



wwPDB EM Map/Model Validation Report ⓘ

Apr 10, 2016 – 01:47 PM BST

PDB ID : 3J6H
EMDB ID: : EMD-5916
Title : Nucleotide-free Kinesin motor domain complexed with GMPCPP-microtubule
Authors : Morikawa, M.; Yajima, H.; Nitta, R.; Inoue, S.; Ogura, T.; Sato, C.; Hirokawa, N.
Deposited on : 2014-02-21
Resolution : 8.10 Å(reported)
Based on PDB ID : 1JFF,1JFF,3WRD

This is a wwPDB EM Map/Model Validation Report for a publicly released PDB/EMDB entry.
For rigid body fitted models, validation errors reported here could stem from errors in the original structure(s) used in the fitting.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at
<http://wwpdb.org/validation/2016/EMValidationReportHelp>

MolProbity : 4.02b-467
Mogul : 1.7.1 (RC1), CSD as537be (2016)
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : trunk27241

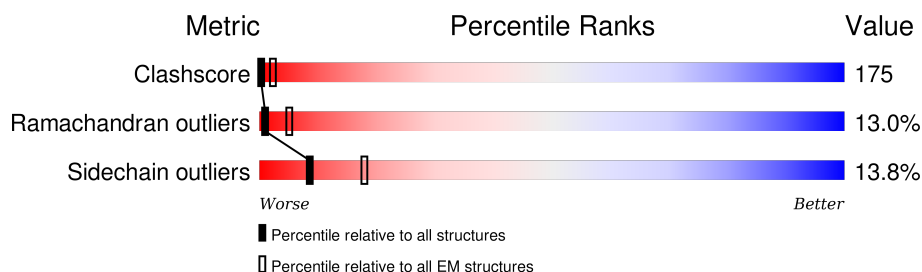
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 8.10 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	114402	924
Ramachandran outliers	111179	726
Sidechain outliers	111093	686

The table below summarises the geometric issues observed across the polymeric chains. 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. 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	436	
2	B	426	
3	K	352	

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
5	GTP	A	502	-	-	X	-
6	G2P	B	602	-	-	X	-

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 8810 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-1A chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	410	Total	C	N	O	S	0	0
			3213	2036	549	608	20		

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	265	GLY	ALA	SEE REMARK 999	UNP P02550

- Molecule 2 is a protein called Tubulin beta chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	426	Total	C	N	O	S	0	0
			3351	2105	575	646	25		

- Molecule 3 is a protein called Kinesin heavy chain isoform 5C.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	K	277	Total	C	N	O	S	0	0
			2175	1369	375	417	14		

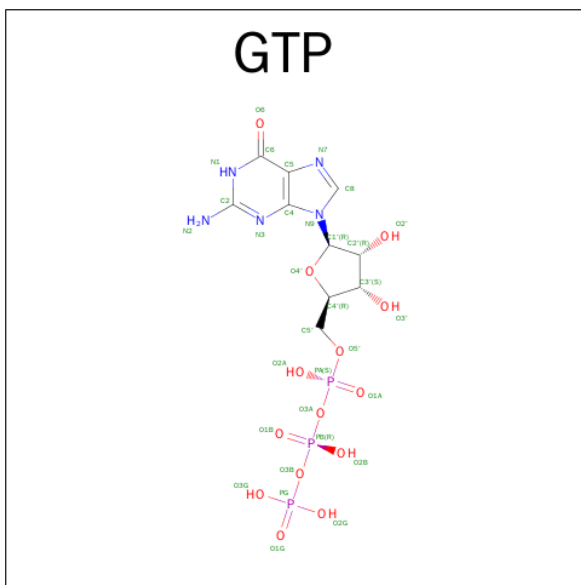
There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
K	346	HIS	-	EXPRESSION TAG	UNP P28738
K	347	HIS	-	EXPRESSION TAG	UNP P28738
K	348	HIS	-	EXPRESSION TAG	UNP P28738
K	349	HIS	-	EXPRESSION TAG	UNP P28738
K	350	HIS	-	EXPRESSION TAG	UNP P28738
K	351	HIS	-	EXPRESSION TAG	UNP P28738
K	352	HIS	-	EXPRESSION TAG	UNP P28738

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

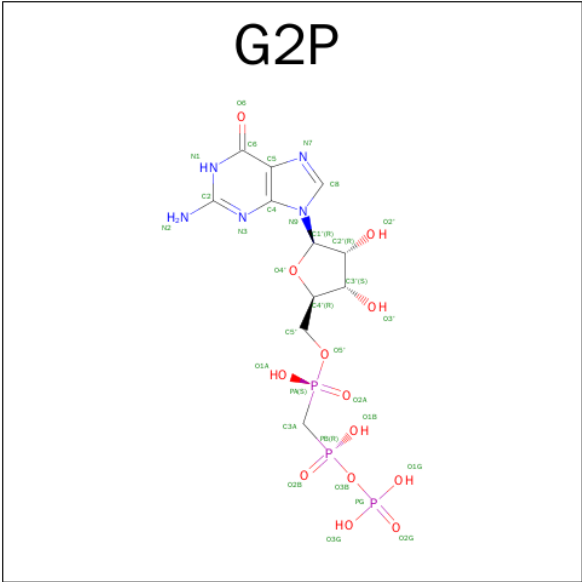
Mol	Chain	Residues	Atoms		AltConf
4	B	1	Total	Mg	0
			1	1	
4	A	1	Total	Mg	0
			1	1	

- Molecule 5 is GUANOSINE-5'-TRIPHOSPHATE (three-letter code: GTP) (formula: $C_{10}H_{16}N_5O_{14}P_3$).



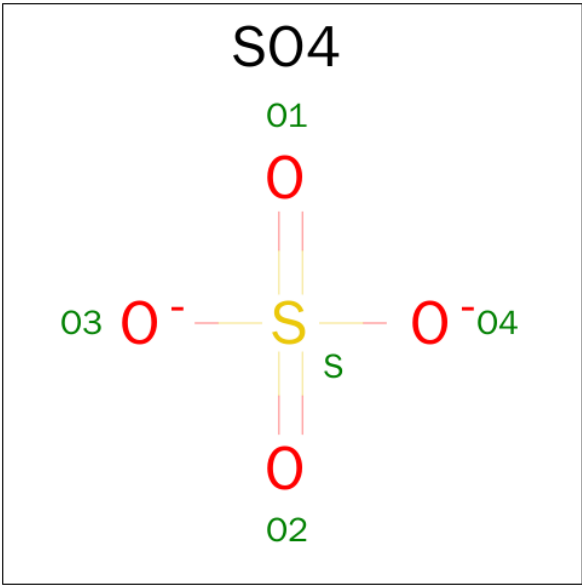
Mol	Chain	Residues	Atoms					AltConf
5	A	1	Total	C	N	O	P	0
			32	10	5	14	3	

- Molecule 6 is PHOSPHOMETHYLPHOSPHONIC ACID GUANYLATE ESTER (three-letter code: G2P) (formula: $C_{11}H_{18}N_5O_{13}P_3$).



Mol	Chain	Residues	Atoms					AltConf
6	B	1	Total	C	N	O	P	0
			32	11	5	13	3	

- Molecule 7 is SULFATE ION (three-letter code: SO4) (formula: O₄S).

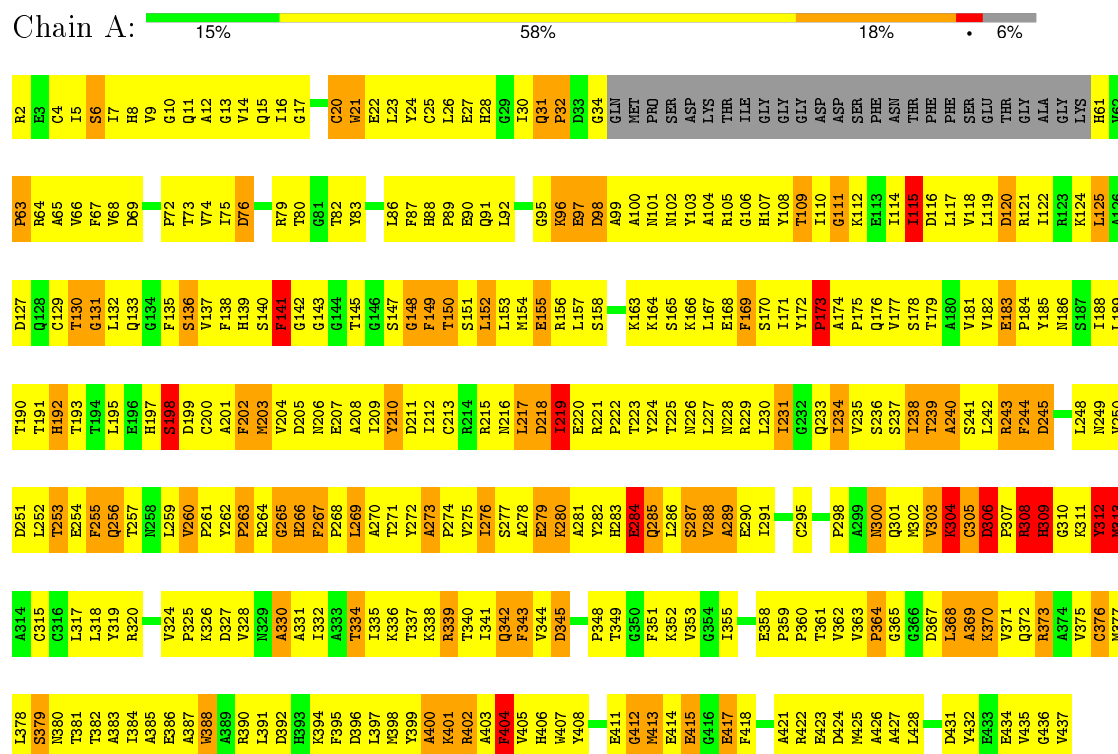


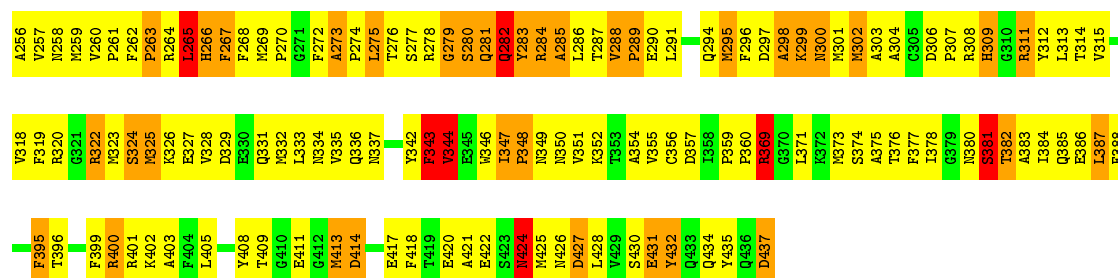
Mol	Chain	Residues	Atoms			AltConf
7	K	1	Total	O	S	0
			5	4	1	

3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

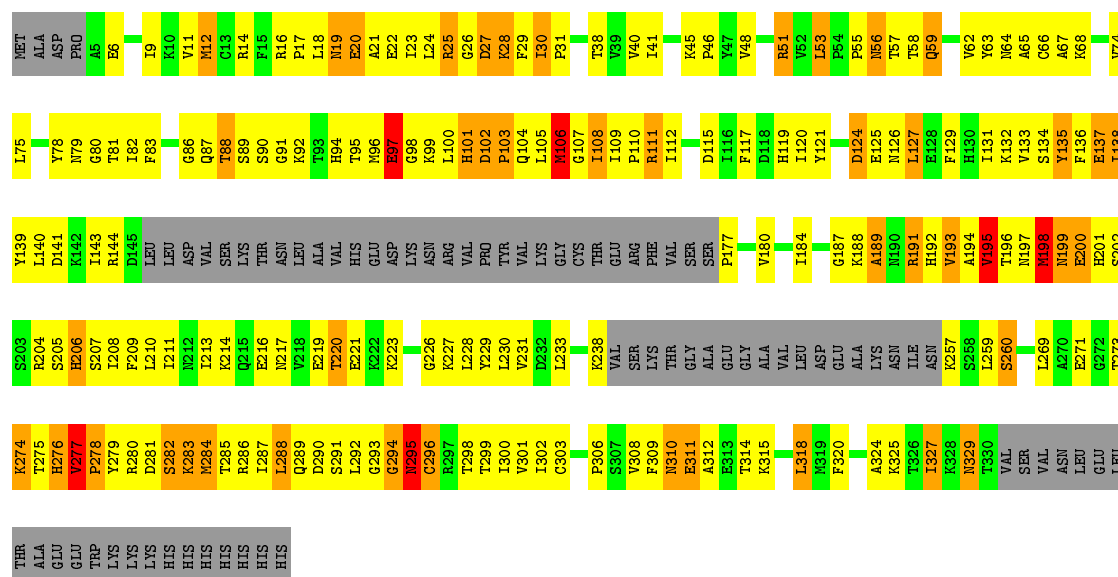
- Molecule 1: Tubulin alpha-1A chain





• Molecule 3: Kinesin heavy chain isoform 5C

Chain K: 25% 39% 13% • 21%



4 Experimental information

Property	Value	Source
Reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	Depositor
Number of images	302000	Depositor
Resolution determination method	Not provided	Depositor
CTF correction method	Each filament	Depositor
Microscope	JEM-2010F	Depositor
Voltage (kV)	200	Depositor
Electron dose ($e^-/\text{\AA}^2$)	10	Depositor
Minimum defocus (nm)	1200	Depositor
Maximum defocus (nm)	2600	Depositor
Magnification	40000	Depositor
Image detector	KODAK SO163 FILM	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, SO4, 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	$\# Z > 2$	RMSZ	$\# Z > 2$
1	A	0.55	0/3286	0.90	12/4463 (0.3%)
2	B	0.56	1/3426 (0.0%)	0.81	8/4642 (0.2%)
3	K	0.56	1/2210 (0.0%)	0.88	11/2973 (0.4%)
All	All	0.56	2/8922 (0.0%)	0.86	31/12078 (0.3%)

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	1
2	B	0	2
3	K	0	6
All	All	0	9

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	381	SER	C-N	11.04	1.59	1.34
3	K	189	ALA	C-N	-5.46	1.21	1.34

The worst 5 of 31 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	381	SER	O-C-N	-11.14	104.88	122.70
1	A	136	SER	CB-CA-C	-10.93	89.34	110.10
1	A	312	TYR	CB-CG-CD1	10.62	127.38	121.00
2	B	145	THR	CA-CB-CG2	-8.71	100.20	112.40
3	K	97	GLU	C-N-CA	8.31	139.75	122.30

There are no chirality outliers.

5 of 9 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	313	MET	Peptide
2	B	143	GLY	Mainchain
2	B	381	SER	Mainchain
3	K	189	ALA	Mainchain
3	K	97	GLU	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	3213	0	3121	1412	0
2	B	3351	0	3224	1072	0
3	K	2175	0	2169	707	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	A	32	0	10	74	0
6	B	32	0	13	17	0
7	K	5	0	0	0	0
All	All	8810	0	8537	3039	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 175.

The worst 5 of 3039 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:169:PHE:CZ	1:A:234:ILE:HD13	1.26	1.65
3:K:83:PHE:CE1	3:K:231:VAL:HG23	1.32	1.64
1:A:312:TYR:CD1	1:A:381:THR:CG2	1.76	1.64
1:A:169:PHE:CG	1:A:235:VAL:HA	1.13	1.64
1:A:169:PHE:CD2	1:A:235:VAL:HA	1.21	1.64

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all 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	406/436 (93%)	262 (64%)	83 (20%)	61 (15%)	0	5
2	B	424/426 (100%)	268 (63%)	100 (24%)	56 (13%)	0	7
3	K	271/352 (77%)	209 (77%)	36 (13%)	26 (10%)	1	15
All	All	1101/1214 (91%)	739 (67%)	219 (20%)	143 (13%)	1	7

5 of 143 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	96	LYS
1	A	97	GLU
1	A	108	TYR
1	A	109	THR
1	A	141	PHE

5.3.2 Protein sidechains

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all 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	345/365 (94%)	299 (87%)	46 (13%)	5	28
2	B	367/367 (100%)	307 (84%)	60 (16%)	3	20
3	K	243/311 (78%)	217 (89%)	26 (11%)	8	36
All	All	955/1043 (92%)	823 (86%)	132 (14%)	8	27

5 of 132 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	141	LEU
2	B	224	TYR
3	K	195	VAL
2	B	153	LEU
2	B	201	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 40 such sidechains are listed below:

Mol	Chain	Res	Type
2	B	50	ASN
2	B	186	ASN
3	K	79	ASN
2	B	107	HIS
2	B	197	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 [i](#)

Of 5 ligands modelled in this entry, 2 are monoatomic - leaving 3 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
5	GTP	A	502	4	26,34,34	1.12	2 (7%)	29,54,54	1.82	5 (17%)
6	G2P	B	602	4	29,34,34	5.63	22 (75%)	32,54,54	4.64	19 (59%)
7	SO4	K	500	-	4,4,4	0.39	0	6,6,6	0.17	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
5	GTP	A	502	4	-	0/18/38/38	0/3/3/3
6	G2P	B	602	4	-	0/15/38/38	0/3/3/3
7	SO4	K	500	-	-	0/0/0/0	0/0/0/0

The worst 5 of 24 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	B	602	G2P	PB-C3A	-18.82	1.60	1.80
6	B	602	G2P	PA-C3A	-9.81	1.70	1.80
6	B	602	G2P	O2'-C2'	-6.08	1.28	1.43
6	B	602	G2P	PA-O1A	-5.79	1.42	1.56
6	B	602	G2P	C8-N7	-4.99	1.25	1.34

The worst 5 of 24 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	B	602	G2P	N3-C2-N1	-10.56	113.20	127.56
6	B	602	G2P	O4'-C4'-C3'	-7.36	90.23	105.16
6	B	602	G2P	C1'-N9-C4	-6.48	119.58	126.81
6	B	602	G2P	C5-C6-N1	-4.79	117.26	123.52
6	B	602	G2P	O5'-PA-O2A	-4.76	100.88	114.05

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 91 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	502	GTP	74	0
6	B	602	G2P	17	0

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.