



Full wwPDB EM Model Validation Report ⓘ

Apr 6, 2020 – 10:11 AM EDT

PDB ID : 6OJQ
EMDB ID : EMD-20092
Title : Monomeric kinesin-1 motor domain in no-nucleotide state bound to GMPCPP-stabilized microtubule
Authors : Cha, H.K.; Debs, G.
Deposited on : 2019-04-12
Resolution : 3.67 Å(reported)

This is a Full wwPDB EM Model Validation 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
buster-report : 1.1.7 (2018)
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.10.1

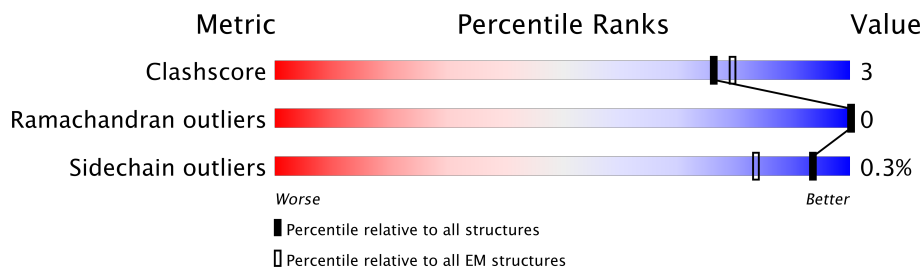
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.67 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	136327	1886
Ramachandran outliers	132723	1663
Sidechain outliers	132532	1531

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 on 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	B	426	92% (green), 8% (yellow)
2	A	437	84% (green), 14% (yellow), 2% (grey)
3	K	317	93% (green), 5% (yellow), 2% (grey)

2 Entry composition i

There are 6 unique types of molecules in this entry. The entry contains 18080 atoms, of which 8903 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 beta-2B chain.

Mol	Chain	Residues	Atoms						AltConf	Trace
			Total	C	H	N	O	S		
1	B	426	6561	2101	3219	572	644	25	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	57	ALA	THR	conflict	UNP Q6B856
B	172	VAL	MET	conflict	UNP Q6B856
B	298	ALA	SER	conflict	UNP Q6B856
B	318	VAL	ILE	conflict	UNP Q6B856

- Molecule 2 is a protein called Tubulin alpha-1B chain.

Mol	Chain	Residues	Atoms						AltConf	Trace
			Total	C	H	N	O	S		
2	A	428	6597	2122	3255	571	628	21	0	0

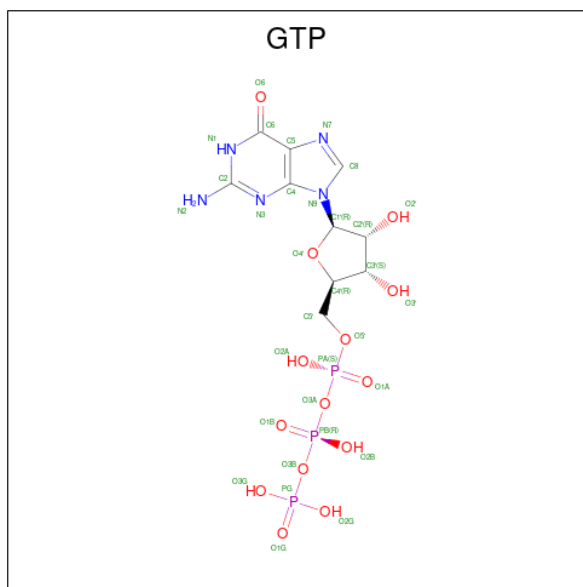
- Molecule 3 is a protein called Kinesin-1 heavy chain.

Mol	Chain	Residues	Atoms						AltConf	Trace
			Total	C	H	N	O	S		
3	K	310	4831	1516	2404	417	485	9	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
K	65	ALA	CYS	conflict	UNP P33176
K	168	ALA	CYS	conflict	UNP P33176
K	174	SER	CYS	conflict	UNP P33176
K	294	ALA	CYS	conflict	UNP P33176

- Molecule 4 is PHOSPHOMETHYLPHOSPHONIC ACID GUANYLATE ESTER (three-letter code: G2P) (formula: C₁₁H₁₈N₅O₁₃P₃).



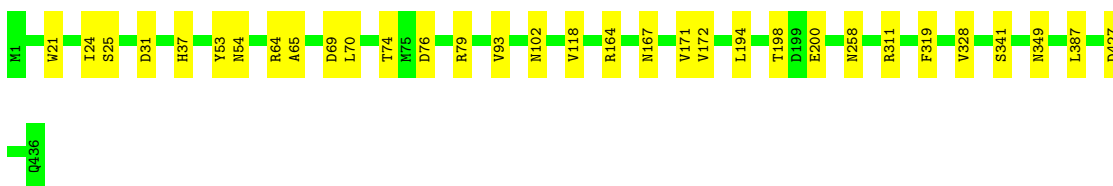
Mol	Chain	Residues	Atoms					AltConf	
			Total	C	H	N	O		P
6	A	1	43	10	11	5	14	3	0

3 Residue-property plots [i](#)


These plots are drawn for all protein, RNA and DNA 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.

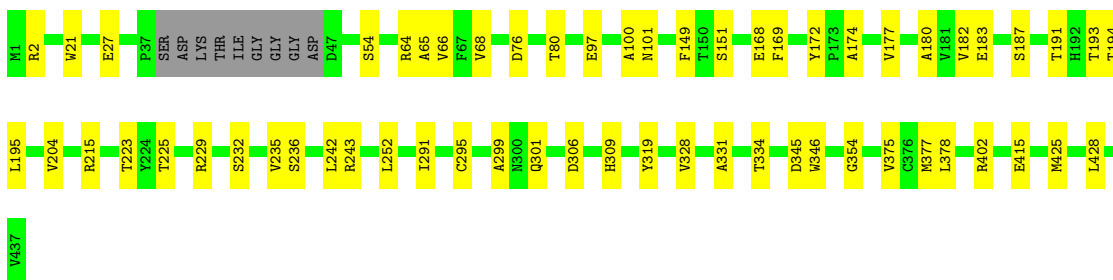
- Molecule 1: Tubulin beta-2B chain

Chain B:  92% 8%



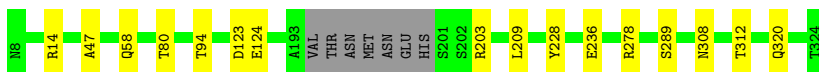
- Molecule 2: Tubulin alpha-1B chain

Chain A:  84% 14%



- Molecule 3: Kinesin-1 heavy chain

Chain K:  93% 5%



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	Depositor
Number of particles used	403424	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	1.625	Depositor
Minimum defocus (nm)	Not provided	Depositor
Maximum defocus (nm)	Not provided	Depositor
Magnification	Not provided	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor

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, MG, G2P

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	B	0.29	0/3417	0.52	0/4631
2	A	0.30	0/3419	0.54	0/4643
3	K	0.27	0/2464	0.49	0/3319
All	All	0.29	0/9300	0.52	0/12593

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	B	3342	3219	3219	19	0
2	A	3342	3255	3255	34	0
3	K	2427	2404	2404	9	0
4	B	32	14	14	0	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
6	A	32	11	12	1	0
All	All	9177	8903	8904	59	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 (59) 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:B:54:ASN:OD1	1:B:64:ARG:NH2	2.19	0.76
1:B:76:ASP:OD1	1:B:79:ARG:NH2	2.21	0.73
3:K:203:ARG:NH1	3:K:236:GLU:OE1	2.27	0.67
2:A:27:GLU:OE1	2:A:243:ARG:NH1	2.27	0.67
2:A:215:ARG:NH2	2:A:299:ALA:O	2.30	0.65
1:B:31:ASP:OD2	1:B:37:HIS:ND1	2.31	0.64
2:A:21:TRP:CZ2	2:A:65:ALA:HB2	2.33	0.63
3:K:14:ARG:NH1	3:K:58:GLN:OE1	2.31	0.63
2:A:187:SER:O	2:A:191:THR:HG23	2.00	0.62
2:A:100:ALA:N	6:A:501:GTP:O1G	2.33	0.61
1:B:311:ARG:NH1	1:B:341:SER:O	2.36	0.57
1:B:194:LEU:O	1:B:198:THR:OG1	2.13	0.57
2:A:295:CYS:O	2:A:301:GLN:NE2	2.39	0.56
1:B:93:VAL:HG11	1:B:118:VAL:HG23	1.89	0.54
1:B:164:ARG:NH1	2:A:97:GLU:OE2	2.40	0.54
3:K:14:ARG:NH1	3:K:94:THR:OG1	2.42	0.52
2:A:68:VAL:HG11	2:A:149:PHE:CE2	2.45	0.52
1:B:21:TRP:CZ2	1:B:65:ALA:HB2	2.44	0.52
1:B:167:ASN:ND2	1:B:200:GLU:OE2	2.43	0.52
2:A:236:SER:OG	2:A:243:ARG:NH2	2.43	0.52
2:A:319:TYR:N	2:A:354:GLY:O	2.43	0.52
2:A:54:SER:OG	2:A:64:ARG:NE	2.37	0.51
2:A:402:ARG:NH2	2:A:415:GLU:OE2	2.44	0.50
3:K:80:THR:OG1	3:K:289:SER:OG	2.08	0.50
2:A:151:SER:HB2	2:A:193:THR:HG21	1.94	0.50
2:A:191:THR:HG21	2:A:425:MET:CE	2.42	0.50
2:A:172:TYR:N	2:A:204:VAL:O	2.44	0.49
1:B:25:SER:OG	1:B:53:TYR:OH	2.20	0.49
1:B:69:ASP:OD2	1:B:74:THR:OG1	2.19	0.49
1:B:319:PHE:CE2	1:B:328:VAL:HG13	2.49	0.48
2:A:331:ALA:O	2:A:334:THR:OG1	2.25	0.48
2:A:180:ALA:HB3	2:A:183:GLU:HG3	1.96	0.48
3:K:47:ALA:O	3:K:320:GLN:NE2	2.46	0.48
2:A:174:ALA:HB3	2:A:177:VAL:O	2.13	0.48
1:B:21:TRP:HA	1:B:24:ILE:HG22	1.96	0.48
3:K:123:ASP:OD1	3:K:124:GLU:N	2.47	0.48
1:B:69:ASP:OD1	1:B:70:LEU:N	2.46	0.48
1:B:172:VAL:HG21	1:B:387:LEU:HD21	1.95	0.47
2:A:345:ASP:OD1	2:A:346:TRP:N	2.47	0.47
2:A:223:THR:HG23	2:A:225:THR:HG22	1.97	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:A:242:LEU:HD11	2:A:252:LEU:HD13	1.96	0.47
1:B:427:ASP:OD2	3:K:278:ARG:NE	2.42	0.46
2:A:291:ILE:HD12	2:A:375:VAL:HG23	1.97	0.46
2:A:319:TYR:HE2	2:A:328:VAL:HG13	1.80	0.46
2:A:195:LEU:HD21	2:A:428:LEU:HD22	1.98	0.46
2:A:377:MET:C	2:A:378:LEU:HD12	2.36	0.46
2:A:2:ARG:NE	2:A:242:LEU:O	2.49	0.45
2:A:76:ASP:O	2:A:80:THR:HG22	2.17	0.45
2:A:168:GLU:OE2	2:A:194:THR:HG23	2.17	0.44
1:B:93:VAL:HG11	1:B:118:VAL:CG2	2.48	0.44
2:A:66:VAL:HG13	2:A:66:VAL:O	2.17	0.44
3:K:209:LEU:HD23	3:K:228:TYR:CE1	2.52	0.44
1:B:258:ASN:HD21	2:A:182:VAL:HG12	1.84	0.43
2:A:229:ARG:O	2:A:232:SER:OG	2.30	0.42
2:A:169:PHE:CD2	2:A:235:VAL:HG22	2.54	0.42
1:B:171:VAL:O	1:B:171:VAL:HG23	2.19	0.42
2:A:242:LEU:HD11	2:A:252:LEU:CD1	2.51	0.41
2:A:306:ASP:OD2	2:A:309:HIS:ND1	2.54	0.41
3:K:308:ASN:O	3:K:312:THR:OG1	2.24	0.41

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	B	424/426 (100%)	409 (96%)	15 (4%)	0	100	100
2	A	424/437 (97%)	401 (95%)	23 (5%)	0	100	100
3	K	306/317 (96%)	298 (97%)	8 (3%)	0	100	100
All	All	1154/1180 (98%)	1108 (96%)	46 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	B	365/367 (100%)	363 (100%)	2 (0%)	90	96
2	A	357/368 (97%)	356 (100%)	1 (0%)	93	97
3	K	272/280 (97%)	272 (100%)	0	100	100
All	All	994/1015 (98%)	991 (100%)	3 (0%)	93	97

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	102	ASN
1	B	349	ASN
2	A	101	ASN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	102	ASN
1	B	258	ASN

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 carbohydrates in this entry.

5.6 Ligand geometry

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 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
6	GTP	A	501	5	26,34,34	5.45	15 (57%)	33,54,54	2.39	10 (30%)
4	G2P	B	501	5	26,34,34	4.50	16 (61%)	30,54,54	1.28	4 (13%)

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
6	GTP	A	501	5	-	5/18/38/38	0/3/3/3
4	G2P	B	501	5	-	4/18/38/38	0/3/3/3

All (31) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	501	GTP	C2'-C1'	-16.50	1.28	1.53
4	B	501	G2P	C4-N9	-10.33	1.34	1.47
6	A	501	GTP	C3'-C4'	-9.83	1.27	1.53
6	A	501	GTP	O4'-C1'	9.52	1.54	1.41
4	B	501	G2P	C3'-C4'	-9.51	1.28	1.53
6	A	501	GTP	C4-N3	8.90	1.49	1.35
4	B	501	G2P	C5-C6	-8.71	1.37	1.52
4	B	501	G2P	C2'-C1'	-8.43	1.26	1.53
6	A	501	GTP	C6-C5	7.31	1.54	1.41
6	A	501	GTP	C6-N1	6.94	1.45	1.33
4	B	501	G2P	O4'-C1'	6.00	1.56	1.42
4	B	501	G2P	PB-O3B	5.97	1.65	1.58
6	A	501	GTP	C2-N2	5.04	1.44	1.33
6	A	501	GTP	O4'-C4'	5.04	1.56	1.45
6	A	501	GTP	C2-N1	4.88	1.44	1.35

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	501	G2P	PA-O5'	4.56	1.64	1.57
6	A	501	GTP	C2'-C3'	4.43	1.65	1.53
4	B	501	G2P	C2'-C3'	4.29	1.65	1.53
4	B	501	G2P	O4'-C4'	4.21	1.54	1.45
6	A	501	GTP	O6-C6	-3.25	1.16	1.24
4	B	501	G2P	C8-N9	-3.15	1.34	1.45
4	B	501	G2P	C5-C4	-2.94	1.34	1.53
6	A	501	GTP	C2-N3	2.64	1.47	1.34
4	B	501	G2P	C5'-C4'	2.21	1.58	1.51
6	A	501	GTP	C5'-C4'	2.20	1.58	1.51
6	A	501	GTP	O3'-C3'	2.19	1.48	1.43
4	B	501	G2P	PA-O1A	-2.12	1.51	1.56
6	A	501	GTP	PA-O5'	2.10	1.67	1.59
4	B	501	G2P	O6-C6	-2.05	1.19	1.23
4	B	501	G2P	C2-N1	-2.05	1.36	1.44
4	B	501	G2P	O2'-C2'	2.01	1.47	1.43

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	501	GTP	C1'-N9-C4	8.82	142.14	126.64
6	A	501	GTP	N3-C2-N1	-5.21	120.27	127.22
4	B	501	G2P	C4-C5-N7	4.16	107.97	102.46
6	A	501	GTP	C2-N3-C4	3.87	119.77	115.36
6	A	501	GTP	PB-O3B-PG	-3.65	120.31	132.83
6	A	501	GTP	O4'-C1'-C2'	-3.19	102.27	106.93
6	A	501	GTP	PA-O3A-PB	-3.08	122.27	132.83
6	A	501	GTP	C5-C6-N1	-2.67	119.78	123.43
6	A	501	GTP	C6-N1-C2	2.40	119.74	115.93
4	B	501	G2P	PG-O3B-PB	-2.39	124.19	132.62
4	B	501	G2P	O6-C6-N1	-2.27	119.64	122.69
6	A	501	GTP	N2-C2-N1	2.17	120.62	117.25
6	A	501	GTP	C2'-C3'-C4'	2.08	106.68	102.64
4	B	501	G2P	C4'-O4'-C1'	-2.02	105.02	109.47

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	501	GTP	C5'-O5'-PA-O1A
4	B	501	G2P	C3'-C4'-C5'-O5'
4	B	501	G2P	O4'-C4'-C5'-O5'

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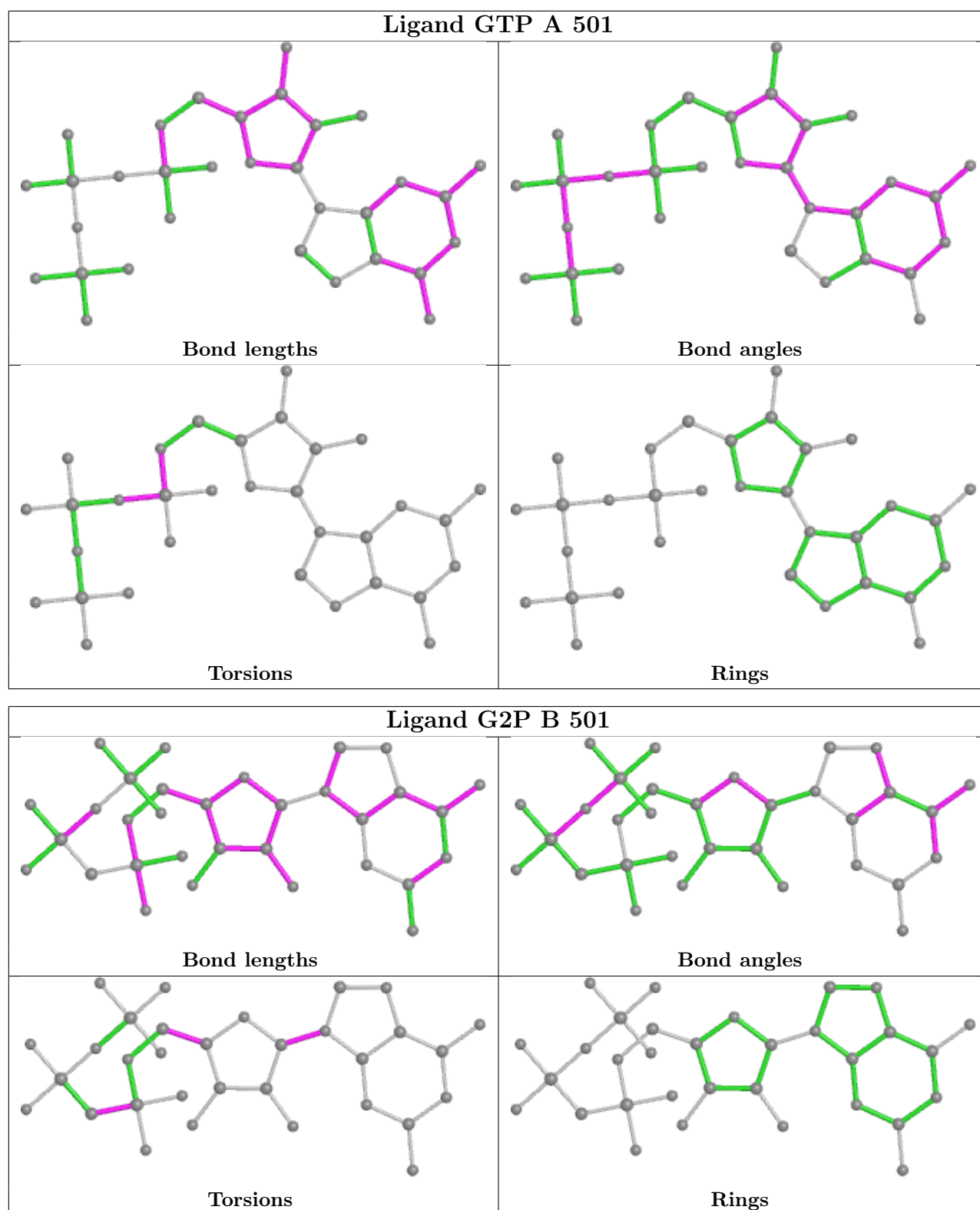
Mol	Chain	Res	Type	Atoms
6	A	501	GTP	C5'-O5'-PA-O3A
6	A	501	GTP	C5'-O5'-PA-O2A
6	A	501	GTP	PB-O3A-PA-O2A
4	B	501	G2P	PB-C3A-PA-O2A
6	A	501	GTP	PB-O3A-PA-O1A
4	B	501	G2P	C2'-C1'-N9-C4

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	501	GTP	1	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

There are no chain breaks in this entry.