



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 20, 2023 – 06:26 AM EDT

PDB ID : 2FYC
Title : Crystal structure of the catalytic domain of bovine beta1,4-galactosyltransferase-I in complex with alpha-lactalbumin, Ca and UDP-galactose
Authors : Ramakrishnan, B.; Ramasamy, V.; Qasba, P.K.
Deposited on : 2006-02-07
Resolution : 2.00 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.35
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.35

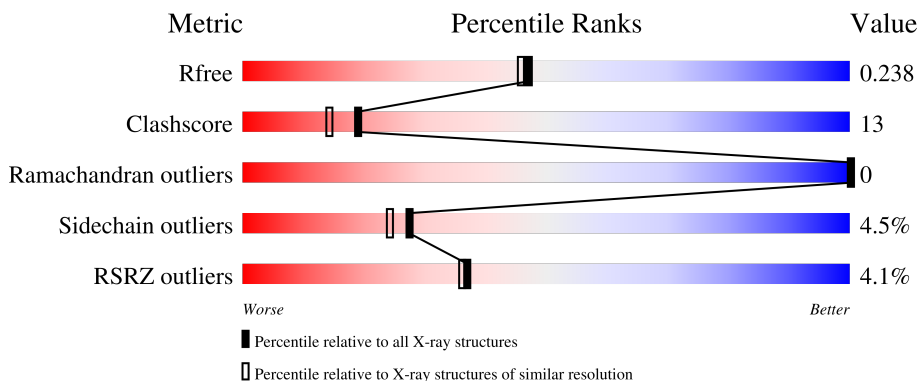
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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}	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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	 5% (poor fit), 79% (0-1 outliers), 20% (2-3 outliers), 5% (not modelled)
1	C	123	 4% (poor fit), 75% (0-1 outliers), 24% (2-3 outliers), 5% (not modelled)
2	B	286	 6% (poor fit), 73% (0-1 outliers), 20% (2-3 outliers), 5% (not modelled)
2	D	286	 2% (poor fit), 70% (0-1 outliers), 23% (2-3 outliers), 5% (not modelled)

2 Entry composition i

There are 7 unique types of molecules in this entry. The entry contains 7305 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
			Total	C	N	O	S			
1	A	123	980	620	156	195	9	0	0	0
1	C	123	980	620	156	195	9	0	0	0

- Molecule 2 is a protein called beta-1,4-galactosyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	272	2221	1426	384	399	12	0	0	0
2	D	272	2221	1426	384	399	12	0	0	0

There are 30 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	117	ALA	-	cloning artifact	UNP P08037
B	118	SER	-	cloning artifact	UNP P08037
B	119	MET	-	cloning artifact	UNP P08037
B	120	THR	-	cloning artifact	UNP P08037
B	121	GLY	-	cloning artifact	UNP P08037
B	122	GLY	-	cloning artifact	UNP P08037
B	123	GLN	-	cloning artifact	UNP P08037
B	124	GLN	-	cloning artifact	UNP P08037
B	125	MET	-	cloning artifact	UNP P08037
B	126	GLY	-	cloning artifact	UNP P08037
B	127	ARG	-	cloning artifact	UNP P08037
B	128	GLY	-	cloning artifact	UNP P08037
B	129	SER	-	cloning artifact	UNP P08037
B	342	THR	CYS	engineered mutation	UNP P08037
B	344	HIS	MET	engineered mutation	UNP P08037
D	117	ALA	-	cloning artifact	UNP P08037

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Chain	Residue	Modelled	Actual	Comment	Reference
D	118	SER	-	cloning artifact	UNP P08037
D	119	MET	-	cloning artifact	UNP P08037
D	120	THR	-	cloning artifact	UNP P08037
D	121	GLY	-	cloning artifact	UNP P08037
D	122	GLY	-	cloning artifact	UNP P08037
D	123	GLN	-	cloning artifact	UNP P08037
D	124	GLN	-	cloning artifact	UNP P08037
D	125	MET	-	cloning artifact	UNP P08037
D	126	GLY	-	cloning artifact	UNP P08037
D	127	ARG	-	cloning artifact	UNP P08037
D	128	GLY	-	cloning artifact	UNP P08037
D	129	SER	-	cloning artifact	UNP P08037
D	342	THR	CYS	engineered mutation	UNP P08037
D	344	HIS	MET	engineered mutation	UNP P08037

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

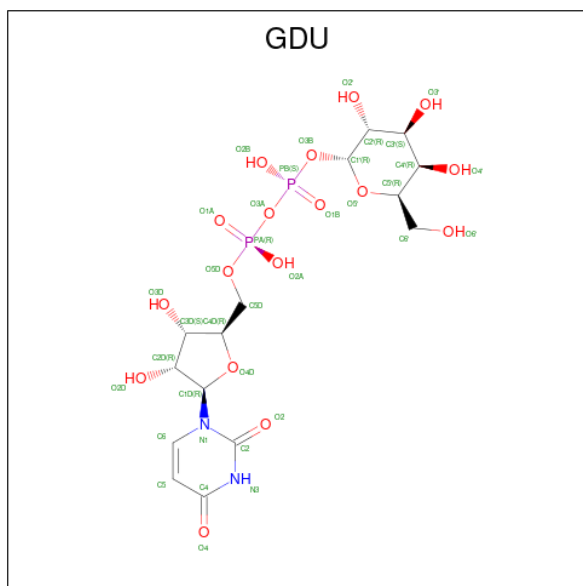
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Ca 1 1	0	0
3	B	1	Total Ca 1 1	0	0
3	C	1	Total Ca 1 1	0	0
3	D	1	Total Ca 1 1	0	0

- Molecule 4 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES) (formula: C₆H₁₃NO₄S).



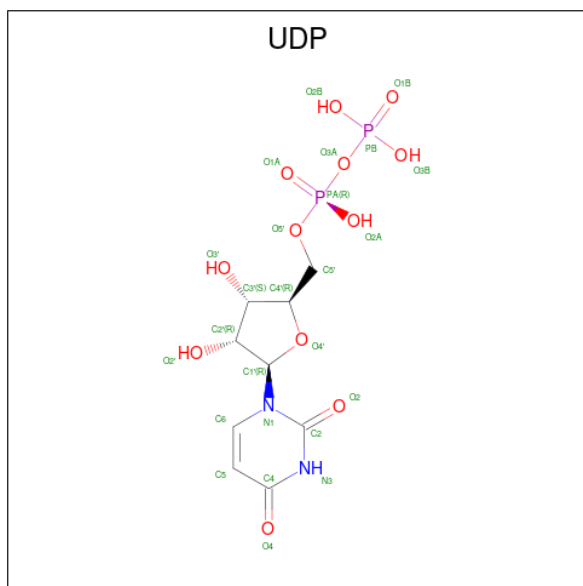
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
4	A	1	12	6	1	4	1	0	0

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



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

- Molecule 6 is URIDINE-5'-DIPHOSPHATE (three-letter code: UDP) (formula: C₉H₁₄N₂O₁₂P₂).



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

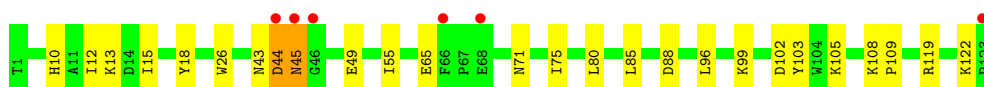
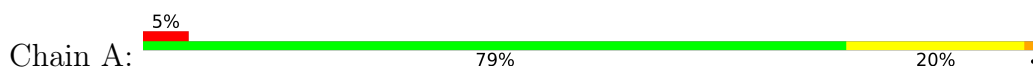
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	157	Total	O	0	0
			157	157		
7	B	222	Total	O	0	0
			222	222		
7	C	144	Total	O	0	0
			144	144		
7	D	242	Total	O	0	0
			242	242		

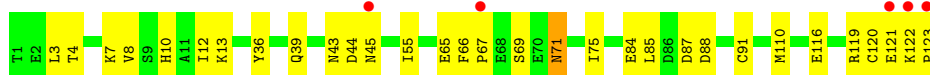
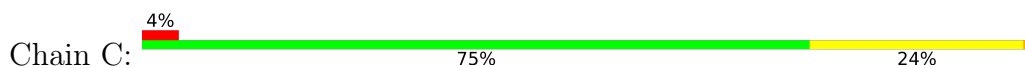
3 Residue-property plots [i](#)

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.

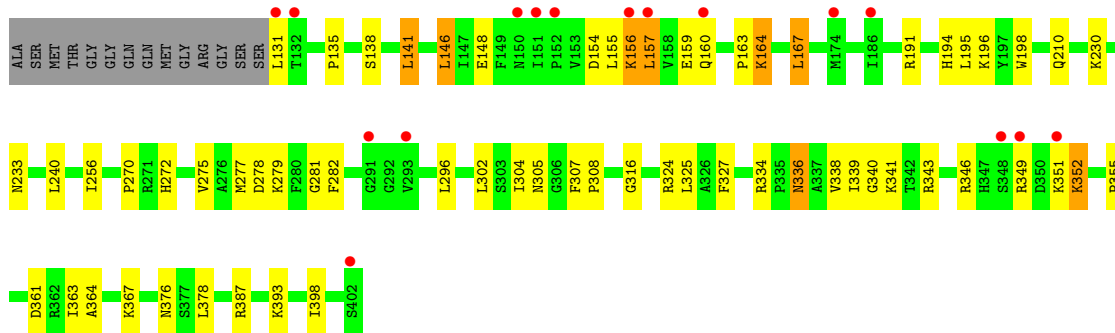
- Molecule 1: Alpha-lactalbumin



- Molecule 1: Alpha-lactalbumin

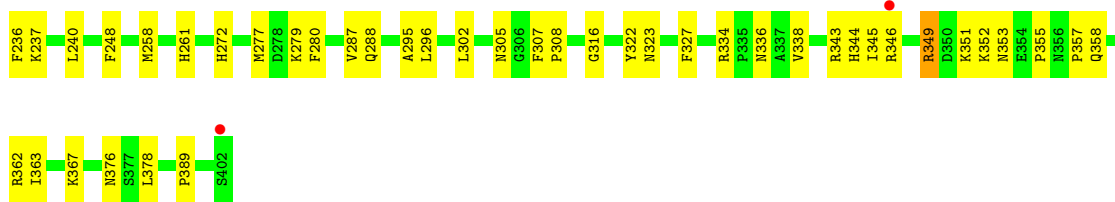


- Molecule 2: beta-1,4-galactosyltransferase



- 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	57.37Å 94.61Å 99.60Å 90.00° 101.78° 90.00°	Depositor
Resolution (Å)	32.56 – 2.00 32.55 – 1.97	Depositor EDS
% Data completeness (in resolution range)	96.2 (32.56-2.00) 95.5 (32.55-1.97)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.04	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.41 (at 1.98Å)	Xtrriage
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.200 , 0.246 0.191 , 0.238	Depositor DCC
R_{free} test set	6867 reflections (9.83%)	wwPDB-VP
Wilson B-factor (Å ²)	30.6	Xtrriage
Anisotropy	0.352	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 54.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7305	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.19% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: GDU, CA, MES, UDP

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	0.58	0/1001	0.89	2/1350 (0.1%)
1	C	0.59	0/1001	0.79	1/1350 (0.1%)
2	B	0.53	0/2282	0.73	0/3092
2	D	0.55	0/2282	0.76	0/3092
All	All	0.55	0/6566	0.78	3/8884 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	44	ASP	N-CA-C	-10.84	81.74	111.00
1	C	87	ASP	CB-CG-OD1	5.83	123.55	118.30
1	A	44	ASP	C-N-CA	-5.51	107.92	121.70

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	45	ASN	Mainchain

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	980	0	936	24	0
1	C	980	0	936	27	0
2	B	2221	0	2185	55	0
2	D	2221	0	2185	64	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
4	A	12	0	13	5	0
5	B	36	0	22	0	0
5	D	36	0	22	0	0
6	B	25	0	11	0	0
6	D	25	0	11	1	0
7	A	157	0	0	2	0
7	B	222	0	0	7	0
7	C	144	0	0	6	0
7	D	242	0	0	4	0
All	All	7305	0	6321	167	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 13.

All (167) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:71:ASN:HD21	1:A:75:ILE:H	1.20	0.90
2:D:349:ARG:HH11	2:D:349:ARG:HG2	1.36	0.89
2:D:236:PHE:O	2:D:240:LEU:HD23	1.73	0.88
1:A:43:ASN:HB3	1:A:44:ASP:O	1.75	0.86
2:B:156:LYS:HA	2:B:156:LYS:HE2	1.57	0.86
1:C:122:LYS:HD3	1:C:123:PRO:HD2	1.59	0.85
2:B:336:ASN:HD22	2:B:338:VAL:H	1.26	0.81
1:C:71:ASN:HD21	1:C:75:ILE:H	1.29	0.81
2:B:327:PHE:CZ	2:B:367:LYS:HB2	2.21	0.75
2:B:191:ARG:HH11	2:B:194:HIS:HD2	1.32	0.75

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:132:THR:HG22	2:D:133:ALA:N	2.03	0.74
2:D:155:LEU:O	2:D:159:GLU:HG3	1.87	0.74
2:B:316:GLY:HA2	2:B:363:ILE:HD11	1.72	0.71
2:D:156:LYS:O	2:D:160:GLN:HG2	1.90	0.71
2:B:305:ASN:HD21	2:B:376:ASN:H	1.39	0.70
2:D:279:LYS:HB3	2:D:346:ARG:NH1	2.07	0.69
2:D:344:HIS:HD1	2:D:346:ARG:HD2	1.59	0.68
2:D:336:ASN:HD22	2:D:338:VAL:H	1.41	0.67
1:C:4:THR:HG23	1:C:7:LYS:HE2	1.77	0.66
1:C:116:GLU:OE1	1:C:119:ARG:NH2	2.30	0.65
2:D:191:ARG:HH11	2:D:194:HIS:HD2	1.42	0.65
2:B:146:LEU:HD22	2:B:148:GLU:OE2	1.96	0.64
2:B:341:LYS:NZ	1:C:39:GLN:HE22	1.94	0.64
2:D:305:ASN:HD21	2:D:376:ASN:H	1.46	0.63
2:D:132:THR:CG2	2:D:133:ALA:N	2.62	0.63
2:D:279:LYS:HD2	2:D:346:ARG:HH12	1.65	0.62
1:C:66:PHE:HB2	7:C:1068:HOH:O	1.98	0.62
2:D:240:LEU:HD21	2:D:248:PHE:CZ	2.35	0.62
2:B:191:ARG:NH1	2:B:194:HIS:HD2	1.97	0.62
1:A:12:ILE:O	1:A:15:ILE:HG22	2.00	0.62
2:B:336:ASN:ND2	2:B:338:VAL:H	1.96	0.60
2:B:346:ARG:HG2	7:B:1571:HOH:O	2.01	0.59
2:D:164:LYS:N	2:D:164:LYS:HD3	2.17	0.59
1:C:122:LYS:HD3	1:C:123:PRO:CD	2.31	0.59
2:D:141:LEU:HD23	2:D:261:HIS:CD2	2.38	0.59
2:B:270:PRO:HB3	2:B:296:LEU:CD2	2.33	0.58
2:B:307:PHE:HB3	2:B:308:PRO:HD2	1.84	0.58
2:B:164:LYS:HE2	7:B:1419:HOH:O	2.04	0.58
2:D:132:THR:CG2	2:D:133:ALA:H	2.17	0.57
1:C:121:GLU:HA	1:C:121:GLU:OE1	2.04	0.57
1:C:43:ASN:HB3	7:C:1627:HOH:O	2.04	0.56
2:B:270:PRO:HG2	2:B:325:LEU:HD22	1.86	0.56
2:B:270:PRO:CG	2:B:325:LEU:HD22	2.35	0.55
2:B:156:LYS:HA	2:B:156:LYS:CE	2.34	0.55
2:D:258:MET:SD	2:D:343:ARG:HG3	2.47	0.55
2:D:355:PRO:O	2:D:357:PRO:HD3	2.06	0.55
2:B:275:VAL:HG22	2:B:340:GLY:HA3	1.88	0.55
2:D:344:HIS:ND1	2:D:346:ARG:NH1	2.55	0.54
1:C:116:GLU:OE2	1:C:119:ARG:NH2	2.37	0.54
2:D:160:GLN:HE21	2:D:160:GLN:HA	1.73	0.54
2:B:346:ARG:HB3	2:B:346:ARG:CZ	2.38	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:277:MET:CE	2:B:279:LYS:HE2	2.39	0.53
2:B:272:HIS:HB3	2:B:334:ARG:HG2	1.89	0.53
2:D:153:VAL:HG22	2:D:196:LYS:HB3	1.90	0.53
2:D:236:PHE:O	2:D:240:LEU:CD2	2.52	0.52
2:D:349:ARG:HH11	2:D:349:ARG:CG	2.13	0.52
2:B:156:LYS:HE2	2:B:156:LYS:CA	2.36	0.52
1:A:71:ASN:HD21	1:A:75:ILE:N	2.00	0.52
1:A:26:TRP:HZ2	1:A:96:LEU:HD11	1.73	0.52
1:A:43:ASN:ND2	1:A:45:ASN:OD1	2.42	0.52
2:D:272:HIS:HB3	2:D:334:ARG:HG2	1.92	0.51
2:D:307:PHE:HB3	2:D:308:PRO:HD2	1.92	0.51
1:A:10:HIS:O	1:A:13:LYS:HG3	2.10	0.51
1:A:108:LYS:HB3	1:A:109:PRO:CD	2.41	0.51
2:B:131:LEU:N	2:B:131:LEU:HD23	2.25	0.51
2:B:196:LYS:HE2	7:B:1280:HOH:O	2.11	0.51
1:C:121:GLU:HG2	7:C:1599:HOH:O	2.09	0.51
2:D:349:ARG:HG2	2:D:349:ARG:NH1	2.15	0.51
2:D:349:ARG:HD2	2:D:353:ASN:O	2.11	0.51
2:D:164:LYS:HD3	2:D:164:LYS:H	1.74	0.51
2:D:174:MET:HE2	7:D:1409:HOH:O	2.11	0.50
1:C:55:ILE:HD13	1:C:91:CYS:SG	2.52	0.50
2:D:279:LYS:HD2	2:D:346:ARG:NH1	2.26	0.50
1:C:116:GLU:CD	1:C:119:ARG:NH2	2.64	0.50
2:D:240:LEU:HD21	2:D:248:PHE:HZ	1.76	0.50
1:A:99:LYS:HD3	1:A:103:TYR:HB2	1.94	0.50
2:B:154:ASP:HB3	2:B:157:LEU:HD23	1.93	0.50
2:B:198:TRP:HA	2:B:256:ILE:HD11	1.94	0.49
1:C:10:HIS:HA	1:C:13:LYS:HE3	1.93	0.49
1:A:105:LYS:NZ	4:A:805:MES:H31	2.28	0.49
2:B:349:ARG:HH12	2:B:355:PRO:HD3	1.78	0.49
2:D:151:ILE:HG13	2:D:151:ILE:O	2.13	0.49
1:C:10:HIS:HB2	7:C:1583:HOH:O	2.12	0.49
2:D:154:ASP:HB3	2:D:157:LEU:HB2	1.94	0.49
2:B:338:VAL:O	2:B:341:LYS:HG3	2.13	0.49
1:A:102:ASP:HB2	7:A:1123:HOH:O	2.13	0.49
2:B:138:SER:HB3	2:B:141:LEU:HD13	1.95	0.49
2:D:336:ASN:ND2	2:D:338:VAL:HB	2.28	0.49
1:C:8:VAL:HG21	1:C:36:TYR:CD1	2.49	0.48
2:D:277:MET:HE1	2:D:280:PHE:CE1	2.47	0.48
2:B:191:ARG:HD2	2:B:194:HIS:CD2	2.48	0.48
1:A:49:GLU:OE1	4:A:805:MES:H52	2.14	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:233:ASN:HB3	2:D:378:LEU:HD22	1.95	0.48
2:D:316:GLY:HA2	2:D:363:ILE:HD11	1.96	0.48
2:D:153:VAL:CG2	2:D:196:LYS:HB3	2.43	0.48
2:D:132:THR:HG22	2:D:133:ALA:H	1.74	0.48
1:A:71:ASN:ND2	1:A:75:ILE:H	2.01	0.47
2:B:160:GLN:O	2:B:163:PRO:HD3	2.14	0.47
2:D:194:HIS:HE1	7:D:1345:HOH:O	1.95	0.47
2:D:237:LYS:HE2	7:D:1435:HOH:O	2.15	0.47
2:B:316:GLY:CA	2:B:363:ILE:HD11	2.43	0.47
2:D:191:ARG:HD2	2:D:194:HIS:CD2	2.50	0.47
2:D:288:GLN:HA	2:D:322:TYR:CE1	2.50	0.47
2:D:148:GLU:OE2	2:D:148:GLU:HA	2.14	0.47
2:D:191:ARG:NH1	2:D:194:HIS:HD2	2.10	0.47
1:A:105:LYS:HE2	7:B:1540:HOH:O	2.15	0.46
2:D:171:TYR:HB3	2:D:213:TYR:CE2	2.50	0.46
2:D:362:ARG:NH2	7:D:1205:HOH:O	2.45	0.46
2:D:351:LYS:HB2	2:D:351:LYS:HE2	1.80	0.46
2:D:277:MET:HE1	2:D:280:PHE:HE1	1.79	0.46
2:B:361:ASP:HB3	7:B:1297:HOH:O	2.15	0.45
1:A:105:LYS:HZ2	4:A:805:MES:H31	1.81	0.45
1:C:10:HIS:CD2	1:C:13:LYS:NZ	2.84	0.45
2:B:167:LEU:HD13	2:B:387:ARG:HB3	1.97	0.45
1:C:65:GLU:O	1:C:67:PRO:HD3	2.16	0.45
2:B:393:LYS:HD2	7:B:1180:HOH:O	2.16	0.45
1:C:110:MET:HE3	7:C:1553:HOH:O	2.16	0.45
2:B:351:LYS:O	2:B:352:LYS:HB2	2.15	0.45
2:B:233:ASN:HB3	2:B:378:LEU:HD22	1.99	0.45
2:B:191:ARG:NH1	2:B:194:HIS:CD2	2.82	0.45
1:A:108:LYS:HB3	1:A:109:PRO:HD3	1.98	0.45
2:B:154:ASP:OD1	2:B:156:LYS:HB2	2.17	0.45
2:B:270:PRO:HB3	2:B:296:LEU:HD21	1.99	0.45
2:B:277:MET:HE1	7:B:1556:HOH:O	2.16	0.45
1:C:10:HIS:O	1:C:13:LYS:HG3	2.17	0.44
1:C:66:PHE:HB3	1:C:69:SER:HB2	1.99	0.44
1:A:109:PRO:HB3	2:B:364:ALA:HB2	1.99	0.44
1:C:8:VAL:O	1:C:12:ILE:HG12	2.17	0.44
1:A:105:LYS:HG3	4:A:805:MES:H31	2.00	0.44
2:D:240:LEU:CD2	2:D:248:PHE:CZ	3.01	0.44
2:D:149:PHE:CZ	2:D:345:ILE:HG12	2.53	0.44
2:B:277:MET:HE1	2:B:279:LYS:HE2	2.00	0.43
2:B:336:ASN:HD22	2:B:338:VAL:N	2.04	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:10:HIS:HE1	1:A:122:LYS:O	2.01	0.43
2:B:336:ASN:ND2	2:B:339:ILE:H	2.15	0.43
2:B:341:LYS:HZ1	1:C:39:GLN:HE22	1.62	0.43
2:D:344:HIS:HD1	2:D:346:ARG:NH1	2.17	0.43
1:A:103:TYR:CE2	4:A:805:MES:H51	2.54	0.43
2:B:336:ASN:HD22	2:B:336:ASN:C	2.22	0.43
1:A:55:ILE:HB	1:A:80:LEU:HD13	2.01	0.43
2:D:146:LEU:HG	2:D:148:GLU:HG2	2.01	0.42
2:D:277:MET:HE3	2:D:280:PHE:HD1	1.83	0.42
2:D:225:MET:HE1	2:D:352:LYS:HE3	2.01	0.42
2:B:135:PRO:HD2	2:B:210:GLN:HE22	1.85	0.42
1:C:44:ASP:HB3	1:C:45:ASN:H	1.70	0.42
2:D:316:GLY:CA	2:D:363:ILE:HD11	2.50	0.42
2:D:323:ASN:HD21	2:D:363:ILE:HG23	1.85	0.42
2:D:336:ASN:HD21	2:D:338:VAL:HB	1.84	0.42
2:B:155:LEU:HA	2:B:155:LEU:HD23	1.80	0.42
2:B:304:ILE:HB	2:B:324:ARG:HB3	2.02	0.42
2:D:327:PHE:CE2	2:D:367:LYS:HD2	2.55	0.41
2:D:279:LYS:CD	2:D:346:ARG:HH12	2.31	0.41
1:A:18:TYR:HB3	7:A:1030:HOH:O	2.20	0.41
2:B:278:ASP:HB3	2:B:282:PHE:CZ	2.56	0.41
1:C:3:LEU:HA	1:C:7:LYS:HE3	2.02	0.41
2:B:281:GLY:O	2:B:282:PHE:HB2	2.21	0.41
1:A:65:GLU:O	1:A:65:GLU:HG2	2.20	0.41
2:B:351:LYS:HD3	2:B:351:LYS:HA	1.87	0.41
2:B:230:LYS:HD3	2:B:398:ILE:HB	2.02	0.40
2:D:295:ALA:C	2:D:296:LEU:HD12	2.42	0.40
1:C:10:HIS:CD2	1:C:13:LYS:HZ2	2.39	0.40
1:A:119:ARG:HG3	1:A:119:ARG:HH21	1.85	0.40
2:B:155:LEU:O	2:B:159:GLU:HG3	2.22	0.40
1:C:119:ARG:NH1	7:C:1440:HOH:O	2.53	0.40
2:D:389:PRO:HD2	6:D:529:UDP:C4	2.57	0.40
2:D:277:MET:HE3	2:D:280:PHE:CD1	2.57	0.40
2:D:358:GLN:O	2:D:362:ARG:HG3	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	121/123 (98%)	117 (97%)	4 (3%)	0	100	100
1	C	121/123 (98%)	117 (97%)	4 (3%)	0	100	100
2	B	270/286 (94%)	262 (97%)	8 (3%)	0	100	100
2	D	270/286 (94%)	261 (97%)	9 (3%)	0	100	100
All	All	782/818 (96%)	757 (97%)	25 (3%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all 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%)	107 (98%)	2 (2%)	59	63
1	C	109/109 (100%)	104 (95%)	5 (5%)	27	23
2	B	245/254 (96%)	233 (95%)	12 (5%)	25	21
2	D	245/254 (96%)	232 (95%)	13 (5%)	22	18
All	All	708/726 (98%)	676 (96%)	32 (4%)	27	24

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

Mol	Chain	Res	Type
1	A	85	LEU
1	A	88	ASP

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Mol	Chain	Res	Type
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	302	LEU
2	B	336	ASN
2	B	343	ARG
2	B	352	LYS
1	C	71	ASN
1	C	84	GLU
1	C	85	LEU
1	C	88	ASP
1	C	120	CYS
2	D	141	LEU
2	D	150	ASN
2	D	153	VAL
2	D	157	LEU
2	D	160	GLN
2	D	167	LEU
2	D	190	ASN
2	D	195	LEU
2	D	223	GLU
2	D	224	SER
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 (20) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	10	HIS
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

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Mol	Chain	Res	Type
2	B	305	ASN
2	B	310	ASN
2	B	336	ASN
1	C	39	GLN
1	C	71	ASN
2	D	150	ASN
2	D	160	GLN
2	D	161	GLN
2	D	194	HIS
2	D	210	GLN
2	D	305	ASN
2	D	336	ASN

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 9 ligands modelled in this entry, 4 are monoatomic - leaving 5 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	1.17	1 (8%)	14,16,16	0.96	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
6	UDP	B	405	-	24,26,26	1.21	2 (8%)	37,40,40	1.47	8 (21%)
6	UDP	D	529	-	24,26,26	1.35	2 (8%)	37,40,40	1.53	6 (16%)
5	GDU	B	403	3	35,38,38	1.26	4 (11%)	53,58,58	1.54	9 (16%)
5	GDU	D	528	3	35,38,38	1.41	4 (11%)	53,58,58	1.53	7 (13%)

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	UDP	B	405	-	-	1/16/32/32	0/2/2/2
6	UDP	D	529	-	-	5/16/32/32	0/2/2/2
5	GDU	B	403	3	-	7/23/59/59	0/3/3/3
5	GDU	D	528	3	-	6/23/59/59	0/3/3/3

All (13) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	D	528	GDU	PB-O3B	-4.56	1.48	1.60
6	D	529	UDP	PB-O1B	3.61	1.62	1.50
5	B	403	GDU	PB-O3B	-3.45	1.51	1.60
6	B	405	UDP	PB-O1B	3.26	1.61	1.50
5	D	528	GDU	O5'-C5'	3.04	1.51	1.44
6	D	529	UDP	C2-N1	2.91	1.43	1.38
5	B	403	GDU	O5'-C5'	2.22	1.49	1.44
4	A	805	MES	C5-N4	2.22	1.53	1.46
5	B	403	GDU	O5'-C1'	2.22	1.47	1.41
6	B	405	UDP	C2-N1	2.21	1.42	1.38
5	D	528	GDU	O5'-C1'	2.07	1.47	1.41
5	D	528	GDU	C4-N3	2.01	1.42	1.38
5	B	403	GDU	C6-N1	2.01	1.42	1.38

All (30) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	403	GDU	O3B-PB-O1B	4.75	127.30	109.47
5	B	403	GDU	O5'-C5'-C6'	-4.19	96.03	106.44
5	D	528	GDU	O3B-PB-O1B	4.18	125.16	109.47

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	D	529	UDP	O5'-C5'-C4'	4.14	123.24	108.99
5	D	528	GDU	O5'-C5'-C6'	-4.11	96.22	106.44
5	D	528	GDU	O5'-C1'-O3B	3.95	116.53	111.36
6	D	529	UDP	O3B-PB-O1B	3.91	125.99	110.68
6	B	405	UDP	O3B-PB-O1B	3.70	125.18	110.68
6	B	405	UDP	O5'-C5'-C4'	3.35	120.52	108.99
5	D	528	GDU	O4D-C4D-C3D	-3.25	98.68	105.11
5	B	403	GDU	O4D-C4D-C3D	-3.24	98.70	105.11
5	B	403	GDU	O5'-C1'-O3B	3.00	115.28	111.36
6	D	529	UDP	C2'-C1'-N1	2.85	121.30	113.22
5	D	528	GDU	O2-C2-N1	-2.83	119.03	122.79
5	B	403	GDU	O2-C2-N1	-2.74	119.14	122.79
5	D	528	GDU	O3'-C3'-C4'	-2.71	104.09	110.35
6	B	405	UDP	O4'-C4'-C3'	-2.69	99.79	105.11
6	B	405	UDP	O2-C2-N1	-2.60	119.34	122.79
5	B	403	GDU	C6'-C5'-C4'	2.53	118.94	113.00
6	B	405	UDP	C2'-C1'-N1	2.49	120.28	113.22
6	D	529	UDP	O2-C2-N1	-2.44	119.55	122.79
6	B	405	UDP	O2-C2-N3	2.37	125.92	121.50
5	D	528	GDU	O2-C2-N3	2.32	125.82	121.50
5	B	403	GDU	O2-C2-N3	2.26	125.72	121.50
6	B	405	UDP	O3A-PB-O1B	-2.21	98.95	111.19
6	D	529	UDP	O2-C2-N3	2.16	125.52	121.50
5	B	403	GDU	O3'-C3'-C4'	-2.10	105.49	110.35
6	B	405	UDP	O3B-PB-O3A	2.07	111.56	104.64
5	B	403	GDU	O5D-C5D-C4D	2.05	116.03	108.99
6	D	529	UDP	O3A-PB-O1B	-2.01	100.02	111.19

There are no chirality outliers.

All (21) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	805	MES	C8-C7-N4-C3
4	A	805	MES	C8-C7-N4-C5
6	D	529	UDP	C5'-O5'-PA-O1A
6	D	529	UDP	C5'-O5'-PA-O2A
5	B	403	GDU	O5'-C5'-C6'-O6'
5	D	528	GDU	C2'-C1'-O3B-PB
6	D	529	UDP	C3'-C4'-C5'-O5'
5	B	403	GDU	C4'-C5'-C6'-O6'
5	D	528	GDU	O5'-C5'-C6'-O6'
5	B	403	GDU	C1'-O3B-PB-O3A

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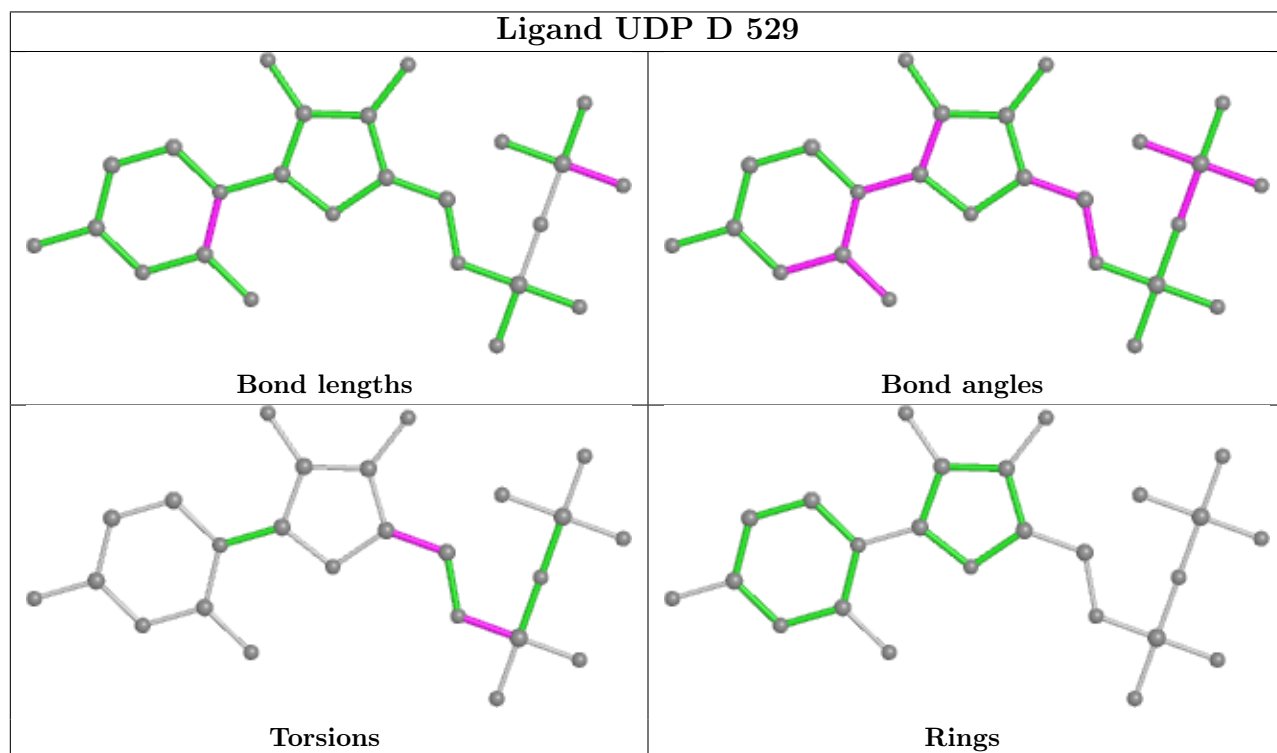
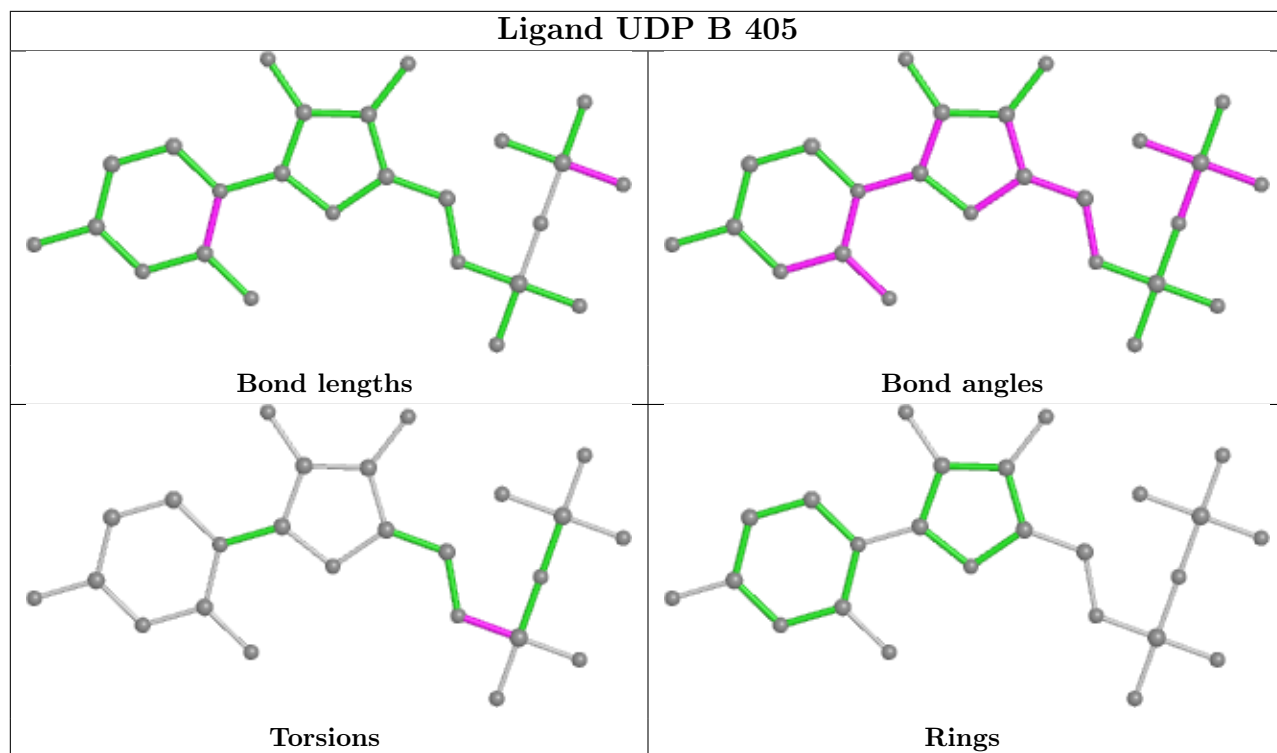
Mol	Chain	Res	Type	Atoms
5	D	528	GDU	C1'-O3B-PB-O3A
6	B	405	UDP	C5'-O5'-PA-O3A
6	D	529	UDP	C5'-O5'-PA-O3A
5	B	403	GDU	PB-O3A-PA-O1A
6	D	529	UDP	O4'-C4'-C5'-O5'
5	B	403	GDU	C2'-C1'-O3B-PB
5	D	528	GDU	PA-O3A-PB-O2B
5	B	403	GDU	PA-O3A-PB-O2B
5	B	403	GDU	PA-O3A-PB-O1B
5	D	528	GDU	PB-O3A-PA-O2A
5	D	528	GDU	PA-O3A-PB-O1B

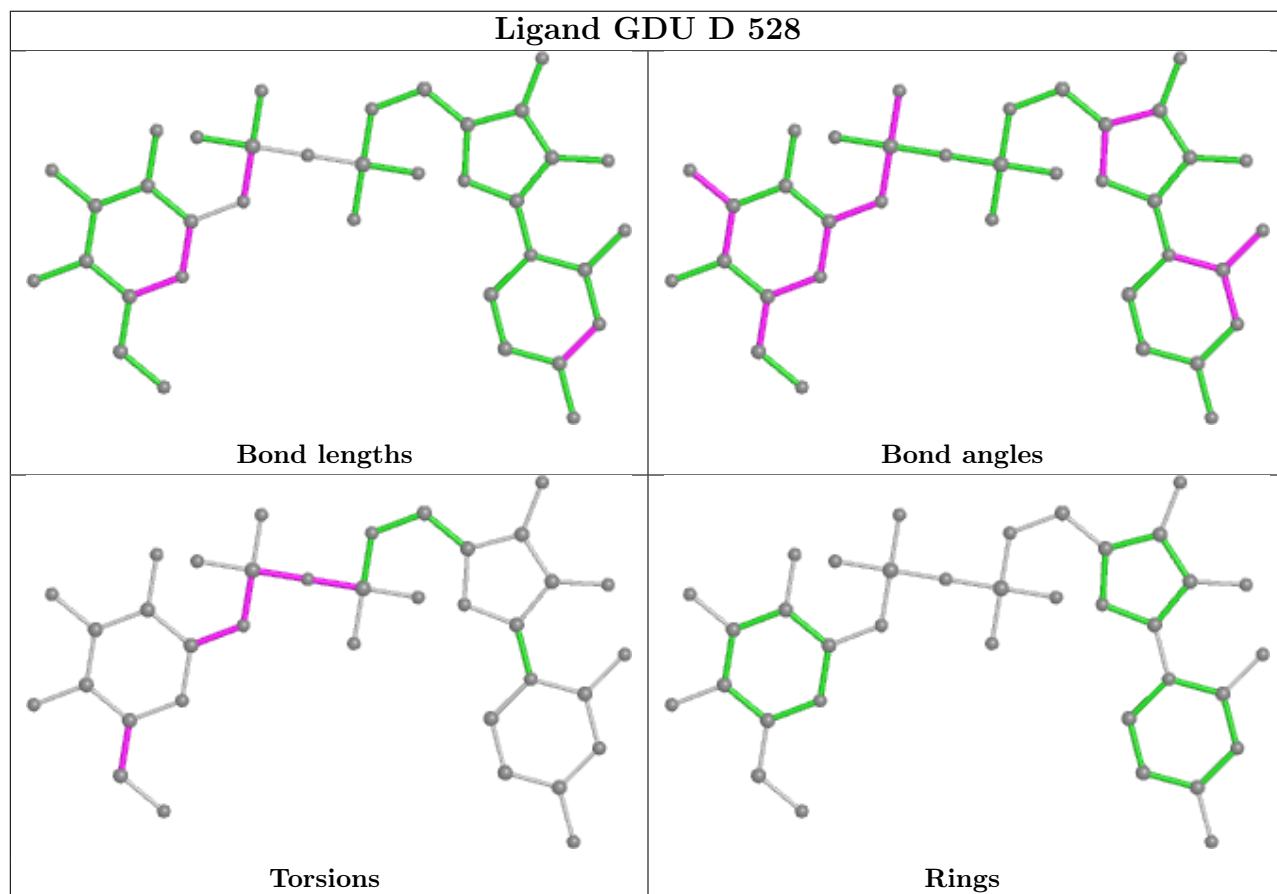
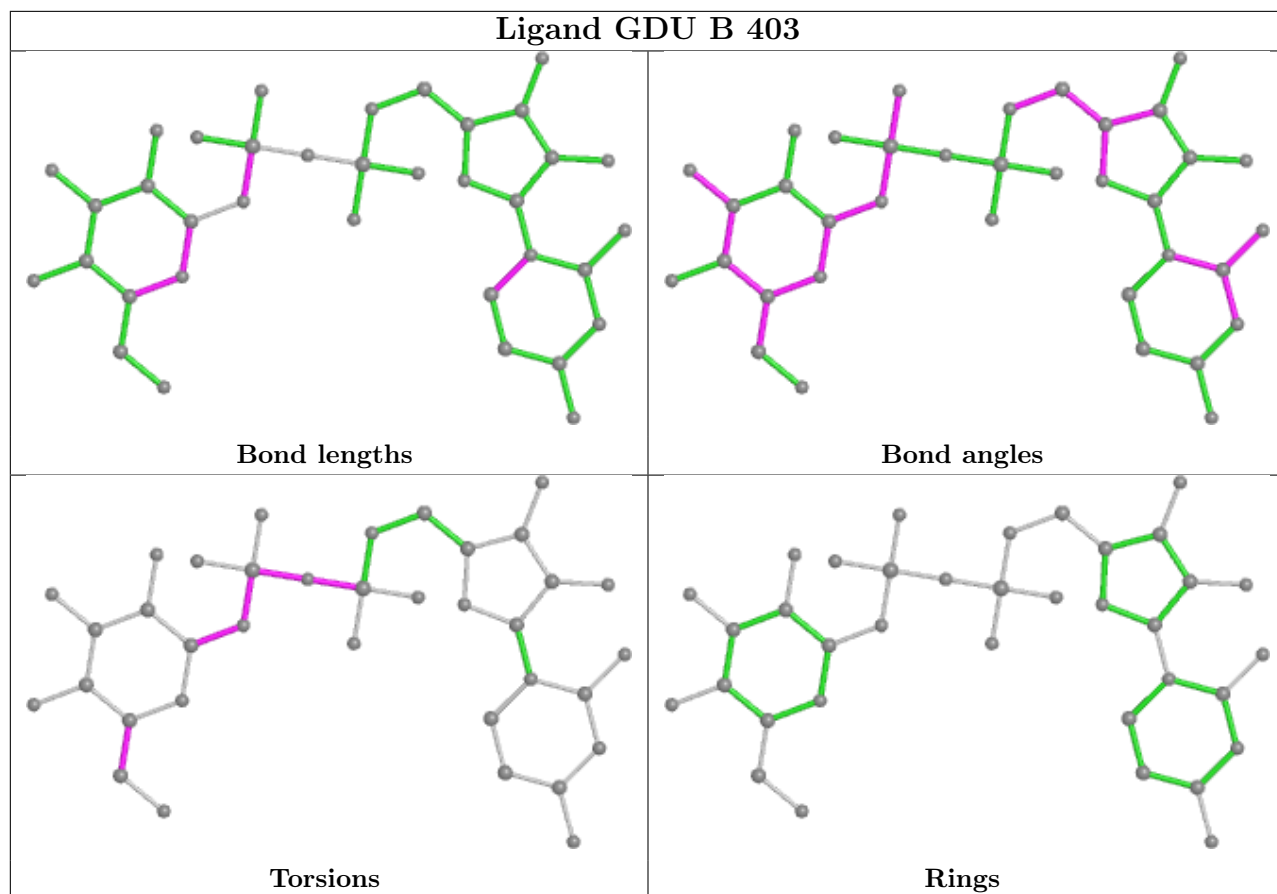
There are no ring outliers.

2 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	805	MES	5	0
6	D	529	UDP	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	123/123 (100%)	-0.27	6 (4%) 29 28	20, 31, 59, 67	0
1	C	123/123 (100%)	-0.26	5 (4%) 37 36	21, 31, 52, 85	0
2	B	272/286 (95%)	0.01	16 (5%) 22 21	22, 33, 57, 67	0
2	D	272/286 (95%)	-0.15	5 (1%) 68 66	21, 32, 51, 65	0
All	All	790/818 (96%)	-0.13	32 (4%) 37 36	20, 32, 56, 85	0

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	123	PRO	8.4
1	A	123	PRO	5.5
1	C	122	LYS	5.2
2	B	402	SER	5.1
2	D	402	SER	5.0
1	C	121	GLU	4.6
1	C	45	ASN	4.0
1	A	68	GLU	4.0
1	A	45	ASN	3.4
1	A	66	PHE	3.3
2	B	151	ILE	3.1
2	B	150	ASN	3.0
1	A	46	GLY	3.0
1	C	67	PRO	2.9
2	B	351	LYS	2.8
2	B	174	MET	2.7
2	B	152	PRO	2.7
2	D	151	ILE	2.6
2	D	346	ARG	2.4
2	B	291	GLY	2.4
2	B	349	ARG	2.3

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Mol	Chain	Res	Type	RSRZ
2	B	293	VAL	2.3
2	B	132	THR	2.2
2	D	174	MET	2.2
2	B	131	LEU	2.2
1	A	44	ASP	2.1
2	B	348	SER	2.1
2	B	157	LEU	2.1
2	B	156	LYS	2.1
2	B	186	ILE	2.1
2	B	160	GLN	2.1
2	D	175	ASP	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 monosaccharides in this entry.

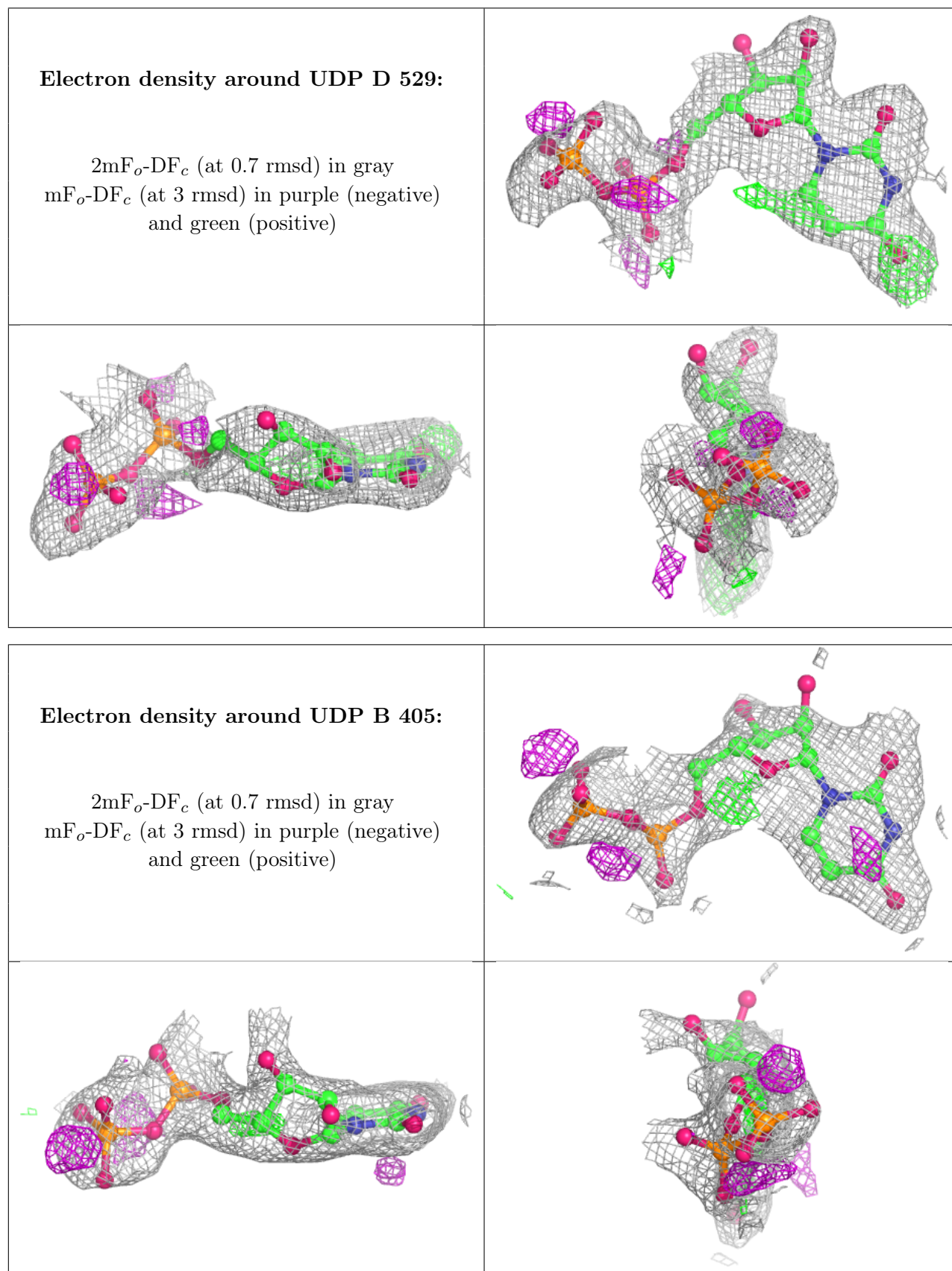
6.4 Ligands [i](#)

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
6	UDP	D	529	25/25	0.66	0.23	65,80,96,96	0
6	UDP	B	405	25/25	0.80	0.19	70,81,93,94	0
4	MES	A	805	12/12	0.86	0.19	53,55,62,62	0
5	GDU	B	403	36/36	0.96	0.15	24,28,32,35	0
5	GDU	D	528	36/36	0.97	0.10	23,26,30,30	0
3	CA	C	526	1/1	0.98	0.05	33,33,33,33	0
3	CA	B	404	1/1	0.98	0.08	34,34,34,34	0
3	CA	D	527	1/1	0.99	0.05	29,29,29,29	0
3	CA	A	124	1/1	0.99	0.07	23,23,23,23	0

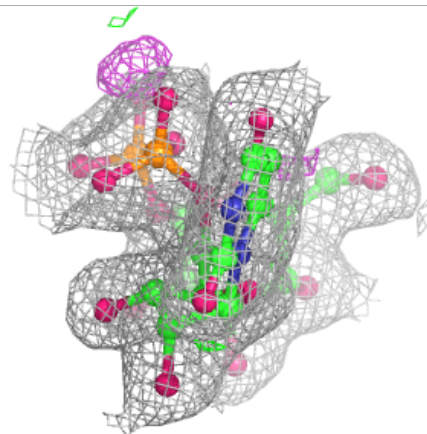
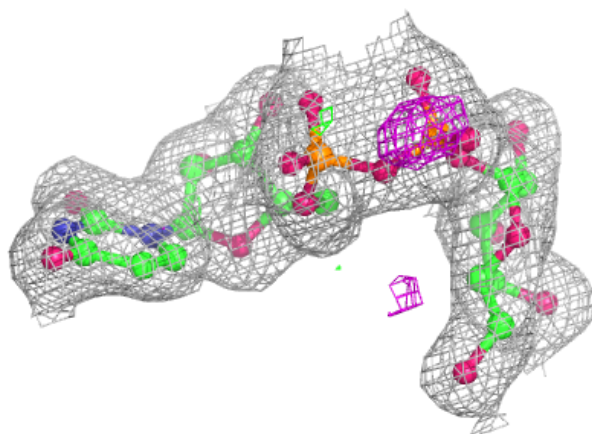
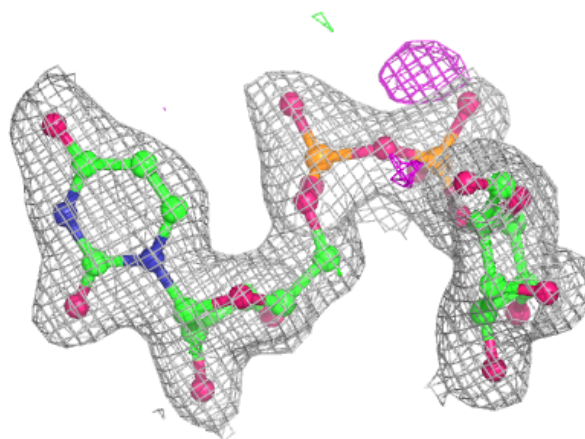
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers

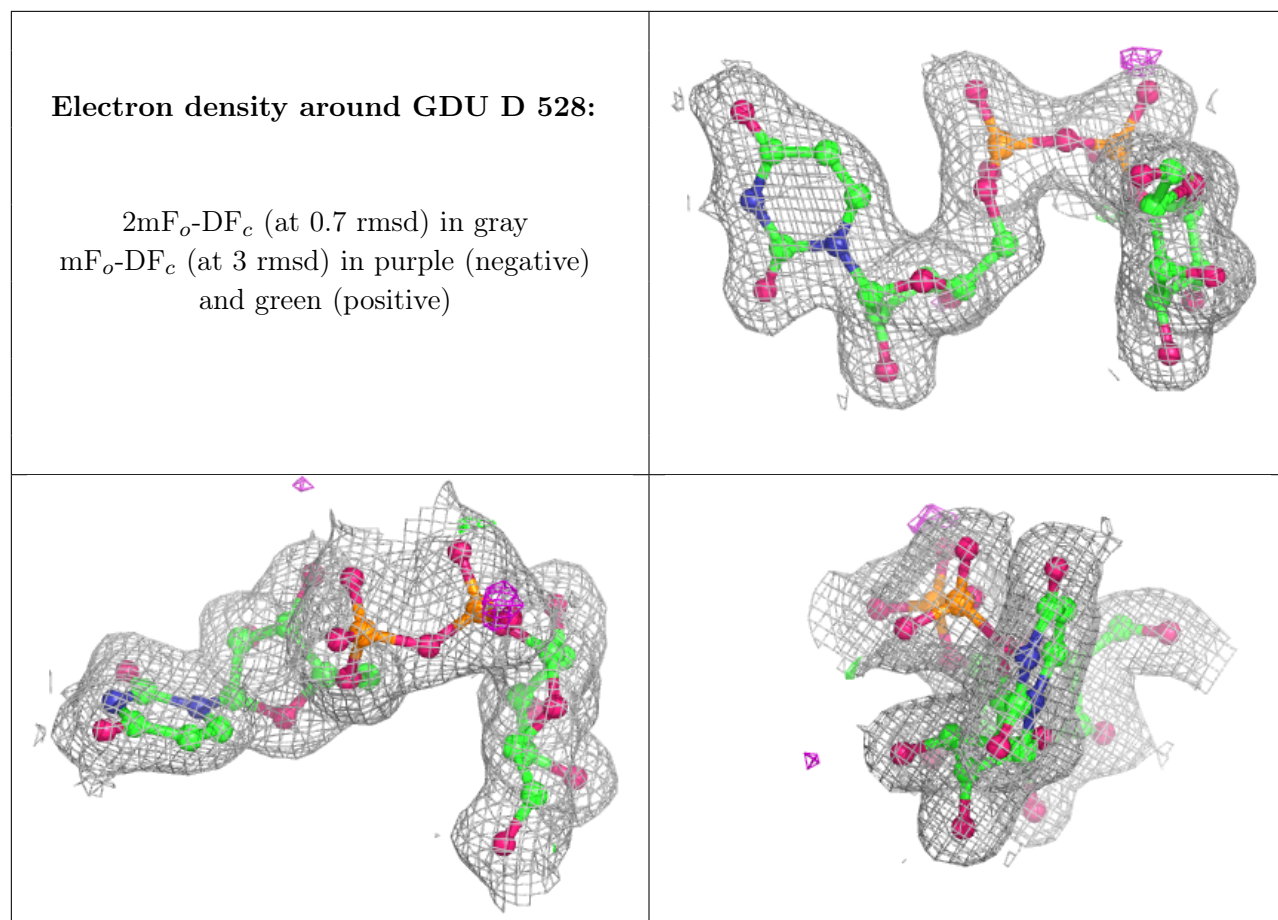
as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.



Electron density around 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.