



wwPDB EM Validation Summary Report ⓘ

Mar 19, 2026 – 08:19 PM UTC

PDB ID : 9OFD / pdb_00009ofd
EMDB ID : EMD-70429
Title : CryoEM structure of Cad1 bound with cA4 and ATP, hexamer with one intact dimer
Authors : Zhao, Y.; Li, H.
Deposited on : 2025-04-29
Resolution : 2.86 Å(reported)

This is a wwPDB EM Validation Summary 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/EMValidationReportHelp>
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:

EMDB validation analysis : 0.0.1.dev132
Mogul : 2022.3.0, CSD as543be (2022)
MolProbity : 4-5-2 with Phenix2.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : **NOT EXECUTED**
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

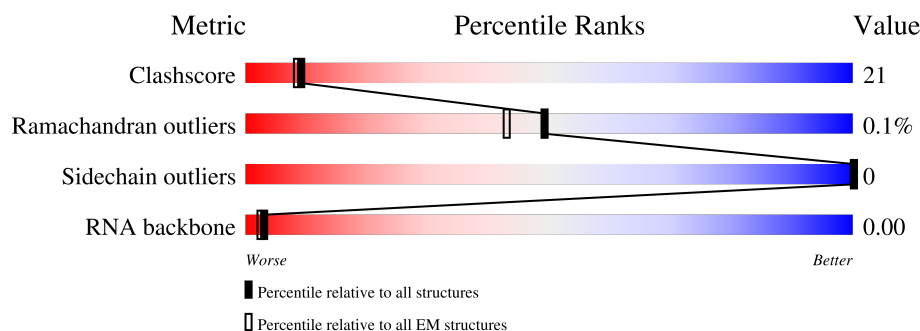
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.86 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)	EM structures (#Entries)
Clashscore	229148	23984
Ramachandran outliers	224038	23583
Sidechain outliers	223484	23102
RNA backbone	8273	3508

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	625	59% 38% .
1	B	625	60% 37% .
1	G	625	42% 21% 37%
1	H	625	41% 22% 37%
1	K	625	38% 23% 38%
1	L	625	35% 28% 37%
2	C	2	50% 50%

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Mol	Chain	Length	Quality of chain
2	D	2	

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 22054 atoms, of which 72 are hydrogens and 0 are deuteriums.

In the tables below, 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.

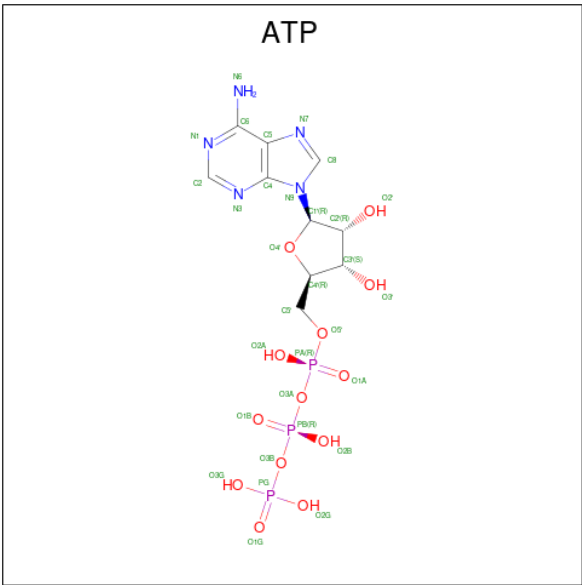
- Molecule 1 is a protein called CRISPR-associated ring nuclease and adenosine deaminase, subunit A.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	604	Total	C	N	O	S	1	0
			4745	3008	862	855	20		
1	B	603	Total	C	N	O	S	1	0
			4735	3003	860	851	21		
1	G	394	Total	C	N	O	S	1	0
			3077	1944	562	560	11		
1	H	393	Total	C	N	O	S	0	0
			3054	1928	558	557	11		
1	K	386	Total	C	N	O	S	1	0
			3015	1909	548	548	10		
1	L	393	Total	C	N	O	S	1	0
			3068	1939	560	558	11		

- Molecule 2 is a RNA chain called cA4 cleavage product, A2>P.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	C	2	Total	C	N	O	P	0	0
			44	20	10	12	2		
2	D	2	Total	C	N	O	P	0	0
			44	20	10	12	2		

- Molecule 3 is ADENOSINE-5'-TRIPHOSPHATE (CCD ID: ATP) (formula: C₁₀H₁₆N₅O₁₃P₃) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms						AltConf
3	A	1	Total	C	H	N	O	P	0
			43	10	12	5	13	3	
3	B	1	Total	C	H	N	O	P	0
			43	10	12	5	13	3	
3	G	1	Total	C	H	N	O	P	0
			43	10	12	5	13	3	
3	H	1	Total	C	H	N	O	P	0
			43	10	12	5	13	3	
3	K	1	Total	C	H	N	O	P	0
			43	10	12	5	13	3	
3	L	1	Total	C	H	N	O	P	0
			43	10	12	5	13	3	

- Molecule 4 is ZINC ION (CCD ID: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
4	A	1	Total	Zn	0
			1	1	
4	B	1	Total	Zn	0
			1	1	
4	G	1	Total	Zn	0
			1	1	
4	H	1	Total	Zn	0
			1	1	
4	K	1	Total	Zn	0
			1	1	

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Mol	Chain	Residues	Atoms		AltConf
4	L	1	Total	Zn	0
			1	1	

- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
5	H	1	Total	Mg	0
			1	1	
5	K	1	Total	Mg	0
			1	1	

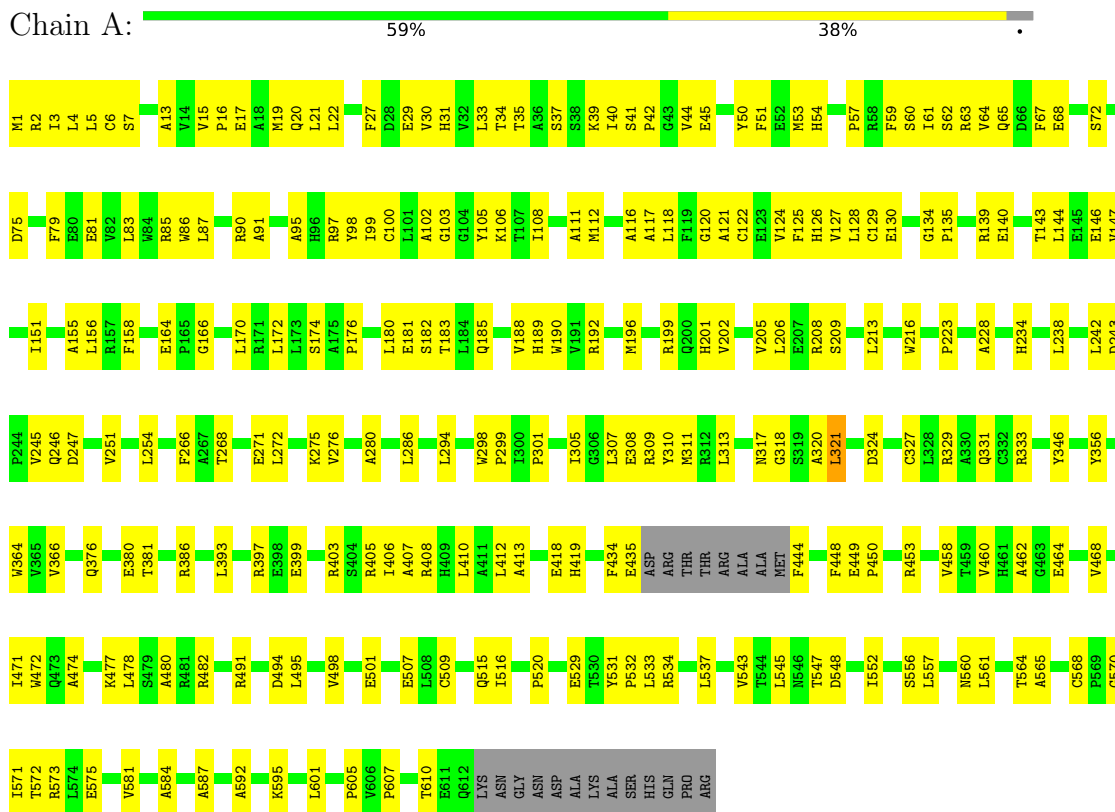
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		AltConf
6	G	1	Total	O	0
			1	1	
6	H	1	Total	O	0
			1	1	
6	K	1	Total	O	0
			1	1	
6	L	3	Total	O	0
			3	3	

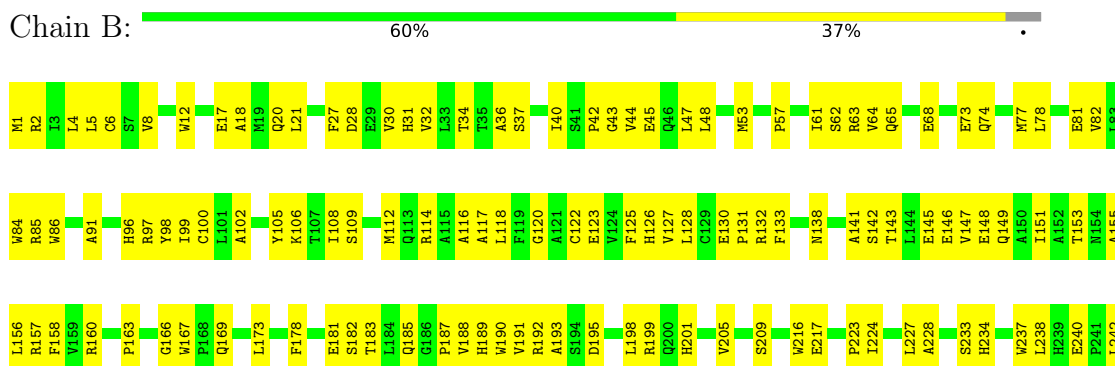
3 Residue-property plots

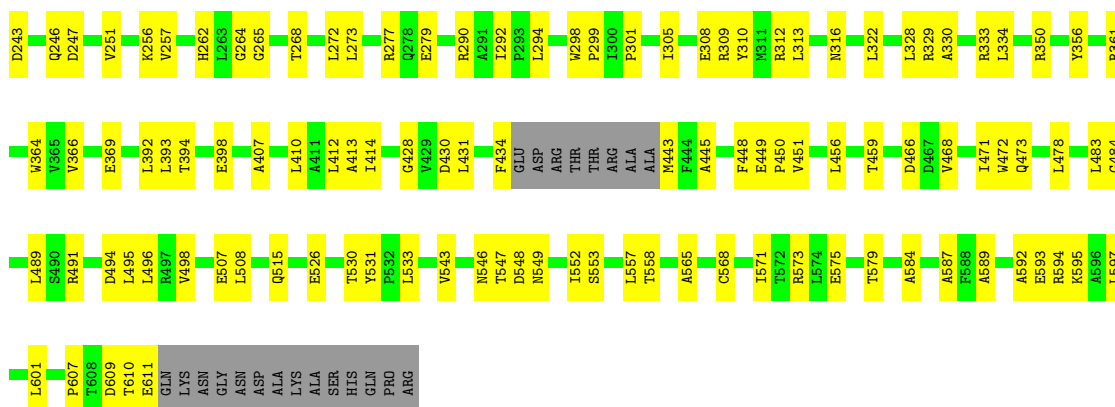
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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: CRISPR-associated ring nuclease and adenosine deaminase, subunit A

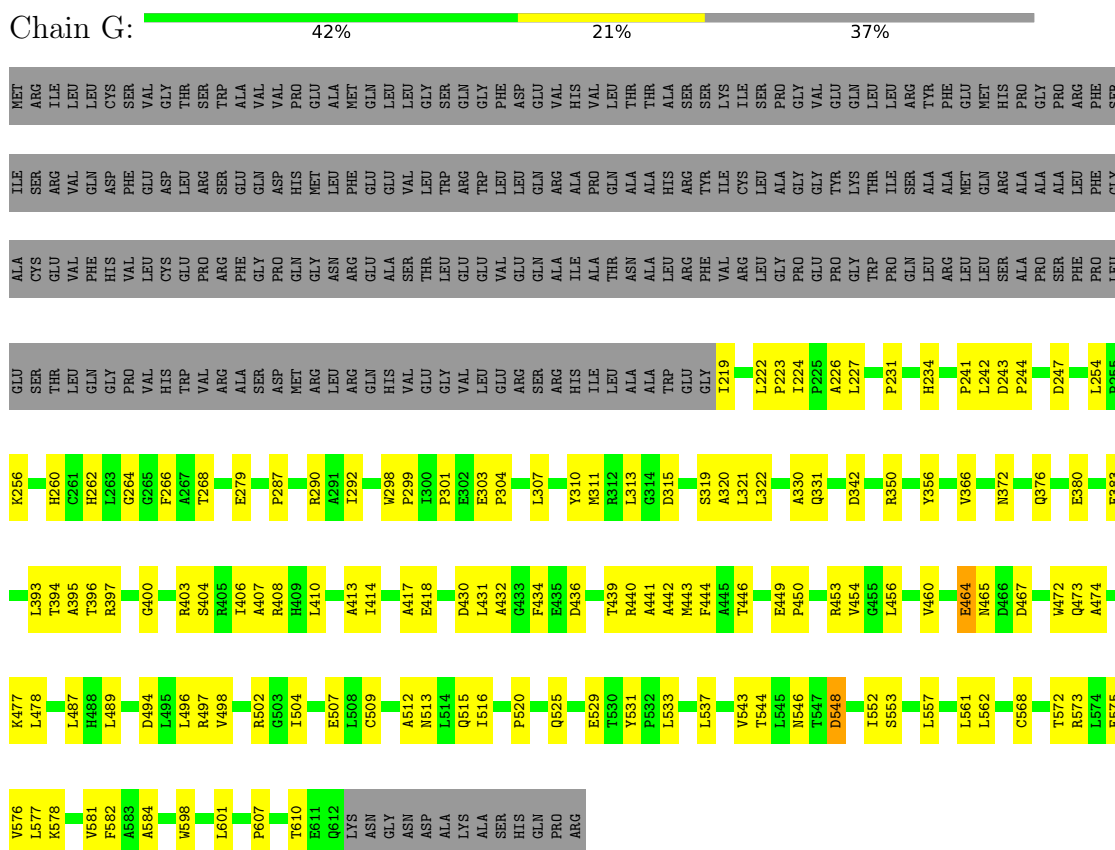


- Molecule 1: CRISPR-associated ring nuclease and adenosine deaminase, subunit A

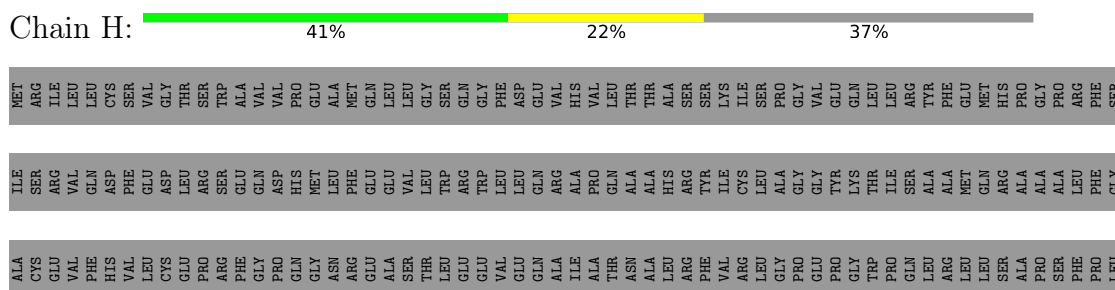


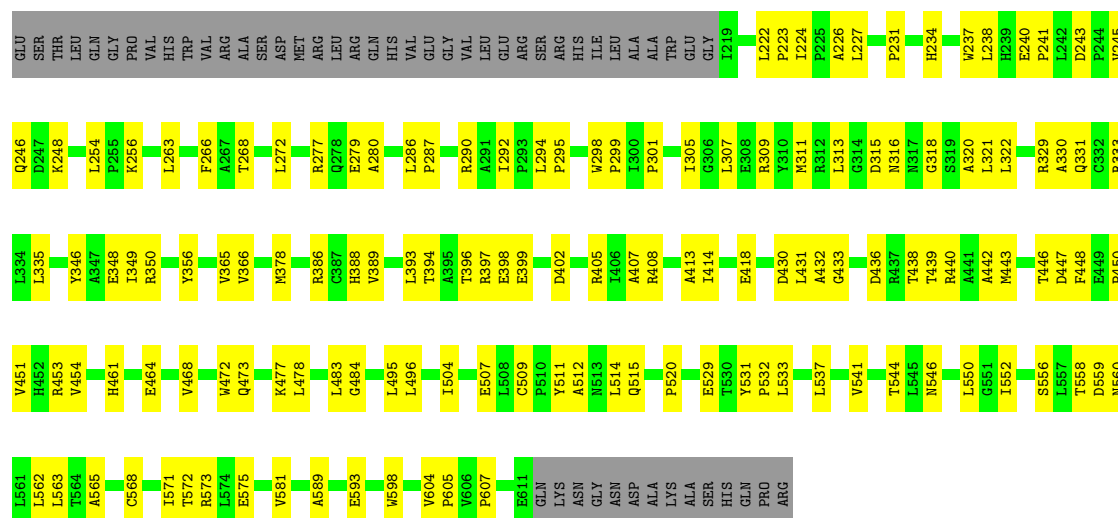


- Molecule 1: CRISPR-associated ring nuclease and adenosine deaminase, subunit A



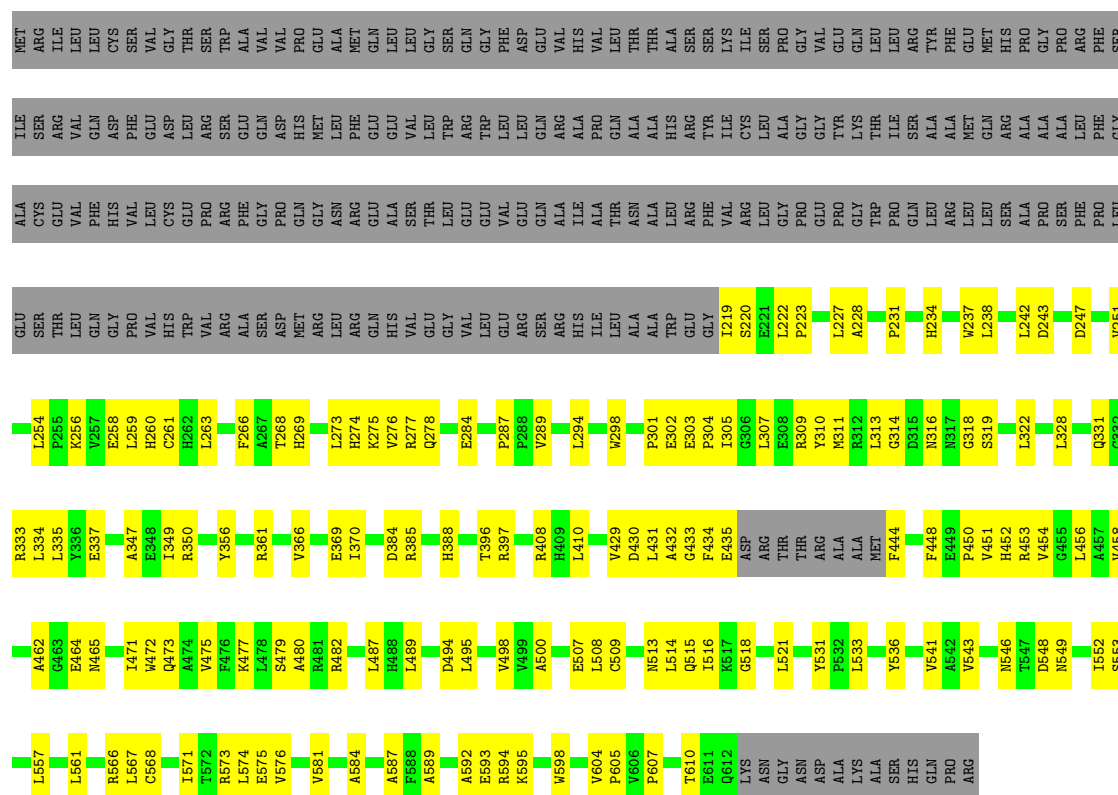
- Molecule 1: CRISPR-associated ring nuclease and adenosine deaminase, subunit A





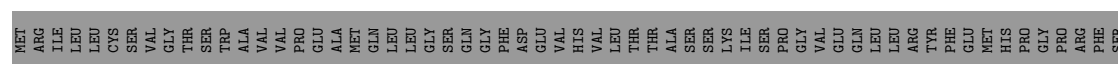
- Molecule 1: CRISPR-associated ring nuclease and adenosine deaminase, subunit A

Chain K: 38% 23% 38%



- Molecule 1: CRISPR-associated ring nuclease and adenosine deaminase, subunit A

Chain L: 35% 28% 37%





4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	165680	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	60	Depositor
Minimum defocus (nm)	820	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	Not provided	
Image detector	GATAN K2 QUANTUM (4k x 4k)	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MG, ATP, A23, ZN

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	0/4866	0.25	0/6630
1	B	0.10	0/4856	0.25	0/6616
1	G	0.12	0/3153	0.30	0/4304
1	H	0.10	0/3128	0.29	0/4269
1	K	0.12	0/3090	0.35	0/4218
1	L	0.13	0/3144	0.34	0/4292
2	C	0.22	0/21	0.61	0/31
2	D	0.10	0/21	0.20	0/31
All	All	0.11	0/22279	0.29	0/30391

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	G	0	1
1	K	0	1
All	All	0	2

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	G	464	GLU	Peptide
1	K	298	TRP	Peptide

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	4745	0	4699	219	0
1	B	4735	0	4693	206	0
1	G	3077	0	3053	103	0
1	H	3054	0	3036	113	0
1	K	3015	0	2989	130	0
1	L	3068	0	3045	146	0
2	C	44	0	20	4	0
2	D	44	0	22	5	0
3	A	31	12	12	0	0
3	B	31	12	12	2	0
3	G	31	12	12	4	0
3	H	31	12	12	2	0
3	K	31	12	12	0	0
3	L	31	12	12	2	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	G	1	0	0	0	0
4	H	1	0	0	0	0
4	K	1	0	0	0	0
4	L	1	0	0	0	0
5	H	1	0	0	0	0
5	K	1	0	0	0	0
6	G	1	0	0	1	0
6	H	1	0	0	0	0
6	K	1	0	0	0	0
6	L	3	0	0	3	0
All	All	21982	72	21629	896	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 21.

The worst 5 of 896 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)
2:C:708:A23:O4'	2:C:708:A23:C4'	1.74	1.17

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:710:A23:O4'	2:D:710:A23:C4'	1.74	1.17
1:B:445:ALA:HB2	1:B:478:LEU:HD23	1.46	0.98
1:B:108:ILE:HG22	1:B:112:MET:HE1	1.48	0.95
1:K:322:LEU:HD11	1:K:331:GLN:HG2	1.48	0.94

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 PDB entries followed by that with respect to all EM entries.

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	601/625 (96%)	585 (97%)	15 (2%)	1 (0%)	43	62
1	B	600/625 (96%)	586 (98%)	13 (2%)	1 (0%)	43	62
1	G	393/625 (63%)	375 (95%)	17 (4%)	1 (0%)	36	54
1	H	391/625 (63%)	372 (95%)	19 (5%)	0	100	100
1	K	383/625 (61%)	361 (94%)	22 (6%)	0	100	100
1	L	392/625 (63%)	378 (96%)	14 (4%)	0	100	100
All	All	2760/3750 (74%)	2657 (96%)	100 (4%)	3 (0%)	49	68

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	321	LEU
1	B	548	ASP
1	G	548	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 PDB entries followed by that with respect to all EM

entries.

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	496/511 (97%)	496 (100%)	0	100	100
1	B	495/511 (97%)	495 (100%)	0	100	100
1	G	320/511 (63%)	320 (100%)	0	100	100
1	H	318/511 (62%)	318 (100%)	0	100	100
1	K	314/511 (61%)	314 (100%)	0	100	100
1	L	319/511 (62%)	319 (100%)	0	100	100
All	All	2262/3066 (74%)	2262 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 38 such sidechains are listed below:

Mol	Chain	Res	Type
1	H	546	ASN
1	L	252	GLN
1	H	549	ASN
1	K	546	ASN
1	L	331	GLN

5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	C	1/2 (50%)	1 (100%)	0
2	D	1/2 (50%)	1 (100%)	0
All	All	2/4 (50%)	2 (100%)	0

All (2) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	C	708	A23
2	D	710	A23

There are no RNA pucker outliers to report.

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

2 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
2	A23	D	710	2	23,28,29	4.19	8 (34%)	32,43,46	2.22	11 (34%)
2	A23	C	708	2	23,28,29	4.29	8 (34%)	32,43,46	2.15	10 (31%)

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	A23	D	710	2	-	1/7/35/36	0/4/4/4
2	A23	C	708	2	-	5/7/35/36	0/4/4/4

The worst 5 of 16 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	708	A23	O4'-C4'	13.24	1.74	1.45
2	D	710	A23	O4'-C4'	13.18	1.74	1.45
2	C	708	A23	C3'-C4'	-9.63	1.28	1.52
2	D	710	A23	C3'-C4'	-9.55	1.28	1.52
2	C	708	A23	C2'-C3'	8.65	1.71	1.53

The worst 5 of 21 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	708	A23	C5-C4-N3	-5.57	119.05	126.72
2	D	710	A23	C5-C4-N3	-5.25	119.49	126.72
2	D	710	A23	N3-C2-N1	-4.22	122.20	128.58
2	C	708	A23	N3-C4-N9	4.18	134.27	127.17
2	C	708	A23	N3-C2-N1	-3.99	122.54	128.58

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	708	A23	O4'-C4'-C5'-O5'
2	C	708	A23	C3'-C4'-C5'-O5'
2	C	708	A23	C2'-C1'-N9-C8
2	C	708	A23	C2'-C1'-N9-C4
2	C	708	A23	O4'-C1'-N9-C8

There are no ring outliers.

2 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	710	A23	5	0
2	C	708	A23	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 14 ligands modelled in this entry, 8 are monoatomic - leaving 6 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	ATP	G	701	-	32,33,33	0.28	0	48,52,52	0.69	0
3	ATP	B	701	-	32,33,33	0.30	0	48,52,52	0.74	0
3	ATP	L	701	-	32,33,33	0.31	0	48,52,52	0.75	1 (2%)
3	ATP	A	701	-	32,33,33	0.28	0	48,52,52	0.68	0
3	ATP	K	701	5	32,33,33	0.26	0	48,52,52	0.66	0
3	ATP	H	702	5	32,33,33	0.28	0	48,52,52	0.71	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
3	ATP	G	701	-	-	10/22/38/38	0/3/3/3
3	ATP	B	701	-	-	4/22/38/38	0/3/3/3
3	ATP	L	701	-	-	4/22/38/38	0/3/3/3
3	ATP	A	701	-	-	0/22/38/38	0/3/3/3
3	ATP	K	701	5	-	3/22/38/38	0/3/3/3
3	ATP	H	702	5	-	5/22/38/38	0/3/3/3

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	L	701	ATP	O3'-C3'-C4'	-2.04	105.23	111.08

There are no chirality outliers.

5 of 26 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	701	ATP	PB-O3B-PG-O2G
3	G	701	ATP	C5'-O5'-PA-O1A
3	G	701	ATP	C5'-O5'-PA-O2A
3	G	701	ATP	C5'-O5'-PA-O3A
3	G	701	ATP	C4'-C5'-O5'-PA

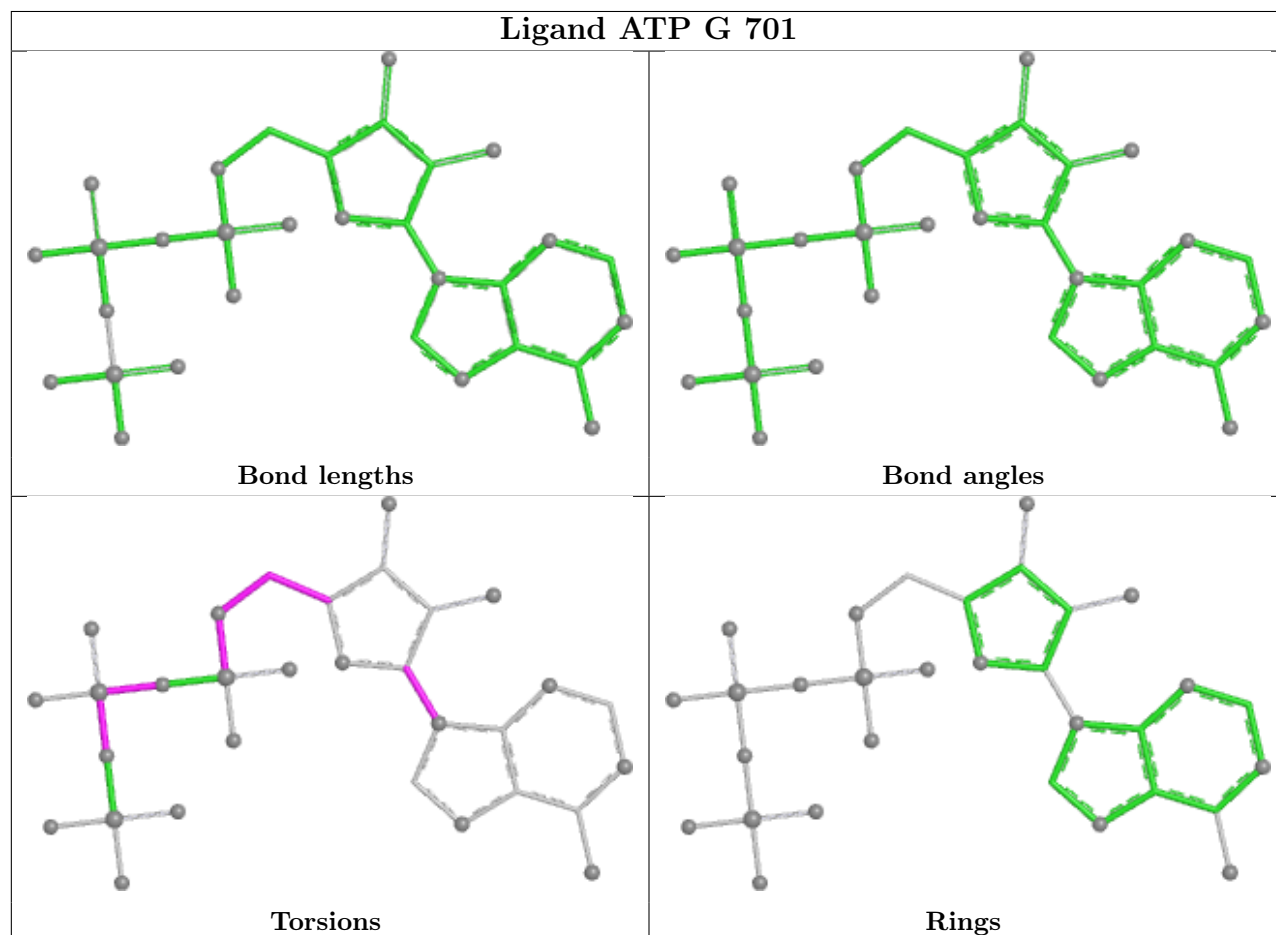
There are no ring outliers.

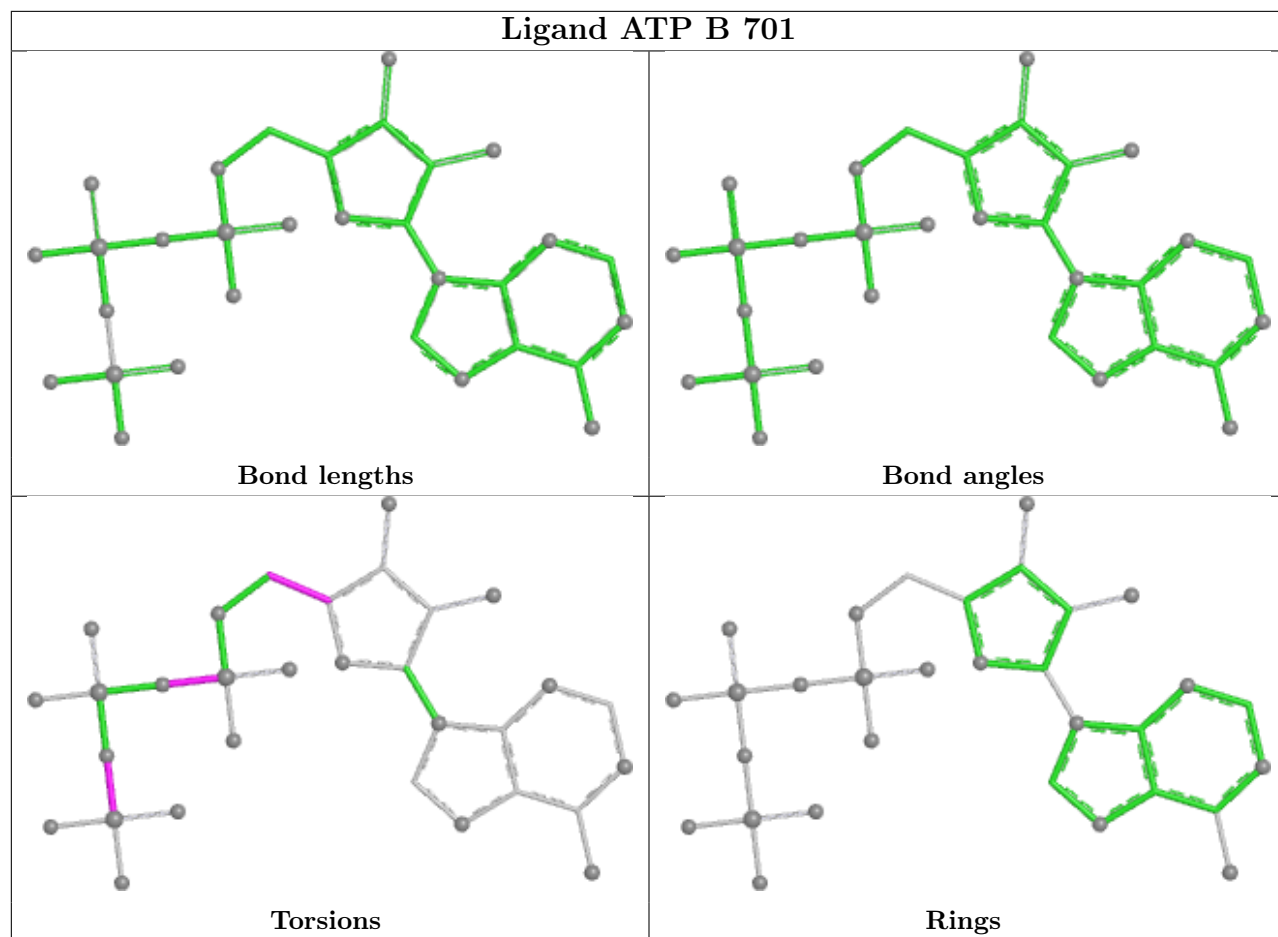
4 monomers are involved in 10 short contacts:

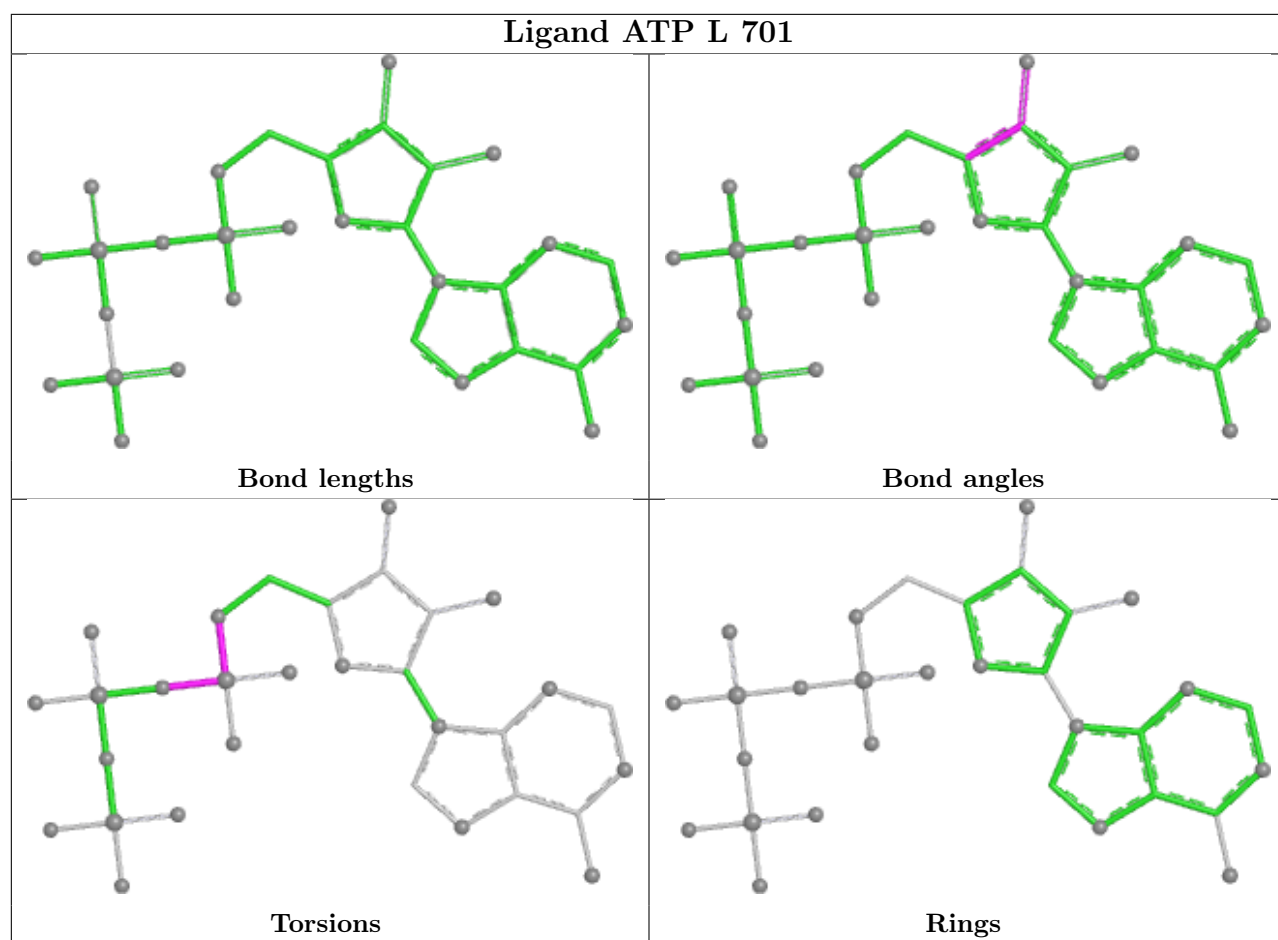
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	G	701	ATP	4	0
3	B	701	ATP	2	0
3	L	701	ATP	2	0
3	H	702	ATP	2	0

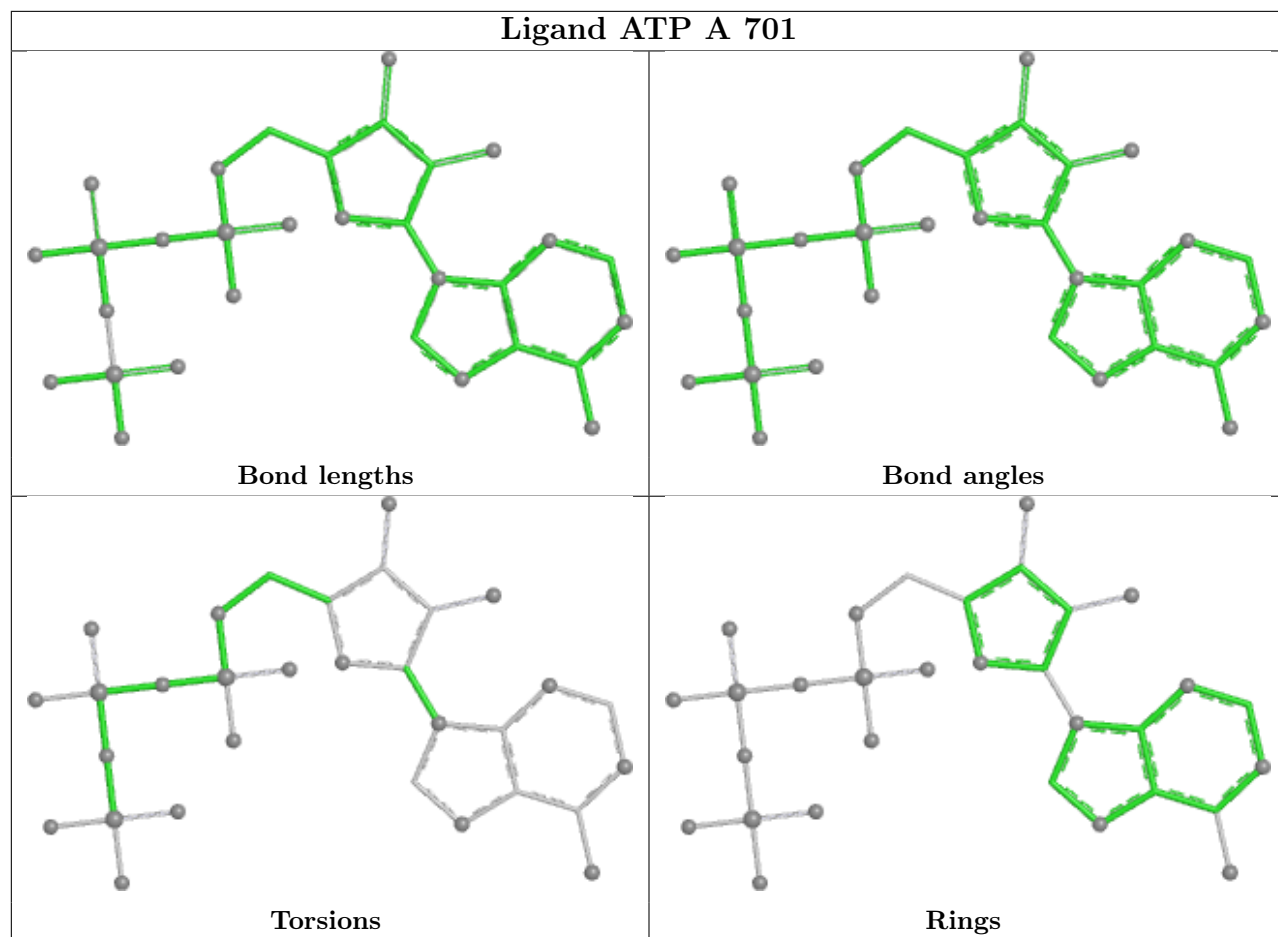
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less 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.

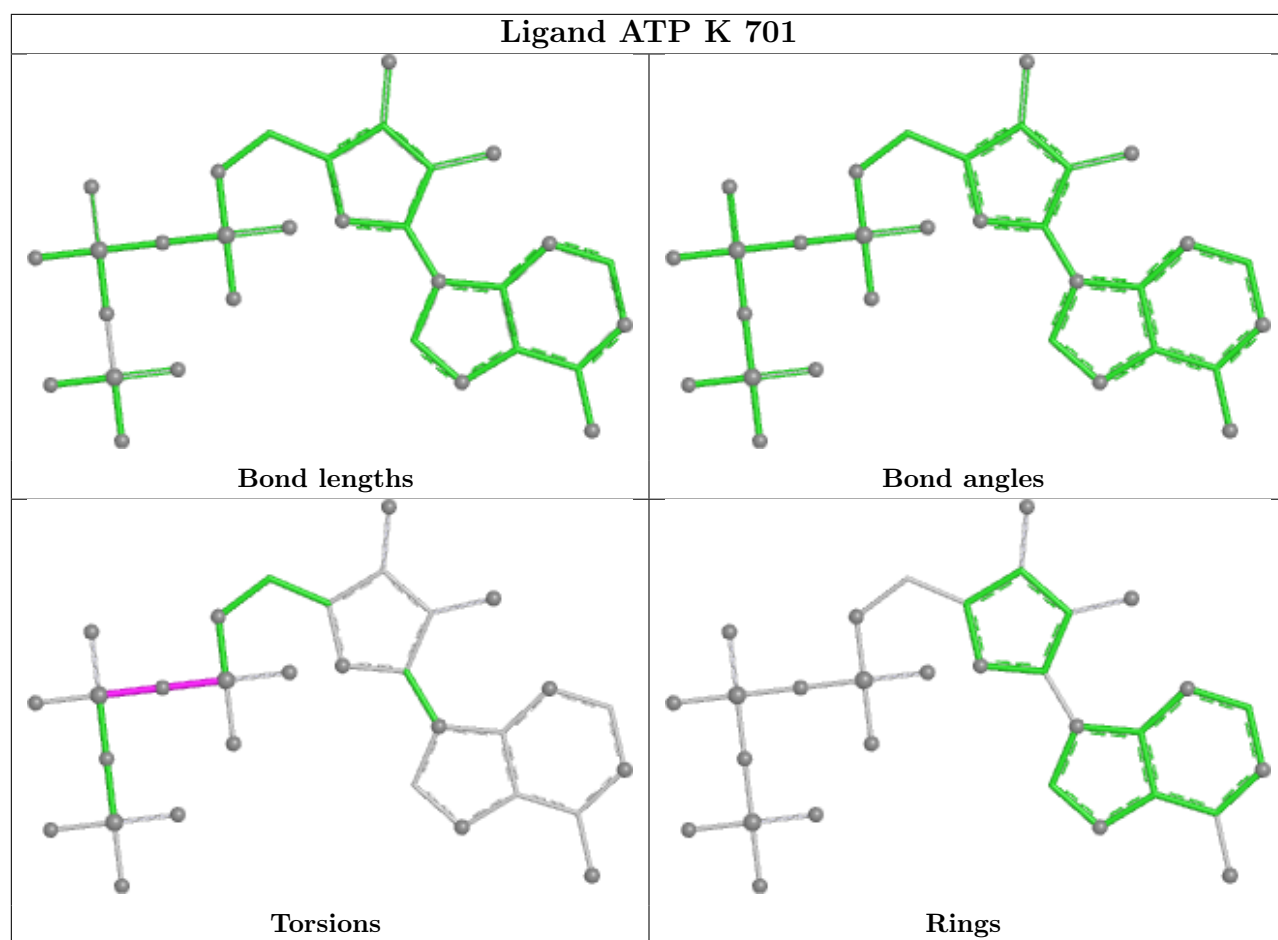
Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD 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.

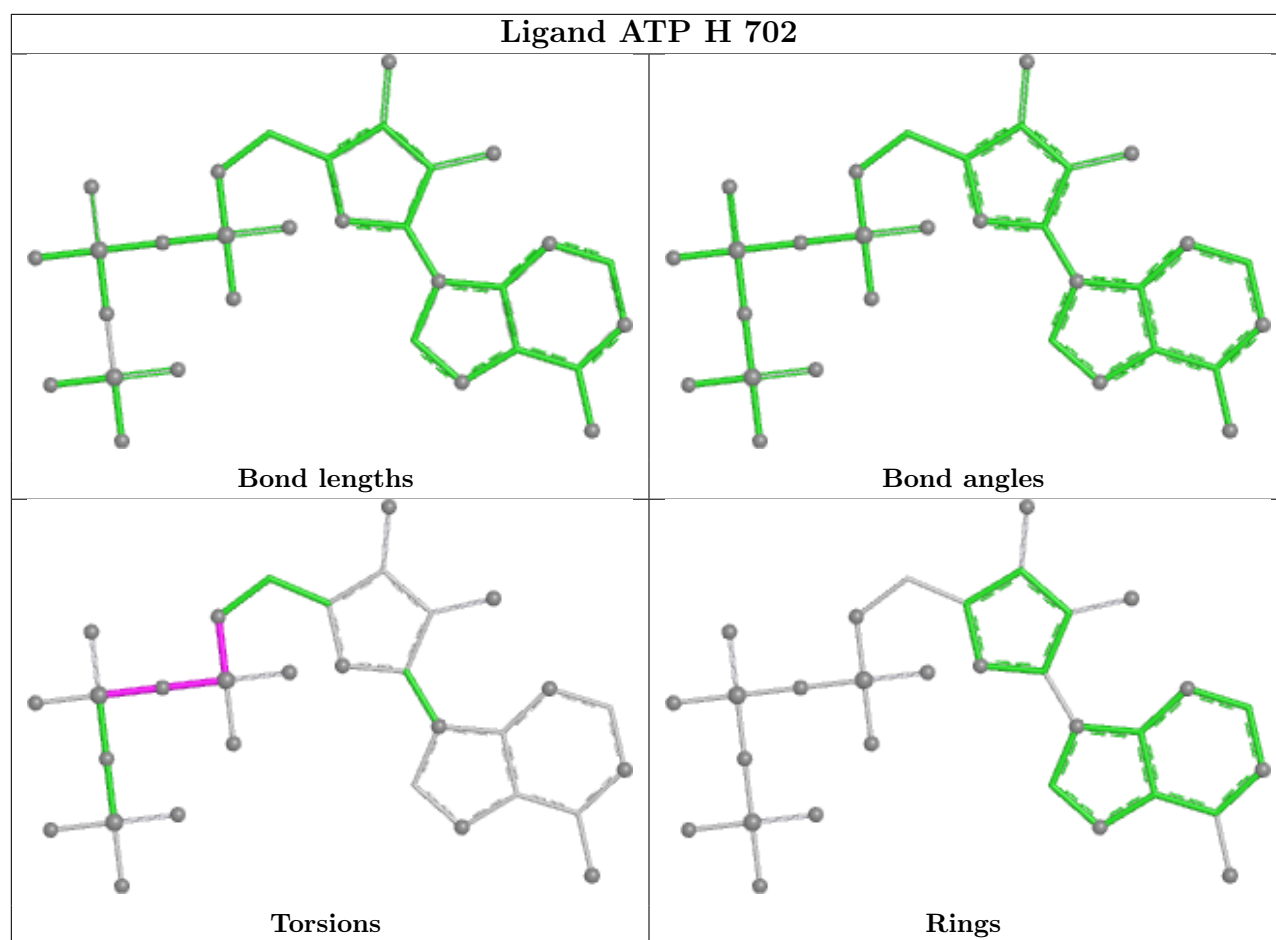












5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-70429. These allow visual inspection of the internal detail of the map and identification of artifacts.

Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

This section was not generated.

6.2 Central slices [i](#)

This section was not generated.

6.3 Largest variance slices [i](#)

This section was not generated.

6.4 Orthogonal standard-deviation projections (False-color) [i](#)

This section was not generated.

6.5 Orthogonal surface views [i](#)

This section was not generated.

6.6 Mask visualisation [i](#)

This section was not generated. No masks/segmentation were deposited.

7 Map analysis ⓘ

This section contains the results of statistical analysis of the map.

7.1 Map-value distribution ⓘ

This section was not generated.

7.2 Volume estimate versus contour level ⓘ

This section was not generated.

7.3 Rotationally averaged power spectrum ⓘ

This section was not generated. The rotationally averaged power spectrum had issues being displayed.

8 Fourier-Shell correlation

This section was not generated. No FSC curve or half-maps provided.

9 Map-model fit

This section was not generated.