



# Full wwPDB X-ray Structure Validation Report ⓘ

May 18, 2026 – 03:02 PM JST

PDB ID : 9UYX / pdb\_00009uyx  
Title : Crystal structure of UMPK from *S. aureus* in complex with UTP  
Authors : Gao, Y.; Niu, L.W.  
Deposited on : 2025-05-15  
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](mailto: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>.

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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 : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 2.0  
EDS : 3.0  
Buster-report : wwPDB partial adaption of 1.1.7 (2018)  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
CCP4 : 9.0.010 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

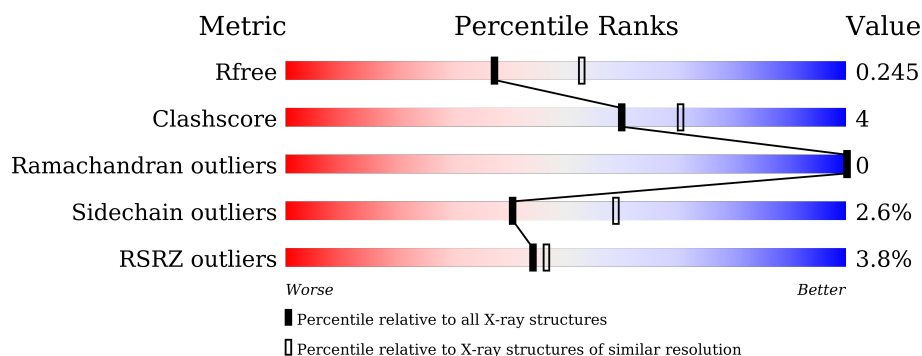
# 1 Overall quality at a glance

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))
$R_{free}$	180053	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (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  $\geq 3$ , 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  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	248	<div> <div>0%</div> <div> <div></div> <div>85%</div> <div>10%</div> <div>5%</div> </div> </div>
1	B	248	<div> <div>3%</div> <div> <div></div> <div>87%</div> <div>8%</div> <div>5%</div> </div> </div>
1	C	248	<div> <div>6%</div> <div> <div></div> <div>83%</div> <div>12%</div> <div>5%</div> </div> </div>
1	D	248	<div> <div>2%</div> <div> <div></div> <div>83%</div> <div>12%</div> <div>• •</div> </div> </div>
1	E	248	<div> <div>4%</div> <div> <div></div> <div>83%</div> <div>10%</div> <div>• •</div> </div> </div>
1	F	248	<div> <div>6%</div> <div> <div></div> <div>84%</div> <div>11%</div> <div>•</div> </div> </div>

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 11037 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 Uridylate kinase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	236	Total	C	N	O	S	0	0	0
			1793	1124	310	344	15			
1	B	236	Total	C	N	O	S	0	0	0
			1793	1124	310	344	15			
1	C	236	Total	C	N	O	S	0	0	0
			1793	1124	310	344	15			
1	D	238	Total	C	N	O	S	0	0	0
			1810	1135	313	347	15			
1	E	237	Total	C	N	O	S	0	0	0
			1801	1130	311	345	15			
1	F	237	Total	C	N	O	S	0	0	0
			1801	1130	311	345	15			

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-7	MET	-	initiating methionine	UNP Q2FZ22
A	-6	GLY	-	expression tag	UNP Q2FZ22
A	-5	HIS	-	expression tag	UNP Q2FZ22
A	-4	HIS	-	expression tag	UNP Q2FZ22
A	-3	HIS	-	expression tag	UNP Q2FZ22
A	-2	HIS	-	expression tag	UNP Q2FZ22
A	-1	HIS	-	expression tag	UNP Q2FZ22
A	0	HIS	-	expression tag	UNP Q2FZ22
B	-7	MET	-	initiating methionine	UNP Q2FZ22
B	-6	GLY	-	expression tag	UNP Q2FZ22
B	-5	HIS	-	expression tag	UNP Q2FZ22
B	-4	HIS	-	expression tag	UNP Q2FZ22
B	-3	HIS	-	expression tag	UNP Q2FZ22
B	-2	HIS	-	expression tag	UNP Q2FZ22
B	-1	HIS	-	expression tag	UNP Q2FZ22
B	0	HIS	-	expression tag	UNP Q2FZ22
C	-7	MET	-	initiating methionine	UNP Q2FZ22

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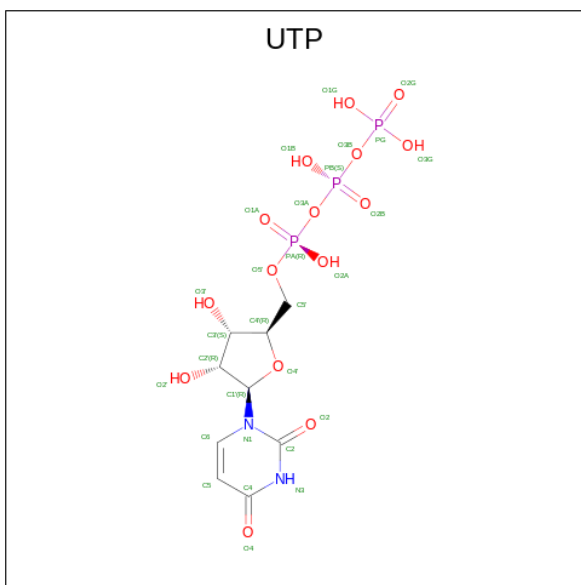
Chain	Residue	Modelled	Actual	Comment	Reference
C	-6	GLY	-	expression tag	UNP Q2FZ22
C	-5	HIS	-	expression tag	UNP Q2FZ22
C	-4	HIS	-	expression tag	UNP Q2FZ22
C	-3	HIS	-	expression tag	UNP Q2FZ22
C	-2	HIS	-	expression tag	UNP Q2FZ22
C	-1	HIS	-	expression tag	UNP Q2FZ22
C	0	HIS	-	expression tag	UNP Q2FZ22
D	-7	MET	-	initiating methionine	UNP Q2FZ22
D	-6	GLY	-	expression tag	UNP Q2FZ22
D	-5	HIS	-	expression tag	UNP Q2FZ22
D	-4	HIS	-	expression tag	UNP Q2FZ22
D	-3	HIS	-	expression tag	UNP Q2FZ22
D	-2	HIS	-	expression tag	UNP Q2FZ22
D	-1	HIS	-	expression tag	UNP Q2FZ22
D	0	HIS	-	expression tag	UNP Q2FZ22
E	-7	MET	-	initiating methionine	UNP Q2FZ22
E	-6	GLY	-	expression tag	UNP Q2FZ22
E	-5	HIS	-	expression tag	UNP Q2FZ22
E	-4	HIS	-	expression tag	UNP Q2FZ22
E	-3	HIS	-	expression tag	UNP Q2FZ22
E	-2	HIS	-	expression tag	UNP Q2FZ22
E	-1	HIS	-	expression tag	UNP Q2FZ22
E	0	HIS	-	expression tag	UNP Q2FZ22
F	-7	MET	-	initiating methionine	UNP Q2FZ22
F	-6	GLY	-	expression tag	UNP Q2FZ22
F	-5	HIS	-	expression tag	UNP Q2FZ22
F	-4	HIS	-	expression tag	UNP Q2FZ22
F	-3	HIS	-	expression tag	UNP Q2FZ22
F	-2	HIS	-	expression tag	UNP Q2FZ22
F	-1	HIS	-	expression tag	UNP Q2FZ22
F	0	HIS	-	expression tag	UNP Q2FZ22

- Molecule 2 is GLYCEROL (CCD ID: GOL) (formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>).



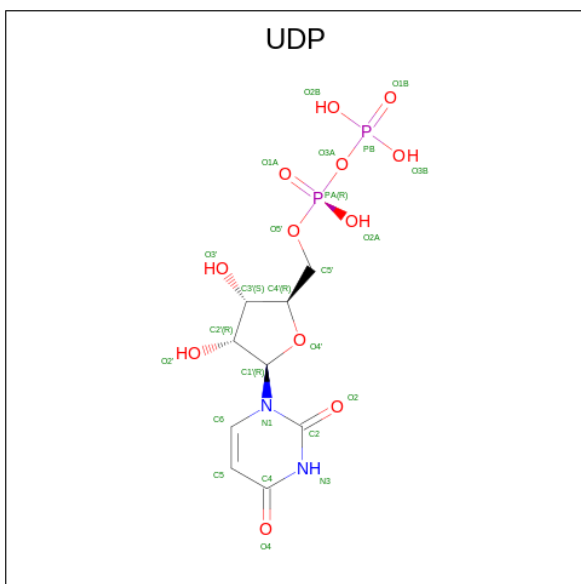
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	B	1	Total	C	O	0	0
			6	3	3		
2	C	1	Total	C	O	0	0
			6	3	3		
2	C	1	Total	C	O	0	0
			6	3	3		
2	C	1	Total	C	O	0	0
			6	3	3		
2	D	1	Total	C	O	0	0
			6	3	3		
2	E	1	Total	C	O	0	0
			6	3	3		
2	E	1	Total	C	O	0	0
			6	3	3		

- Molecule 3 is URIDINE 5'-TRIPHOSPHATE (CCD ID: UTP) (formula:  $C_9H_{15}N_2O_{15}P_3$ ) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	B	1	Total 29	C 9	N 2	O 15	P 3	0	0
3	C	1	Total 29	C 9	N 2	O 15	P 3	0	0

- Molecule 4 is URIDINE-5'-DIPHOSPHATE (CCD ID: UDP) (formula:  $\text{C}_9\text{H}_{14}\text{N}_2\text{O}_{12}\text{P}_2$ ) (labeled as "Ligand of Interest" by depositor).



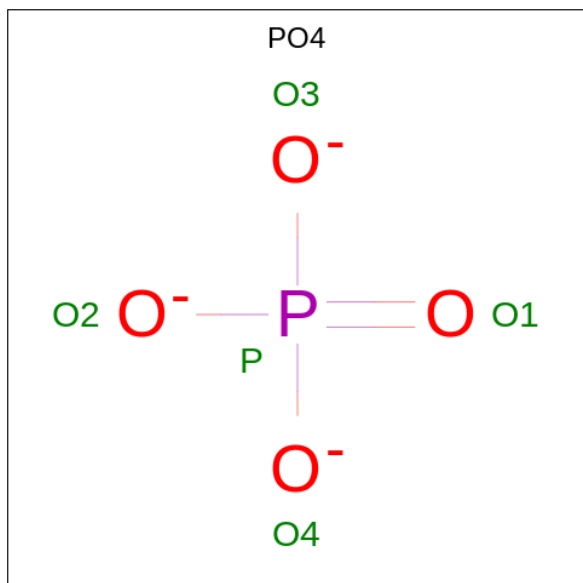
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	D	1	Total	C	N	O	P	0	0
			25	9	2	12	2		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	E	1	Total	C	N	O	P	0	0
			25	9	2	12	2		
4	F	1	Total	C	N	O	P	0	0
			25	9	2	12	2		

- Molecule 5 is PHOSPHATE ION (CCD ID: PO4) (formula:  $O_4P$ ) (labeled as "Ligand of Interest" by depositor).



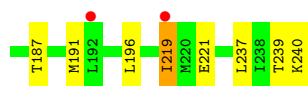
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	F	1	Total	O	P	0	0
			5	4	1		

- Molecule 6 is water.

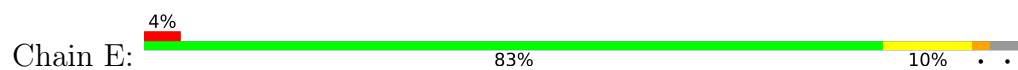
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	13	Total	O	0	0
			13	13		
6	B	9	Total	O	0	0
			9	9		
6	C	5	Total	O	0	0
			5	5		
6	D	6	Total	O	0	0
			6	6		
6	E	7	Total	O	0	0
			7	7		
6	F	8	Total	O	0	0
			8	8		



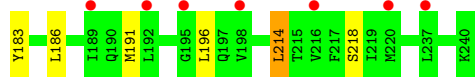
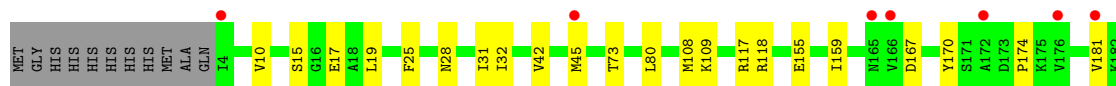
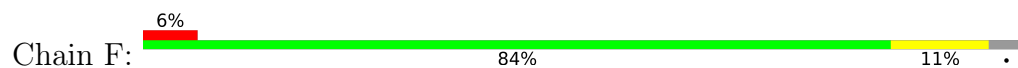




- Molecule 1: Uridylate kinase



- Molecule 1: Uridylate kinase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	76.94Å 114.79Å 101.34Å 90.00° 90.63° 90.00°	Depositor
Resolution (Å)	46.35 – 2.30 46.35 – 2.30	Depositor EDS
% Data completeness (in resolution range)	98.6 (46.35-2.30) 91.6 (46.35-2.30)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	0.85 (at 2.29Å)	Xtriage
Refinement program	PHENIX 1.11.1_2575	Depositor
R, $R_{free}$	0.200 , 0.242 0.203 , 0.245	Depositor DCC
$R_{free}$ test set	3784 reflections (4.83%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	52.0	Xtriage
Anisotropy	0.470	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 43.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.027 for h,-k,-l	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	11037	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	71.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.72% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: UDP, UTP, GOL, PO4

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	0.25	0/1813	0.44	0/2441
1	B	0.23	0/1813	0.40	0/2441
1	C	0.23	0/1813	0.42	0/2441
1	D	0.21	0/1830	0.40	0/2464
1	E	0.21	0/1821	0.40	0/2452
1	F	0.23	0/1821	0.43	0/2452
All	All	0.22	0/10911	0.42	0/14691

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

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	1793	0	1839	15	0
1	B	1793	0	1839	14	0
1	C	1793	0	1839	16	0
1	D	1810	0	1858	21	0
1	E	1801	0	1850	18	0
1	F	1801	0	1850	18	0
2	A	18	0	24	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	6	0	8	1	0
2	C	18	0	24	2	0
2	D	6	0	8	0	0
2	E	12	0	16	1	0
3	B	29	0	10	0	0
3	C	29	0	10	0	0
4	D	25	0	11	0	0
4	E	25	0	11	0	0
4	F	25	0	11	0	0
5	F	5	0	0	0	0
6	A	13	0	0	0	0
6	B	9	0	0	0	0
6	C	5	0	0	0	0
6	D	6	0	0	0	0
6	E	7	0	0	0	0
6	F	8	0	0	0	0
All	All	11037	0	11208	96	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 4.

All (96) 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:F:191:MET:HG3	1:F:196:LEU:HB2	1.74	0.68
1:D:42:VAL:HA	1:D:45:MET:HE2	1.75	0.68
1:C:6:LYS:HD2	1:C:231:GLY:HA3	1.78	0.65
1:C:141:PHE:HE1	1:E:149:LEU:HD21	1.64	0.63
1:D:52:ILE:HD12	1:D:147:ALA:HA	1.79	0.62
1:F:80:LEU:HD23	1:F:108:MET:HE1	1.81	0.61
1:A:42:VAL:HA	1:A:45:MET:HE2	1.83	0.60
1:D:52:ILE:HG12	1:D:132:PHE:HB2	1.82	0.60
1:F:17:GLU:OE1	1:F:17:GLU:N	2.34	0.60
1:B:54:GLY:HA3	2:B:302:GOL:H2	1.84	0.59
1:F:42:VAL:HA	1:F:45:MET:HE2	1.85	0.59
1:B:141:PHE:CZ	1:D:141:PHE:HE2	2.21	0.58
1:C:169:VAL:HG22	1:C:198:VAL:HG21	1.84	0.58
1:D:17:GLU:OE1	1:D:17:GLU:N	2.34	0.58
1:F:159:ILE:HB	1:F:214:LEU:HD23	1.88	0.56
2:C:304:GOL:H11	1:F:25:PHE:HB3	1.87	0.56
1:D:99:ASP:HB3	1:D:128:ARG:HG2	1.88	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:169:VAL:HG22	1:E:198:VAL:HG11	1.87	0.55
1:A:143:THR:HB	2:A:301:GOL:H2	1.88	0.55
1:D:103:LEU:HD23	1:D:115:TYR:HD1	1.72	0.54
1:D:23:LYS:HB3	1:D:25:PHE:CE2	2.43	0.54
1:E:167:ASP:HA	1:E:218:SER:HB2	1.89	0.54
1:C:87:LEU:HD11	1:C:111:VAL:HG13	1.90	0.54
1:A:169:VAL:HG22	1:A:198:VAL:HG11	1.90	0.53
1:C:71:ARG:HD3	1:C:140:TYR:CE1	2.44	0.52
1:E:116:ILE:HB	1:E:119:ARG:HG3	1.90	0.52
1:E:52:ILE:HD12	1:E:147:ALA:HA	1.91	0.52
1:A:33:LYS:O	1:A:37:GLU:HG3	2.10	0.52
1:F:191:MET:HE2	1:F:196:LEU:HD12	1.92	0.51
1:D:138:ASN:HD21	1:D:140:TYR:HB2	1.75	0.51
1:B:136:ILE:HD11	1:B:141:PHE:CD1	2.46	0.50
1:E:54:GLY:HA3	2:E:302:GOL:H2	1.94	0.49
1:E:150:ARG:O	1:E:154:VAL:HG22	2.12	0.49
1:C:170:TYR:HB3	1:C:180:ALA:HB1	1.95	0.49
1:E:107:GLU:OE1	1:F:109:LYS:NZ	2.38	0.49
1:F:183:TYR:CD2	1:F:186:LEU:HD11	2.49	0.48
1:E:5:SER:OG	1:E:7:TYR:O	2.29	0.48
1:C:71:ARG:NH1	1:C:140:TYR:HA	2.28	0.48
1:B:17:GLU:OE1	1:B:17:GLU:N	2.44	0.47
1:A:170:TYR:CE2	1:A:182:LYS:HB2	2.49	0.47
1:A:188:HIS:ND1	1:A:208:MET:HB3	2.30	0.47
1:C:71:ARG:NH1	1:C:75:ASP:OD2	2.48	0.47
1:D:219:ILE:H	1:D:219:ILE:HG13	1.64	0.47
1:B:107:GLU:CD	1:E:109:LYS:HE2	2.40	0.46
1:D:22:GLU:H	1:D:22:GLU:CD	2.23	0.46
1:E:79:MET:HE2	1:E:135:GLY:HA3	1.97	0.46
1:B:94:GLU:OE2	1:F:118:ARG:NH2	2.47	0.46
1:A:110:GLN:O	1:D:117:ARG:HG3	2.16	0.46
1:E:163:LYS:O	1:E:219:ILE:HG12	2.15	0.46
1:D:170:TYR:CG	1:D:174:PRO:HG3	2.51	0.46
1:F:183:TYR:HD2	1:F:186:LEU:HD11	1.81	0.45
1:D:187:THR:HA	1:D:239:THR:O	2.16	0.45
1:B:87:LEU:HD11	1:B:111:VAL:HG13	1.97	0.45
1:F:19:LEU:HD22	1:F:32:ILE:HG13	1.97	0.45
1:C:118:ARG:HG3	1:C:119:ARG:N	2.32	0.45
1:D:115:TYR:OH	1:D:153:GLU:OE1	2.31	0.45
1:D:23:LYS:HD3	1:D:25:PHE:CZ	2.51	0.45
1:E:121:ILE:HD11	1:E:154:VAL:HA	1.99	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:117:ARG:HH11	2:A:303:GOL:H12	1.82	0.45
2:A:303:GOL:H2	1:F:73:THR:HG23	1.99	0.45
1:C:167:ASP:HA	1:C:218:SER:HB2	1.99	0.44
1:C:183:TYR:CD2	1:C:186:LEU:HD21	2.52	0.44
1:F:167:ASP:HA	1:F:218:SER:HB2	1.99	0.44
1:B:78:GLY:O	1:B:82:THR:HG23	2.17	0.44
1:E:4:ILE:HD12	1:E:4:ILE:HA	1.85	0.44
1:E:161:MET:HG2	1:E:163:LYS:HD3	1.98	0.44
1:E:91:ASP:OD1	1:E:95:GLN:NE2	2.51	0.44
1:D:191:MET:HG3	1:D:196:LEU:HB2	2.00	0.43
1:A:152:ALA:HB2	1:A:212:ILE:HD11	2.01	0.43
1:B:186:LEU:O	1:B:238:ILE:HA	2.18	0.43
1:B:233:LYS:HE3	1:B:233:LYS:HB2	1.73	0.43
1:F:191:MET:HE3	1:F:191:MET:HB2	1.81	0.43
1:A:116:ILE:HB	1:A:119:ARG:HB2	2.01	0.43
1:A:208:MET:HE3	1:A:208:MET:HB2	1.75	0.43
1:A:109:LYS:O	1:A:110:GLN:HB2	2.18	0.43
1:C:191:MET:HA	1:C:196:LEU:HD12	2.01	0.43
1:A:143:THR:CB	2:A:301:GOL:H2	2.49	0.42
1:D:119:ARG:O	1:D:122:ARG:HG2	2.19	0.42
1:F:28:ASN:HB3	1:F:31:ILE:HG12	2.01	0.42
1:C:219:ILE:H	1:C:219:ILE:HG12	1.73	0.41
1:B:220:MET:HA	1:B:220:MET:HE3	2.02	0.41
1:C:187:THR:HA	1:C:239:THR:O	2.20	0.41
1:C:199:MET:HE1	1:C:214:LEU:HD22	2.02	0.41
1:B:160:LEU:HD22	1:B:228:ALA:HB1	2.02	0.41
1:E:237:LEU:HD22	1:E:239:THR:HG23	2.02	0.41
1:F:170:TYR:CG	1:F:174:PRO:HB3	2.55	0.41
1:E:161:MET:HE3	1:E:161:MET:HB2	1.85	0.41
1:B:91:ASP:OD1	1:B:95:GLN:NE2	2.53	0.41
1:C:54:GLY:HA3	2:C:302:GOL:H32	2.02	0.40
1:A:161:MET:HE2	1:A:163:LYS:HE3	2.04	0.40
1:A:197:GLN:HG2	1:A:199:MET:O	2.21	0.40
1:D:136:ILE:CD1	1:D:138:ASN:HB3	2.51	0.40
1:D:138:ASN:ND2	1:D:140:TYR:HB2	2.36	0.40
1:F:170:TYR:HA	1:F:181:VAL:O	2.20	0.40
1:D:116:ILE:HB	1:D:119:ARG:HG3	2.03	0.40
1:B:186:LEU:HD13	1:B:191:MET:HG2	2.03	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	234/248 (94%)	228 (97%)	6 (3%)	0	100	100
1	B	234/248 (94%)	230 (98%)	4 (2%)	0	100	100
1	C	234/248 (94%)	229 (98%)	5 (2%)	0	100	100
1	D	236/248 (95%)	230 (98%)	6 (2%)	0	100	100
1	E	235/248 (95%)	231 (98%)	4 (2%)	0	100	100
1	F	235/248 (95%)	229 (97%)	6 (3%)	0	100	100
All	All	1408/1488 (95%)	1377 (98%)	31 (2%)	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	193/203 (95%)	190 (98%)	3 (2%)	55	73
1	B	193/203 (95%)	190 (98%)	3 (2%)	55	73
1	C	193/203 (95%)	187 (97%)	6 (3%)	35	52
1	D	195/203 (96%)	189 (97%)	6 (3%)	35	52
1	E	194/203 (96%)	187 (96%)	7 (4%)	31	47
1	F	194/203 (96%)	189 (97%)	5 (3%)	40	59
All	All	1162/1218 (95%)	1132 (97%)	30 (3%)	40	59

All (30) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	165	ASN
1	A	184	GLU
1	A	186	LEU
1	B	108	MET
1	B	165	ASN
1	B	220	MET
1	C	15	SER
1	C	108	MET
1	C	177	ASN
1	C	198	VAL
1	C	233	LYS
1	C	237	LEU
1	D	22	GLU
1	D	136	ILE
1	D	219	ILE
1	D	221	GLU
1	D	237	LEU
1	D	240	LYS
1	E	37	GLU
1	E	52	ILE
1	E	99	ASP
1	E	118	ARG
1	E	121	ILE
1	E	219	ILE
1	E	237	LEU
1	F	10	VAL
1	F	15	SER
1	F	117	ARG
1	F	155	GLU
1	F	214	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	95	GLN
1	A	210	ASN
1	E	90	GLN
1	E	95	GLN
1	F	90	GLN
1	F	210	ASN
1	F	224	ASN



### 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 ⓘ

16 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	$\# Z  > 2$
4	UDP	F	301	-	24,26,26	0.33	0	37,40,40	0.76	2 (5%)
2	GOL	C	303	-	5,5,5	0.36	0	5,5,5	0.33	0
4	UDP	D	301	-	24,26,26	0.34	0	37,40,40	0.70	2 (5%)
2	GOL	B	302	-	5,5,5	0.33	0	5,5,5	0.44	0
2	GOL	A	301	-	5,5,5	0.47	0	5,5,5	0.44	0
3	UTP	C	301	-	26,30,30	2.87	8 (30%)	39,47,47	1.59	5 (12%)
2	GOL	A	302	-	5,5,5	0.37	0	5,5,5	0.16	0
5	PO4	F	302	-	4,4,4	0.63	0	6,6,6	0.48	0
2	GOL	E	303	-	5,5,5	0.40	0	5,5,5	0.67	0
2	GOL	D	302	-	5,5,5	0.41	0	5,5,5	0.39	0
2	GOL	E	302	-	5,5,5	0.27	0	5,5,5	0.51	0
3	UTP	B	301	-	26,30,30	2.91	8 (30%)	39,47,47	1.67	6 (15%)
2	GOL	A	303	-	5,5,5	0.35	0	5,5,5	0.38	0
4	UDP	E	301	-	24,26,26	0.37	0	37,40,40	0.75	2 (5%)
2	GOL	C	302	-	5,5,5	0.33	0	5,5,5	0.61	0
2	GOL	C	304	-	5,5,5	0.29	0	5,5,5	0.38	0

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
4	UDP	F	301	-	-	10/16/32/32	0/2/2/2
2	GOL	C	303	-	-	2/4/4/4	-
4	UDP	D	301	-	-	10/16/32/32	0/2/2/2
2	GOL	B	302	-	-	4/4/4/4	-
2	GOL	A	301	-	-	2/4/4/4	-
3	UTP	C	301	-	-	0/22/38/38	0/2/2/2
2	GOL	A	302	-	-	3/4/4/4	-
2	GOL	E	303	-	-	2/4/4/4	-
2	GOL	D	302	-	-	2/4/4/4	-
2	GOL	E	302	-	-	4/4/4/4	-
3	UTP	B	301	-	-	1/22/38/38	0/2/2/2
2	GOL	A	303	-	-	4/4/4/4	-
4	UDP	E	301	-	-	9/16/32/32	0/2/2/2
2	GOL	C	302	-	-	0/4/4/4	-
2	GOL	C	304	-	-	2/4/4/4	-

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	301	UTP	C3'-C4'	-8.39	1.31	1.53
3	B	301	UTP	O4'-C4'	8.20	1.63	1.45
3	C	301	UTP	C3'-C4'	-7.92	1.32	1.53
3	C	301	UTP	O4'-C4'	7.76	1.62	1.45
3	C	301	UTP	C4-N3	-5.38	1.28	1.38
3	B	301	UTP	C4-N3	-4.85	1.29	1.38
3	C	301	UTP	O4'-C1'	-3.90	1.32	1.42
3	B	301	UTP	O4'-C1'	-3.57	1.33	1.42
3	C	301	UTP	O2'-C2'	-3.50	1.34	1.43
3	C	301	UTP	O3'-C3'	3.35	1.50	1.43
3	B	301	UTP	O2'-C2'	-3.11	1.35	1.43
3	B	301	UTP	C6-N1	-3.10	1.30	1.38
3	B	301	UTP	O3'-C3'	3.04	1.50	1.43
3	C	301	UTP	C6-N1	-2.44	1.32	1.38
3	B	301	UTP	C5-C4	-2.33	1.38	1.43
3	C	301	UTP	PA-O5'	2.15	1.68	1.59

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	301	UTP	C4-N3-C2	-5.07	119.90	126.58
3	C	301	UTP	C4-N3-C2	-4.55	120.58	126.58
3	C	301	UTP	C5-C4-N3	4.02	120.85	114.84
3	B	301	UTP	N3-C2-N1	4.00	120.20	114.89
3	C	301	UTP	PB-O3A-PA	-3.73	120.02	132.83
3	C	301	UTP	N3-C2-N1	3.67	119.76	114.89
3	B	301	UTP	C5-C4-N3	3.60	120.22	114.84
3	B	301	UTP	PB-O3A-PA	-3.20	121.86	132.83
3	B	301	UTP	O4-C4-C5	-3.09	119.72	125.16
3	C	301	UTP	PB-O3B-PG	-3.03	122.43	132.83
3	B	301	UTP	O2-C2-N1	-2.80	119.06	122.79
4	E	301	UDP	PA-O3A-PB	-2.42	124.51	132.83
4	F	301	UDP	PA-O3A-PB	-2.30	124.92	132.83
4	D	301	UDP	PA-O3A-PB	-2.30	124.95	132.83
4	E	301	UDP	O3B-PB-O3A	2.20	112.00	104.64
4	D	301	UDP	O3B-PB-O3A	2.19	111.97	104.64
4	F	301	UDP	O3B-PB-O3A	2.09	111.65	104.64

There are no chirality outliers.

All (55) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	301	GOL	C1-C2-C3-O3
2	A	302	GOL	O1-C1-C2-C3
2	A	303	GOL	O1-C1-C2-C3
2	B	302	GOL	O1-C1-C2-O2
2	B	302	GOL	O1-C1-C2-C3
2	C	303	GOL	O1-C1-C2-C3
2	D	302	GOL	O1-C1-C2-C3
2	E	302	GOL	O1-C1-C2-C3
2	E	302	GOL	C1-C2-C3-O3
4	D	301	UDP	C2'-C1'-N1-C6
4	D	301	UDP	C5'-O5'-PA-O1A
4	D	301	UDP	C5'-O5'-PA-O2A
4	D	301	UDP	C5'-O5'-PA-O3A
4	E	301	UDP	C2'-C1'-N1-C2
4	E	301	UDP	C2'-C1'-N1-C6
4	E	301	UDP	C5'-O5'-PA-O2A
4	E	301	UDP	C5'-O5'-PA-O3A
4	F	301	UDP	C5'-O5'-PA-O1A
4	F	301	UDP	C5'-O5'-PA-O2A

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Mol	Chain	Res	Type	Atoms
4	F	301	UDP	C5'-O5'-PA-O3A
4	F	301	UDP	O4'-C4'-C5'-O5'
4	D	301	UDP	C2'-C1'-N1-C2
2	E	302	GOL	O1-C1-C2-O2
4	F	301	UDP	C3'-C4'-C5'-O5'
2	A	303	GOL	C1-C2-C3-O3
2	B	302	GOL	C1-C2-C3-O3
2	C	304	GOL	O1-C1-C2-C3
2	A	301	GOL	O2-C2-C3-O3
2	A	303	GOL	O1-C1-C2-O2
2	C	303	GOL	O1-C1-C2-O2
2	E	302	GOL	O2-C2-C3-O3
4	D	301	UDP	C3'-C4'-C5'-O5'
2	A	302	GOL	O1-C1-C2-O2
2	C	304	GOL	O1-C1-C2-O2
4	D	301	UDP	C4'-C5'-O5'-PA
4	F	301	UDP	C4'-C5'-O5'-PA
4	E	301	UDP	PB-O3A-PA-O5'
2	A	303	GOL	O2-C2-C3-O3
2	D	302	GOL	O1-C1-C2-O2
2	E	303	GOL	O1-C1-C2-O2
4	E	301	UDP	C4'-C5'-O5'-PA
4	D	301	UDP	O4'-C4'-C5'-O5'
4	D	301	UDP	O4'-C1'-N1-C2
4	D	301	UDP	O4'-C1'-N1-C6
4	F	301	UDP	C2'-C1'-N1-C6
4	E	301	UDP	O4'-C1'-N1-C6
2	A	302	GOL	C1-C2-C3-O3
2	B	302	GOL	O2-C2-C3-O3
4	F	301	UDP	O4'-C1'-N1-C6
4	E	301	UDP	O4'-C4'-C5'-O5'
4	E	301	UDP	O4'-C1'-N1-C2
4	F	301	UDP	O4'-C1'-N1-C2
4	F	301	UDP	PB-O3A-PA-O2A
2	E	303	GOL	O1-C1-C2-C3
3	B	301	UTP	C5'-O5'-PA-O1A

There are no ring outliers.

6 monomers are involved in 8 short contacts:

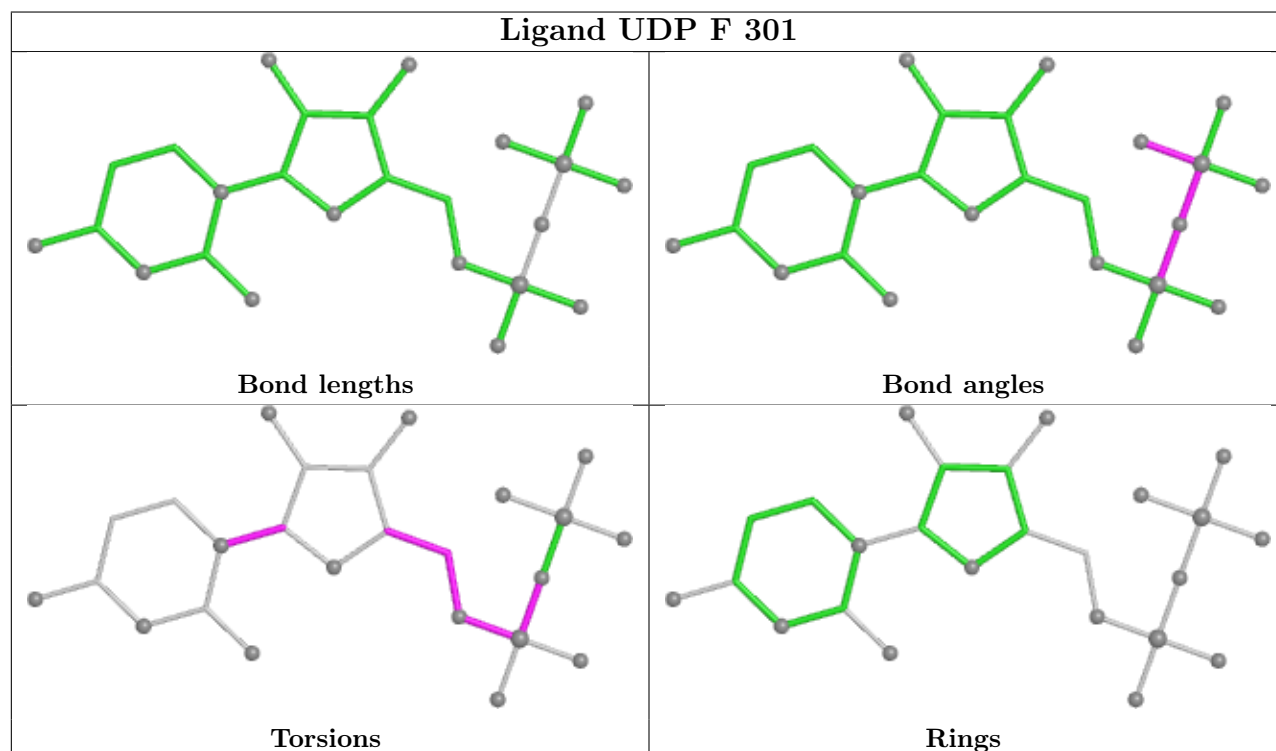
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	302	GOL	1	0

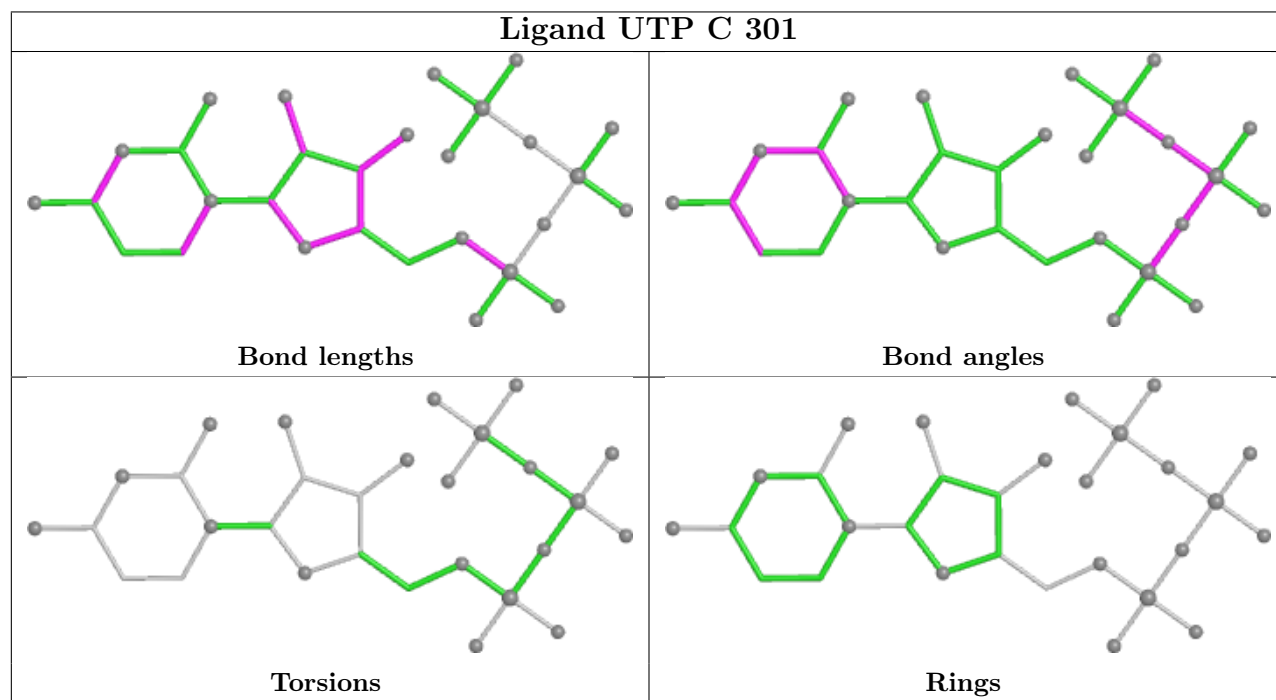
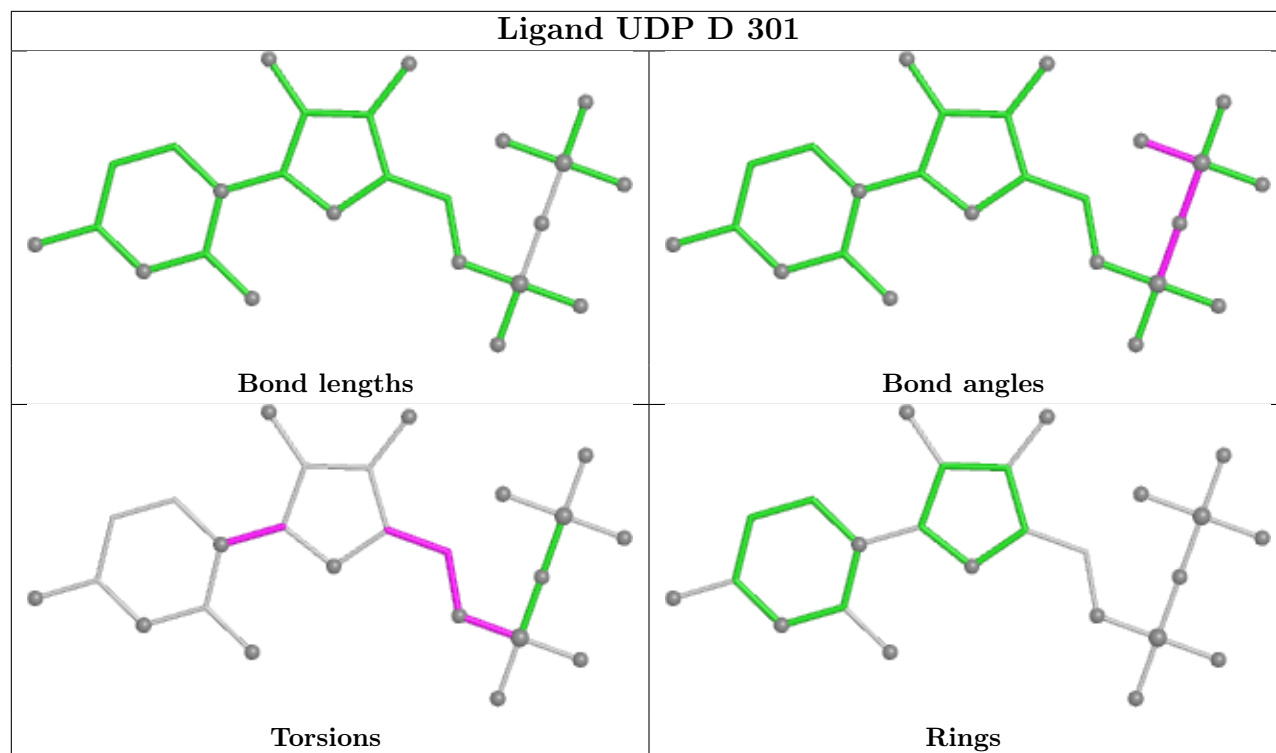
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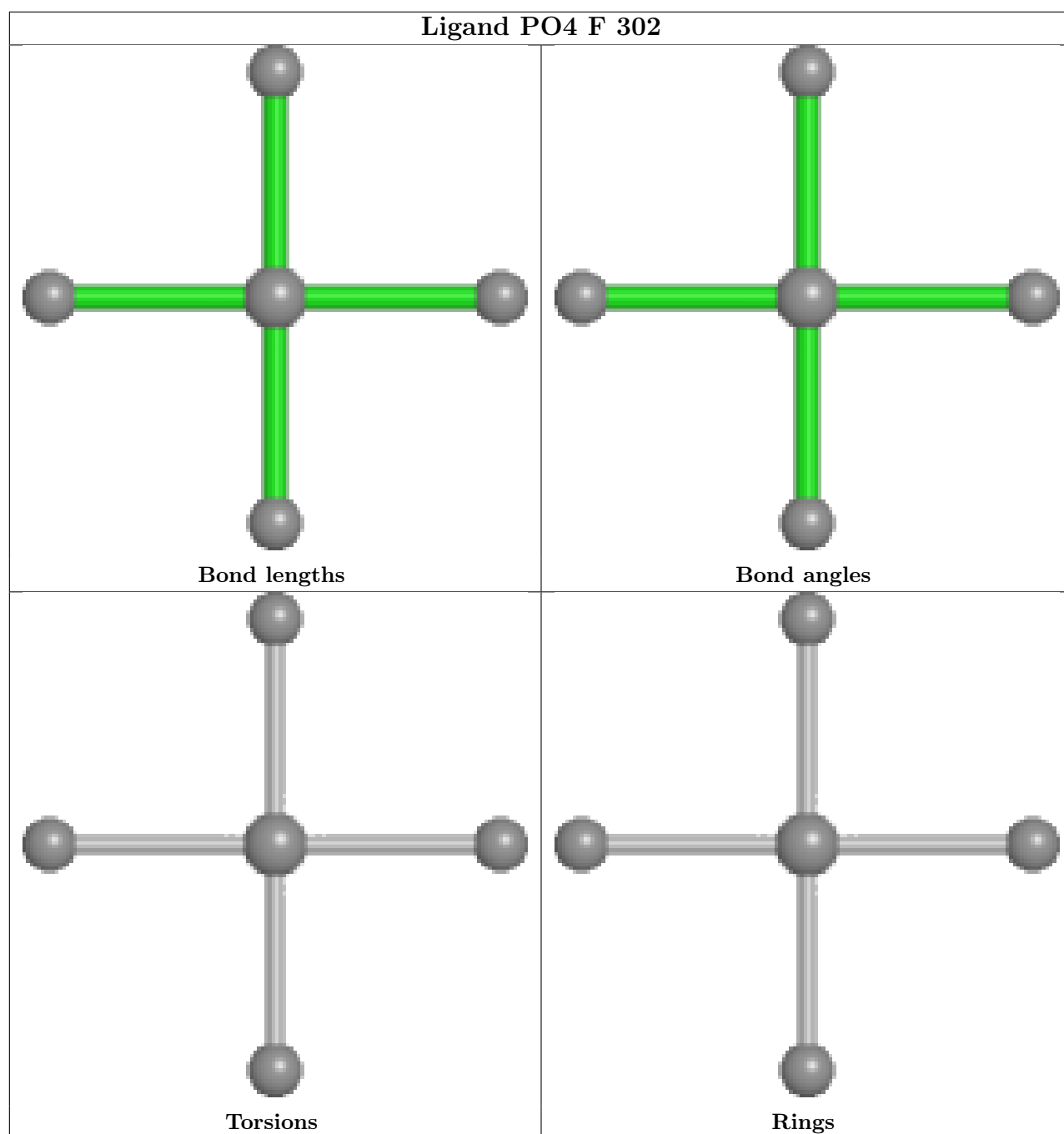
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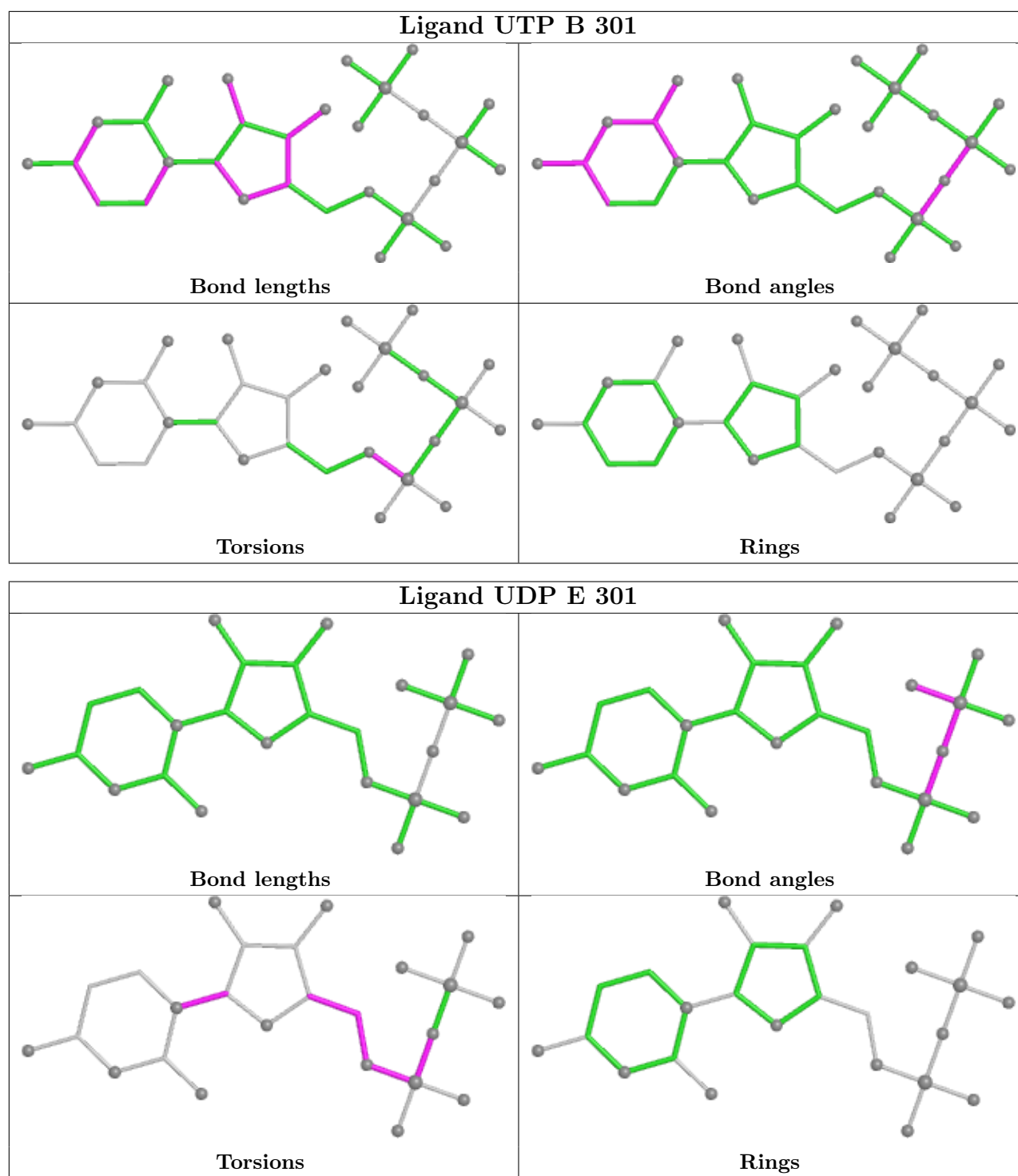
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	301	GOL	2	0
2	E	302	GOL	1	0
2	A	303	GOL	2	0
2	C	302	GOL	1	0
2	C	304	GOL	1	0

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 ⓘ

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	236/248 (95%)	0.15	3 (1%) 75 76	40, 57, 88, 125	0
1	B	236/248 (95%)	0.44	7 (2%) 52 54	42, 66, 104, 137	0
1	C	236/248 (95%)	0.60	15 (6%) 25 27	41, 68, 118, 135	0
1	D	238/248 (95%)	0.49	6 (2%) 58 60	46, 68, 97, 121	0
1	E	237/248 (95%)	0.63	9 (3%) 44 46	50, 73, 103, 126	0
1	F	237/248 (95%)	0.53	14 (5%) 28 30	42, 66, 119, 130	0
All	All	1420/1488 (95%)	0.47	54 (3%) 44 46	40, 67, 108, 137	0

All (54) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	172	ALA	4.3
1	C	192	LEU	4.0
1	C	25	PHE	4.0
1	C	189	ILE	3.8
1	C	176	VAL	3.7
1	F	4	ILE	3.6
1	C	172	ALA	3.6
1	D	25	PHE	3.5
1	F	176	VAL	3.5
1	E	198	VAL	3.4
1	E	4	ILE	3.3
1	B	172	ALA	3.2
1	B	189	ILE	3.2
1	F	189	ILE	3.1
1	E	137	GLY	3.0
1	C	186	LEU	2.9
1	E	176	VAL	2.9
1	B	198	VAL	2.9
1	A	172	ALA	2.8

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Mol	Chain	Res	Type	RSRZ
1	F	165	ASN	2.8
1	B	174	PRO	2.7
1	F	237	LEU	2.6
1	B	176	VAL	2.6
1	F	181	VAL	2.6
1	E	141	PHE	2.5
1	B	141	PHE	2.4
1	C	196	LEU	2.4
1	C	191	MET	2.4
1	A	176	VAL	2.4
1	E	25	PHE	2.4
1	F	166	VAL	2.4
1	E	192	LEU	2.4
1	F	45	MET	2.3
1	E	136	ILE	2.3
1	D	166	VAL	2.3
1	A	46	ASP	2.3
1	D	4	ILE	2.3
1	C	164	ASN	2.3
1	C	183	TYR	2.3
1	D	176	VAL	2.3
1	F	220	MET	2.2
1	F	192	LEU	2.2
1	E	46	ASP	2.2
1	D	192	LEU	2.2
1	C	181	VAL	2.1
1	F	198	VAL	2.1
1	C	206	PHE	2.1
1	C	5	SER	2.1
1	C	180	ALA	2.1
1	F	216	VAL	2.1
1	F	195	GLY	2.1
1	B	192	LEU	2.0
1	C	166	VAL	2.0
1	D	219	ILE	2.0

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

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

## 6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

## 6.4 Ligands ⓘ

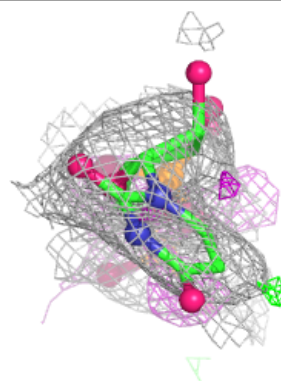
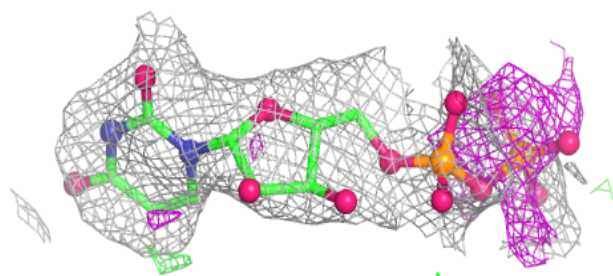
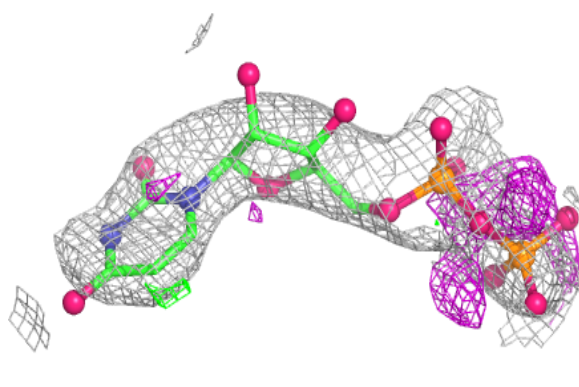
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
4	UDP	F	301	25/25	0.64	0.15	106,124,146,195	0
2	GOL	E	303	6/6	0.71	0.21	60,78,84,87	0
5	PO4	F	302	5/5	0.71	0.12	93,94,108,134	0
2	GOL	B	302	6/6	0.73	0.18	51,76,82,88	0
2	GOL	A	301	6/6	0.74	0.19	59,77,80,88	0
4	UDP	E	301	25/25	0.74	0.12	87,116,145,191	0
4	UDP	D	301	25/25	0.75	0.12	71,94,133,172	0
2	GOL	A	302	6/6	0.76	0.18	79,83,85,93	0
2	GOL	C	302	6/6	0.78	0.18	65,83,87,90	0
2	GOL	E	302	6/6	0.79	0.15	76,82,93,94	0
2	GOL	C	304	6/6	0.83	0.15	73,78,84,86	0
2	GOL	C	303	6/6	0.86	0.12	70,94,99,102	0
2	GOL	A	303	6/6	0.88	0.18	64,78,84,84	0
2	GOL	D	302	6/6	0.89	0.14	67,77,82,87	0
3	UTP	B	301	29/29	0.97	0.06	41,52,71,73	0
3	UTP	C	301	29/29	0.97	0.06	37,45,59,67	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

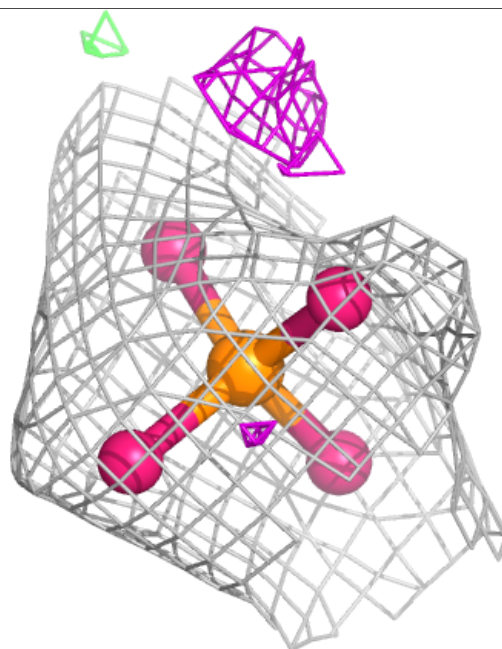
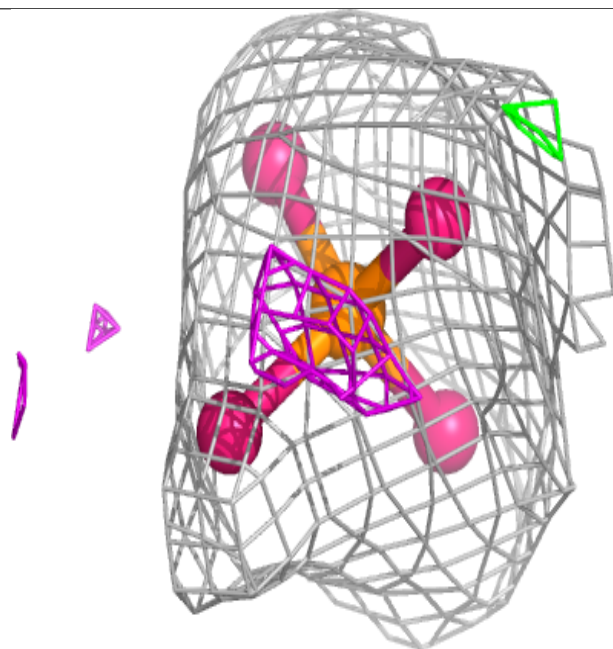
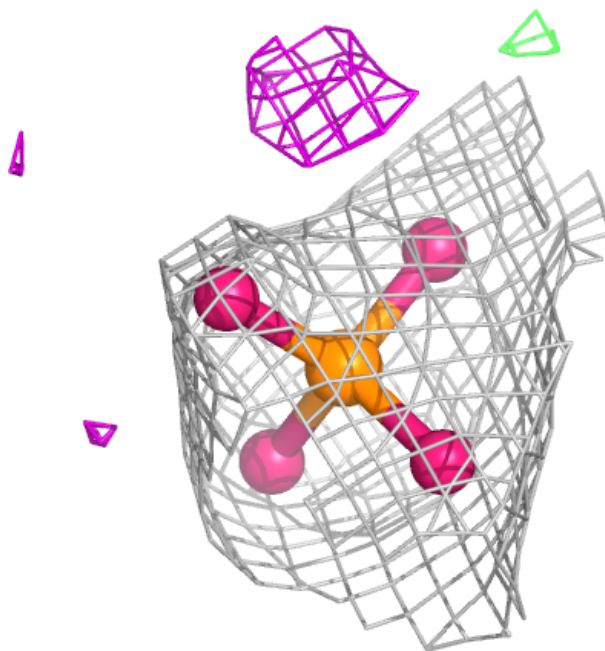
**Electron density around UDP F 301:**

$2mF_o - DF_c$  (at 0.7 rmsd) in gray  
 $mF_o - DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



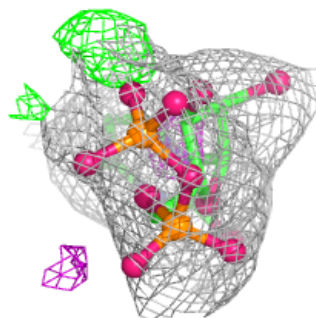
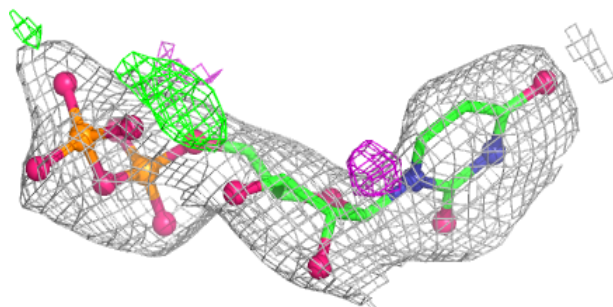
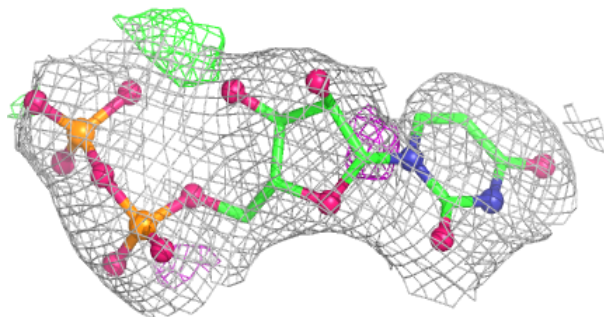
**Electron density around PO4 F 302:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

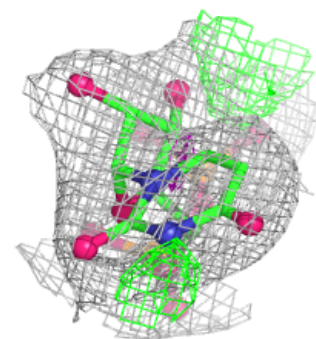
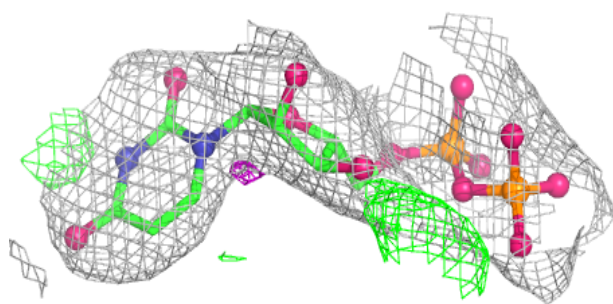
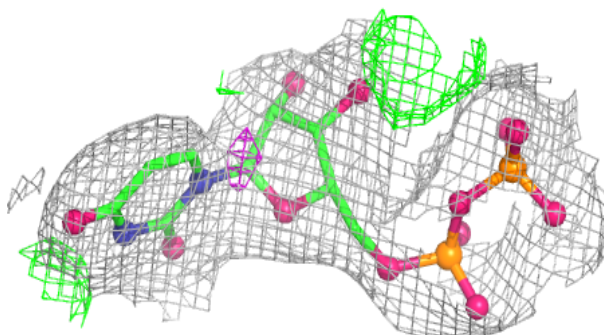


**Electron density around UDP E 301:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

**Electron density around UDP D 301:**

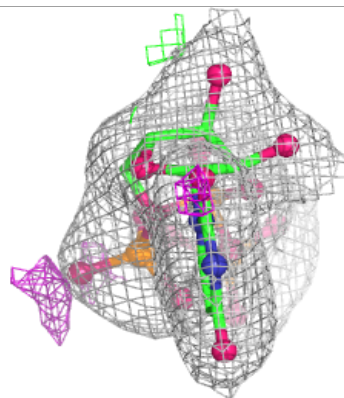
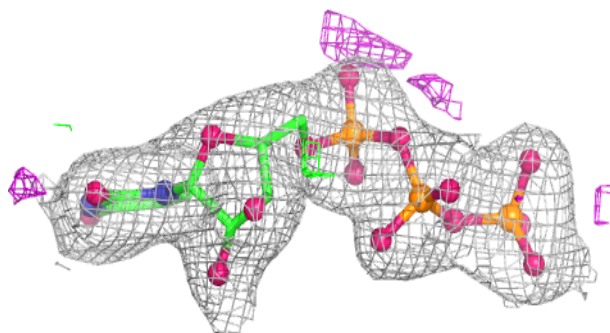
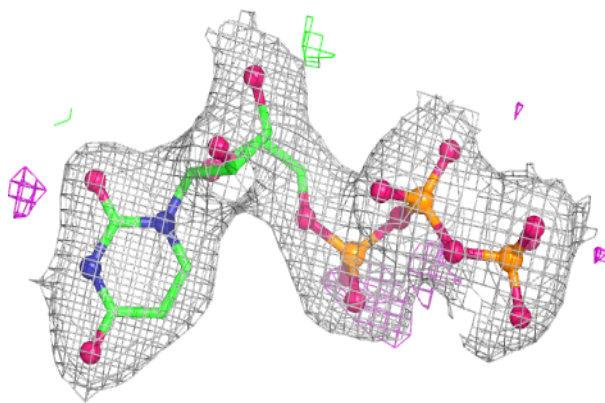
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



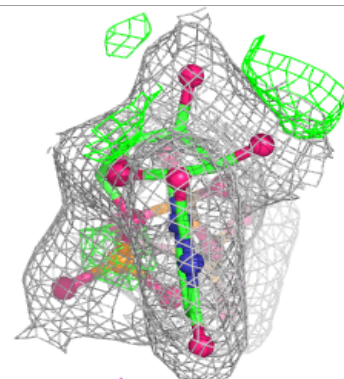
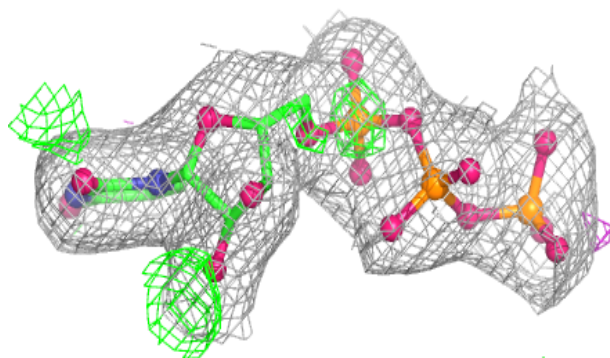
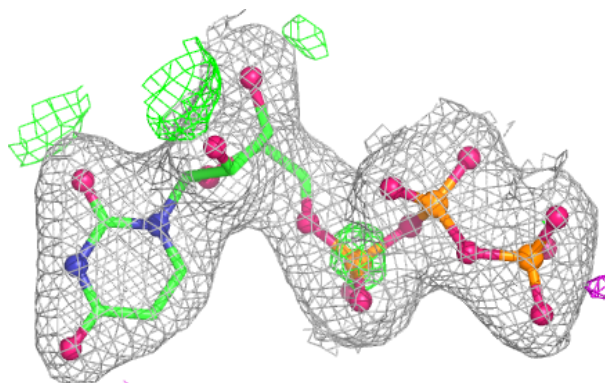


**Electron density around UTP B 301:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

**Electron density around UTP C 301:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





## 6.5 Other polymers [i](#)

There are no such residues in this entry.