



## Full wwPDB EM Validation Report ⓘ

Jul 7, 2025 – 07:11 PM JST

PDB ID : 8Z90 / pdb\_00008z90  
EMDB ID : EMD-39852  
Title : Cryo-EM structure of Thogoto virus polymerase in transcription initiation conformation 2  
Authors : Xue, L.; Chang, T.; Li, Z.; Zhao, H.; Li, M.; He, J.; Chen, X.; Xiong, X.  
Deposited on : 2024-04-22  
Resolution : 2.87 Å(reported)

This is a Full wwPDB EM Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/EMValidationReportHelp>

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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

EMDB validation analysis : **FAILED**  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
MolProbity : 4-5-2 with Phenix2.0rc1  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
MapQ : **FAILED**  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.44

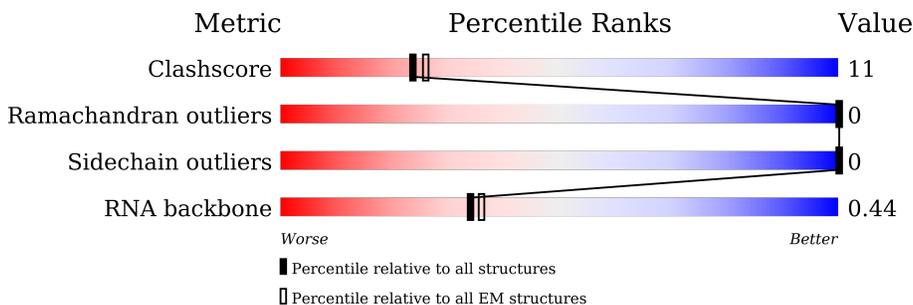
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 2.87 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	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415
RNA backbone	6643	2191

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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  $\leq 5\%$ .

Mol	Chain	Length	Quality of chain
1	A	622	74% (Green) 26% (Yellow)
2	B	710	71% (Green) 29% (Yellow)
3	C	827	23% (Green) 6% (Yellow) 70% (Grey)
4	D	18	50% (Green) 50% (Yellow)
5	E	17	12% (Green) 59% (Yellow) 29% (Orange)

## 2 Entry composition i

There are 6 unique types of molecules in this entry. The entry contains 13481 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 Polymerase acidic protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	620	5014	3168	873	945	28	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	471	GLU	GLY	conflict	UNP P27194

- Molecule 2 is a protein called RNA-directed RNA polymerase catalytic subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	B	710	5710	3624	991	1059	36	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	7	LEU	ARG	conflict	UNP O41353
B	230	TRP	CYS	conflict	UNP O41353

- Molecule 3 is a protein called Polymerase basic protein 2.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	C	245	1986	1266	346	361	13	0	0

There are 58 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	770	LEU	-	expression tag	UNP Q9YNA4
C	771	GLU	-	expression tag	UNP Q9YNA4
C	772	VAL	-	expression tag	UNP Q9YNA4

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Chain	Residue	Modelled	Actual	Comment	Reference
C	773	LEU	-	expression tag	UNP Q9YNA4
C	774	PHE	-	expression tag	UNP Q9YNA4
C	775	GLN	-	expression tag	UNP Q9YNA4
C	776	GLY	-	expression tag	UNP Q9YNA4
C	777	PRO	-	expression tag	UNP Q9YNA4
C	778	GLY	-	expression tag	UNP Q9YNA4
C	779	HIS	-	expression tag	UNP Q9YNA4
C	780	HIS	-	expression tag	UNP Q9YNA4
C	781	HIS	-	expression tag	UNP Q9YNA4
C	782	HIS	-	expression tag	UNP Q9YNA4
C	783	HIS	-	expression tag	UNP Q9YNA4
C	784	HIS	-	expression tag	UNP Q9YNA4
C	785	HIS	-	expression tag	UNP Q9YNA4
C	786	HIS	-	expression tag	UNP Q9YNA4
C	787	SER	-	expression tag	UNP Q9YNA4
C	788	ALA	-	expression tag	UNP Q9YNA4
C	789	ASP	-	expression tag	UNP Q9YNA4
C	790	TYR	-	expression tag	UNP Q9YNA4
C	791	LYS	-	expression tag	UNP Q9YNA4
C	792	ASP	-	expression tag	UNP Q9YNA4
C	793	ASP	-	expression tag	UNP Q9YNA4
C	794	ASP	-	expression tag	UNP Q9YNA4
C	795	ASP	-	expression tag	UNP Q9YNA4
C	796	LYS	-	expression tag	UNP Q9YNA4
C	797	GLY	-	expression tag	UNP Q9YNA4
C	798	GLY	-	expression tag	UNP Q9YNA4
C	799	TRP	-	expression tag	UNP Q9YNA4
C	800	SER	-	expression tag	UNP Q9YNA4
C	801	HIS	-	expression tag	UNP Q9YNA4
C	802	PRO	-	expression tag	UNP Q9YNA4
C	803	GLN	-	expression tag	UNP Q9YNA4
C	804	PHE	-	expression tag	UNP Q9YNA4
C	805	GLU	-	expression tag	UNP Q9YNA4
C	806	LYS	-	expression tag	UNP Q9YNA4
C	807	GLY	-	expression tag	UNP Q9YNA4
C	808	GLY	-	expression tag	UNP Q9YNA4
C	809	GLY	-	expression tag	UNP Q9YNA4
C	810	SER	-	expression tag	UNP Q9YNA4
C	811	GLY	-	expression tag	UNP Q9YNA4
C	812	GLY	-	expression tag	UNP Q9YNA4
C	813	GLY	-	expression tag	UNP Q9YNA4
C	814	GLY	-	expression tag	UNP Q9YNA4

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Chain	Residue	Modelled	Actual	Comment	Reference
C	815	SER	-	expression tag	UNP Q9YNA4
C	816	GLY	-	expression tag	UNP Q9YNA4
C	817	GLY	-	expression tag	UNP Q9YNA4
C	818	SER	-	expression tag	UNP Q9YNA4
C	819	ALA	-	expression tag	UNP Q9YNA4
C	820	TRP	-	expression tag	UNP Q9YNA4
C	821	SER	-	expression tag	UNP Q9YNA4
C	822	HIS	-	expression tag	UNP Q9YNA4
C	823	PRO	-	expression tag	UNP Q9YNA4
C	824	GLN	-	expression tag	UNP Q9YNA4
C	825	PHE	-	expression tag	UNP Q9YNA4
C	826	GLU	-	expression tag	UNP Q9YNA4
C	827	LYS	-	expression tag	UNP Q9YNA4

- Molecule 4 is a RNA chain called RNA (5'-R(\*AP\*GP\*AP\*GP\*AP\*AP\*AP\*UP\*CP\*AP\*AP\*GP\*GP\*CP\*AP\*GP\*UP\*U)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
4	D	18	388	175	77	119	17	0	0

- Molecule 5 is a RNA chain called RNA (5'-R(\*GP\*AP\*CP\*UP\*GP\*CP\*CP\*UP\*GP\*UP\*UP\*UP\*UP\*GP\*CP\*U)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
5	E	17	351	158	53	124	16	0	0

- Molecule 6 is PHOSPHOMETHYLPHOSPHONIC ACID GUANYLATE ESTER (CCD ID: G2P) (formula: C<sub>11</sub>H<sub>18</sub>N<sub>5</sub>O<sub>13</sub>P<sub>3</sub>) (labeled as "Ligand of Interest" by depositor).







G1	A2	C3	D4	G5	C6	C7	U8	G9	U10	U11	U12	U13	U14	G15	C16	U17
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## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	132762	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ( $e^-/\text{\AA}^2$ )	50	Depositor
Minimum defocus (nm)	600	Depositor
Maximum defocus (nm)	2400	Depositor
Magnification	Not provided	
Image detector	TFS FALCON 4i (4k x 4k)	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: 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  >5	RMSZ	# Z  >5
1	A	0.14	0/5129	0.41	0/6957
2	B	0.15	0/5829	0.41	0/7876
3	C	0.15	0/2036	0.42	0/2759
4	D	0.09	0/436	0.26	0/679
5	E	0.13	0/389	0.36	0/603
All	All	0.14	0/13819	0.40	0/18874

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

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	5014	0	4953	120	0
2	B	5710	0	5757	152	0
3	C	1986	0	2003	40	0
4	D	388	0	197	8	0
5	E	351	0	181	9	0
6	B	32	0	14	3	0
All	All	13481	0	13105	284	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 11.

All (284) 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)
2:B:701:ARG:HH22	2:B:704:ARG:HD3	1.49	0.77
2:B:422:ASP:HB3	6:B:801:G2P:H4'	1.70	0.73
1:A:406:ARG:HH22	1:A:408:ARG:HE	1.38	0.71
1:A:183:LEU:HB3	2:B:340:MET:HE2	1.73	0.70
1:A:41:ILE:HD11	1:A:145:LEU:HD21	1.74	0.70
1:A:531:LEU:HD12	1:A:536:ARG:HB2	1.74	0.69
2:B:626:VAL:HG11	3:C:123:LEU:HD23	1.75	0.68
2:B:302:GLN:NE2	2:B:452:ILE:HG22	2.10	0.67
2:B:447:LEU:HB3	2:B:452:ILE:HB	1.77	0.67
4:D:14:C:H2'	4:D:15:A:H8	1.60	0.66
2:B:599:ASN:OD1	3:C:107:TRP:NE1	2.29	0.66
2:B:308:CYS:SG	2:B:453:ASN:ND2	2.69	0.64
1:A:46:SER:HB3	1:A:57:TYR:HB2	1.79	0.64
2:B:147:GLU:HG3	2:B:154:ILE:HG12	1.79	0.64
2:B:190:GLU:OE2	2:B:202:ARG:NH1	2.30	0.64
1:A:318:SER:OG	1:A:320:GLU:OE1	2.14	0.63
2:B:663:ASN:O	3:C:209:GLN:NE2	2.33	0.62
1:A:406:ARG:NH2	1:A:408:ARG:HE	1.97	0.62
2:B:538:MET:HB2	2:B:545:ARG:HD3	1.81	0.62
1:A:586:PHE:HE1	2:B:463:SER:HB2	1.65	0.61
2:B:253:PHE:HB3	2:B:338:PRO:HG3	1.82	0.61
1:A:292:SER:HA	1:A:408:ARG:HD2	1.82	0.61
2:B:144:GLU:OE1	3:C:33:LYS:NZ	2.33	0.61
3:C:48:LYS:O	5:E:10:U:N3	2.30	0.61
3:C:100:ASN:OD1	3:C:101:ILE:N	2.33	0.61
5:E:7:C:H2'	5:E:8:U:C6	2.35	0.61
1:A:451:MET:HE3	1:A:477:SER:HB3	1.81	0.61
2:B:237:ARG:NH1	2:B:239:ASN:O	2.35	0.60
2:B:262:LYS:O	2:B:266:GLU:HG3	2.01	0.60
2:B:608:SER:HB3	2:B:620:ILE:HD11	1.84	0.60
3:C:229:THR:OG1	3:C:231:VAL:O	2.19	0.60
1:A:364:VAL:HG22	3:C:141:ILE:HD11	1.84	0.60
2:B:701:ARG:NH2	2:B:704:ARG:HD3	2.15	0.60
4:D:14:C:H2'	4:D:15:A:C8	2.37	0.60
1:A:429:VAL:HG13	1:A:447:ILE:HG12	1.82	0.60
1:A:129:CYS:HA	1:A:132:VAL:HG12	1.85	0.59
1:A:135:GLY:O	1:A:139:GLN:NE2	2.35	0.59
2:B:87:LEU:HD13	2:B:407:SER:HA	1.85	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:313:ALA:HB1	2:B:360:LEU:HB3	1.84	0.58
1:A:501:PRO:HG3	1:A:547:ILE:HG22	1.86	0.58
1:A:104:LEU:HB2	1:A:120:ASN:HB3	1.85	0.57
2:B:506:ASN:ND2	2:B:622:GLU:O	2.37	0.57
3:C:93:GLU:HB3	3:C:96:ARG:HB3	1.85	0.57
2:B:306:ASN:OD1	6:B:801:G2P:O2'	2.11	0.57
2:B:685:LYS:O	2:B:689:GLU:HG3	2.04	0.57
2:B:298:LEU:HD12	2:B:461:LEU:HD12	1.85	0.57
3:C:171:LEU:HD12	3:C:175:PHE:HE2	1.69	0.57
1:A:558:ASN:ND2	2:B:25:PRO:O	2.35	0.57
2:B:196:GLU:O	2:B:198:ASP:N	2.38	0.56
1:A:399:PHE:HE1	1:A:485:ARG:HG2	1.70	0.56
2:B:658:VAL:HG21	3:C:30:GLU:HB3	1.87	0.56
1:A:45:ILE:O	1:A:137:GLN:NE2	2.39	0.56
1:A:264:ARG:NH1	1:A:456:GLU:OE1	2.39	0.56
2:B:625:SER:HG	2:B:631:LYS:HZ1	1.53	0.55
4:D:15:A:H2'	4:D:16:G:C8	2.41	0.55
2:B:402:LEU:O	2:B:406:ILE:HG23	2.06	0.55
2:B:530:ASN:ND2	2:B:565:PRO:HB3	2.22	0.55
2:B:376:LEU:HB3	2:B:385:ILE:HD11	1.87	0.55
2:B:666:PHE:HE1	2:B:684:LEU:HD23	1.71	0.55
1:A:9:ASP:OD1	1:A:10:SER:N	2.40	0.55
1:A:333:LEU:HD12	1:A:334:PRO:HD2	1.88	0.55
2:B:224:ARG:HD2	2:B:344:SER:O	2.07	0.54
1:A:50:THR:HA	1:A:55:PRO:HA	1.90	0.54
1:A:269:THR:HG21	1:A:479:LYS:HA	1.89	0.54
1:A:120:ASN:ND2	1:A:124:GLU:HB2	2.23	0.54
2:B:32:THR:HG22	2:B:351:GLU:HG2	1.90	0.54
2:B:432:THR:HG23	2:B:435:GLU:H	1.73	0.54
2:B:463:SER:HB3	2:B:464:PRO:HD3	1.89	0.54
1:A:137:GLN:O	1:A:141:ILE:HG12	2.08	0.54
2:B:79:PHE:CG	2:B:313:ALA:HB2	2.43	0.54
1:A:86:ASP:HB3	1:A:97:LYS:HA	1.90	0.53
3:C:157:PRO:HG3	3:C:236:ARG:HA	1.89	0.53
2:B:34:THR:HG23	2:B:353:LEU:HD23	1.90	0.53
2:B:221:ASP:OD1	2:B:224:ARG:NH2	2.26	0.53
1:A:65:ARG:HD2	3:C:181:THR:HG22	1.90	0.53
1:A:596:LYS:HE2	2:B:457:SER:HB2	1.90	0.53
1:A:9:ASP:HB3	1:A:12:VAL:HG22	1.91	0.53
1:A:489:TYR:HE1	2:B:491:VAL:HG11	1.73	0.53
1:A:527:ILE:HD12	1:A:540:LEU:HB2	1.90	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:268:SER:O	4:D:1:A:O2'	2.26	0.52
2:B:617:MET:HE3	2:B:618:PRO:HD2	1.90	0.52
2:B:48:PHE:O	2:B:65:LYS:NZ	2.42	0.52
2:B:315:ARG:HD3	2:B:339:PHE:HB2	1.91	0.52
2:B:575:ASP:OD2	2:B:576:GLU:N	2.42	0.52
2:B:688:LEU:O	2:B:692:VAL:HG12	2.08	0.52
1:A:418:ASP:OD1	1:A:422:ASN:N	2.42	0.52
2:B:404:ALA:O	2:B:408:ILE:HG12	2.10	0.52
1:A:127:GLU:O	1:A:131:LEU:HG	2.10	0.52
2:B:548:PHE:O	2:B:552:ASN:ND2	2.33	0.52
1:A:485:ARG:HH12	3:C:55:MET:HE3	1.74	0.52
2:B:404:ALA:O	2:B:407:SER:OG	2.21	0.52
1:A:560:PRO:HB3	2:B:240:ARG:HH12	1.75	0.51
1:A:23:ILE:HG23	1:A:24:THR:HG23	1.92	0.51
1:A:64:ASP:OD2	1:A:66:SER:OG	2.27	0.51
3:C:127:ASP:OD2	3:C:131:GLN:NE2	2.43	0.51
1:A:147:ARG:O	1:A:150:GLU:HG3	2.10	0.51
1:A:101:VAL:HG22	1:A:102:SER:H	1.76	0.51
1:A:577:HIS:CD2	2:B:12:PRO:HD2	2.46	0.51
1:A:389:GLU:O	1:A:393:ILE:HD12	2.10	0.51
1:A:487:LYS:HA	1:A:490:THR:HG22	1.92	0.51
1:A:562:MET:HE1	1:A:606:ILE:HB	1.92	0.51
2:B:76:SER:O	2:B:453:ASN:ND2	2.35	0.50
2:B:232:HIS:O	2:B:615:ASN:ND2	2.44	0.50
2:B:443:LEU:O	2:B:447:LEU:HG	2.10	0.50
1:A:21:ASP:OD2	1:A:24:THR:OG1	2.16	0.50
1:A:116:ASP:OD1	1:A:117:LEU:N	2.45	0.50
1:A:583:ARG:HD3	2:B:464:PRO:HB2	1.93	0.50
2:B:39:GLU:O	2:B:43:ARG:HG3	2.12	0.50
2:B:587:ASP:OD1	2:B:588:GLU:N	2.43	0.50
3:C:85:LYS:HA	3:C:99:ALA:HA	1.94	0.50
1:A:212:MET:HE3	1:A:587:LEU:HD11	1.94	0.50
1:A:406:ARG:HH11	1:A:407:SER:H	1.60	0.50
1:A:119:PHE:CE1	1:A:141:ILE:HG21	2.47	0.49
1:A:491:PHE:HD1	1:A:494:ILE:HD13	1.77	0.49
2:B:586:LEU:HB3	2:B:591:LEU:HG	1.94	0.49
2:B:351:GLU:N	2:B:351:GLU:OE1	2.45	0.49
2:B:444:ARG:O	2:B:448:LYS:HG3	2.11	0.49
2:B:593:ARG:HD3	3:C:111:GLY:H	1.77	0.49
2:B:102:LEU:O	2:B:106:ILE:HG12	2.12	0.49
1:A:180:ARG:HG2	1:A:184:LYS:HE2	1.95	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:577:HIS:HD1	2:B:13:THR:HG1	1.61	0.49
5:E:7:C:H2'	5:E:8:U:H6	1.78	0.49
1:A:264:ARG:HD2	1:A:456:GLU:OE1	2.13	0.48
2:B:220:TRP:O	2:B:224:ARG:HG3	2.13	0.48
1:A:321:TRP:CE2	2:B:357:LYS:HE2	2.48	0.48
2:B:34:THR:HG21	2:B:352:GLY:C	2.39	0.48
1:A:160:GLU:O	1:A:164:THR:HG23	2.13	0.48
2:B:538:MET:HE3	3:C:62:ARG:HG2	1.95	0.48
2:B:612:ARG:HH21	2:B:618:PRO:HG3	1.79	0.48
1:A:489:TYR:CE1	2:B:491:VAL:HG11	2.49	0.48
1:A:525:PRO:HD2	1:A:540:LEU:HD23	1.96	0.48
3:C:246:SER:OG	3:C:249:HIS:ND1	2.46	0.47
5:E:1:G:H5'	5:E:2:A:C8	2.49	0.47
1:A:512:ARG:NH2	1:A:525:PRO:HB3	2.29	0.47
2:B:587:ASP:CG	2:B:588:GLU:H	2.21	0.47
1:A:242:CYS:HB2	1:A:423:CYS:HB2	1.96	0.47
2:B:653:GLU:HB2	3:C:94:SER:HB3	1.96	0.47
1:A:235:ALA:HB2	1:A:344:LEU:HG	1.97	0.47
2:B:22:TYR:CD1	2:B:235:ARG:HD3	2.50	0.47
2:B:661:ILE:HD13	3:C:19:GLU:HG2	1.97	0.47
1:A:559:ASN:ND2	1:A:604:ASN:HD22	2.13	0.47
1:A:162:VAL:HA	1:A:165:ILE:HG12	1.97	0.47
2:B:42:ILE:HB	2:B:376:LEU:HD11	1.96	0.47
2:B:450:VAL:HG23	2:B:452:ILE:HG12	1.96	0.47
2:B:493:ASN:O	3:C:57:LEU:HD22	2.15	0.47
2:B:547:ARG:O	2:B:550:GLU:N	2.48	0.46
1:A:201:VAL:HG23	2:B:86:LYS:HG2	1.96	0.46
1:A:104:LEU:HD13	1:A:120:ASN:HB3	1.98	0.46
1:A:232:LEU:HB2	1:A:391:TRP:CE2	2.50	0.46
2:B:115:TYR:HA	2:B:158:LEU:HD13	1.97	0.46
2:B:309:LEU:HD21	2:B:452:ILE:HD13	1.96	0.46
4:D:7:A:O2'	4:D:8:U:OP2	2.29	0.46
1:A:613:GLY:HA3	2:B:1:MET:H3	1.79	0.46
2:B:322:LEU:HD13	2:B:331:ILE:HG22	1.96	0.46
3:C:183:ASP:O	3:C:187:LYS:HG2	2.16	0.46
2:B:364:LYS:HD2	2:B:369:MET:HE1	1.97	0.46
3:C:124:TYR:CE2	3:C:219:LEU:HD21	2.51	0.46
2:B:254:VAL:HG13	2:B:396:TYR:CE1	2.50	0.45
1:A:345:ARG:HD3	1:A:546:MET:HG2	1.98	0.45
2:B:127:PHE:HB2	2:B:222:GLN:HB3	1.97	0.45
1:A:41:ILE:O	1:A:45:ILE:HG13	2.17	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:700:GLU:HG2	2:B:703:LYS:HZ3	1.82	0.45
1:A:504:ILE:HG13	2:B:18:LEU:HD11	1.99	0.45
2:B:321:PHE:O	2:B:325:LEU:HG	2.17	0.45
2:B:493:ASN:HA	3:C:54:GLN:HG3	1.98	0.45
3:C:240:MET:O	3:C:244:LEU:HG	2.16	0.45
1:A:17:GLU:OE1	1:A:32:ARG:NH2	2.50	0.45
1:A:264:ARG:NE	1:A:454:ASP:OD2	2.42	0.45
2:B:44:PRO:HB3	2:B:307:GLU:O	2.16	0.45
1:A:510:LEU:HB3	3:C:248:TYR:CG	2.52	0.45
1:A:430:LEU:HD12	1:A:446:LEU:HD23	1.99	0.44
2:B:202:ARG:HB3	3:C:89:LEU:HD12	2.00	0.44
1:A:439:ASP:HB2	1:A:486:ASN:ND2	2.32	0.44
1:A:539:THR:O	1:A:540:LEU:HB3	2.17	0.44
1:A:596:LYS:HE3	2:B:458:LYS:HG3	1.99	0.44
4:D:15:A:H2'	4:D:16:G:H8	1.82	0.44
2:B:11:ASN:O	2:B:14:THR:OG1	2.31	0.44
2:B:210:TYR:CE2	2:B:212:ILE:HD11	2.53	0.44
2:B:241:ARG:HH12	6:B:801:G2P:H5'1	1.82	0.44
1:A:406:ARG:HH12	1:A:408:ARG:HG3	1.81	0.44
1:A:485:ARG:NH1	1:A:486:ASN:OD1	2.51	0.44
2:B:122:ARG:HD3	5:E:16:C:OP2	2.17	0.44
2:B:337:ILE:O	2:B:341:VAL:HG23	2.17	0.44
3:C:52:ALA:HB1	3:C:55:MET:HE2	2.00	0.44
2:B:102:LEU:HD22	2:B:264:ILE:HD11	1.99	0.44
1:A:260:ILE:HG21	1:A:274:ILE:HG12	2.00	0.44
2:B:148:GLN:NE2	2:B:176:TYR:O	2.47	0.44
1:A:4:ARG:HG3	1:A:13:TRP:CG	2.53	0.44
1:A:612:LYS:HE3	1:A:612:LYS:HB2	1.84	0.44
2:B:17:GLU:HG2	2:B:482:ASN:HA	1.99	0.44
4:D:16:G:H2'	4:D:17:U:C6	2.53	0.44
1:A:358:ASN:HB2	1:A:369:GLU:OE2	2.18	0.43
1:A:442:ASN:HB3	1:A:482:SER:HB3	2.00	0.43
2:B:700:GLU:HA	2:B:703:LYS:NZ	2.33	0.43
1:A:491:PHE:CD1	1:A:494:ILE:HD13	2.54	0.43
2:B:362:ASP:OD1	2:B:363:ARG:N	2.51	0.43
2:B:494:GLY:HA2	3:C:57:LEU:HD13	2.00	0.43
2:B:650:ASN:O	2:B:653:GLU:HG2	2.18	0.43
1:A:489:TYR:CE2	3:C:55:MET:HG2	2.53	0.43
2:B:261:ALA:HB2	2:B:399:THR:HG22	1.99	0.43
1:A:298:ILE:H	1:A:298:ILE:HD12	1.84	0.43
2:B:92:PHE:CD2	2:B:99:MET:HG3	2.54	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:382:THR:HG22	1:A:384:VAL:HG12	2.00	0.43
2:B:223:MET:HE2	2:B:341:VAL:HG21	2.00	0.43
2:B:263:GLU:O	2:B:267:ASN:ND2	2.52	0.43
2:B:482:ASN:H	2:B:516:GLN:HG2	1.84	0.43
1:A:107:HIS:ND1	1:A:109:PRO:HD3	2.33	0.43
1:A:158:THR:HA	1:A:161:VAL:HG22	2.01	0.43
1:A:253:TRP:NE1	1:A:257:GLN:OE1	2.52	0.43
2:B:91:PHE:CG	2:B:406:ILE:HG22	2.54	0.43
3:C:217:ARG:HA	3:C:220:ILE:HG22	2.00	0.43
1:A:72:CYS:HB3	1:A:77:VAL:O	2.19	0.43
2:B:246:PRO:HD3	2:B:393:MET:HE1	2.01	0.43
2:B:530:ASN:HD21	2:B:565:PRO:HB3	1.83	0.43
2:B:686:ARG:NH1	2:B:689:GLU:OE2	2.52	0.43
2:B:92:PHE:CD1	2:B:324:LYS:HD3	2.54	0.43
1:A:41:ILE:HG12	1:A:141:ILE:HG23	2.00	0.42
2:B:180:ARG:HB3	2:B:210:TYR:CE1	2.54	0.42
1:A:47:ASN:O	1:A:49:HIS:HD2	2.02	0.42
1:A:404:THR:HG22	5:E:9:G:O2'	2.19	0.42
2:B:41:ILE:HD11	2:B:347:ALA:HB3	2.01	0.42
2:B:508:ILE:HG22	2:B:572:MET:HE1	2.00	0.42
1:A:524:ASN:OD1	1:A:539:THR:HB	2.19	0.42
2:B:538:MET:HE2	2:B:543:THR:OG1	2.20	0.42
1:A:21:ASP:OD1	2:B:160:SER:OG	2.27	0.42
1:A:504:ILE:O	1:A:508:VAL:HG23	2.19	0.42
2:B:148:GLN:HE22	2:B:176:TYR:C	2.27	0.42
2:B:393:MET:HE3	2:B:395:MET:HB2	2.01	0.42
2:B:662:ILE:O	2:B:663:ASN:HB2	2.18	0.42
3:C:171:LEU:HD21	3:C:220:ILE:HG21	2.01	0.42
2:B:175:THR:HG22	2:B:213:LYS:HD2	2.02	0.42
2:B:496:ASN:HB3	2:B:632:TYR:O	2.19	0.42
3:C:99:ALA:HB1	3:C:103:VAL:HG21	2.00	0.42
1:A:520:ASN:HB3	1:A:523:VAL:HG13	2.01	0.42
1:A:573:HIS:HE1	2:B:12:PRO:O	2.03	0.42
3:C:69:MET:HE3	3:C:99:ALA:HB2	2.00	0.42
3:C:182:LEU:HG	3:C:186:ARG:NH1	2.35	0.42
2:B:195:ASP:OD1	2:B:195:ASP:N	2.50	0.42
2:B:447:LEU:HD12	2:B:454:MET:HG3	2.02	0.42
1:A:375:TYR:O	1:A:379:VAL:HG22	2.20	0.42
1:A:399:PHE:CE2	3:C:58:VAL:HB	2.55	0.42
2:B:210:TYR:HE2	2:B:212:ILE:HD11	1.84	0.42
2:B:174:THR:OG1	2:B:214:PHE:HB2	2.20	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:56:GLN:OE1	1:A:134:ARG:NH2	2.53	0.41
1:A:512:ARG:HD3	1:A:515:GLU:OE2	2.20	0.41
2:B:467:ILE:HA	2:B:475:HIS:O	2.20	0.41
5:E:5:G:H2'	5:E:6:C:C6	2.55	0.41
1:A:232:LEU:HD13	1:A:390:LYS:HZ2	1.85	0.41
2:B:24:GLY:O	2:B:235:ARG:NH2	2.40	0.41
2:B:94:LYS:HE2	2:B:95:TYR:CE1	2.55	0.41
1:A:318:SER:O	2:B:357:LYS:HD3	2.21	0.41
1:A:334:PRO:HB2	1:A:336:TRP:CD1	2.55	0.41
1:A:387:VAL:HA	1:A:390:LYS:HG2	2.02	0.41
2:B:698:ASP:HB2	2:B:701:ARG:HG3	2.01	0.41
1:A:508:VAL:HG11	1:A:540:LEU:HD22	2.02	0.41
2:B:22:TYR:HB3	2:B:488:PRO:HD3	2.02	0.41
2:B:662:ILE:C	2:B:664:LYS:H	2.27	0.41
2:B:665:LEU:HD12	2:B:684:LEU:HD22	2.02	0.41
3:C:126:GLU:O	3:C:130:VAL:HG23	2.20	0.41
5:E:8:U:H2'	5:E:9:G:C4	2.56	0.41
1:A:229:ARG:HH12	1:A:461:LYS:HE3	1.85	0.41
1:A:500:GLN:HB2	1:A:501:PRO:HD3	2.02	0.41
2:B:50:LYS:HE3	2:B:50:LYS:HB2	1.82	0.41
1:A:132:VAL:HG13	1:A:133:LEU:HD12	2.02	0.41
1:A:229:ARG:NH2	4:D:4:G:N7	2.69	0.41
1:A:372:VAL:O	1:A:376:ILE:HG13	2.21	0.41
2:B:273:VAL:N	2:B:274:PRO:HD2	2.36	0.41
2:B:596:ASN:O	2:B:599:ASN:ND2	2.54	0.41
2:B:250:ILE:O	2:B:254:VAL:HG23	2.21	0.41
2:B:434:GLU:HG3	2:B:438:LYS:NZ	2.36	0.41
1:A:543:TRP:HH2	2:B:10:ILE:HD11	1.87	0.40
1:A:566:LEU:O	1:A:570:ARG:HG3	2.22	0.40
2:B:410:ARG:NH1	2:B:446:THR:OG1	2.53	0.40
2:B:113:LEU:O	2:B:158:LEU:N	2.33	0.40
2:B:201:PHE:HB2	3:C:88:ILE:HD13	2.03	0.40
2:B:337:ILE:HB	2:B:338:PRO:HD3	2.04	0.40
5:E:11:U:H5''	5:E:12:U:C5	2.56	0.40
2:B:102:LEU:HD23	2:B:325:LEU:HD11	2.03	0.40
2:B:139:LEU:O	2:B:143:VAL:HG23	2.21	0.40
3:C:68:SER:OG	3:C:96:ARG:HD2	2.21	0.40
1:A:462:HIS:NE2	1:A:479:LYS:HD2	2.37	0.40
1:A:521:LEU:HD23	1:A:521:LEU:HA	1.89	0.40
2:B:84:VAL:HG22	2:B:450:VAL:HG12	2.04	0.40
2:B:302:GLN:HE21	2:B:302:GLN:HB3	1.70	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 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	618/622 (99%)	589 (95%)	29 (5%)	0	100	100
2	B	708/710 (100%)	679 (96%)	29 (4%)	0	100	100
3	C	243/827 (29%)	241 (99%)	2 (1%)	0	100	100
All	All	1569/2159 (73%)	1509 (96%)	60 (4%)	0	100	100

There are no Ramachandran outliers to report.

#### 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 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	559/561 (100%)	559 (100%)	0	100	100
2	B	633/633 (100%)	633 (100%)	0	100	100
3	C	223/736 (30%)	223 (100%)	0	100	100
All	All	1415/1930 (73%)	1415 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	29	HIS
1	A	51	HIS
1	A	63	GLN
1	A	137	GLN
1	A	139	GLN
1	A	155	ASN
1	A	348	GLN
2	B	302	GLN
2	B	598	ASN
2	B	641	GLN
3	C	113	GLN
3	C	207	GLN

### 5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
4	D	17/18 (94%)	1 (5%)	0
5	E	16/17 (94%)	7 (43%)	3 (18%)
All	All	33/35 (94%)	8 (24%)	3 (9%)

All (8) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
4	D	11	A
5	E	3	C
5	E	4	U
5	E	8	U
5	E	9	G
5	E	12	U
5	E	14	U
5	E	15	G

All (3) RNA pucker outliers are listed below:

Mol	Chain	Res	Type
5	E	2	A
5	E	3	C
5	E	7	C

## 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](#)

1 ligand is 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
6	G2P	B	801	-	27,34,34	1.81	6 (22%)	33,54,54	2.31	7 (21%)

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	G2P	B	801	-	-	4/15/38/38	0/3/3/3

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	B	801	G2P	PA-O5'	5.80	1.66	1.57
6	B	801	G2P	C6-N1	4.25	1.40	1.33
6	B	801	G2P	PB-O3B	2.85	1.61	1.58
6	B	801	G2P	C8-N7	-2.57	1.30	1.34
6	B	801	G2P	PA-O1A	-2.25	1.51	1.56
6	B	801	G2P	PB-O1B	-2.18	1.51	1.56

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	B	801	G2P	C5-C6-N1	-9.10	110.98	123.43
6	B	801	G2P	C2-N1-C6	6.23	125.83	115.93
6	B	801	G2P	N3-C2-N1	-3.06	123.14	127.22
6	B	801	G2P	O1B-PB-O2B	2.25	117.58	110.07
6	B	801	G2P	O1A-PA-O2A	2.20	117.41	110.07
6	B	801	G2P	C4-C5-C6	-2.18	118.72	120.80
6	B	801	G2P	O3G-PG-O1G	2.11	115.69	107.64

There are no chirality outliers.

All (4) torsion outliers are listed below:

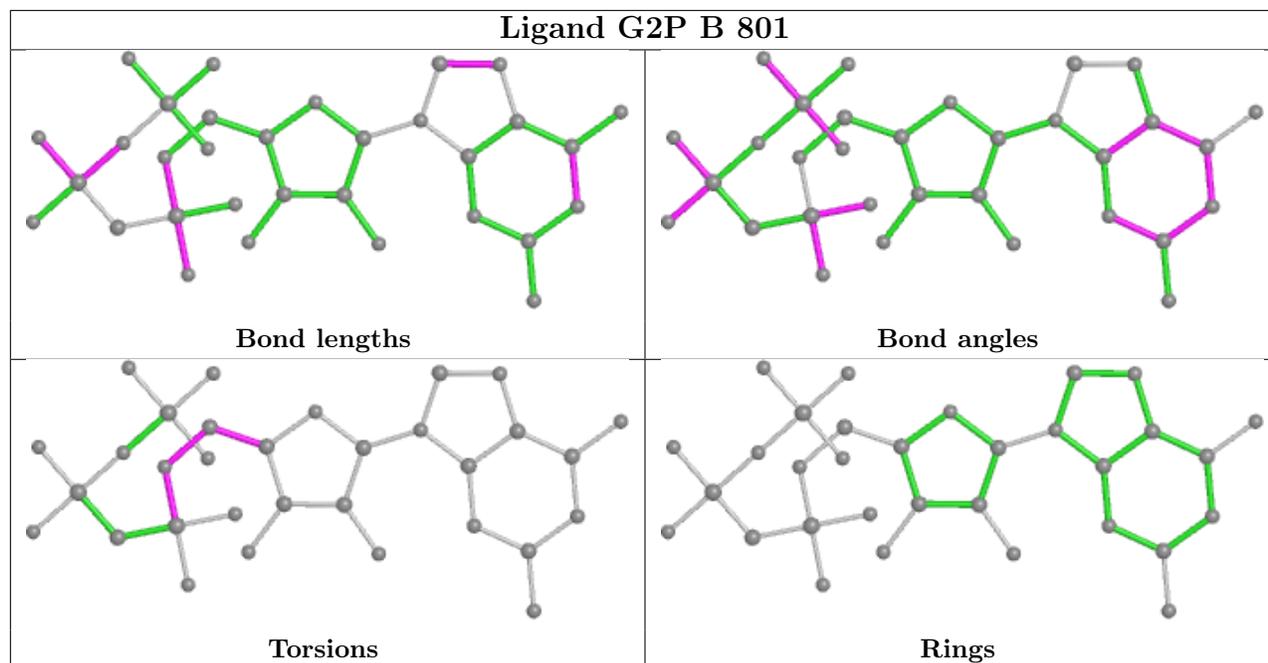
Mol	Chain	Res	Type	Atoms
6	B	801	G2P	O4'-C4'-C5'-O5'
6	B	801	G2P	C5'-O5'-PA-O2A
6	B	801	G2P	C4'-C5'-O5'-PA
6	B	801	G2P	C3'-C4'-C5'-O5'

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	B	801	G2P	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.