



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 18, 2026 – 07:01 PM UTC

PDB ID : 8HRP / pdb_00008hrp
Title : Crystal structure of glyceraldehyde-3-phosphate dehydrogenase from
Corynebacterium glutamicum ATCC13032 in complex with NAD and G3P
Authors : Son, H.F.; Kim, K.J.
Deposited on : 2022-12-15
Resolution : 1.99 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

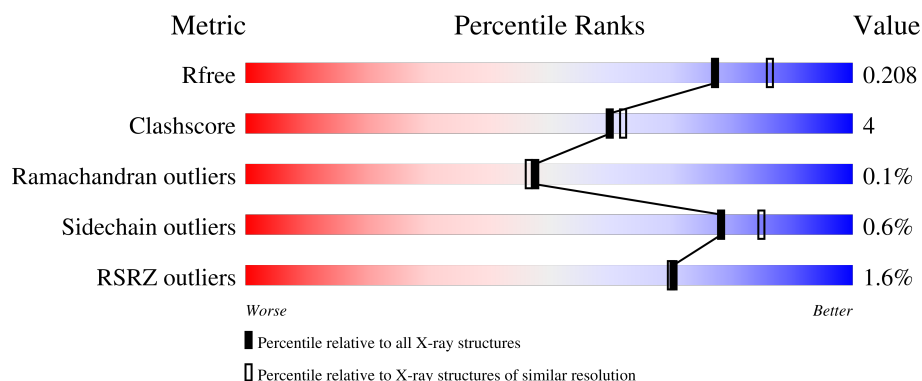
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.99 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.



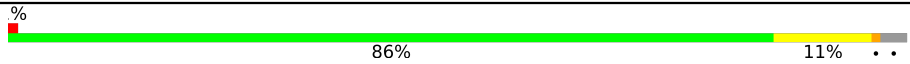
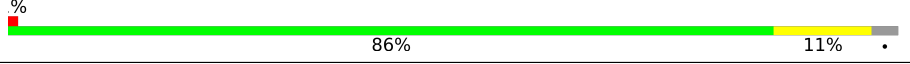
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	342	89% 8% ..
1	B	342	91% 7% .
1	C	342	87% 10% .
1	D	342	87% 10% .
1	E	342	89% 9% .

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Mol	Chain	Length	Quality of chain
1	F	342	
1	G	342	
1	H	342	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	G3H	B	402	-	-	X	-
3	G3H	C	402	-	-	X	-
3	G3H	D	402	-	-	X	-
3	G3H	E	402	-	-	X	-
3	G3H	G	402	-	-	X	-

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 22219 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 Glyceraldehyde-3-phosphate dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	334	Total	C	N	O	S	0	0	0
			2537	1590	439	502	6			
1	B	334	Total	C	N	O	S	0	0	0
			2537	1590	439	502	6			
1	C	335	Total	C	N	O	S	0	0	0
			2546	1595	440	505	6			
1	D	334	Total	C	N	O	S	0	0	0
			2537	1590	439	502	6			
1	E	333	Total	C	N	O	S	0	0	0
			2529	1584	438	501	6			
1	F	333	Total	C	N	O	S	0	0	0
			2529	1584	438	501	6			
1	G	333	Total	C	N	O	S	0	0	0
			2529	1584	438	501	6			
1	H	333	Total	C	N	O	S	0	0	0
			2529	1584	438	501	6			

There are 64 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	335	LEU	-	expression tag	UNP Q01651
A	336	GLU	-	expression tag	UNP Q01651
A	337	HIS	-	expression tag	UNP Q01651
A	338	HIS	-	expression tag	UNP Q01651
A	339	HIS	-	expression tag	UNP Q01651
A	340	HIS	-	expression tag	UNP Q01651
A	341	HIS	-	expression tag	UNP Q01651
A	342	HIS	-	expression tag	UNP Q01651
B	335	LEU	-	expression tag	UNP Q01651
B	336	GLU	-	expression tag	UNP Q01651
B	337	HIS	-	expression tag	UNP Q01651
B	338	HIS	-	expression tag	UNP Q01651
B	339	HIS	-	expression tag	UNP Q01651

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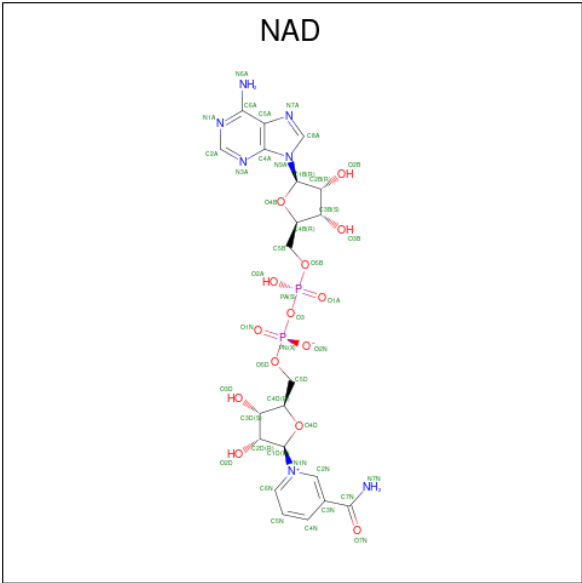
Chain	Residue	Modelled	Actual	Comment	Reference
B	340	HIS	-	expression tag	UNP Q01651
B	341	HIS	-	expression tag	UNP Q01651
B	342	HIS	-	expression tag	UNP Q01651
C	335	LEU	-	expression tag	UNP Q01651
C	336	GLU	-	expression tag	UNP Q01651
C	337	HIS	-	expression tag	UNP Q01651
C	338	HIS	-	expression tag	UNP Q01651
C	339	HIS	-	expression tag	UNP Q01651
C	340	HIS	-	expression tag	UNP Q01651
C	341	HIS	-	expression tag	UNP Q01651
C	342	HIS	-	expression tag	UNP Q01651
D	335	LEU	-	expression tag	UNP Q01651
D	336	GLU	-	expression tag	UNP Q01651
D	337	HIS	-	expression tag	UNP Q01651
D	338	HIS	-	expression tag	UNP Q01651
D	339	HIS	-	expression tag	UNP Q01651
D	340	HIS	-	expression tag	UNP Q01651
D	341	HIS	-	expression tag	UNP Q01651
D	342	HIS	-	expression tag	UNP Q01651
E	335	LEU	-	expression tag	UNP Q01651
E	336	GLU	-	expression tag	UNP Q01651
E	337	HIS	-	expression tag	UNP Q01651
E	338	HIS	-	expression tag	UNP Q01651
E	339	HIS	-	expression tag	UNP Q01651
E	340	HIS	-	expression tag	UNP Q01651
E	341	HIS	-	expression tag	UNP Q01651
E	342	HIS	-	expression tag	UNP Q01651
F	335	LEU	-	expression tag	UNP Q01651
F	336	GLU	-	expression tag	UNP Q01651
F	337	HIS	-	expression tag	UNP Q01651
F	338	HIS	-	expression tag	UNP Q01651
F	339	HIS	-	expression tag	UNP Q01651
F	340	HIS	-	expression tag	UNP Q01651
F	341	HIS	-	expression tag	UNP Q01651
F	342	HIS	-	expression tag	UNP Q01651
G	335	LEU	-	expression tag	UNP Q01651
G	336	GLU	-	expression tag	UNP Q01651
G	337	HIS	-	expression tag	UNP Q01651
G	338	HIS	-	expression tag	UNP Q01651
G	339	HIS	-	expression tag	UNP Q01651
G	340	HIS	-	expression tag	UNP Q01651
G	341	HIS	-	expression tag	UNP Q01651

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Chain	Residue	Modelled	Actual	Comment	Reference
G	342	HIS	-	expression tag	UNP Q01651
H	335	LEU	-	expression tag	UNP Q01651
H	336	GLU	-	expression tag	UNP Q01651
H	337	HIS	-	expression tag	UNP Q01651
H	338	HIS	-	expression tag	UNP Q01651
H	339	HIS	-	expression tag	UNP Q01651
H	340	HIS	-	expression tag	UNP Q01651
H	341	HIS	-	expression tag	UNP Q01651
H	342	HIS	-	expression tag	UNP Q01651

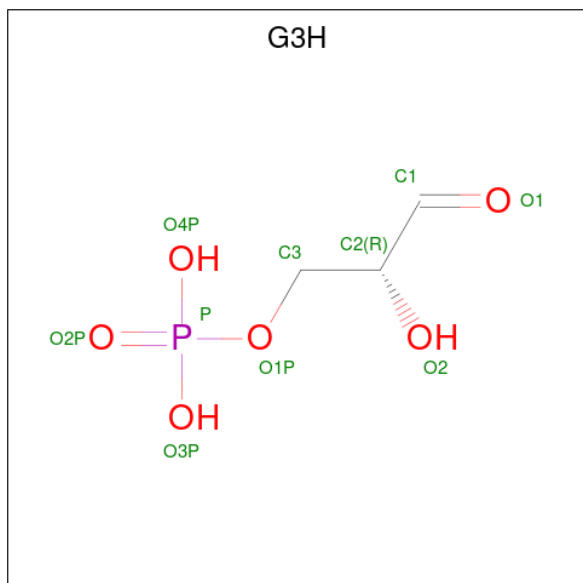
- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (CCD ID: NAD) (formula: C₂₁H₂₇N₇O₁₄P₂) (labeled as "Ligand of Interest" by depositor).



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

- Molecule 3 is GLYCERALDEHYDE-3-PHOSPHATE (CCD ID: G3H) (formula: $C_3H_7O_6P$) (labeled as "Ligand of Interest" by depositor).



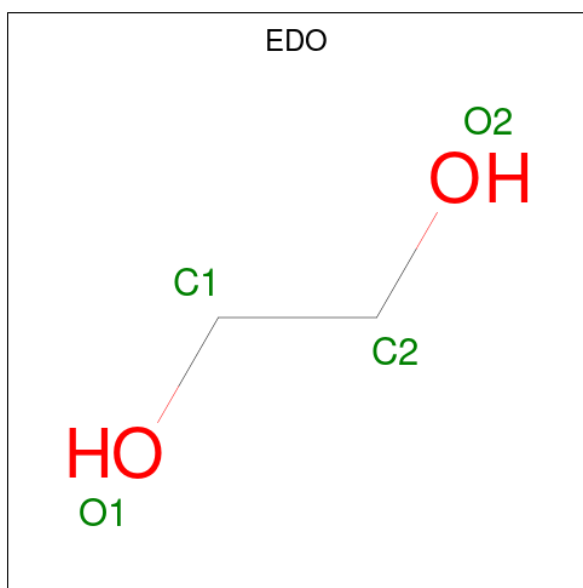
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	P	0	0
			10	3	6	1		
3	B	1	Total	C	O	P	0	0
			10	3	6	1		
3	C	1	Total	C	O	P	0	0
			10	3	6	1		
3	D	1	Total	C	O	P	0	0
			10	3	6	1		
3	E	1	Total	C	O	P	0	0
			10	3	6	1		
3	F	1	Total	C	O	P	0	0
			10	3	6	1		
3	G	1	Total	C	O	P	0	0
			10	3	6	1		
3	H	1	Total	C	O	P	0	0
			10	3	6	1		

- Molecule 4 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



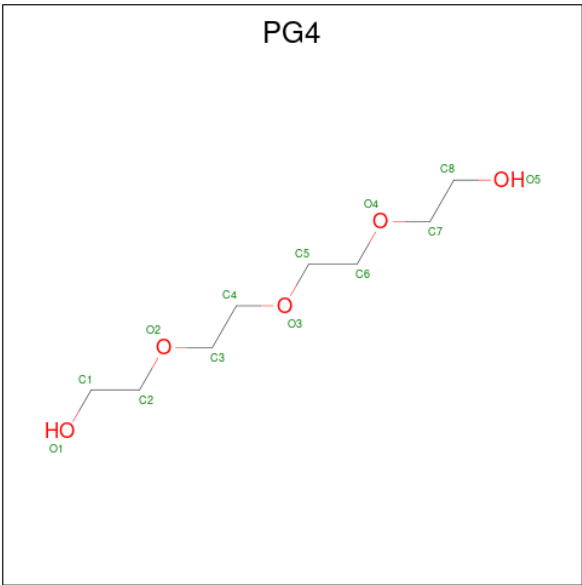
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			6	3	3		
4	A	1	Total	C	O	0	0
			6	3	3		
4	B	1	Total	C	O	0	0
			6	3	3		
4	B	1	Total	C	O	0	0
			6	3	3		
4	B	1	Total	C	O	0	0
			6	3	3		
4	C	1	Total	C	O	0	0
			6	3	3		
4	C	1	Total	C	O	0	0
			6	3	3		
4	C	1	Total	C	O	0	0
			6	3	3		
4	C	1	Total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

- Molecule 5 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	C	1	Total	C	O	0	0
			4	2	2		
5	D	1	Total	C	O	0	0
			4	2	2		
5	E	1	Total	C	O	0	0
			4	2	2		
5	E	1	Total	C	O	0	0
			4	2	2		
5	F	1	Total	C	O	0	0
			4	2	2		
5	G	1	Total	C	O	0	0
			4	2	2		

- Molecule 6 is TETRAETHYLENE GLYCOL (CCD ID: PG4) (formula: $C_8H_{18}O_5$).



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

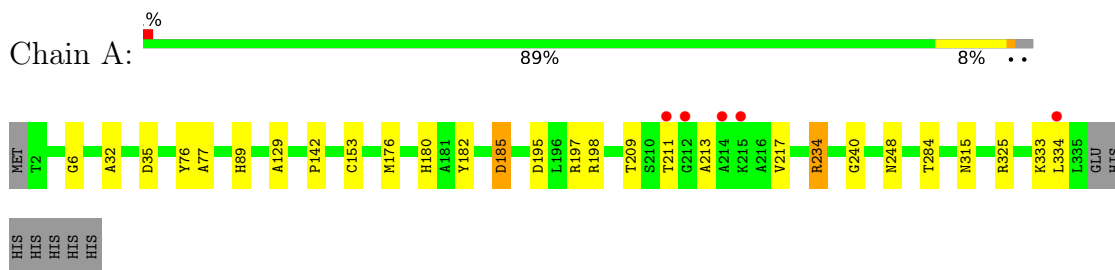
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	168	Total	O	0	0
			168	168		
7	B	196	Total	O	0	0
			196	196		
7	C	203	Total	O	0	0
			203	203		
7	D	224	Total	O	0	0
			224	224		
7	E	170	Total	O	0	0
			170	170		
7	F	161	Total	O	0	0
			161	161		
7	G	114	Total	O	0	0
			114	114		
7	H	157	Total	O	0	0
			157	157		

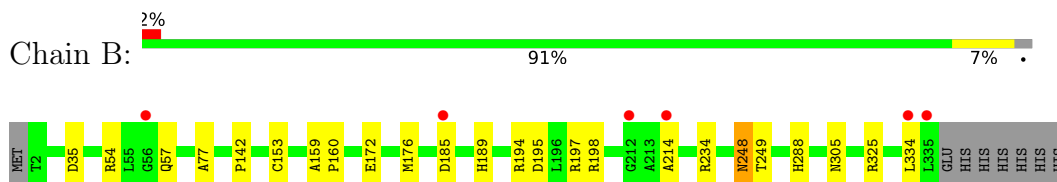
3 Residue-property plots [i](#)

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.

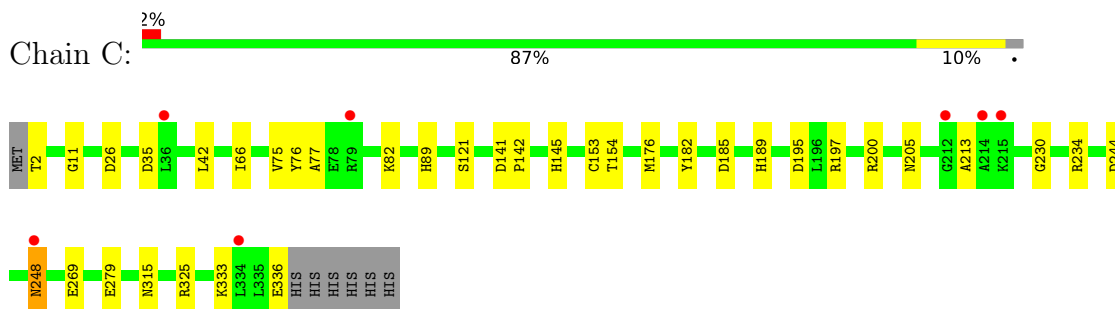
- Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase



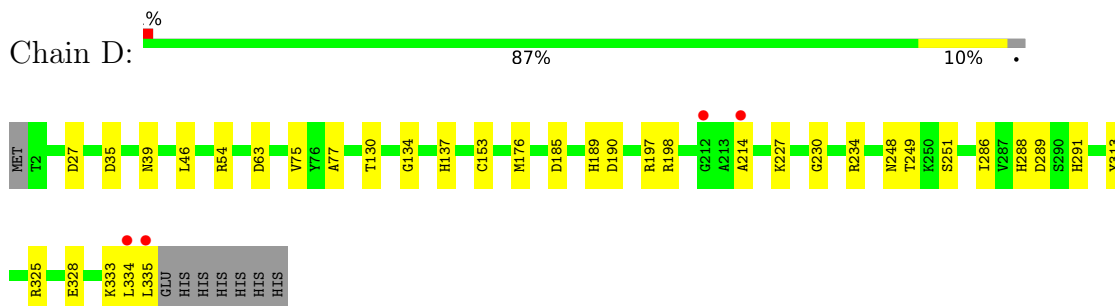
- Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase



- Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase

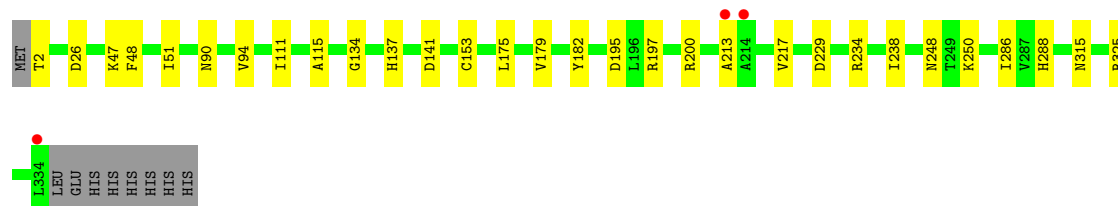


- Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase



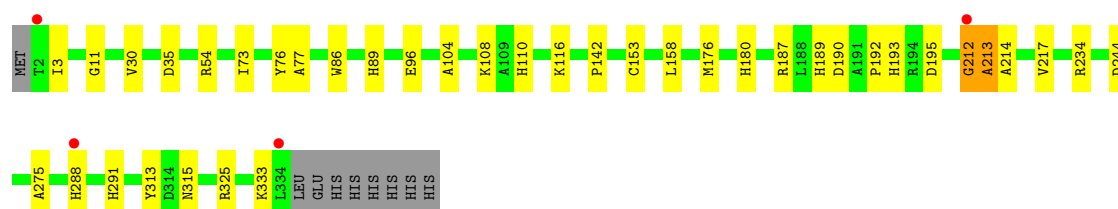
- Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase

Chain E:  89% 9% .



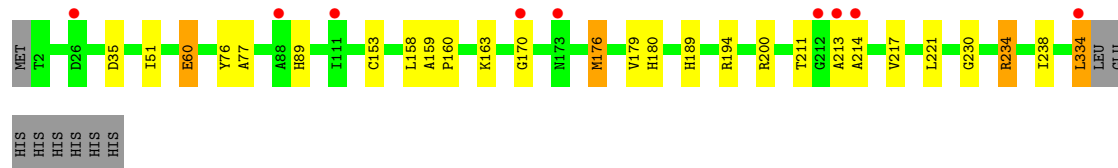
- Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase

Chain F:  86% 11% ..



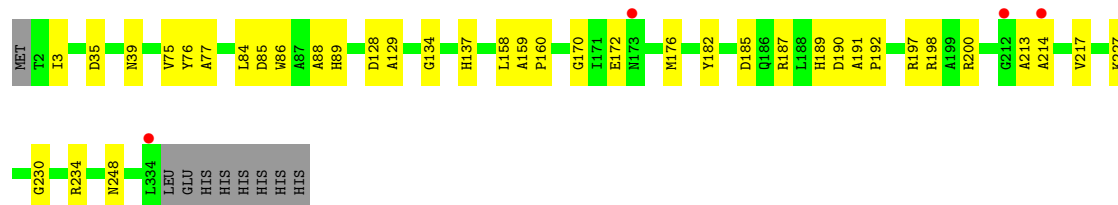
- Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase

Chain G:  89% 3% 7% ..



- Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase

Chain H:  86% 11% .



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	86.95Å 119.85Å 140.63Å 90.00° 91.27° 90.00°	Depositor
Resolution (Å)	32.86 – 1.99 32.86 – 1.99	Depositor EDS
% Data completeness (in resolution range)	94.5 (32.86-1.99) 94.5 (32.86-1.99)	Depositor EDS
R_{merge}	0.99	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.16 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.8.0403	Depositor
R, R_{free}	0.164 , 0.201 0.175 , 0.208	Depositor DCC
R_{free} test set	9121 reflections (4.66%)	wwPDB-VP
Wilson B-factor (Å ²)	23.6	Xtriage
Anisotropy	0.322	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 40.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.030 for h,-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	22219	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.57% 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: NAD, PG4, G3H, EDO, GOL

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.68	0/2580	1.05	2/3508 (0.1%)
1	B	0.66	0/2580	1.06	2/3508 (0.1%)
1	C	0.67	0/2589	1.08	6/3520 (0.2%)
1	D	0.68	0/2580	1.02	1/3508 (0.0%)
1	E	0.61	0/2572	1.02	4/3497 (0.1%)
1	F	0.61	0/2572	1.03	6/3497 (0.2%)
1	G	0.60	0/2572	0.99	0/3497
1	H	0.60	0/2572	1.01	1/3497 (0.0%)
All	All	0.64	0/20617	1.03	22/28032 (0.1%)

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	3
1	B	0	4
1	C	0	4
1	D	0	4
1	E	0	5
1	F	0	3
1	G	0	4
1	H	0	3
All	All	0	30

There are no bond length outliers.

The worst 5 of 22 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	248	ASN	CB-CA-C	-9.46	92.69	109.71
1	E	195	ASP	CA-CB-CG	6.97	119.58	112.60
1	F	190	ASP	CA-CB-CG	6.69	119.29	112.60
1	C	248	ASN	CA-CB-CG	-6.32	106.28	112.60
1	F	193	HIS	CA-CB-CG	5.96	119.76	113.80

There are no chirality outliers.

5 of 30 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	197	ARG	Sidechain
1	A	234	ARG	Sidechain
1	A	325	ARG	Sidechain
1	B	197	ARG	Sidechain
1	B	54	ARG	Sidechain

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	2537	0	2505	20	0
1	B	2537	0	2505	18	0
1	C	2546	0	2511	27	0
1	D	2537	0	2505	32	0
1	E	2529	0	2494	17	0
1	F	2529	0	2494	22	0
1	G	2529	0	2494	18	0
1	H	2529	0	2494	24	0
2	A	44	0	26	0	0
2	B	44	0	26	1	0
2	C	44	0	26	6	0
2	D	44	0	26	1	0
2	E	44	0	26	3	0
2	F	44	0	26	2	0
2	G	44	0	26	2	0
2	H	44	0	26	0	0
3	A	10	0	5	2	0
3	B	10	0	5	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	10	0	5	7	0
3	D	10	0	5	4	0
3	E	10	0	5	4	0
3	F	10	0	5	1	0
3	G	10	0	5	5	0
3	H	10	0	5	0	0
4	A	12	0	16	2	0
4	B	18	0	24	2	0
4	C	24	0	32	1	0
4	D	12	0	16	1	0
4	E	12	0	16	0	0
4	H	6	0	8	0	0
5	C	4	0	6	1	0
5	D	4	0	6	0	0
5	E	8	0	12	0	0
5	F	4	0	6	0	0
5	G	4	0	6	0	0
6	D	13	0	18	3	0
7	A	168	0	0	0	0
7	B	196	0	0	4	0
7	C	203	0	0	1	0
7	D	224	0	0	9	0
7	E	170	0	0	1	0
7	F	161	0	0	0	0
7	G	114	0	0	2	0
7	H	157	0	0	2	0
All	All	22219	0	20416	176	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

The worst 5 of 176 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:C:153:CYS:SG	3:C:402:G3H:H2	1.55	1.44
1:B:153:CYS:SG	3:B:402:G3H:H2	1.72	1.27
1:E:153:CYS:SG	3:E:402:G3H:H2	1.91	1.10
1:G:153:CYS:SG	3:G:402:G3H:H2	1.93	1.08
1:C:153:CYS:SG	3:C:402:G3H:C2	2.45	1.05

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	332/342 (97%)	321 (97%)	11 (3%)	0	100	100
1	B	332/342 (97%)	322 (97%)	10 (3%)	0	100	100
1	C	333/342 (97%)	319 (96%)	14 (4%)	0	100	100
1	D	332/342 (97%)	321 (97%)	11 (3%)	0	100	100
1	E	331/342 (97%)	319 (96%)	12 (4%)	0	100	100
1	F	331/342 (97%)	318 (96%)	13 (4%)	0	100	100
1	G	331/342 (97%)	315 (95%)	15 (4%)	1 (0%)	36	35
1	H	331/342 (97%)	317 (96%)	13 (4%)	1 (0%)	36	35
All	All	2653/2736 (97%)	2552 (96%)	99 (4%)	2 (0%)	48	46

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	H	170	GLY
1	G	170	GLY

5.3.2 Protein sidechains

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	272/280 (97%)	271 (100%)	1 (0%)	84	89
1	B	272/280 (97%)	271 (100%)	1 (0%)	84	89
1	C	273/280 (98%)	272 (100%)	1 (0%)	84	89

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	272/280 (97%)	270 (99%)	2 (1%)	76	82
1	E	271/280 (97%)	268 (99%)	3 (1%)	65	73
1	F	271/280 (97%)	268 (99%)	3 (1%)	65	73
1	G	271/280 (97%)	268 (99%)	3 (1%)	65	73
1	H	271/280 (97%)	271 (100%)	0	100	100
All	All	2173/2240 (97%)	2159 (99%)	14 (1%)	78	85

5 of 14 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	288	HIS
1	F	116	LYS
1	G	334	LEU
1	G	60	GLU
1	G	176	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 42 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	146	ASN
1	G	315	ASN
1	F	189	HIS
1	G	146	ASN
1	H	146	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 oligosaccharides in this entry.

5.6 Ligand geometry

37 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$
2	NAD	E	401	-	46,48,48	0.72	1 (2%)	64,73,73	0.73	0
4	GOL	E	403	-	5,5,5	0.13	0	5,5,5	0.42	0
3	G3H	H	402	-	8,9,9	0.63	0	7,12,12	1.05	1 (14%)
5	EDO	F	403	-	3,3,3	0.09	0	2,2,2	0.08	0
5	EDO	D	405	-	3,3,3	0.16	0	2,2,2	0.58	0
2	NAD	H	401	-	46,48,48	0.81	1 (2%)	64,73,73	0.76	1 (1%)
2	NAD	G	401	-	46,48,48	0.78	1 (2%)	64,73,73	0.72	1 (1%)
4	GOL	A	404	-	5,5,5	0.23	0	5,5,5	0.50	0
2	NAD	B	401	-	46,48,48	0.69	1 (2%)	64,73,73	0.77	0
2	NAD	D	401	-	46,48,48	0.81	1 (2%)	64,73,73	0.74	1 (1%)
3	G3H	C	402	-	8,9,9	0.25	0	7,12,12	1.76	1 (14%)
4	GOL	C	406	-	5,5,5	0.17	0	5,5,5	0.25	0
5	EDO	E	405	-	3,3,3	0.24	0	2,2,2	0.58	0
3	G3H	G	402	-	8,9,9	0.61	0	7,12,12	1.46	1 (14%)
3	G3H	B	402	-	8,9,9	0.69	0	7,12,12	1.54	1 (14%)
4	GOL	D	403	-	5,5,5	0.15	0	5,5,5	0.30	0
5	EDO	C	407	-	3,3,3	0.57	0	2,2,2	0.32	0
3	G3H	D	402	-	8,9,9	0.59	0	7,12,12	1.11	1 (14%)
2	NAD	A	401	-	46,48,48	0.88	2 (4%)	64,73,73	0.75	1 (1%)
4	GOL	B	405	-	5,5,5	0.19	0	5,5,5	0.35	0
5	EDO	E	406	-	3,3,3	0.22	0	2,2,2	0.09	0
3	G3H	A	402	-	8,9,9	0.77	0	7,12,12	0.84	0
4	GOL	B	403	-	5,5,5	0.12	0	5,5,5	0.45	0
4	GOL	E	404	-	5,5,5	0.18	0	5,5,5	0.34	0
4	GOL	H	403	-	5,5,5	0.21	0	5,5,5	0.37	0
5	EDO	G	403	-	3,3,3	0.22	0	2,2,2	0.19	0
3	G3H	F	402	-	8,9,9	0.49	0	7,12,12	0.93	0
4	GOL	C	404	-	5,5,5	0.10	0	5,5,5	0.34	0
2	NAD	C	401	-	46,48,48	0.93	2 (4%)	64,73,73	0.82	2 (3%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	G3H	E	402	-	8,9,9	0.57	0	7,12,12	1.16	1 (14%)
4	GOL	B	404	-	5,5,5	0.21	0	5,5,5	0.30	0
4	GOL	C	405	-	5,5,5	0.26	0	5,5,5	0.46	0
4	GOL	A	403	-	5,5,5	0.15	0	5,5,5	0.47	0
4	GOL	D	404	-	5,5,5	0.07	0	5,5,5	0.51	0
6	PG4	D	406	-	12,12,12	0.21	0	11,11,11	0.18	0
2	NAD	F	401	-	46,48,48	0.77	1 (2%)	64,73,73	0.75	2 (3%)
4	GOL	C	403	-	5,5,5	0.13	0	5,5,5	0.49	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
2	NAD	E	401	-	-	4/30/62/62	0/5/5/5
4	GOL	E	403	-	-	3/4/4/4	-
3	G3H	H	402	-	-	1/7/8/8	-
5	EDO	F	403	-	-	0/1/1/1	-
5	EDO	D	405	-	-	1/1/1/1	-
2	NAD	H	401	-	-	7/30/62/62	0/5/5/5
2	NAD	G	401	-	-	6/30/62/62	0/5/5/5
4	GOL	A	404	-	-	2/4/4/4	-
2	NAD	B	401	-	-	4/30/62/62	0/5/5/5
2	NAD	D	401	-	-	4/30/62/62	0/5/5/5
3	G3H	C	402	-	-	3/7/8/8	-
4	GOL	C	406	-	-	2/4/4/4	-
5	EDO	E	405	-	-	1/1/1/1	-
3	G3H	G	402	-	-	4/7/8/8	-
3	G3H	B	402	-	-	3/7/8/8	-
4	GOL	D	403	-	-	0/4/4/4	-
5	EDO	C	407	-	-	1/1/1/1	-
3	G3H	D	402	-	-	3/7/8/8	-
2	NAD	A	401	-	-	4/30/62/62	0/5/5/5
4	GOL	B	405	-	-	0/4/4/4	-
5	EDO	E	406	-	-	0/1/1/1	-
3	G3H	A	402	-	-	3/7/8/8	-
4	GOL	B	403	-	-	3/4/4/4	-
4	GOL	E	404	-	-	3/4/4/4	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	GOL	H	403	-	-	0/4/4/4	-
5	EDO	G	403	-	-	1/1/1/1	-
3	G3H	F	402	-	-	3/7/8/8	-
4	GOL	C	404	-	-	2/4/4/4	-
2	NAD	C	401	-	-	4/30/62/62	0/5/5/5
3	G3H	E	402	-	-	3/7/8/8	-
4	GOL	B	404	-	-	4/4/4/4	-
4	GOL	C	405	-	-	1/4/4/4	-
4	GOL	A	403	-	-	2/4/4/4	-
4	GOL	D	404	-	-	2/4/4/4	-
6	PG4	D	406	-	-	3/10/10/10	-
2	NAD	F	401	-	-	4/30/62/62	0/5/5/5
4	GOL	C	403	-	-	2/4/4/4	-

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	G	401	NAD	C2N-N1N	4.07	1.39	1.35
2	C	401	NAD	C2N-N1N	4.01	1.39	1.35
2	F	401	NAD	C2N-N1N	3.87	1.39	1.35
2	H	401	NAD	C2N-N1N	3.79	1.39	1.35
2	A	401	NAD	C2N-N1N	3.76	1.39	1.35

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	402	G3H	O2-C2-C1	3.92	117.46	109.03
3	B	402	G3H	O2-C2-C1	3.04	115.58	109.03
2	G	401	NAD	C6N-N1N-C2N	-2.99	119.33	121.88
3	G	402	G3H	O2-C2-C1	2.88	115.23	109.03
3	E	402	G3H	O2-C2-C1	2.58	114.58	109.03

There are no chirality outliers.

5 of 93 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401	NAD	O4D-C1D-N1N-C2N
2	A	401	NAD	O4D-C1D-N1N-C6N
2	A	401	NAD	C2D-C1D-N1N-C2N

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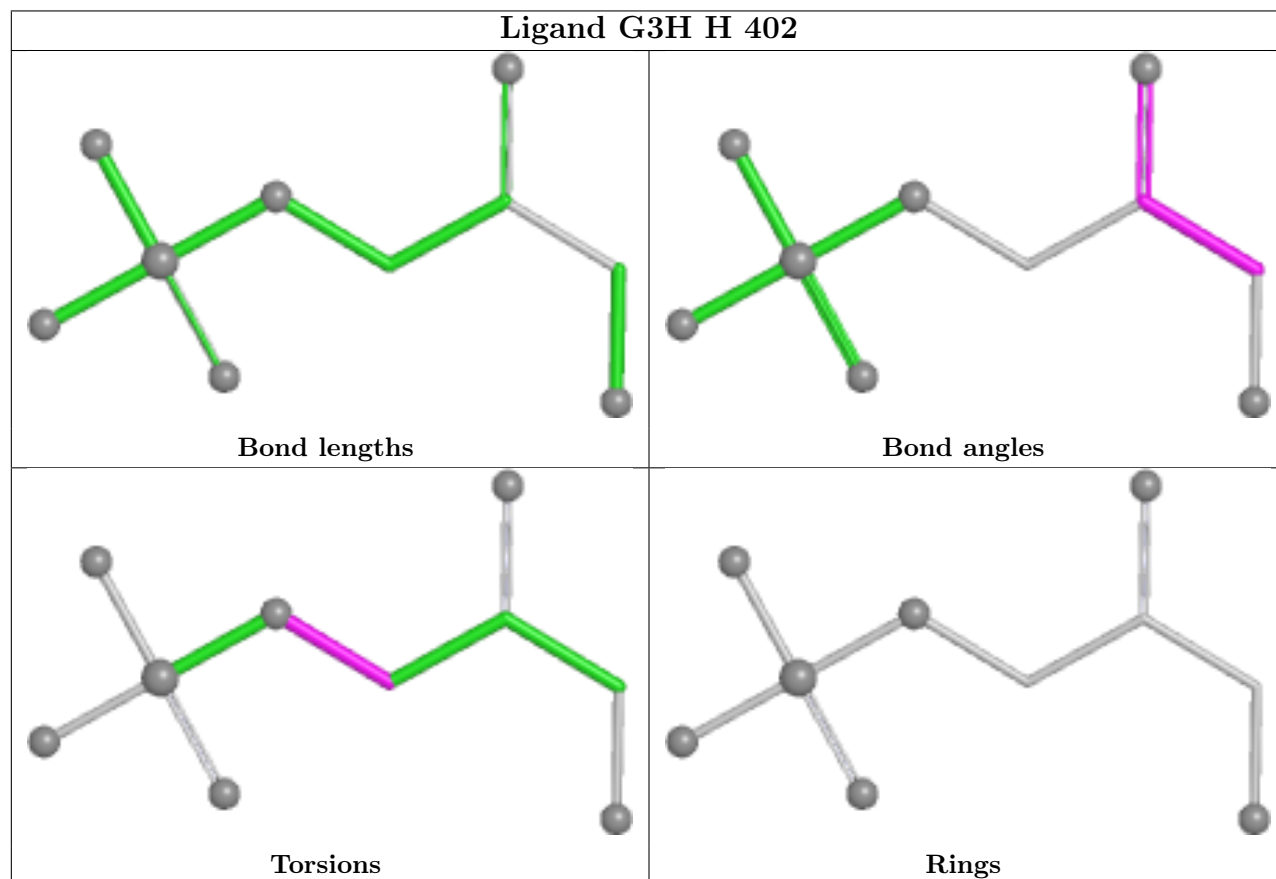
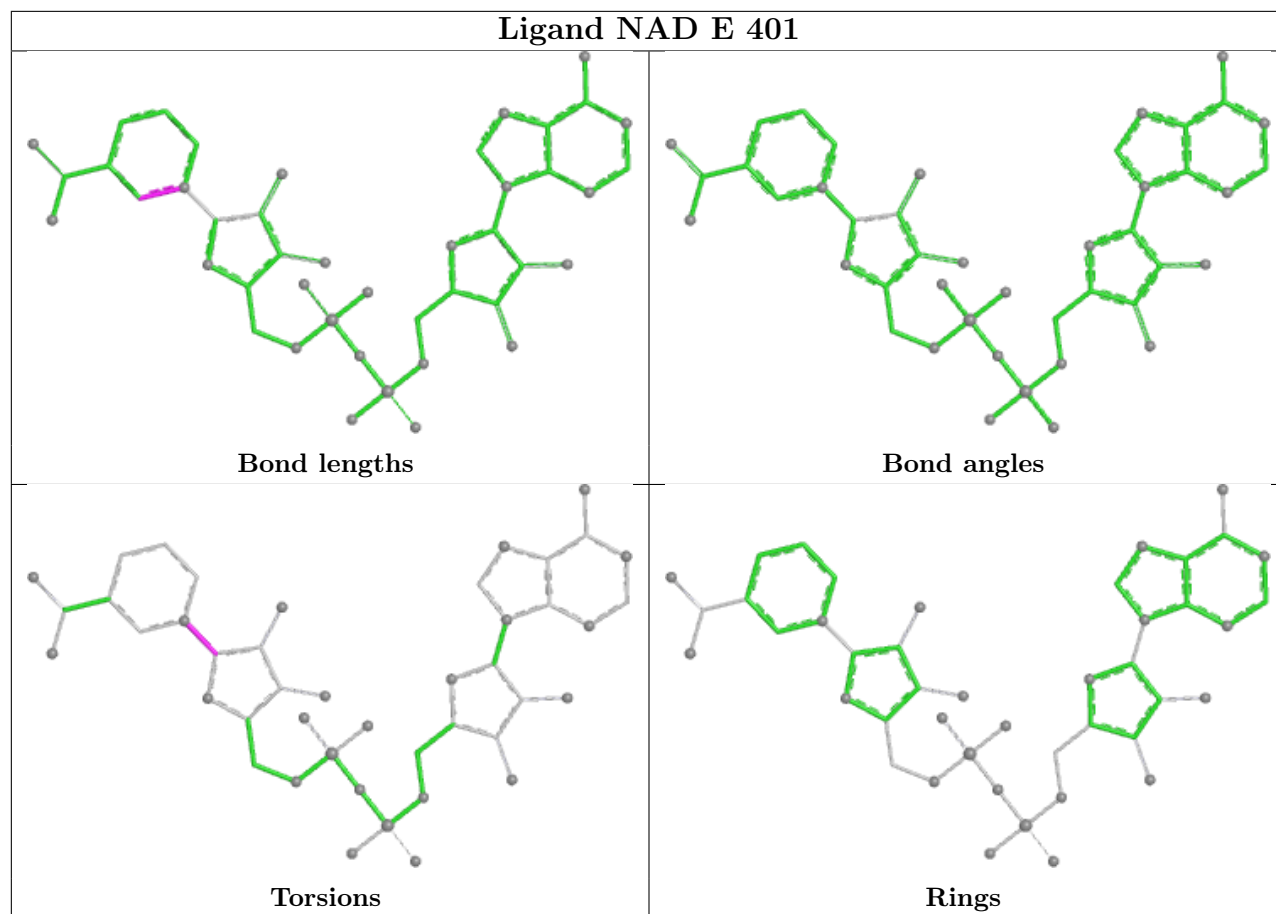
Mol	Chain	Res	Type	Atoms
2	A	401	NAD	C2D-C1D-N1N-C6N
2	B	401	NAD	O4D-C1D-N1N-C2N

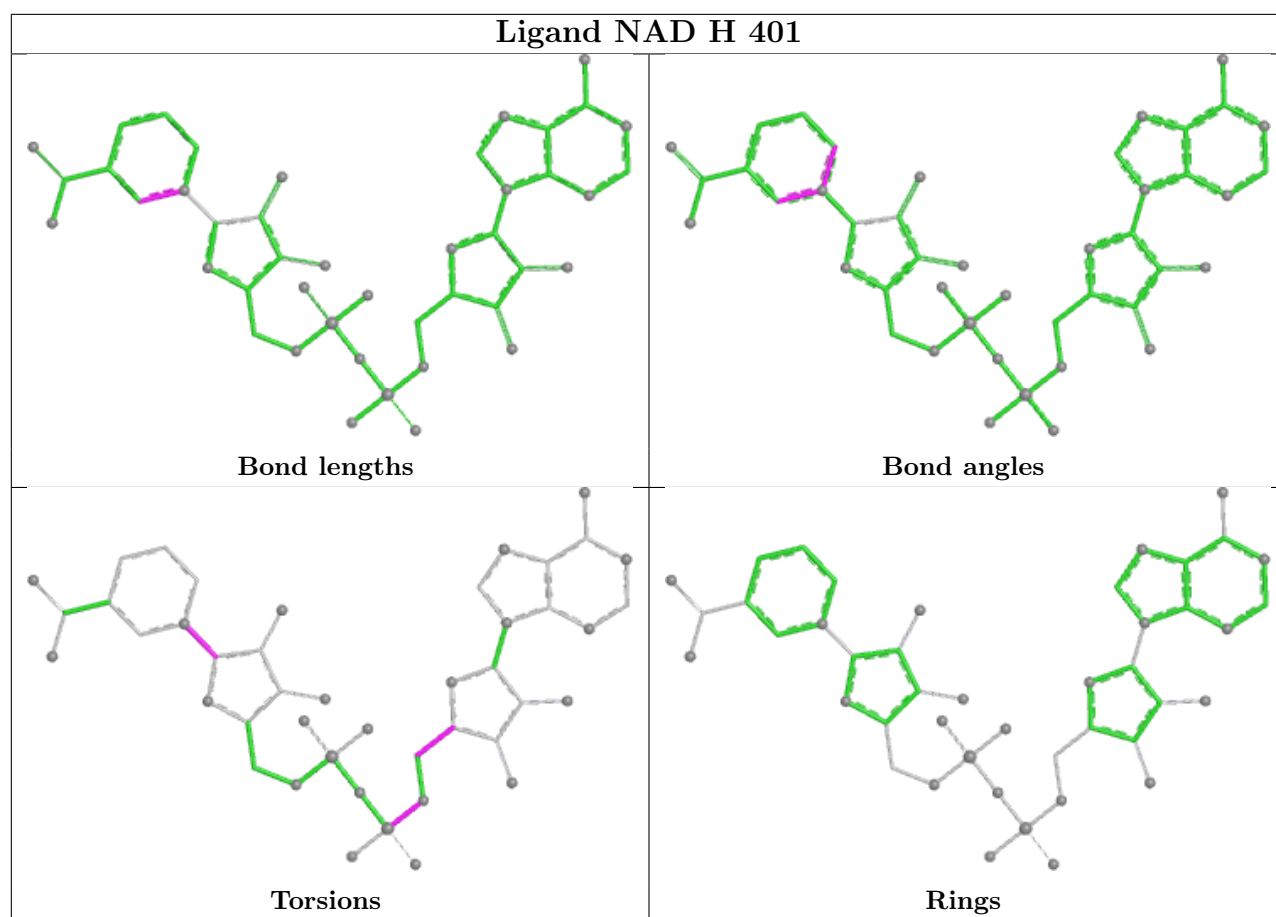
There are no ring outliers.

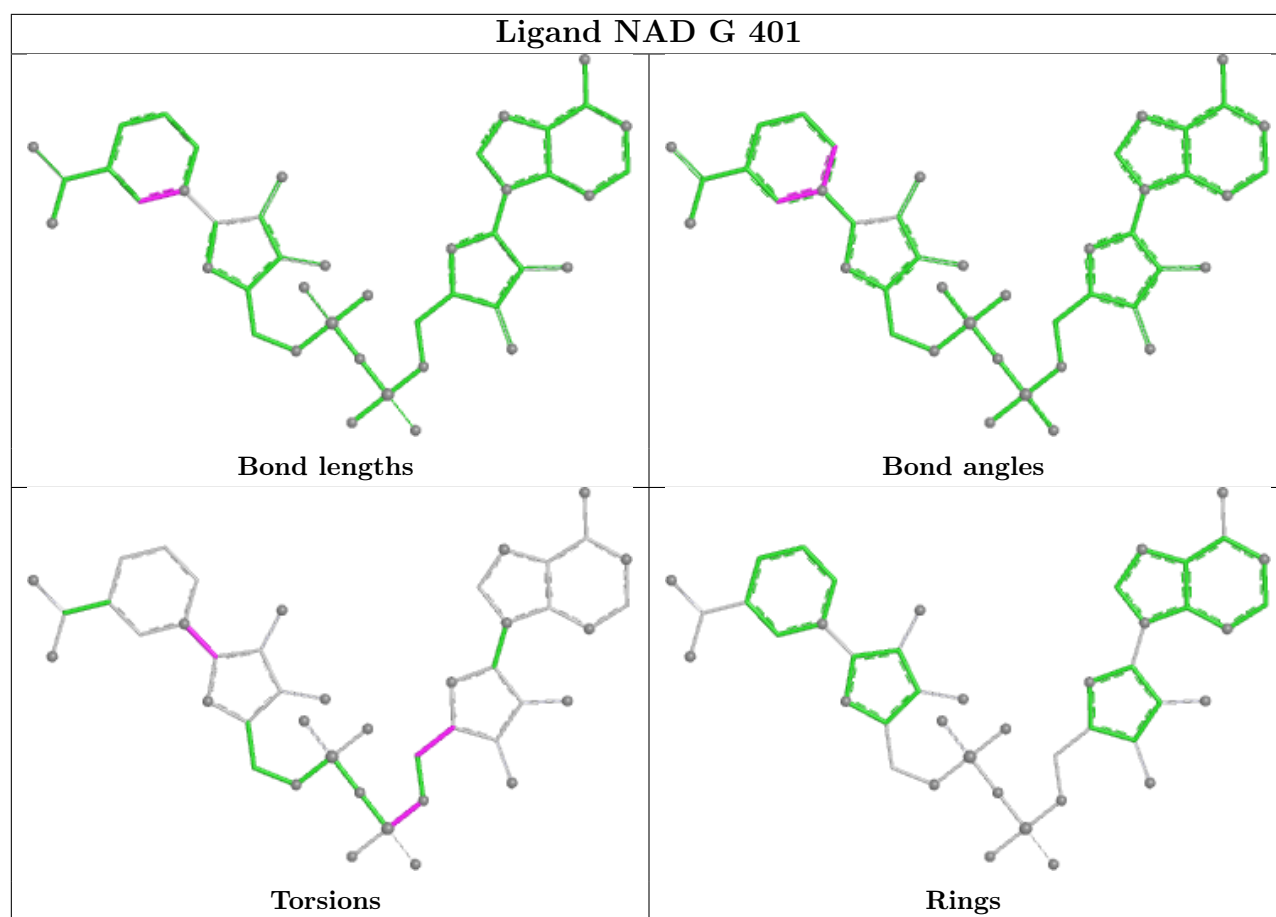
19 monomers are involved in 42 short contacts:

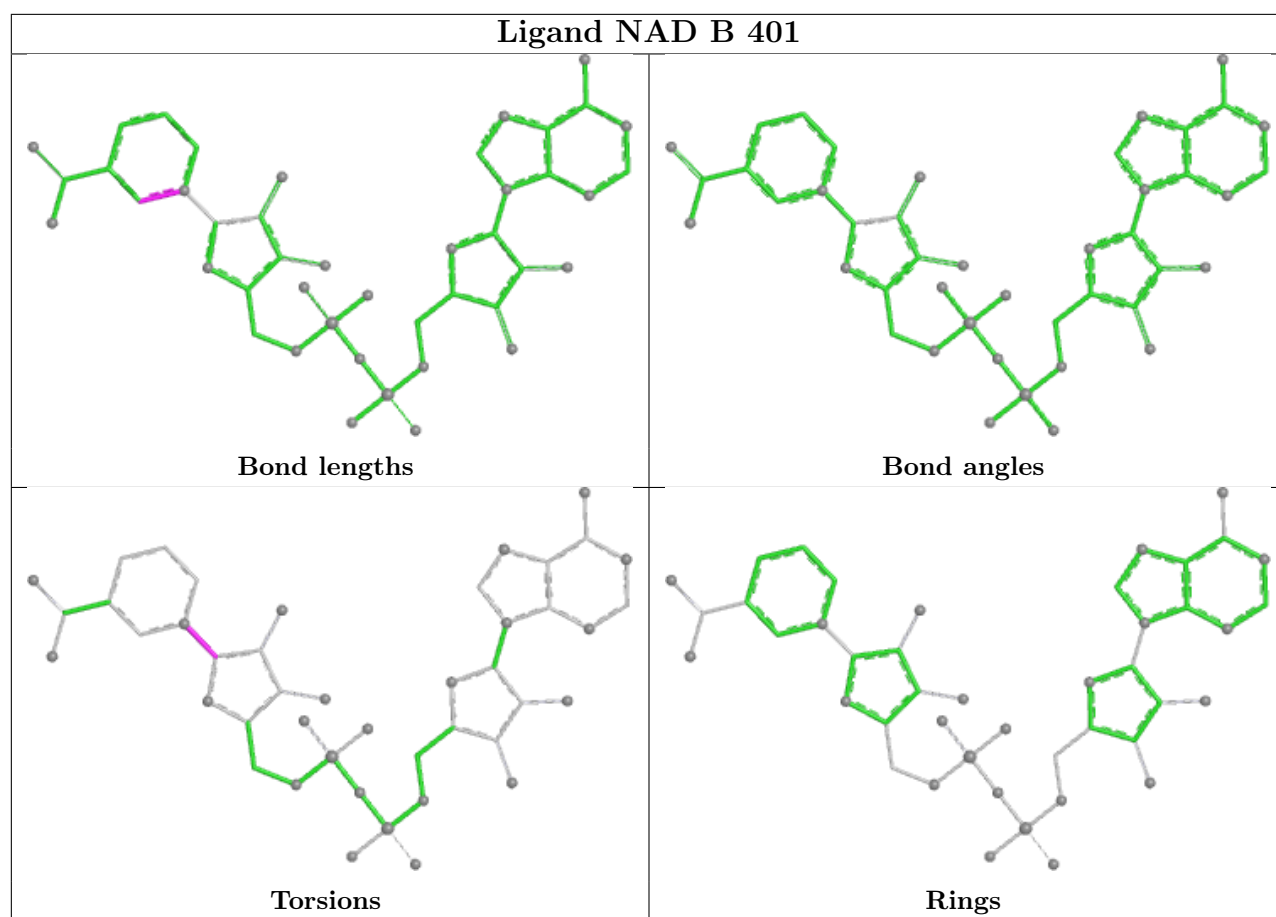
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	E	401	NAD	3	0
2	G	401	NAD	2	0
4	A	404	GOL	2	0
2	B	401	NAD	1	0
2	D	401	NAD	1	0
3	C	402	G3H	7	0
3	G	402	G3H	5	0
3	B	402	G3H	4	0
5	C	407	EDO	1	0
3	D	402	G3H	4	0
3	A	402	G3H	2	0
3	F	402	G3H	1	0
4	C	404	GOL	1	0
2	C	401	NAD	6	0
3	E	402	G3H	4	0
4	B	404	GOL	2	0
4	D	404	GOL	1	0
6	D	406	PG4	3	0
2	F	401	NAD	2	0

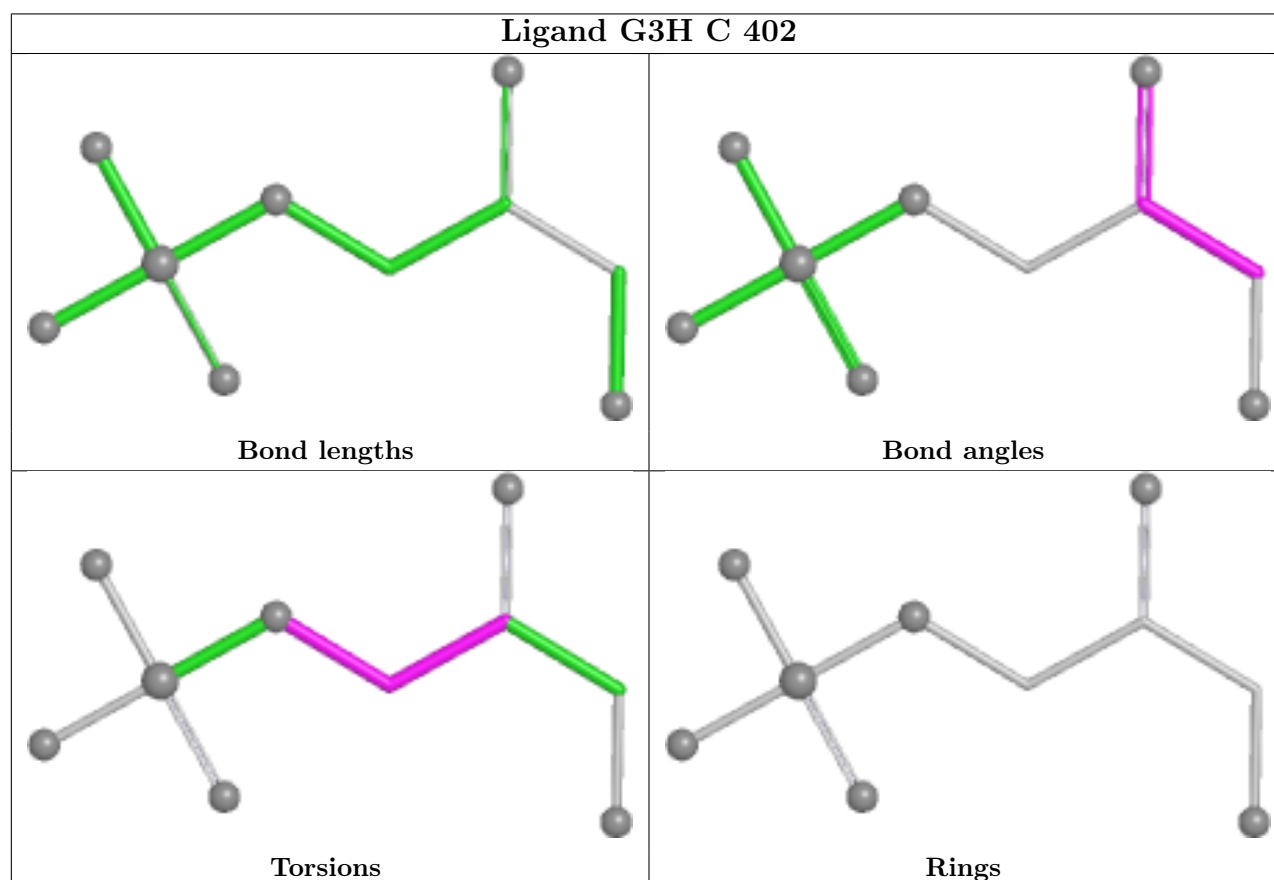
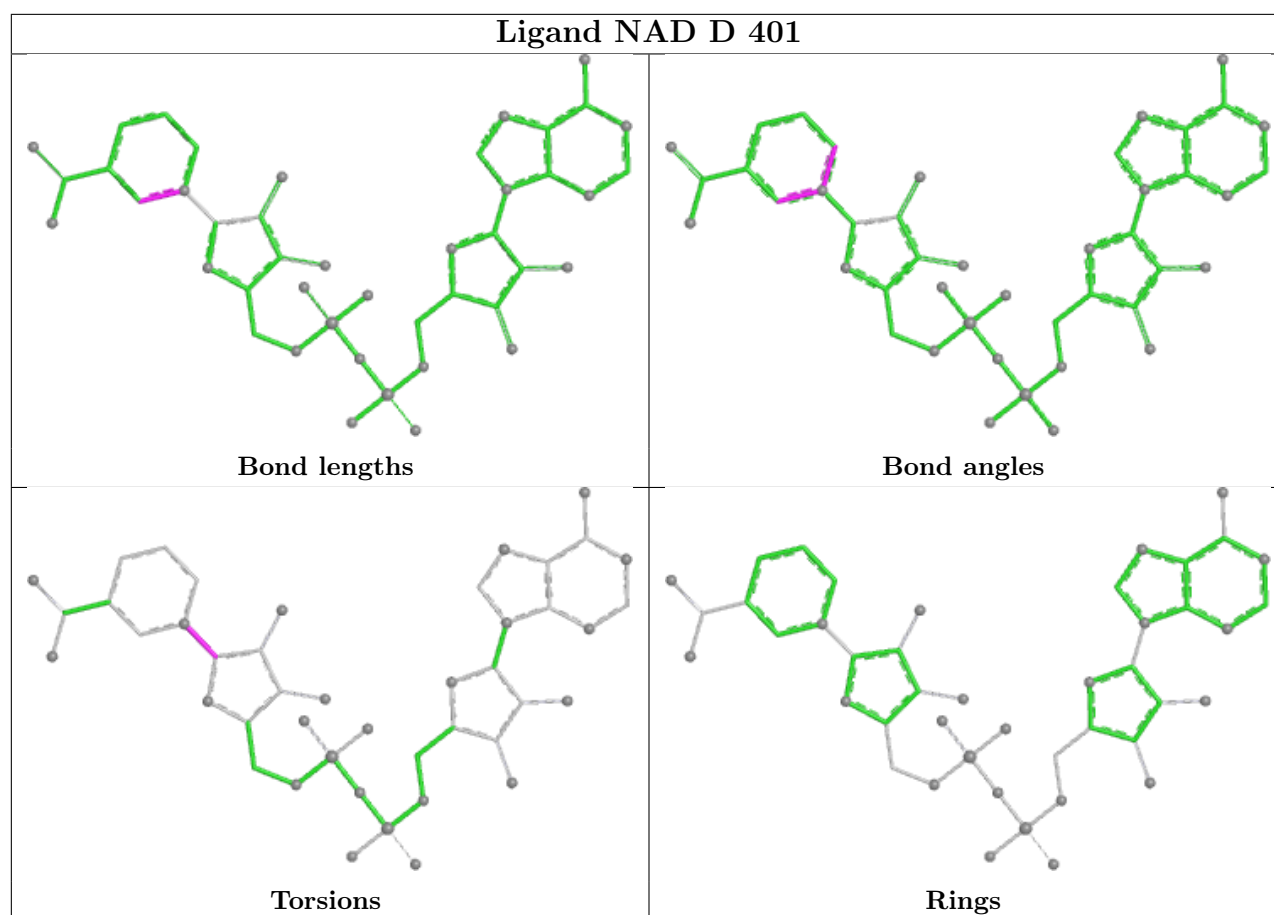
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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.

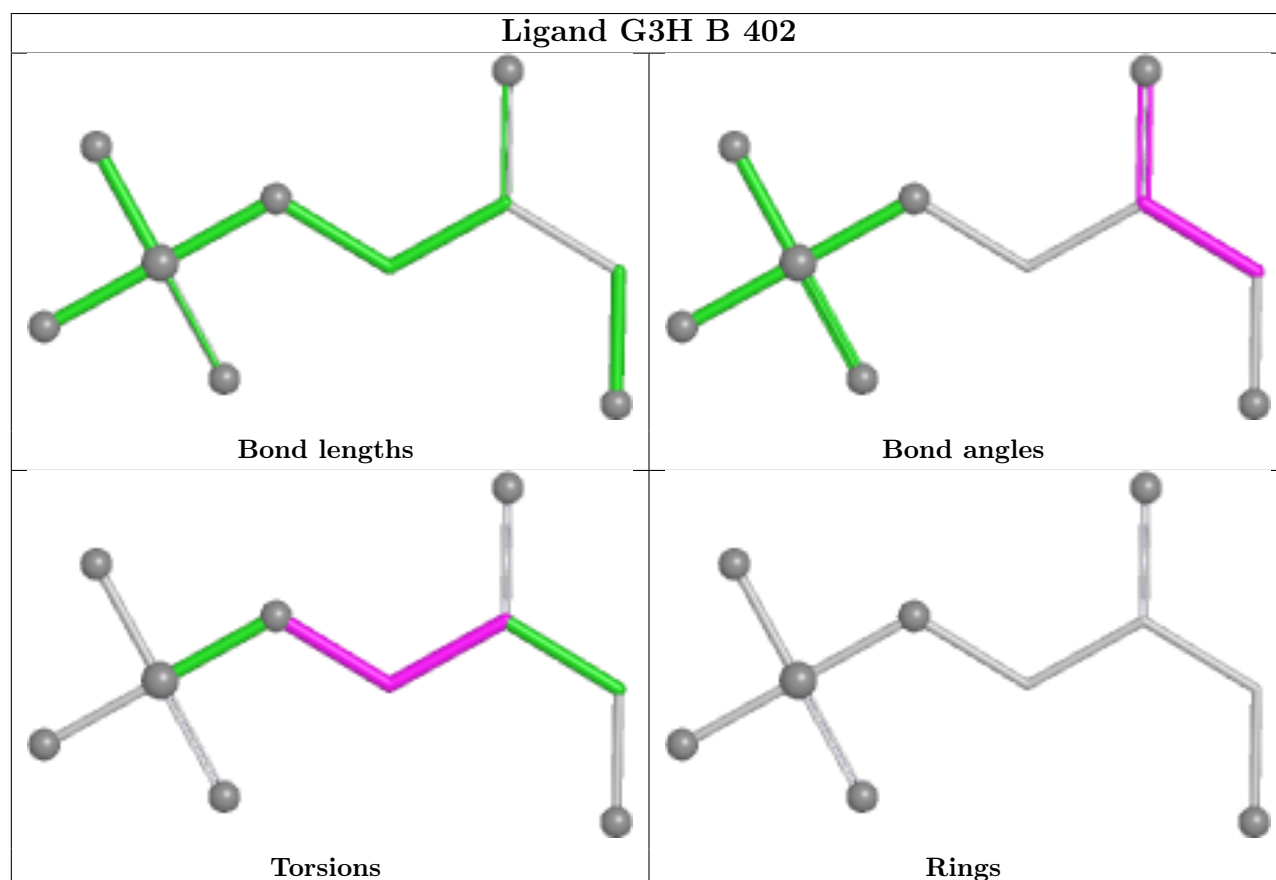
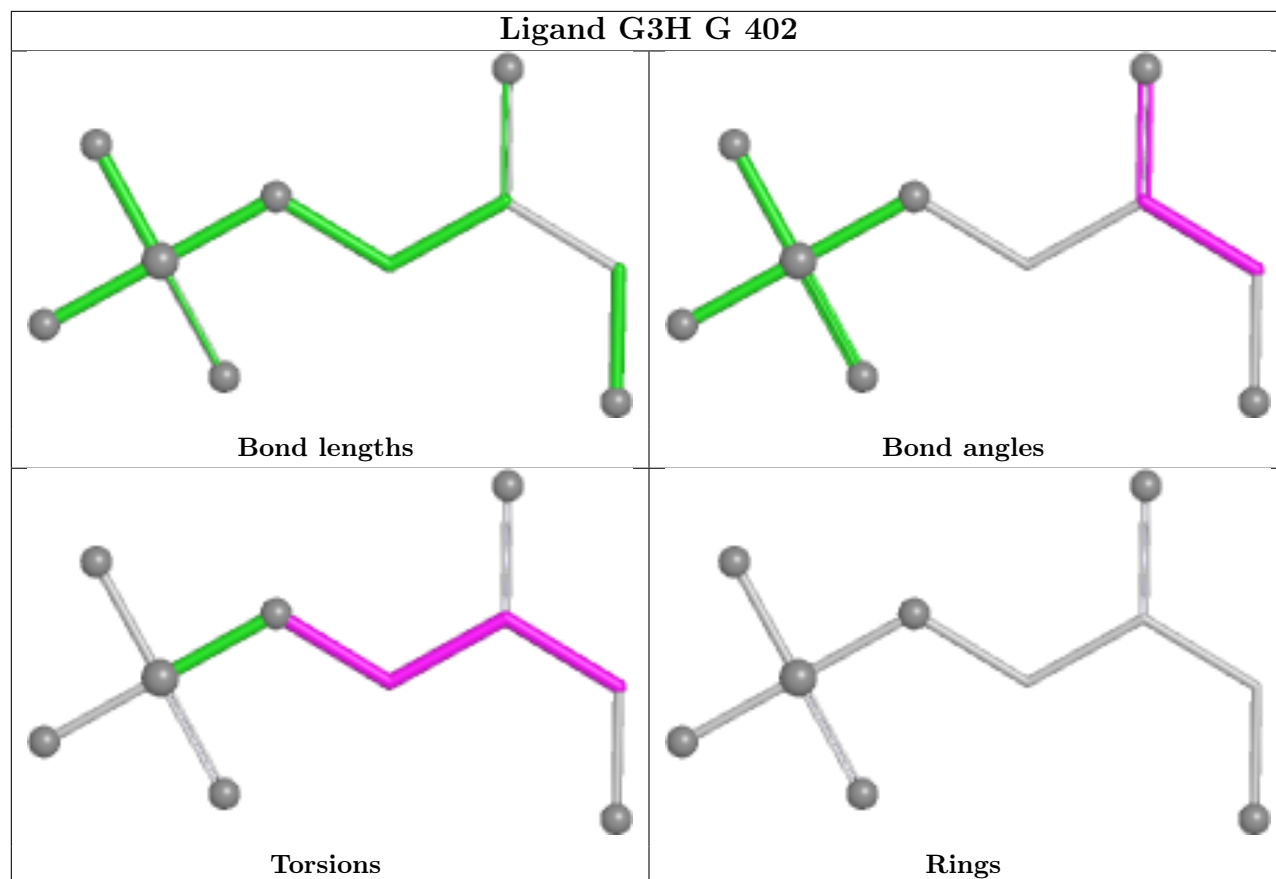


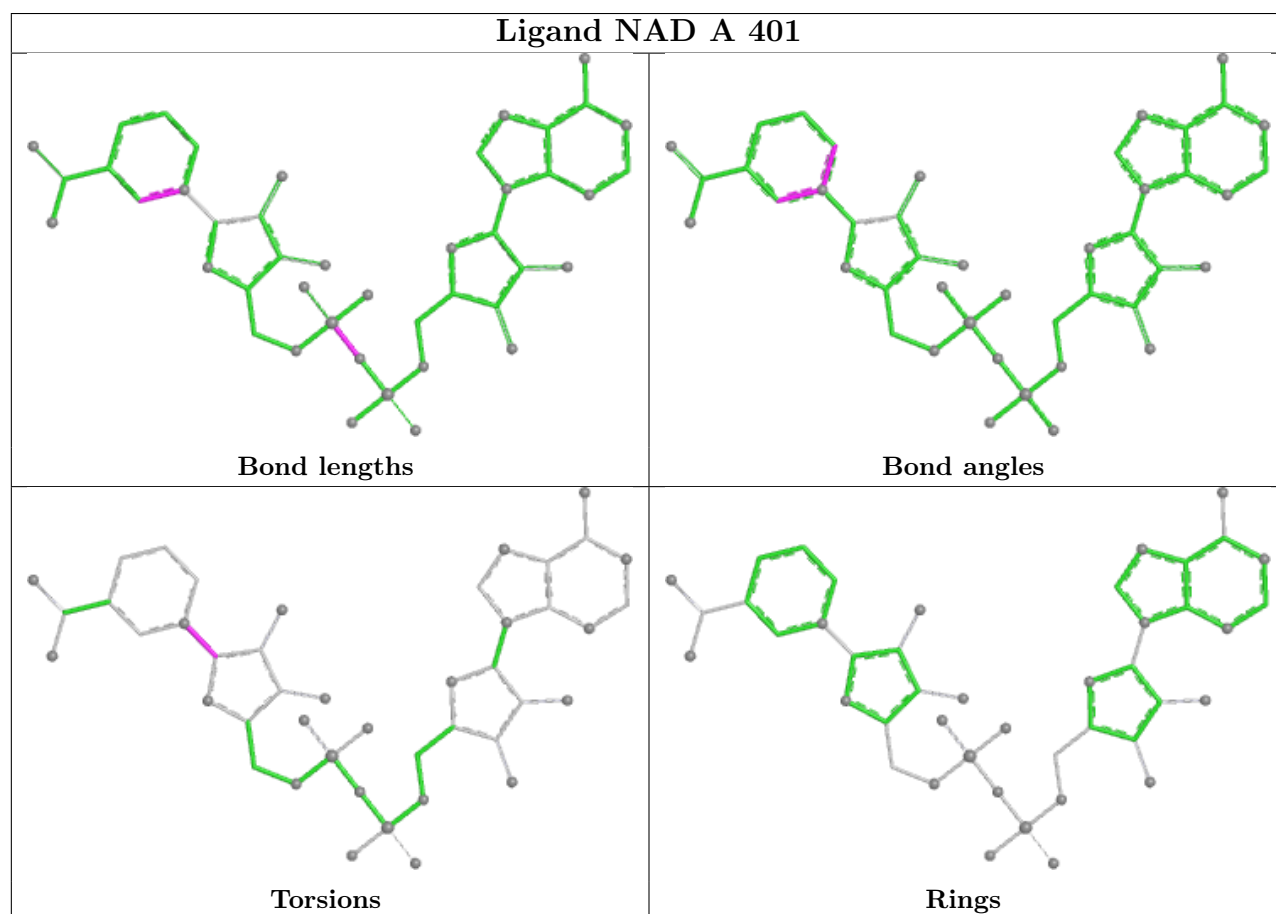
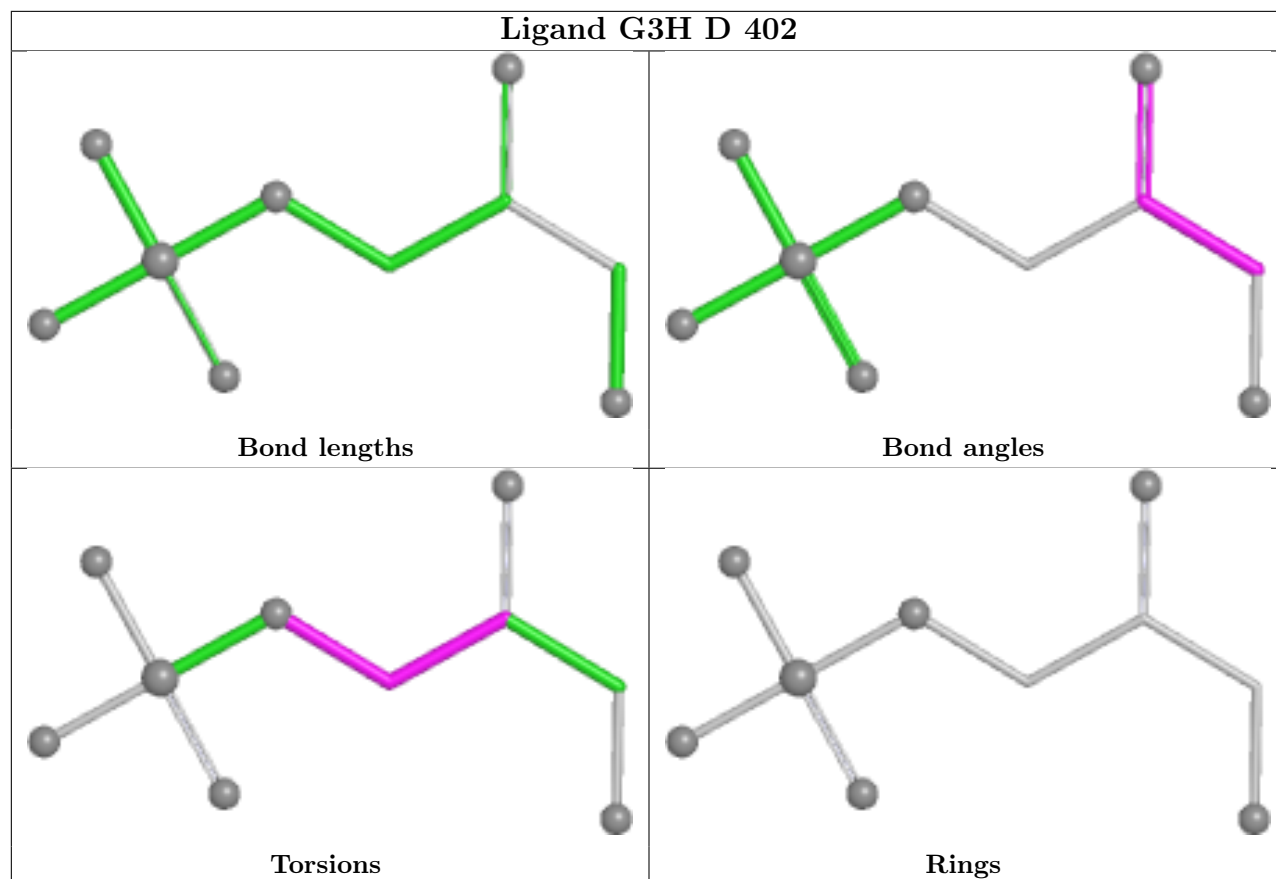




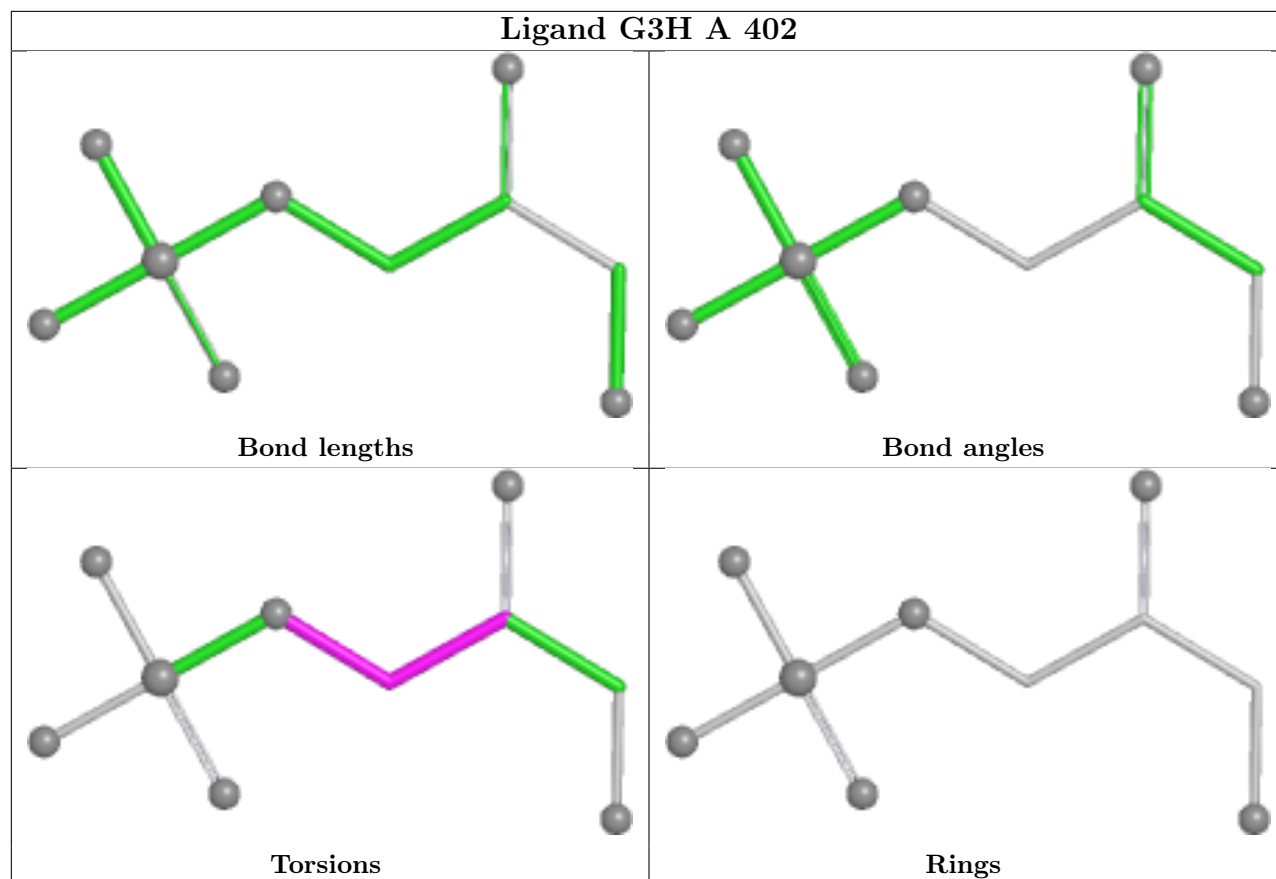




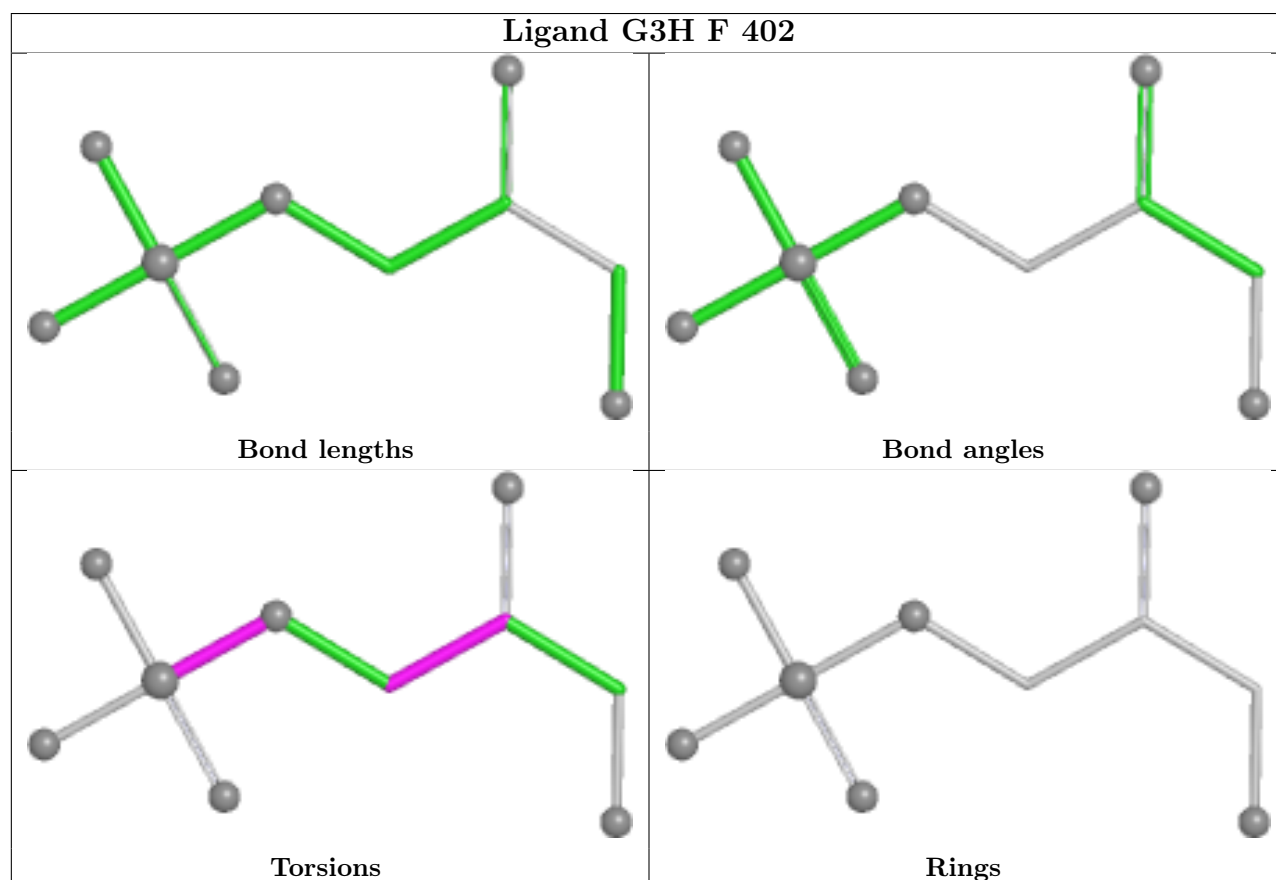


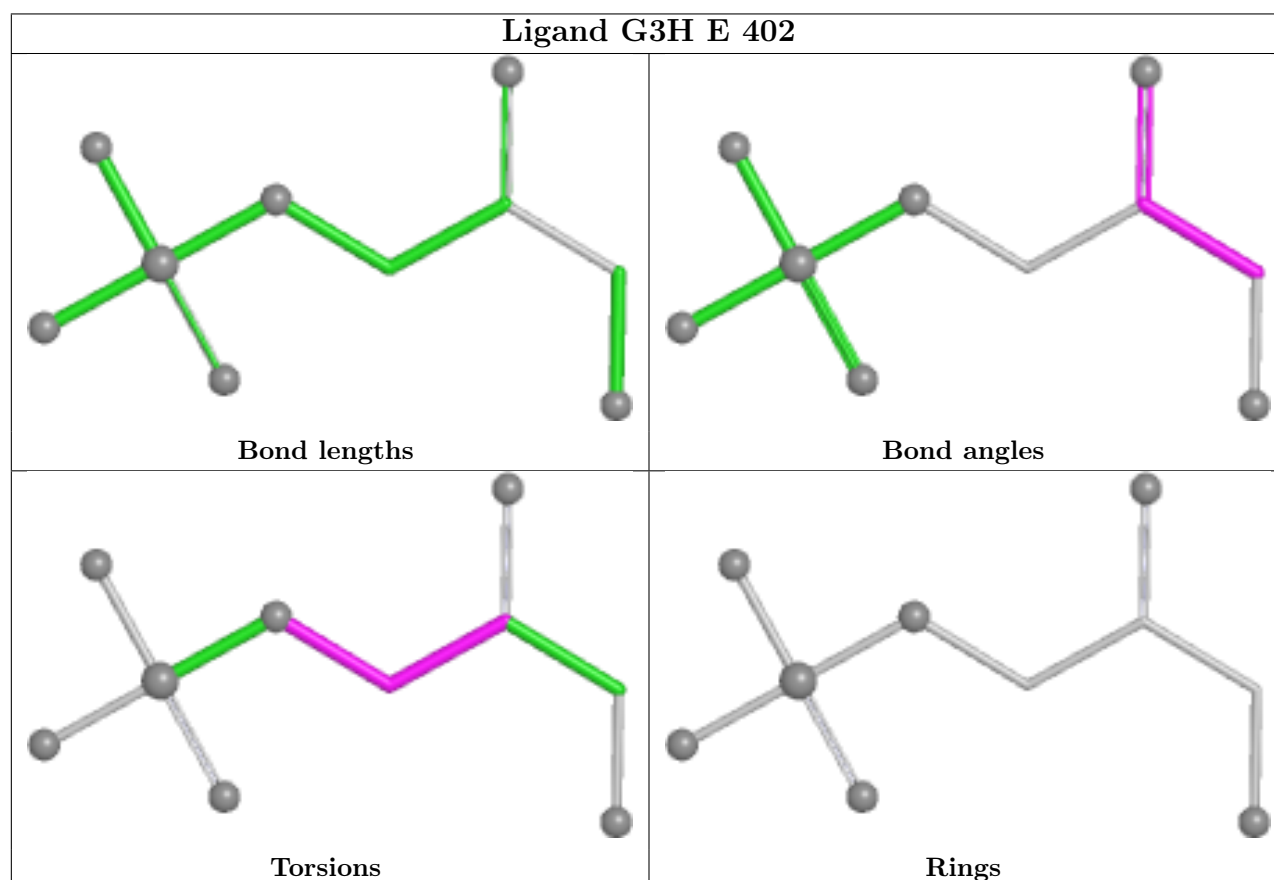
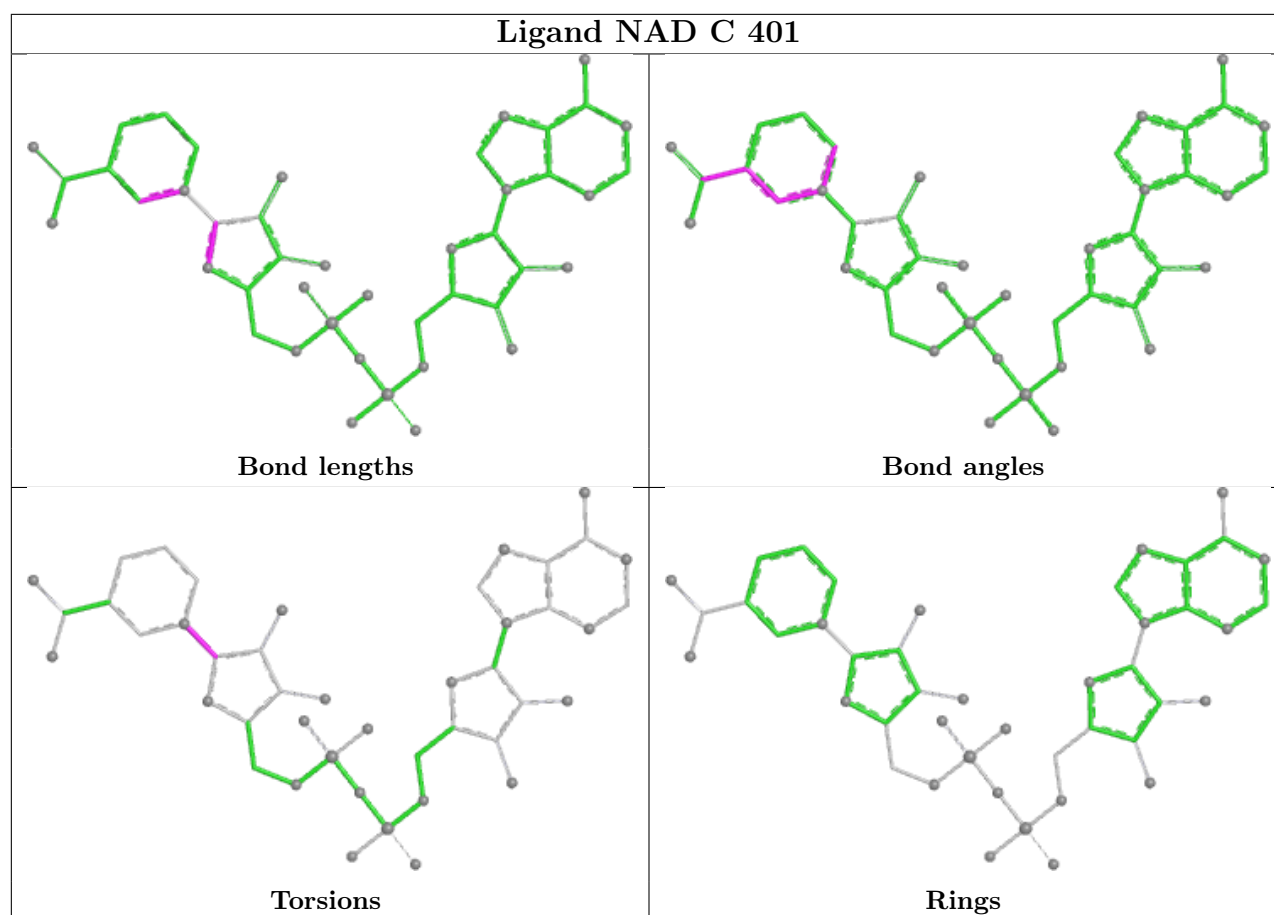


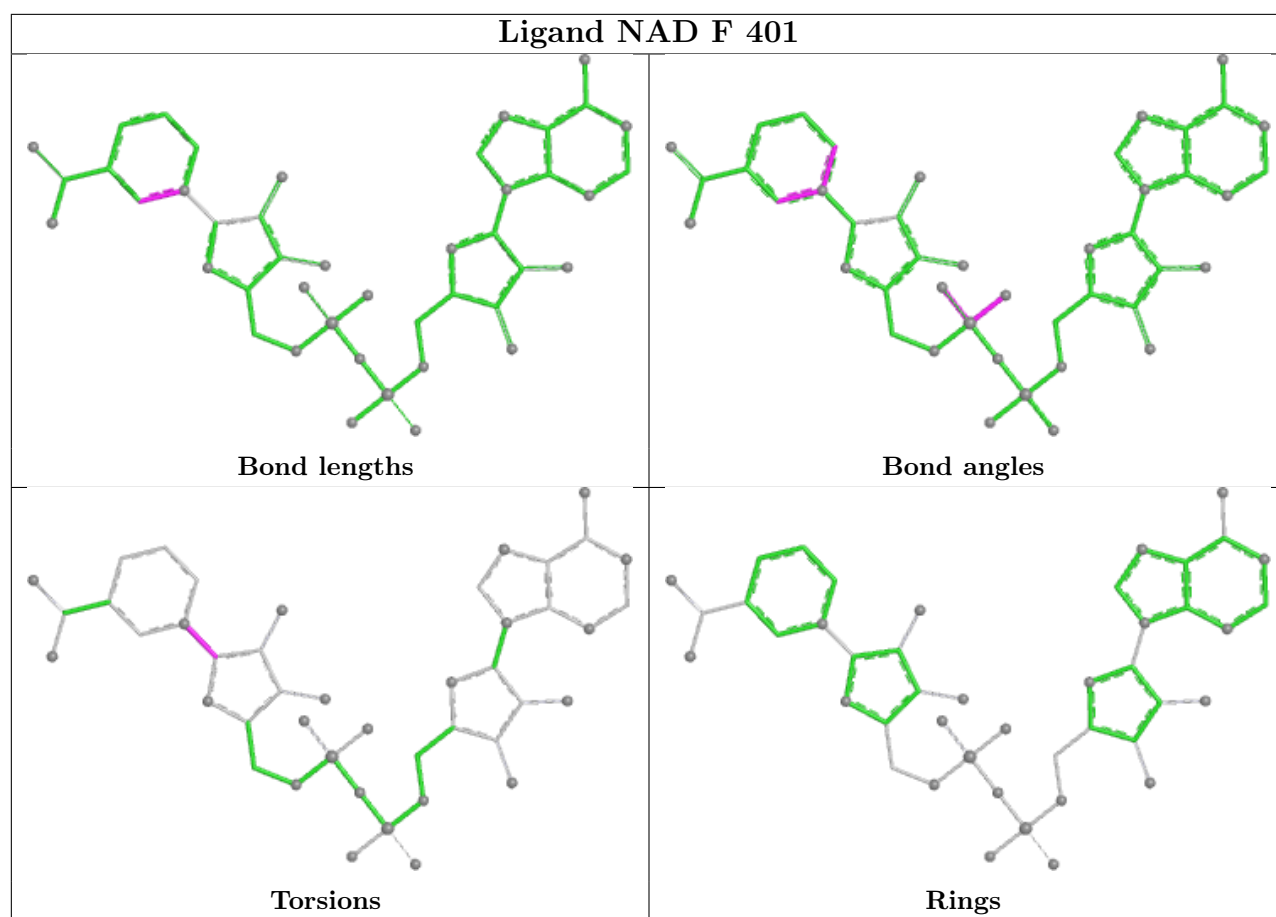
Ligand G3H A 402



Ligand G3H F 402







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 [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	334/342 (97%)	-0.29	5 (1%) 72 71	13, 20, 35, 67	0
1	B	334/342 (97%)	-0.20	6 (1%) 67 67	12, 22, 38, 59	0
1	C	335/342 (97%)	-0.15	7 (2%) 63 63	12, 22, 40, 65	0
1	D	334/342 (97%)	-0.28	4 (1%) 76 76	11, 21, 40, 61	0
1	E	333/342 (97%)	-0.09	3 (0%) 81 80	18, 27, 43, 79	0
1	F	333/342 (97%)	0.03	4 (1%) 76 76	18, 28, 46, 70	0
1	G	333/342 (97%)	0.28	9 (2%) 56 55	18, 32, 54, 68	0
1	H	333/342 (97%)	0.12	4 (1%) 76 76	18, 29, 49, 67	0
All	All	2669/2736 (97%)	-0.07	42 (1%) 70 70	11, 25, 46, 79	0

The worst 5 of 42 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	334	LEU	6.0
1	H	334	LEU	6.0
1	B	335	LEU	5.7
1	D	335	LEU	5.3
1	G	334	LEU	5.3

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](#)

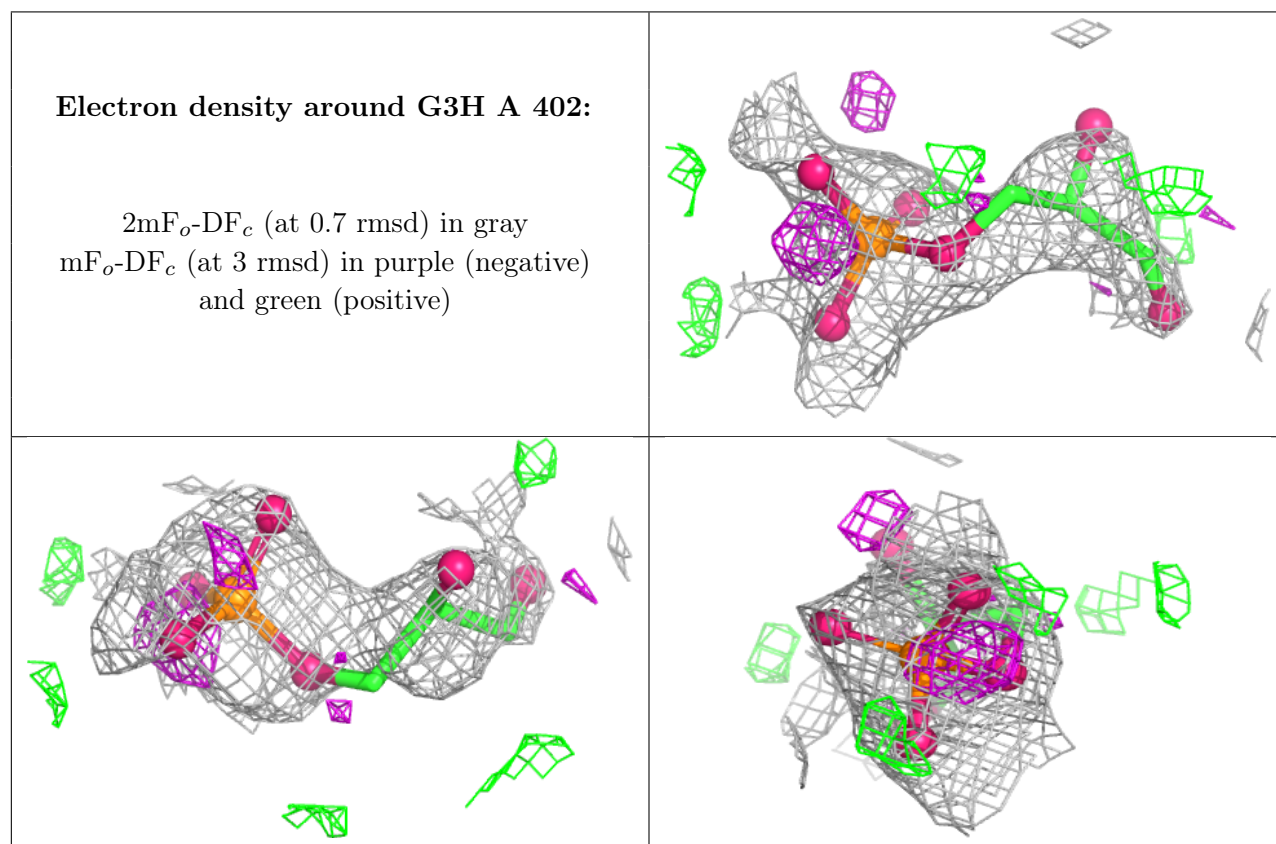
There are no oligosaccharides in this entry.

6.4 Ligands

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.

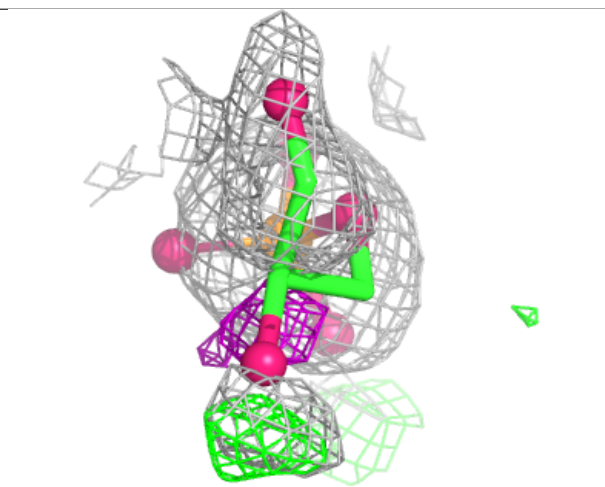
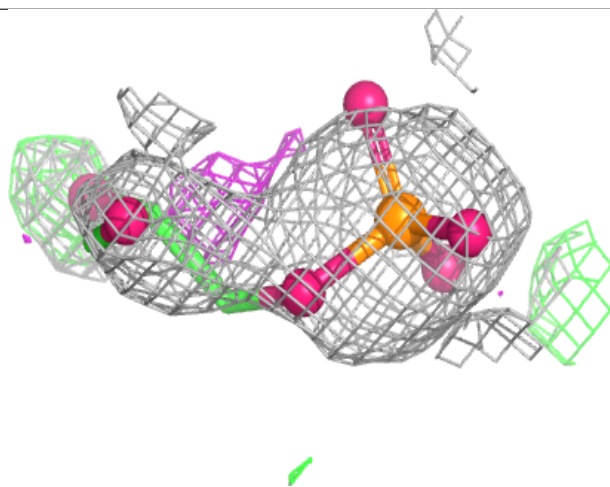
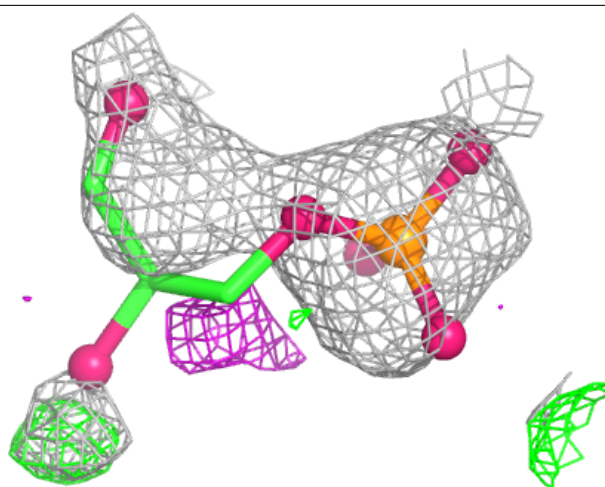
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
5	EDO	C	407	4/4	0.75	0.19	43,43,45,51	0
4	GOL	C	406	6/6	0.78	0.18	39,47,51,53	0
5	EDO	F	403	4/4	0.80	0.19	52,52,53,53	0
5	EDO	E	406	4/4	0.83	0.12	37,39,41,44	0
4	GOL	B	404	6/6	0.83	0.18	44,45,49,54	0
3	G3H	A	402	10/10	0.84	0.16	46,62,70,73	0
3	G3H	H	402	10/10	0.84	0.19	61,80,85,86	0
4	GOL	E	404	6/6	0.84	0.15	34,40,43,48	0
4	GOL	A	404	6/6	0.86	0.12	39,42,44,45	0
4	GOL	B	405	6/6	0.86	0.13	42,49,54,54	0
4	GOL	H	403	6/6	0.86	0.12	40,43,44,47	0
5	EDO	G	403	4/4	0.86	0.15	41,42,46,48	0
6	PG4	D	406	13/13	0.86	0.15	37,50,68,71	0
4	GOL	E	403	6/6	0.87	0.13	48,49,52,55	0
3	G3H	D	402	10/10	0.88	0.14	43,55,64,67	0
4	GOL	D	403	6/6	0.88	0.12	32,39,41,42	0
3	G3H	G	402	10/10	0.90	0.14	39,55,67,75	0
4	GOL	D	404	6/6	0.90	0.11	31,37,42,43	0
3	G3H	E	402	10/10	0.90	0.12	44,57,62,64	0
5	EDO	E	405	4/4	0.90	0.12	41,42,44,47	0
3	G3H	F	402	10/10	0.91	0.12	35,46,51,67	0
4	GOL	C	403	6/6	0.92	0.12	30,36,38,48	0
4	GOL	C	404	6/6	0.92	0.09	29,39,43,43	0
5	EDO	D	405	4/4	0.93	0.09	29,30,31,32	0
4	GOL	B	403	6/6	0.93	0.10	27,34,35,41	0
4	GOL	C	405	6/6	0.94	0.11	23,30,33,37	0
4	GOL	A	403	6/6	0.94	0.08	31,34,36,37	0
3	G3H	C	402	10/10	0.95	0.09	34,38,48,49	0
2	NAD	F	401	44/44	0.95	0.08	24,30,37,39	0
3	G3H	B	402	10/10	0.95	0.10	32,38,46,47	0
2	NAD	G	401	44/44	0.96	0.07	29,34,40,42	0
2	NAD	C	401	44/44	0.96	0.07	20,25,28,32	0
2	NAD	H	401	44/44	0.97	0.06	20,28,33,35	0
2	NAD	A	401	44/44	0.97	0.06	12,18,21,22	0
2	NAD	E	401	44/44	0.98	0.05	22,25,30,32	0
2	NAD	B	401	44/44	0.98	0.05	15,20,22,23	0
2	NAD	D	401	44/44	0.98	0.05	14,21,25,29	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.



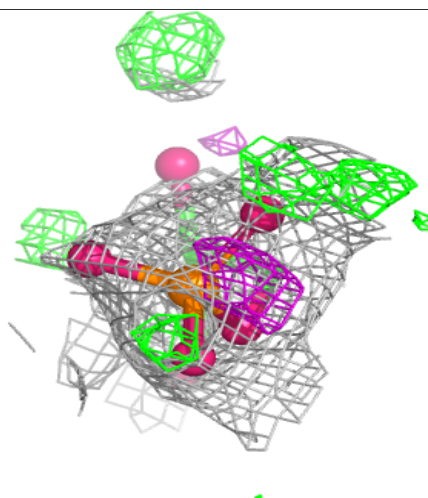
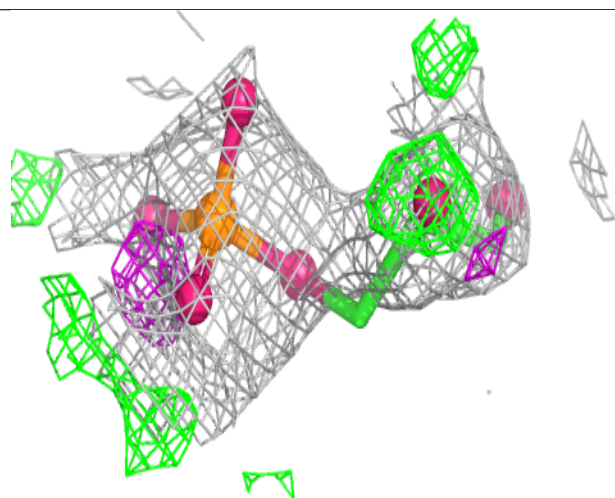
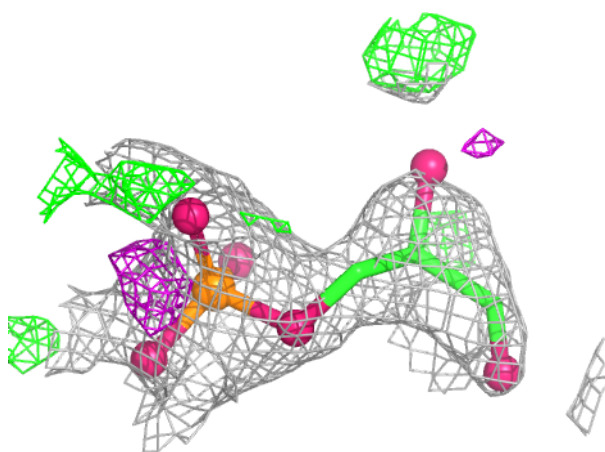
Electron density around G3H H 402:

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



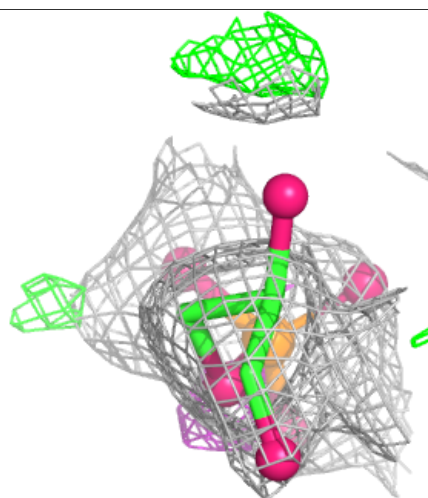
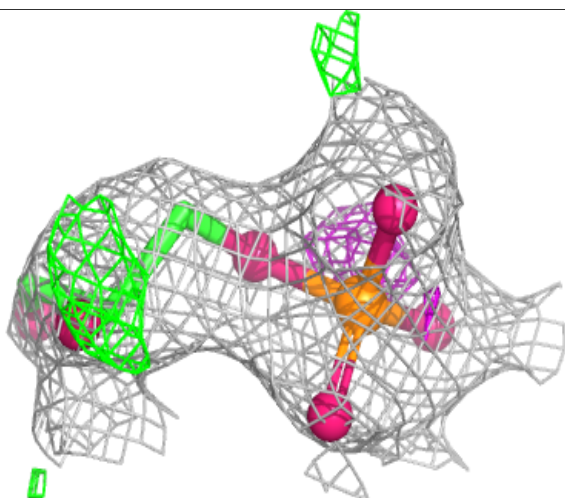
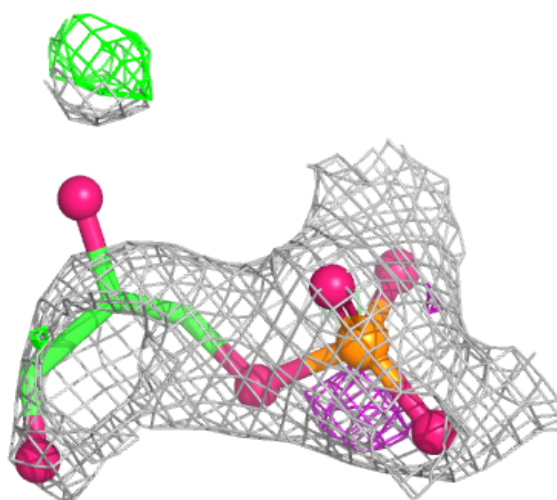
Electron density around G3H D 402:

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



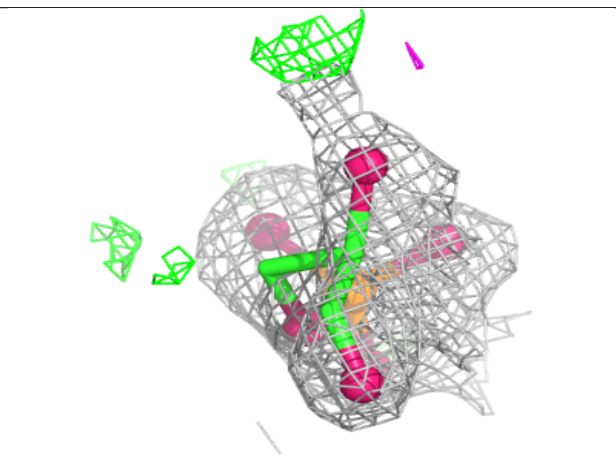
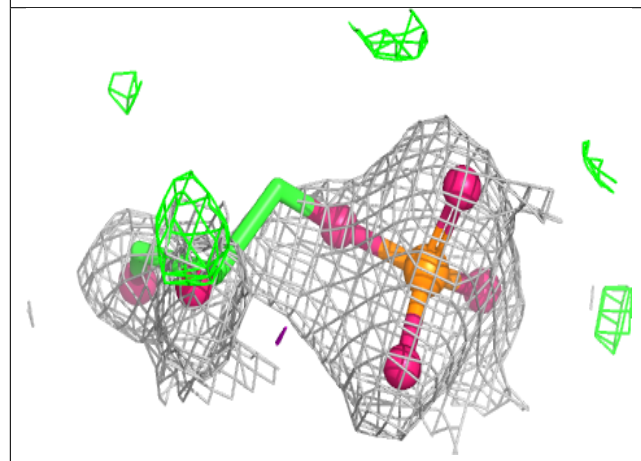
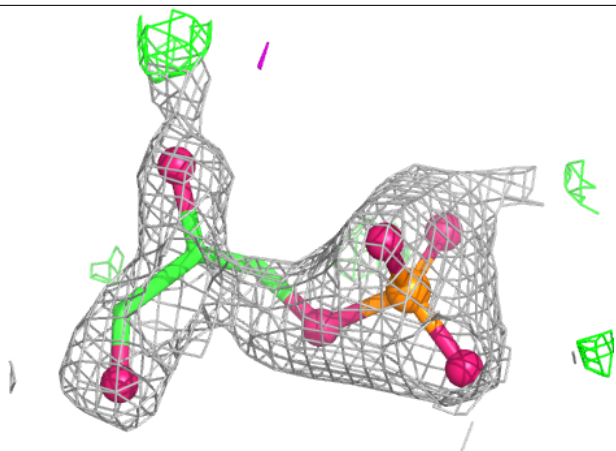
Electron density around G3H G 402:

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



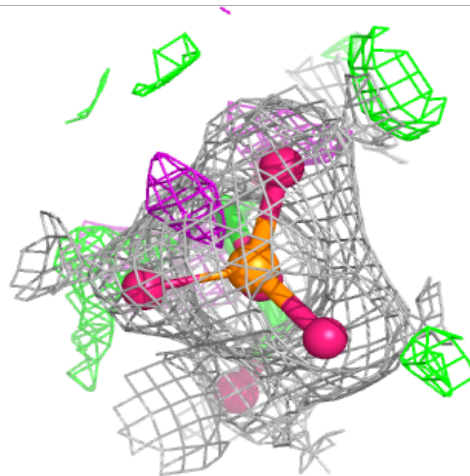
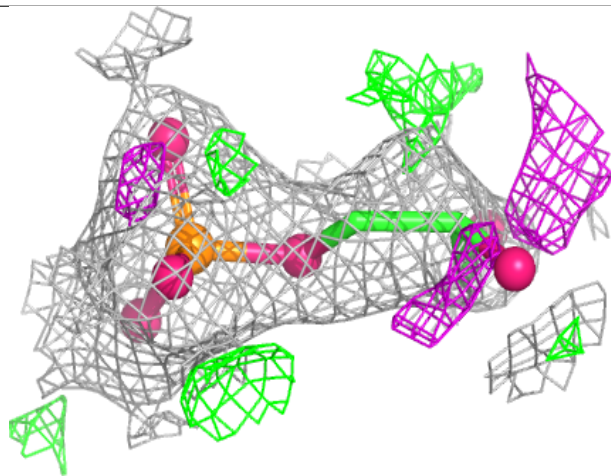
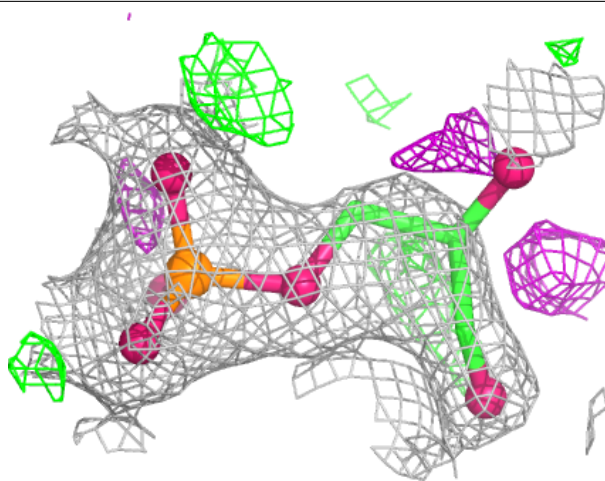
Electron density around G3H E 402:

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



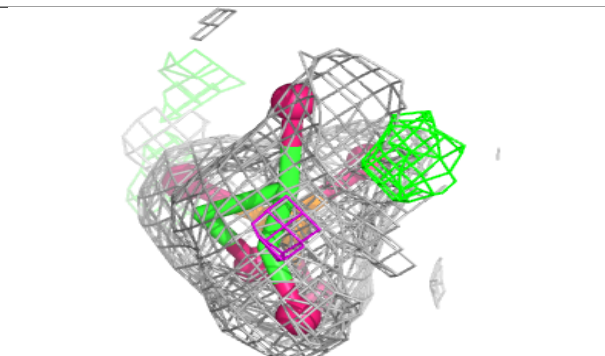
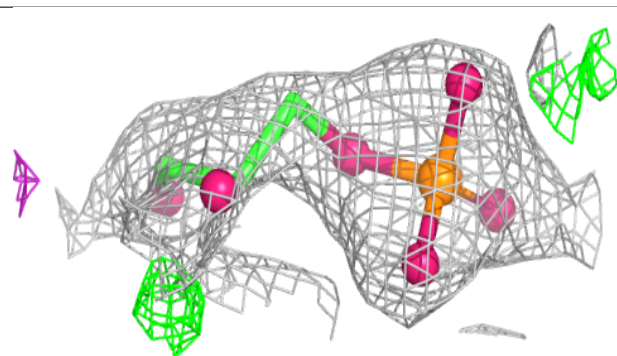
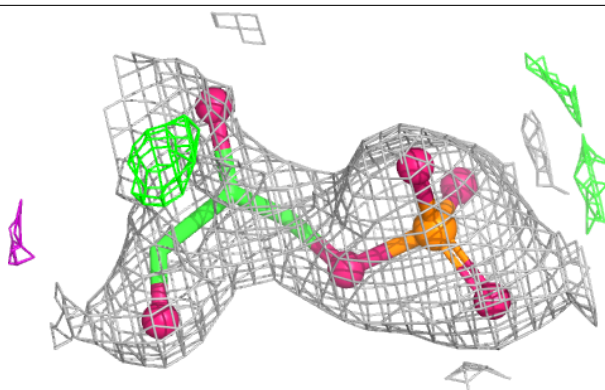
Electron density around G3H F 402:

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

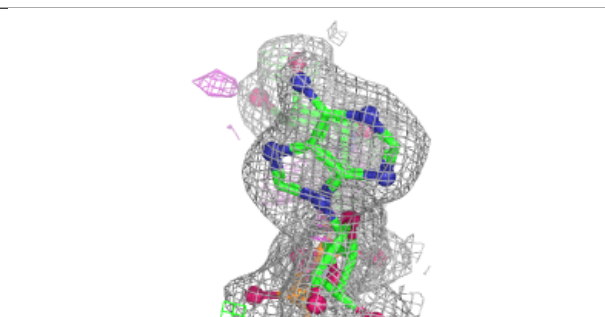
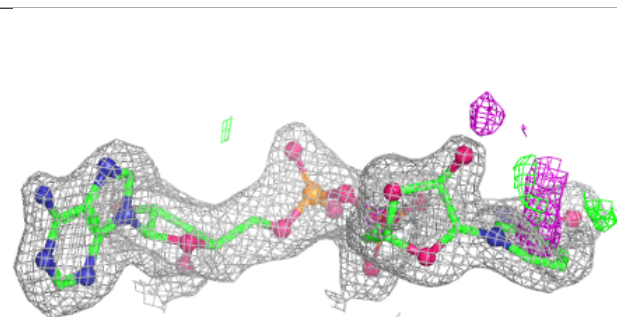
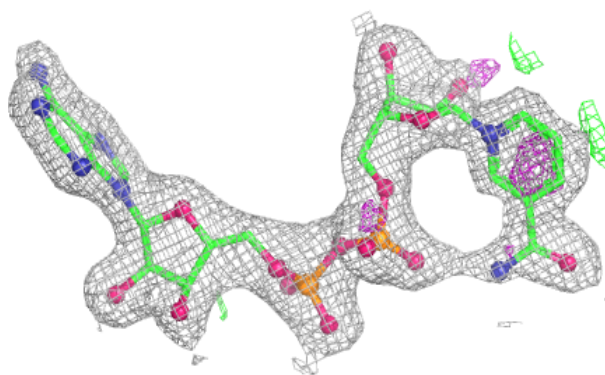


Electron density around G3H C 402:

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

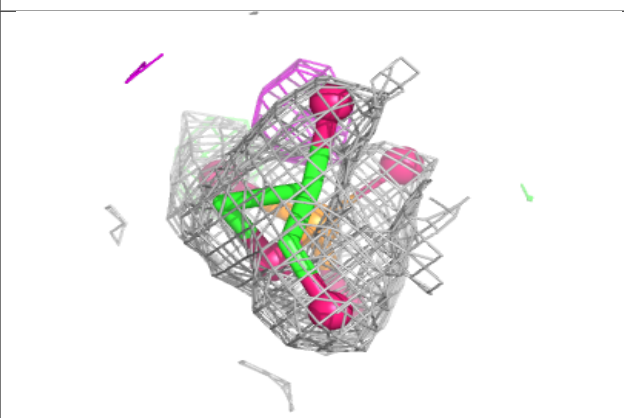
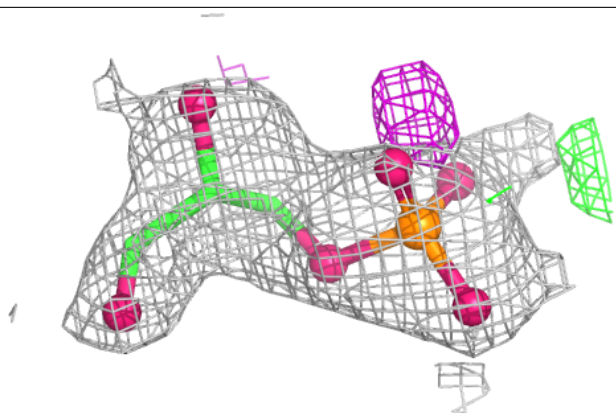
**Electron density around NAD F 401:**

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

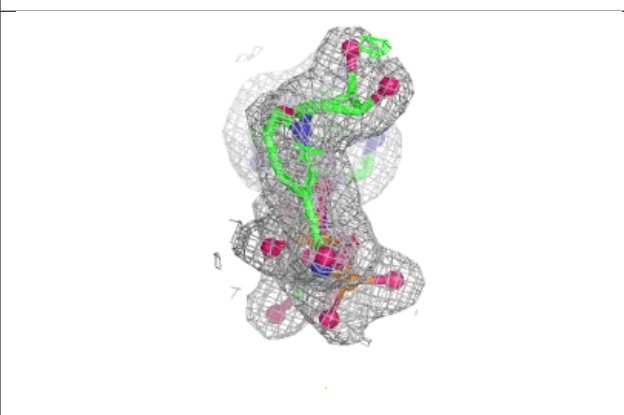
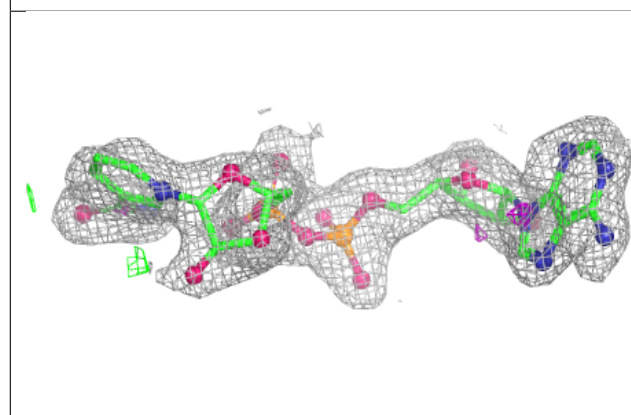
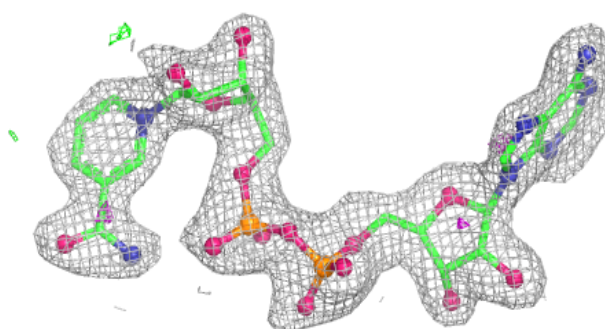


Electron density around G3H B 402:

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

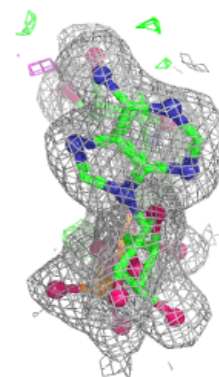
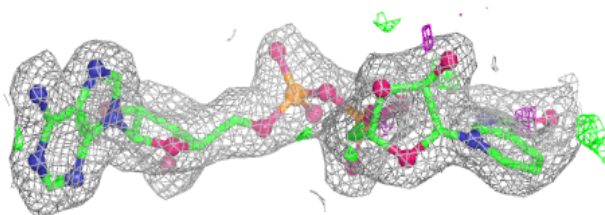
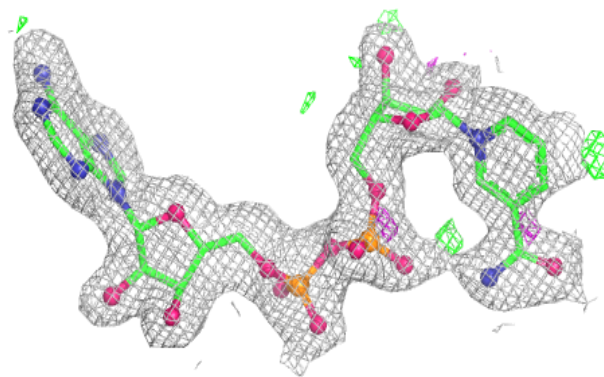
**Electron density around NAD G 401:**

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and green (positive)

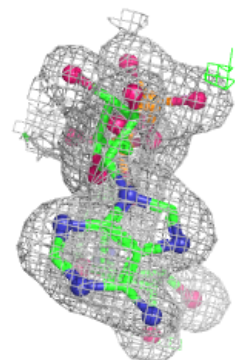
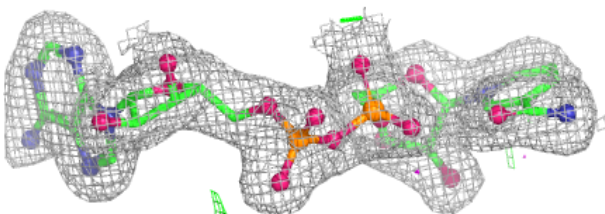
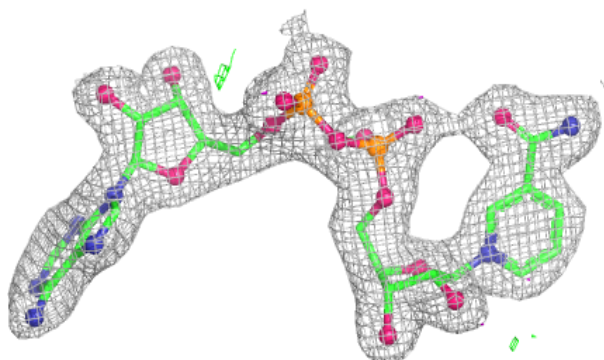


Electron density around NAD C 401:

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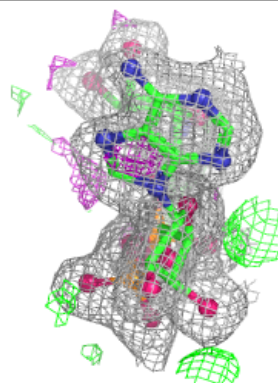
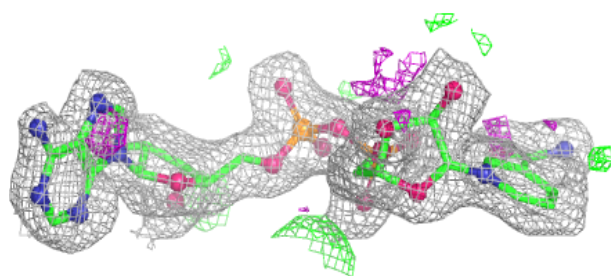
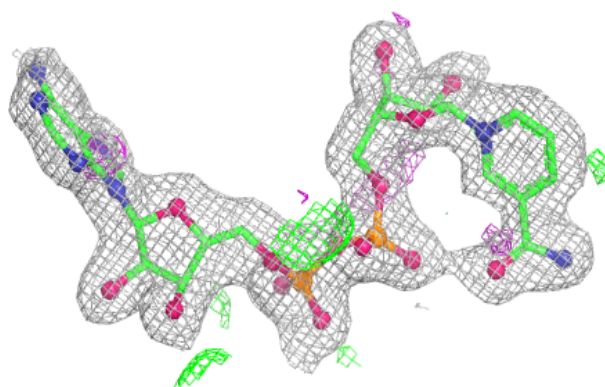
**Electron density around NAD H 401:**

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 mF_o-DF_c (at 3 rmsd) in purple (negative)
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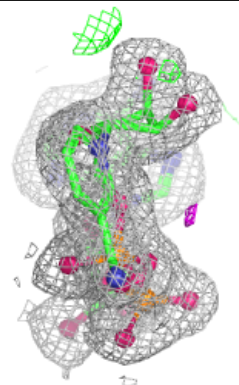
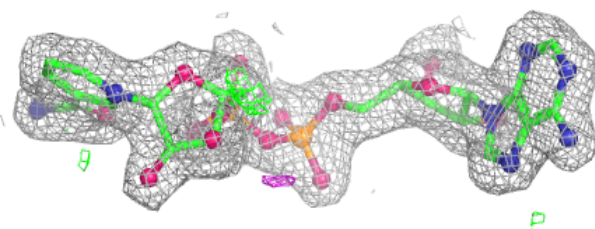
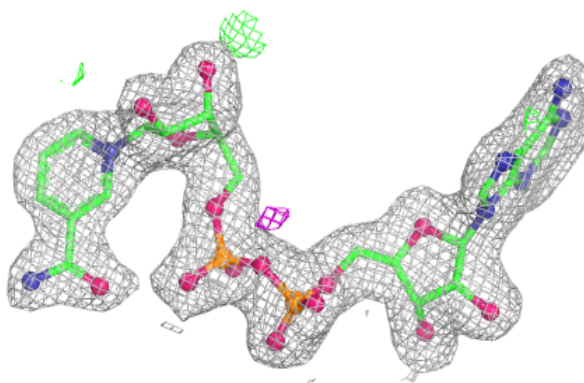


Electron density around NAD A 401:

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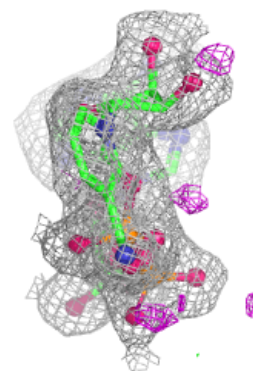
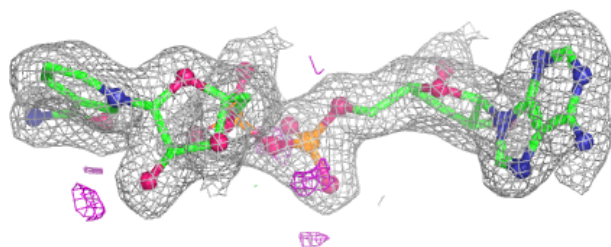
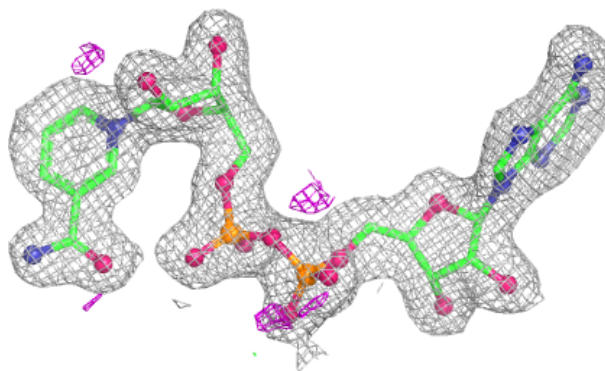
**Electron density around NAD E 401:**

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 mF_o-DF_c (at 3 rmsd) in purple (negative)
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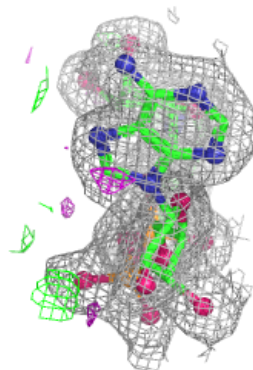
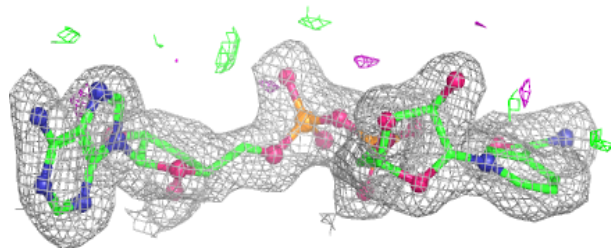
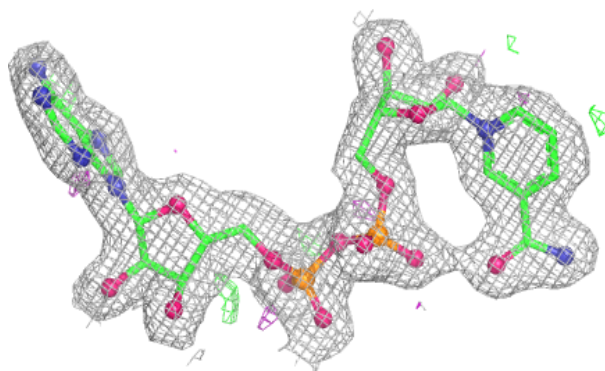


Electron density around NAD B 401:

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

**Electron density around NAD 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)



6.5 Other polymers [i](#)

There are no such residues in this entry.