



wwPDB EM Validation Summary Report ⓘ

Mar 25, 2026 – 03:20 AM UTC

PDB ID : 1IA0 / pdb_00001ia0
Title : KIF1A HEAD-MICROTUBULE COMPLEX STRUCTURE IN ATP-FORM
Authors : Kikkawa, M.; Sablin, E.P.; Okada, Y.; Yajima, H.; Fletterick, R.J.; Hirokawa, N.
Deposited on : 2001-03-22
Resolution : 15.00 Å (reported)
Based on initial model : 1TUB

This is a wwPDB EM Validation Summary Report for a publicly released PDB/EMDB 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:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

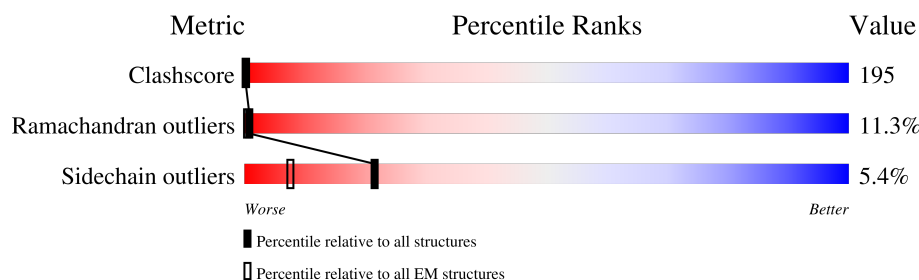
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 15.00 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

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	451	
2	B	445	
3	K	394	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	GTP	A	500	-	-	X	-
5	GDP	B	501	-	-	X	-
6	TXL	B	502	-	-	X	-

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 9606 atoms, of which 0 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 TUBULIN ALPHA CHAIN.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	440	Total	C	N	O	S	0	0
			3430	2168	583	657	22		

- Molecule 2 is a protein called TUBULIN BETA CHAIN.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	427	Total	C	N	O	S	0	0
			3359	2110	576	647	26		

- Molecule 3 is a protein called KINESIN-LIKE PROTEIN KIF1A.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	K	328	Total	C	N	O	S	10	0
			2667	1651	469	531	16		

There are 42 discrepancies between the modelled and reference sequences:

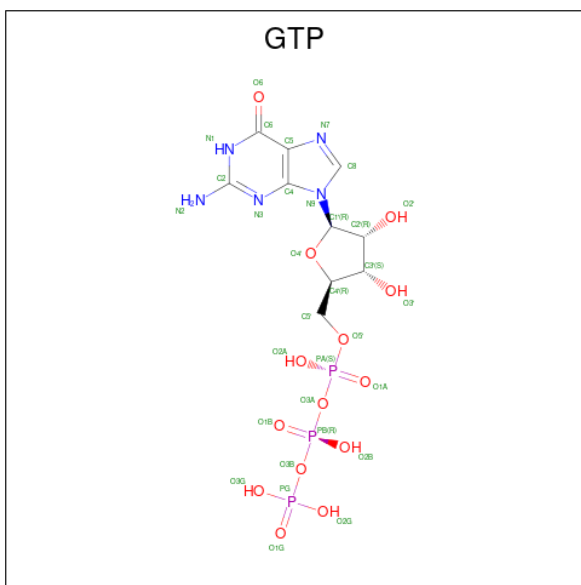
Chain	Residue	Modelled	Actual	Comment	Reference
K	-15	MET	-	see remark 999	UNP P33173
K	-14	ALA	-	see remark 999	UNP P33173
K	-13	SER	-	see remark 999	UNP P33173
K	-12	MET	-	see remark 999	UNP P33173
K	-11	THR	-	see remark 999	UNP P33173
K	-10	GLY	-	see remark 999	UNP P33173
K	-9	GLY	-	see remark 999	UNP P33173
K	-8	GLN	-	see remark 999	UNP P33173
K	-7	GLN	-	see remark 999	UNP P33173
K	-6	MET	-	see remark 999	UNP P33173
K	-5	GLY	-	see remark 999	UNP P33173
K	-4	ARG	-	see remark 999	UNP P33173
K	-3	ASP	-	see remark 999	UNP P33173
K	-2	PRO	-	see remark 999	UNP P33173
K	-1	ILE	-	see remark 999	UNP P33173

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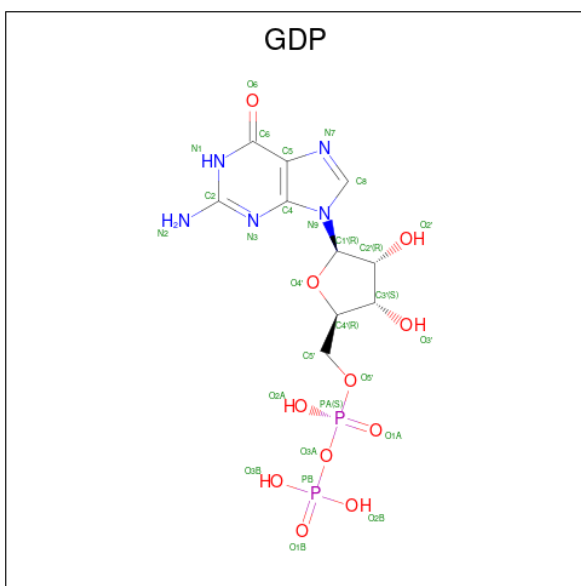
Chain	Residue	Modelled	Actual	Comment	Reference
K	0	ASN	-	see remark 999	UNP P33173
K	1	MET	-	see remark 999	UNP P33173
K	2	PRO	-	see remark 999	UNP P33173
K	202	ALA	PRO	engineered mutation	UNP P33173
K	356	ASN	-	SEE REMARK 999	UNP P33173
K	357	THR	-	SEE REMARK 999	UNP P33173
K	358	VAL	-	SEE REMARK 999	UNP P33173
K	359	SER	-	SEE REMARK 999	UNP P33173
K	360	VAL	-	SEE REMARK 999	UNP P33173
K	361	ASN	-	SEE REMARK 999	UNP P33173
K	362	LEU	-	SEE REMARK 999	UNP P33173
K	363	GLU	-	SEE REMARK 999	UNP P33173
K	364	LEU	-	SEE REMARK 999	UNP P33173
K	365	THR	-	SEE REMARK 999	UNP P33173
K	366	ALA	-	SEE REMARK 999	UNP P33173
K	367	GLU	-	SEE REMARK 999	UNP P33173
K	368	GLU	-	SEE REMARK 999	UNP P33173
K	369	TRP	-	SEE REMARK 999	UNP P33173
K	370	LYS	-	SEE REMARK 999	UNP P33173
K	371	LYS	-	SEE REMARK 999	UNP P33173
K	372	LYS	-	SEE REMARK 999	UNP P33173
K	373	HIS	-	SEE REMARK 999	UNP P33173
K	374	HIS	-	SEE REMARK 999	UNP P33173
K	375	HIS	-	SEE REMARK 999	UNP P33173
K	376	HIS	-	SEE REMARK 999	UNP P33173
K	377	HIS	-	SEE REMARK 999	UNP P33173
K	378	HIS	-	SEE REMARK 999	UNP P33173

- Molecule 4 is GUANOSINE-5'-TRIPHOSPHATE (CCD ID: GTP) (formula: $C_{10}H_{16}N_5O_{14}P_3$).



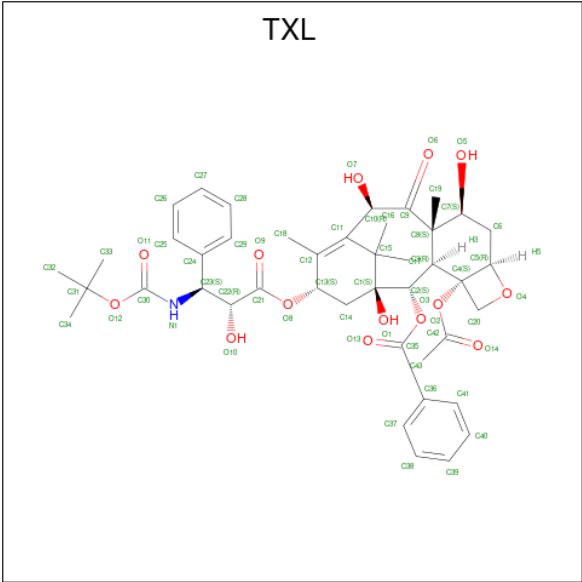
Mol	Chain	Residues	Atoms					AltConf
4	A	1	Total	C	N	O	P	0
			32	10	5	14	3	

- Molecule 5 is GUANOSINE-5'-DIPHOSPHATE (CCD ID: GDP) (formula: $\text{C}_{10}\text{H}_{15}\text{N}_5\text{O}_{11}\text{P}_2$).



Mol	Chain	Residues	Atoms					AltConf
5	B	1	Total	C	N	O	P	0
			28	10	5	11	2	

- Molecule 6 is TAXOTERE (CCD ID: TXL) (formula: $\text{C}_{43}\text{H}_{53}\text{NO}_{14}$).

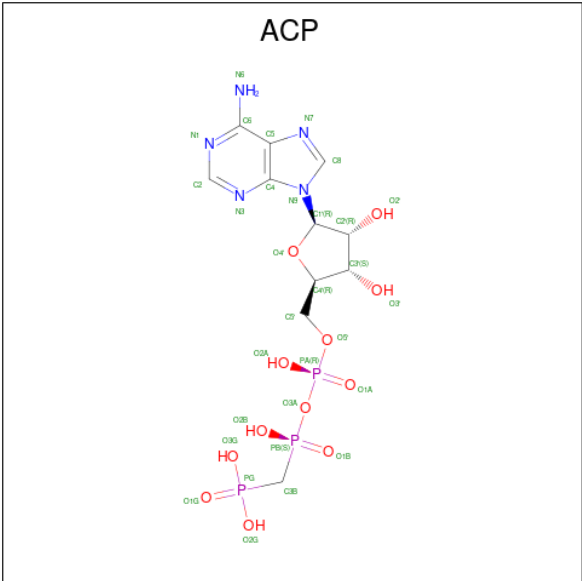


Mol	Chain	Residues	Atoms				AltConf
			Total	C	N	O	
6	B	1	58	43	1	14	0

- Molecule 7 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		AltConf
			Total	Mg	
7	K	1	1	1	0

- Molecule 8 is PHOSPHOMETHYLPHOSPHONIC ACID ADENYLATE ESTER (CCD ID: ACP) (formula: C₁₁H₁₈N₅O₁₂P₃).

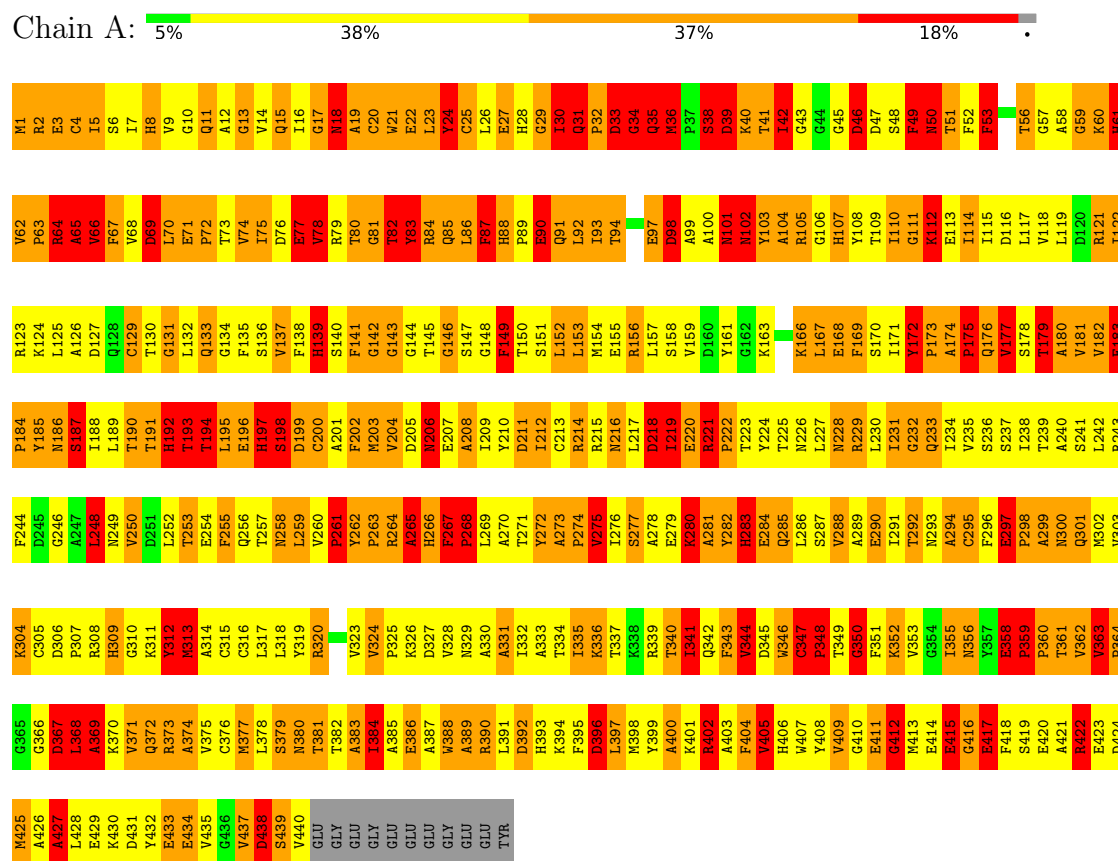


Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	P	
8	K	1	31	11	5	12	3	0

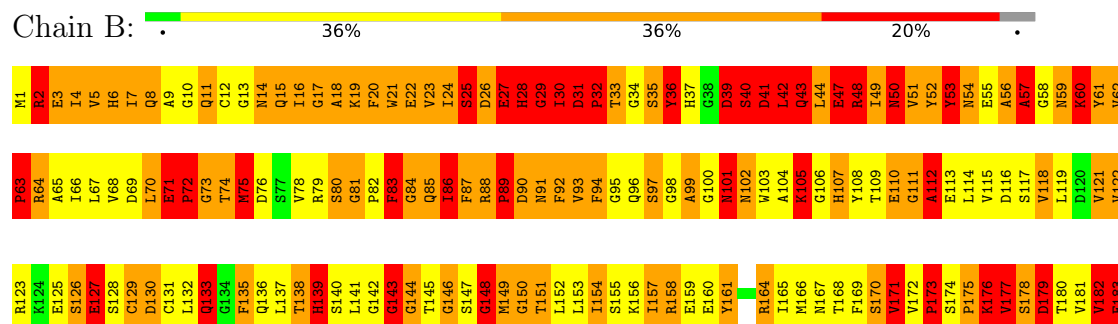
3 Residue-property plots

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. 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: TUBULIN ALPHA CHAIN



• Molecule 2: TUBULIN BETA CHAIN



4 Data and refinement statistics

Xtriage (Phenix) and EDS failed to run properly - this section is therefore incomplete.

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	1.00Å 1.00Å 1.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 15.00	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-15.00)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	unknown	Depositor
R, R_{free}	(Not available) , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	9606	wwPDB-VP
Average B, all atoms (Å ²)	23.0	wwPDB-VP

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: GTP, ACP, MG, GDP, TXL

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	3.36	243/3508 (6.9%)	3.46	307/4762 (6.4%)
2	B	3.61	243/3434 (7.1%)	3.81	360/4652 (7.7%)
3	K	0.57	0/2708	1.04	15/3655 (0.4%)
All	All	2.97	486/9650 (5.0%)	3.14	682/13069 (5.2%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	57
2	B	0	59
All	All	0	116

The worst 5 of 486 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	278	ARG	CA-CB	48.79	2.30	1.53
1	A	38	SER	C-N	-44.89	0.70	1.33
2	B	73	GLY	C-N	-44.03	0.69	1.33
2	B	105	LYS	C-N	-37.87	0.80	1.33
1	A	218	ASP	C-N	-35.87	0.84	1.33

The worst 5 of 682 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	368	LEU	O-C-N	-65.11	35.99	122.59
2	B	105	LYS	O-C-N	-56.44	47.53	122.59
2	B	73	GLY	O-C-N	-47.19	76.42	122.19

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	283	HIS	O-C-N	-41.56	67.31	122.59
2	B	275	LEU	O-C-N	-39.60	79.33	122.09

There are no chirality outliers.

5 of 116 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	18	ASN	Mainchain
1	A	24	TYR	Mainchain,Peptide
1	A	30	ILE	Mainchain,Peptide
1	A	34	GLY	Peptide
1	A	36	MET	Mainchain

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	3430	0	3272	1721	0
2	B	3359	0	3181	1900	0
3	K	2667	0	2614	160	0
4	A	32	0	11	22	0
5	B	28	0	12	20	0
6	B	58	0	51	61	0
7	K	1	0	0	0	0
8	K	31	0	14	2	0
All	All	9606	0	9155	3654	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 195.

The worst 5 of 3654 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:B:405:LEU:HD22	2:B:418:PHE:CZ	1.17	1.68
2:B:151:THR:CB	2:B:192:HIS:CD2	1.75	1.68

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:229:HIS:CE1	6:B:502:TXL:H343	1.28	1.67
1:A:115:ILE:HD12	1:A:152:LEU:CG	1.26	1.64
2:B:184:PRO:HG2	2:B:399:PHE:CE2	1.12	1.63

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	438/451 (97%)	322 (74%)	63 (14%)	53 (12%)	0	4
2	B	425/445 (96%)	298 (70%)	48 (11%)	79 (19%)	0	2
3	K	332/394 (84%)	319 (96%)	11 (3%)	2 (1%)	21	59
All	All	1195/1290 (93%)	939 (79%)	122 (10%)	134 (11%)	1	5

5 of 134 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	31	GLN
1	A	33	ASP
1	A	35	GLN
1	A	39	ASP
1	A	42	ILE

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	369/377 (98%)	353 (96%)	16 (4%)	26	47
2	B	368/381 (97%)	354 (96%)	14 (4%)	29	50
3	K	300/345 (87%)	271 (90%)	29 (10%)	8	24
All	All	1037/1103 (94%)	978 (94%)	59 (6%)	21	40

5 of 59 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	416	MET
3	K	303	PHE
3	K	83[A]	GLN
3	K	275	LEU
3	K	235	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 41 such sidechains are listed below:

Mol	Chain	Res	Type
2	B	294	GLN
3	K	137	ASN
2	B	336	GLN
2	B	426	ASN
3	K	171	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 1 is monoatomic - leaving 4 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	$\# Z > 2$
4	GTP	A	500	-	33,34,34	1.93	6 (18%)	50,54,54	1.45	5 (10%)
6	TXL	B	502	-	63,63,63	4.48	48 (76%)	100,100,100	3.47	55 (55%)
8	ACP	K	503	7	31,33,33	1.43	6 (19%)	47,52,52	2.01	9 (19%)
5	GDP	B	501	-	29,30,30	1.32	3 (10%)	45,47,47	0.96	2 (4%)

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
4	GTP	A	500	-	-	1/22/38/38	0/3/3/3
6	TXL	B	502	-	-	0/38/124/124	0/6/6/6
8	ACP	K	503	7	-	0/19/38/38	0/3/3/3
5	GDP	B	501	-	-	4/16/32/32	0/3/3/3

The worst 5 of 63 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	B	502	TXL	O3-C4	-10.07	1.26	1.46
6	B	502	TXL	C41-C36	9.38	1.53	1.39
6	B	502	TXL	C37-C36	-8.72	1.26	1.39
6	B	502	TXL	C8-C3	-8.12	1.38	1.57
6	B	502	TXL	O6-C9	-8.01	1.08	1.21

The worst 5 of 71 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	B	502	TXL	C39-C38-C37	11.07	133.89	120.24
6	B	502	TXL	C15-C1-C2	10.90	123.90	111.93
6	B	502	TXL	C38-C37-C36	-9.75	110.78	120.36
6	B	502	TXL	O7-C10-C9	7.22	121.55	109.51
8	K	503	ACP	C5-C4-N3	-6.47	117.80	126.72

There are no chirality outliers.

All (5) torsion outliers are listed below:

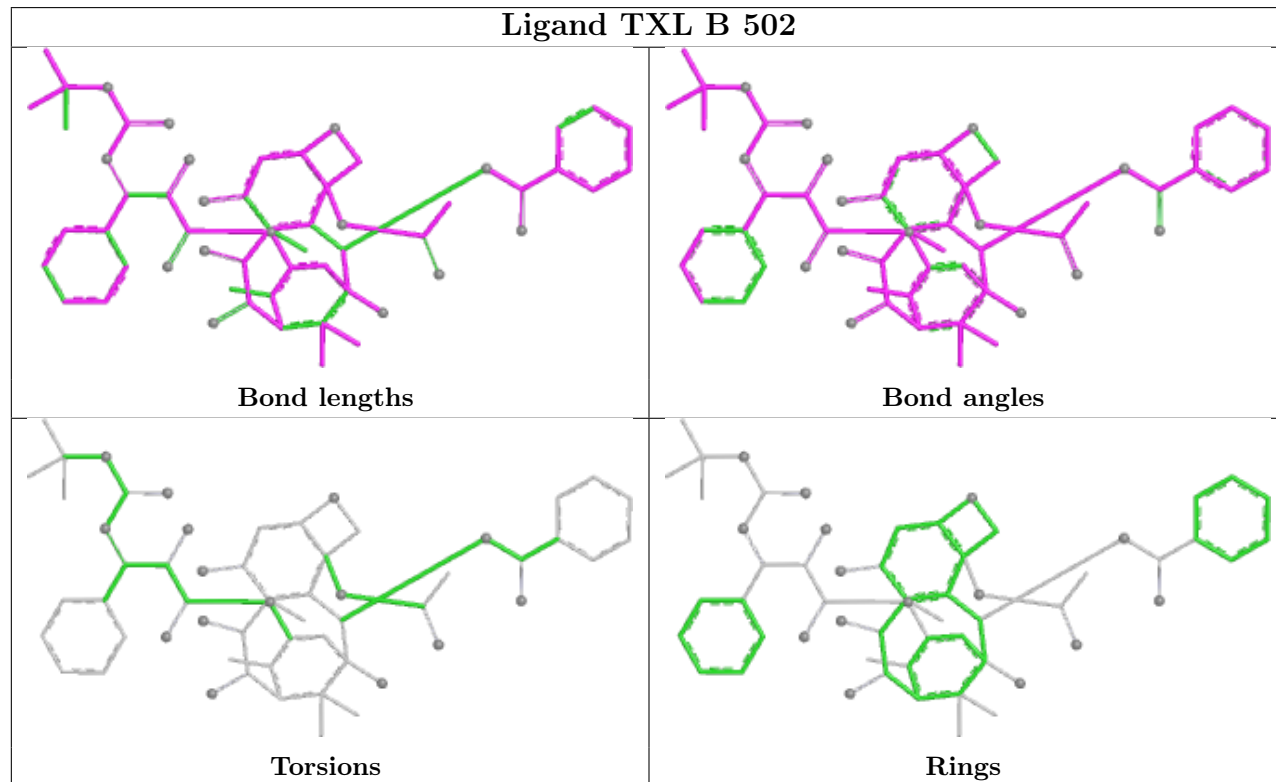
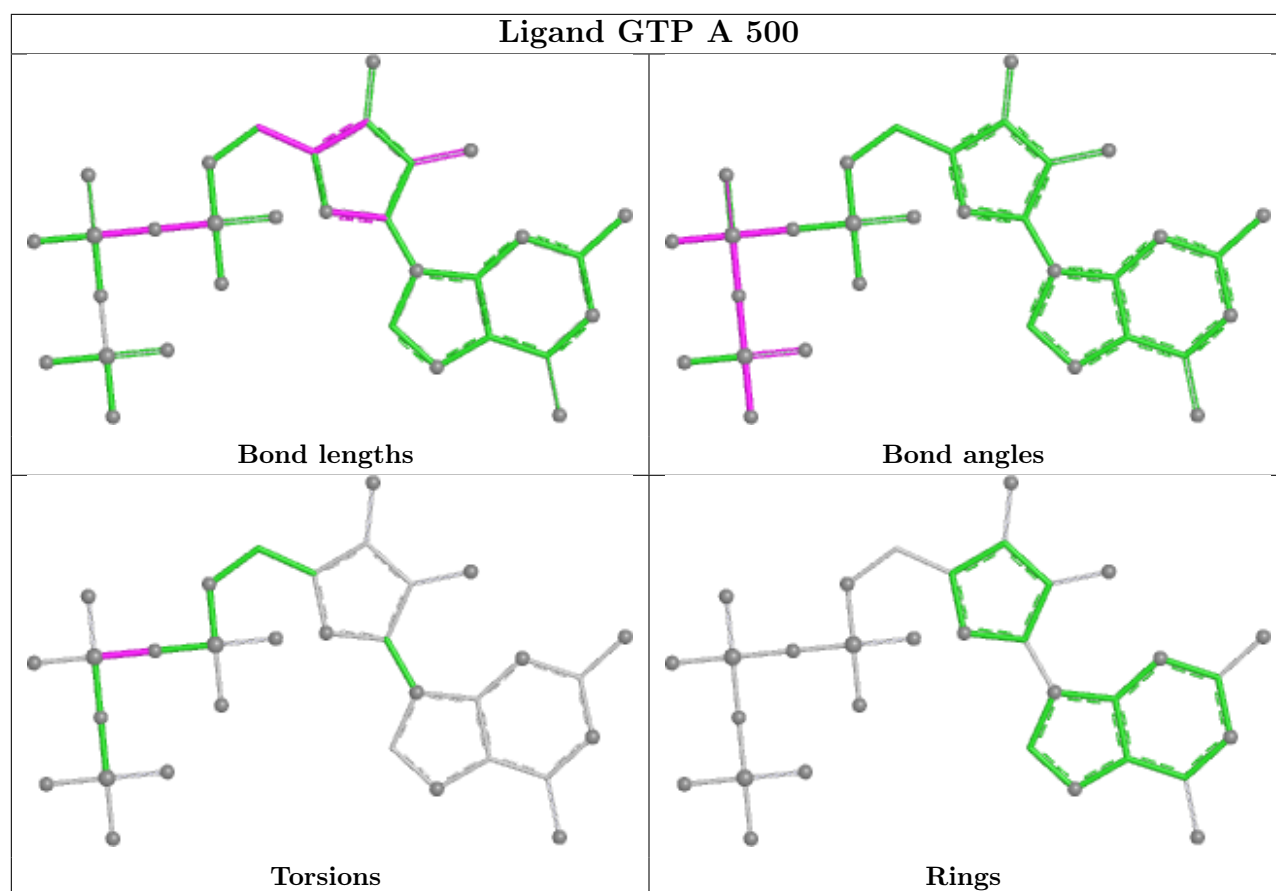
Mol	Chain	Res	Type	Atoms
5	B	501	GDP	PA-O3A-PB-O2B
5	B	501	GDP	C5'-O5'-PA-O1A
5	B	501	GDP	PA-O3A-PB-O1B
5	B	501	GDP	PA-O3A-PB-O3B
4	A	500	GTP	PA-O3A-PB-O2B

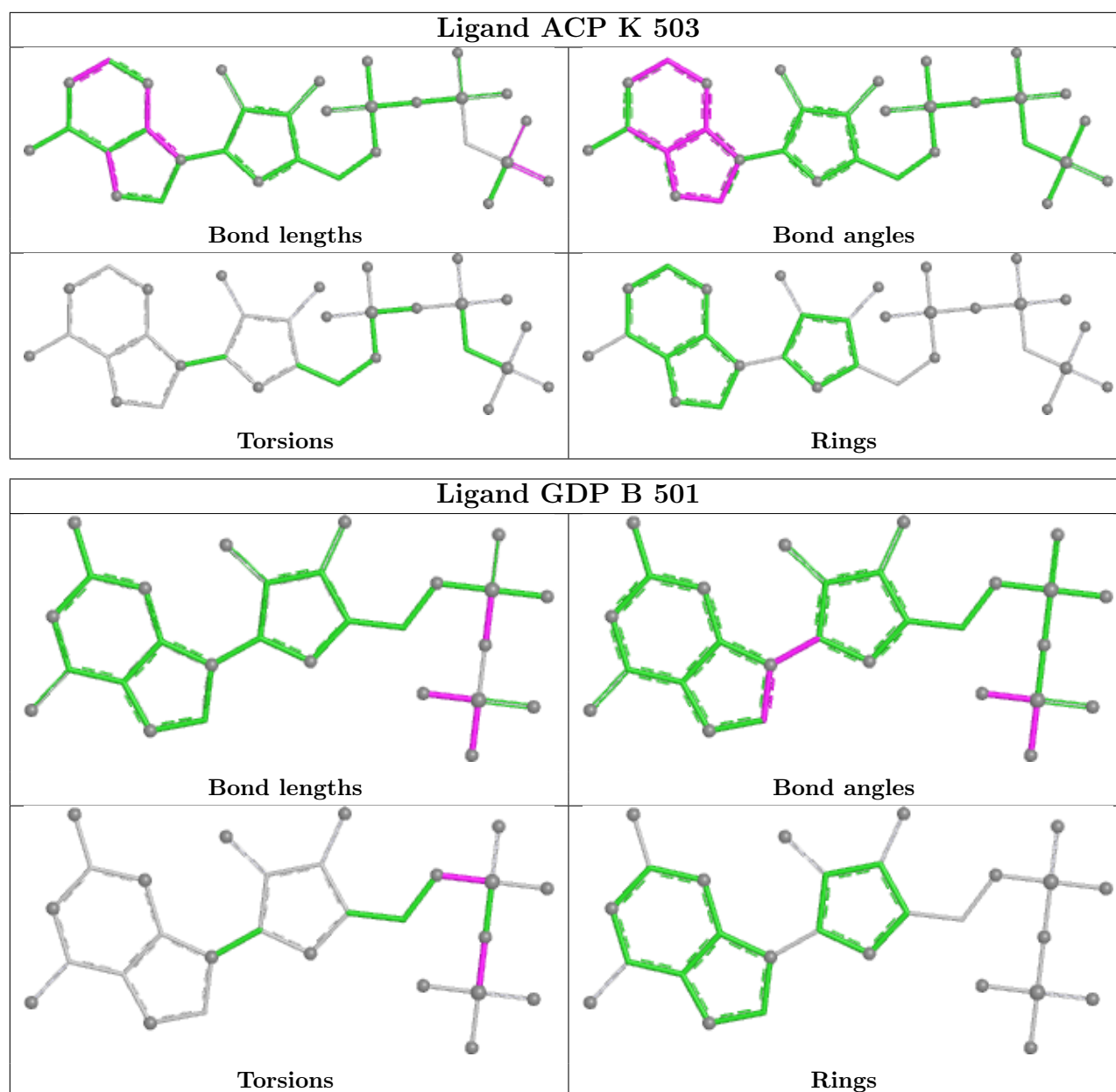
There are no ring outliers.

4 monomers are involved in 105 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	500	GTP	22	0
6	B	502	TXL	61	0
8	K	503	ACP	2	0
5	B	501	GDP	20	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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
2	B	52
1	A	41

The worst 5 of 93 chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	B	387:LEU	C	388:PHE	N	1.63
1	A	283:HIS	C	284:GLU	N	1.20
1	A	380:ASN	C	381:THR	N	1.20
1	A	437:VAL	C	438:ASP	N	1.20
1	B	52:TYR	C	53:TYR	N	1.20