



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 10:59 PM UTC

PDB ID : 1SA0 / pdb_00001sa0
Title : TUBULIN-COLCHICINE: STATHMIN-LIKE DOMAIN COMPLEX
Authors : Ravelli, R.B.; Gigant, B.; Curmi, P.A.; Jourdain, I.; Lachkar, S.; Sobel, A.; Knossow, M.
Deposited on : 2004-02-06
Resolution : 3.58 Å(reported)

This is a wwPDB X-ray Structure 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/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>.

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)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
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

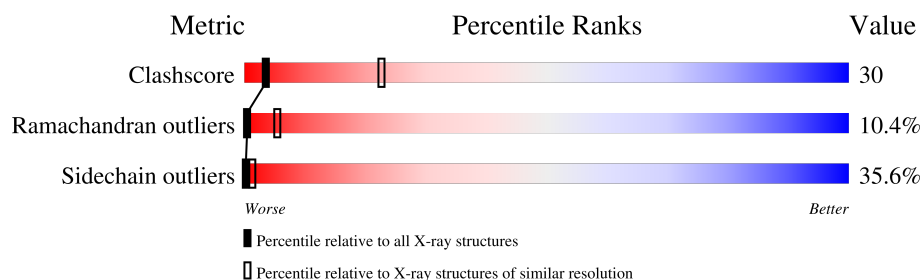
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.58 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))
Clashscore	190562	1595 (3.66-3.50)
Ramachandran outliers	187476	1551 (3.66-3.50)
Sidechain outliers	187428	1551 (3.66-3.50)

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 ≥ 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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	451	41% 33% 16% 5% 5%
1	C	451	37% 37% 16% • 7%
2	B	445	31% 39% 18% 5% 6%
2	D	445	34% 36% 19% 5% 6%
3	E	142	37% 32% 16% • 13%

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
7	CN2	B	700	-	-	X	-
7	CN2	D	701	-	-	X	-

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 14074 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 Tubulin alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	427	Total	C	N	O	S	0	0	0
			3291	2091	555	624	21			
1	C	421	Total	C	N	O	S	0	0	0
			3220	2043	544	612	21			

There are 2 discrepancies between the modelled and reference sequences:

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

- Molecule 2 is a protein called Tubulin beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	419	Total	C	N	O	S	0	0	0
			3236	2037	543	631	25			
2	D	419	Total	C	N	O	S	0	0	0
			3237	2037	544	631	25			

- Molecule 3 is a protein called Stathmin 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	E	124	Total	C	N	O	S	0	0	0
			907	549	170	183	5			

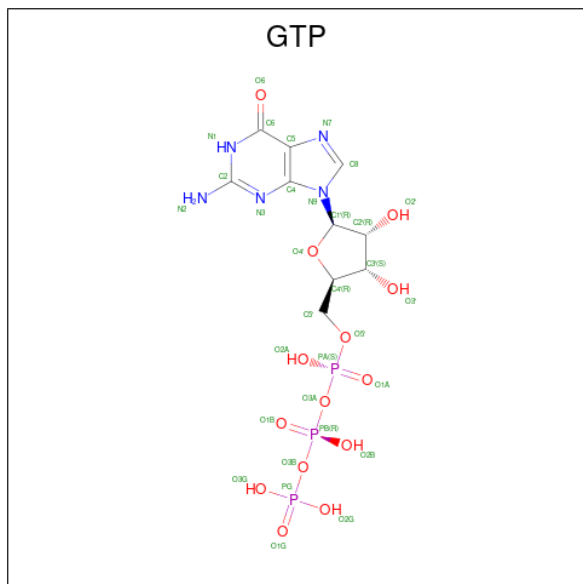
There is a discrepancy between the modelled and reference sequences:

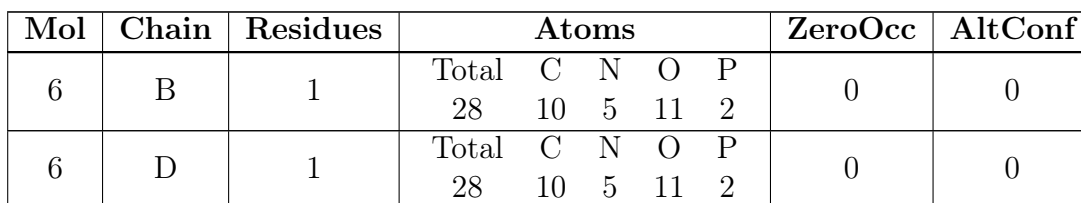
Chain	Residue	Modelled	Actual	Comment	Reference
E	4	ALA	-	SEE REMARK 999	UNP P63043

- Molecule 4 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

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

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





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- The ORTEP diagram illustrates the molecular structure of compound 1. The molecule features a bicyclic system consisting of a benzene ring fused to a cyclohexene ring. Substituents include a 2-mercaptoethyl ester group at C11(S), a 2-methoxyphenyl group at C1, and a 2-methoxy-5-oxocyclohex-1-en-1-yl group at C21. Thermal ellipsoids are drawn at the 50% probability level, and hydrogen atoms are represented by small spheres of arbitrary radii.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
7	B	1	Total	C	N	O	S	0	0
			30	22	1	6	1		



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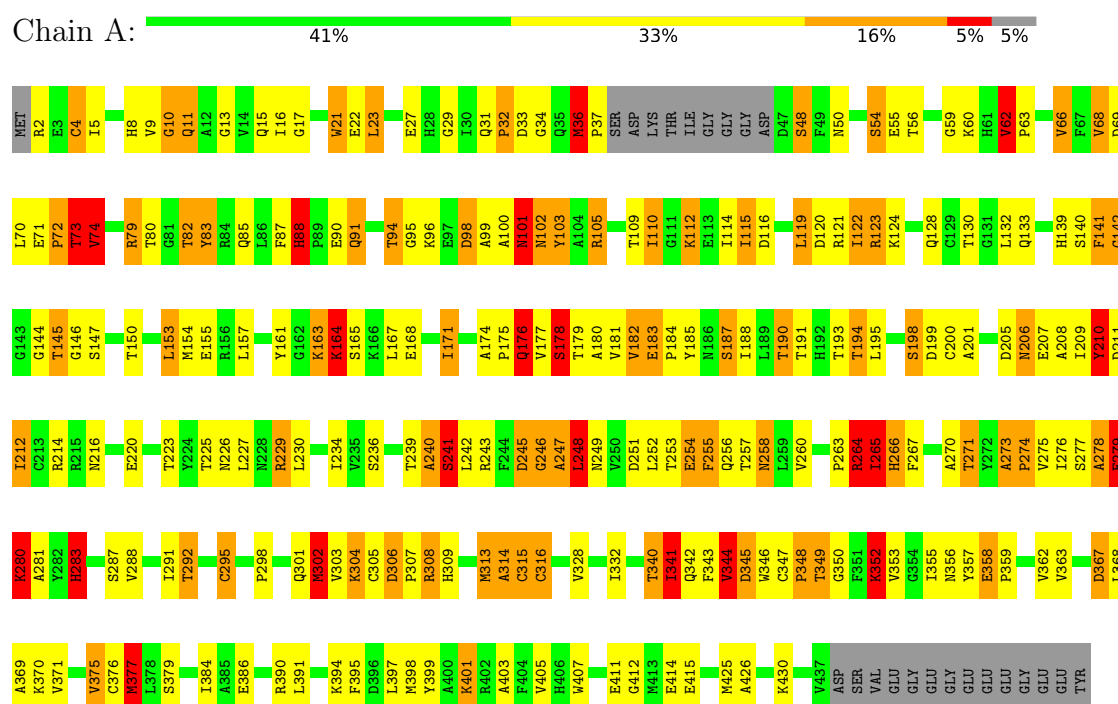
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
7	D	1	Total	C	N	O	S	0	0
			30	22	1	6	1		

3 Residue-property plots

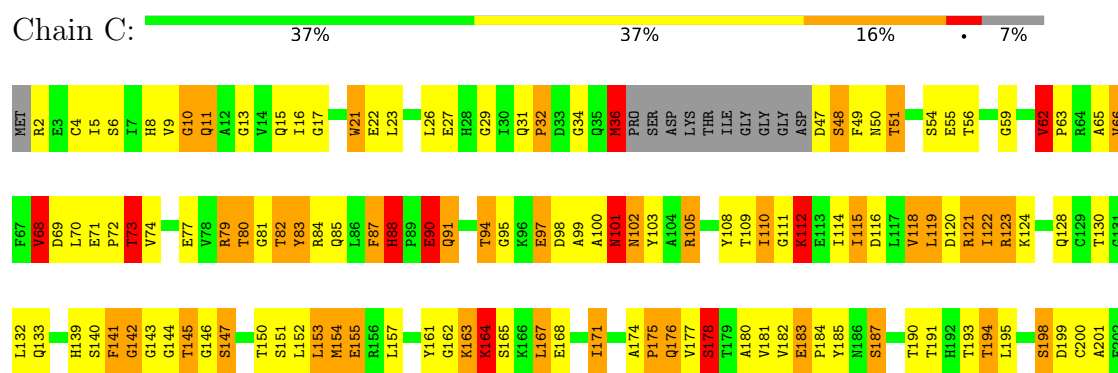
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded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

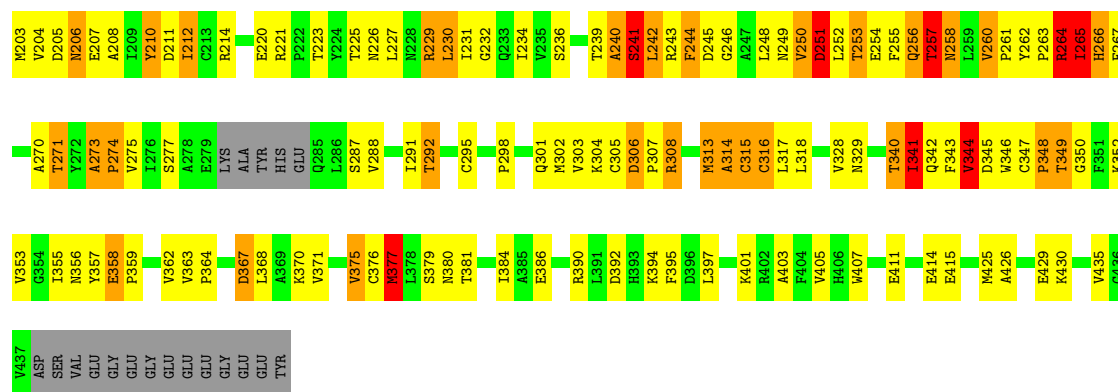
Note EDS was not executed.

• Molecule 1: Tubulin alpha chain



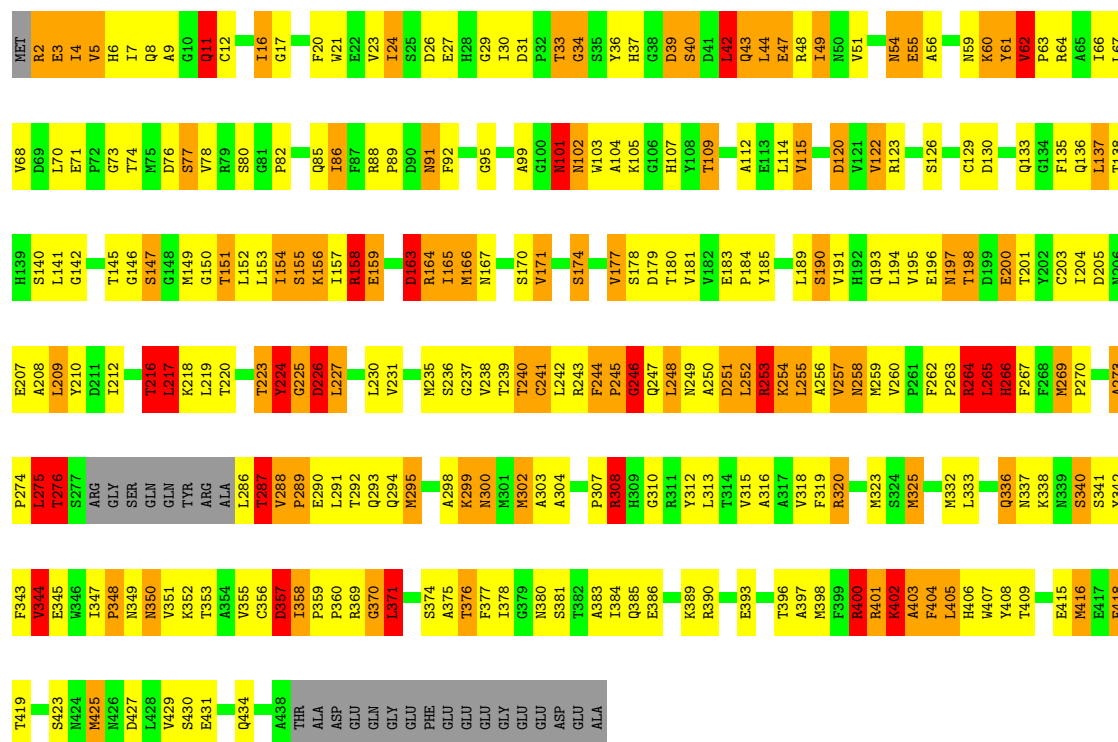
• Molecule 1: Tubulin alpha chain





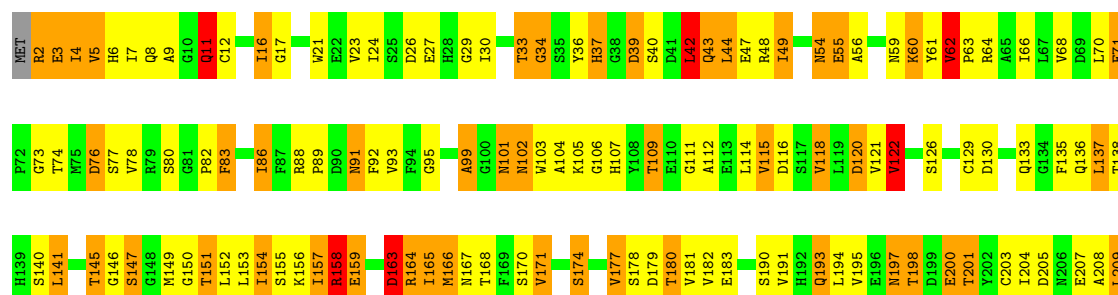
• Molecule 2: Tubulin beta chain

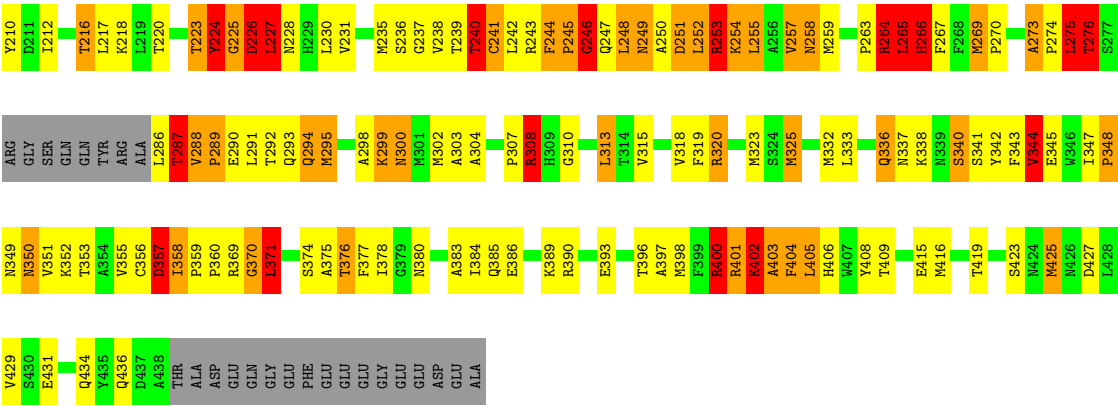
Chain B: 31% 39% 18% 5% 6%



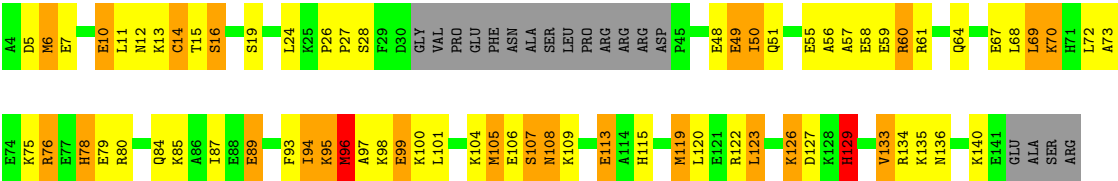
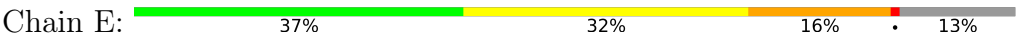
• Molecule 2: Tubulin beta chain

Chain D: 34% 36% 19% 5% 6%





● Molecule 3: Stathmin 4



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, α , β , γ	328.69Å 328.69Å 54.68Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 3.58	Depositor
% Data completeness (in resolution range)	98.8 (20.00-3.58)	Depositor
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.232 , 0.249	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	14074	wwPDB-VP
Average B, all atoms (Å ²)	83.0	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: CN2, GTP, GDP, MG

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	0.89	3/3368 (0.1%)	1.30	30/4581 (0.7%)
1	C	0.84	5/3292 (0.2%)	1.30	28/4479 (0.6%)
2	B	0.82	4/3308 (0.1%)	1.31	35/4494 (0.8%)
2	D	0.79	1/3309 (0.0%)	1.31	33/4494 (0.7%)
3	E	0.96	2/915 (0.2%)	1.57	24/1230 (2.0%)
All	All	0.84	15/14192 (0.1%)	1.32	150/19278 (0.8%)

The worst 5 of 15 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	E	96	MET	SD-CE	8.90	2.01	1.79
1	A	36	MET	SD-CE	7.79	1.99	1.79
3	E	105	MET	SD-CE	7.78	1.99	1.79
1	C	341	ILE	CA-CB	6.45	1.61	1.54
1	C	250	VAL	CA-CB	6.24	1.61	1.54

The worst 5 of 150 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	244	PHE	N-CA-C	12.50	129.26	113.88
3	E	51	GLN	N-CA-C	-9.19	101.77	113.72
1	C	142	GLY	N-CA-C	-8.93	98.77	112.89
1	A	142	GLY	N-CA-C	-8.86	98.89	112.89
3	E	93	PHE	N-CA-C	-8.85	102.40	113.55

There are no chirality outliers.

There are no planarity outliers.

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	3291	0	3155	162	0
1	C	3220	0	3074	188	0
2	B	3236	0	3058	226	0
2	D	3237	0	3060	229	0
3	E	907	0	781	33	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
5	A	32	0	12	4	0
5	C	32	0	12	2	0
6	B	28	0	12	2	0
6	D	28	0	12	1	0
7	B	30	0	23	12	0
7	D	30	0	23	9	0
All	All	14074	0	13222	808	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 30.

The worst 5 of 808 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)
3:E:96:MET:CE	3:E:96:MET:SD	2.01	1.47
2:B:316:ALA:HB1	7:B:700:CN2:C2	1.55	1.36
2:B:316:ALA:CB	7:B:700:CN2:H21	1.70	1.20
1:A:99:ALA:HB2	1:A:145:THR:HG22	1.22	1.15
1:C:198:SER:CB	1:C:265:ILE:HD11	1.78	1.13

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	423/451 (94%)	327 (77%)	53 (12%)	43 (10%)	0	5
1	C	415/451 (92%)	316 (76%)	59 (14%)	40 (10%)	0	6
2	B	415/445 (93%)	310 (75%)	58 (14%)	47 (11%)	0	4
2	D	415/445 (93%)	311 (75%)	56 (14%)	48 (12%)	0	4
3	E	120/142 (84%)	91 (76%)	21 (18%)	8 (7%)	1	11
All	All	1788/1934 (92%)	1355 (76%)	247 (14%)	186 (10%)	0	5

5 of 186 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	11	GLN
1	A	62	VAL
1	A	73	THR
1	A	178	SER
1	A	240	ALA

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	346/378 (92%)	218 (63%)	128 (37%)	0	1
1	C	336/378 (89%)	217 (65%)	119 (35%)	0	1
2	B	348/381 (91%)	228 (66%)	120 (34%)	0	2
2	D	348/381 (91%)	231 (66%)	117 (34%)	0	2

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
3	E	78/126 (62%)	44 (56%)	34 (44%)	0	0
All	All	1456/1644 (89%)	938 (64%)	518 (36%)	0	1

5 of 518 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	D	344	VAL
2	D	405	LEU
2	D	341	SER
2	B	230	LEU
2	B	216	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 65 such sidechains are listed below:

Mol	Chain	Res	Type
2	D	331	GLN
2	D	350	ASN
2	B	294	GLN
2	B	266	HIS
2	D	380	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 9 ligands modelled in this entry, 3 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
6	GDP	B	602	4	29,30,30	0.92	1 (3%)	45,47,47	1.86	11 (24%)
5	GTP	C	601	4	33,34,34	1.22	4 (12%)	50,54,54	1.73	12 (24%)
7	CN2	B	700	-	32,32,32	2.85	6 (18%)	44,45,45	4.50	24 (54%)
5	GTP	A	600	4	33,34,34	1.34	4 (12%)	50,54,54	1.72	11 (22%)
6	GDP	D	603	-	29,30,30	1.05	3 (10%)	45,47,47	1.87	12 (26%)
7	CN2	D	701	-	32,32,32	2.61	7 (21%)	44,45,45	4.46	22 (50%)

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	GDP	B	602	4	-	4/16/32/32	0/3/3/3
5	GTP	C	601	4	-	5/22/38/38	0/3/3/3
7	CN2	B	700	-	-	4/12/27/27	0/3/3/3
5	GTP	A	600	4	-	5/22/38/38	0/3/3/3
6	GDP	D	603	-	-	3/16/32/32	0/3/3/3
7	CN2	D	701	-	-	4/12/27/27	0/3/3/3

The worst 5 of 25 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	B	700	CN2	C20-C21	-8.34	1.23	1.37
7	D	701	CN2	C20-C21	-7.28	1.24	1.37
7	B	700	CN2	C19-C20	-7.24	1.20	1.41
7	B	700	CN2	C21-C14	-6.50	1.34	1.43
7	D	701	CN2	C21-C14	-6.12	1.34	1.43

The worst 5 of 92 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
7	D	701	CN2	O6-C17-C16	14.80	123.20	109.60
7	B	700	CN2	O6-C17-C16	13.93	122.40	109.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
7	B	700	CN2	C19-C17-C16	-11.99	109.25	128.57
7	B	700	CN2	C20-C21-C14	-11.59	112.91	124.67
7	D	701	CN2	C19-C17-C16	-11.10	110.68	128.57

There are no chirality outliers.

5 of 25 torsion outliers are listed below:

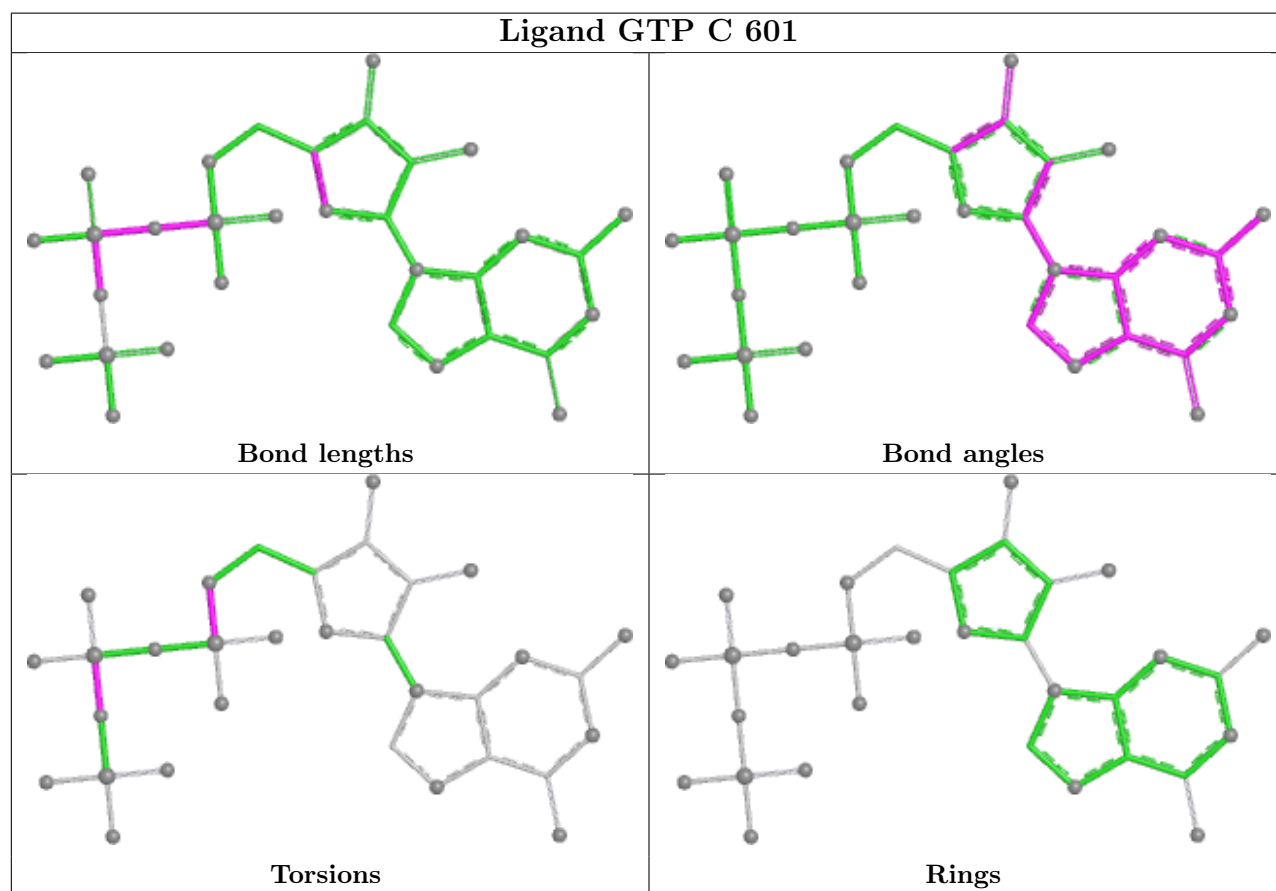
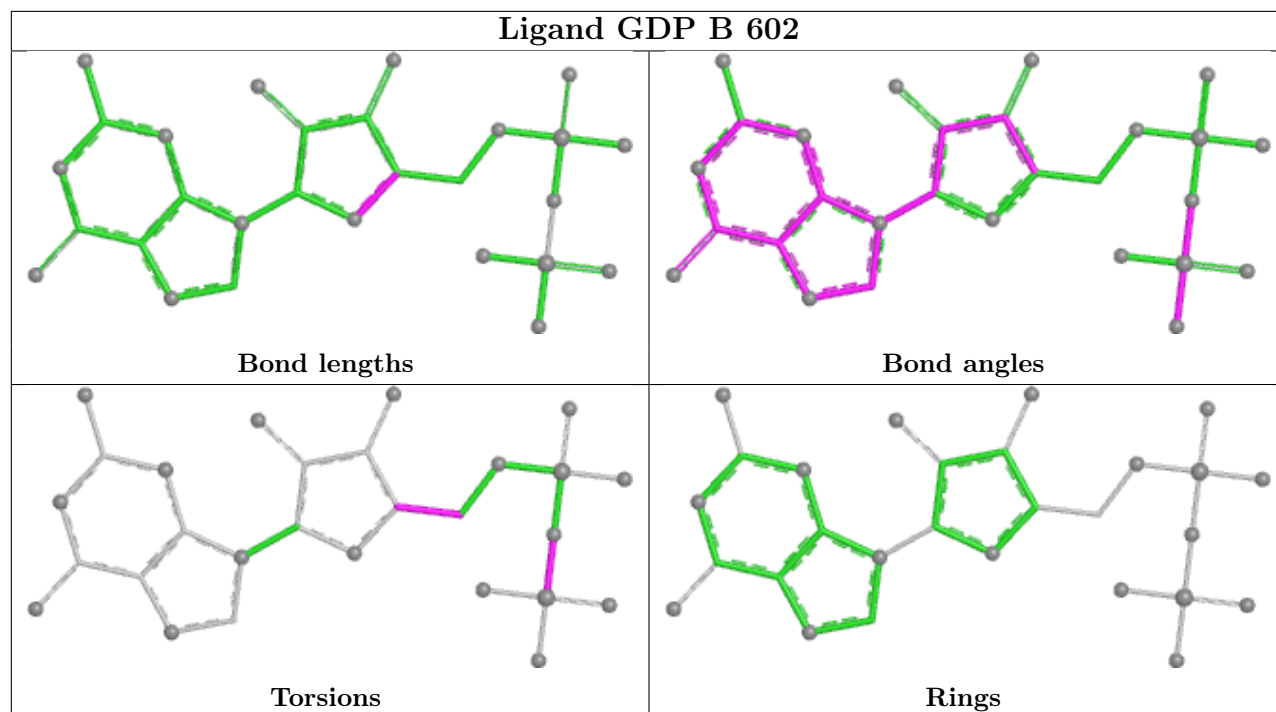
Mol	Chain	Res	Type	Atoms
5	A	600	GTP	C5'-O5'-PA-O3A
5	A	600	GTP	C5'-O5'-PA-O1A
5	C	601	GTP	C5'-O5'-PA-O3A
5	C	601	GTP	C5'-O5'-PA-O1A
6	B	602	GDP	PA-O3A-PB-O2B

There are no ring outliers.

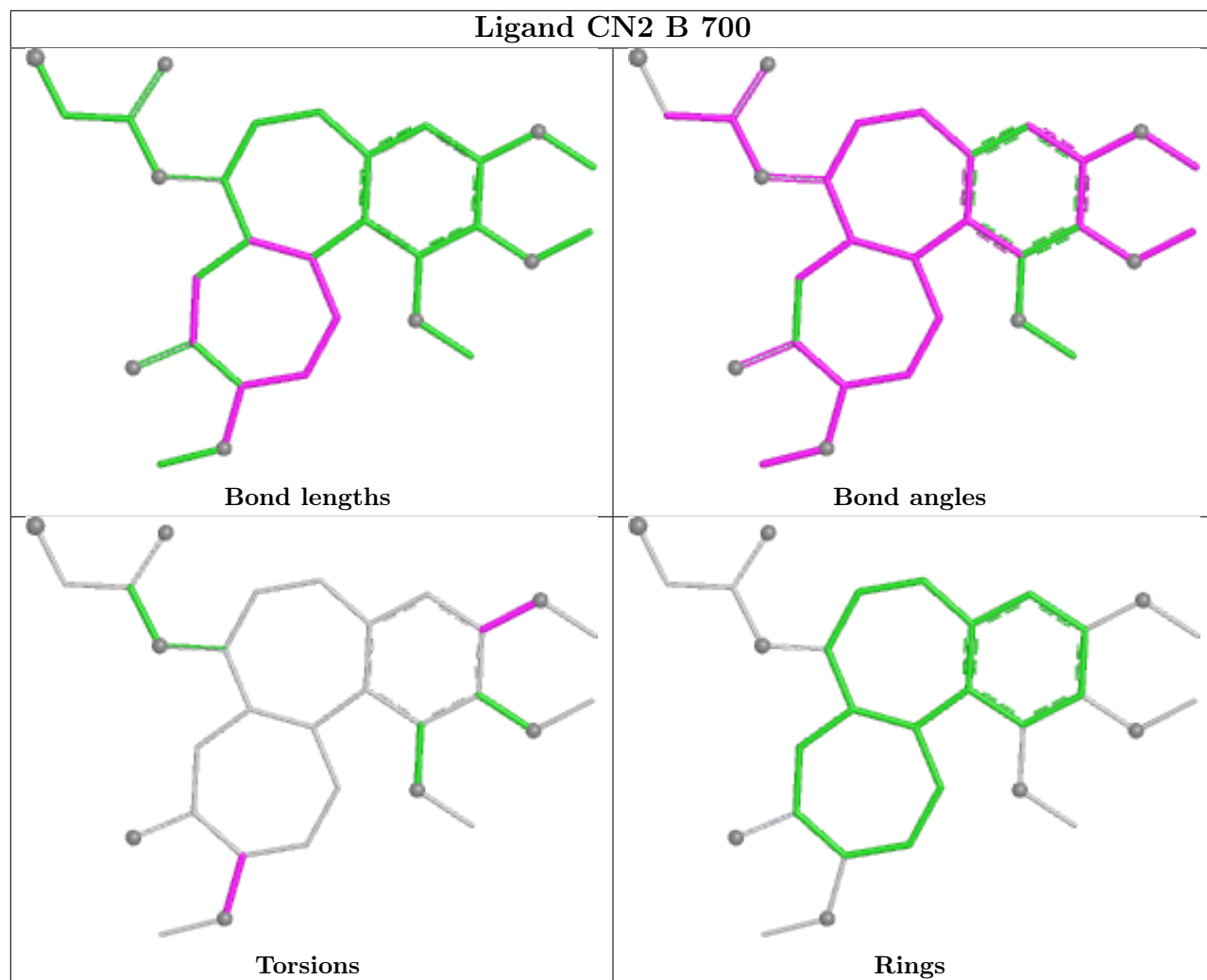
6 monomers are involved in 30 short contacts:

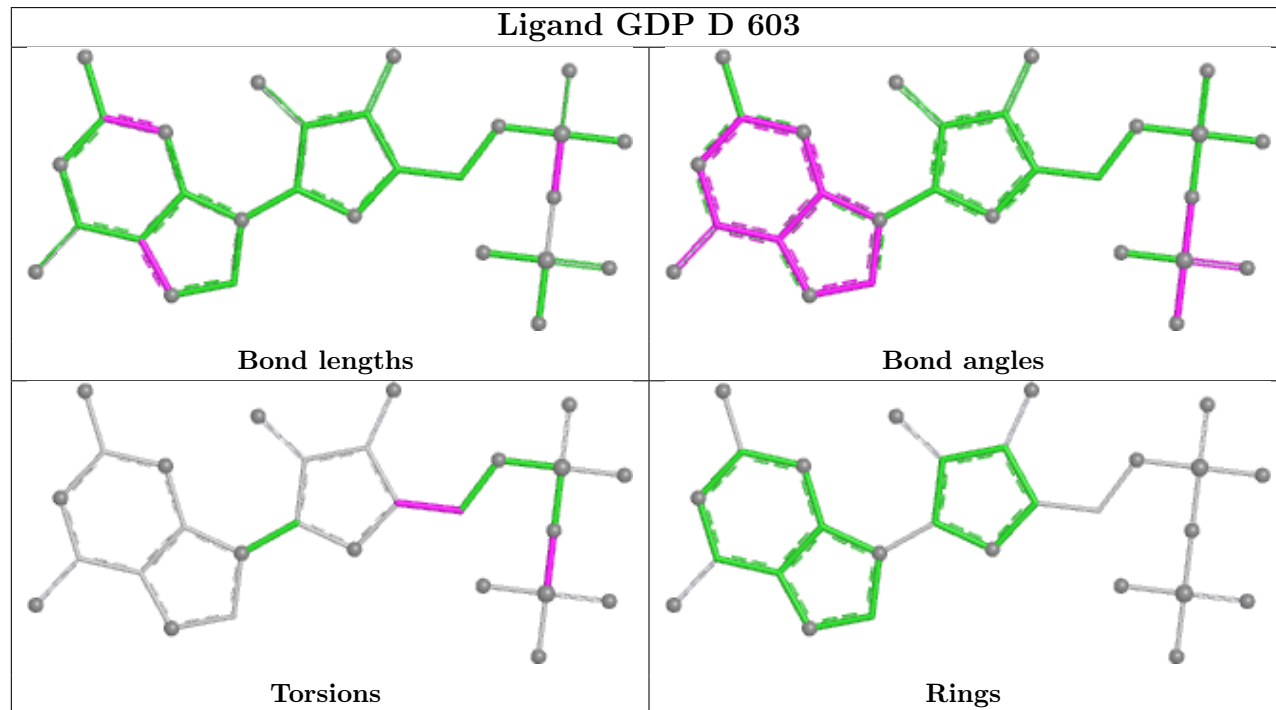
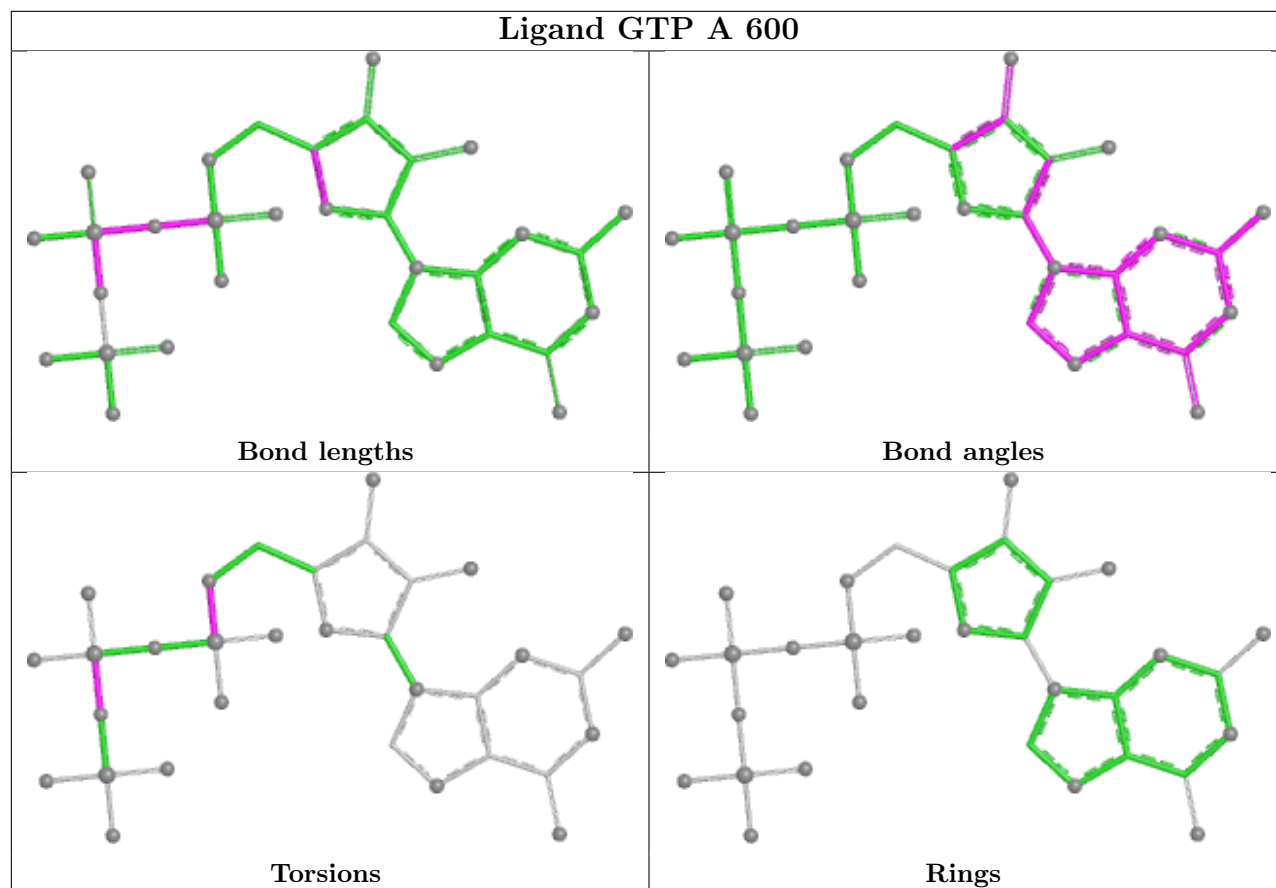
Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	B	602	GDP	2	0
5	C	601	GTP	2	0
7	B	700	CN2	12	0
5	A	600	GTP	4	0
6	D	603	GDP	1	0
7	D	701	CN2	9	0

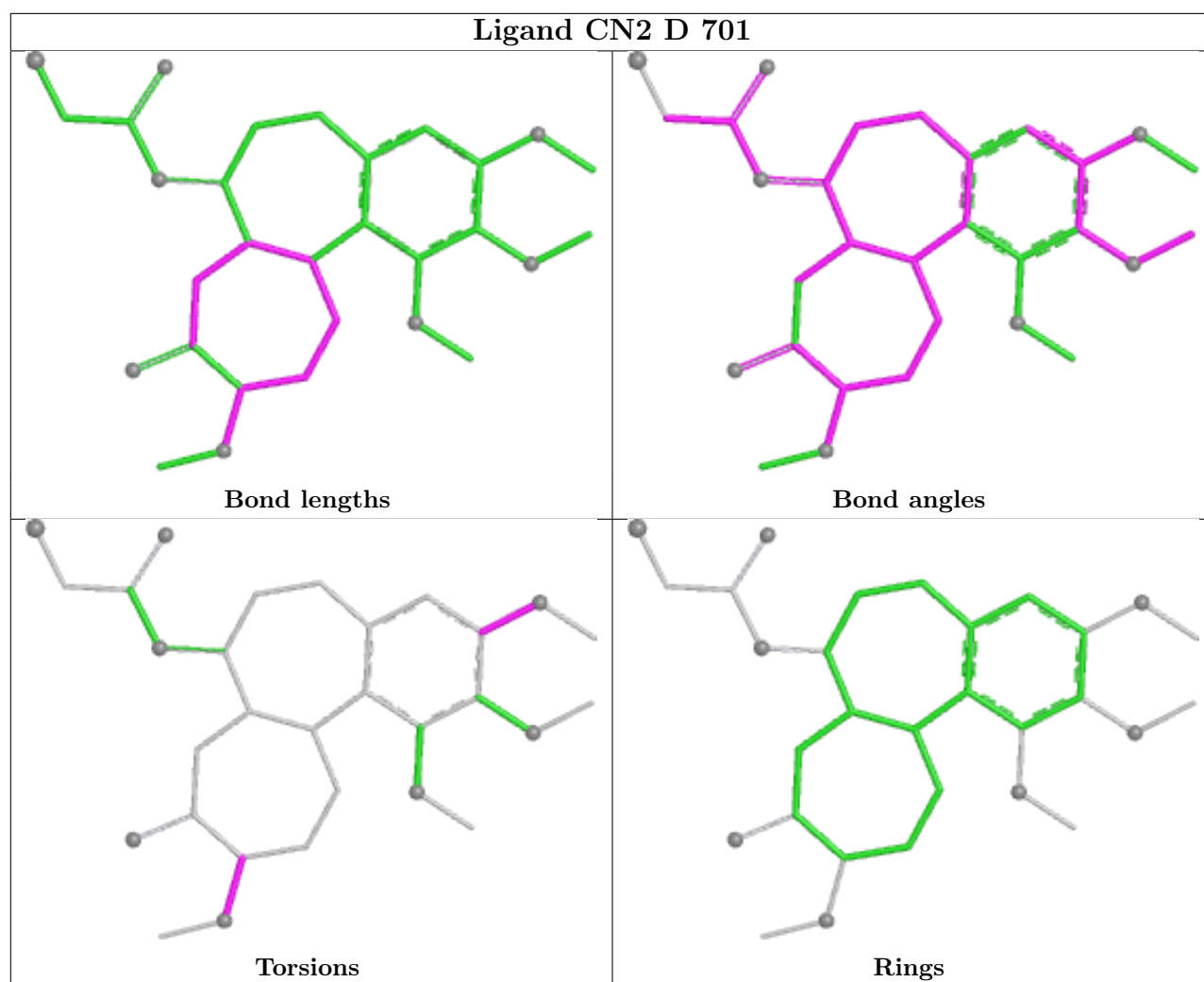
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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



Ligand CN2 B 700







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 Fit of model and data

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.