



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 03:51 AM UTC

PDB ID : 1YRO / pdb_00001yro
Title : Crystal structure of beta14,-galactosyltransferase mutant ARG228Lys in complex with alpha-lactalbumin in the presence of UDP-galactose and Mn
Authors : Ramakrishnan, B.; Boeggeman, E.; Qasba, P.K.
Deposited on : 2005-02-04
Resolution : 1.90 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

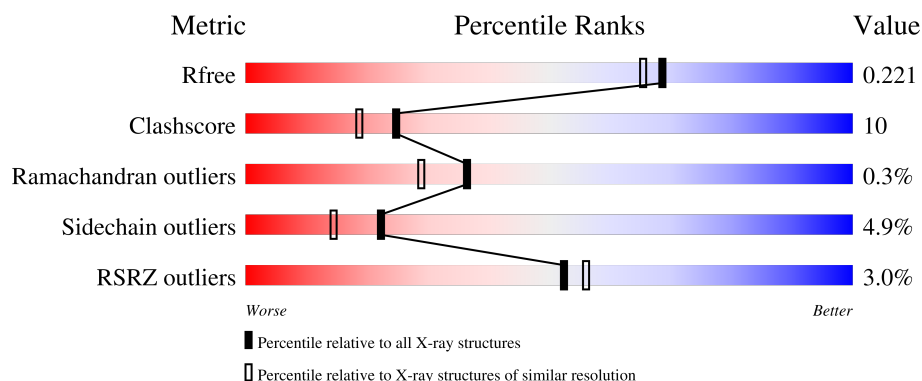
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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	123	6% 80% 18% .
1	C	123	7% 80% 18% ..
2	B	286	2% 73% 19% • 5%
2	D	286	% 73% 20% • 5%

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 7388 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 ALPHA-LACTALBUMIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	123	Total	C	N	O	S	0	0	0
			980	620	156	195	9			
1	C	123	Total	C	N	O	S	0	0	0
			980	620	156	195	9			

- Molecule 2 is a protein called BETA-1,4-GALACTOSYLTRANSFERASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	272	Total	C	N	O	S	0	0	0
			2217	1425	380	399	13			
2	D	272	Total	C	N	O	S	0	0	0
			2217	1425	380	399	13			

There are 30 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	117	ALA	-	SEE REMARK 999	UNP P08037
B	118	SER	-	SEE REMARK 999	UNP P08037
B	119	MET	-	SEE REMARK 999	UNP P08037
B	120	THR	-	SEE REMARK 999	UNP P08037
B	121	GLY	-	SEE REMARK 999	UNP P08037
B	122	GLY	-	SEE REMARK 999	UNP P08037
B	123	GLN	-	SEE REMARK 999	UNP P08037
B	124	GLN	-	SEE REMARK 999	UNP P08037
B	125	MET	-	SEE REMARK 999	UNP P08037
B	126	GLY	-	SEE REMARK 999	UNP P08037
B	127	ARG	-	SEE REMARK 999	UNP P08037
B	128	GLY	-	SEE REMARK 999	UNP P08037
B	129	SER	-	SEE REMARK 999	UNP P08037
B	228	LYS	ARG	engineered mutation	UNP P08037
B	342	THR	CYS	engineered mutation	UNP P08037
D	117	ALA	-	SEE REMARK 999	UNP P08037

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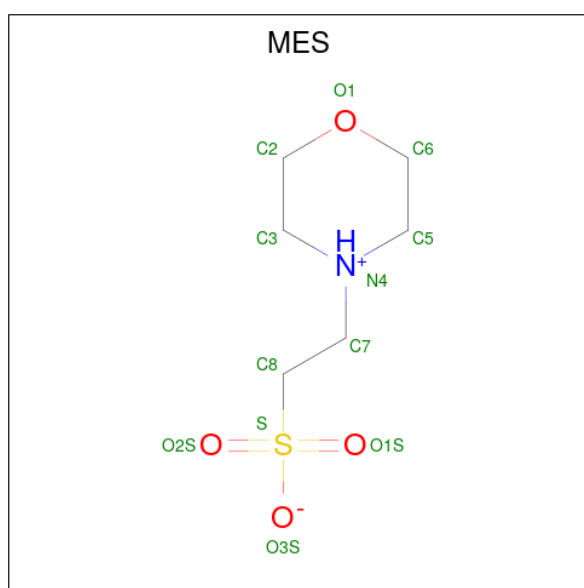
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Chain	Residue	Modelled	Actual	Comment	Reference
D	118	SER	-	SEE REMARK 999	UNP P08037
D	119	MET	-	SEE REMARK 999	UNP P08037
D	120	THR	-	SEE REMARK 999	UNP P08037
D	121	GLY	-	SEE REMARK 999	UNP P08037
D	122	GLY	-	SEE REMARK 999	UNP P08037
D	123	GLN	-	SEE REMARK 999	UNP P08037
D	124	GLN	-	SEE REMARK 999	UNP P08037
D	125	MET	-	SEE REMARK 999	UNP P08037
D	126	GLY	-	SEE REMARK 999	UNP P08037
D	127	ARG	-	SEE REMARK 999	UNP P08037
D	128	GLY	-	SEE REMARK 999	UNP P08037
D	129	SER	-	SEE REMARK 999	UNP P08037
D	228	LYS	ARG	engineered mutation	UNP P08037
D	342	THR	CYS	engineered mutation	UNP P08037

- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

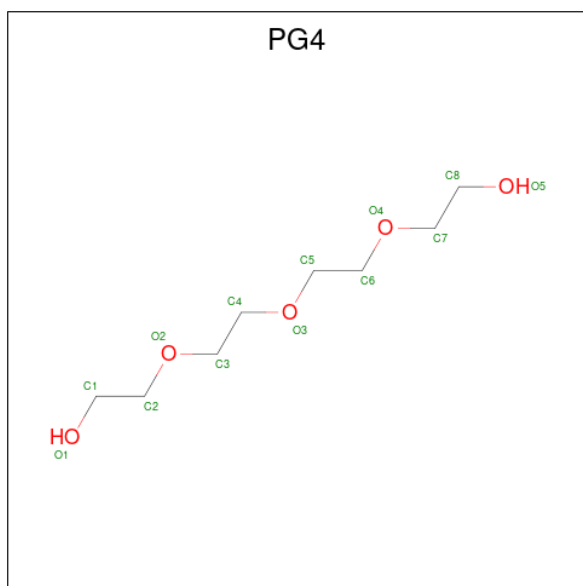
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Ca 1 1	0	0
3	C	1	Total Ca 1 1	0	0

- Molecule 4 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: C₆H₁₃NO₄S).



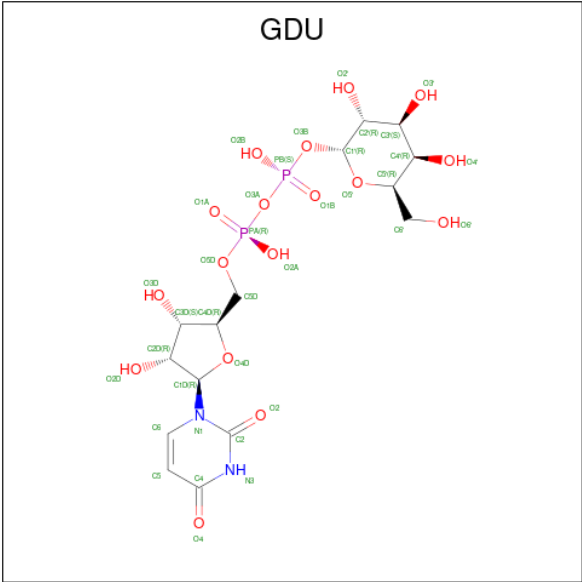
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 5 is TETRAETHYLENE GLYCOL (CCD ID: PG4) (formula: $C_8H_{18}O_5$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			13	8	5		
5	C	1	Total	C	O	0	0
			13	8	5		

- Molecule 6 is GALACTOSE-URIDINE-5'-DIPHOSPHATE (CCD ID: GDU) (formula: $C_{15}H_{24}N_2O_{17}P_2$).

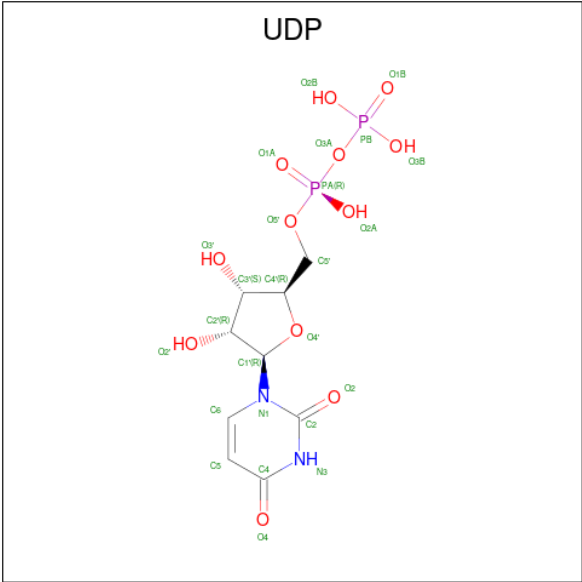


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
6	B	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
6	D	1	Total	C	N	O	P	0	0
			36	15	2	17	2		

- Molecule 7 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	B	1	Total	Mn	0	0
			1	1		
7	D	1	Total	Mn	0	0
			1	1		

- Molecule 8 is URIDINE-5'-DIPHOSPHATE (CCD ID: UDP) (formula: C₉H₁₄N₂O₁₂P₂).



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

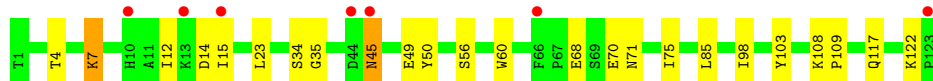
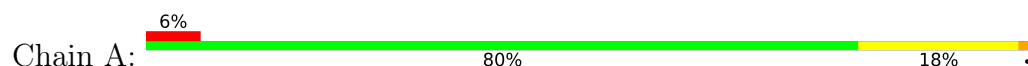
- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	156	Total	O	0	0
			156	156		
9	B	253	Total	O	0	0
			253	253		
9	C	151	Total	O	0	0
			151	151		
9	D	270	Total	O	0	0
			270	270		

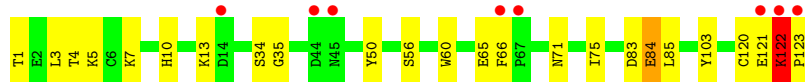
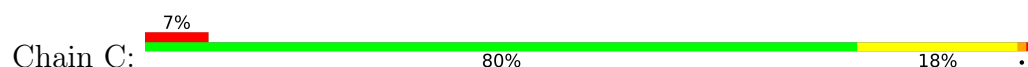
3 Residue-property plots [i](#)

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.

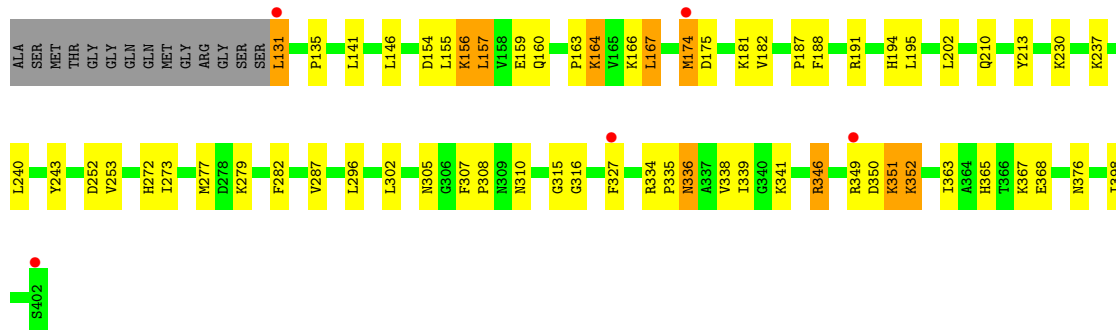
- Molecule 1: ALPHA-LACTALBUMIN



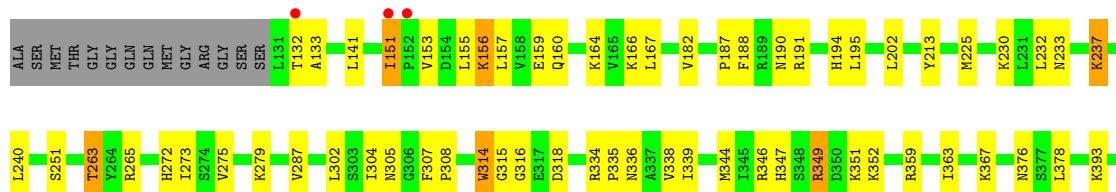
- Molecule 1: ALPHA-LACTALBUMIN



- Molecule 2: BETA-1,4-GALACTOSYLTRANSFERASE



- Molecule 2: BETA-1,4-GALACTOSYLTRANSFERASE





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	57.33Å 94.09Å 99.70Å 90.00° 101.64° 90.00°	Depositor
Resolution (Å)	32.55 – 1.90 32.55 – 1.90	Depositor EDS
% Data completeness (in resolution range)	97.9 (32.55-1.90) 97.9 (32.55-1.90)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.05	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.70 (at 1.88Å)	Xtriage
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.189 , 0.225 0.185 , 0.221	Depositor DCC
R_{free} test set	8001 reflections (9.72%)	wwPDB-VP
Wilson B-factor (Å ²)	27.2	Xtriage
Anisotropy	0.216	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 46.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7388	wwPDB-VP
Average B, all atoms (Å ²)	31.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.30% 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: UDP, MN, PG4, CA, GDU, MES

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	0.62	0/1001	1.04	5/1350 (0.4%)
1	C	0.67	0/1001	1.17	8/1350 (0.6%)
2	B	0.63	0/2277	1.06	13/3084 (0.4%)
2	D	0.65	0/2277	1.06	11/3084 (0.4%)
All	All	0.64	0/6556	1.08	37/8868 (0.4%)

There are no bond length outliers.

All (37) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	122	LYS	N-CA-C	11.74	135.76	109.81
2	B	315	GLY	N-CA-C	9.28	123.71	112.48
2	D	182	VAL	N-CA-C	8.79	120.54	107.80
1	A	50	TYR	N-CA-C	8.23	122.82	109.40
2	B	182	VAL	N-CA-C	7.95	119.33	107.80
1	A	60	TRP	N-CA-C	7.60	123.02	112.45
1	C	103	TYR	N-CA-C	-7.48	103.13	111.28
2	B	273	ILE	N-CA-C	7.25	119.27	111.58
1	C	50	TYR	N-CA-C	7.23	121.18	109.40
2	D	315	GLY	N-CA-C	7.20	121.75	112.68
1	C	60	TRP	N-CA-C	6.99	122.16	112.45
2	D	202	LEU	N-CA-C	6.82	118.80	111.36
2	D	273	ILE	N-CA-C	6.65	117.63	111.45
2	D	156	LYS	N-CA-C	-6.26	104.45	111.28
2	B	335	PRO	N-CA-C	-6.16	101.96	111.13
1	A	70	GLU	N-CA-C	-6.14	104.65	111.71
2	B	188	PHE	N-CA-C	6.10	118.57	108.99
2	B	310	ASN	N-CA-C	6.08	120.31	113.02
2	B	351	LYS	N-CA-C	-6.03	102.00	110.50
2	B	202	LEU	N-CA-C	6.02	118.81	111.82

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	213	TYR	N-CA-C	5.98	118.50	109.41
2	B	213	TYR	N-CA-C	5.86	118.78	109.81
2	D	188	PHE	N-CA-C	5.82	118.12	108.99
2	B	174	MET	N-CA-C	-5.66	106.54	113.50
2	B	175	ASP	N-CA-C	5.62	118.60	111.69
1	C	65	GLU	N-CA-C	5.61	120.18	113.23
2	D	314	TRP	N-CA-C	5.57	119.00	110.20
2	D	335	PRO	N-CA-C	-5.45	103.01	111.13
1	A	98	ILE	N-CA-C	5.33	116.41	111.45
2	D	359	ARG	N-CA-C	5.20	116.95	111.28
2	B	187	PRO	N-CA-C	-5.18	103.05	111.19
1	A	56	SER	N-CA-C	5.12	118.28	110.20
2	B	252	ASP	N-CA-C	-5.04	103.49	110.35
1	C	65	GLU	CA-C-N	-5.04	116.05	123.30
1	C	65	GLU	C-N-CA	-5.04	116.05	123.30
1	C	56	SER	N-CA-C	5.02	118.39	109.96
2	D	251	SER	N-CA-C	5.01	117.23	108.76

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	980	0	936	15	0
1	C	980	0	936	20	0
2	B	2217	0	2187	46	0
2	D	2217	0	2187	47	0
3	A	1	0	0	0	0
3	C	1	0	0	0	0
4	A	12	0	13	2	0
5	A	13	0	18	2	0
5	C	13	0	18	2	0
6	B	36	0	22	1	0
6	D	36	0	22	4	0
7	B	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
7	D	1	0	0	0	0
8	B	25	0	11	0	0
8	D	25	0	11	0	0
9	A	156	0	0	3	0
9	B	253	0	0	6	0
9	C	151	0	0	5	0
9	D	270	0	0	7	0
All	All	7388	0	6361	127	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 10.

All (127) 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:346:ARG:HB3	2:B:346:ARG:HH11	1.30	0.96
2:D:349:ARG:HH11	2:D:349:ARG:HG2	1.39	0.85
2:D:346:ARG:HD3	9:D:1182:HOH:O	1.78	0.82
2:B:277:MET:HE1	2:B:279:LYS:HE2	1.60	0.81
1:A:71:ASN:HD21	1:A:75:ILE:H	1.28	0.81
2:B:327:PHE:CZ	2:B:367:LYS:HB2	2.16	0.80
2:D:225:MET:HE2	2:D:352:LYS:HE3	1.62	0.80
2:B:305:ASN:HD21	2:B:376:ASN:H	1.30	0.77
2:D:151:ILE:H	2:D:151:ILE:HD13	1.53	0.74
2:B:237:LYS:HD2	9:B:1398:HOH:O	1.89	0.73
1:C:4:THR:H	1:C:7:LYS:HE3	1.54	0.72
2:B:277:MET:CE	2:B:279:LYS:HE2	2.21	0.70
2:B:336:ASN:HD22	2:B:338:VAL:H	1.40	0.69
2:B:191:ARG:HH11	2:B:194:HIS:HD2	1.39	0.69
2:B:346:ARG:HH11	2:B:346:ARG:CB	2.06	0.68
2:D:336:ASN:HD22	2:D:338:VAL:H	1.41	0.67
2:D:191:ARG:HH11	2:D:194:HIS:HD2	1.43	0.65
2:D:225:MET:HE2	2:D:352:LYS:CE	2.26	0.64
1:C:71:ASN:HD21	1:C:75:ILE:H	1.43	0.64
2:B:349:ARG:HD3	2:B:350:ASP:H	1.62	0.64
2:B:131:LEU:N	2:B:131:LEU:HD23	2.13	0.63
1:C:34:SER:HA	5:C:807:PG4:H51	1.81	0.63
2:D:155:LEU:O	2:D:159:GLU:HG3	1.97	0.63
2:B:352:LYS:HE3	9:B:1361:HOH:O	1.99	0.62
2:D:279:LYS:HD2	2:D:346:ARG:HH12	1.64	0.62
2:D:305:ASN:HD21	2:D:376:ASN:H	1.48	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:349:ARG:HH11	2:D:349:ARG:CG	2.11	0.62
2:B:351:LYS:O	2:B:352:LYS:HB2	1.99	0.61
1:C:7:LYS:HD3	9:C:1216:HOH:O	2.00	0.61
2:B:174:MET:HG2	9:B:1468:HOH:O	2.01	0.60
2:D:316:GLY:HA2	2:D:363:ILE:HD11	1.83	0.60
2:D:151:ILE:H	2:D:151:ILE:CD1	2.15	0.60
1:C:66:PHE:HB2	9:C:996:HOH:O	2.02	0.59
2:B:191:ARG:NH1	2:B:194:HIS:HD2	2.00	0.59
2:B:272:HIS:HB3	2:B:334:ARG:HG2	1.85	0.58
1:A:7:LYS:HE3	9:A:1510:HOH:O	2.03	0.58
2:D:151:ILE:HD13	2:D:151:ILE:N	2.18	0.58
1:C:35:GLY:N	5:C:807:PG4:H32	2.18	0.57
2:B:160:GLN:O	2:B:163:PRO:HD3	2.06	0.56
1:C:122:LYS:HG3	9:C:1270:HOH:O	2.04	0.56
1:A:12:ILE:O	1:A:15:ILE:HG22	2.06	0.56
1:A:49:GLU:OE1	4:A:805:MES:H52	2.07	0.55
2:D:164:LYS:HD2	9:D:1443:HOH:O	2.05	0.55
1:C:4:THR:HG23	1:C:7:LYS:HE2	1.87	0.55
2:B:365:HIS:O	2:B:368:GLU:HG2	2.08	0.54
2:B:191:ARG:HD2	2:B:194:HIS:CD2	2.43	0.54
2:D:132:THR:HG22	2:D:133:ALA:N	2.22	0.53
2:D:344:MET:HE1	9:D:1050:HOH:O	2.08	0.53
1:A:108:LYS:HB3	1:A:109:PRO:CD	2.39	0.52
2:D:314:TRP:NE1	6:D:528:GDU:H6'1	2.24	0.52
2:D:279:LYS:HB2	2:D:346:ARG:NH1	2.23	0.52
2:D:367:LYS:HE3	9:D:1726:HOH:O	2.09	0.52
1:C:10:HIS:CD2	1:C:13:LYS:NZ	2.78	0.52
1:A:45:ASN:O	1:A:45:ASN:OD1	2.29	0.51
2:B:327:PHE:CE2	2:B:367:LYS:HD2	2.46	0.51
1:C:10:HIS:O	1:C:13:LYS:HG3	2.11	0.51
1:A:117:GLN:NE2	2:B:287:VAL:HG12	2.25	0.51
2:B:327:PHE:CE1	2:B:367:LYS:HB2	2.45	0.51
2:B:336:ASN:ND2	2:B:339:ILE:H	2.08	0.51
2:D:318:ASP:OD2	6:D:528:GDU:O4'	2.22	0.51
2:B:316:GLY:HA2	2:B:363:ILE:HD11	1.93	0.51
1:A:7:LYS:HG3	9:A:1545:HOH:O	2.11	0.51
1:C:84:GLU:HG3	9:C:1148:HOH:O	2.10	0.50
2:B:164:LYS:HD3	9:B:1026:HOH:O	2.12	0.50
1:A:68:GLU:HG2	1:A:68:GLU:O	2.11	0.50
2:B:164:LYS:HE2	9:B:1341:HOH:O	2.12	0.50
1:C:4:THR:H	1:C:7:LYS:CE	2.23	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:314:TRP:CD1	6:D:528:GDU:H6'1	2.47	0.49
2:B:155:LEU:O	2:B:159:GLU:HG3	2.13	0.49
1:C:120:CYS:O	1:C:122:LYS:N	2.45	0.49
2:D:344:MET:HE3	2:D:347:HIS:CD2	2.47	0.49
2:D:156:LYS:O	2:D:160:GLN:HG3	2.13	0.49
2:D:344:MET:HE2	2:D:346:ARG:NH1	2.28	0.49
2:B:336:ASN:HD22	2:B:338:VAL:N	2.08	0.48
2:B:336:ASN:ND2	2:B:338:VAL:H	2.08	0.48
2:D:191:ARG:NH1	2:D:194:HIS:HD2	2.09	0.47
2:D:230:LYS:HD3	2:D:398:ILE:HB	1.96	0.47
1:C:4:THR:N	1:C:7:LYS:HE3	2.27	0.47
2:D:336:ASN:ND2	2:D:339:ILE:H	2.12	0.47
1:A:4:THR:OG1	1:A:7:LYS:HB2	2.15	0.46
1:C:1:THR:OG1	1:C:83:ASP:OD2	2.30	0.46
2:D:272:HIS:HB3	2:D:334:ARG:HG2	1.97	0.46
2:D:275:VAL:HG11	9:D:1362:HOH:O	2.15	0.46
2:B:194:HIS:HE1	9:B:1132:HOH:O	1.99	0.46
2:D:237:LYS:HD3	2:D:378:LEU:HD23	1.98	0.45
2:D:132:THR:CG2	2:D:133:ALA:N	2.79	0.45
2:B:230:LYS:HD3	2:B:398:ILE:HB	1.98	0.45
2:D:307:PHE:HB3	2:D:308:PRO:HD2	1.99	0.45
2:D:314:TRP:CE2	6:D:528:GDU:H6'1	2.51	0.45
2:B:135:PRO:HD2	2:B:210:GLN:HE22	1.81	0.45
1:C:10:HIS:HA	1:C:13:LYS:HE3	1.99	0.45
2:D:187:PRO:HD3	2:D:232:LEU:HD21	1.99	0.45
2:D:166:LYS:HE3	9:D:1447:HOH:O	2.16	0.44
2:D:191:ARG:HD2	2:D:194:HIS:CD2	2.53	0.44
1:A:103:TYR:CE2	4:A:805:MES:H51	2.53	0.44
2:B:336:ASN:HD22	2:B:336:ASN:C	2.25	0.44
2:D:263:THR:HG22	2:D:265:ARG:HG3	2.00	0.44
1:A:108:LYS:HB3	1:A:109:PRO:HD3	1.99	0.43
1:C:10:HIS:CD2	1:C:13:LYS:HE3	2.54	0.43
2:B:282:PHE:CD2	2:B:341:LYS:HD2	2.54	0.43
2:B:346:ARG:HB3	2:B:346:ARG:NH1	2.14	0.43
2:D:155:LEU:HD23	2:D:155:LEU:HA	1.83	0.43
2:B:191:ARG:NH1	2:B:194:HIS:CD2	2.85	0.43
2:D:304:ILE:O	2:D:305:ASN:HB3	2.19	0.43
2:B:156:LYS:HA	2:B:156:LYS:HE3	2.01	0.43
1:C:3:LEU:HA	1:C:7:LYS:HE3	1.99	0.43
1:A:34:SER:C	5:A:806:PG4:H52	2.44	0.42
1:A:35:GLY:N	5:A:806:PG4:H52	2.34	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:349:ARG:NE	2:B:349:ARG:HA	2.33	0.42
2:B:253:VAL:HG12	6:B:403:GDU:H2D	2.01	0.42
2:D:346:ARG:HA	2:D:346:ARG:HD2	1.63	0.42
2:D:351:LYS:HB2	2:D:351:LYS:HE2	1.74	0.42
2:D:233:ASN:HB3	2:D:378:LEU:HD22	2.01	0.42
2:B:277:MET:HE2	2:B:279:LYS:HG2	2.01	0.42
1:C:5:LYS:NZ	9:C:1195:HOH:O	2.52	0.42
2:D:151:ILE:O	2:D:151:ILE:HG12	2.19	0.42
2:D:393:LYS:HD2	9:D:1163:HOH:O	2.20	0.42
2:B:131:LEU:N	2:B:131:LEU:CD2	2.83	0.42
2:B:368:GLU:HG2	2:B:368:GLU:H	1.61	0.42
2:B:181:LYS:HD3	2:B:243:TYR:CE2	2.55	0.41
2:B:307:PHE:HB3	2:B:308:PRO:HD2	2.01	0.41
1:C:122:LYS:HA	1:C:123:PRO:HD3	1.56	0.41
2:D:336:ASN:ND2	2:D:338:VAL:HB	2.35	0.41
2:B:166:LYS:O	2:B:167:LEU:C	2.64	0.40
2:D:164:LYS:N	2:D:164:LYS:HD3	2.37	0.40
2:B:154:ASP:HB3	2:B:157:LEU:HB2	2.03	0.40
1:A:14:ASP:HA	9:A:1083:HOH:O	2.22	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	121/123 (98%)	119 (98%)	1 (1%)	1 (1%)	16	8
1	C	121/123 (98%)	116 (96%)	4 (3%)	1 (1%)	16	8
2	B	270/286 (94%)	264 (98%)	6 (2%)	0	100	100
2	D	270/286 (94%)	265 (98%)	5 (2%)	0	100	100
All	All	782/818 (96%)	764 (98%)	16 (2%)	2 (0%)	36	29

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	45	ASN
1	C	122	LYS

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 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	109/109 (100%)	105 (96%)	4 (4%)	30	22
1	C	109/109 (100%)	105 (96%)	4 (4%)	30	22
2	B	245/254 (96%)	231 (94%)	14 (6%)	18	11
2	D	245/254 (96%)	232 (95%)	13 (5%)	20	12
All	All	708/726 (98%)	673 (95%)	35 (5%)	22	14

All (35) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	7	LYS
1	A	23	LEU
1	A	85	LEU
1	A	122	LYS
2	B	131	LEU
2	B	141	LEU
2	B	146	LEU
2	B	156	LYS
2	B	157	LEU
2	B	164	LYS
2	B	167	LEU
2	B	195	LEU
2	B	240	LEU
2	B	296	LEU
2	B	302	LEU
2	B	336	ASN
2	B	346	ARG
2	B	352	LYS

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Mol	Chain	Res	Type
1	C	84	GLU
1	C	85	LEU
1	C	121	GLU
1	C	122	LYS
2	D	141	LEU
2	D	151	ILE
2	D	153	VAL
2	D	157	LEU
2	D	167	LEU
2	D	190	ASN
2	D	195	LEU
2	D	237	LYS
2	D	240	LEU
2	D	263	THR
2	D	287	VAL
2	D	302	LEU
2	D	349	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (22) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	39	GLN
1	A	45	ASN
1	A	71	ASN
2	B	150	ASN
2	B	160	GLN
2	B	161	GLN
2	B	194	HIS
2	B	210	GLN
2	B	299	GLN
2	B	305	ASN
2	B	310	ASN
2	B	336	ASN
1	C	10	HIS
1	C	32	HIS
1	C	71	ASN
2	D	160	GLN
2	D	180	HIS
2	D	194	HIS
2	D	305	ASN
2	D	310	ASN
2	D	336	ASN

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Mol	Chain	Res	Type
2	D	365	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 11 ligands modelled in this entry, 4 are monoatomic - leaving 7 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
4	MES	A	805	-	12,12,12	1.26	2 (16%)	15,16,16	1.18	2 (13%)
6	GDU	D	528	7	37,38,38	1.67	6 (16%)	55,58,58	1.84	9 (16%)
8	UDP	D	530	-	25,26,26	1.82	2 (8%)	38,40,40	1.51	6 (15%)
6	GDU	B	403	7	37,38,38	1.40	5 (13%)	55,58,58	1.81	7 (12%)
5	PG4	A	806	-	12,12,12	0.50	0	11,11,11	0.39	0
8	UDP	B	405	-	25,26,26	1.92	2 (8%)	38,40,40	1.56	8 (21%)
5	PG4	C	807	-	12,12,12	0.51	0	11,11,11	0.33	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	MES	A	805	-	-	2/6/14/14	0/1/1/1
6	GDU	D	528	7	-	5/23/59/59	0/3/3/3
8	UDP	D	530	-	-	5/16/32/32	0/2/2/2
6	GDU	B	403	7	-	4/23/59/59	0/3/3/3
5	PG4	A	806	-	-	7/10/10/10	-
8	UDP	B	405	-	-	0/16/32/32	0/2/2/2
5	PG4	C	807	-	-	6/10/10/10	-

All (17) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
8	B	405	UDP	PA-O3A	7.58	1.67	1.59
8	D	530	UDP	PA-O3A	6.81	1.66	1.59
6	D	528	GDU	PA-O3A	5.02	1.64	1.59
6	D	528	GDU	PB-O3B	-4.33	1.46	1.59
6	D	528	GDU	O5'-C5'	4.21	1.54	1.44
8	B	405	UDP	PB-O1B	3.64	1.61	1.50
6	D	528	GDU	O5'-C1'	3.40	1.50	1.41
6	B	403	GDU	PB-O3A	-3.37	1.55	1.59
8	D	530	UDP	PB-O1B	3.34	1.60	1.50
6	B	403	GDU	PB-O3B	-2.91	1.50	1.59
6	B	403	GDU	O5'-C5'	2.68	1.50	1.44
6	B	403	GDU	O5'-C1'	2.67	1.48	1.41
4	A	805	MES	C5-N4	2.31	1.53	1.46
6	D	528	GDU	PB-O1B	2.12	1.58	1.50
4	A	805	MES	C3-N4	2.06	1.52	1.46
6	D	528	GDU	PA-O2A	-2.05	1.45	1.55
6	B	403	GDU	C2-N1	2.05	1.41	1.38

All (32) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	B	403	GDU	O3B-PB-O1B	7.11	132.55	109.81
6	D	528	GDU	O5'-C1'-O3B	6.93	120.43	111.36
6	D	528	GDU	O3B-PB-O1B	6.06	129.19	109.81
8	B	405	UDP	O5'-C5'-C4'	4.55	124.49	108.99
6	B	403	GDU	O5'-C1'-O3B	4.46	117.20	111.36
8	D	530	UDP	O5'-C5'-C4'	4.03	122.73	108.99
8	D	530	UDP	O3B-PB-O1B	4.02	126.50	110.83
6	B	403	GDU	O5'-C5'-C6'	-4.02	96.48	106.44
8	B	405	UDP	O3B-PB-O1B	3.81	125.69	110.83
6	B	403	GDU	O4D-C4D-C3D	-3.64	97.92	105.15

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	D	528	GDU	O5'-C5'-C6'	-3.47	97.85	106.44
6	D	528	GDU	O4D-C4D-C3D	-3.41	98.39	105.15
6	B	403	GDU	O2-C2-N1	-2.92	118.99	122.80
8	D	530	UDP	O2-C2-N1	-2.86	119.07	122.80
6	D	528	GDU	O3'-C3'-C4'	-2.85	103.65	110.38
8	B	405	UDP	O2-C2-N1	-2.73	119.25	122.80
6	D	528	GDU	O2-C2-N1	-2.71	119.27	122.80
8	D	530	UDP	C2'-C1'-N1	2.65	120.63	113.25
6	B	403	GDU	O2A-PA-O3A	2.64	114.41	107.27
6	B	403	GDU	O3'-C3'-C4'	-2.55	104.37	110.38
8	B	405	UDP	C2'-C1'-N1	2.49	120.17	113.25
8	B	405	UDP	O4'-C4'-C5'	2.47	117.23	109.33
8	B	405	UDP	O4'-C4'-C3'	-2.46	100.28	105.15
8	B	405	UDP	O2-C2-N3	2.36	125.84	121.49
8	D	530	UDP	O2-C2-N3	2.35	125.81	121.49
8	D	530	UDP	O3A-PB-O1B	-2.33	98.77	111.04
8	B	405	UDP	O3A-PB-O1B	-2.33	98.79	111.04
4	A	805	MES	C2-C3-N4	-2.17	106.83	110.12
4	A	805	MES	C8-C7-N4	-2.15	104.24	112.36
6	D	528	GDU	O2A-PA-O3A	2.09	112.91	107.27
6	D	528	GDU	O2-C2-N3	2.08	125.33	121.49
6	D	528	GDU	O5D-C5D-C4D	2.06	116.02	108.99

There are no chirality outliers.

All (29) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	805	MES	C8-C7-N4-C5
6	B	403	GDU	O5'-C1'-O3B-PB
6	D	528	GDU	O5'-C1'-O3B-PB
8	D	530	UDP	O4'-C4'-C5'-O5'
8	D	530	UDP	C5'-O5'-PA-O2A
8	D	530	UDP	C5'-O5'-PA-O3A
5	C	807	PG4	O2-C3-C4-O3
8	D	530	UDP	C3'-C4'-C5'-O5'
5	A	806	PG4	O1-C1-C2-O2
5	A	806	PG4	O3-C5-C6-O4
5	A	806	PG4	O2-C3-C4-O3
6	B	403	GDU	C2'-C1'-O3B-PB
6	D	528	GDU	O5'-C5'-C6'-O6'
6	B	403	GDU	O5'-C5'-C6'-O6'
4	A	805	MES	C8-C7-N4-C3

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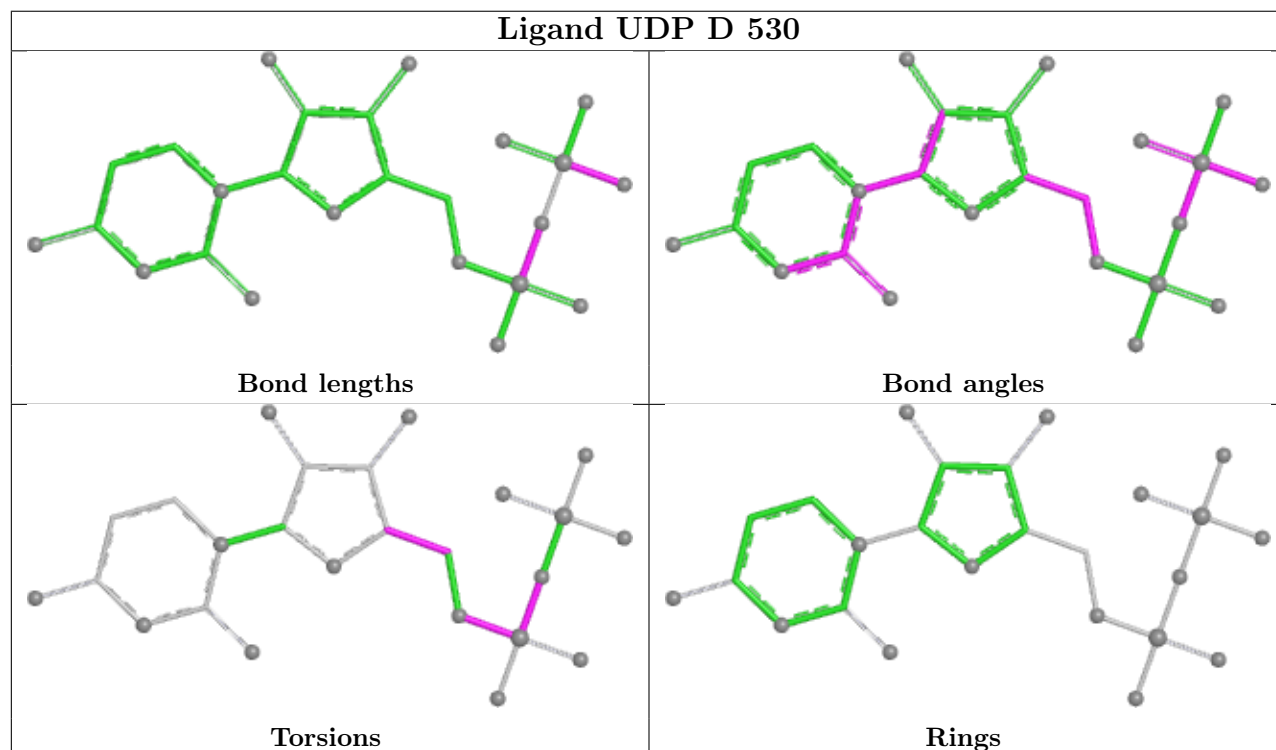
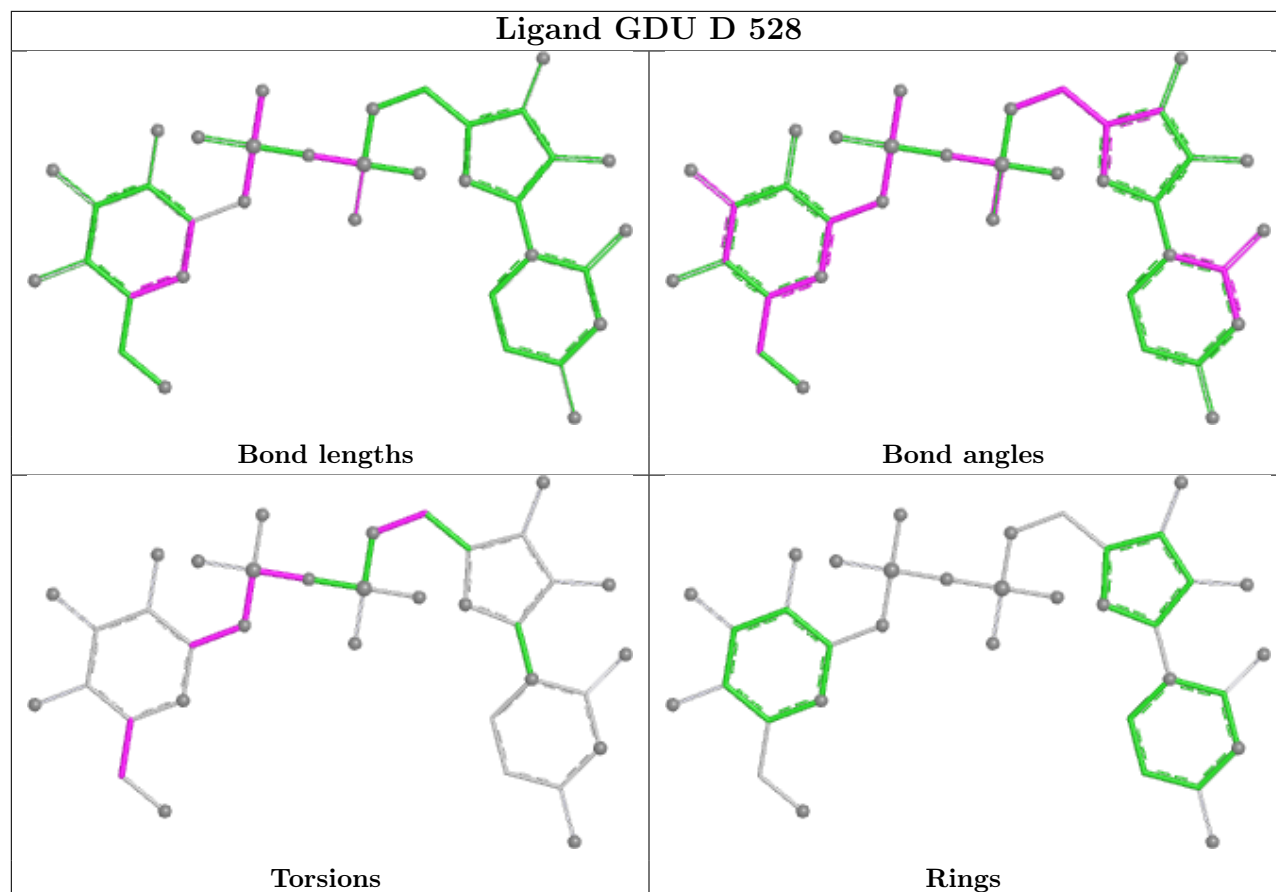
Mol	Chain	Res	Type	Atoms
5	C	807	PG4	O1-C1-C2-O2
8	D	530	UDP	PB-O3A-PA-O5'
5	C	807	PG4	C3-C4-O3-C5
5	A	806	PG4	C1-C2-O2-C3
5	A	806	PG4	C6-C5-O3-C4
5	A	806	PG4	C4-C3-O2-C2
5	A	806	PG4	C3-C4-O3-C5
6	B	403	GDU	PA-O3A-PB-O2B
5	C	807	PG4	C5-C6-O4-C7
6	D	528	GDU	C4D-C5D-O5D-PA
6	D	528	GDU	C1'-O3B-PB-O2B
5	C	807	PG4	C1-C2-O2-C3
5	C	807	PG4	C8-C7-O4-C6
6	D	528	GDU	PA-O3A-PB-O2B

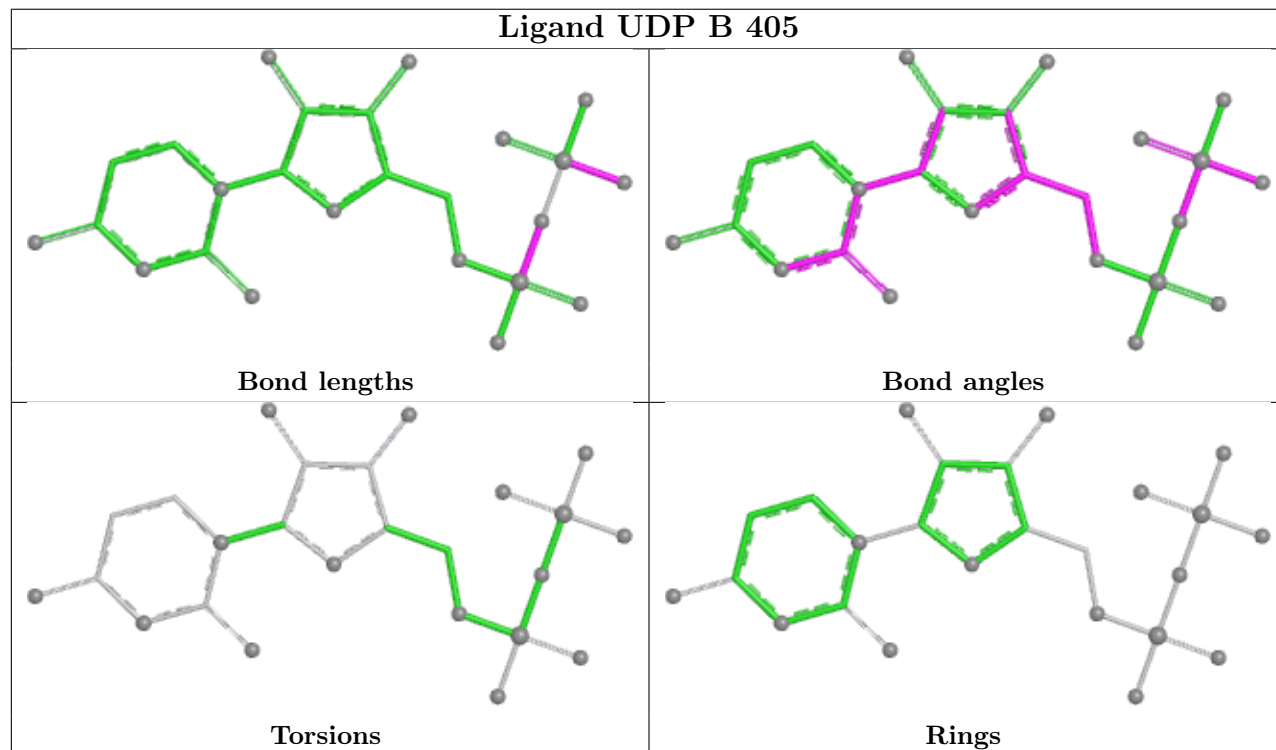
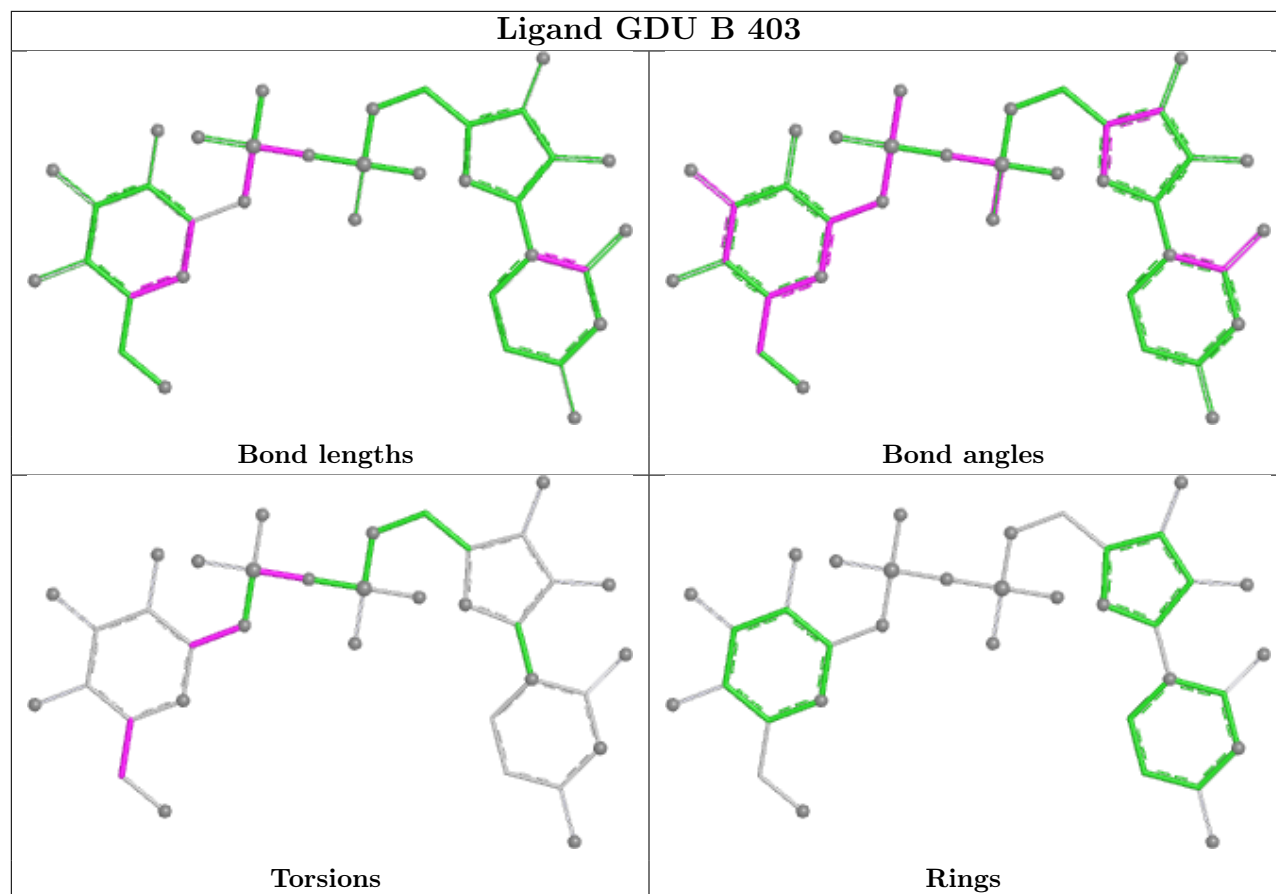
There are no ring outliers.

5 monomers are involved in 11 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	805	MES	2	0
6	D	528	GDU	4	0
6	B	403	GDU	1	0
5	A	806	PG4	2	0
5	C	807	PG4	2	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





5.7 Other polymers [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	123/123 (100%)	0.12	7 (5%) 29 31	19, 25, 51, 62	0
1	C	123/123 (100%)	0.11	8 (6%) 25 26	17, 25, 48, 82	0
2	B	272/286 (95%)	0.01	5 (1%) 67 71	18, 28, 49, 60	0
2	D	272/286 (95%)	-0.08	4 (1%) 72 75	18, 27, 44, 58	0
All	All	790/818 (96%)	0.01	24 (3%) 52 56	17, 27, 48, 82	0

All (24) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	123	PRO	6.5
1	A	45	ASN	5.4
1	C	122	LYS	4.6
1	A	123	PRO	4.5
2	D	402	SER	4.3
2	D	151	ILE	3.8
1	A	44	ASP	3.6
1	C	67	PRO	3.4
1	C	45	ASN	3.0
1	A	66	PHE	3.0
1	C	66	PHE	2.9
2	B	349	ARG	2.8
2	B	402	SER	2.7
2	B	327	PHE	2.7
2	B	131	LEU	2.6
1	C	14	ASP	2.6
1	C	44	ASP	2.5
2	B	174	MET	2.4
1	A	10	HIS	2.4
1	A	15	ILE	2.4
1	A	13	LYS	2.3

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Mol	Chain	Res	Type	RSRZ
1	C	121	GLU	2.2
2	D	152	PRO	2.2
2	D	132	THR	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](#)

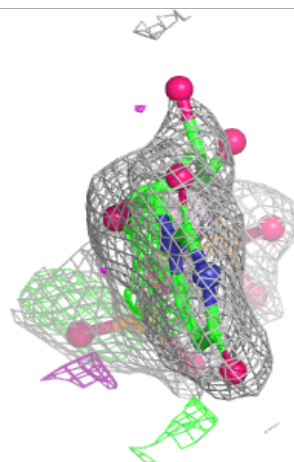
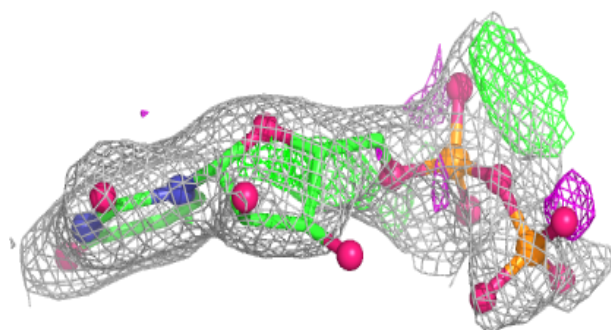
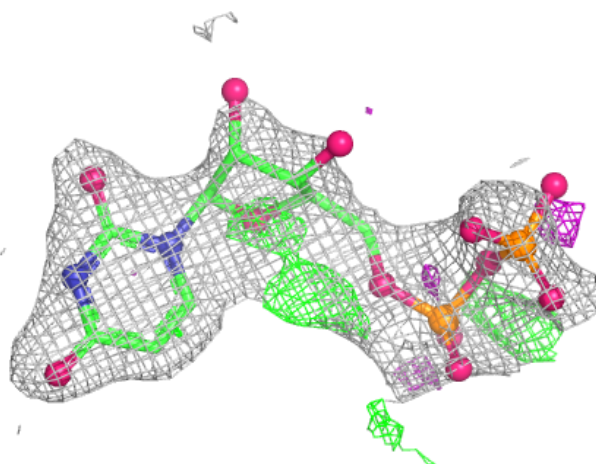
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
5	PG4	A	806	13/13	0.73	0.22	51,53,58,61	0
8	UDP	B	405	25/25	0.74	0.18	70,79,98,99	0
8	UDP	D	530	25/25	0.74	0.17	62,80,98,98	0
4	MES	A	805	12/12	0.83	0.16	42,46,50,52	0
5	PG4	C	807	13/13	0.84	0.17	46,50,58,61	0
6	GDU	B	403	36/36	0.96	0.07	20,25,29,31	0
6	GDU	D	528	36/36	0.96	0.07	19,24,33,35	0
3	CA	C	124	1/1	0.98	0.03	26,26,26,26	0
3	CA	A	124	1/1	0.99	0.03	21,21,21,21	0
7	MN	B	404	1/1	0.99	0.01	25,25,25,25	0
7	MN	D	529	1/1	1.00	0.03	21,21,21,21	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.

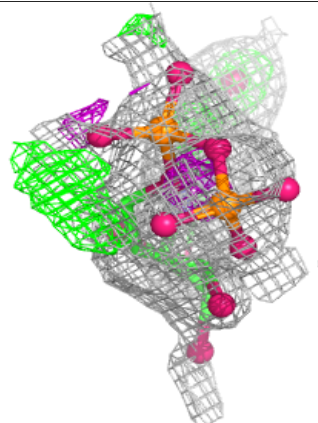
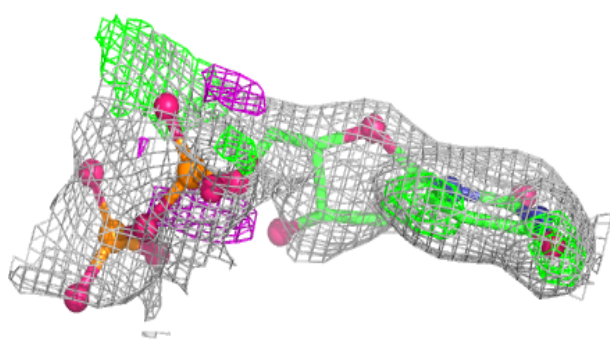
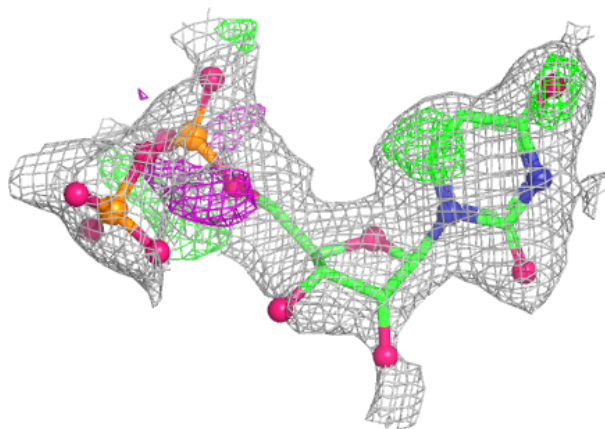
Electron density around UDP B 405:

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

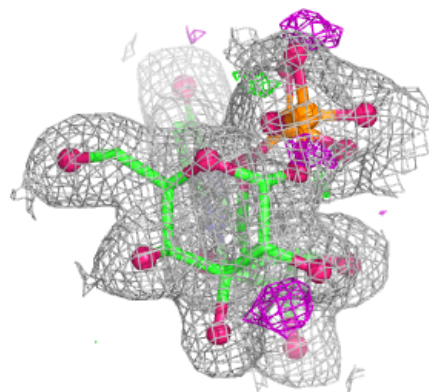
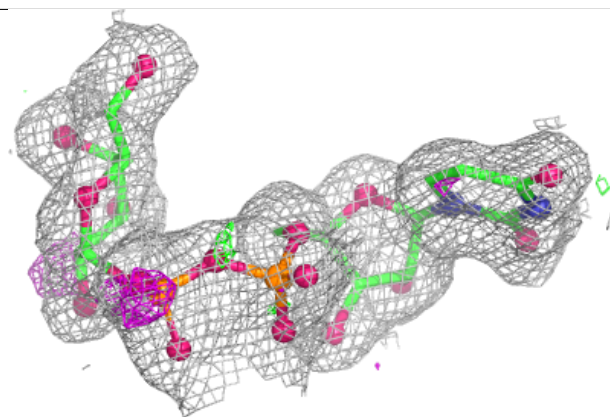
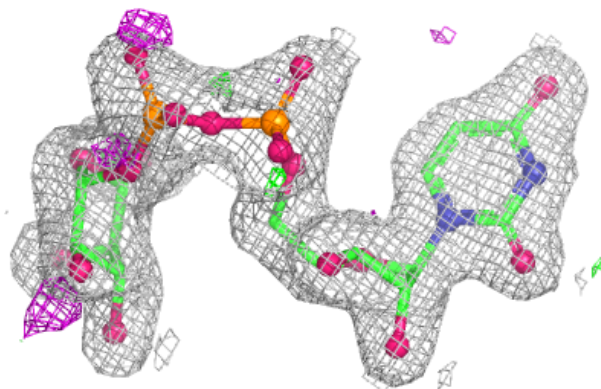


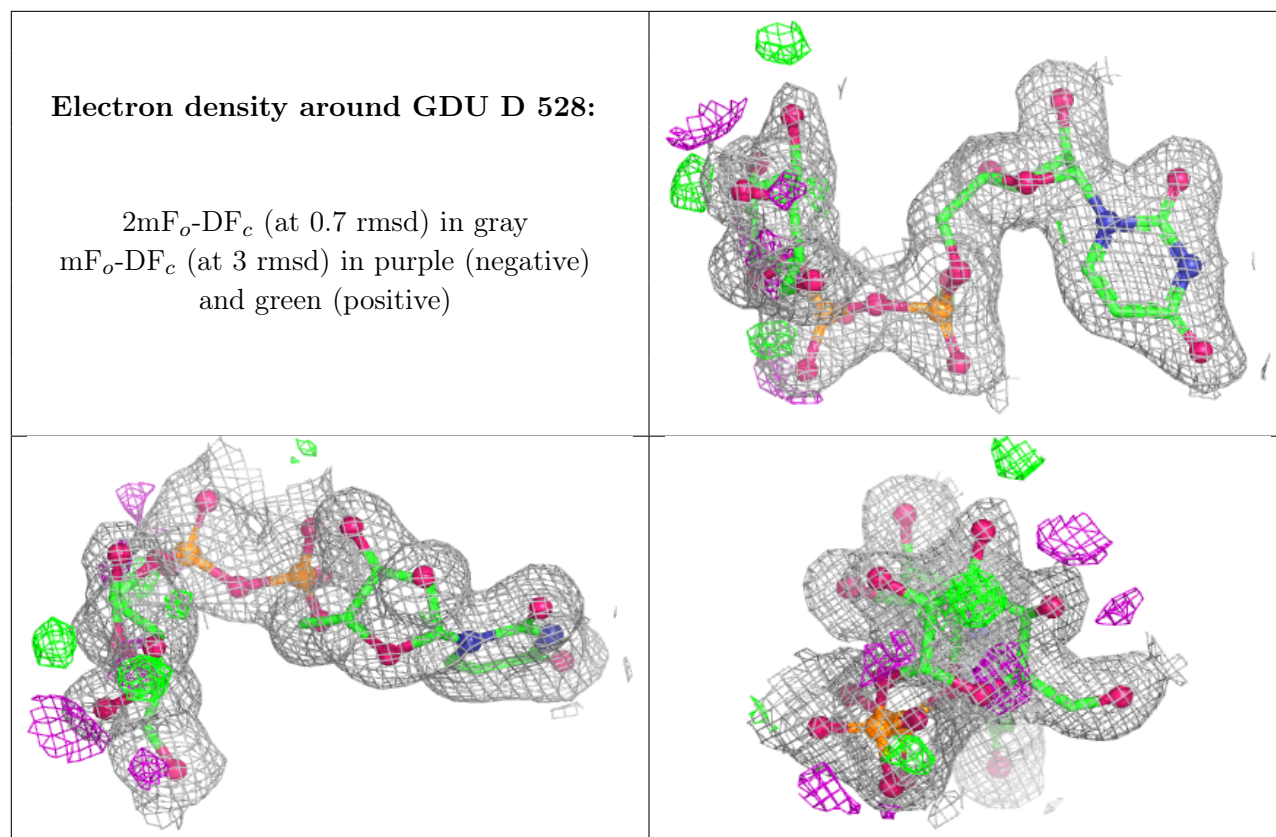
Electron density around UDP D 530:

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

**Electron density around GDU B 403:**

$2mF_o-DF_c$ (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.