



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 10:46 PM UTC

PDB ID : 1F7N / pdb_00001f7n
Title : CRYSTAL STRUCTURES OF FELINE IMMUNODEFICIENCY VIRUS
DUTP PYROPHOSPHATASE AND ITS NUCLEOTIDE COMPLEXES IN
THREE CRYSTAL FORMS.
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Deposited on : 2000-06-27
Resolution : 2.20 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

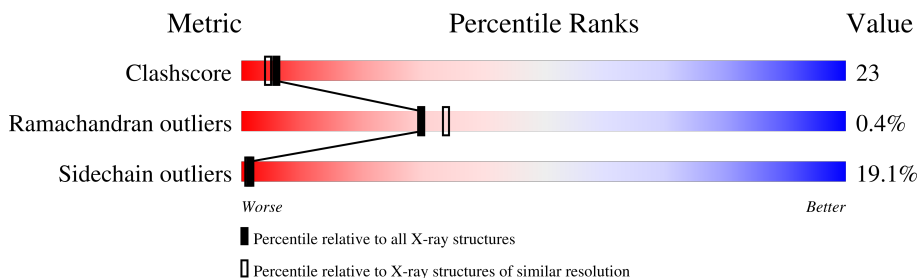
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)

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	136	
1	B	136	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 1896 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.

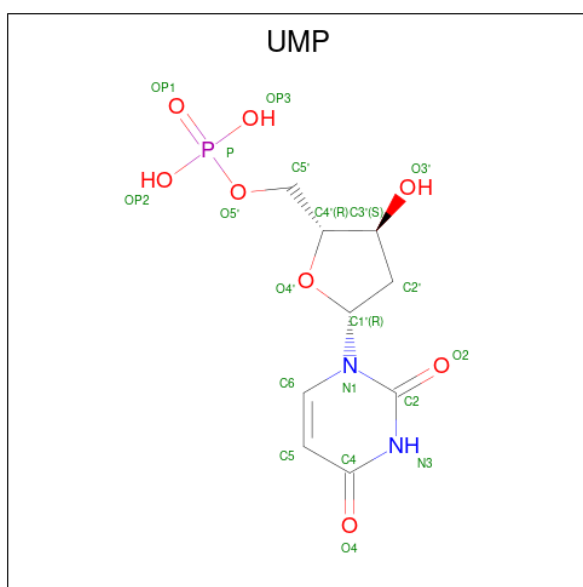
- Molecule 1 is a protein called POL POLYPROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	117	Total	C	N	O	S	0	0	0
			887	571	149	162	5			
1	B	117	Total	C	N	O	S	0	0	0
			887	571	149	162	5			

- Molecule 2 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Mg	0	0
			2	2		
2	B	1	Total	Mg	0	0
			1	1		

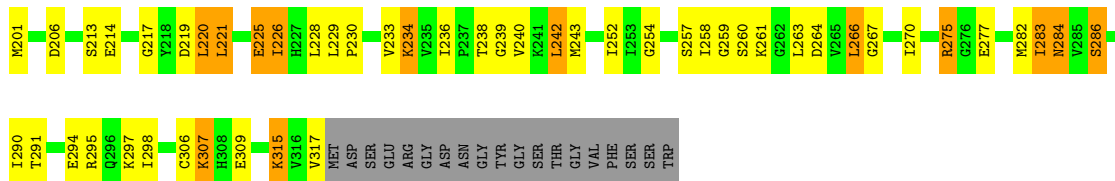
- Molecule 3 is 2'-DEOXYURIDINE 5'-MONOPHOSPHATE (CCD ID: UMP) (formula: C₉H₁₃N₂O₈P).



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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	59	Total	O	0	0
			59	59		
4	B	20	Total	O	0	0
			20	20		



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	79.13Å 79.13Å 87.21Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.20	Depositor
% Data completeness (in resolution range)	(Not available) (50.00-2.20)	Depositor
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.216 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1896	wwPDB-VP
Average B, all atoms (Å ²)	32.0	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: UMP, 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	0.70	0/897	1.05	6/1204 (0.5%)
1	B	0.56	0/897	1.05	3/1204 (0.2%)
All	All	0.63	0/1794	1.05	9/2408 (0.4%)

There are no bond length outliers.

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	225	GLU	N-CA-C	-6.98	100.65	110.50
1	A	9	LEU	N-CA-C	5.73	118.81	109.59
1	A	17	GLY	N-CA-C	5.46	119.12	111.14
1	A	83	ILE	CB-CA-C	-5.42	102.15	110.50
1	B	217	GLY	N-CA-C	5.37	120.98	112.06
1	A	54	GLY	N-CA-C	5.35	119.39	112.54
1	A	104	LEU	CA-C-N	5.24	125.00	119.76
1	A	104	LEU	C-N-CA	5.24	125.00	119.76
1	B	298	ILE	CB-CA-C	-5.24	106.27	111.30

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	887	0	957	41	0
1	B	887	0	954	47	0
2	A	2	0	0	0	0
2	B	1	0	0	0	0
3	A	20	0	11	2	0
3	B	20	0	11	0	0
4	A	59	0	0	10	0
4	B	20	0	0	5	0
All	All	1896	0	1933	87	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 23.

All (87) 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:306:CYS:SG	4:B:470:HOH:O	2.21	0.97
1:B:306:CYS:SG	4:B:457:HOH:O	2.24	0.95
1:B:264:ASP:HB3	1:B:283:ILE:HD12	1.57	0.87
1:B:228:LEU:HD21	1:B:234:LYS:HB2	1.57	0.85
1:B:233:VAL:HG22	1:B:283:ILE:HG23	1.63	0.80
1:B:284:ASN:HD22	1:B:286:SER:H	1.33	0.76
1:B:266:LEU:CD1	1:B:283:ILE:HD11	2.15	0.75
1:A:36:ILE:HD12	1:A:82:MET:HG3	1.67	0.74
1:B:266:LEU:HD13	1:B:283:ILE:HD11	1.70	0.73
1:B:284:ASN:HD22	1:B:284:ASN:C	1.95	0.73
1:B:284:ASN:ND2	1:B:286:SER:H	1.89	0.70
1:B:306:CYS:HA	4:B:464:HOH:O	1.94	0.68
1:A:106:CYS:HB3	4:A:428:HOH:O	1.93	0.67
1:A:57:SER:O	1:A:61:LYS:HD3	1.94	0.66
1:A:58:ILE:HD13	1:A:82:MET:HE1	1.77	0.66
1:A:63:LEU:HD13	1:A:90:ILE:HD12	1.78	0.66
1:A:14:GLU:HG3	4:A:436:HOH:O	1.96	0.65
1:A:58:ILE:HD11	4:A:409:HOH:O	1.99	0.63
1:A:106:CYS:SG	4:A:428:HOH:O	2.56	0.63
1:B:201:MET:HE1	1:B:242:LEU:HD22	1.81	0.61
1:B:258:ILE:HG13	1:B:259:GLY:N	2.15	0.60
1:A:106:CYS:CB	4:A:428:HOH:O	2.50	0.59
1:A:58:ILE:CD1	1:A:82:MET:HE1	2.32	0.59
1:B:225:GLU:O	1:B:226:ILE:HG12	2.03	0.58
1:B:228:LEU:CD2	1:B:234:LYS:HB2	2.29	0.58
1:A:58:ILE:HG13	1:A:59:GLY:N	2.20	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:28:LEU:HD21	1:A:34:LYS:HB2	1.87	0.56
1:A:58:ILE:HG12	4:A:405:HOH:O	2.06	0.55
1:A:106:CYS:SG	4:A:449:HOH:O	2.53	0.55
1:A:3:ILE:HG22	1:A:42:LEU:HB3	1.89	0.55
1:B:284:ASN:C	1:B:284:ASN:ND2	2.64	0.54
1:B:225:GLU:C	1:B:226:ILE:HG12	2.34	0.53
1:A:64:ASP:HB3	1:A:83:ILE:CD1	2.39	0.52
1:A:66:LEU:CD2	1:A:83:ILE:HG12	2.39	0.52
1:B:307:LYS:HE3	1:B:309:GLU:OE1	2.10	0.52
1:B:266:LEU:HD22	1:B:283:ILE:CG1	2.40	0.52
1:B:284:ASN:HD21	1:B:286:SER:CB	2.23	0.52
1:B:259:GLY:O	1:B:261:LYS:N	2.43	0.51
1:A:33:VAL:HG22	1:A:83:ILE:CG2	2.40	0.51
1:B:239:GLY:N	1:B:277:GLU:OE1	2.39	0.51
1:A:62:GLY:HA3	1:A:86:SER:HB3	1.92	0.51
1:A:52:ILE:HD13	1:A:101:LEU:HD12	1.93	0.51
1:B:254:GLY:HA2	4:B:414:HOH:O	2.10	0.51
1:B:294:GLU:O	1:B:295:ARG:HB2	2.11	0.51
1:B:307:LYS:HE3	1:B:309:GLU:CG	2.41	0.50
1:B:201:MET:CE	1:B:242:LEU:HD22	2.41	0.50
1:B:243:MET:HG2	1:B:275:ARG:NH2	2.27	0.50
1:B:263:LEU:HD22	1:B:282:MET:HG2	1.93	0.50
1:B:306:CYS:SG	1:B:306:CYS:O	2.70	0.49
1:B:252:ILE:HD11	1:B:270:ILE:HD11	1.95	0.48
1:B:266:LEU:HD22	1:B:283:ILE:HG12	1.95	0.48
1:A:93:MET:O	1:A:96:GLN:HB3	2.13	0.48
1:B:290:ILE:HG22	1:B:291:THR:N	2.27	0.48
1:A:11:LYS:HG3	1:A:12:ARG:O	2.13	0.48
1:A:87:ARG:HB2	4:A:440:HOH:O	2.13	0.47
1:B:258:ILE:O	1:B:259:GLY:C	2.55	0.46
1:B:259:GLY:C	1:B:261:LYS:H	2.24	0.46
1:B:220:LEU:HG	1:B:238:THR:HG21	1.98	0.45
1:B:259:GLY:C	1:B:261:LYS:N	2.73	0.45
1:A:8:ILE:HG23	1:A:8:ILE:O	2.15	0.45
1:B:221:LEU:CD1	1:B:297:LYS:HG2	2.46	0.45
1:A:64:ASP:HB3	1:A:83:ILE:HD11	2.00	0.44
1:B:219:ASP:OD1	1:B:297:LYS:HD3	2.18	0.44
1:A:64:ASP:HB3	1:A:83:ILE:HD12	2.00	0.43
1:A:66:LEU:HD22	1:A:83:ILE:HG12	2.00	0.43
1:A:74:TYR:CD1	3:A:139:UMP:H2"	2.54	0.43
1:B:201:MET:HE3	1:B:242:LEU:HB3	2.00	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:36:ILE:CD1	1:A:82:MET:HG3	2.42	0.43
1:A:42:LEU:HD21	1:A:78:ILE:HD11	1.99	0.43
1:A:66:LEU:HD21	1:A:83:ILE:HG12	2.00	0.42
1:A:63:LEU:CD1	1:A:90:ILE:HD12	2.48	0.42
1:A:43:MET:HB3	4:A:435:HOH:O	2.20	0.42
1:B:229:LEU:O	1:B:230:PRO:C	2.62	0.42
1:A:69:VAL:O	3:A:139:UMP:H3'	2.19	0.42
1:B:315:LYS:CB	1:B:315:LYS:NZ	2.82	0.42
1:B:266:LEU:HD11	1:B:283:ILE:HD11	1.98	0.42
1:B:266:LEU:O	1:B:267:GLY:C	2.62	0.41
1:B:258:ILE:HD11	4:B:414:HOH:O	2.21	0.41
1:B:252:ILE:CD1	1:B:270:ILE:HD11	2.49	0.41
1:A:6:ASP:OD1	1:A:6:ASP:N	2.54	0.41
1:A:12:ARG:NH2	1:B:206:ASP:OD1	2.53	0.41
1:A:33:VAL:HG22	1:A:83:ILE:HG23	2.02	0.41
1:A:36:ILE:HA	1:A:37:PRO:HD3	1.88	0.41
1:A:29:LEU:O	1:A:30:PRO:C	2.61	0.40
1:B:290:ILE:CG2	1:B:291:THR:N	2.84	0.40
1:A:27:HIS:HD2	1:A:91:THR:OG1	2.05	0.40
1:A:58:ILE:CG1	4:A:405:HOH:O	2.65	0.40

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 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	115/136 (85%)	115 (100%)	0	0	100	100
1	B	115/136 (85%)	111 (96%)	3 (3%)	1 (1%)	14	14
All	All	230/272 (85%)	226 (98%)	3 (1%)	1 (0%)	30	34

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	260	SER

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 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	97/112 (87%)	78 (80%)	19 (20%)	1	1
1	B	97/112 (87%)	79 (81%)	18 (19%)	1	1
All	All	194/224 (87%)	157 (81%)	37 (19%)	1	1

All (37) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	14	GLU
1	A	20	LEU
1	A	21	LEU
1	A	33	VAL
1	A	40	VAL
1	A	42	LEU
1	A	43	MET
1	A	58	ILE
1	A	66	LEU
1	A	83	ILE
1	A	87	ARG
1	A	88	LYS
1	A	92	LEU
1	A	93	MET
1	A	107	LYS
1	A	110	VAL
1	A	111	LEU
1	A	116	VAL
1	A	117	VAL
1	B	213	SER
1	B	214	GLU
1	B	220	LEU
1	B	221	LEU

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Mol	Chain	Res	Type
1	B	226	ILE
1	B	234	LYS
1	B	236	ILE
1	B	240	VAL
1	B	242	LEU
1	B	257	SER
1	B	266	LEU
1	B	275	ARG
1	B	283	ILE
1	B	284	ASN
1	B	286	SER
1	B	307	LYS
1	B	315	LYS
1	B	317	VAL

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

Mol	Chain	Res	Type
1	A	27	HIS
1	B	284	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 5 ligands modelled in this entry, 3 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
3	UMP	B	337	-	21,21,21	2.14	9 (42%)	30,31,31	2.50	11 (36%)
3	UMP	A	139	-	21,21,21	2.36	9 (42%)	30,31,31	2.34	11 (36%)

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
3	UMP	B	337	-	-	2/10/22/22	0/2/2/2
3	UMP	A	139	-	-	2/10/22/22	0/2/2/2

All (18) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	139	UMP	C1'-N1	-5.98	1.33	1.48
3	B	337	UMP	C1'-N1	-5.11	1.35	1.48
3	A	139	UMP	O2-C2	-4.85	1.14	1.23
3	B	337	UMP	O2-C2	-3.65	1.16	1.23
3	A	139	UMP	O5'-C5'	-3.58	1.31	1.44
3	B	337	UMP	C5'-C4'	-3.22	1.41	1.51
3	A	139	UMP	C5'-C4'	-3.17	1.42	1.51
3	A	139	UMP	C2'-C1'	2.98	1.60	1.52
3	B	337	UMP	C2'-C1'	2.90	1.60	1.52
3	B	337	UMP	O4'-C1'	2.82	1.48	1.42
3	B	337	UMP	P-OP2	2.72	1.64	1.54
3	A	139	UMP	O4-C4	-2.61	1.19	1.24
3	B	337	UMP	O5'-C5'	-2.49	1.35	1.44
3	B	337	UMP	C2-N1	2.45	1.42	1.38
3	A	139	UMP	O4'-C1'	2.29	1.47	1.42
3	A	139	UMP	C2-N1	2.24	1.42	1.38
3	A	139	UMP	P-OP2	2.11	1.62	1.54
3	B	337	UMP	O4-C4	-2.03	1.20	1.24

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	337	UMP	C6-N1-C2	-6.28	113.35	121.00
3	B	337	UMP	C1'-N1-C2	5.88	129.16	117.66
3	A	139	UMP	C6-N1-C2	-5.68	114.09	121.00
3	B	337	UMP	C5-C6-N1	4.85	129.72	121.84
3	A	139	UMP	C1'-N1-C2	4.83	127.10	117.66
3	A	139	UMP	O5'-C5'-C4'	4.53	124.41	108.99
3	A	139	UMP	C5-C6-N1	4.19	128.64	121.84
3	B	337	UMP	C2'-C1'-N1	3.43	122.39	113.81
3	B	337	UMP	O4-C4-N3	3.30	124.06	119.27
3	B	337	UMP	O4'-C1'-N1	3.27	113.66	107.86
3	A	139	UMP	O4'-C1'-N1	3.23	113.59	107.86
3	B	337	UMP	N3-C2-N1	3.09	118.91	114.89
3	B	337	UMP	OP2-P-O5'	-3.06	98.68	106.67
3	A	139	UMP	O4-C4-N3	2.78	123.30	119.27
3	A	139	UMP	N3-C2-N1	2.66	118.35	114.89
3	A	139	UMP	C2'-C1'-N1	2.57	120.24	113.81
3	A	139	UMP	O2-C2-N3	-2.22	117.39	121.49
3	A	139	UMP	O4'-C4'-C3'	2.21	110.69	105.65
3	B	337	UMP	O2-C2-N3	-2.12	117.58	121.49
3	A	139	UMP	C6-C5-C4	-2.10	116.85	119.53
3	B	337	UMP	O5'-C5'-C4'	2.10	116.13	108.99
3	B	337	UMP	C1'-N1-C6	-2.05	117.49	121.53

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	139	UMP	O4'-C4'-C5'-O5'
3	A	139	UMP	C3'-C4'-C5'-O5'
3	B	337	UMP	O4'-C4'-C5'-O5'
3	B	337	UMP	C3'-C4'-C5'-O5'

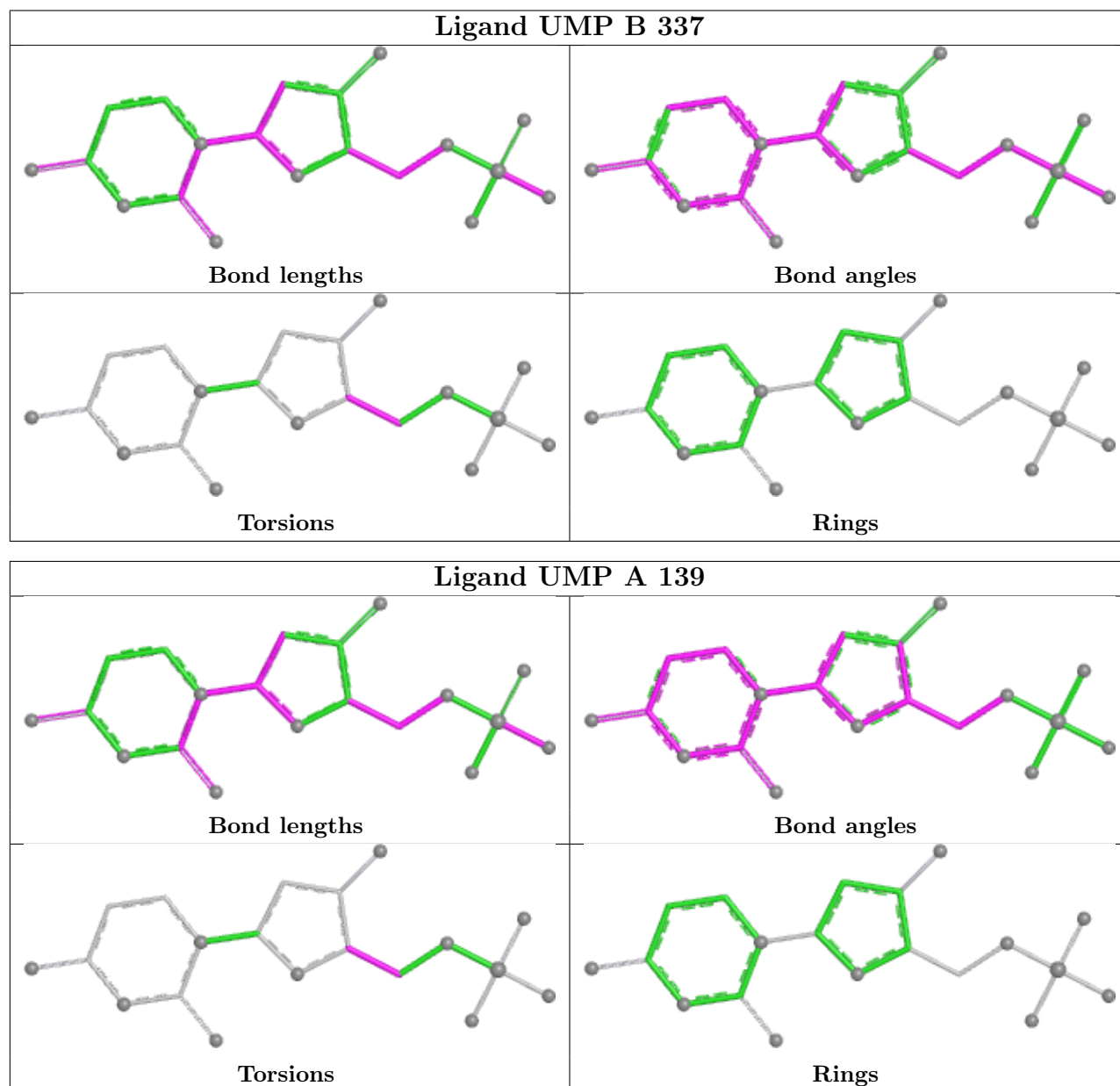
There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	139	UMP	2	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 ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues

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.