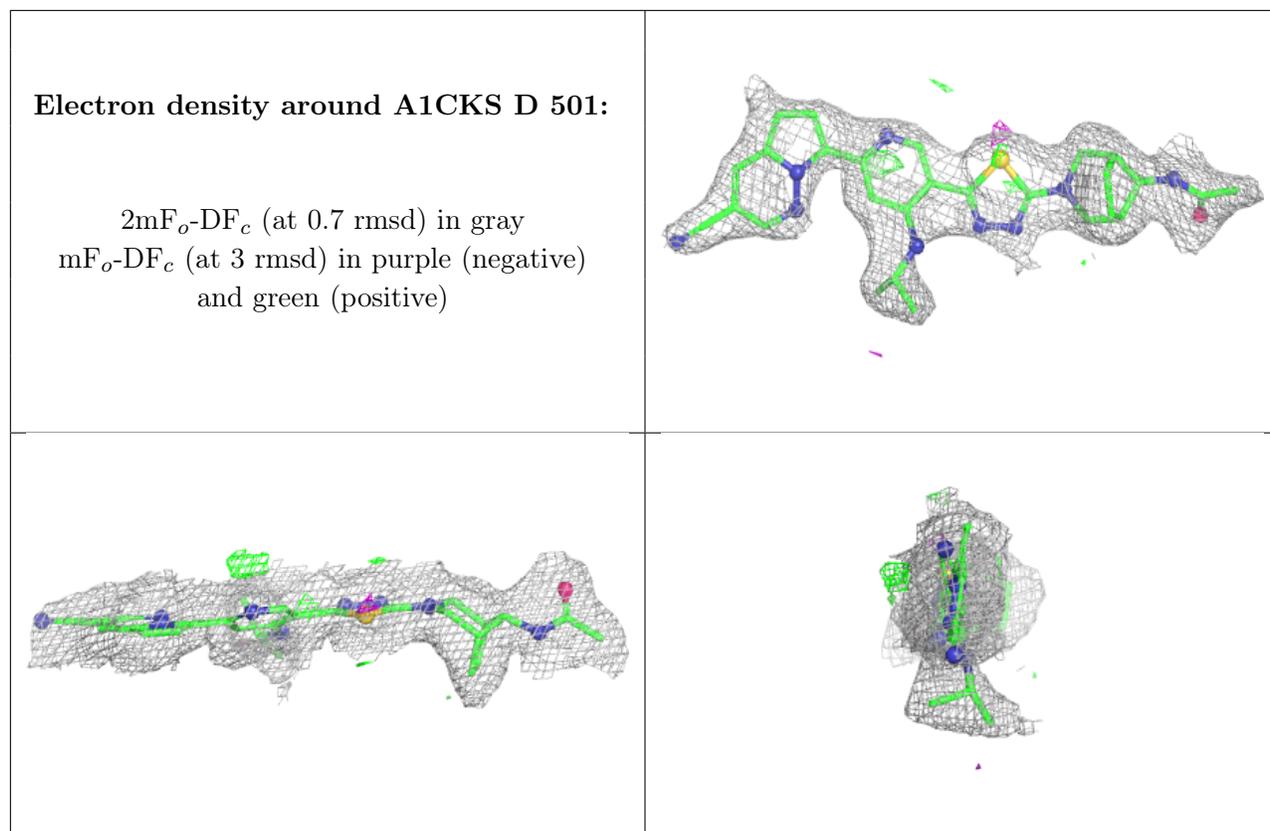
**Electron density around A1CKS B 501:**

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

**Electron density around A1CKS C 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.