



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 03:06 AM UTC

PDB ID : 5KX6 / pdb_00005kx6
Title : The structure of Arabidopsis thaliana FUT1 Mutant R284K in complex with GDP
Authors : Alahuhta, P.M.; Lunin, V.V.
Deposited on : 2016-07-20
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)	:	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

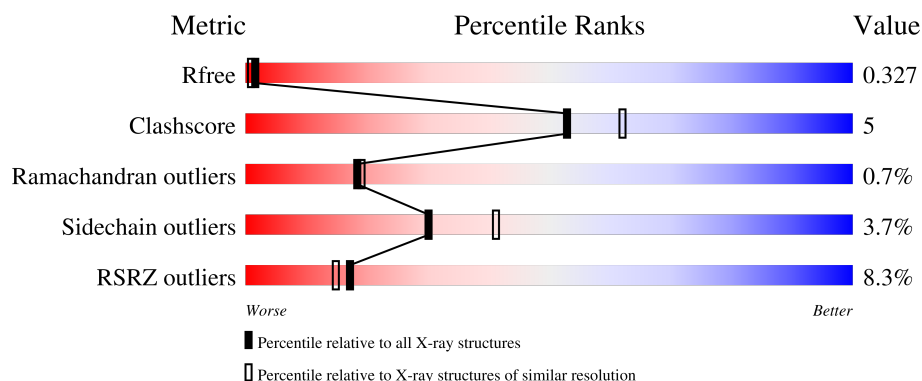
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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))
R_{free}	180053	6164 (2.20-2.20)
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (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 $\leq 5\%$. 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	476	<div> <div>7%</div> <div>74%</div> <div>17%</div> <div>• 8%</div> </div>
1	B	476	<div> <div>8%</div> <div>74%</div> <div>18%</div> <div>• 5%</div> </div>

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 7978 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.

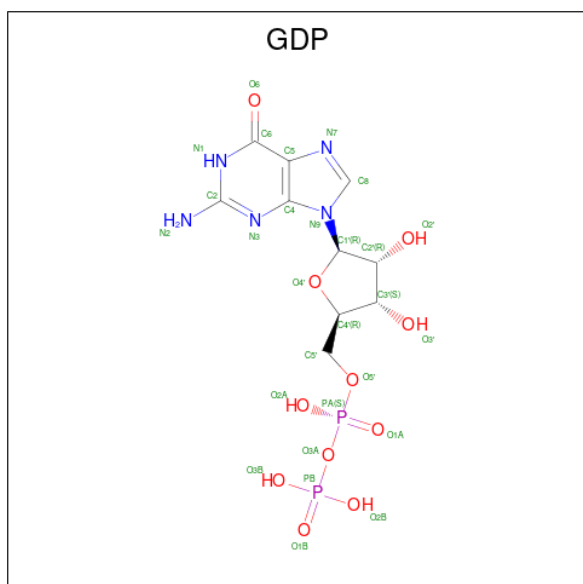
- Molecule 1 is a protein called Galactoside 2-alpha-L-fucosyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	440	Total	C	N	O	S	0	9	0
			3606	2322	599	663	22			
1	B	450	Total	C	N	O	S	0	9	0
			3676	2366	605	682	23			

There are 4 discrepancies between the modelled and reference sequences:

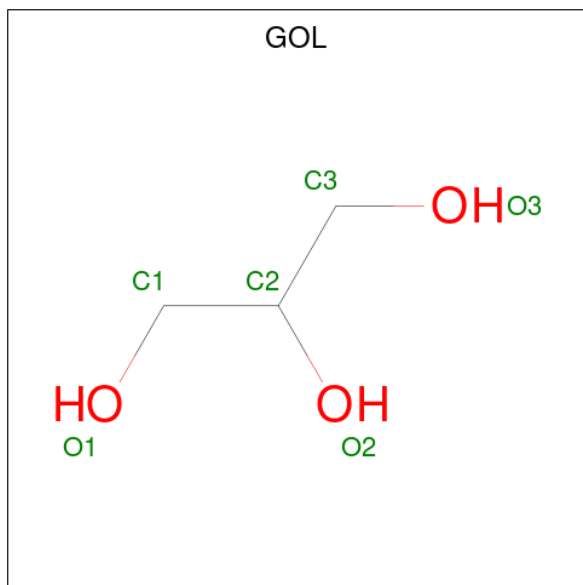
Chain	Residue	Modelled	Actual	Comment	Reference
A	83	GLY	-	expression tag	UNP Q9SWH5
A	366	LYS	ARG	engineered mutation	UNP Q9SWH5
B	83	GLY	-	expression tag	UNP Q9SWH5
B	366	LYS	ARG	engineered mutation	UNP Q9SWH5

- Molecule 2 is GUANOSINE-5'-DIPHOSPHATE (CCD ID: GDP) (formula: $C_{10}H_{15}N_5O_{11}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			28	10	5	11	2		
2	B	1	Total	C	N	O	P	0	0
			28	10	5	11	2		

- Molecule 3 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



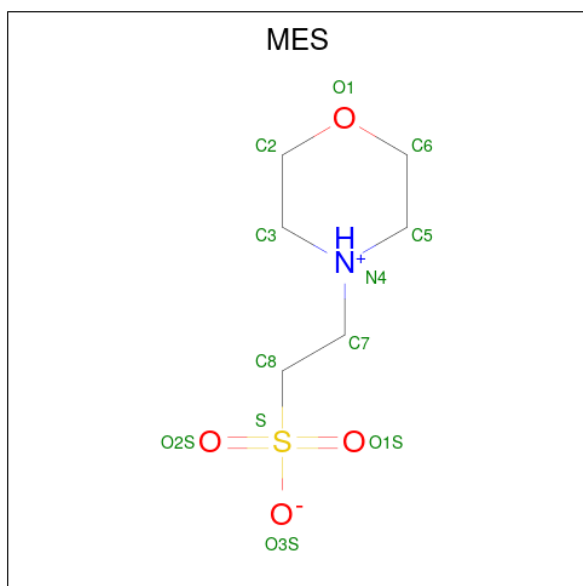
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	B	1	Total	C	O	0	0
			6	3	3		

- Molecule 4 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	B	1	Total	C	O	0	0
			4	2	2		

- Molecule 5 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: $C_6H_{13}NO_4S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	B	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

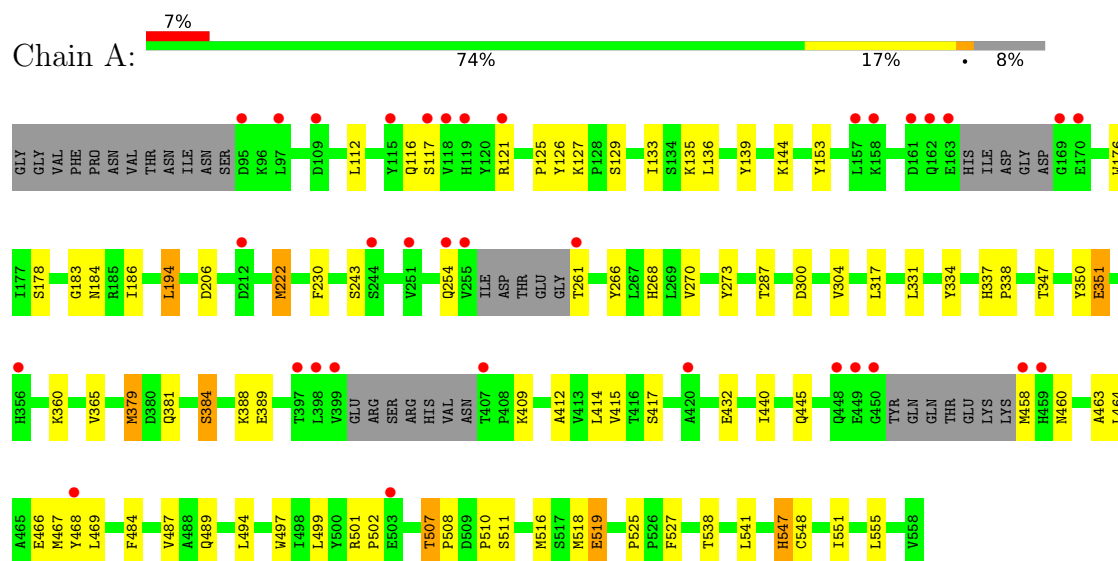
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	309	Total	O	0	4
			313	313		
6	B	301	Total	O	0	4
			305	305		

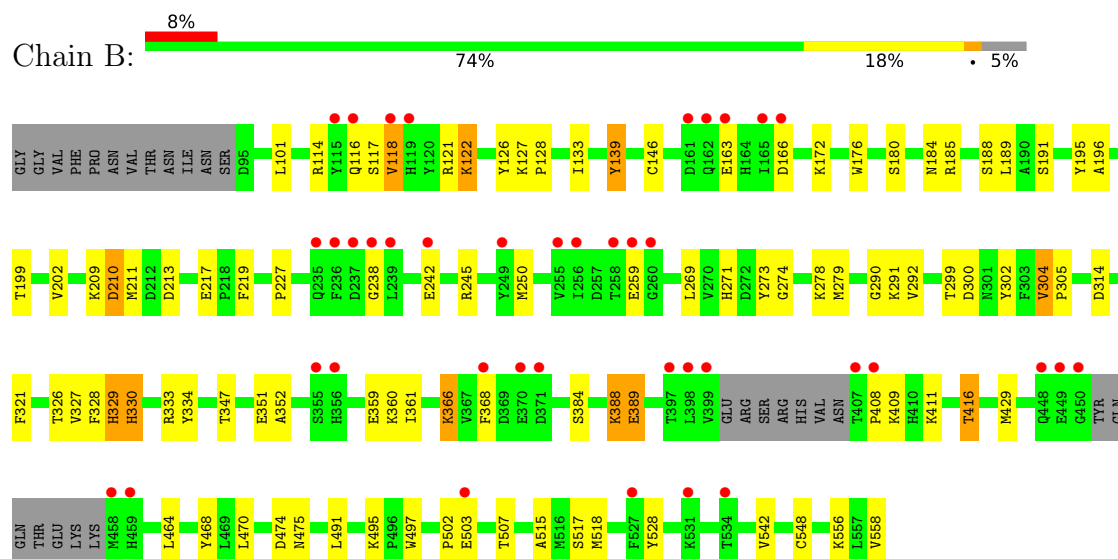
3 Residue-property plots

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

• Molecule 1: Galactoside 2-alpha-L-fucosyltransferase



• Molecule 1: Galactoside 2-alpha-L-fucosyltransferase



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	54.22Å 112.96Å 87.82Å 90.00° 104.48° 90.00°	Depositor
Resolution (Å)	85.03 – 2.20 85.03 – 2.20	Depositor EDS
% Data completeness (in resolution range)	91.0 (85.03-2.20) 91.2 (85.03-2.20)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.08 (at 2.20Å)	Xtriage
Refinement program	REFMAC 5.8.0155	Depositor
R, R_{free}	0.253 , 0.327 0.252 , 0.327	Depositor DCC
R_{free} test set	2288 reflections (4.39%)	wwPDB-VP
Wilson B-factor (Å ²)	17.6	Xtriage
Anisotropy	0.285	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 37.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.54$, $\langle L^2 \rangle = 0.38$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	7978	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.14% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: GDP, EDO, MES, GOL

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	1.34	13/3707 (0.4%)	1.28	16/5022 (0.3%)
1	B	1.38	20/3781 (0.5%)	1.29	16/5127 (0.3%)
All	All	1.36	33/7488 (0.4%)	1.28	32/10149 (0.3%)

All (33) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	466	GLU	C-O	-8.41	1.14	1.24
1	A	183	GLY	N-CA	7.53	1.55	1.45
1	B	304	VAL	CA-C	7.26	1.60	1.52
1	B	411	LYS	CA-C	-6.97	1.44	1.52
1	B	219	PHE	N-CA	6.73	1.54	1.46
1	A	379	MET	N-CA	6.60	1.54	1.46
1	A	331	LEU	N-CA	6.47	1.54	1.46
1	A	337	HIS	CA-C	-6.29	1.46	1.52
1	B	491	LEU	N-CA	-5.96	1.39	1.46
1	B	329	HIS	CA-CB	-5.84	1.44	1.53
1	B	416	THR	CA-C	-5.80	1.45	1.52
1	A	547	HIS	CA-C	5.75	1.60	1.52
1	A	186	ILE	CA-CB	5.75	1.61	1.54
1	A	511	SER	C-O	-5.72	1.17	1.24
1	B	329	HIS	N-CA	-5.66	1.39	1.46
1	B	334	TYR	C-O	-5.62	1.17	1.24
1	B	330	HIS	CA-C	-5.49	1.46	1.52
1	B	184	ASN	N-CA	-5.49	1.39	1.46
1	B	302	TYR	N-CA	-5.48	1.39	1.46
1	B	475	ASN	C-O	5.27	1.29	1.23
1	A	412	ALA	CA-C	5.19	1.58	1.52
1	A	135	LYS	C-O	-5.19	1.18	1.24
1	B	210	ASP	CA-C	5.17	1.59	1.52
1	B	195	TYR	N-CA	-5.16	1.40	1.46

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	300	ASP	CA-C	5.11	1.59	1.52
1	B	196	ALA	C-O	-5.11	1.18	1.24
1	B	328	PHE	C-O	5.09	1.30	1.24
1	B	517	SER	N-CA	-5.06	1.40	1.46
1	A	153	TYR	CA-C	5.05	1.59	1.52
1	B	366	LYS	C-O	5.04	1.29	1.23
1	B	507	THR	C-O	-5.04	1.17	1.24
1	B	389	GLU	N-CA	5.03	1.53	1.46
1	A	460	ASN	C-O	-5.02	1.17	1.24

All (32) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	217	GLU	CA-C-N	6.52	127.08	120.04
1	B	217	GLU	C-N-CA	6.52	127.08	120.04
1	B	542	VAL	CA-C-N	6.38	126.07	119.56
1	B	542	VAL	C-N-CA	6.38	126.07	119.56
1	A	458	MET	CA-C-N	6.32	128.99	120.65
1	A	458	MET	C-N-CA	6.32	128.99	120.65
1	A	432	GLU	N-CA-C	6.30	118.96	111.71
1	B	429	MET	N-CA-C	-5.92	104.74	111.14
1	A	519	GLU	N-CA-C	5.89	118.68	110.20
1	A	194	LEU	N-CA-C	-5.87	104.89	111.28
1	A	184	ASN	N-CA-C	5.79	117.59	111.28
1	A	510	PRO	CA-C-N	5.77	128.01	120.28
1	A	510	PRO	C-N-CA	5.77	128.01	120.28
1	B	491	LEU	N-CA-C	5.67	117.46	111.28
1	A	507	THR	CA-C-N	-5.65	114.44	120.03
1	A	507	THR	C-N-CA	-5.65	114.44	120.03
1	A	304	VAL	CA-C-N	-5.63	113.22	119.19
1	A	304	VAL	C-N-CA	-5.63	113.22	119.19
1	B	210	ASP	N-CA-C	5.43	122.36	110.80
1	A	497	TRP	N-CA-C	-5.40	100.37	109.07
1	B	118	VAL	CB-CA-C	-5.38	105.00	112.04
1	A	463	ALA	N-CA-C	-5.38	105.50	111.36
1	B	238	GLY	N-CA-C	5.30	120.58	114.16
1	B	388	LYS	N-CA-C	-5.25	105.73	111.82
1	B	292	VAL	CA-C-N	-5.20	114.39	119.64
1	B	292	VAL	C-N-CA	-5.20	114.39	119.64
1	B	352	ALA	N-CA-C	5.18	116.93	111.28
1	B	191	SER	N-CA-C	-5.15	105.35	111.69
1	B	139	TYR	CA-CB-CG	-5.13	104.66	113.90

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	230	PHE	O-C-N	5.08	125.73	121.31
1	B	133	ILE	N-CA-C	-5.04	105.07	110.36
1	A	153	TYR	N-CA-C	5.01	117.47	111.71

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	3606	0	3496	37	0
1	B	3676	0	3545	36	0
2	A	28	0	12	0	0
2	B	28	0	12	0	0
3	B	6	0	8	1	0
4	B	4	0	6	0	0
5	B	12	0	13	0	0
6	A	313	0	0	3	0
6	B	305	0	0	2	0
All	All	7978	0	7092	73	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 5.

All (73) 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:188:SER:HB2	1:B:299:THR:HG23	1.75	0.68
1:A:384[B]:SER:O	1:A:388[B]:LYS:HB3	1.97	0.64
1:B:279:MET:HE1	1:B:528:TYR:CD2	2.32	0.64
1:A:126:TYR:CE2	1:A:518:MET:HE1	2.34	0.62
1:A:467:MET:HE2	1:A:487:VAL:HB	1.81	0.61
1:A:112:LEU:O	1:A:116:GLN:HG2	2.01	0.61
1:A:467:MET:HE3	1:A:484:PHE:HA	1.84	0.59
1:B:245:ARG:HA	1:B:250:MET:HE2	1.84	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:329:HIS:HB2	1:B:518[B]:MET:HE3	1.84	0.58
1:A:538:THR:HA	1:A:541:LEU:HD13	1.86	0.56
1:A:551:ILE:O	1:A:551:ILE:HG23	2.04	0.56
1:A:347:THR:O	1:A:351[B]:GLU:HB2	2.06	0.56
1:A:527:PHE:HD1	1:A:538:THR:HG1	1.55	0.55
1:B:502:PRO:HD3	3:B:602:GOL:H31	1.87	0.55
1:A:464:LEU:HD11	1:A:468[A]:TYR:HE2	1.72	0.54
1:A:347:THR:O	1:A:351[A]:GLU:HB2	2.09	0.53
1:A:125:PRO:HG2	1:A:126:TYR:CE2	2.45	0.52
1:B:127:LYS:HD3	1:B:128:PRO:HD2	1.92	0.52
1:B:180:SER:O	1:B:185:ARG:HD2	2.11	0.51
1:B:321:PHE:CE1	1:B:327:VAL:HA	2.46	0.51
1:A:467:MET:CE	1:A:484:PHE:HA	2.41	0.51
1:B:122:LYS:NZ	1:B:474:ASP:OD1	2.43	0.49
1:B:329:HIS:CB	1:B:518[B]:MET:HE3	2.41	0.49
1:B:176:TRP:CG	1:B:189:LEU:HD13	2.48	0.48
1:B:185:ARG:NH2	1:B:211:MET:SD	2.87	0.48
1:B:495:LYS:HD3	1:B:515:ALA:O	2.14	0.48
1:A:379:MET:HG2	6:A:817:HOH:O	2.13	0.47
1:B:210:ASP:HA	1:B:213:ASP:OD2	2.15	0.47
1:B:359:GLU:OE1	1:B:361:ILE:HD11	2.15	0.47
1:B:326:THR:O	1:B:327:VAL:C	2.56	0.46
1:A:129:SER:O	1:A:133:ILE:HG13	2.15	0.46
1:A:365:VAL:HB	1:A:417:SER:HB2	1.97	0.46
1:B:366:LYS:HE3	1:B:368:PHE:CE2	2.50	0.46
1:B:176:TRP:CD2	1:B:189:LEU:HD13	2.51	0.46
1:B:347:THR:O	1:B:351:GLU:HG2	2.15	0.46
1:A:268:HIS:CE1	1:A:270:VAL:HB	2.51	0.45
1:B:304:VAL:HB	1:B:305:PRO:HD3	1.98	0.45
1:B:146:CYS:HB2	1:B:202:VAL:HG21	1.97	0.45
1:B:351:GLU:HG3	6:B:975:HOH:O	2.16	0.45
1:B:314[B]:ASP:OD1	1:B:314[B]:ASP:C	2.59	0.45
1:A:414:LEU:HD21	1:A:469:LEU:HB3	1.98	0.45
1:A:388[A]:LYS:NZ	1:A:389:GLU:OE2	2.41	0.44
1:A:121[A]:ARG:NH2	6:A:721:HOH:O	2.50	0.44
1:B:139:TYR:CD2	1:B:139:TYR:C	2.95	0.44
1:A:415:VAL:O	1:A:445:GLN:HG3	2.18	0.44
1:A:548:CYS:HB2	1:A:551:ILE:O	2.18	0.44
1:B:389:GLU:HG3	1:B:497:TRP:CD1	2.53	0.44
1:A:507:THR:HG22	1:A:508:PRO:O	2.18	0.43
1:B:330:HIS:HD2	1:B:333:ARG:HH21	1.66	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:516:MET:HE1	1:A:547:HIS:O	2.18	0.43
1:B:416:THR:OG1	1:B:470:LEU:HD11	2.19	0.43
1:A:136:LEU:HD13	1:A:334:TYR:CD1	2.54	0.43
1:A:139:TYR:CD2	1:A:139:TYR:C	2.95	0.43
1:A:350:TYR:CE2	1:A:360:LYS:HE2	2.53	0.43
1:A:144:LYS:HA	1:A:222:MET:HG3	2.01	0.42
1:A:176:TRP:CH2	1:A:178:SER:HA	2.54	0.42
1:A:338:PRO:HD3	1:A:468[A]:TYR:CZ	2.54	0.42
1:B:464:LEU:HD11	1:B:468[A]:TYR:HE1	1.84	0.42
1:B:126:TYR:CE2	1:B:518[A]:MET:HE1	2.54	0.42
1:A:501:ARG:HA	1:A:502:PRO:HD3	1.95	0.42
1:B:101:LEU:HB2	1:B:128:PRO:HG3	2.02	0.42
1:B:274:GLY:O	1:B:278:LYS:HG3	2.20	0.41
1:B:269:LEU:HB2	1:B:299:THR:HB	2.02	0.41
1:B:279:MET:CE	6:B:943:HOH:O	2.68	0.41
1:A:266:TYR:OH	1:A:268:HIS:HD2	2.04	0.41
1:A:525:PRO:CB	1:A:555:LEU:HD12	2.50	0.41
1:B:271:HIS:ND1	1:B:300:ASP:OD2	2.45	0.41
1:A:381:GLN:HG2	1:A:499:LEU:HD22	2.03	0.40
1:B:172:LYS:HE3	1:B:199:THR:O	2.21	0.40
1:A:194:LEU:HD21	1:A:317:LEU:HD21	2.03	0.40
1:B:116:GLN:O	1:B:117:SER:C	2.64	0.40
1:A:287:THR:HA	6:A:823:HOH:O	2.21	0.40
1:A:489:GLN:HB2	1:A:494:LEU:O	2.21	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	439/476 (92%)	412 (94%)	25 (6%)	2 (0%)	24 27

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	453/476 (95%)	428 (94%)	21 (5%)	4 (1%)	14	14
All	All	892/952 (94%)	840 (94%)	46 (5%)	6 (1%)	18	19

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	254	GLN
1	B	408	PRO
1	B	114	ARG
1	B	290	GLY
1	A	206	ASP
1	B	548	CYS

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	398/423 (94%)	385 (97%)	13 (3%)	33	45
1	B	405/423 (96%)	386 (95%)	19 (5%)	23	31
All	All	803/846 (95%)	771 (96%)	32 (4%)	30	38

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	117	SER
1	A	127	LYS
1	A	222	MET
1	A	243	SER
1	A	261	THR
1	A	273	TYR
1	A	351[A]	GLU
1	A	351[B]	GLU
1	A	384[A]	SER
1	A	384[B]	SER

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Mol	Chain	Res	Type
1	A	409	LYS
1	A	440	ILE
1	A	519	GLU
1	B	118	VAL
1	B	121	ARG
1	B	122	LYS
1	B	163	GLU
1	B	166	ASP
1	B	209	LYS
1	B	227	PRO
1	B	242	GLU
1	B	259	GLU
1	B	273	TYR
1	B	291	LYS
1	B	360	LYS
1	B	384[A]	SER
1	B	384[B]	SER
1	B	388	LYS
1	B	409	LYS
1	B	503	GLU
1	B	556	LYS
1	B	558	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	268	HIS
1	A	376	GLN
1	A	459	HIS
1	B	264	HIS
1	B	301	ASN
1	B	330	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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

5 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	GOL	B	602	-	5,5,5	0.85	0	5,5,5	1.41	1 (20%)
4	EDO	B	603	-	3,3,3	0.59	0	2,2,2	0.22	0
2	GDP	A	601	-	29,30,30	1.21	3 (10%)	45,47,47	1.85	7 (15%)
2	GDP	B	601	-	29,30,30	1.20	4 (13%)	45,47,47	1.67	6 (13%)
5	MES	B	604	-	12,12,12	2.77	1 (8%)	15,16,16	2.19	5 (33%)

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	GOL	B	602	-	-	2/4/4/4	-
4	EDO	B	603	-	-	1/1/1/1	-
2	GDP	A	601	-	-	1/16/32/32	0/3/3/3
2	GDP	B	601	-	-	7/16/32/32	0/3/3/3
5	MES	B	604	-	-	5/6/14/14	0/1/1/1

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	604	MES	C8-S	-9.47	1.64	1.77
2	A	601	GDP	C5-C4	3.21	1.47	1.38
2	B	601	GDP	C5-C4	3.03	1.47	1.38
2	A	601	GDP	PA-O3A	2.88	1.62	1.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	601	GDP	PA-O3A	2.83	1.62	1.59
2	B	601	GDP	C5-N7	-2.47	1.34	1.39
2	A	601	GDP	C5-N7	-2.23	1.34	1.39
2	B	601	GDP	C6-N1	-2.03	1.35	1.38

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	601	GDP	C5-C4-N3	-5.63	119.43	128.39
2	B	601	GDP	C5-C4-N3	-5.44	119.73	128.39
2	A	601	GDP	C2-N3-C4	5.34	121.50	112.30
2	B	601	GDP	C2-N3-C4	4.62	120.25	112.30
5	B	604	MES	O3S-S-C8	4.47	114.75	106.00
2	B	601	GDP	N9-C4-N3	4.25	134.46	125.95
2	A	601	GDP	N9-C4-N3	4.18	134.31	125.95
5	B	604	MES	O1S-S-C8	3.87	112.58	106.73
2	A	601	GDP	C6-C5-N7	3.57	136.79	130.29
5	B	604	MES	O2S-S-C8	-3.25	101.82	106.73
2	B	601	GDP	C6-C5-N7	2.90	135.56	130.29
2	A	601	GDP	O6-C6-C5	-2.85	119.00	126.53
2	B	601	GDP	O6-C6-C5	-2.75	119.27	126.53
5	B	604	MES	C6-C5-N4	-2.61	106.16	110.12
5	B	604	MES	C2-C3-N4	-2.55	106.24	110.12
2	A	601	GDP	C5-C6-N1	2.28	119.05	113.25
2	A	601	GDP	C4-C5-N7	-2.25	107.11	110.67
3	B	602	GOL	O1-C1-C2	2.08	119.75	110.38
2	B	601	GDP	C4-C5-N7	-2.05	107.42	110.67

There are no chirality outliers.

All (16) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	601	GDP	C5'-O5'-PA-O3A
2	B	601	GDP	C5'-O5'-PA-O1A
2	B	601	GDP	C5'-O5'-PA-O2A
3	B	602	GOL	C1-C2-C3-O3
3	B	602	GOL	O2-C2-C3-O3
5	B	604	MES	C8-C7-N4-C3
5	B	604	MES	C7-C8-S-O1S
5	B	604	MES	C7-C8-S-O3S
2	B	601	GDP	O4'-C4'-C5'-O5'
2	B	601	GDP	C3'-C4'-C5'-O5'

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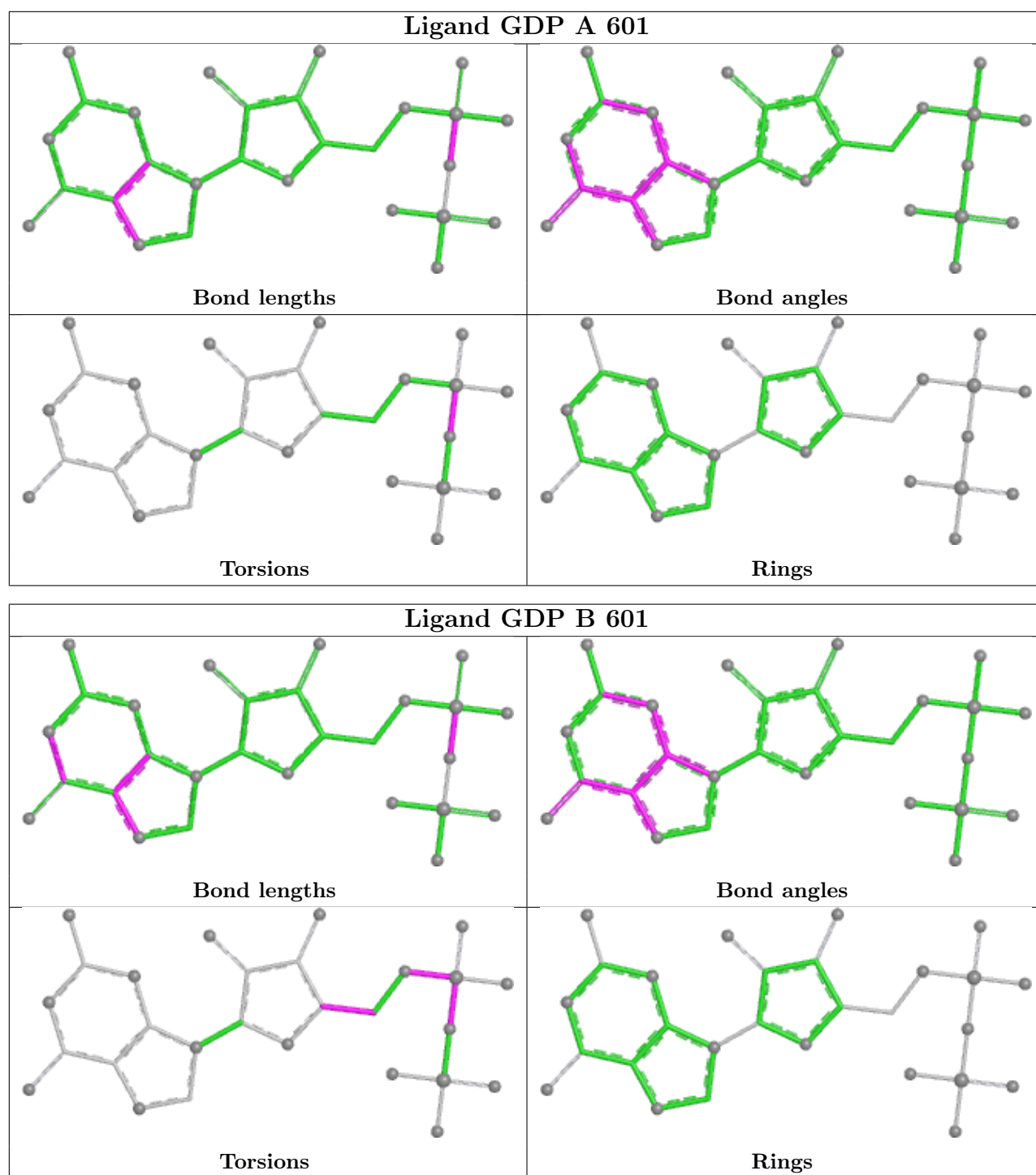
Mol	Chain	Res	Type	Atoms
4	B	603	EDO	O1-C1-C2-O2
2	B	601	GDP	PB-O3A-PA-O1A
2	B	601	GDP	PB-O3A-PA-O5'
5	B	604	MES	C7-C8-S-O2S
5	B	604	MES	C8-C7-N4-C5
2	A	601	GDP	PB-O3A-PA-O2A

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	602	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 [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

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, 95th 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 ²)	Q<0.9
1	A	440/476 (92%)	0.78	34 (7%)	19 17	10, 25, 54, 93	9 (2%)
1	B	450/476 (94%)	0.67	40 (8%)	15 13	8, 22, 52, 77	9 (2%)
All	All	890/952 (93%)	0.73	74 (8%)	17 15	8, 23, 53, 93	18 (2%)

All (74) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	399	VAL	7.0
1	B	399	VAL	5.9
1	A	398	LEU	5.7
1	A	162	GLN	5.5
1	B	370	GLU	5.4
1	A	261	THR	4.9
1	A	163	GLU	4.7
1	A	169	GLY	4.5
1	A	458	MET	4.5
1	B	256	ILE	4.4
1	B	255	VAL	4.3
1	B	407	THR	4.3
1	A	255	VAL	4.2
1	B	459	HIS	4.1
1	B	162	GLN	3.9
1	A	468[A]	TYR	3.7
1	B	398	LEU	3.6
1	B	242	GLU	3.6
1	A	161	ASP	3.6
1	A	118	VAL	3.5
1	B	458	MET	3.5
1	A	119	HIS	3.4
1	A	121[A]	ARG	3.3
1	B	260	GLY	3.3

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Mol	Chain	Res	Type	RSRZ
1	B	408	PRO	3.2
1	B	527[A]	PHE	3.2
1	A	448	GLN	3.2
1	B	449	GLU	3.1
1	A	95	ASP	3.1
1	A	449	GLU	3.0
1	A	459	HIS	3.0
1	B	397	THR	3.0
1	A	117	SER	3.0
1	B	161	ASP	2.9
1	A	356	HIS	2.9
1	A	407	THR	2.8
1	B	165	ILE	2.7
1	B	238	GLY	2.7
1	B	116	GLN	2.7
1	A	212[A]	ASP	2.7
1	B	239	LEU	2.7
1	A	97	LEU	2.7
1	B	166	ASP	2.6
1	A	397	THR	2.6
1	A	450	GLY	2.6
1	A	244	SER	2.5
1	B	259	GLU	2.5
1	B	355	SER	2.5
1	A	115	TYR	2.5
1	B	237	ASP	2.4
1	A	251	VAL	2.4
1	B	531	LYS	2.4
1	B	356	HIS	2.4
1	B	534	THR	2.3
1	A	503	GLU	2.3
1	B	448	GLN	2.3
1	B	368	PHE	2.3
1	B	371	ASP	2.3
1	B	450	GLY	2.3
1	B	258	THR	2.3
1	B	163	GLU	2.3
1	A	170	GLU	2.2
1	B	235	GLN	2.2
1	B	115	TYR	2.2
1	B	236	PHE	2.2
1	B	503	GLU	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	109	ASP	2.1
1	B	249	TYR	2.1
1	A	157	LEU	2.1
1	A	158	LYS	2.1
1	A	254	GLN	2.1
1	B	118	VAL	2.1
1	B	119	HIS	2.1
1	A	420	ALA	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

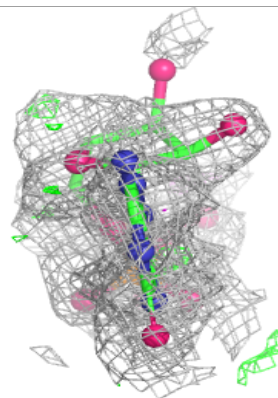
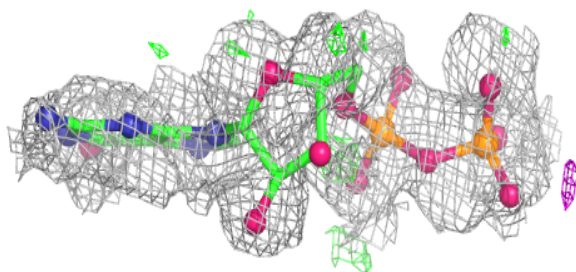
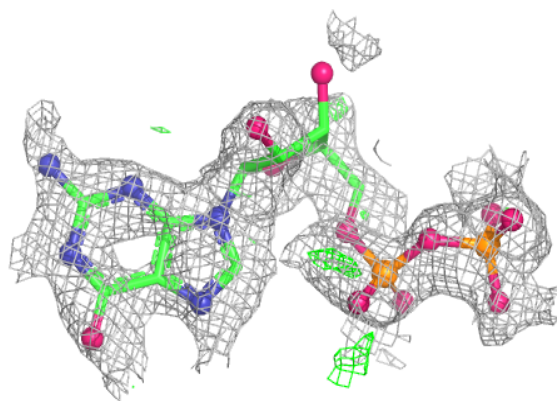
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
2	GDP	A	601	28/28	0.70	0.23	32,46,54,56	28
3	GOL	B	602	6/6	0.70	0.30	39,40,41,41	0
4	EDO	B	603	4/4	0.71	0.26	42,43,45,46	0
2	GDP	B	601	28/28	0.79	0.15	34,50,103,108	0
5	MES	B	604	12/12	0.81	0.30	17,18,18,19	12

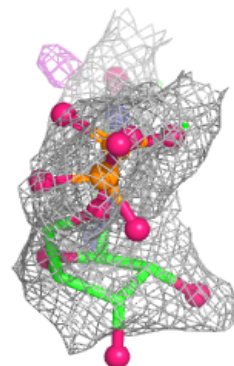
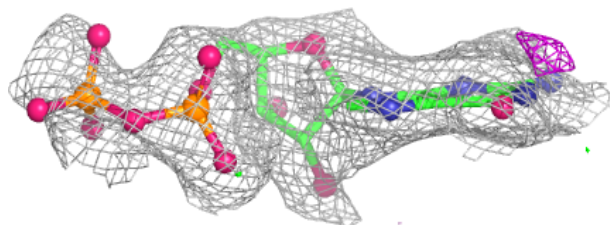
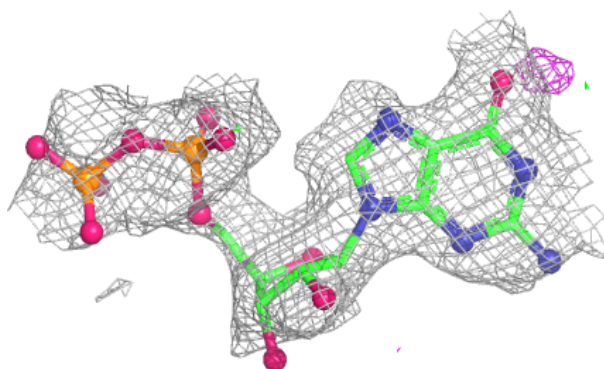
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around GDP A 601:

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

**Electron density around GDP B 601:**

$2mF_o-DF_c$ (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.