



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 04:12 PM UTC

PDB ID : 1KLK / pdb_00001klk
Title : CRYSTAL STRUCTURE OF PNEUMOCYSTIS CARINII DIHYDROFOLATE REDUCTASE TERNARY COMPLEX WITH PT653 AND NADPH
Authors : Cody, V.; Galitsky, N.; Luft, J.R.; Pangborn, W.; Rosowsky, A.; Queener, S.F.
Deposited on : 2001-12-12
Resolution : 2.30 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

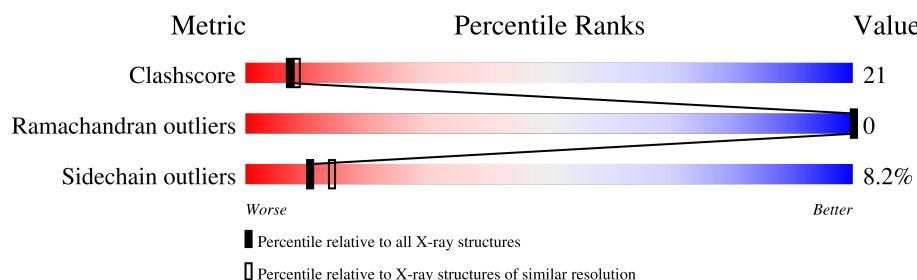
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)

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	206	

2 Entry composition [i](#)

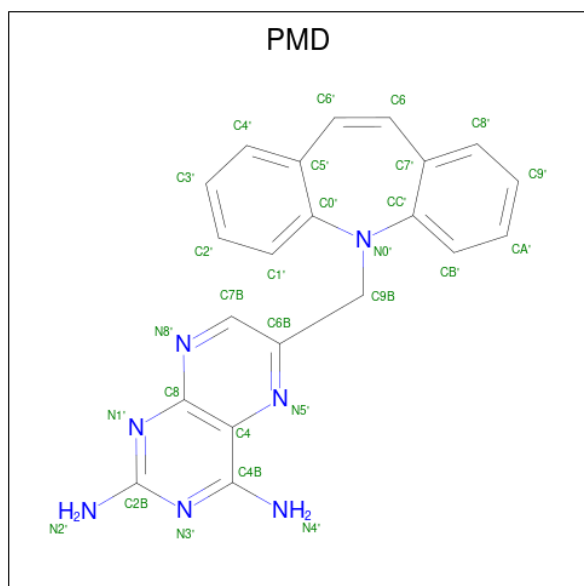
There are 4 unique types of molecules in this entry. The entry contains 1770 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Dihydrofolate reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	203	Total	C	N	O	S	0	0	0
			1661	1072	283	300	6			

- Molecule 2 is [N-(2,4-DIAMINOPTERIDIN-6-YL)-METHYL]-DIBENZ[B,F]AZEPINE (CCD ID: PMD) (formula: C₂₁H₁₇N₇).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	N	0	0
			28	21	7		

- Molecule 3 is NADPH DIHYDRO-NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (CCD ID: NDP) (formula: C₂₁H₃₀N₇O₁₇P₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			48	21	7	17	3		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	33	Total O 33 33	0	0

Note EDS was not executed.

- Molecule 1: Dihydrofolate reductase



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	36.84Å 43.14Å 59.32Å 90.00° 95.03° 90.00°	Depositor
Resolution (Å)	8.00 – 2.30	Depositor
% Data completeness (in resolution range)	(Not available) (8.00-2.30)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.196 , 0.289	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1770	wwPDB-VP
Average B, all atoms (Å ²)	35.0	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: PMD, NDP

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	0.54	0/1703	1.02	9/2297 (0.4%)

There are no bond length outliers.

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	124	GLY	N-CA-C	11.39	123.66	112.04
1	A	206	LEU	CA-C-O	10.93	153.79	121.00
1	A	114	SER	N-CA-C	-7.16	104.12	112.92
1	A	125	GLY	N-CA-C	-5.73	99.61	113.18
1	A	82	ARG	N-CA-C	-5.37	105.42	112.72
1	A	90	ASN	N-CA-C	-5.31	106.83	113.15
1	A	77	ASN	N-CA-C	5.29	117.87	109.24
1	A	123	ILE	CA-C-N	-5.04	114.73	122.69
1	A	123	ILE	C-N-CA	-5.04	114.73	122.69

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	1661	0	1667	68	0
2	A	28	0	17	3	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	48	0	25	10	0
4	A	33	0	0	3	0
All	All	1770	0	1709	71	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 21.

All (71) 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:142:MET:HE1	1:A:201:MET:SD	2.14	0.87
1:A:150:ILE:HD11	1:A:195:PHE:HE2	1.39	0.86
1:A:125:GLY:HA3	3:A:207:NDP:O1A	1.83	0.79
3:A:207:NDP:H8A	3:A:207:NDP:H52A	1.68	0.75
1:A:65:ILE:HB	1:A:70:ARG:HD3	1.68	0.75
1:A:21:ARG:HG2	1:A:21:ARG:HH11	1.51	0.73
1:A:124:GLY:HA2	1:A:129:TYR:CZ	2.24	0.70
1:A:186:PRO:HB2	1:A:190:ILE:HD11	1.74	0.69
1:A:51:SER:OG	1:A:118:ASN:HB2	1.94	0.68
1:A:60:LYS:HD2	3:A:207:NDP:O2N	1.94	0.68
1:A:191:ASN:HA	1:A:195:PHE:O	1.95	0.67
1:A:139:ASP:HB3	1:A:206:LEU:HD11	1.77	0.65
1:A:99:ASP:OD2	1:A:135:HIS:HE1	1.80	0.64
1:A:78:VAL:HG22	1:A:93:HIS:HB2	1.82	0.62
1:A:107:ARG:HH11	1:A:107:ARG:HG2	1.65	0.61
1:A:52:MET:HE2	1:A:76:ILE:HG13	1.85	0.59
1:A:4:GLN:HA	1:A:106:TYR:OH	2.03	0.59
1:A:26:PRO:HG2	1:A:27:TRP:CE3	2.37	0.59
1:A:153:ASP:OD2	1:A:154:VAL:HG23	2.02	0.59
1:A:172:GLU:HG3	1:A:201:MET:HE3	1.85	0.58
1:A:140:ARG:CD	1:A:142:MET:HE3	2.34	0.58
1:A:56:LEU:HD23	1:A:98:LEU:CD2	2.35	0.56
1:A:21:ARG:HG2	1:A:21:ARG:NH1	2.20	0.56
1:A:174:HIS:HD2	1:A:177:LEU:HD23	1.71	0.56
1:A:19:ILE:O	3:A:207:NDP:H2N	2.06	0.55
1:A:181:VAL:HG12	1:A:181:VAL:O	2.05	0.55
1:A:174:HIS:NE2	1:A:185:VAL:HG23	2.22	0.55
1:A:125:GLY:HA3	3:A:207:NDP:PA	2.46	0.54
1:A:52:MET:HE2	1:A:76:ILE:CG1	2.37	0.54
2:A:653:PMD:H2'1	3:A:207:NDP:O2D	2.07	0.54
1:A:20:GLY:O	1:A:152:CYS:HB3	2.10	0.52

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:124:GLY:HA2	1:A:129:TYR:CE1	2.44	0.52
1:A:145:ILE:O	1:A:197:TYR:HA	2.09	0.52
1:A:77:ASN:N	1:A:77:ASN:HD22	2.09	0.51
1:A:31:LYS:HB3	1:A:197:TYR:OH	2.10	0.51
1:A:146:ILE:HD12	1:A:146:ILE:N	2.26	0.51
1:A:59:ARG:NH2	3:A:207:NDP:O3X	2.44	0.49
1:A:142:MET:HE1	1:A:201:MET:CG	2.41	0.49
1:A:159:LYS:HD3	1:A:162:ASP:OD2	2.13	0.49
1:A:38:ARG:HB3	4:A:671:HOH:O	2.12	0.48
1:A:174:HIS:CD2	1:A:177:LEU:HD23	2.49	0.47
1:A:35:TYR:O	1:A:39:VAL:HG23	2.15	0.47
1:A:96:LYS:O	3:A:207:NDP:H2A	2.16	0.46
1:A:84:GLU:OE2	1:A:96:LYS:HD3	2.16	0.46
2:A:653:PMD:N5'	3:A:207:NDP:H42N	2.30	0.46
1:A:89:GLY:HA3	1:A:92:ILE:HG12	1.98	0.46
1:A:17:TYR:OH	1:A:161:ARG:HB2	2.16	0.46
1:A:107:ARG:HG2	1:A:107:ARG:NH1	2.31	0.45
1:A:7:LEU:O	1:A:138:LEU:HD23	2.17	0.45
1:A:13:LEU:HB3	1:A:19:ILE:HG22	1.99	0.45
1:A:43:VAL:O	1:A:43:VAL:HG23	2.17	0.45
1:A:174:HIS:CE1	1:A:185:VAL:O	2.69	0.44
1:A:89:GLY:C	1:A:91:GLY:H	2.25	0.44
1:A:69:PHE:CD2	2:A:653:PMD:H8'1	2.52	0.44
1:A:25:LEU:C	1:A:27:TRP:H	2.26	0.43
1:A:68:GLN:HE21	1:A:68:GLN:HB2	1.67	0.43
1:A:142:MET:CE	1:A:201:MET:HG3	2.47	0.43
1:A:126:ALA:HB3	3:A:207:NDP:O1N	2.19	0.43
1:A:174:HIS:HE1	1:A:185:VAL:O	2.02	0.43
1:A:186:PRO:HG3	4:A:670:HOH:O	2.19	0.43
1:A:104:LEU:HD22	1:A:107:ARG:HH22	1.84	0.42
1:A:150:ILE:HG22	1:A:151:HIS:N	2.34	0.42
1:A:98:LEU:HD23	1:A:98:LEU:HA	1.87	0.42
1:A:135:HIS:CD2	1:A:137:LYS:HG2	2.54	0.42
1:A:79:VAL:O	1:A:94:SER:HA	2.21	0.41
1:A:135:HIS:HD2	1:A:137:LYS:HB2	1.85	0.41
1:A:177:LEU:HD13	1:A:201:MET:HB2	2.01	0.41
1:A:61:THR:O	1:A:65:ILE:HG13	2.21	0.40
1:A:4:GLN:HB2	1:A:137:LYS:HE2	2.03	0.40
1:A:21:ARG:NH1	1:A:21:ARG:CG	2.83	0.40
1:A:111:SER:HA	4:A:677:HOH:O	2.20	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	201/206 (98%)	183 (91%)	18 (9%)	0	100	100

There are no Ramachandran outliers to report.

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	184/187 (98%)	169 (92%)	15 (8%)	10	14

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	GLN
1	A	13	LEU
1	A	45	THR
1	A	68	GLN
1	A	69	PHE
1	A	77	ASN
1	A	88	LEU
1	A	96	LYS
1	A	104	LEU
1	A	115	VAL
1	A	138	LEU
1	A	145	ILE
1	A	149	ASP

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	203	THR
1	A	205	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	23	ASN
1	A	68	GLN
1	A	77	ASN
1	A	116	GLN
1	A	118	ASN
1	A	127	GLN
1	A	135	HIS
1	A	174	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

2 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
3	NDP	A	207	-	51,52,52	1.67	9 (17%)	71,80,80	1.97	11 (15%)
2	PMD	A	653	-	32,32,32	2.64	17 (53%)	42,46,46	2.22	15 (35%)

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	NDP	A	207	-	-	8/34/77/77	0/5/5/5
2	PMD	A	653	-	-	1/4/17/17	0/5/5/5

All (26) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	653	PMD	C9B-N0'	5.01	1.55	1.47
3	A	207	NDP	C7N-C3N	5.01	1.59	1.48
2	A	653	PMD	C5'-C6'	4.58	1.54	1.46
2	A	653	PMD	C7'-C6	4.11	1.53	1.46
2	A	653	PMD	C7'-CC'	4.08	1.47	1.41
2	A	653	PMD	C9B-C6B	4.03	1.58	1.51
2	A	653	PMD	C1'-C0'	3.84	1.45	1.39
3	A	207	NDP	C4N-C3N	-3.82	1.42	1.50
2	A	653	PMD	CB'-CC'	3.70	1.45	1.39
3	A	207	NDP	C5A-N7A	-3.55	1.32	1.39
2	A	653	PMD	CC'-N0'	3.52	1.51	1.43
2	A	653	PMD	C5'-C0'	3.48	1.47	1.41
2	A	653	PMD	C6B-N5'	3.17	1.37	1.32
2	A	653	PMD	C7B-N8'	3.17	1.37	1.31
2	A	653	PMD	C7B-C6B	2.96	1.44	1.39
3	A	207	NDP	C2N-C3N	2.91	1.43	1.35
3	A	207	NDP	C6N-C5N	2.89	1.41	1.33
2	A	653	PMD	C4-C8	2.59	1.44	1.40
3	A	207	NDP	C1B-N9A	2.42	1.53	1.46
2	A	653	PMD	C4B-N3'	2.34	1.38	1.33
2	A	653	PMD	C9'-C8'	2.24	1.42	1.38
3	A	207	NDP	O4B-C1B	2.08	1.46	1.42
3	A	207	NDP	C4N-C5N	-2.08	1.43	1.49
2	A	653	PMD	C8'-C7'	2.07	1.44	1.41
3	A	207	NDP	C4A-N3A	2.03	1.38	1.34
2	A	653	PMD	CA'-C9'	2.01	1.42	1.38

All (26) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	207	NDP	C5A-C4A-N3A	-7.07	116.99	126.72
3	A	207	NDP	N3A-C4A-N9A	6.94	138.97	127.17
2	A	653	PMD	N1'-C2B-N3'	-5.82	119.82	127.21
2	A	653	PMD	C2B-N1'-C8	5.24	121.13	115.48
3	A	207	NDP	N3A-C2A-N1A	-4.51	121.75	128.58
2	A	653	PMD	N8'-C8-N1'	4.16	120.31	115.77
3	A	207	NDP	C2A-N3A-C4A	3.96	121.51	111.83
3	A	207	NDP	O2B-C2B-C3B	3.81	125.33	111.68
3	A	207	NDP	O2B-C2B-C1B	3.72	123.14	110.05
2	A	653	PMD	C4B-C4-N5'	3.65	123.14	120.33
3	A	207	NDP	C6A-C5A-N7A	-3.57	125.20	132.09
3	A	207	NDP	C6A-C5A-C4A	3.48	121.93	117.18
3	A	207	NDP	O4B-C4B-C5B	-3.36	98.56	109.33
2	A	653	PMD	CC'-C7'-C6	3.35	126.11	122.98
2	A	653	PMD	C0'-C5'-C6'	3.31	126.08	122.98
2	A	653	PMD	C5'-C0'-N0'	3.21	120.64	118.79
2	A	653	PMD	C9B-C6B-N5'	3.10	122.13	117.09
2	A	653	PMD	C7'-CC'-N0'	2.97	120.50	118.79
3	A	207	NDP	O4B-C1B-C2B	-2.88	101.63	106.59
2	A	653	PMD	C7B-N8'-C8	2.77	121.06	117.20
2	A	653	PMD	C7B-C6B-N5'	-2.74	119.09	120.87
2	A	653	PMD	C6B-C7B-N8'	-2.69	120.56	123.14
3	A	207	NDP	O4D-C1D-N1N	2.48	112.81	108.08
2	A	653	PMD	C8-C4-N5'	-2.43	119.63	122.35
2	A	653	PMD	N2'-C2B-N3'	2.34	120.72	117.22
2	A	653	PMD	C2B-N3'-C4B	2.06	122.60	116.72

There are no chirality outliers.

All (9) torsion outliers are listed below:

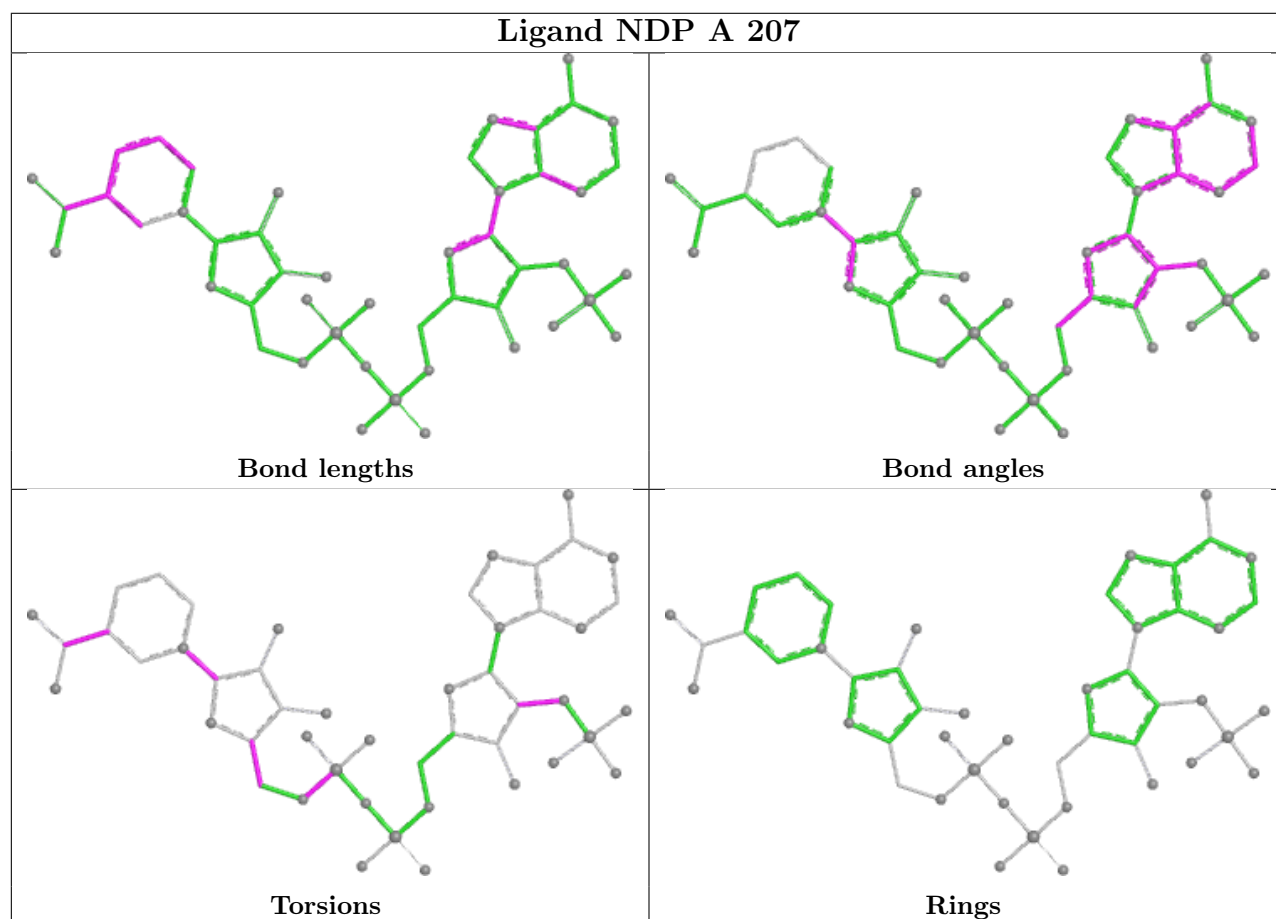
Mol	Chain	Res	Type	Atoms
3	A	207	NDP	C3B-C2B-O2B-P2B
3	A	207	NDP	C5D-O5D-PN-O3
3	A	207	NDP	C5D-O5D-PN-O1N
3	A	207	NDP	C5D-O5D-PN-O2N
3	A	207	NDP	C3D-C4D-C5D-O5D
3	A	207	NDP	O4D-C4D-C5D-O5D
3	A	207	NDP	O4D-C1D-N1N-C2N
2	A	653	PMD	C6B-C9B-N0'-C0'
3	A	207	NDP	C2N-C3N-C7N-O7N

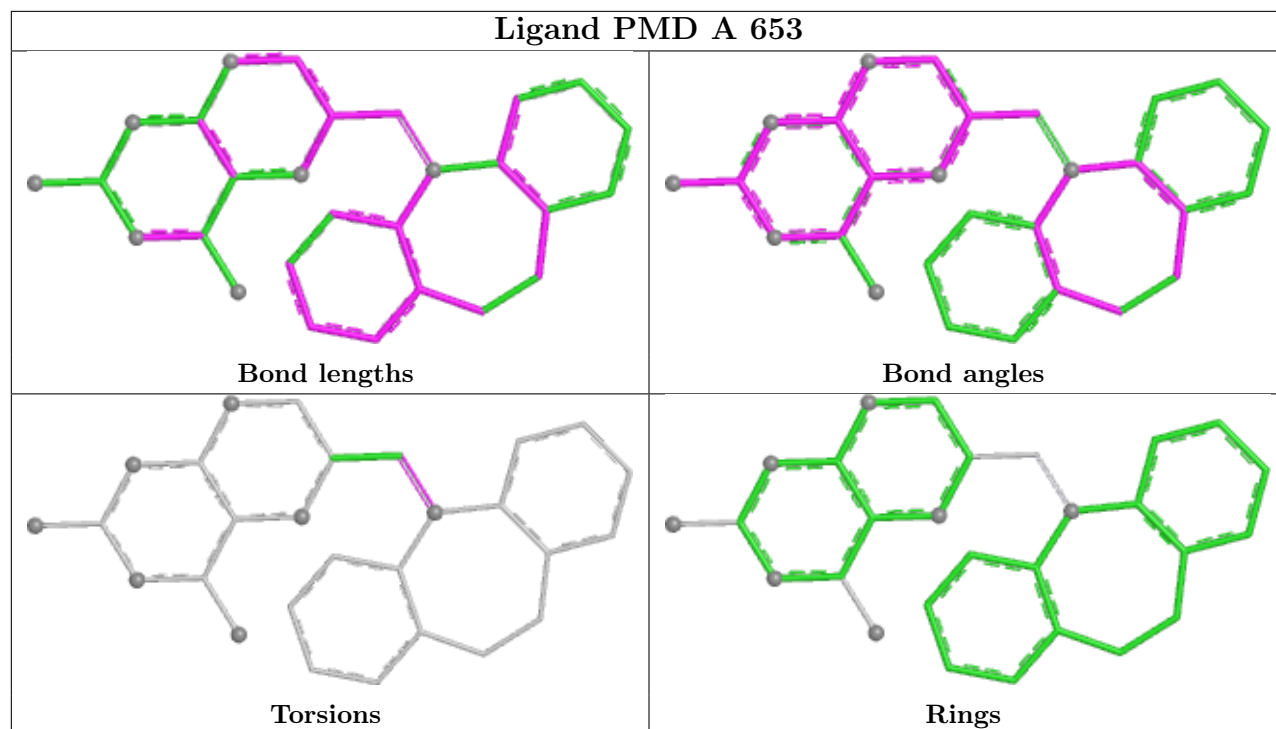
There are no ring outliers.

2 monomers are involved in 11 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	207	NDP	10	0
2	A	653	PMD	3	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 [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.