



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 08:46 PM UTC

PDB ID : 1NCE / pdb_00001nce
Title : Crystal structure of a ternary complex of E. coli thymidylate synthase D169C with dUMP and the antifolate CB3717
Authors : Birdsall, D.L.; Finer-Moore, J.; Stroud, R.M.
Deposited on : 2002-12-05
Resolution : 2.40 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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

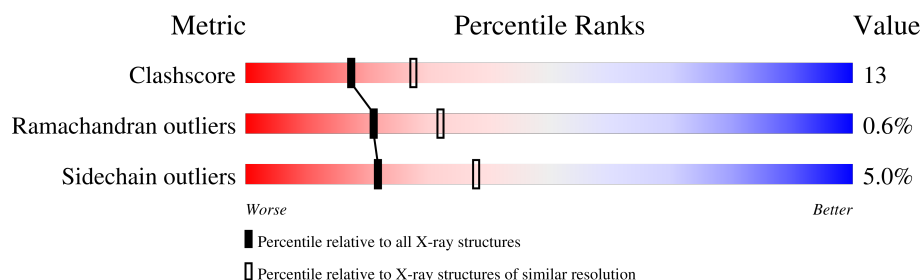
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)

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	264	
1	B	264	

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
1	CXM	B	1	-	-	X	-

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4588 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.

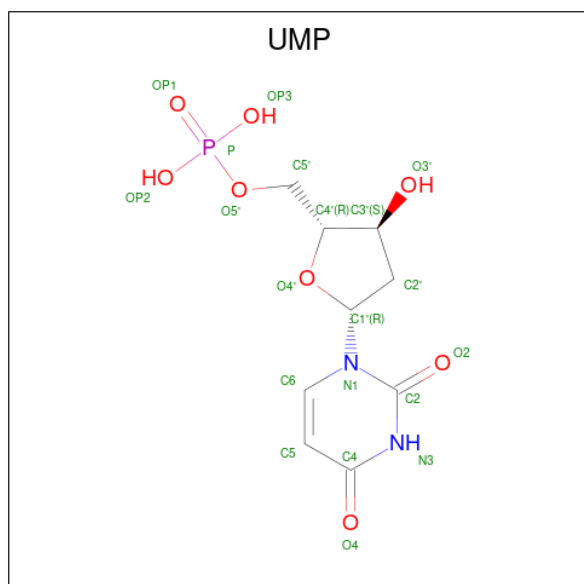
- Molecule 1 is a protein called Thymidylate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	264	Total	C	N	O	S	0	0	0
			2150	1374	371	392	13			
1	B	264	Total	C	N	O	S	0	0	0
			2150	1374	371	392	13			

There are 4 discrepancies between the modelled and reference sequences:

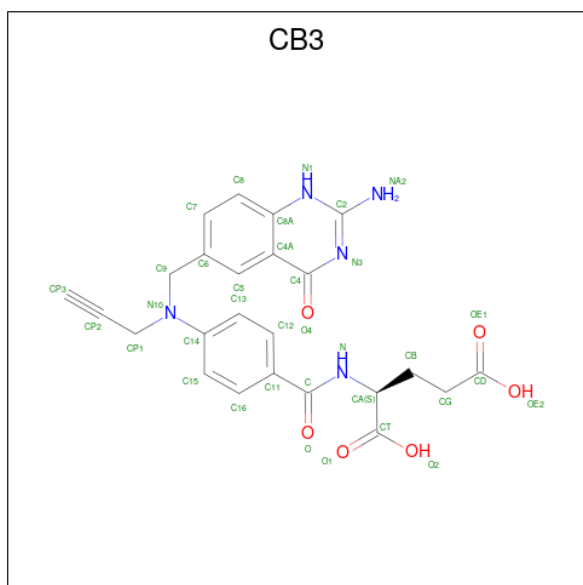
Chain	Residue	Modelled	Actual	Comment	Reference
A	1	CXM	MET	modified residue	UNP P0A884
A	169	CYS	ASP	engineered mutation	UNP P0A884
B	1	CXM	MET	modified residue	UNP P0A884
B	169	CYS	ASP	engineered mutation	UNP P0A884

- Molecule 2 is 2'-DEOXYURIDINE 5'-MONOPHOSPHATE (CCD ID: UMP) (formula: $C_9H_{13}N_2O_8P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			20	9	2	8	1		
2	B	1	Total	C	N	O	P	0	0
			20	9	2	8	1		

- Molecule 3 is 10-PROPARGYL-5,8-DIDEAZAFOLIC ACID (CCD ID: CB3) (formula: $C_{24}H_{23}N_5O_6$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			35	24	5	6		
3	B	1	Total	C	N	O	0	0
			35	24	5	6		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	117	Total	O	0	0
			117	117		
4	B	61	Total	O	0	0
			61	61		

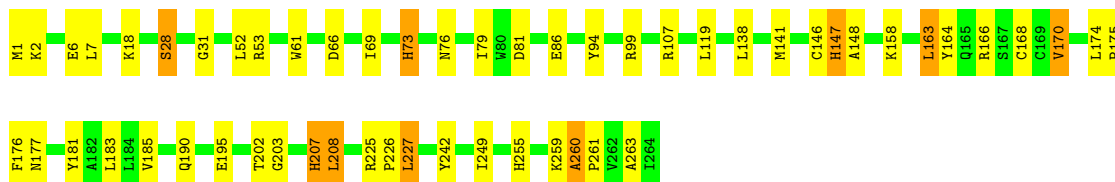
3 Residue-property plots

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.

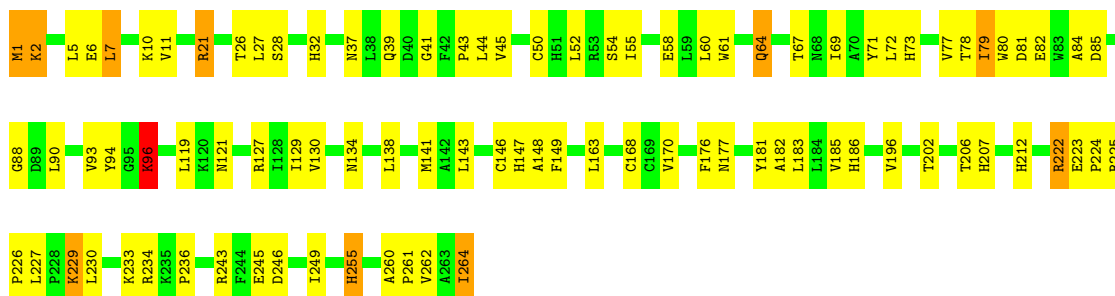
• Molecule 1: Thymidylate synthase

Chain A: 



• Molecule 1: Thymidylate synthase

Chain B: 



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 63	Depositor
Cell constants a, b, c, α , β , γ	127.10 Å 127.10 Å 68.10 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	36.69 – 2.40	Depositor
% Data completeness (in resolution range)	100.0 (36.69-2.40)	Depositor
R_{merge}	0.17	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.187 , 0.246	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4588	wwPDB-VP
Average B, all atoms (Å ²)	34.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CXM, UMP, CB3

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	0.42	0/2199	0.99	8/2986 (0.3%)
1	B	0.40	0/2199	0.96	10/2986 (0.3%)
All	All	0.41	0/4398	0.97	18/5972 (0.3%)

There are no bond length outliers.

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	148	ALA	N-CA-C	8.36	123.60	113.23
1	A	170	VAL	N-CA-C	7.99	118.75	110.36
1	B	96	LYS	N-CA-C	-6.78	103.82	111.07
1	B	148	ALA	N-CA-C	6.34	121.29	113.50
1	A	260	ALA	CA-C-N	6.32	126.27	119.76
1	A	260	ALA	C-N-CA	6.32	126.27	119.76
1	A	207	HIS	N-CA-C	6.01	118.09	109.14
1	B	170	VAL	N-CA-C	6.00	116.66	110.36
1	B	27	LEU	N-CA-C	-5.96	99.48	109.07
1	B	168	CYS	N-CA-C	5.66	117.66	108.26
1	B	255	HIS	N-CA-C	-5.51	102.26	110.20
1	B	207	HIS	N-CA-C	5.43	117.23	109.14
1	B	182	ALA	N-CA-C	-5.42	105.37	111.28
1	A	255	HIS	N-CA-C	-5.35	102.26	110.07
1	B	28	SER	N-CA-C	5.34	117.51	109.23
1	B	121	ASN	N-CA-C	5.34	120.07	113.50
1	A	28	SER	N-CA-C	5.30	117.45	109.23
1	A	168	CYS	N-CA-C	5.28	117.02	108.26

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	2150	0	2080	37	0
1	B	2150	0	2081	72	0
2	A	20	0	10	5	0
2	B	20	0	11	2	0
3	A	35	0	21	0	0
3	B	35	0	21	1	0
4	A	117	0	0	3	0
4	B	61	0	0	2	0
All	All	4588	0	4224	108	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 13.

All (108) 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:2:LYS:HD3	1:B:2:LYS:H	1.36	0.88
1:B:41:GLY:HA2	1:B:229:LYS:HE2	1.54	0.87
1:A:52:LEU:HD13	1:A:249:ILE:HG13	1.56	0.87
1:A:170:VAL:HB	1:A:208:LEU:HD13	1.56	0.85
1:A:52:LEU:CD1	1:A:249:ILE:HG13	2.12	0.79
1:B:82:GLU:OE2	1:B:264:ILE:HG12	1.84	0.76
1:B:69:ILE:HD12	1:B:72:LEU:HD12	1.67	0.76
1:B:52:LEU:HD23	1:B:55:ILE:HD12	1.68	0.75
1:A:53:ARG:NH2	1:A:53:ARG:HB2	2.05	0.70
1:B:1:CXM:HE1	1:B:43:PRO:C	2.17	0.69
1:B:229:LYS:HA	1:B:229:LYS:NZ	2.08	0.69
1:B:69:ILE:HD13	1:B:80:TRP:HB2	1.74	0.68
1:B:212:HIS:HE1	1:B:261:PRO:O	1.78	0.67
1:B:78:THR:O	1:B:80:TRP:N	2.29	0.65
1:B:1:CXM:ON1	1:B:45:VAL:HG13	1.97	0.64
1:B:222:ARG:HG2	1:B:255:HIS:CD2	2.32	0.64
1:B:229:LYS:HA	1:B:229:LYS:HZ3	1.63	0.63
1:A:53:ARG:HB2	1:A:53:ARG:HH21	1.64	0.62
1:A:2:LYS:O	1:A:6:GLU:HG3	1.99	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:80:TRP:HB3	1:B:90:LEU:HD21	1.81	0.61
1:B:134:ASN:HD22	1:B:134:ASN:C	2.07	0.61
1:A:259:LYS:HD3	1:A:260:ALA:N	2.16	0.59
1:B:245:GLU:H	1:B:245:GLU:CD	2.11	0.59
1:B:64:GLN:NE2	4:B:801:HOH:O	2.36	0.58
1:B:67:THR:HG21	1:B:96:LYS:HB2	1.87	0.57
1:B:78:THR:HA	1:B:81:ASP:OD2	2.05	0.57
1:A:170:VAL:HB	1:A:208:LEU:CD1	2.32	0.56
1:B:69:ILE:CD1	1:B:80:TRP:HB2	2.35	0.56
1:B:229:LYS:NZ	1:B:230:LEU:H	2.04	0.56
1:A:225:ARG:HB3	1:A:226:PRO:HD2	1.88	0.55
1:A:166:ARG:HH12	2:A:565:UMP:P	2.30	0.55
1:B:73:HIS:NE2	1:B:81:ASP:OD1	2.40	0.55
1:B:7:LEU:HD21	1:B:206:THR:HG21	1.89	0.54
1:A:163:LEU:HD22	1:A:164:TYR:N	2.22	0.54
1:B:1:CXM:HE1	1:B:43:PRO:HA	1.89	0.54
1:B:67:THR:O	1:B:90:LEU:HD12	2.08	0.54
1:A:138:LEU:HA	1:A:141:MET:HE3	1.90	0.54
1:B:7:LEU:O	1:B:11:VAL:HG23	2.07	0.54
1:B:234:ARG:O	1:B:236:PRO:HD3	2.08	0.54
1:A:86:GLU:H	1:A:86:GLU:CD	2.16	0.53
1:A:166:ARG:NH1	2:A:565:UMP:OP2	2.41	0.53
1:B:143:LEU:HD12	1:B:143:LEU:O	2.07	0.53
1:A:259:LYS:HD2	4:A:808:HOH:O	2.10	0.52
1:B:177:ASN:HD21	2:B:567:UMP:HN3	1.56	0.52
1:B:84:ALA:HB1	1:B:88:GLY:HA2	1.90	0.52
1:A:147:HIS:H	1:A:147:HIS:CD2	2.27	0.52
1:A:28:SER:HB3	1:A:207:HIS:HB3	1.92	0.52
1:B:41:GLY:HA2	1:B:229:LYS:CE	2.34	0.52
1:B:147:HIS:HB2	1:B:163:LEU:HD11	1.93	0.51
1:B:44:LEU:HD11	1:B:50:CYS:HB2	1.94	0.50
1:B:146:CYS:SG	2:B:567:UMP:C6	3.05	0.50
1:B:77:VAL:HG12	1:B:79:ILE:HG12	1.95	0.49
1:A:53:ARG:HH21	1:A:53:ARG:CB	2.26	0.49
1:B:243:ARG:HG2	1:B:246:ASP:OD2	2.12	0.48
1:A:177:ASN:HD21	2:A:565:UMP:HN3	1.60	0.48
1:B:58:GLU:O	1:B:61:TRP:HB3	2.14	0.48
1:B:147:HIS:HD2	1:B:181:TYR:OH	1.97	0.48
1:B:10:LYS:NZ	1:B:32:HIS:HD2	2.12	0.48
1:B:2:LYS:O	1:B:6:GLU:HG3	2.14	0.47
1:B:138:LEU:HA	1:B:141:MET:HE3	1.96	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:93:VAL:O	1:B:94:TYR:C	2.57	0.47
1:B:55:ILE:HG12	1:B:176:PHE:CE1	2.51	0.46
1:B:37:ASN:OD1	1:B:39:GLN:HB2	2.16	0.45
1:A:158:LYS:HA	1:A:195:GLU:O	2.16	0.45
1:B:79:ILE:HG13	1:B:80:TRP:H	1.81	0.45
1:A:61:TRP:CD1	1:A:66:ASP:HB3	2.51	0.45
1:A:107:ARG:CD	4:A:742:HOH:O	2.65	0.45
1:A:174:LEU:HB3	1:A:175:PRO:HD3	1.99	0.45
1:B:262:VAL:HG13	1:B:262:VAL:O	2.17	0.45
1:B:1:CXM:HE1	1:B:44:LEU:N	2.32	0.44
1:B:181:TYR:O	1:B:185:VAL:HG23	2.17	0.44
1:A:146:CYS:HB2	2:A:565:UMP:C4	2.51	0.44
1:B:134:ASN:C	1:B:134:ASN:ND2	2.75	0.44
1:A:52:LEU:HD11	1:A:249:ILE:HG13	1.96	0.44
1:B:79:ILE:HG13	1:B:80:TRP:N	2.33	0.44
1:B:249:ILE:O	1:B:249:ILE:HG23	2.17	0.44
1:B:233:LYS:O	1:B:234:ARG:HB2	2.18	0.44
1:B:1:CXM:HE1	1:B:43:PRO:CA	2.48	0.43
1:B:186:HIS:CE1	1:B:196:VAL:HG11	2.53	0.43
1:B:21:ARG:H	1:B:21:ARG:HG3	1.55	0.43
1:A:73:HIS:HE1	1:A:81:ASP:OD1	2.01	0.43
1:A:181:TYR:O	1:A:185:VAL:HG23	2.18	0.43
1:B:212:HIS:CE1	1:B:261:PRO:O	2.66	0.43
1:B:260:ALA:HA	1:B:261:PRO:HD3	1.87	0.43
1:B:223:GLU:HA	1:B:224:PRO:HD3	1.93	0.43
1:A:18:LYS:HE2	1:A:18:LYS:HB3	1.86	0.42
1:B:229:LYS:NZ	1:B:229:LYS:CA	2.80	0.42
1:B:69:ILE:HG22	1:B:88:GLY:HA3	2.00	0.42
1:B:85:ASP:OD1	1:B:85:ASP:C	2.62	0.42
1:B:143:LEU:HD13	4:B:638:HOH:O	2.19	0.42
1:A:99:ARG:HG3	1:A:99:ARG:HH21	1.84	0.42
1:B:129:ILE:HG22	1:B:130:VAL:N	2.34	0.42
1:B:69:ILE:HD13	1:B:80:TRP:CB	2.48	0.42
1:A:202:THR:HG21	1:B:202:THR:HG21	2.02	0.41
1:A:263:ALA:HB2	4:A:741:HOH:O	2.19	0.41
1:A:227:LEU:HD12	1:A:227:LEU:HA	1.83	0.41
1:B:225:ARG:O	1:B:226:PRO:C	2.63	0.41
1:B:54:SER:HB2	3:B:568:CB3:OE1	2.20	0.41
1:B:71:TYR:CD1	1:B:71:TYR:C	2.99	0.41
1:B:69:ILE:O	1:B:69:ILE:HG13	2.20	0.41
1:B:129:ILE:HG21	1:B:149:PHE:CZ	2.56	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:31:GLY:HA2	1:A:203:GLY:O	2.21	0.40
1:B:1:CXM:HE3	1:B:227:LEU:CD2	2.51	0.40
1:A:28:SER:CB	1:A:207:HIS:HB3	2.51	0.40
1:A:69:ILE:HD12	1:A:73:HIS:CE1	2.55	0.40
1:A:260:ALA:HA	1:A:261:PRO:HD3	1.79	0.40
1:A:190:GLN:NE2	1:A:242:TYR:OH	2.54	0.40
2:A:565:UMP:OP3	1:B:127:ARG:NH1	2.54	0.40

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	262/264 (99%)	253 (97%)	7 (3%)	2 (1%)	16	25
1	B	262/264 (99%)	241 (92%)	20 (8%)	1 (0%)	30	43
All	All	524/528 (99%)	494 (94%)	27 (5%)	3 (1%)	21	32

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	79	ILE
1	A	94	TYR
1	A	79	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 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	232/232 (100%)	222 (96%)	10 (4%)	26	44
1	B	232/232 (100%)	219 (94%)	13 (6%)	19	33
All	All	464/464 (100%)	441 (95%)	23 (5%)	22	38

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	7	LEU
1	A	73	HIS
1	A	76	ASN
1	A	119	LEU
1	A	147	HIS
1	A	163	LEU
1	A	176	PHE
1	A	183	LEU
1	A	208	LEU
1	A	227	LEU
1	B	2	LYS
1	B	5	LEU
1	B	7	LEU
1	B	21	ARG
1	B	26	THR
1	B	60	LEU
1	B	64	GLN
1	B	96	LYS
1	B	119	LEU
1	B	183	LEU
1	B	222	ARG
1	B	229	LYS
1	B	264	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (18) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	9	GLN
1	A	57	HIS
1	A	73	HIS
1	A	76	ASN
1	A	87	ASN

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Mol	Chain	Res	Type
1	A	177	ASN
1	A	190	GLN
1	A	207	HIS
1	A	219	GLN
1	B	32	HIS
1	B	117	ASN
1	B	134	ASN
1	B	147	HIS
1	B	177	ASN
1	B	191	GLN
1	B	212	HIS
1	B	219	GLN
1	B	255	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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
1	CXM	A	1	1	9,10,11	0.97	1 (11%)	9,11,13	2.88	1 (11%)
1	CXM	B	1	1	9,10,11	0.92	0	9,11,13	3.45	1 (11%)

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
1	CXM	A	1	1	-	1/9/10/12	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	CXM	B	1	1	-	3/9/10/12	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1	CXM	ON1-CN	2.36	1.26	1.21

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	1	CXM	ON1-CN-N	-10.12	108.25	124.86
1	A	1	CXM	ON1-CN-N	-8.43	111.03	124.86

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	B	1	CXM	N-CA-CB-CG
1	B	1	CXM	C-CA-CB-CG
1	B	1	CXM	ON1-CN-N-CA
1	A	1	CXM	ON1-CN-N-CA

There are no ring outliers.

1 monomer is involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	B	1	CXM	6	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

4 ligands 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	UMP	B	567	-	21,21,21	1.59	3 (14%)	30,31,31	1.93	8 (26%)
3	CB3	A	566	-	37,37,37	2.72	18 (48%)	50,51,51	1.86	8 (16%)
3	CB3	B	568	-	37,37,37	2.71	17 (45%)	50,51,51	1.95	11 (22%)
2	UMP	A	565	1	21,21,21	2.74	5 (23%)	30,31,31	2.49	12 (40%)

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	UMP	B	567	-	-	0/10/22/22	0/2/2/2
3	CB3	A	566	-	-	11/27/28/28	0/3/3/3
3	CB3	B	568	-	-	7/27/28/28	0/3/3/3
2	UMP	A	565	1	-	1/10/22/22	0/2/2/2

All (43) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	566	CB3	O4-C4	8.98	1.38	1.23
3	B	568	CB3	O4-C4	8.67	1.38	1.23
2	A	565	UMP	C6-C5	8.32	1.54	1.35
2	A	565	UMP	C6-N1	5.49	1.51	1.38
2	B	567	UMP	O4'-C1'	4.62	1.52	1.42
3	A	566	CB3	C5-C6	4.32	1.46	1.39
2	A	565	UMP	C5-C4	4.30	1.53	1.43
2	A	565	UMP	O4'-C1'	4.19	1.51	1.42
3	B	568	CB3	C8-C7	4.15	1.45	1.38
3	B	568	CB3	C5-C6	4.13	1.46	1.39
3	B	568	CB3	C4A-C8A	3.90	1.47	1.41
3	B	568	CB3	C15-C14	3.84	1.46	1.39
3	A	566	CB3	C4A-C8A	3.83	1.47	1.41
3	A	566	CB3	C15-C14	3.73	1.46	1.39
3	A	566	CB3	C13-C12	3.66	1.44	1.38
3	B	568	CB3	C4A-C4	-3.63	1.42	1.48
3	A	566	CB3	C8-C7	3.63	1.44	1.38
3	A	566	CB3	C13-C14	3.62	1.46	1.39

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	568	CB3	C13-C12	3.41	1.44	1.38
3	A	566	CB3	C4A-C4	-3.39	1.42	1.48
3	B	568	CB3	C9-N10	3.38	1.51	1.46
3	A	566	CB3	C12-C11	3.37	1.44	1.39
3	B	568	CB3	C12-C11	3.37	1.44	1.39
3	B	568	CB3	C13-C14	3.31	1.45	1.39
3	B	568	CB3	C16-C15	3.29	1.44	1.38
3	A	566	CB3	C9-N10	3.27	1.51	1.46
3	A	566	CB3	C7-C6	3.15	1.45	1.38
3	B	568	CB3	C7-C6	3.15	1.45	1.38
3	B	568	CB3	C8-C8A	3.10	1.44	1.39
3	A	566	CB3	C8-C8A	3.10	1.44	1.39
3	B	568	CB3	C11-C	-3.10	1.43	1.50
3	A	566	CB3	C16-C11	3.09	1.44	1.39
3	A	566	CB3	C16-C15	2.92	1.43	1.38
3	B	568	CB3	C16-C11	2.91	1.43	1.39
3	B	568	CB3	C5-C4A	2.80	1.44	1.39
2	A	565	UMP	O4'-C4'	2.70	1.51	1.45
2	B	567	UMP	O4'-C4'	2.61	1.50	1.45
3	A	566	CB3	CP1-N10	2.59	1.48	1.46
3	A	566	CB3	C11-C	-2.58	1.44	1.50
3	A	566	CB3	C2-N3	2.56	1.39	1.33
2	B	567	UMP	C6-C5	2.33	1.40	1.35
3	A	566	CB3	C5-C4A	2.20	1.43	1.39
3	B	568	CB3	CP1-N10	2.11	1.48	1.46

All (39) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	567	UMP	O4'-C1'-N1	6.95	120.19	107.86
3	A	566	CB3	CP1-N10-C9	-6.81	110.33	117.19
3	B	568	CB3	C6-C9-N10	5.55	123.11	114.13
3	B	568	CB3	CP2-CP1-N10	-5.15	108.70	113.45
2	A	565	UMP	C6-C5-C4	-4.97	113.19	119.53
3	A	566	CB3	C6-C9-N10	4.90	122.06	114.13
2	A	565	UMP	O4'-C1'-N1	4.66	116.14	107.86
3	B	568	CB3	C8A-C4A-C4	-4.66	115.08	120.11
2	A	565	UMP	C5-C4-N3	4.61	121.26	114.80
2	A	565	UMP	C5-C6-N1	-4.59	114.38	121.84
2	A	565	UMP	O4'-C4'-C3'	-4.05	96.42	105.65
3	B	568	CB3	CP1-N10-C9	-4.04	113.12	117.19
2	A	565	UMP	O4'-C1'-C2'	-3.60	99.52	106.25

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	567	UMP	O4'-C4'-C3'	-3.44	97.79	105.65
3	A	566	CB3	C8A-C4A-C4	-3.39	116.44	120.11
3	B	568	CB3	CP1-N10-C14	3.24	125.11	119.03
2	A	565	UMP	O5'-P-OP1	3.17	115.01	106.44
3	B	568	CB3	NA2-C2-N1	3.12	123.33	116.77
2	A	565	UMP	OP2-P-O5'	-3.10	98.58	106.67
3	B	568	CB3	C9-C6-C7	-3.05	115.12	120.75
3	A	566	CB3	N1-C2-N3	-3.01	117.81	123.32
2	A	565	UMP	C1'-N1-C6	-2.89	115.84	121.53
3	A	566	CB3	C9-N10-C14	2.85	125.66	120.72
3	B	568	CB3	C9-C6-C5	2.85	125.64	120.27
3	B	568	CB3	N1-C2-N3	-2.76	118.28	123.32
3	A	566	CB3	CB-CA-N	-2.73	105.50	110.91
2	A	565	UMP	O4-C4-C5	-2.72	120.47	125.16
2	B	567	UMP	C6-N1-C2	2.72	124.30	121.00
3	A	566	CB3	CP2-CP1-N10	-2.70	110.96	113.45
2	A	565	UMP	C4'-O4'-C1'	2.66	115.82	109.51
3	A	566	CB3	CP1-N10-C14	2.65	124.00	119.03
2	B	567	UMP	O4'-C1'-C2'	-2.58	101.42	106.25
2	B	567	UMP	OP2-P-O5'	2.53	113.27	106.67
2	A	565	UMP	C6-N1-C2	2.47	124.00	121.00
3	B	568	CB3	CP1-CP2-CP3	-2.42	173.71	177.63
2	B	567	UMP	C1'-N1-C6	-2.33	116.94	121.53
2	B	567	UMP	O4-C4-N3	2.25	122.53	119.27
3	B	568	CB3	C5-C4A-C8A	2.23	121.10	119.09
2	B	567	UMP	O4-C4-C5	-2.17	121.42	125.16

There are no chirality outliers.

All (19) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	566	CB3	C11-C-N-CA
3	B	568	CB3	C11-C-N-CA
3	A	566	CB3	O-C-N-CA
3	B	568	CB3	O-C-N-CA
3	B	568	CB3	C13-C14-N10-C9
3	B	568	CB3	C13-C14-N10-CP1
3	B	568	CB3	C15-C14-N10-C9
3	B	568	CB3	C15-C14-N10-CP1
3	A	566	CB3	C13-C14-N10-C9
3	A	566	CB3	CT-CA-N-C
3	A	566	CB3	C13-C14-N10-CP1

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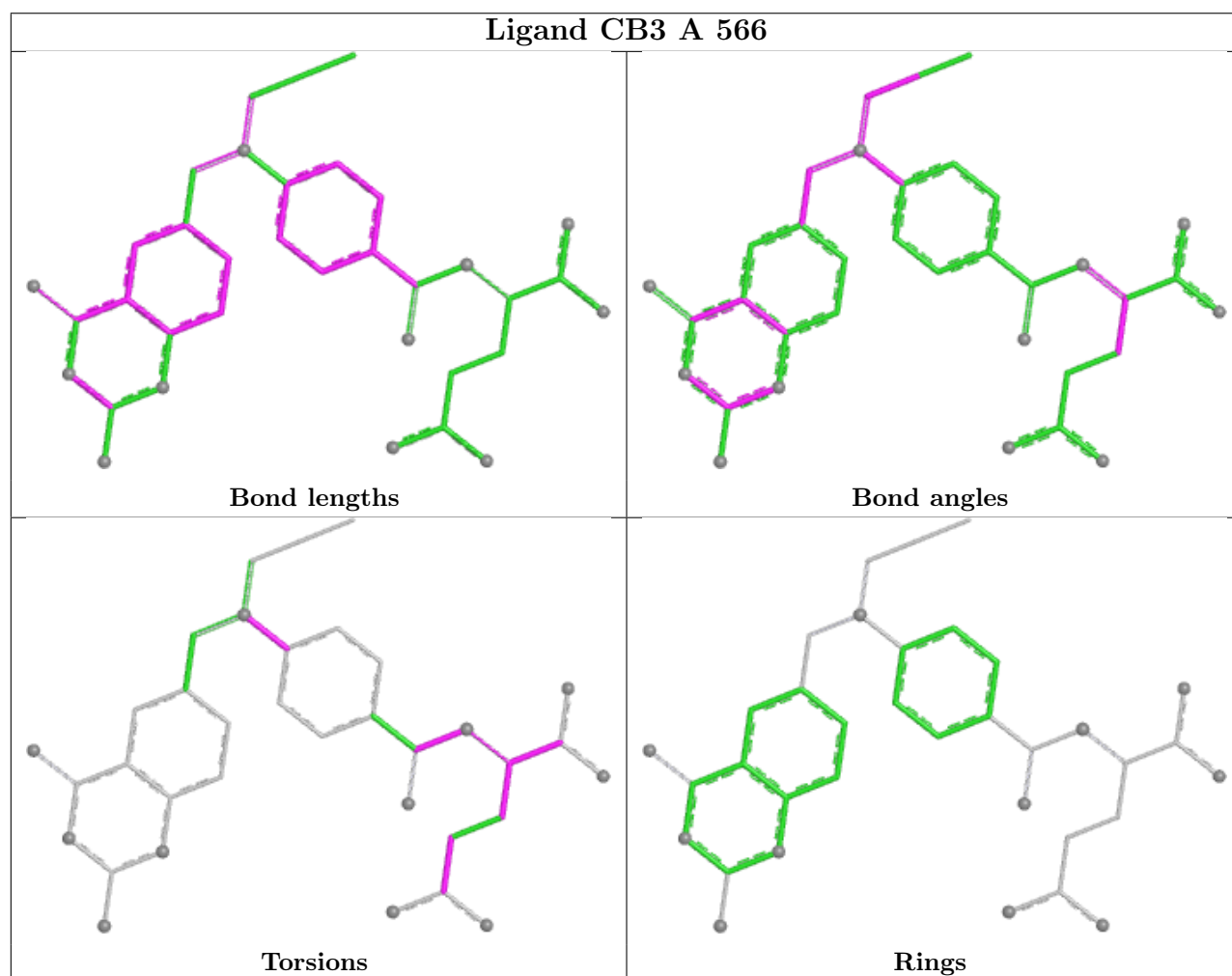
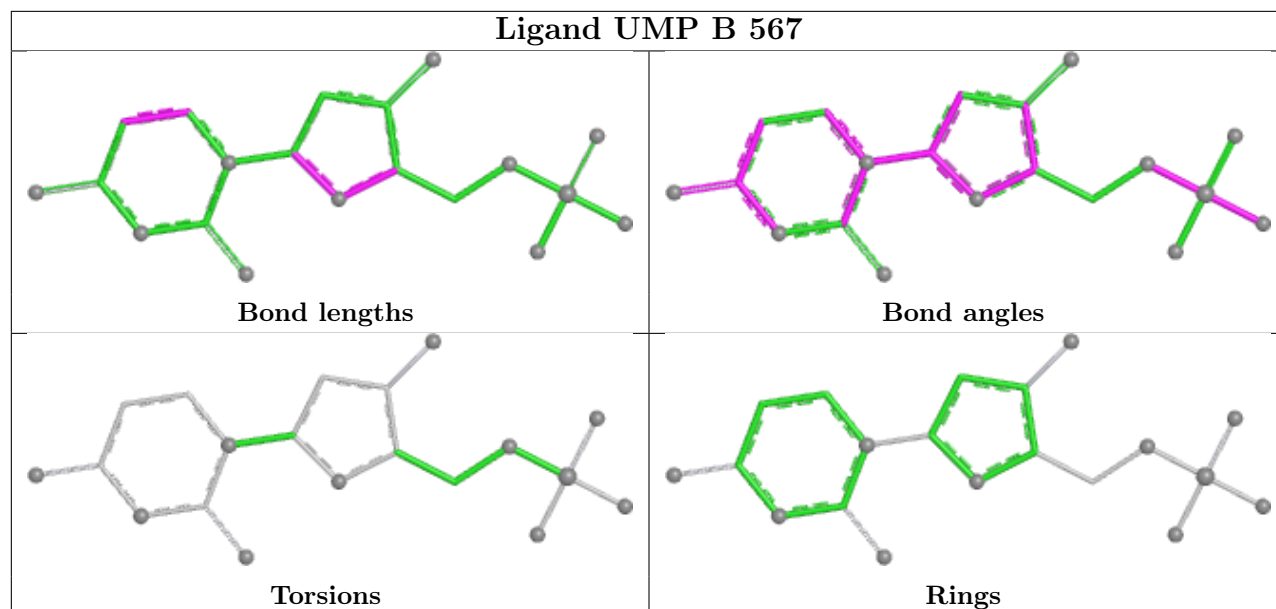
Mol	Chain	Res	Type	Atoms
3	A	566	CB3	CB-CA-N-C
3	A	566	CB3	N-CA-CT-O1
3	A	566	CB3	N-CA-CT-O2
3	A	566	CB3	OE1-CD-CG-CB
3	A	566	CB3	OE2-CD-CG-CB
2	A	565	UMP	C3'-C4'-C5'-O5'
3	A	566	CB3	CT-CA-CB-CG
3	B	568	CB3	OE2-CD-CG-CB

There are no ring outliers.

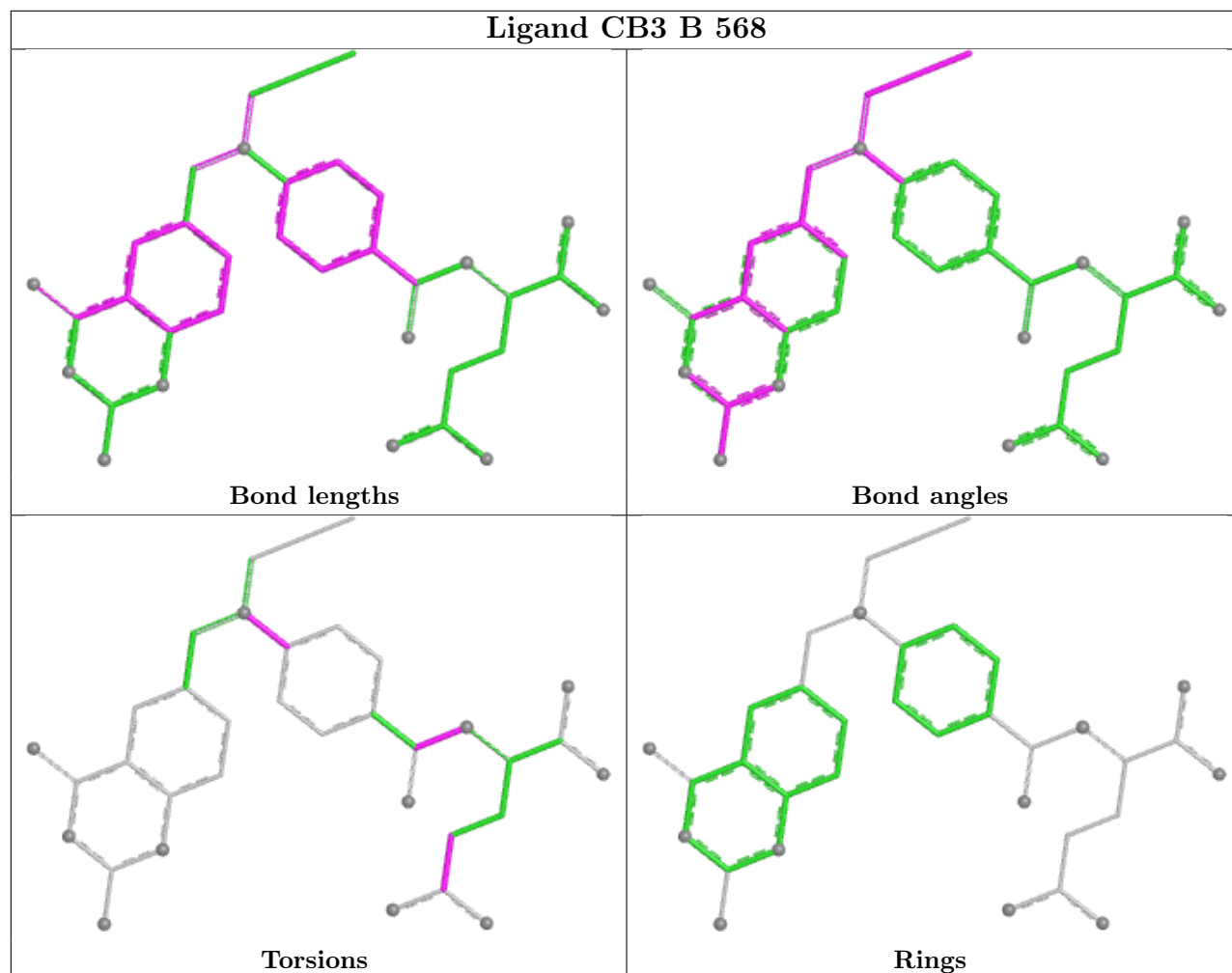
3 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	567	UMP	2	0
3	B	568	CB3	1	0
2	A	565	UMP	5	0

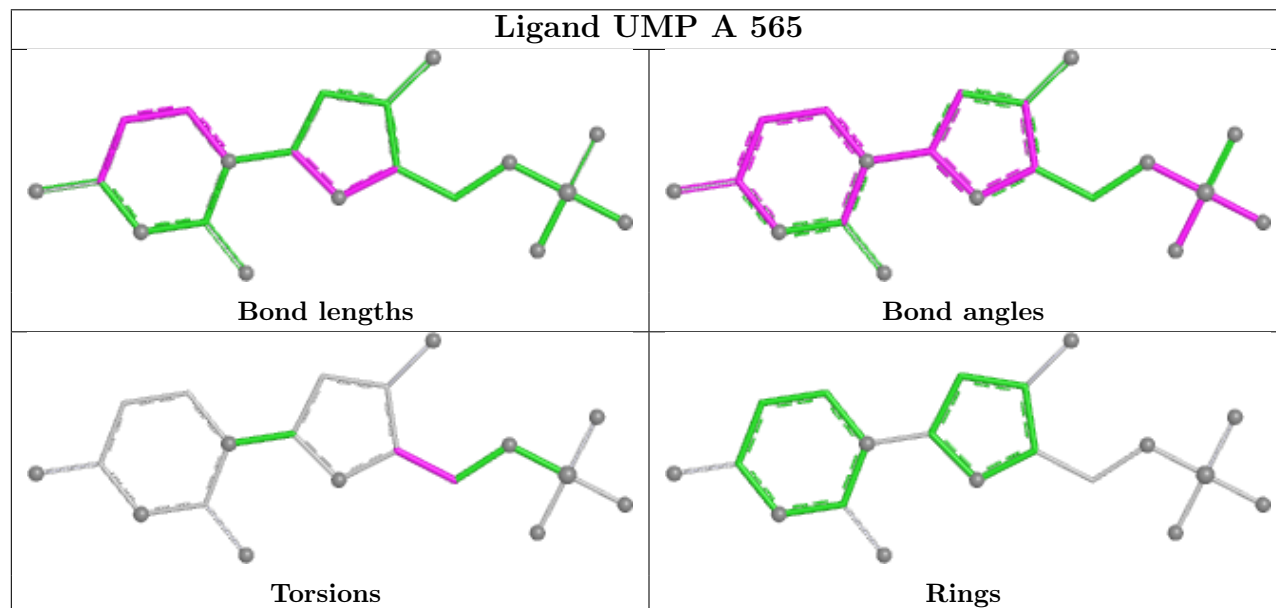
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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 CB3 B 568



Ligand UMP A 565



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.