



Full wwPDB X-ray Structure Validation Report ⓘ

Jun 24, 2024 – 08:15 PM EDT

PDB ID : 6ZLK
Title : Equilibrium Structure of UDP-Glucuronic acid 4-epimerase from *Bacillus cereus* in complex with UDP-Glucuronic acid/UDP-Galacturonic acid and NAD
Authors : Iacovino, L.G.; Mattevi, A.
Deposited on : 2020-06-30
Resolution : 1.50 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	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.37.1
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)	:	2.37.1

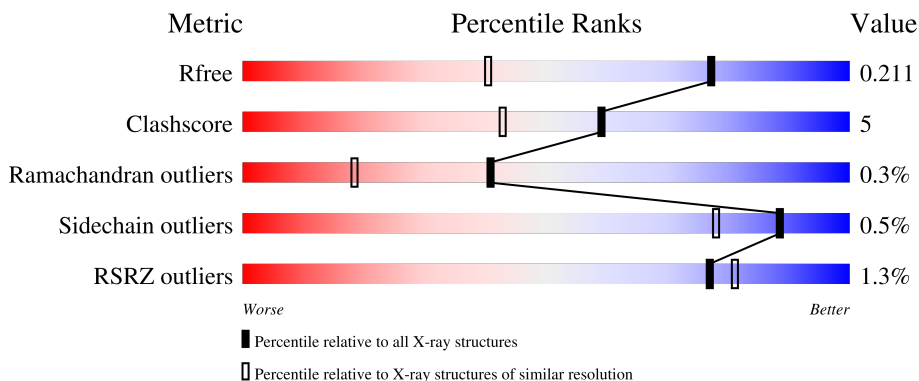
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION





The reported resolution of this entry is 1.50 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	2936 (1.50-1.50)
Clashscore	141614	3144 (1.50-1.50)
Ramachandran outliers	138981	3066 (1.50-1.50)
Sidechain outliers	138945	3064 (1.50-1.50)
RSRZ outliers	127900	2884 (1.50-1.50)

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	327	
1	B	327	
1	C	327	
1	D	327	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 11279 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 Epimerase domain-containing protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	315	Total	C	N	O	S	0	0	0
			2464	1584	412	459	9			
1	B	315	Total	C	N	O	S	0	0	0
			2471	1589	414	459	9			
1	C	315	Total	C	N	O	S	0	0	1
			2464	1585	413	457	9			
1	D	315	Total	C	N	O	S	0	1	0
			2474	1589	417	459	9			

There are 40 discrepancies between the modelled and reference sequences:

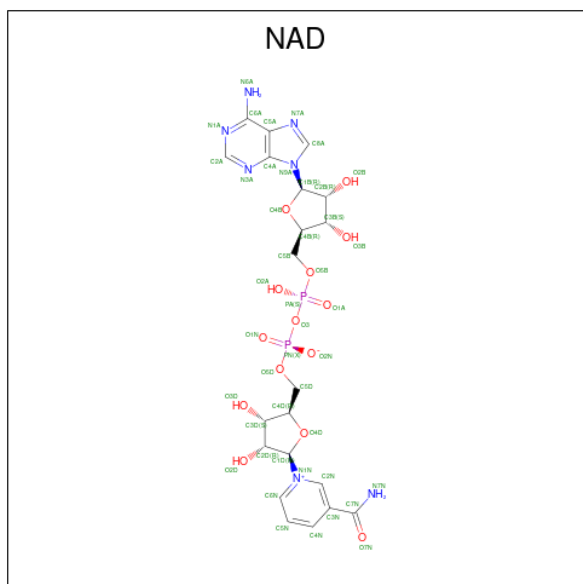
Chain	Residue	Modelled	Actual	Comment	Reference
A	318	ALA	-	expression tag	UNP J8BY31
A	319	ALA	-	expression tag	UNP J8BY31
A	320	TRP	-	expression tag	UNP J8BY31
A	321	SER	-	expression tag	UNP J8BY31
A	322	HIS	-	expression tag	UNP J8BY31
A	323	PRO	-	expression tag	UNP J8BY31
A	324	GLN	-	expression tag	UNP J8BY31
A	325	PHE	-	expression tag	UNP J8BY31
A	326	GLU	-	expression tag	UNP J8BY31
A	327	LYS	-	expression tag	UNP J8BY31
B	318	ALA	-	expression tag	UNP J8BY31
B	319	ALA	-	expression tag	UNP J8BY31
B	320	TRP	-	expression tag	UNP J8BY31
B	321	SER	-	expression tag	UNP J8BY31
B	322	HIS	-	expression tag	UNP J8BY31
B	323	PRO	-	expression tag	UNP J8BY31
B	324	GLN	-	expression tag	UNP J8BY31
B	325	PHE	-	expression tag	UNP J8BY31
B	326	GLU	-	expression tag	UNP J8BY31
B	327	LYS	-	expression tag	UNP J8BY31
C	318	ALA	-	expression tag	UNP J8BY31

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Chain	Residue	Modelled	Actual	Comment	Reference
C	319	ALA	-	expression tag	UNP J8BY31
C	320	TRP	-	expression tag	UNP J8BY31
C	321	SER	-	expression tag	UNP J8BY31
C	322	HIS	-	expression tag	UNP J8BY31
C	323	PRO	-	expression tag	UNP J8BY31
C	324	GLN	-	expression tag	UNP J8BY31
C	325	PHE	-	expression tag	UNP J8BY31
C	326	GLU	-	expression tag	UNP J8BY31
C	327	LYS	-	expression tag	UNP J8BY31
D	318	ALA	-	expression tag	UNP J8BY31
D	319	ALA	-	expression tag	UNP J8BY31
D	320	TRP	-	expression tag	UNP J8BY31
D	321	SER	-	expression tag	UNP J8BY31
D	322	HIS	-	expression tag	UNP J8BY31
D	323	PRO	-	expression tag	UNP J8BY31
D	324	GLN	-	expression tag	UNP J8BY31
D	325	PHE	-	expression tag	UNP J8BY31
D	326	GLU	-	expression tag	UNP J8BY31
D	327	LYS	-	expression tag	UNP J8BY31

- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: $C_{21}H_{27}N_7O_{14}P_2$) (labeled as "Ligand of Interest" by depositor).



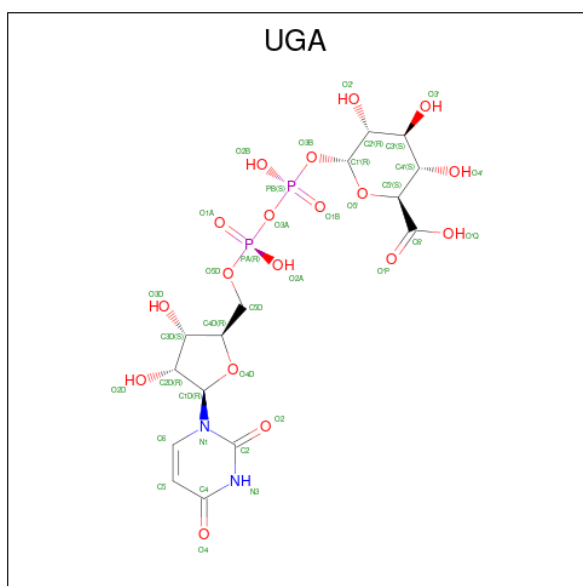
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	
			44	21	7	14	2	

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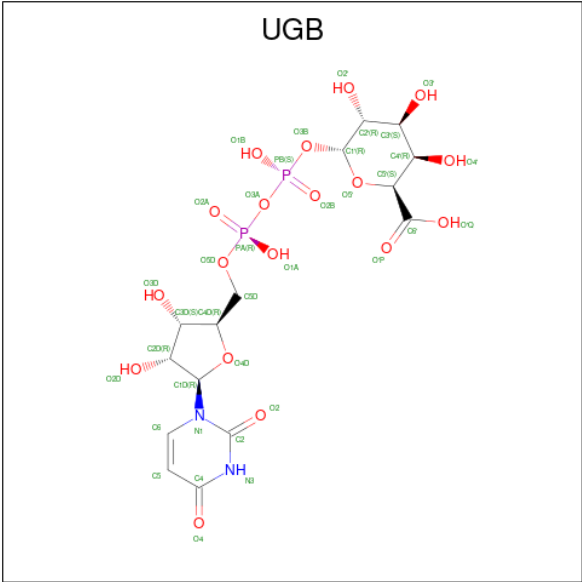
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	B	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	C	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	D	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

- Molecule 3 is URIDINE-5'-DIPHOSPHATE-GLUCURONIC ACID (three-letter code: UGA) (formula: $C_{15}H_{22}N_2O_{18}P_2$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	1
			37	15	2	18	2		
3	B	1	Total	C	N	O	P	0	1
			37	15	2	18	2		
3	C	1	Total	C	N	O	P	0	1
			37	15	2	18	2		
3	D	1	Total	C	N	O	P	0	1
			37	15	2	18	2		

- Molecule 4 is (2S,3R,4S,5R,6R)-6-[[[(2R,3S,4R,5R)-5-(2,4-dioxypyrimidin-1-yl)-3,4-dihydroxy-oxolan-2-yl]methoxy-hydroxy-phosphoryl]oxy-hydroxy-phosphoryl]oxy-3,4,5-trihydroxy-oxane-2-carboxylic acid (three-letter code: UGB) (formula: $C_{15}H_{22}N_2O_{18}P_2$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	1
			37	15	2	18	2		
4	B	1	Total	C	N	O	P	0	1
			37	15	2	18	2		
4	C	1	Total	C	N	O	P	0	1
			37	15	2	18	2		
4	D	1	Total	C	N	O	P	0	1
			37	15	2	18	2		

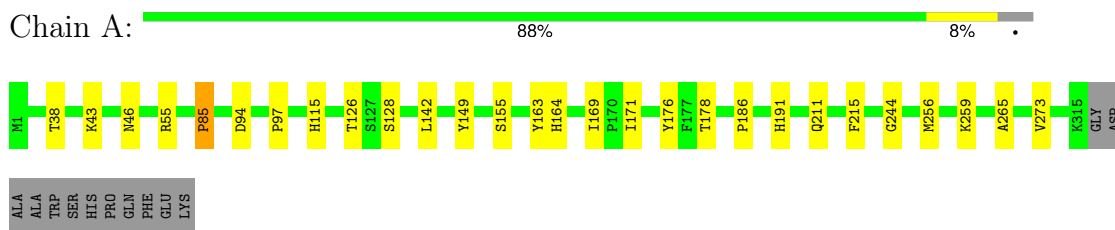
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	294	Total	O	0	0
			294	294		
5	B	226	Total	O	0	0
			226	226		
5	C	212	Total	O	0	0
			212	212		
5	D	202	Total	O	0	0
			202	202		

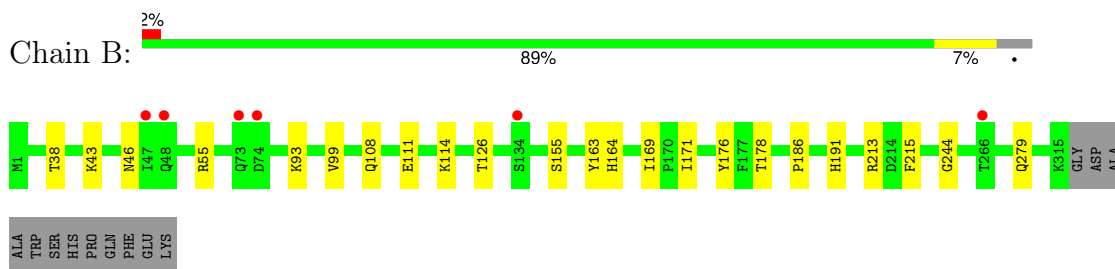
3 Residue-property plots [i](#)

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.

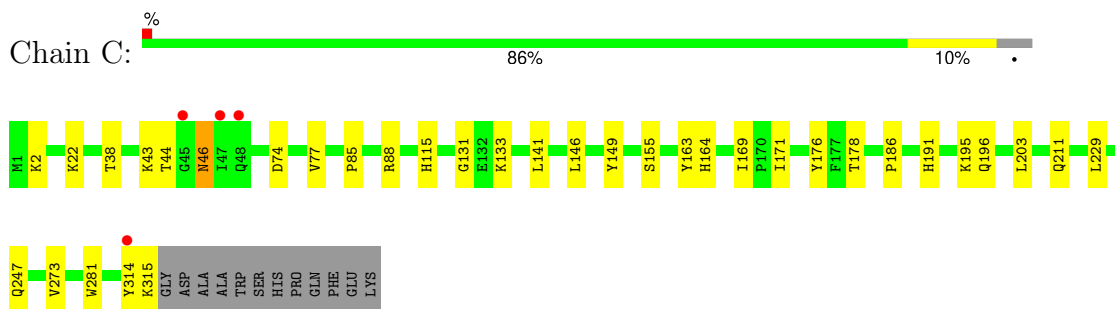
- Molecule 1: Epimerase domain-containing protein



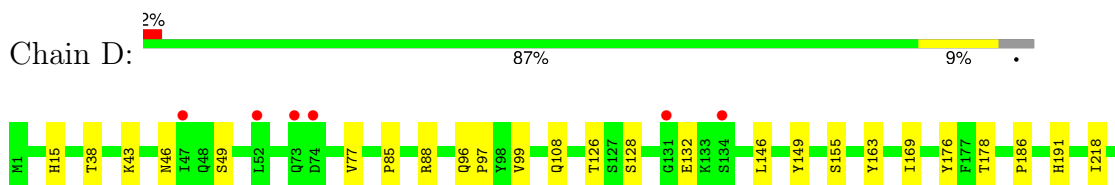
- Molecule 1: Epimerase domain-containing protein



- Molecule 1: Epimerase domain-containing protein



- Molecule 1: Epimerase domain-containing protein



L229	V273	Y307	K311	Q312	K315	GLY	ASP	ALA	ALA	TRP	SER	HIS	PRO	GLN	PHE	GLU	LYS
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4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	53.74Å 124.35Å 98.36Å 90.00° 90.63° 90.00°	Depositor
Resolution (Å)	49.37 – 1.50 49.33 – 1.50	Depositor EDS
% Data completeness (in resolution range)	97.3 (49.37-1.50) 97.3 (49.33-1.50)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.30 (at 1.50Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, R_{free}	0.172 , 0.203 0.181 , 0.211	Depositor DCC
R_{free} test set	10018 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	20.2	Xtriage
Anisotropy	0.119	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 46.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.020 for h,-k,-l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	11279	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.72% 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: UGA, NAD, UGB

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	0.76	0/2517	0.90	2/3413 (0.1%)
1	B	0.72	0/2523	0.84	3/3419 (0.1%)
1	C	0.72	0/2517	0.84	0/3411
1	D	0.71	0/2531	0.82	0/3430
All	All	0.73	0/10088	0.85	5/13673 (0.0%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	176	TYR	CB-CG-CD1	8.58	126.15	121.00
1	B	176	TYR	CB-CG-CD2	-7.69	116.39	121.00
1	A	176	TYR	CB-CG-CD1	6.81	125.09	121.00
1	B	55	ARG	NE-CZ-NH2	-5.58	117.51	120.30
1	A	55	ARG	NE-CZ-NH1	5.39	123.00	120.30

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	2464	0	2492	16	0
1	B	2471	0	2513	17	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	2464	0	2505	26	0
1	D	2474	0	2515	25	0
2	A	44	0	26	5	0
2	B	44	0	26	6	0
2	C	44	0	26	3	0
2	D	44	0	26	5	0
3	A	37	0	19	5	0
3	B	37	0	19	4	0
3	C	37	0	19	2	0
3	D	37	0	19	4	0
4	A	37	0	19	3	0
4	B	37	0	19	3	0
4	C	37	0	19	2	0
4	D	37	0	19	2	0
5	A	294	0	0	4	0
5	B	226	0	0	4	0
5	C	212	0	0	5	0
5	D	202	0	0	6	0
All	All	11279	0	10281	97	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 (97) 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:273:VAL:HG12	5:A:508:HOH:O	1.76	0.84
2:A:401:NAD:C4N	3:A:402[B]:UGA:H4'1	2.09	0.83
2:D:401:NAD:C4N	3:D:402[B]:UGA:H4'1	2.12	0.80
1:B:126:THR:OG1	3:B:402[B]:UGA:O'P	2.02	0.77
1:B:155:SER:HG	1:D:155:SER:HG	1.31	0.77
2:B:401:NAD:C4N	4:B:403[A]:UGB:H4'	2.16	0.74
2:C:401:NAD:C4N	4:C:403[A]:UGB:H4'	2.17	0.74
2:D:401:NAD:C4N	4:D:403[A]:UGB:H4'	2.21	0.71
2:A:401:NAD:C4N	4:A:403[A]:UGB:H4'	2.21	0.71
2:B:401:NAD:C4N	3:B:402[B]:UGA:H4'1	2.21	0.69
1:A:126:THR:OG1	3:A:402[B]:UGA:O'P	2.07	0.69
2:C:401:NAD:C4N	3:C:402[B]:UGA:H4'1	2.24	0.67
1:D:307:TYR:CE2	1:D:311:LYS:HD3	2.31	0.65
1:D:88:ARG:HG2	1:D:273:VAL:HG11	1.78	0.63
1:A:163:TYR:HB3	1:A:169:ILE:HD12	1.79	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:46:ASN:HB2	5:B:533:HOH:O	2.00	0.62
1:C:46:ASN:OD1	1:C:46:ASN:N	2.33	0.62
1:D:46:ASN:HB2	5:D:557:HOH:O	2.00	0.61
1:B:111:GLU:OE1	1:B:114:LYS:HE3	2.01	0.59
1:B:38:THR:HB	1:B:43:LYS:HE3	1.84	0.59
2:B:401:NAD:C5N	3:B:402[B]:UGA:H4'1	2.32	0.59
1:A:155:SER:OG	1:C:155:SER:OG	2.20	0.58
1:C:163:TYR:HB3	1:C:169:ILE:HD12	1.86	0.57
1:A:115:HIS:HE1	5:A:643:HOH:O	1.87	0.56
1:A:256:MET:O	1:A:259:LYS:HG2	2.05	0.56
1:C:88:ARG:HG2	1:C:273:VAL:HG11	1.86	0.56
1:C:88:ARG:NH1	4:C:403[A]:UGB:H2D	2.22	0.55
2:A:401:NAD:C3N	3:A:402[B]:UGA:H4'1	2.36	0.55
1:D:132:GLU:HG2	1:D:146:LEU:HD11	1.89	0.55
1:B:155:SER:OG	1:D:155:SER:OG	2.13	0.53
1:B:108:GLN:HG3	5:B:518:HOH:O	2.09	0.53
1:D:88:ARG:HD2	1:D:273:VAL:HG21	1.92	0.51
1:D:108:GLN:NE2	5:D:504:HOH:O	2.42	0.51
1:B:164:HIS:HB2	1:B:171:ILE:HG12	1.90	0.51
1:B:93:LYS:HD3	5:D:504:HOH:O	2.09	0.51
1:A:38:THR:HB	1:A:43:LYS:HE3	1.91	0.51
1:C:176:TYR:HB2	2:C:401:NAD:C5N	2.41	0.51
1:C:186:PRO:HA	1:C:191:HIS:CG	2.46	0.50
1:C:38:THR:HB	1:C:43:LYS:HE3	1.93	0.50
1:D:15:HIS:CD2	1:D:218:ILE:HG12	2.47	0.49
1:C:164:HIS:HB2	1:C:171:ILE:HG12	1.93	0.49
1:C:141:LEU:HD11	5:C:567:HOH:O	2.12	0.49
1:D:163:TYR:HB3	1:D:169:ILE:HD12	1.94	0.49
1:B:163:TYR:HB3	1:B:169:ILE:HD12	1.94	0.49
1:C:133:LYS:HD3	1:C:141:LEU:HD13	1.96	0.48
1:D:108:GLN:HG3	5:D:517:HOH:O	2.13	0.48
1:D:128:SER:OG	4:D:403[A]:UGB:H2'	2.13	0.48
1:D:88:ARG:CD	1:D:273:VAL:HG21	2.44	0.48
1:A:265:ALA:HB3	5:A:528:HOH:O	2.13	0.48
1:B:114:LYS:HE2	5:B:630:HOH:O	2.13	0.48
1:A:85:PRO:HA	1:A:149:TYR:CE1	2.49	0.48
2:B:401:NAD:C5N	4:B:403[A]:UGB:H4'	2.44	0.48
1:C:195:LYS:HD2	1:C:314:TYR:CE2	2.49	0.48
1:D:38:THR:HB	1:D:43:LYS:HE3	1.96	0.47
1:D:46:ASN:O	1:D:49:SER:HB3	2.14	0.47
1:C:115:HIS:CD2	5:C:684:HOH:O	2.67	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:186:PRO:HA	1:D:191:HIS:CG	2.50	0.46
1:D:312:GLN:HG2	5:D:562:HOH:O	2.15	0.46
1:C:74:ASP:OD1	1:C:74:ASP:N	2.37	0.46
2:B:401:NAD:C3N	4:B:403[A]:UGB:H4'	2.45	0.46
1:C:211:GLN:HG3	3:C:402[B]:UGA:O3D	2.16	0.45
1:C:77:VAL:HG21	1:C:229:LEU:CD1	2.47	0.45
1:C:315:LYS:N	5:C:508:HOH:O	2.49	0.45
1:D:85:PRO:HA	1:D:149:TYR:CE1	2.51	0.45
1:D:77:VAL:HG21	1:D:229:LEU:CD1	2.47	0.45
2:A:401:NAD:C5N	3:A:402[B]:UGA:H4'1	2.47	0.45
1:D:126:THR:OG1	3:D:402[B]:UGA:O'P	2.29	0.44
1:C:88:ARG:HD2	1:C:273:VAL:HG21	2.00	0.44
1:C:88:ARG:CG	1:C:273:VAL:HG11	2.48	0.44
2:D:401:NAD:C5N	3:D:402[B]:UGA:H4'1	2.48	0.44
1:D:315:LYS:CA	5:D:659:HOH:O	2.65	0.43
1:B:213:ARG:HB2	1:B:215:PHE:CZ	2.53	0.43
1:D:88:ARG:CG	1:D:273:VAL:HG11	2.47	0.43
1:A:186:PRO:HA	1:A:191:HIS:CG	2.54	0.43
1:C:2:LYS:NZ	5:C:510:HOH:O	2.51	0.43
1:A:94:ASP:O	1:A:97:PRO:HD2	2.19	0.43
2:D:401:NAD:C3N	3:D:402[B]:UGA:H4'1	2.49	0.43
1:A:46:ASN:HB2	5:A:555:HOH:O	2.18	0.42
1:A:211:GLN:HG3	3:A:402[B]:UGA:O3D	2.20	0.42
1:C:247:GLN:OE1	1:C:281:TRP:HB2	2.19	0.42
1:A:128:SER:OG	4:A:403[A]:UGB:H2'	2.20	0.42
1:B:111:GLU:OE1	1:B:114:LYS:CE	2.67	0.42
1:C:85:PRO:HA	1:C:149:TYR:CE1	2.55	0.42
1:B:186:PRO:HA	1:B:191:HIS:CG	2.55	0.42
1:B:215:PHE:O	1:B:244:GLY:HA3	2.20	0.42
2:B:401:NAD:C3N	3:B:402[B]:UGA:H4'1	2.49	0.42
1:B:108:GLN:CG	5:B:518:HOH:O	2.68	0.41
2:A:401:NAD:C5N	4:A:403[A]:UGB:H4'	2.50	0.41
1:C:247:GLN:OE1	1:C:281:TRP:CB	2.69	0.41
1:A:215:PHE:O	1:A:244:GLY:HA3	2.21	0.41
1:B:99:VAL:CG1	1:D:99:VAL:CG1	2.99	0.41
1:D:176:TYR:HB2	2:D:401:NAD:C5N	2.51	0.40
1:D:96:GLN:HB3	1:D:97:PRO:HD3	2.03	0.40
1:A:164:HIS:HB2	1:A:171:ILE:HG12	2.04	0.40
1:C:22:LYS:HE2	5:C:692:HOH:O	2.21	0.40
1:C:196:GLN:OE1	1:C:203:LEU:HA	2.21	0.40
1:C:131:GLY:CA	1:C:146:LEU:HG	2.51	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	313/327 (96%)	308 (98%)	4 (1%)	1 (0%)	41	18
1	B	313/327 (96%)	306 (98%)	6 (2%)	1 (0%)	41	18
1	C	313/327 (96%)	305 (97%)	7 (2%)	1 (0%)	41	18
1	D	314/327 (96%)	307 (98%)	6 (2%)	1 (0%)	41	18
All	All	1253/1308 (96%)	1226 (98%)	23 (2%)	4 (0%)	41	18

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	178	THR
1	D	178	THR
1	A	178	THR
1	B	178	THR

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	272/285 (95%)	270 (99%)	2 (1%)	84	69
1	B	275/285 (96%)	274 (100%)	1 (0%)	91	82
1	C	273/285 (96%)	271 (99%)	2 (1%)	84	69

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	275/285 (96%)	275 (100%)	0	100	100
All	All	1095/1140 (96%)	1090 (100%)	5 (0%)	88	78

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	85	PRO
1	A	142	LEU
1	B	279	GLN
1	C	44	THR
1	C	46	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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](#)

12 ligands are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	UGB	C	403[A]	-	38,39,39	0.64	1 (2%)	56,60,60	0.83	2 (3%)
3	UGA	A	402[B]	-	34,39,39	1.53	3 (8%)	46,60,60	3.10	5 (10%)
3	UGA	C	402[B]	-	34,39,39	1.45	3 (8%)	46,60,60	3.27	5 (10%)
4	UGB	A	403[A]	-	38,39,39	0.65	1 (2%)	56,60,60	0.90	3 (5%)
4	UGB	D	403[A]	-	38,39,39	0.67	1 (2%)	56,60,60	0.81	1 (1%)
3	UGA	D	402[B]	-	34,39,39	1.39	3 (8%)	46,60,60	3.15	5 (10%)
2	NAD	B	401	-	42,48,48	1.23	3 (7%)	50,73,73	1.12	4 (8%)
2	NAD	A	401	-	42,48,48	1.20	3 (7%)	50,73,73	1.28	5 (10%)
3	UGA	B	402[B]	-	34,39,39	1.53	3 (8%)	46,60,60	3.11	3 (6%)
2	NAD	C	401	-	42,48,48	0.82	1 (2%)	50,73,73	1.18	4 (8%)
2	NAD	D	401	-	42,48,48	0.87	1 (2%)	50,73,73	1.11	3 (6%)
4	UGB	B	403[A]	-	38,39,39	0.75	1 (2%)	56,60,60	0.74	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	UGB	C	403[A]	-	-	6/25/61/61	0/3/3/3
3	UGA	A	402[B]	-	-	5/23/61/61	0/3/3/3
3	UGA	C	402[B]	-	-	3/23/61/61	0/3/3/3
4	UGB	A	403[A]	-	-	4/25/61/61	0/3/3/3
4	UGB	D	403[A]	-	-	6/25/61/61	0/3/3/3
3	UGA	D	402[B]	-	-	5/23/61/61	0/3/3/3
2	NAD	B	401	-	-	5/26/62/62	0/5/5/5
2	NAD	A	401	-	-	4/26/62/62	0/5/5/5
3	UGA	B	402[B]	-	-	6/23/61/61	0/3/3/3
2	NAD	C	401	-	-	6/26/62/62	0/5/5/5
2	NAD	D	401	-	-	3/26/62/62	0/5/5/5
4	UGB	B	403[A]	-	-	5/25/61/61	0/3/3/3

All (24) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	402[B]	UGA	C5-C4	6.84	1.44	1.37
3	B	402[B]	UGA	C5-C4	6.65	1.44	1.37

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	402[B]	UGA	C5-C4	6.51	1.44	1.37
3	D	402[B]	UGA	C5-C4	5.78	1.43	1.37
2	B	401	NAD	PN-O3	4.43	1.64	1.59
2	A	401	NAD	PN-O3	4.26	1.64	1.59
2	B	401	NAD	C2N-N1N	3.40	1.38	1.35
3	B	402[B]	UGA	O'Q-C6'	-3.31	1.20	1.30
3	D	402[B]	UGA	C4-N3	3.24	1.38	1.33
3	A	402[B]	UGA	O'Q-C6'	-3.16	1.20	1.30
2	D	401	NAD	C2N-N1N	3.10	1.38	1.35
3	C	402[B]	UGA	O'Q-C6'	-3.05	1.20	1.30
3	C	402[B]	UGA	C4-N3	3.01	1.38	1.33
3	D	402[B]	UGA	O'Q-C6'	-2.92	1.21	1.30
3	A	402[B]	UGA	C4-N3	2.89	1.38	1.33
4	B	403[A]	UGB	O'Q-C6'	-2.82	1.21	1.30
4	A	403[A]	UGB	O'Q-C6'	-2.79	1.21	1.30
4	D	403[A]	UGB	O'Q-C6'	-2.78	1.21	1.30
3	B	402[B]	UGA	C4-N3	2.78	1.37	1.33
4	C	403[A]	UGB	O'Q-C6'	-2.65	1.22	1.30
2	A	401	NAD	C2N-C3N	-2.20	1.35	1.39
2	A	401	NAD	PN-O2N	-2.15	1.45	1.55
2	C	401	NAD	C2N-N1N	2.15	1.37	1.35
2	B	401	NAD	PA-O3	2.08	1.61	1.59

All (40) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	402[B]	UGA	C2-N3-C4	19.97	127.77	114.49
3	A	402[B]	UGA	C2-N3-C4	18.98	127.11	114.49
3	B	402[B]	UGA	C2-N3-C4	18.90	127.05	114.49
3	D	402[B]	UGA	C2-N3-C4	18.83	127.01	114.49
3	B	402[B]	UGA	C6-C5-C4	6.21	119.84	115.60
3	D	402[B]	UGA	C6-C5-C4	6.09	119.76	115.60
3	C	402[B]	UGA	C6-C5-C4	5.37	119.26	115.60
3	C	402[B]	UGA	C5-C4-N3	-4.58	113.97	123.48
3	A	402[B]	UGA	C6-C5-C4	4.47	118.65	115.60
2	A	401	NAD	C4B-O4B-C1B	-4.35	105.94	109.92
3	D	402[B]	UGA	C5-C4-N3	-4.30	114.55	123.48
3	B	402[B]	UGA	C5-C4-N3	-4.28	114.61	123.48
2	D	401	NAD	C4B-O4B-C1B	-4.23	106.05	109.92
3	D	402[B]	UGA	O5'-C1'-O3B	-3.90	106.27	111.36
2	C	401	NAD	O7N-C7N-C3N	-3.87	114.86	119.60
3	A	402[B]	UGA	C5-C4-N3	-3.87	115.45	123.48

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	401	NAD	C4B-O4B-C1B	-3.28	106.92	109.92
2	A	401	NAD	O7N-C7N-C3N	-3.05	115.87	119.60
2	B	401	NAD	C4B-O4B-C1B	-2.99	107.19	109.92
4	D	403[A]	UGB	O5'-C1'-O3B	2.89	115.15	111.36
4	C	403[A]	UGB	O3B-C1'-C2'	-2.88	103.11	108.38
2	B	401	NAD	O7N-C7N-C3N	-2.86	116.10	119.60
2	D	401	NAD	O7N-C7N-C3N	-2.83	116.14	119.60
4	A	403[A]	UGB	O3B-C1'-C2'	-2.82	103.22	108.38
3	C	402[B]	UGA	O3B-PB-O1B	2.75	118.59	109.81
2	A	401	NAD	C5A-C6A-N6A	2.58	124.24	120.31
2	C	401	NAD	C3N-C7N-N7N	2.55	120.89	117.74
2	C	401	NAD	C5A-C6A-N6A	2.50	124.12	120.31
4	A	403[A]	UGB	O5'-C5'-C6'	2.46	113.82	106.14
2	A	401	NAD	O3-PA-O1A	-2.45	103.34	110.70
2	B	401	NAD	O2N-PN-O1N	2.37	123.47	112.44
3	A	402[B]	UGA	C1'-O5'-C5'	2.34	116.07	112.23
3	A	402[B]	UGA	O3D-C3D-C4D	-2.27	104.56	111.08
4	C	403[A]	UGB	O1B-PB-O2B	2.24	122.89	112.44
4	A	403[A]	UGB	O5'-C5'-C4'	-2.17	105.19	109.48
2	A	401	NAD	O2N-PN-O1N	2.15	122.43	112.44
2	B	401	NAD	O7N-C7N-N7N	2.12	125.68	122.62
3	D	402[B]	UGA	O2'-C2'-C3'	-2.10	105.42	110.38
3	C	402[B]	UGA	C6-N1-C1D	2.05	123.85	119.82
2	D	401	NAD	C5A-C6A-N6A	2.01	123.37	120.31

There are no chirality outliers.

All (58) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401	NAD	C5D-O5D-PN-O2N
2	B	401	NAD	C5D-O5D-PN-O3
2	B	401	NAD	C5D-O5D-PN-O2N
2	C	401	NAD	C5D-O5D-PN-O3
2	C	401	NAD	C5D-O5D-PN-O2N
2	D	401	NAD	C5D-O5D-PN-O2N
3	A	402[B]	UGA	PB-O3A-PA-O5D
3	A	402[B]	UGA	O4D-C1D-N1-C6
3	A	402[B]	UGA	C2D-C1D-N1-C6
3	B	402[B]	UGA	O4D-C1D-N1-C6
3	B	402[B]	UGA	C2D-C1D-N1-C6
3	C	402[B]	UGA	O4D-C1D-N1-C6
3	C	402[B]	UGA	C2D-C1D-N1-C6

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Mol	Chain	Res	Type	Atoms
3	D	402[B]	UGA	O4D-C1D-N1-C6
3	D	402[B]	UGA	C2D-C1D-N1-C6
4	A	403[A]	UGB	C4'-C5'-C6'-O'P
4	A	403[A]	UGB	C4'-C5'-C6'-O'Q
4	B	403[A]	UGB	C1'-O3B-PB-O3A
4	B	403[A]	UGB	C4'-C5'-C6'-O'P
4	B	403[A]	UGB	C4'-C5'-C6'-O'Q
4	D	403[A]	UGB	C1'-O3B-PB-O3A
4	D	403[A]	UGB	C4'-C5'-C6'-O'P
4	D	403[A]	UGB	C4'-C5'-C6'-O'Q
3	B	402[B]	UGA	PB-O3A-PA-O5D
3	C	402[B]	UGA	PB-O3A-PA-O5D
3	D	402[B]	UGA	PB-O3A-PA-O5D
4	A	403[A]	UGB	PB-O3A-PA-O5D
4	B	403[A]	UGB	PB-O3A-PA-O5D
4	C	403[A]	UGB	PB-O3A-PA-O5D
4	D	403[A]	UGB	PB-O3A-PA-O5D
4	B	403[A]	UGB	C1'-O3B-PB-O2B
4	D	403[A]	UGB	C1'-O3B-PB-O2B
3	A	402[B]	UGA	C4'-C5'-C6'-O'Q
4	C	403[A]	UGB	C4'-C5'-C6'-O'P
2	A	401	NAD	C5D-O5D-PN-O3
2	B	401	NAD	C5D-O5D-PN-O1N
2	C	401	NAD	C5D-O5D-PN-O1N
4	C	403[A]	UGB	C1'-O3B-PB-O3A
3	A	402[B]	UGA	PA-O3A-PB-O2B
3	B	402[B]	UGA	C1'-O3B-PB-O1B
3	D	402[B]	UGA	C1'-O3B-PB-O2B
4	A	403[A]	UGB	C1'-O3B-PB-O2B
4	C	403[A]	UGB	C1'-O3B-PB-O2B
2	A	401	NAD	O4B-C4B-C5B-O5B
2	A	401	NAD	PA-O3-PN-O1N
2	B	401	NAD	PA-O3-PN-O1N
2	C	401	NAD	PA-O3-PN-O1N
2	C	401	NAD	PA-O3-PN-O2N
2	D	401	NAD	PA-O3-PN-O1N
3	B	402[B]	UGA	PA-O3A-PB-O1B
4	C	403[A]	UGB	PB-O3A-PA-O1A
4	C	403[A]	UGB	C4'-C5'-C6'-O'Q
2	D	401	NAD	PA-O3-PN-O2N
3	B	402[B]	UGA	PA-O3A-PB-O2B
3	D	402[B]	UGA	PB-O3A-PA-O2A

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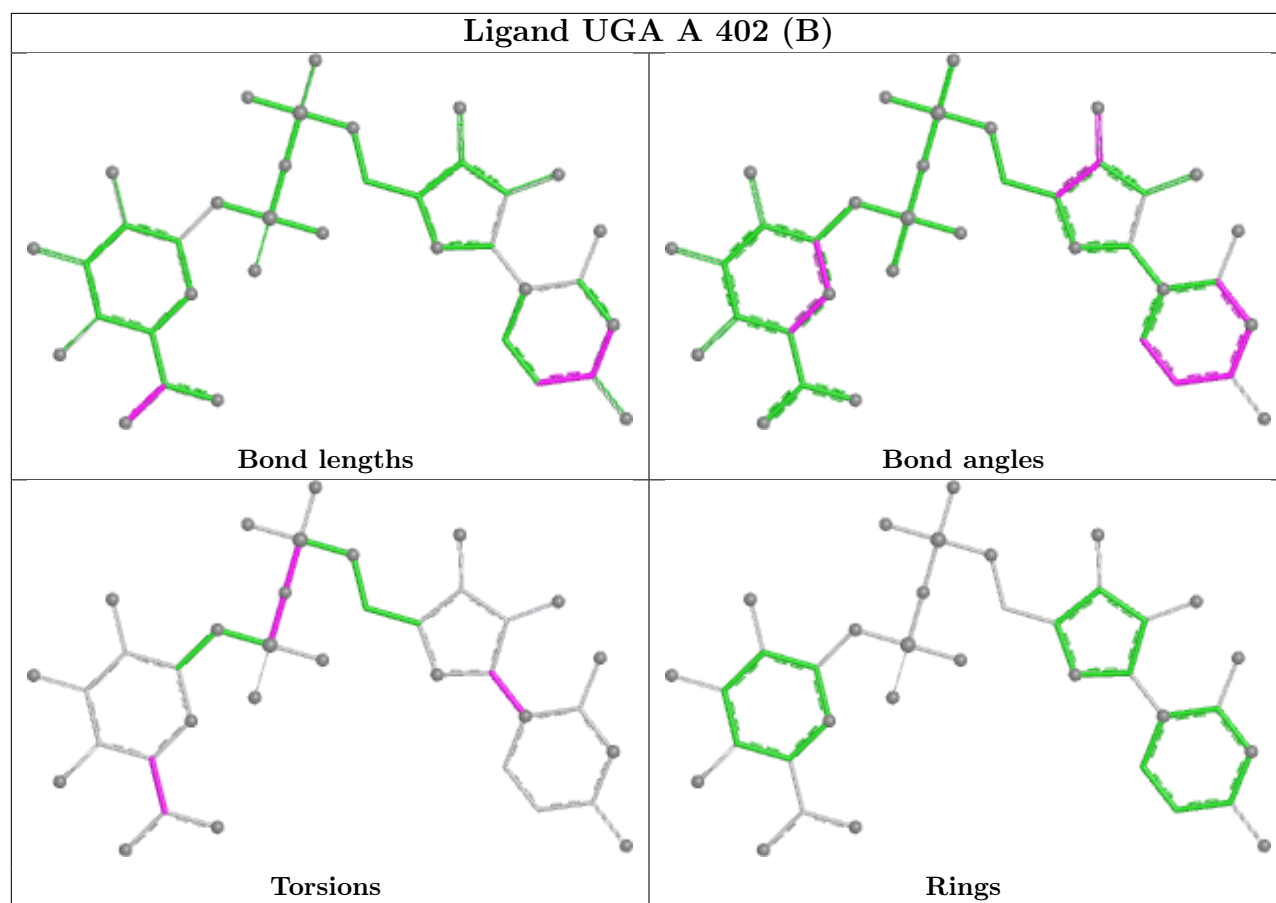
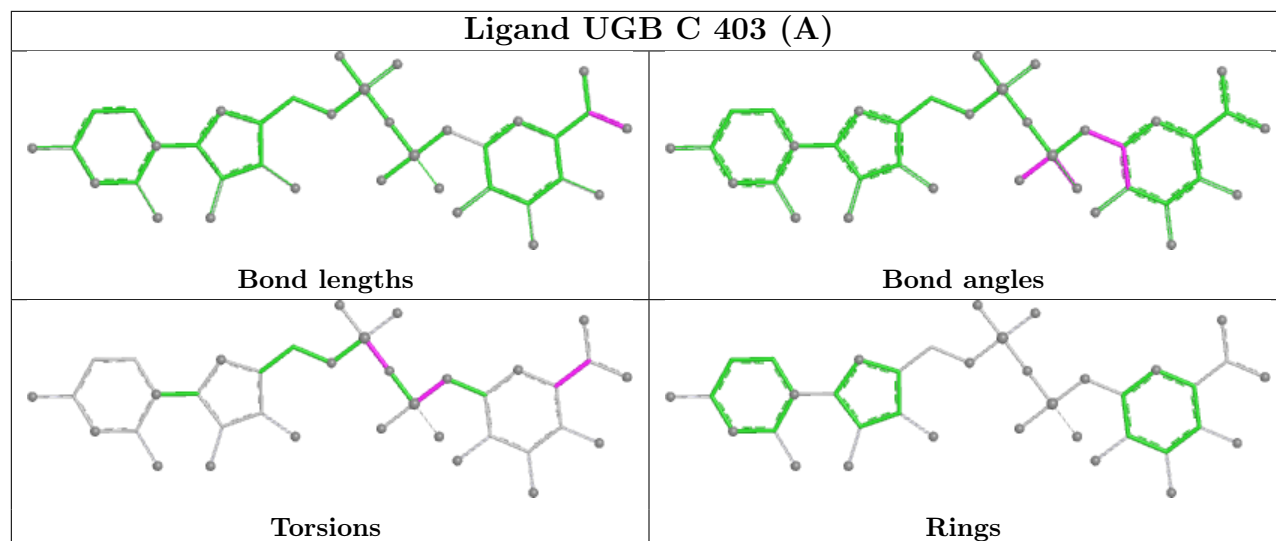
Mol	Chain	Res	Type	Atoms
4	D	403[A]	UGB	PB-O3A-PA-O1A
2	B	401	NAD	O4B-C4B-C5B-O5B
2	C	401	NAD	O4B-C4B-C5B-O5B

There are no ring outliers.

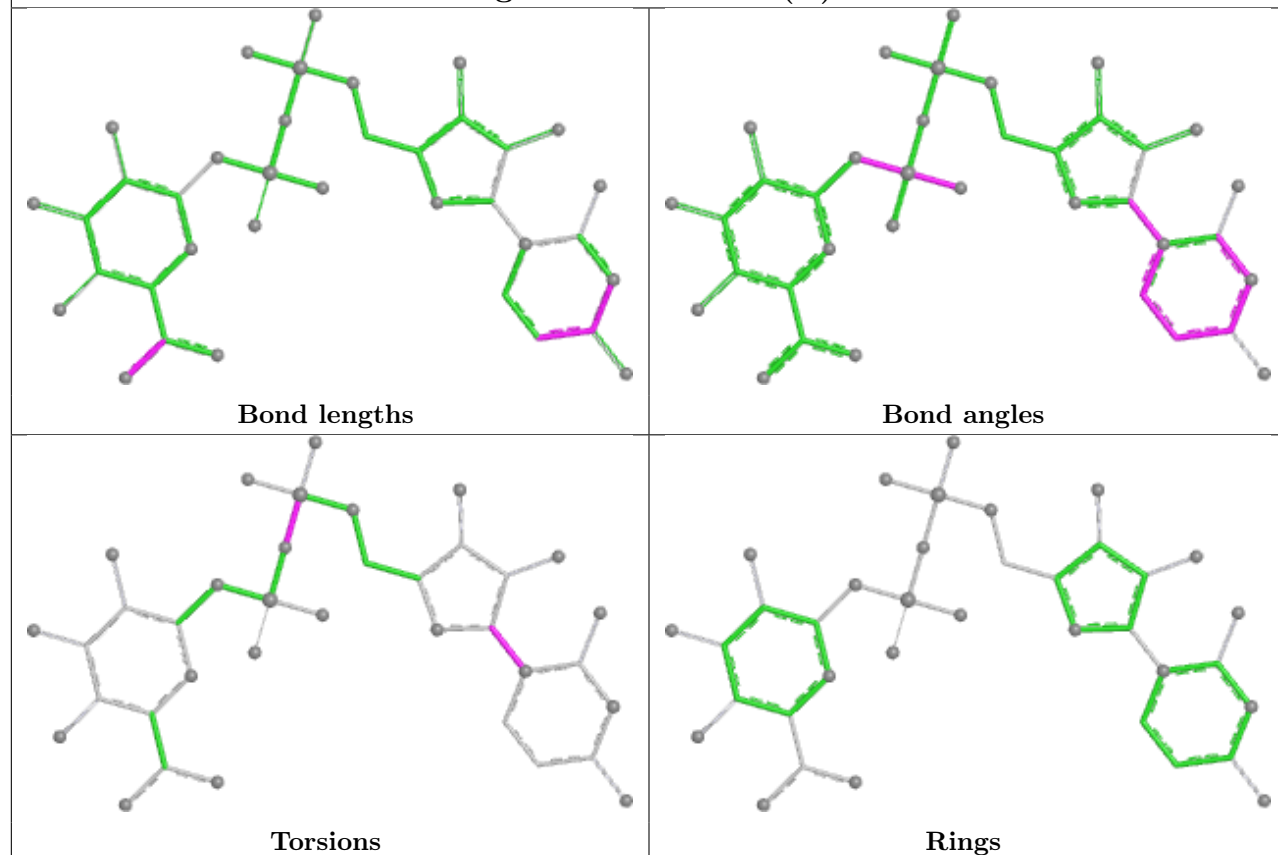
12 monomers are involved in 27 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	C	403[A]	UGB	2	0
3	A	402[B]	UGA	5	0
3	C	402[B]	UGA	2	0
4	A	403[A]	UGB	3	0
4	D	403[A]	UGB	2	0
3	D	402[B]	UGA	4	0
2	B	401	NAD	6	0
2	A	401	NAD	5	0
3	B	402[B]	UGA	4	0
2	C	401	NAD	3	0
2	D	401	NAD	5	0
4	B	403[A]	UGB	3	0

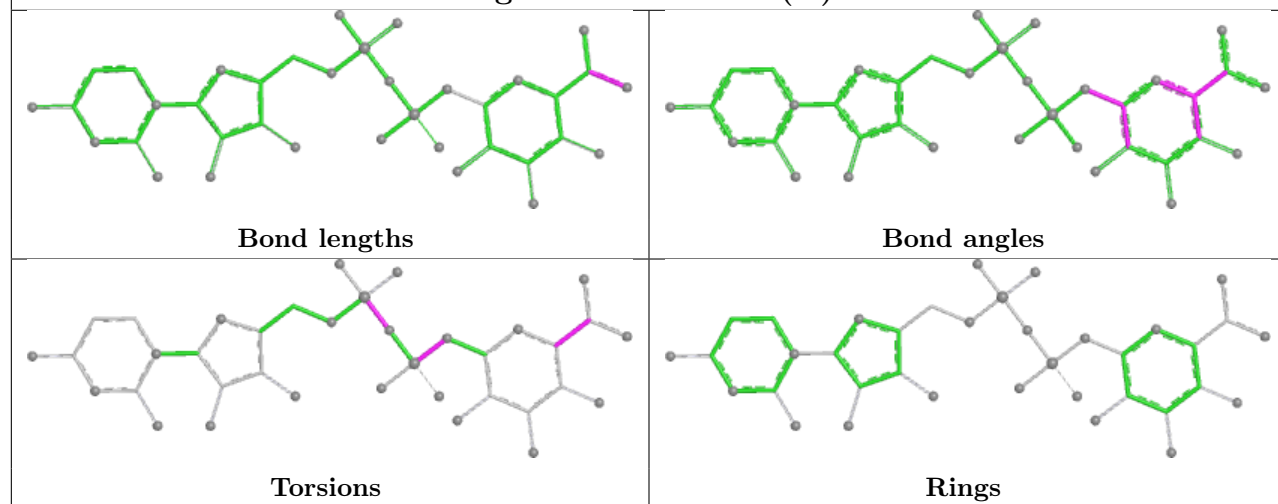
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

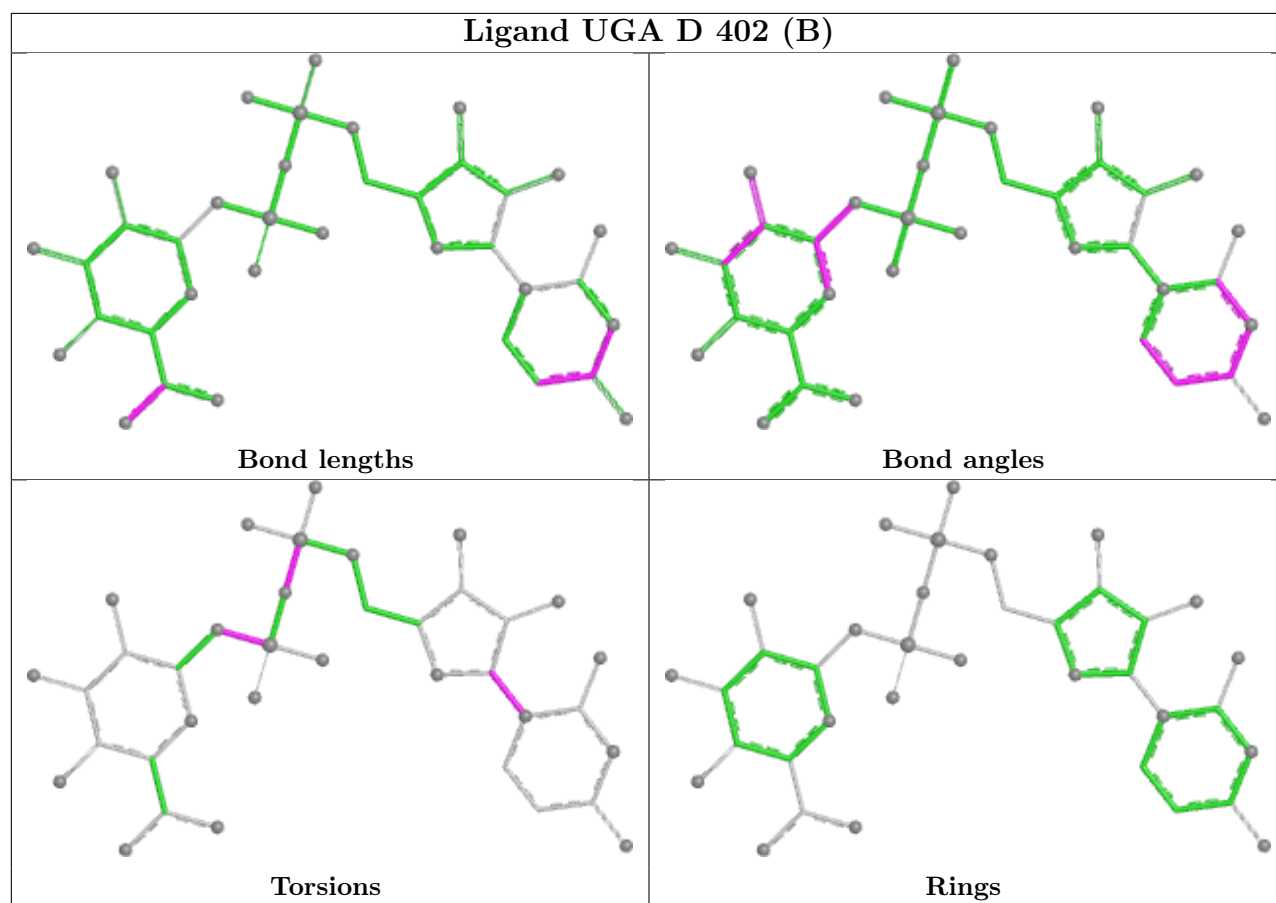
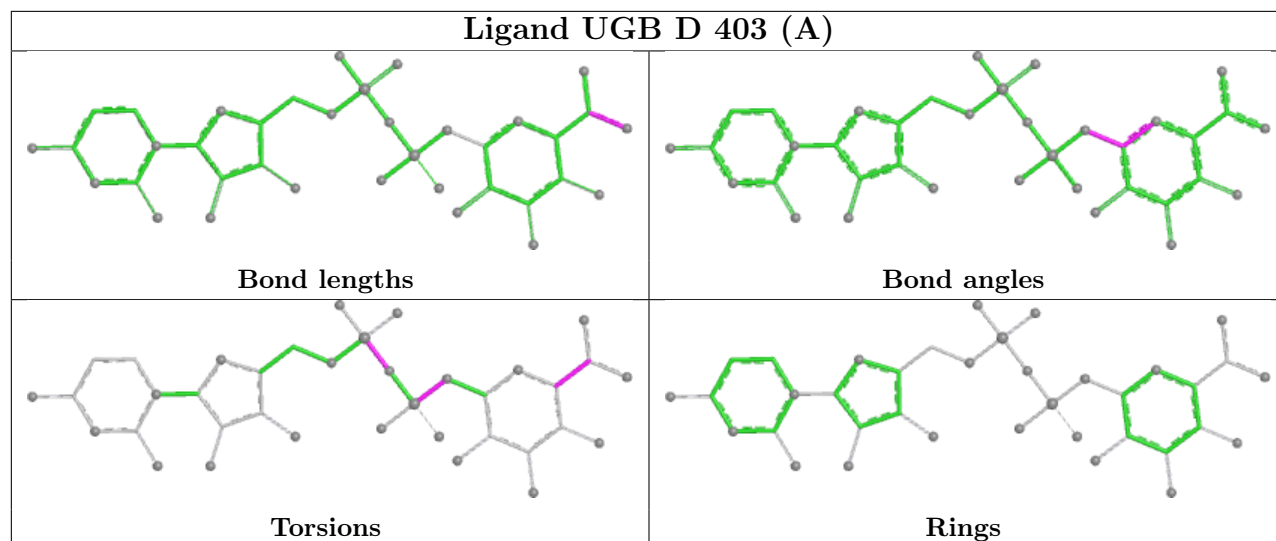


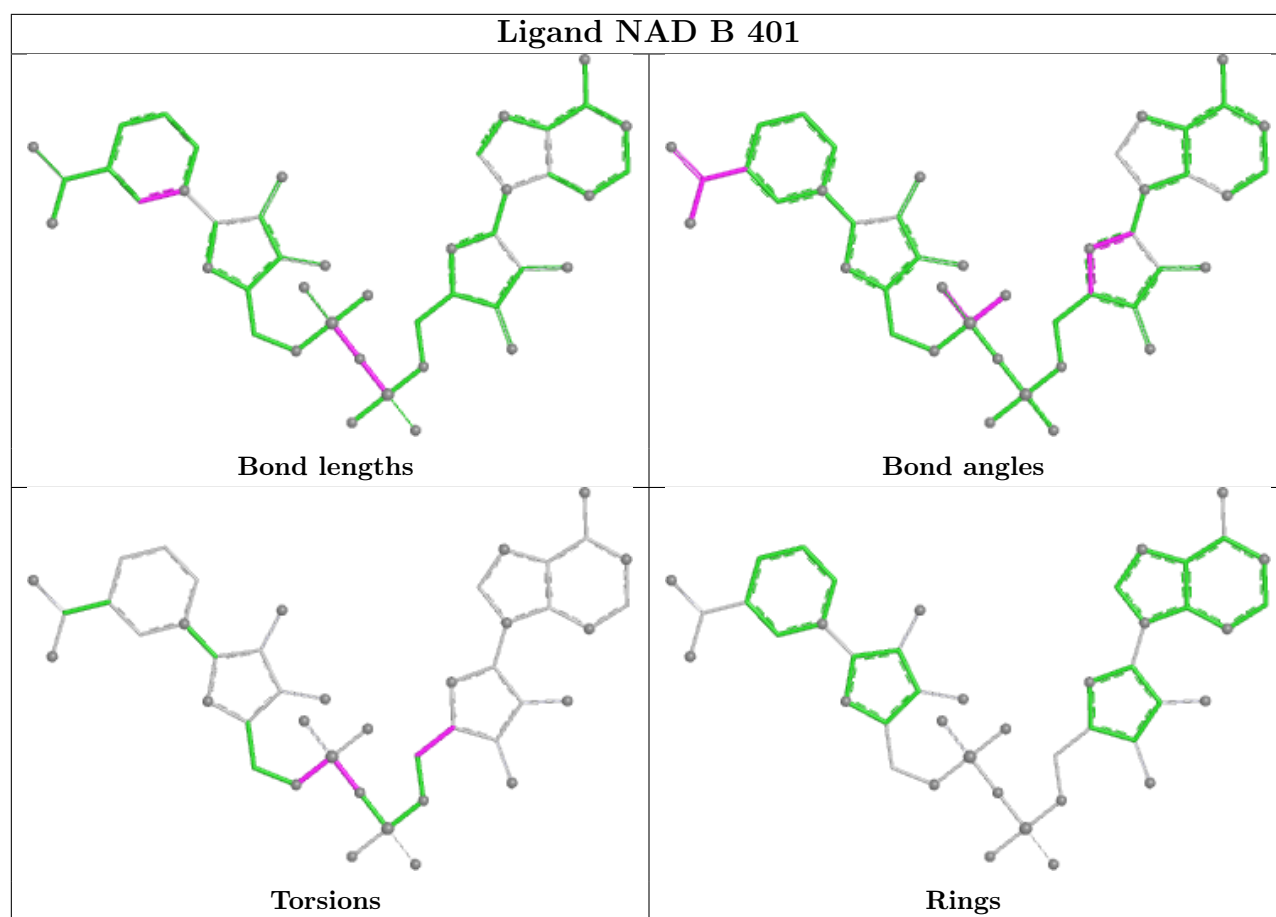
Ligand UGA C 402 (B)

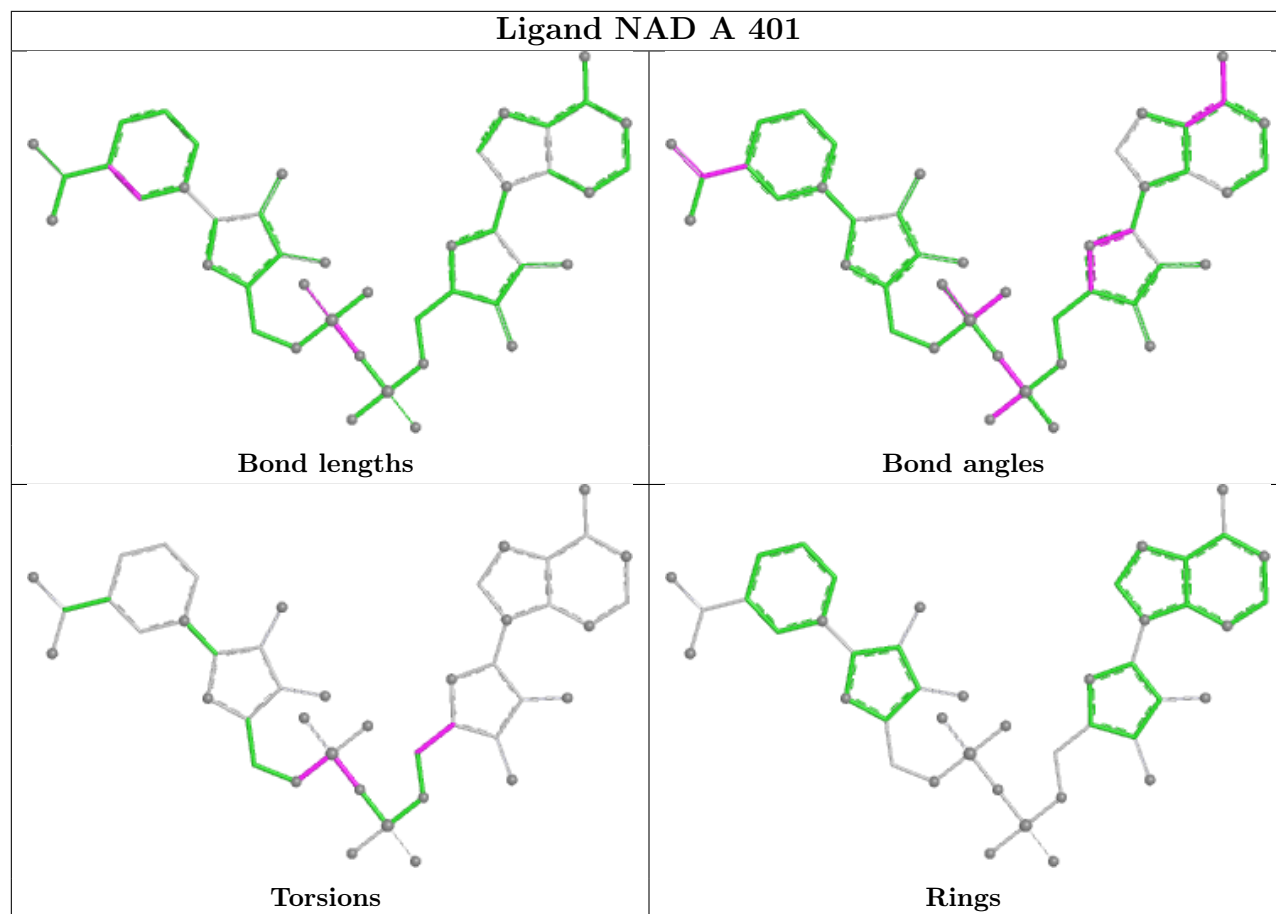


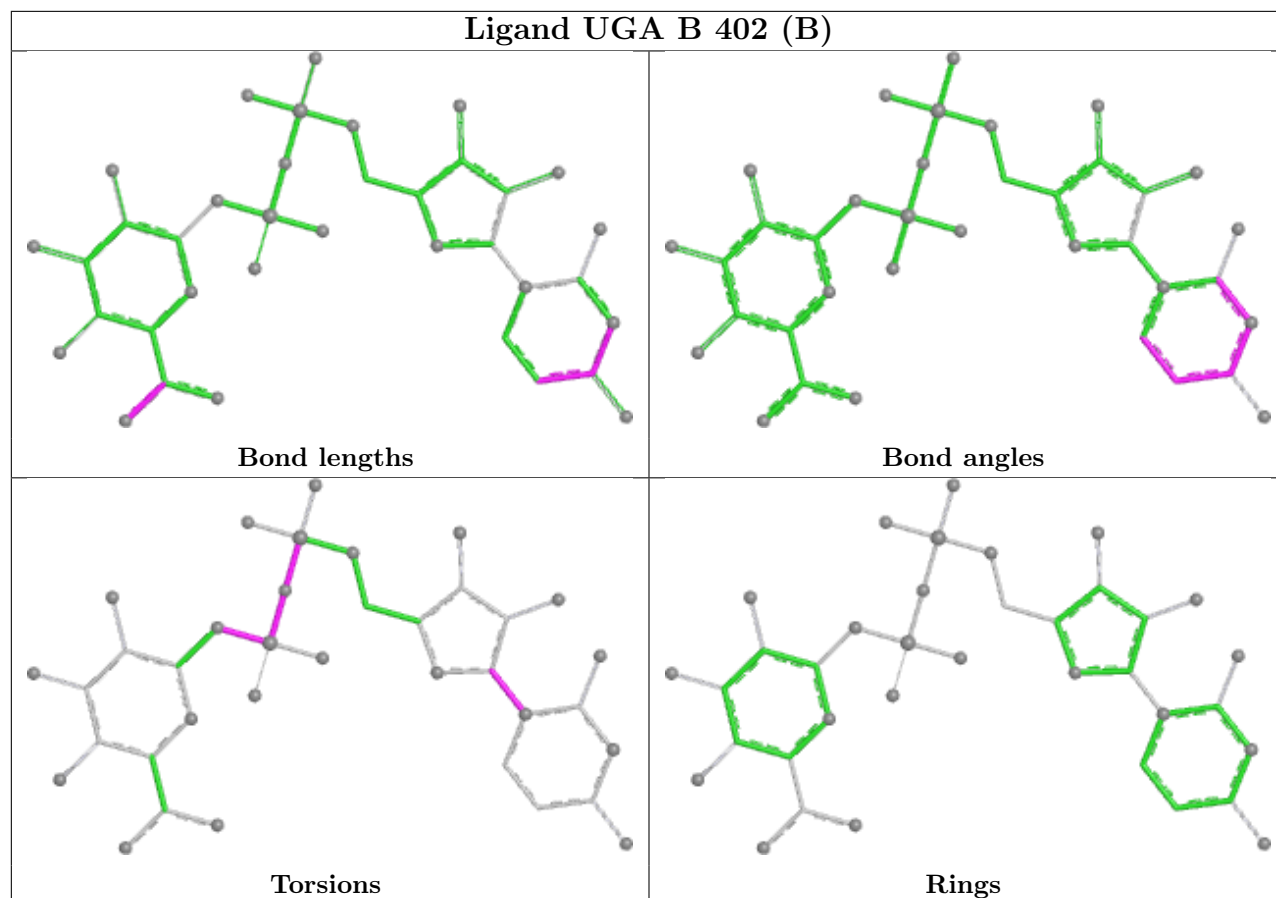
Ligand UGB A 403 (A)

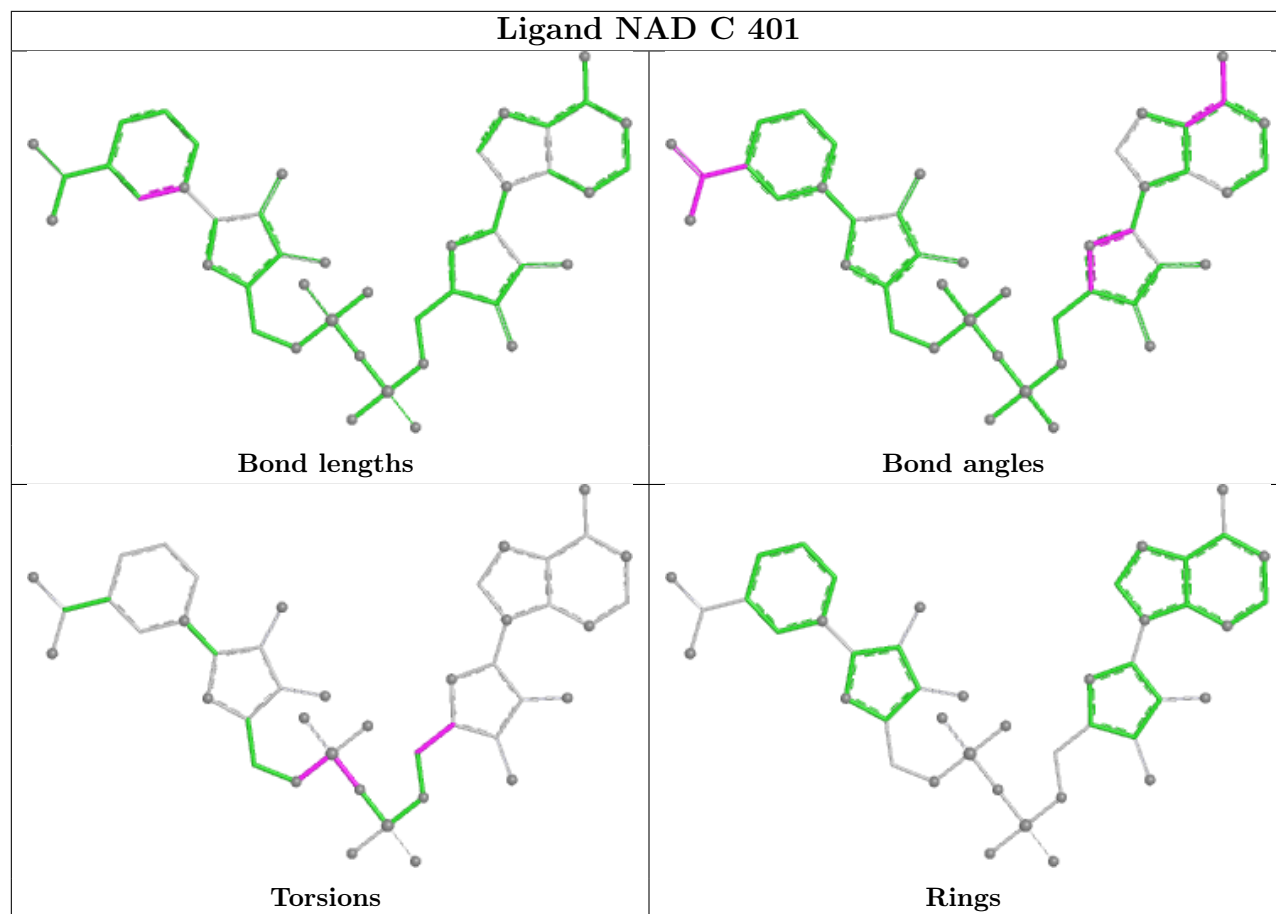


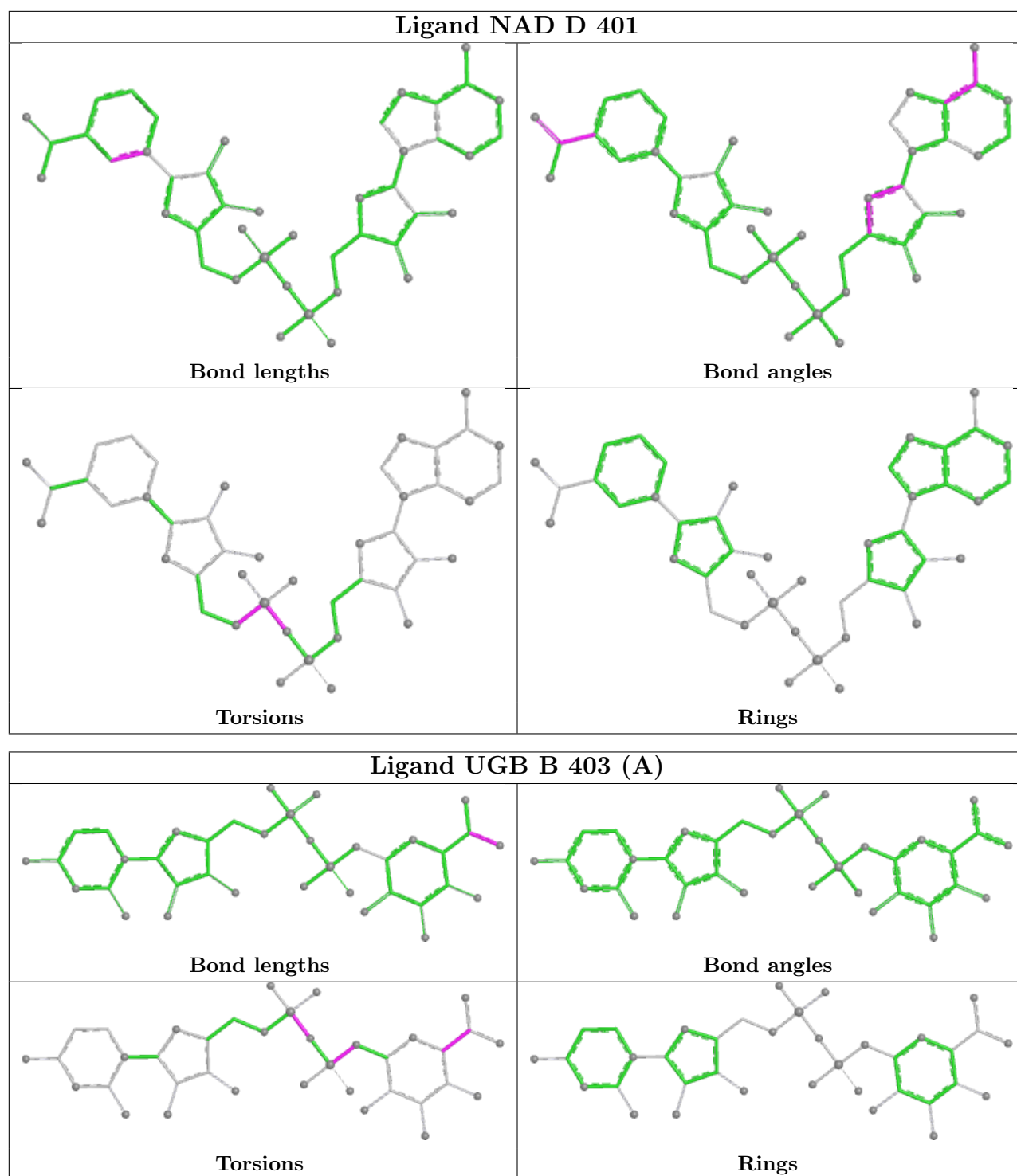












5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	315/327 (96%)	-0.36	0 100 100	13, 19, 34, 49	0
1	B	315/327 (96%)	-0.09	6 (1%) 66 71	15, 23, 41, 60	0
1	C	315/327 (96%)	-0.09	4 (1%) 77 81	15, 24, 43, 55	0
1	D	315/327 (96%)	-0.11	6 (1%) 66 71	17, 26, 45, 59	0
All	All	1260/1308 (96%)	-0.16	16 (1%) 77 81	13, 23, 42, 60	0

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	52	LEU	5.6
1	B	48	GLN	3.7
1	D	73	GLN	3.4
1	C	47	ILE	3.2
1	D	134	SER	2.9
1	C	48	GLN	2.8
1	B	74	ASP	2.8
1	C	314	TYR	2.6
1	D	47	ILE	2.3
1	D	131	GLY	2.3
1	B	266	THR	2.3
1	D	74	ASP	2.2
1	B	134	SER	2.1
1	C	45	GLY	2.1
1	B	73	GLN	2.0
1	B	47	ILE	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](#)

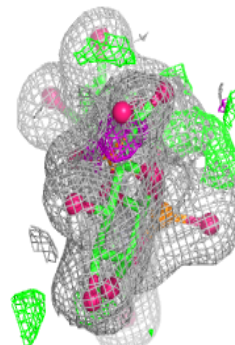
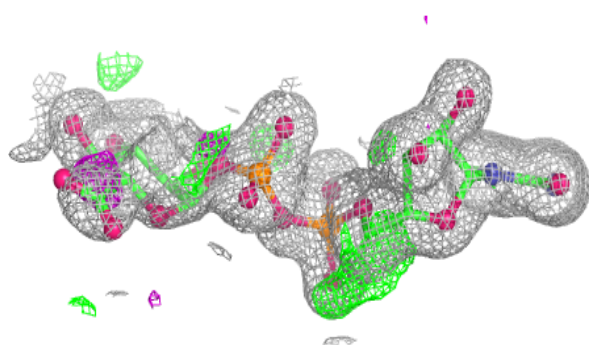
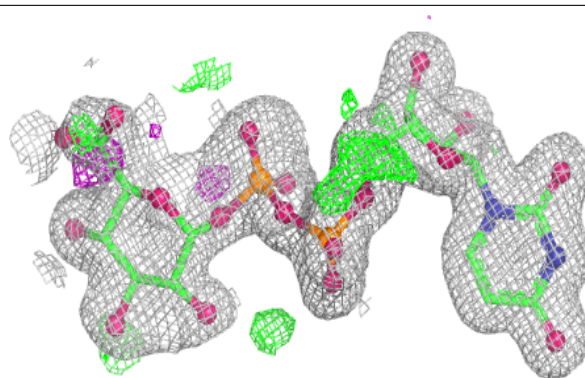
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	UGA	A	402[B]	37/37	0.97	0.08	11,14,31,38	37
3	UGA	B	402[B]	37/37	0.97	0.10	16,21,42,54	37
3	UGA	C	402[B]	37/37	0.97	0.08	19,22,42,52	37
3	UGA	D	402[B]	37/37	0.97	0.09	16,21,44,48	37
4	UGB	A	403[A]	37/37	0.97	0.09	23,31,37,42	37
4	UGB	B	403[A]	37/37	0.97	0.09	22,33,44,47	37
4	UGB	C	403[A]	37/37	0.97	0.08	30,34,38,42	37
2	NAD	D	401	44/44	0.98	0.07	16,19,28,31	0
2	NAD	A	401	44/44	0.98	0.06	11,14,23,28	0
2	NAD	B	401	44/44	0.98	0.07	13,15,27,30	0
2	NAD	C	401	44/44	0.98	0.07	17,19,29,32	0
4	UGB	D	403[A]	37/37	0.98	0.07	26,31,41,42	37

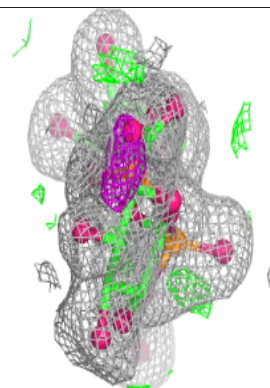
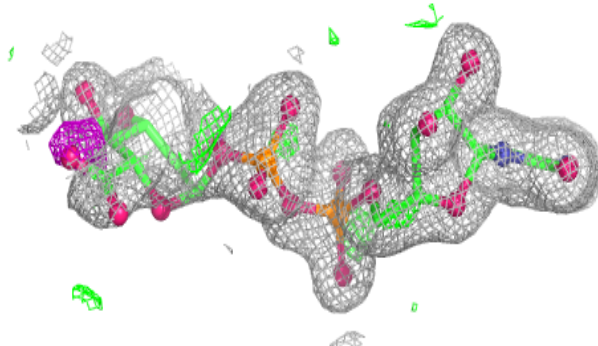
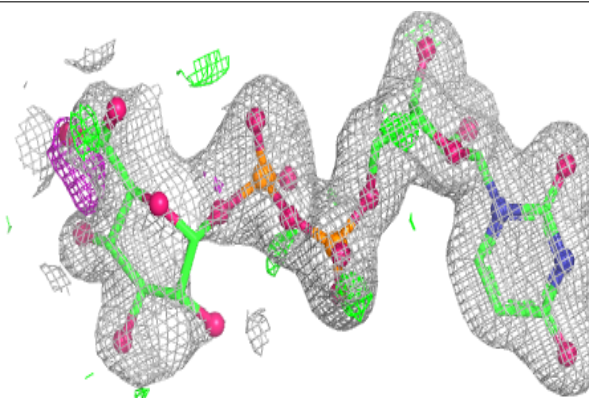
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around UGA A 402 (B):

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

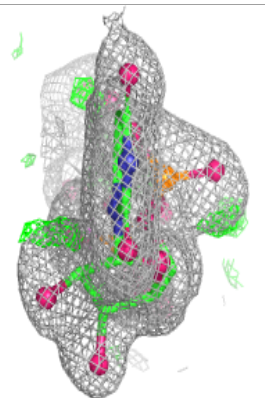
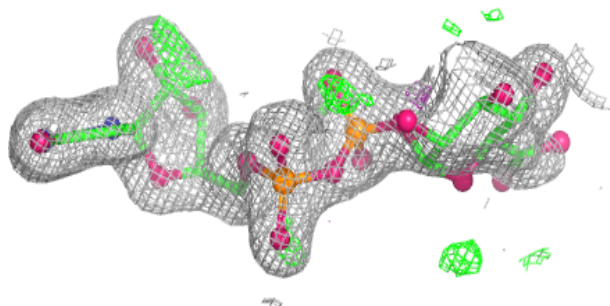
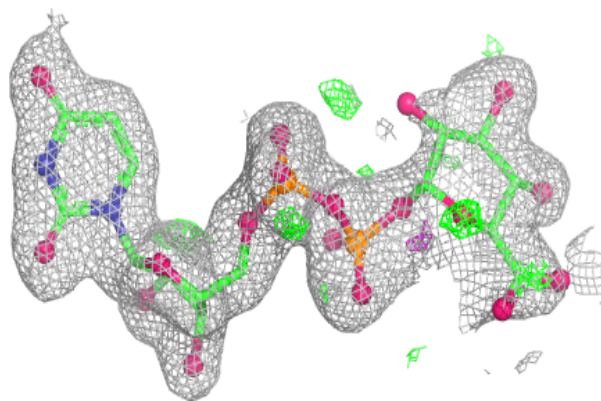
**Electron density around UGA B 402 (B):**

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

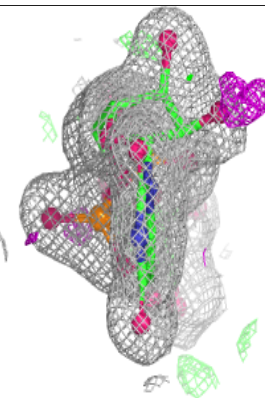
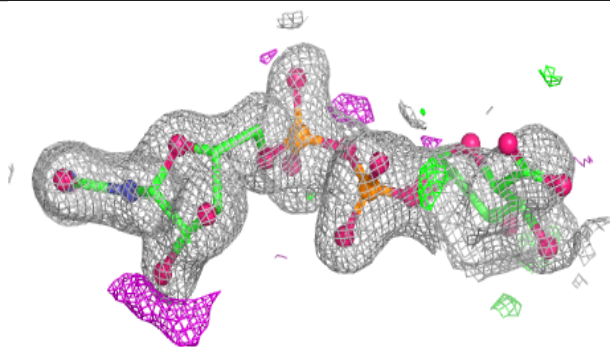
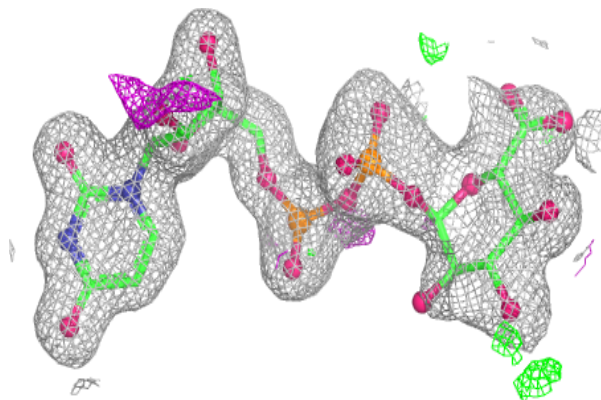


Electron density around UGA C 402 (B):

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

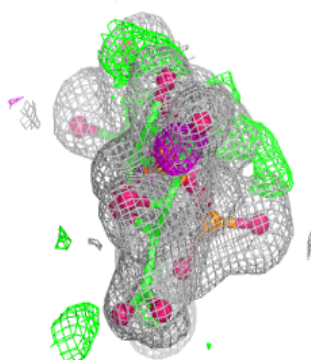
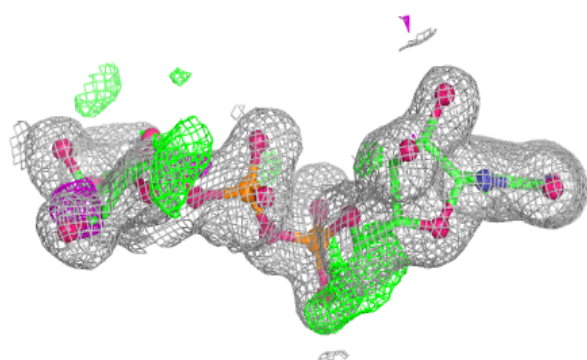
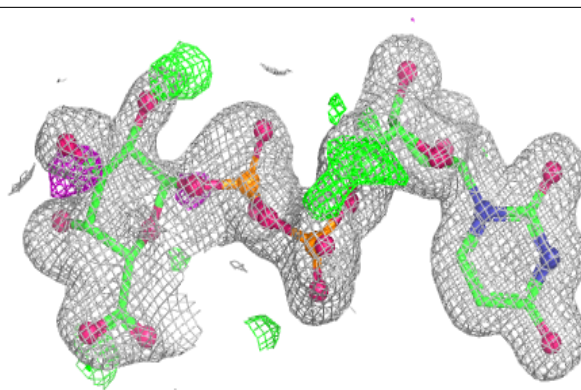
**Electron density around UGA D 402 (B):**

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 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

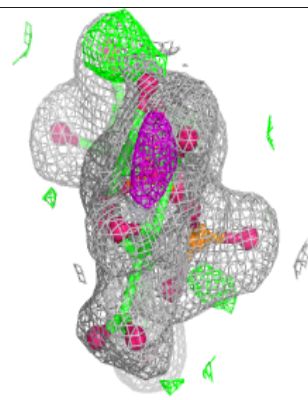
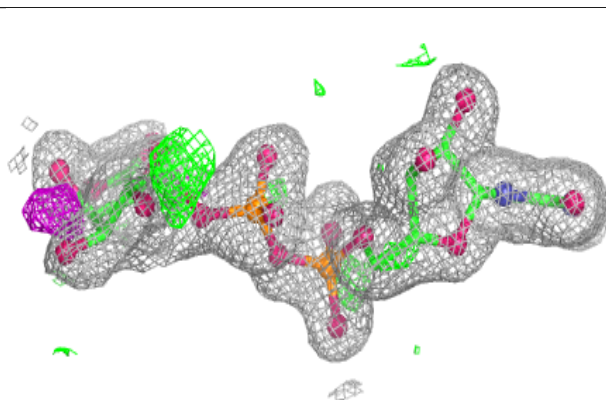
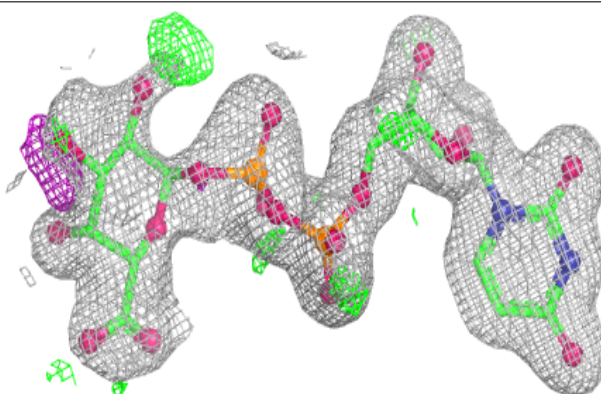


Electron density around UGB A 403 (A):

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

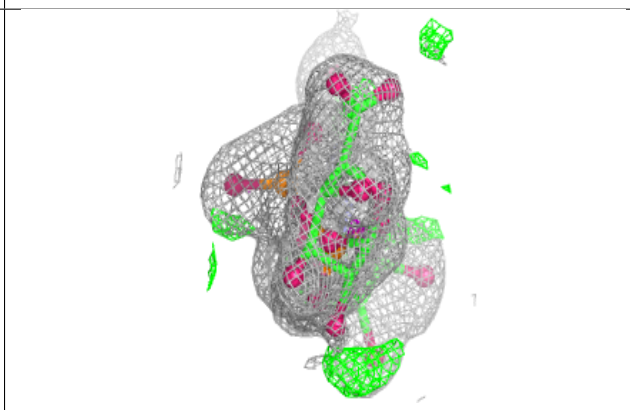
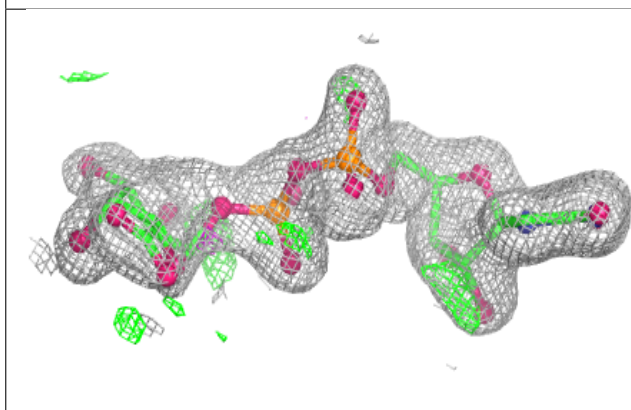
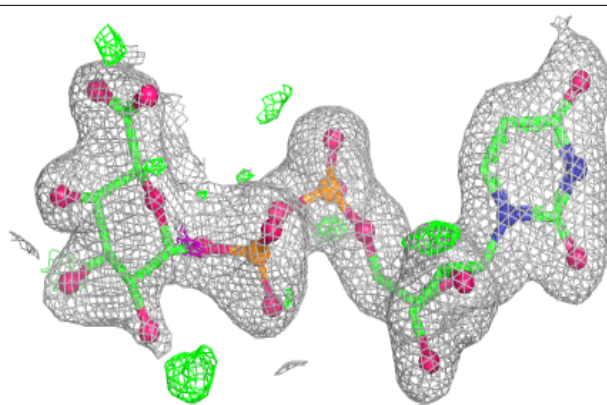
**Electron density around UGB B 403 (A):**

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

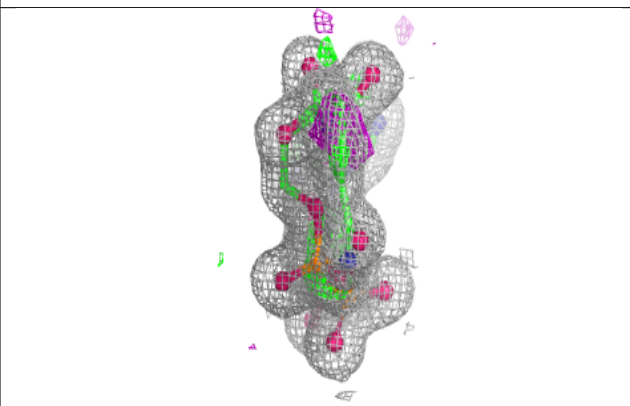
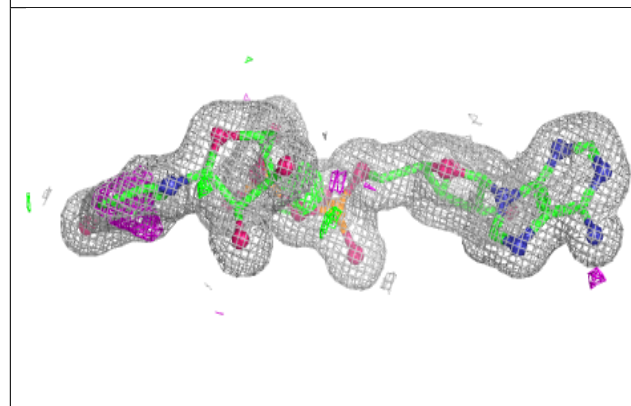
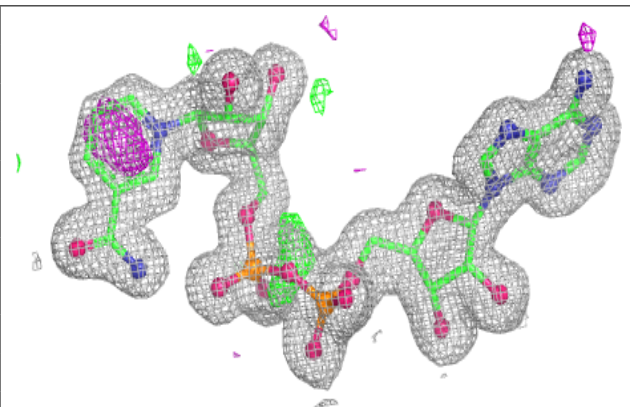


Electron density around UGB C 403 (A):

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

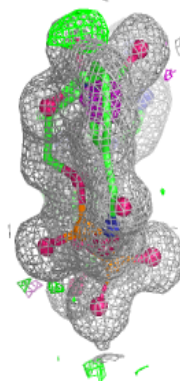
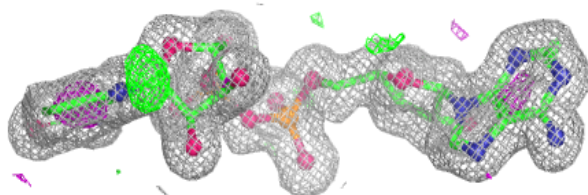
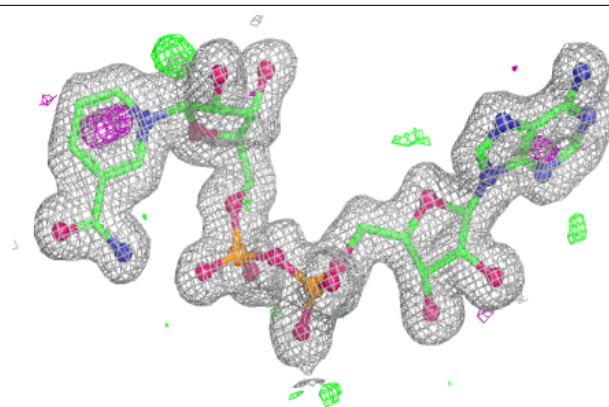
**Electron density around NAD D 401:**

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

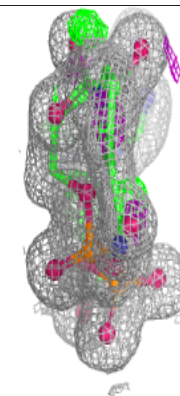
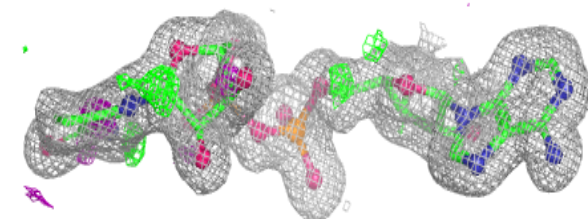
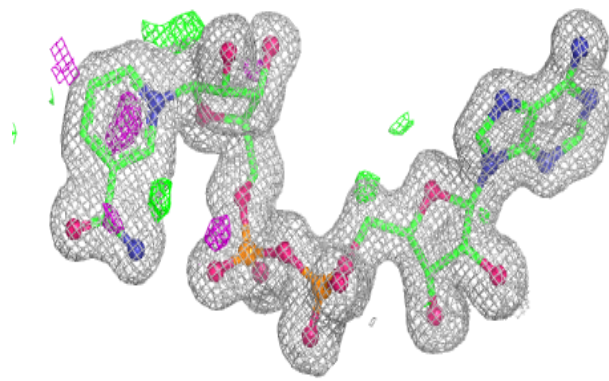


Electron density around NAD A 401:

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

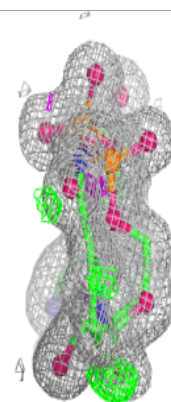
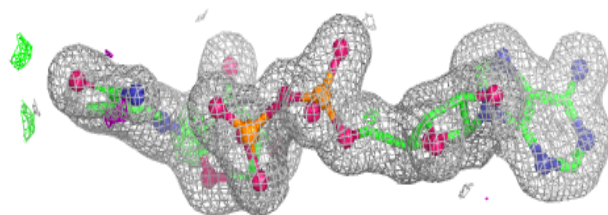
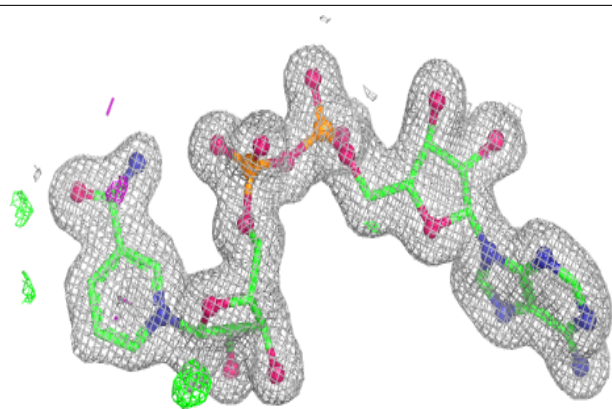
**Electron density around NAD B 401:**

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

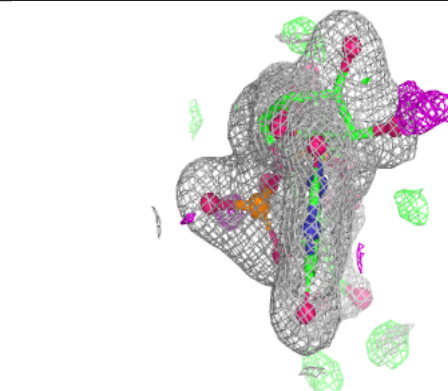
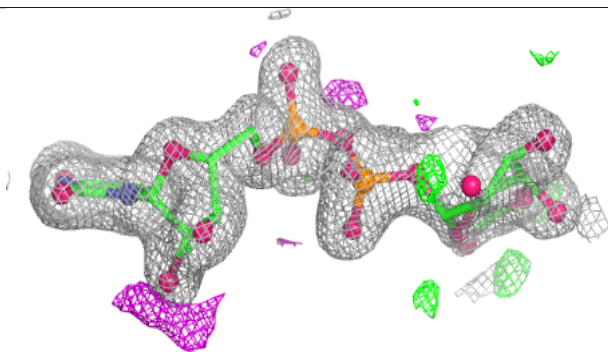
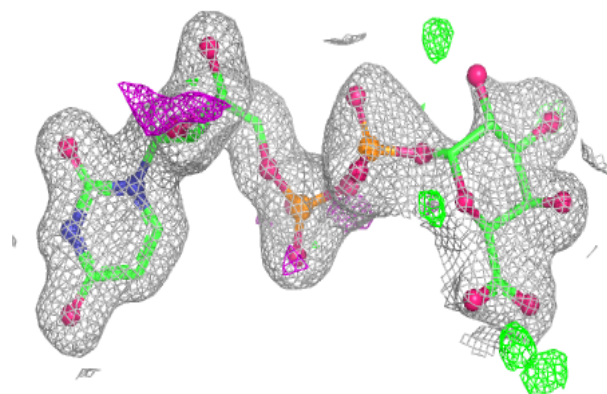


Electron density around NAD C 401:

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

**Electron density around UGB D 403 (A):**

$2mF_o-DF_c$ (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.