



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 02:18 AM UTC

PDB ID : 5IXY / pdb_00005ixy
Title : Lactate Dehydrogenase in complex with hydroxylactam inhibitor compound
31: (2 {S})-5-(2-chlorophenyl)sulfanyl-2-(4-morpholin-4-ylphenyl)-4-oxidanyl
-2-thiophen-3-yl-1,3-dihydropyridin-6-one
Authors : Chen, Z.; Eigenbrot, C.
Deposited on : 2016-03-23
Resolution : 3.00 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	:	4-5-2 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

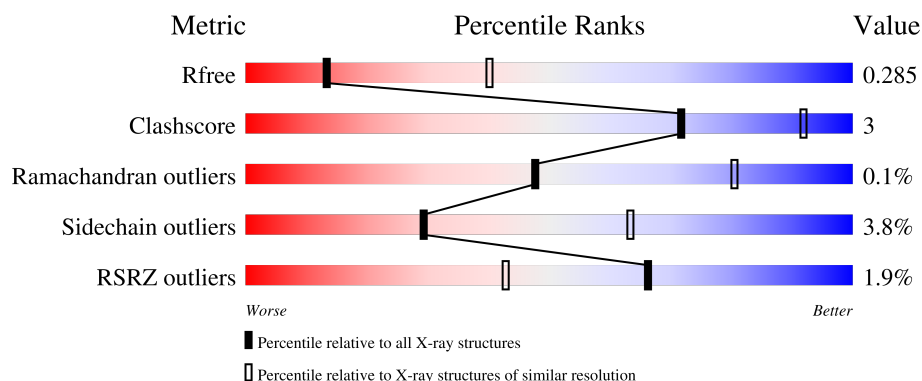
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.00 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}	180053	2672 (3.00-3.00)
Clashscore	190562	2977 (3.00-3.00)
Ramachandran outliers	187476	2877 (3.00-3.00)
Sidechain outliers	187428	2880 (3.00-3.00)
RSRZ outliers	180081	2671 (3.00-3.00)

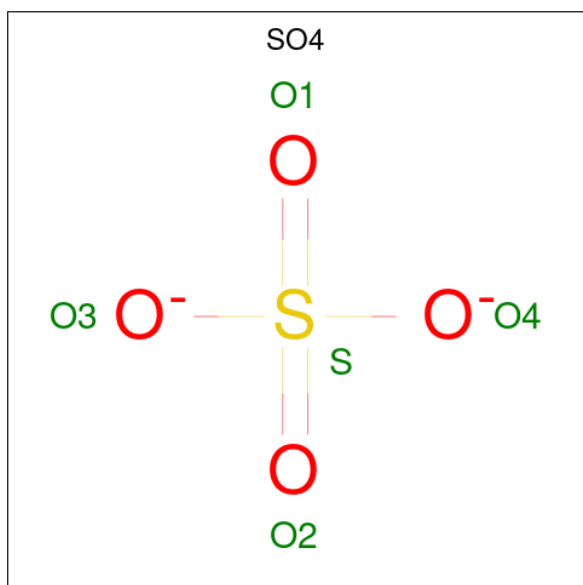
The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. 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	331	2% 90% 10%
1	B	331	% 87% 12% .
1	C	331	3% 83% 16%
1	D	331	2% 86% 12% ..

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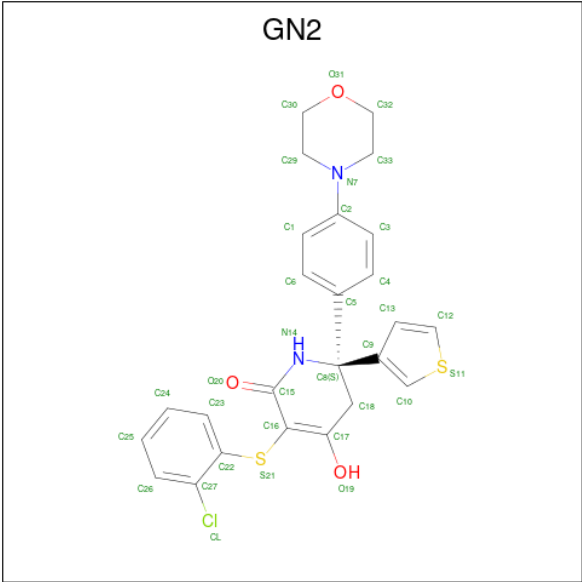
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	C	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	D	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	S	0	0
			5	4	1		
3	A	1	Total	O	S	0	0
			5	4	1		
3	B	1	Total	O	S	0	0
			5	4	1		
3	B	1	Total	O	S	0	0
			5	4	1		
3	C	1	Total	O	S	0	0
			5	4	1		
3	C	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is (2 {S})-5-(2-chlorophenyl)sulfanyl-2-(4-morpholin-4-ylphenyl)-4-oxidanyl-2-thiophen-3-yl-1,3-dihydropyridin-6-one (CCD ID: GN2) (formula: C₂₅H₂₃ClN₂O₃S₂).

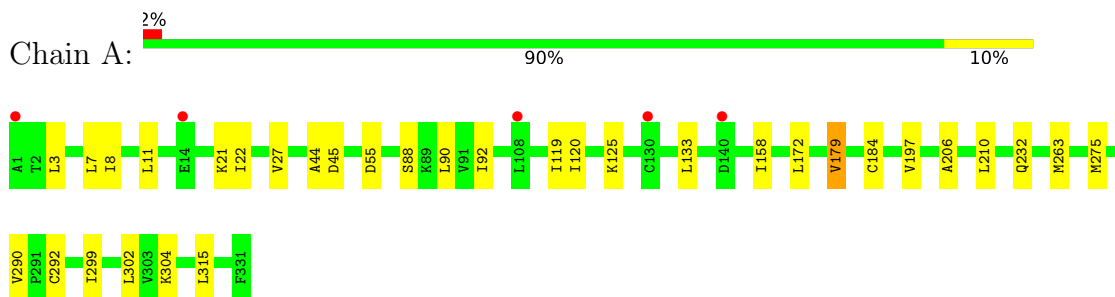


Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
4	A	1	Total	C	Cl	N	O	S	0	0
			33	25	1	2	3	2		
4	B	1	Total	C	Cl	N	O	S	0	0
			33	25	1	2	3	2		
4	C	1	Total	C	Cl	N	O	S	0	0
			33	25	1	2	3	2		
4	D	1	Total	C	Cl	N	O	S	0	0
			33	25	1	2	3	2		

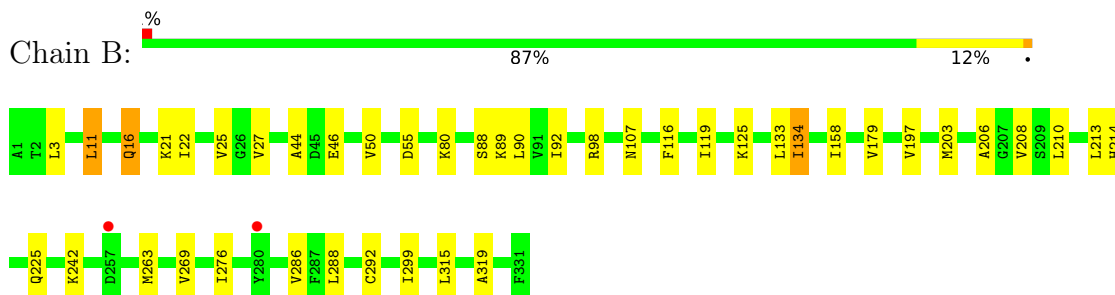
3 Residue-property plots

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

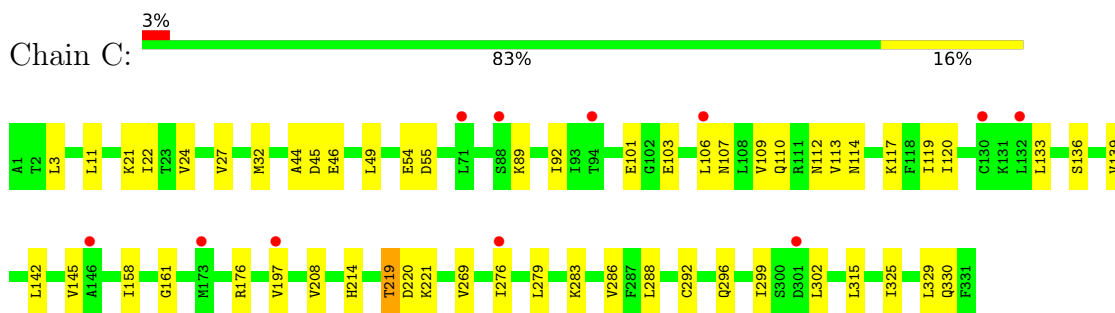
- Molecule 1: L-lactate dehydrogenase A chain



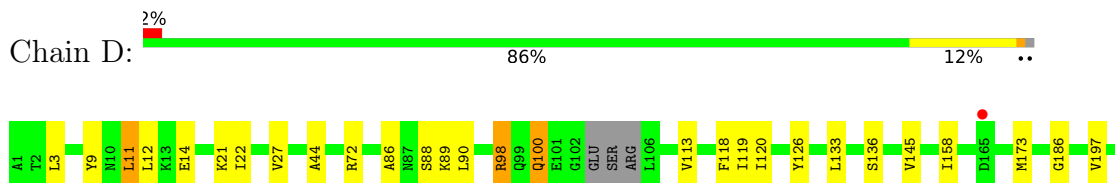
- Molecule 1: L-lactate dehydrogenase A chain

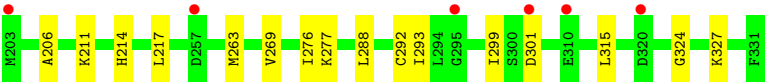


- Molecule 1: L-lactate dehydrogenase A chain



- Molecule 1: L-lactate dehydrogenase A chain





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	78.45Å 80.70Å 102.24Å 90.00° 97.90° 90.00°	Depositor
Resolution (Å)	33.10 – 3.00 33.10 – 3.00	Depositor EDS
% Data completeness (in resolution range)	88.5 (33.10-3.00) 88.4 (33.10-3.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.76 (at 3.00Å)	Xtriage
Refinement program	BUSTER 2.11.5	Depositor
R, R_{free}	0.236 , 0.279 0.244 , 0.285	Depositor DCC
R_{free} test set	506 reflections (2.24%)	wwPDB-VP
Wilson B-factor (Å ²)	49.1	Xtriage
Anisotropy	0.033	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 13.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.88	EDS
Total number of atoms	10593	wwPDB-VP
Average B, all atoms (Å ²)	55.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.15% 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: NAD, SO4, GN2

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	0.72	1/2612 (0.0%)	1.32	6/3532 (0.2%)
1	B	0.72	0/2612	1.33	3/3532 (0.1%)
1	C	0.73	1/2612 (0.0%)	1.33	4/3532 (0.1%)
1	D	0.72	1/2592 (0.0%)	1.33	4/3504 (0.1%)
All	All	0.72	3/10428 (0.0%)	1.33	17/14100 (0.1%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	120	ILE	CA-CB	5.63	1.56	1.54
1	C	120	ILE	CA-CB	5.55	1.56	1.54
1	A	120	ILE	CA-CB	5.01	1.56	1.54

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	119	ILE	CA-C-N	6.18	126.36	120.43
1	D	119	ILE	C-N-CA	6.18	126.36	120.43
1	A	119	ILE	CA-C-N	6.17	126.35	120.43
1	A	119	ILE	C-N-CA	6.17	126.35	120.43
1	C	119	ILE	CA-C-N	5.70	125.90	120.43
1	C	119	ILE	C-N-CA	5.70	125.90	120.43
1	D	118	PHE	CA-CB-CG	5.67	119.47	113.80
1	A	290	VAL	N-CA-C	-5.66	104.55	109.19
1	D	197	VAL	N-CA-C	5.59	113.08	107.55
1	B	119	ILE	CA-C-N	5.59	125.79	120.43
1	B	119	ILE	C-N-CA	5.59	125.79	120.43
1	B	197	VAL	N-CA-C	5.42	112.92	107.55
1	C	197	VAL	N-CA-C	5.35	112.84	107.55
1	A	55	ASP	CA-CB-CG	5.18	117.78	112.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	45	ASP	CA-CB-CG	5.16	117.76	112.60
1	A	45	ASP	CA-CB-CG	5.16	117.75	112.60
1	A	197	VAL	N-CA-C	5.01	112.97	107.60

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	2568	0	2656	18	0
1	B	2568	0	2656	22	0
1	C	2568	0	2656	23	0
1	D	2546	0	2635	22	0
2	A	44	0	26	0	0
2	B	44	0	26	0	0
2	C	44	0	26	0	0
2	D	44	0	26	0	0
3	A	10	0	0	0	0
3	B	15	0	0	0	0
3	C	10	0	0	0	0
4	A	33	0	0	0	0
4	B	33	0	0	0	0
4	C	33	0	0	0	0
4	D	33	0	0	0	0
All	All	10593	0	10707	71	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 3.

All (71) 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:179:VAL:CG1	1:A:184:CYS:SG	2.78	0.71
1:B:89:LYS:HB3	1:B:263:MET:HE1	1.75	0.69

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:11:LEU:HD11	1:C:302:LEU:HD23	1.83	0.59
1:A:179:VAL:HG12	1:A:184:CYS:SG	2.43	0.59
1:B:276:ILE:HG21	1:B:288:LEU:HD12	1.84	0.59
1:A:22:ILE:HD12	1:A:44:ALA:HB2	1.84	0.58
1:D:12:LEU:HD13	1:D:14:GLU:HG2	1.85	0.58
1:B:22:ILE:HD12	1:B:44:ALA:HB2	1.85	0.58
1:D:22:ILE:HD12	1:D:44:ALA:HB2	1.86	0.58
1:C:22:ILE:HD12	1:C:44:ALA:HB2	1.86	0.57
1:C:3:LEU:HD13	1:D:214:HIS:HB2	1.85	0.57
1:A:3:LEU:HD13	1:B:214:HIS:HB2	1.88	0.56
1:D:98:ARG:HG2	1:D:100:GLN:HG3	1.88	0.55
1:D:21:LYS:HB3	1:D:88:SER:HA	1.89	0.54
1:C:110:GLN:HE22	1:C:330:GLN:H	1.55	0.54
1:A:8:ILE:CG2	1:D:301:ASP:HB3	2.38	0.53
1:D:211:LYS:HG3	1:D:217:LEU:HB3	1.89	0.53
1:A:210:LEU:HD23	1:B:3:LEU:HD21	1.90	0.53
1:B:269:VAL:HG11	1:D:206:ALA:HB2	1.91	0.52
1:D:89:LYS:HB3	1:D:263:MET:HE1	1.92	0.52
1:A:7:LEU:HD22	1:B:210:LEU:HD21	1.91	0.51
1:A:21:LYS:HB3	1:A:88:SER:HA	1.94	0.51
1:B:27:VAL:HG12	1:B:27:VAL:O	2.12	0.50
1:A:27:VAL:HG12	1:A:27:VAL:O	2.11	0.50
1:B:179:VAL:HG22	1:D:293:ILE:HG12	1.93	0.50
1:D:27:VAL:O	1:D:27:VAL:HG12	2.12	0.49
1:C:32:MET:HE1	1:C:49:LEU:HD22	1.95	0.49
1:A:302:LEU:HD23	1:D:11:LEU:HD11	1.95	0.48
1:C:114:ASN:HA	1:C:117:LYS:HE3	1.96	0.47
1:C:219:THR:HG23	1:C:221:LYS:H	1.79	0.47
1:B:25:VAL:HG13	1:B:50:VAL:HG23	1.95	0.47
1:B:292:CYS:HB3	1:B:299:ILE:HG23	1.97	0.47
1:C:106:LEU:HD12	1:C:325:ILE:HG23	1.98	0.46
1:C:214:HIS:HB2	1:D:3:LEU:HD13	1.98	0.46
1:C:24:VAL:HB	1:C:49:LEU:HD23	1.98	0.45
1:C:292:CYS:HB3	1:C:299:ILE:HG23	1.99	0.45
1:A:172:LEU:HD13	1:A:232:GLN:HB3	1.98	0.45
1:B:116:PHE:CZ	1:B:134:ILE:HD13	2.52	0.45
1:B:286:VAL:HG11	1:B:319:ALA:HA	1.99	0.44
1:C:27:VAL:HA	1:C:32:MET:HE3	2.00	0.44
1:D:292:CYS:HB3	1:D:299:ILE:HG23	1.98	0.44
1:A:292:CYS:HB3	1:A:299:ILE:HG23	1.99	0.44
1:A:304:LYS:HD2	1:D:9:TYR:HB2	1.99	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:16:GLN:HB2	1:C:296:GLN:NE2	2.33	0.43
1:B:116:PHE:HZ	1:B:134:ILE:HD13	1.83	0.43
1:C:139:VAL:HG21	1:C:161:GLY:H	1.83	0.43
1:B:21:LYS:HB3	1:B:88:SER:HA	2.00	0.43
1:C:112:ASN:HD22	1:C:142:LEU:HD11	1.84	0.43
1:B:206:ALA:HB2	1:D:269:VAL:HG11	2.01	0.42
1:C:109:VAL:O	1:C:113:VAL:HG23	2.18	0.42
1:A:206:ALA:HB2	1:C:269:VAL:HG11	2.02	0.42
1:C:276:ILE:HG21	1:C:288:LEU:HD12	2.01	0.42
1:D:90:LEU:HB2	1:D:263:MET:HE3	2.01	0.42
1:B:90:LEU:HB2	1:B:263:MET:HE3	2.02	0.42
1:C:27:VAL:O	1:C:27:VAL:HG12	2.20	0.42
1:A:92:ILE:HG12	1:A:133:LEU:HD23	2.02	0.41
1:C:92:ILE:HG12	1:C:133:LEU:HD23	2.02	0.41
1:D:276:ILE:HG13	1:D:288:LEU:HB2	2.00	0.41
1:D:113:VAL:HG22	1:D:145:VAL:HG21	2.02	0.41
1:B:92:ILE:HG12	1:B:133:LEU:HD23	2.03	0.41
1:C:113:VAL:HG22	1:C:145:VAL:HG21	2.01	0.41
1:D:324:GLY:HA2	1:D:327:LYS:HE3	2.02	0.41
1:A:90:LEU:HB2	1:A:263:MET:HE3	2.02	0.41
1:A:27:VAL:O	1:A:27:VAL:CG1	2.69	0.41
1:A:179:VAL:HG13	1:A:184:CYS:SG	2.57	0.41
1:D:86:ALA:HA	1:D:126:TYR:HB3	2.03	0.41
1:B:203:MET:HE2	1:B:210:LEU:HD12	2.03	0.40
1:D:173:MET:HE1	1:D:186:GLY:HA3	2.03	0.40
1:B:21:LYS:HG3	1:B:46:GLU:HB3	2.03	0.40
1:C:21:LYS:HG3	1:C:46:GLU:HB3	2.03	0.40
1:C:103:GLU:HG3	1:C:107:ASN:HD22	1.86	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	329/331 (99%)	318 (97%)	11 (3%)	0	100	100
1	B	329/331 (99%)	317 (96%)	12 (4%)	0	100	100
1	C	329/331 (99%)	317 (96%)	12 (4%)	0	100	100
1	D	325/331 (98%)	313 (96%)	11 (3%)	1 (0%)	36	70
All	All	1312/1324 (99%)	1265 (96%)	46 (4%)	1 (0%)	48	80

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	277	LYS

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	287/287 (100%)	281 (98%)	6 (2%)	47	75
1	B	287/287 (100%)	273 (95%)	14 (5%)	22	56
1	C	287/287 (100%)	271 (94%)	16 (6%)	19	52
1	D	285/287 (99%)	277 (97%)	8 (3%)	38	70
All	All	1146/1148 (100%)	1102 (96%)	44 (4%)	29	63

All (44) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	11	LEU
1	A	125	LYS
1	A	158	ILE
1	A	179	VAL
1	A	275	MET
1	A	315	LEU
1	B	11	LEU
1	B	16	GLN
1	B	55	ASP
1	B	80	LYS

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Mol	Chain	Res	Type
1	B	98	ARG
1	B	107	ASN
1	B	125	LYS
1	B	134	ILE
1	B	158	ILE
1	B	208	VAL
1	B	213	LEU
1	B	225	GLN
1	B	242	LYS
1	B	315	LEU
1	C	11	LEU
1	C	54	GLU
1	C	55	ASP
1	C	89	LYS
1	C	101	GLU
1	C	136	SER
1	C	158	ILE
1	C	176	ARG
1	C	208	VAL
1	C	219	THR
1	C	220	ASP
1	C	279	LEU
1	C	283	LYS
1	C	286	VAL
1	C	315	LEU
1	C	329	LEU
1	D	11	LEU
1	D	72	ARG
1	D	98	ARG
1	D	100	GLN
1	D	133	LEU
1	D	136	SER
1	D	158	ILE
1	D	315	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	19	GLN
1	A	296	GLN
1	B	107	ASN
1	B	114	ASN

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Mol	Chain	Res	Type
1	B	232	GLN
1	B	296	GLN
1	B	297	ASN
1	C	16	GLN
1	C	107	ASN
1	C	110	GLN
1	C	114	ASN
1	C	225	GLN
1	C	326	GLN
1	D	87	ASN
1	D	296	GLN
1	D	326	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

15 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	GN2	A	404	-	36,37,37	0.94	2 (5%)	41,53,53	1.72	4 (9%)
3	SO4	A	402	-	4,4,4	0.25	0	6,6,6	0.12	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	SO4	B	403	-	4,4,4	0.33	0	6,6,6	0.15	0
3	SO4	C	402	-	4,4,4	0.25	0	6,6,6	0.11	0
3	SO4	B	404	-	4,4,4	0.18	0	6,6,6	0.17	0
3	SO4	B	402	-	4,4,4	0.29	0	6,6,6	0.04	0
2	NAD	A	401	-	46,48,48	1.20	4 (8%)	64,73,73	1.14	4 (6%)
4	GN2	D	402	-	36,37,37	0.93	3 (8%)	41,53,53	1.83	4 (9%)
2	NAD	D	401	-	46,48,48	1.11	4 (8%)	64,73,73	1.14	3 (4%)
4	GN2	C	404	-	36,37,37	0.93	2 (5%)	41,53,53	1.76	4 (9%)
2	NAD	C	401	-	46,48,48	1.11	4 (8%)	64,73,73	1.26	5 (7%)
3	SO4	A	403	-	4,4,4	0.24	0	6,6,6	0.10	0
2	NAD	B	401	-	46,48,48	1.17	4 (8%)	64,73,73	1.16	4 (6%)
4	GN2	B	405	-	36,37,37	0.96	3 (8%)	41,53,53	1.86	5 (12%)
3	SO4	C	403	-	4,4,4	0.22	0	6,6,6	0.14	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	GN2	A	404	-	-	0/14/46/46	0/5/5/5
2	NAD	A	401	-	-	7/30/62/62	0/5/5/5
4	GN2	D	402	-	-	2/14/46/46	0/5/5/5
2	NAD	D	401	-	-	7/30/62/62	0/5/5/5
4	GN2	C	404	-	-	1/14/46/46	0/5/5/5
2	NAD	C	401	-	-	7/30/62/62	0/5/5/5
2	NAD	B	401	-	-	7/30/62/62	0/5/5/5
4	GN2	B	405	-	-	1/14/46/46	0/5/5/5

All (26) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	NAD	PN-O3	4.31	1.64	1.59
2	B	401	NAD	PN-O3	4.23	1.64	1.59
2	D	401	NAD	PN-O3	3.90	1.63	1.59
2	A	401	NAD	PA-O3	3.85	1.63	1.59
2	C	401	NAD	PN-O3	3.81	1.63	1.59
2	B	401	NAD	PA-O3	3.58	1.63	1.59
2	C	401	NAD	PA-O3	3.12	1.62	1.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	401	NAD	PA-O3	3.08	1.62	1.59
4	B	405	GN2	O19-C17	-2.89	1.24	1.32
2	C	401	NAD	C7N-N7N	2.74	1.38	1.33
4	A	404	GN2	O19-C17	-2.69	1.25	1.32
4	D	402	GN2	O19-C17	-2.68	1.25	1.32
2	A	401	NAD	C7N-N7N	2.65	1.37	1.33
2	B	401	NAD	C7N-N7N	2.62	1.37	1.33
4	C	404	GN2	O19-C17	-2.61	1.25	1.32
2	B	401	NAD	C6A-N6A	2.61	1.40	1.34
4	A	404	GN2	C16-S21	-2.60	1.72	1.76
2	D	401	NAD	C7N-N7N	2.57	1.37	1.33
2	A	401	NAD	C6A-N6A	2.36	1.40	1.34
2	C	401	NAD	C6A-N6A	2.33	1.40	1.34
2	D	401	NAD	C6A-N6A	2.30	1.40	1.34
4	C	404	GN2	C8-C5	-2.29	1.51	1.53
4	B	405	GN2	C8-C5	-2.19	1.51	1.53
4	D	402	GN2	C16-S21	-2.19	1.72	1.76
4	B	405	GN2	C16-S21	-2.10	1.73	1.76
4	D	402	GN2	C8-C5	-2.05	1.51	1.53

All (33) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	402	GN2	C8-N14-C15	8.91	123.96	117.33
4	B	405	GN2	C8-N14-C15	8.88	123.94	117.33
4	C	404	GN2	C8-N14-C15	8.34	123.54	117.33
4	A	404	GN2	C8-N14-C15	7.96	123.26	117.33
2	C	401	NAD	C4D-O4D-C1D	-5.18	105.18	109.92
2	B	401	NAD	C4D-O4D-C1D	-4.66	105.66	109.92
2	D	401	NAD	C4D-O4D-C1D	-4.64	105.67	109.92
4	D	402	GN2	O19-C17-C16	4.58	131.64	122.15
2	A	401	NAD	C4D-O4D-C1D	-4.49	105.82	109.92
4	C	404	GN2	O19-C17-C16	4.08	130.61	122.15
4	A	404	GN2	O19-C17-C16	3.99	130.43	122.15
4	B	405	GN2	O19-C17-C16	3.83	130.08	122.15
4	A	404	GN2	C33-N7-C29	3.68	119.86	111.57
4	B	405	GN2	C33-N7-C29	3.54	119.53	111.57
4	C	404	GN2	C33-N7-C29	3.13	118.60	111.57
4	D	402	GN2	C33-N7-C29	2.86	118.00	111.57
4	D	402	GN2	O19-C17-C18	-2.50	108.47	114.24
2	D	401	NAD	C3N-C7N-N7N	-2.39	114.80	117.74
2	B	401	NAD	C3N-C7N-N7N	-2.38	114.81	117.74

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	401	NAD	C3N-C7N-N7N	-2.36	114.83	117.74
2	A	401	NAD	C3N-C7N-N7N	-2.35	114.85	117.74
2	C	401	NAD	O2N-PN-O3	2.30	113.49	107.27
2	C	401	NAD	O3-PN-O1N	-2.29	103.83	110.70
4	B	405	GN2	O19-C17-C18	-2.28	108.96	114.24
4	C	404	GN2	O19-C17-C18	-2.25	109.03	114.24
4	B	405	GN2	C4-C5-C8	2.13	124.20	120.88
2	B	401	NAD	O4B-C1B-N9A	2.09	112.11	108.09
2	B	401	NAD	O2A-PA-O1A	2.07	122.06	112.44
4	A	404	GN2	O19-C17-C18	-2.06	109.47	114.24
2	A	401	NAD	C4A-N9A-C8A	2.03	107.87	105.74
2	A	401	NAD	O4B-C1B-N9A	2.01	111.95	108.09
2	C	401	NAD	O4B-C1B-N9A	2.01	111.95	108.09
2	D	401	NAD	O2A-PA-O1A	2.00	121.75	112.44

There are no chirality outliers.

All (32) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401	NAD	C5B-O5B-PA-O2A
2	A	401	NAD	C5B-O5B-PA-O3
2	A	401	NAD	O4D-C1D-N1N-C6N
2	B	401	NAD	C5B-O5B-PA-O2A
2	B	401	NAD	C5B-O5B-PA-O3
2	B	401	NAD	O4D-C1D-N1N-C6N
2	C	401	NAD	C5B-O5B-PA-O2A
2	C	401	NAD	C5B-O5B-PA-O3
2	C	401	NAD	O4D-C1D-N1N-C6N
2	D	401	NAD	C5B-O5B-PA-O2A
2	D	401	NAD	C5B-O5B-PA-O3
2	D	401	NAD	O4D-C1D-N1N-C6N
2	A	401	NAD	PN-O3-PA-O5B
2	B	401	NAD	PN-O3-PA-O5B
2	C	401	NAD	PN-O3-PA-O5B
2	D	401	NAD	PN-O3-PA-O5B
4	B	405	GN2	C4-C5-C8-C9
4	C	404	GN2	C4-C5-C8-C9
4	D	402	GN2	C4-C5-C8-C9
2	A	401	NAD	C5B-O5B-PA-O1A
2	B	401	NAD	C5B-O5B-PA-O1A
2	C	401	NAD	C5B-O5B-PA-O1A
2	D	401	NAD	C5B-O5B-PA-O1A

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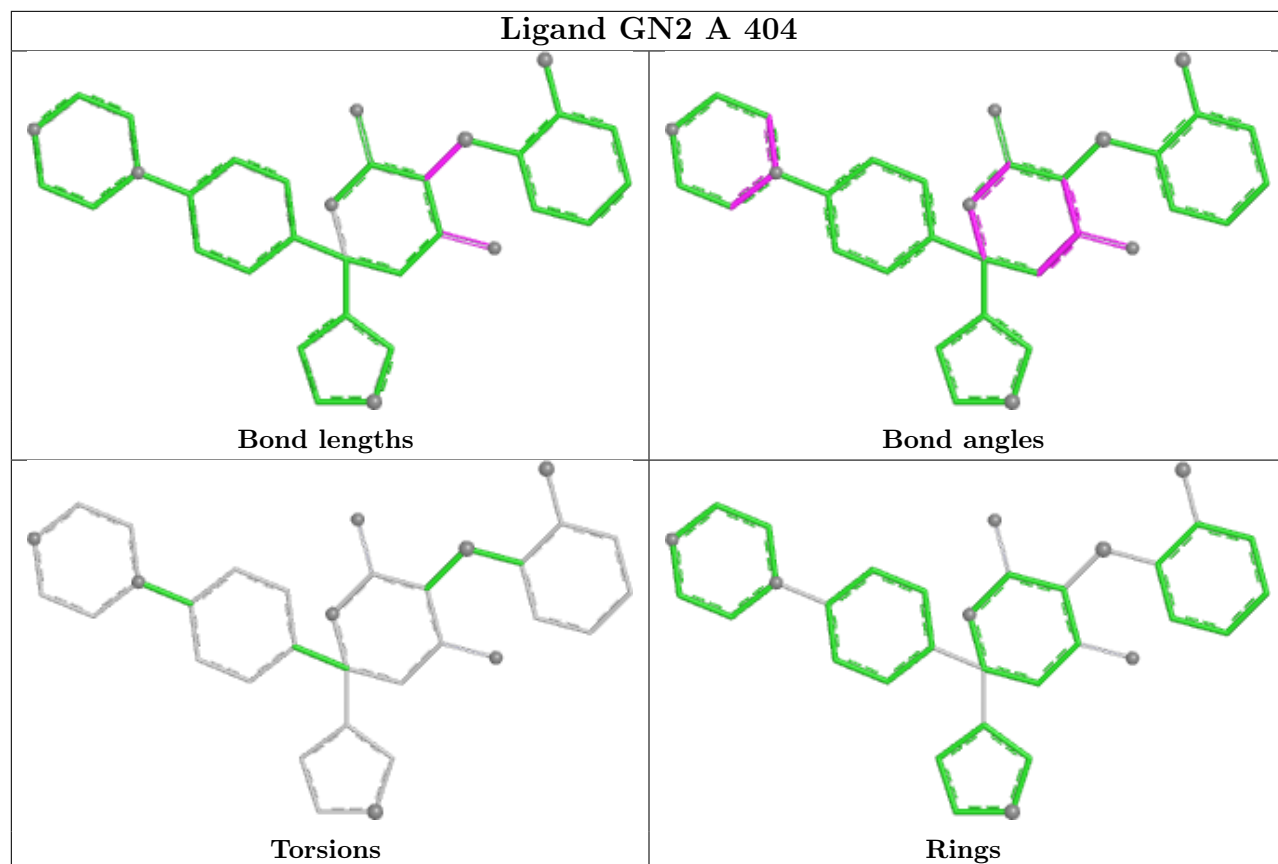
Mol	Chain	Res	Type	Atoms
2	B	401	NAD	O4B-C4B-C5B-O5B
2	A	401	NAD	O4B-C4B-C5B-O5B
2	C	401	NAD	O4B-C4B-C5B-O5B
2	D	401	NAD	O4B-C4B-C5B-O5B
2	A	401	NAD	O4D-C1D-N1N-C2N
2	B	401	NAD	O4D-C1D-N1N-C2N
2	C	401	NAD	O4D-C1D-N1N-C2N
2	D	401	NAD	O4D-C1D-N1N-C2N
4	D	402	GN2	C6-C5-C8-C9

There are no ring outliers.

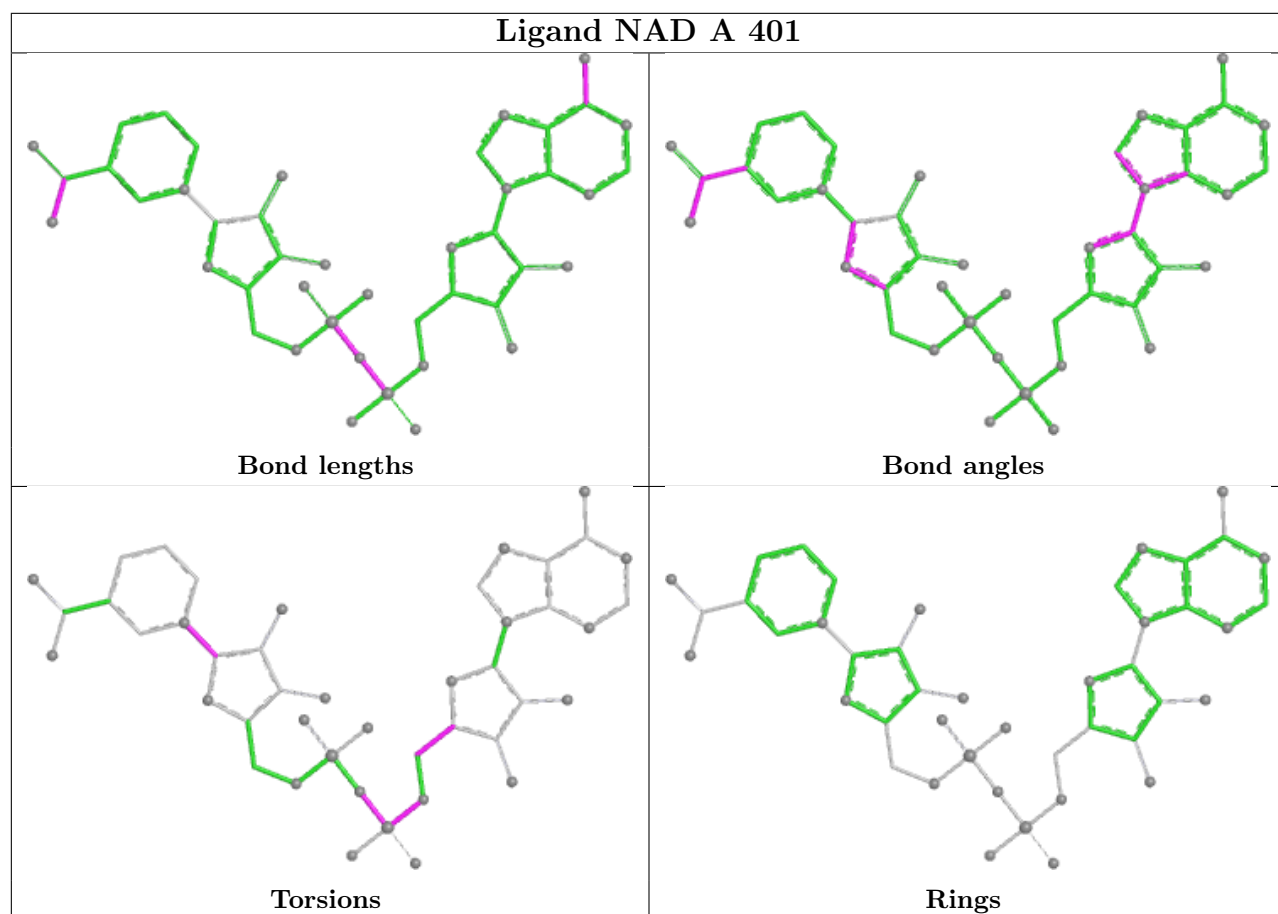
No monomer is involved in short contacts.

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.

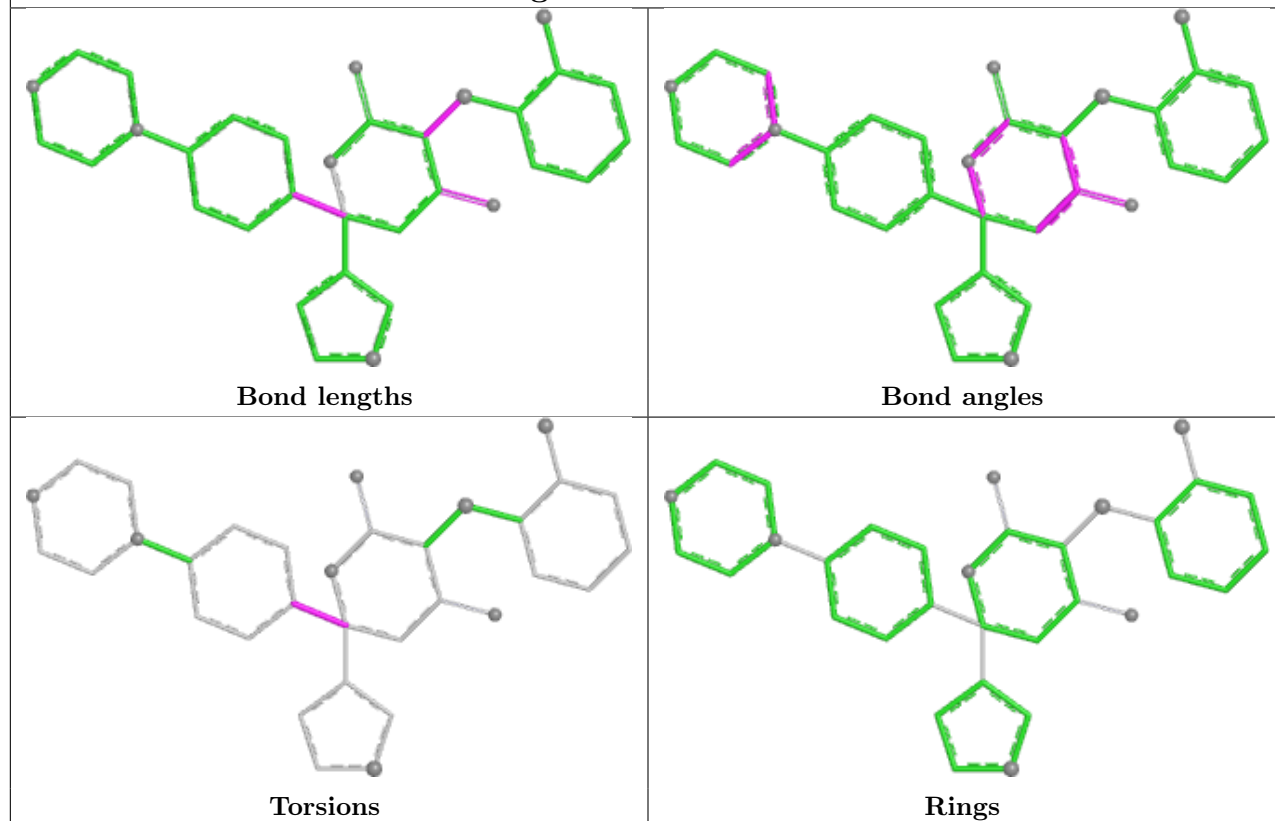
Ligand GN2 A 404



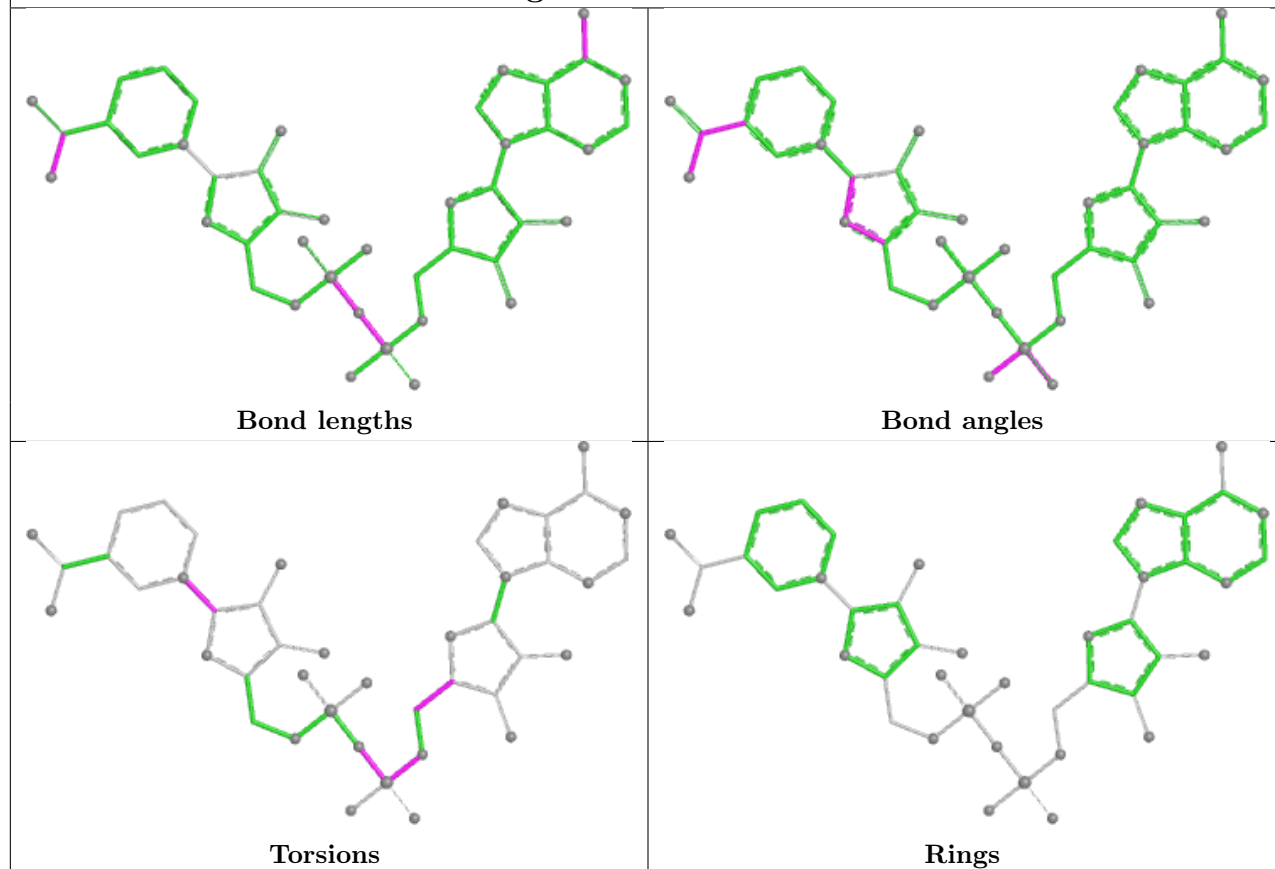
Ligand NAD A 401



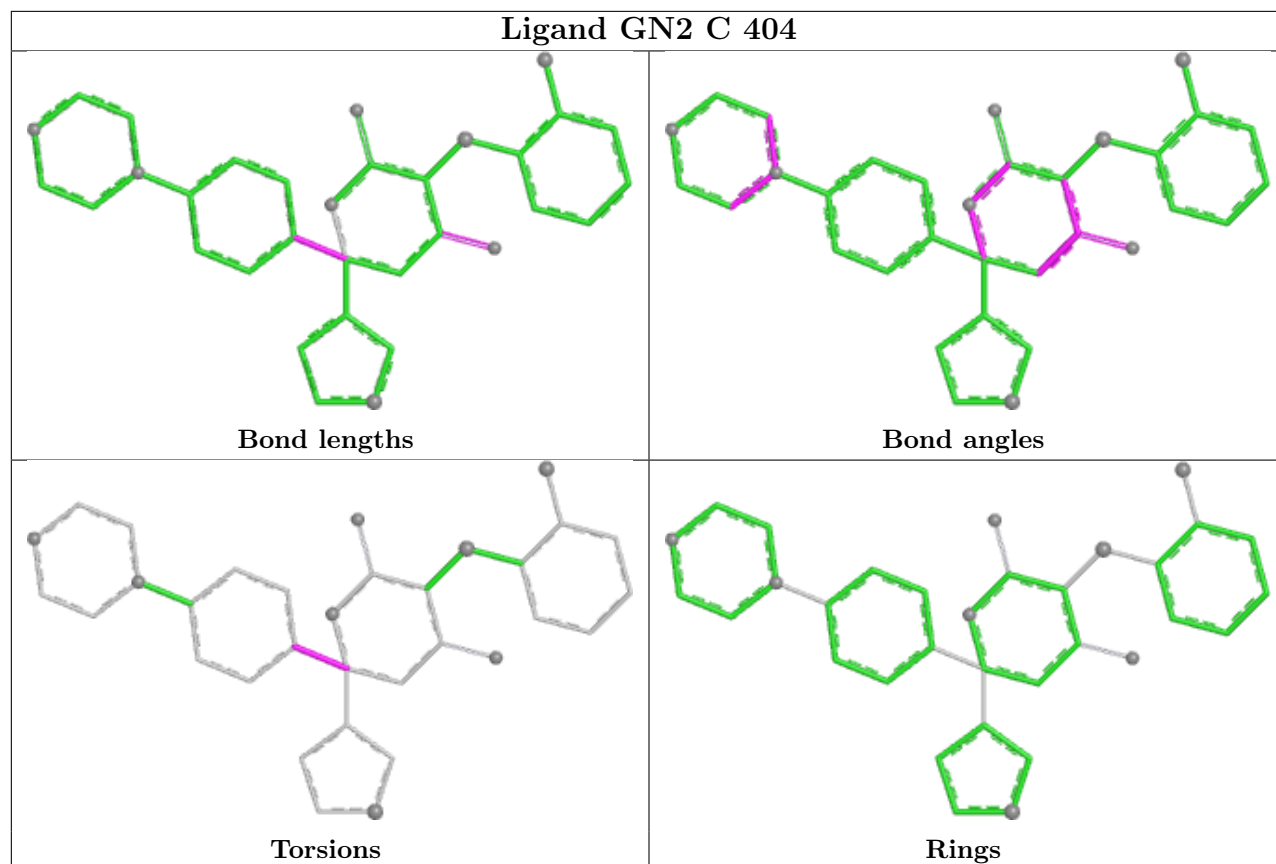
Ligand GN2 D 402



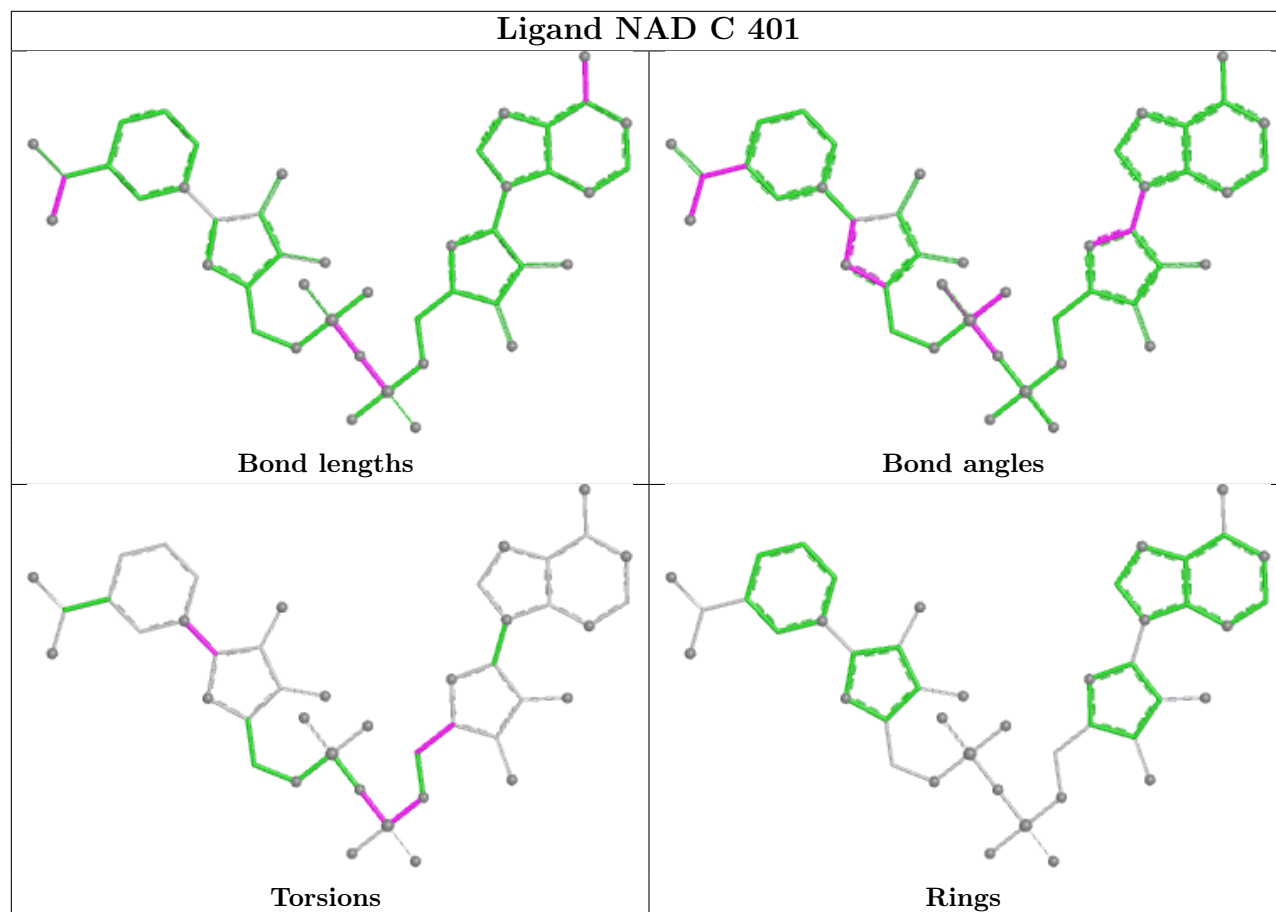
Ligand NAD D 401

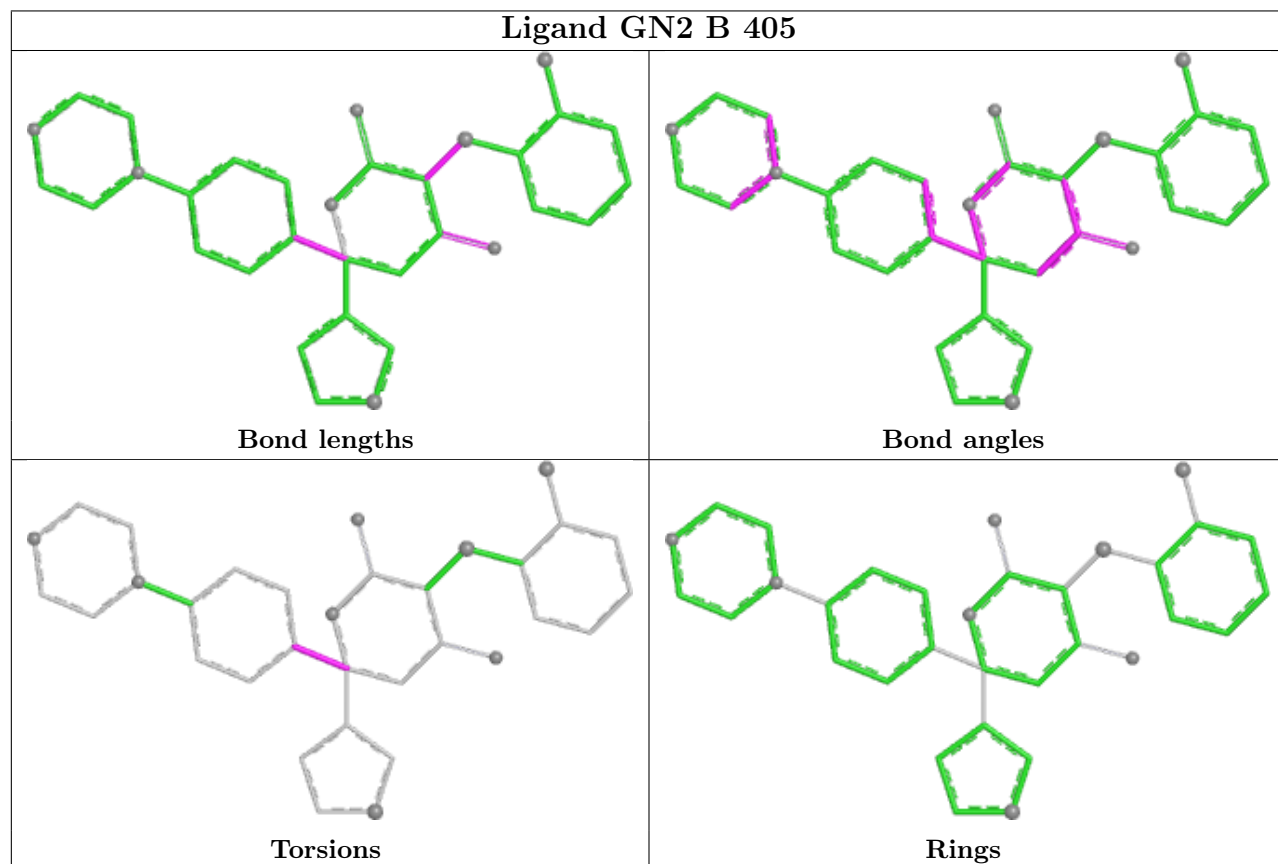
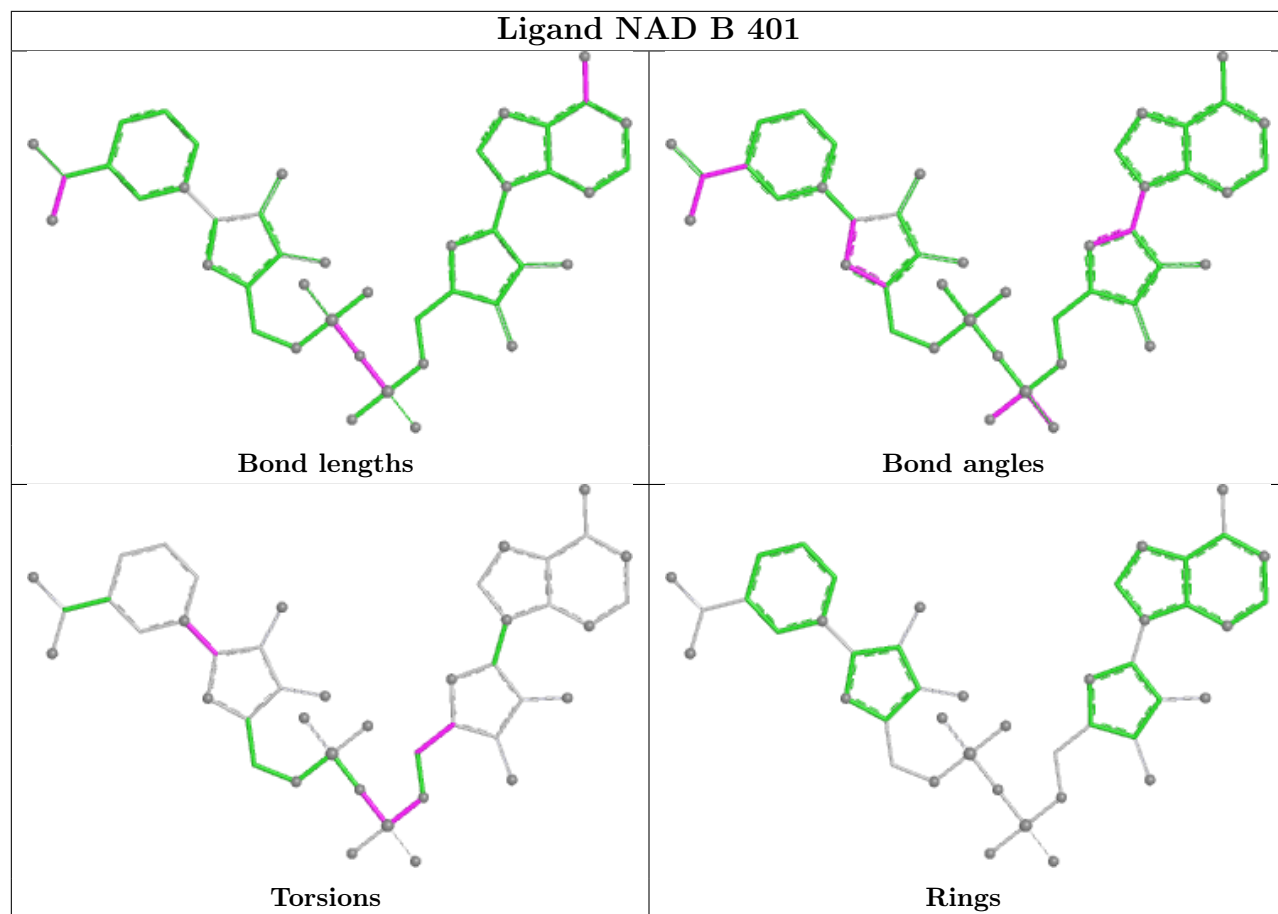


Ligand GN2 C 404



Ligand NAD C 401





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	331/331 (100%)	0.30	5 (1%) 72 49	34, 53, 79, 100	0
1	B	331/331 (100%)	0.27	2 (0%) 85 69	34, 51, 78, 103	1 (0%)
1	C	331/331 (100%)	0.33	11 (3%) 49 28	34, 52, 80, 92	2 (0%)
1	D	328/331 (99%)	0.36	7 (2%) 63 40	28, 48, 80, 107	2 (0%)
All	All	1321/1324 (99%)	0.31	25 (1%) 66 43	28, 51, 79, 107	5 (0%)

All (25) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	130	CYS	3.7
1	D	320	ASP	3.4
1	A	108	LEU	3.1
1	C	301	ASP	3.0
1	C	146	ALA	2.9
1	C	132	LEU	2.7
1	A	140	ASP	2.5
1	D	165	ASP	2.5
1	D	301	ASP	2.5
1	B	280	TYR	2.4
1	C	197	VAL	2.4
1	C	88	SER	2.4
1	C	106	LEU	2.3
1	C	276	ILE	2.3
1	D	257	ASP	2.2
1	C	173	MET	2.2
1	B	257	ASP	2.2
1	C	71	LEU	2.1
1	A	1	ALA	2.1
1	D	295	GLY	2.1
1	D	203	MET	2.0

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Mol	Chain	Res	Type	RSRZ
1	C	94	THR	2.0
1	A	14	GLU	2.0
1	A	130	CYS	2.0
1	D	310	GLU	2.0

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

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

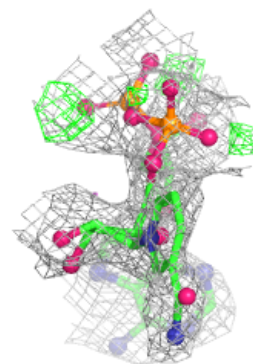
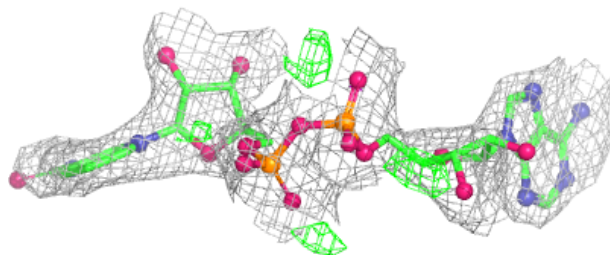
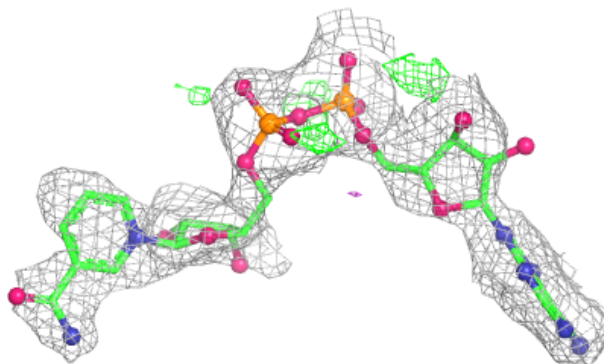
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	SO4	C	403	5/5	0.72	0.22	113,113,113,113	0
3	SO4	C	402	5/5	0.73	0.12	103,103,103,103	0
3	SO4	A	402	5/5	0.76	0.20	104,104,105,105	0
3	SO4	B	402	5/5	0.81	0.19	44,45,45,45	5
3	SO4	B	403	5/5	0.82	0.16	85,85,86,87	0
3	SO4	B	404	5/5	0.86	0.12	86,86,86,86	0
3	SO4	A	403	5/5	0.87	0.09	78,78,79,79	5
2	NAD	C	401	44/44	0.89	0.11	34,44,52,52	0
4	GN2	A	404	33/33	0.90	0.11	54,56,58,60	0
4	GN2	B	405	33/33	0.90	0.12	51,53,57,59	0
2	NAD	B	401	44/44	0.91	0.11	41,46,56,59	0
2	NAD	A	401	44/44	0.91	0.10	44,52,68,68	0
2	NAD	D	401	44/44	0.91	0.10	40,46,51,52	0
4	GN2	C	404	33/33	0.91	0.11	53,58,70,71	0
4	GN2	D	402	33/33	0.93	0.10	50,55,62,64	0

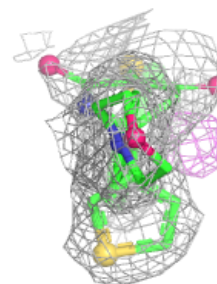
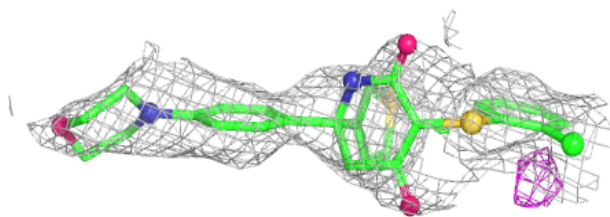
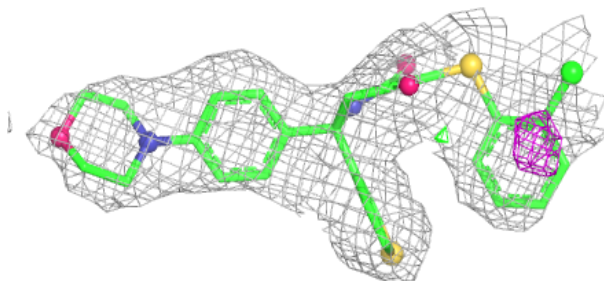
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around 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)

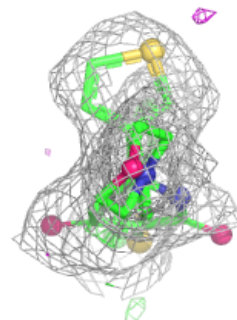
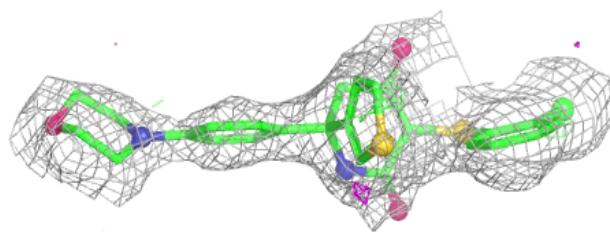
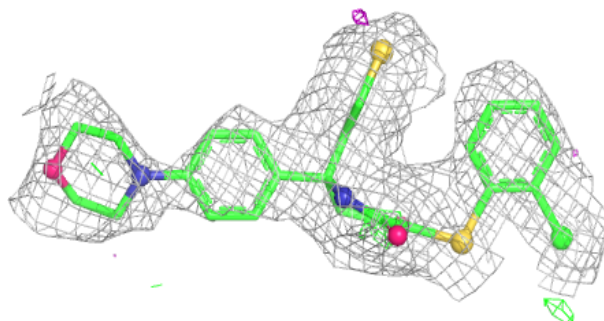
**Electron density around GN2 A 404:**

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

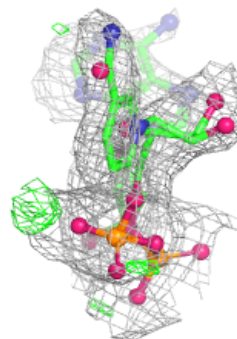
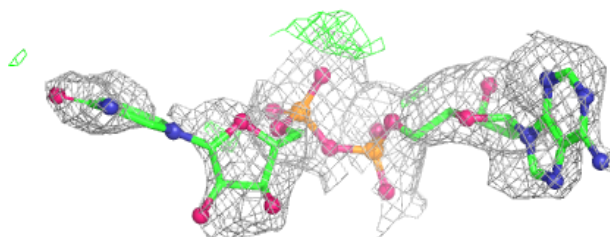
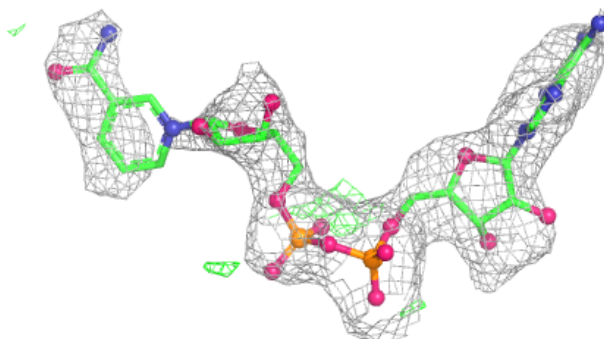


Electron density around GN2 B 405:

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

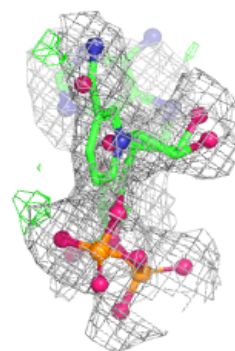
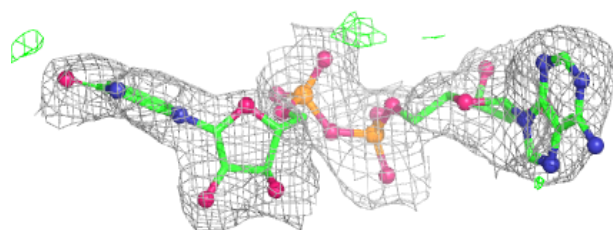
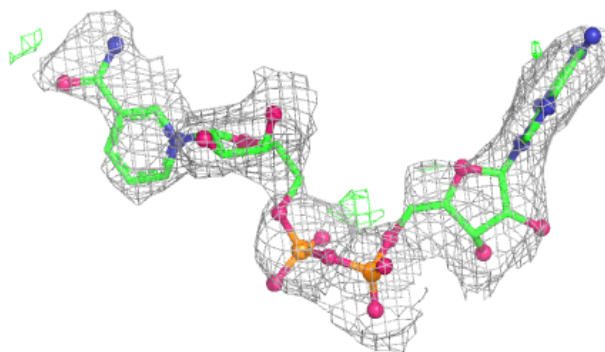
**Electron density around NAD B 401:**

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

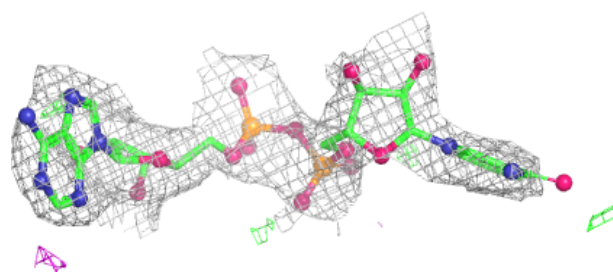
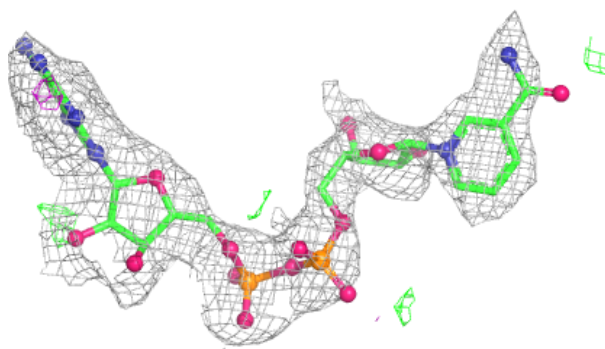


Electron density around NAD A 401:

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

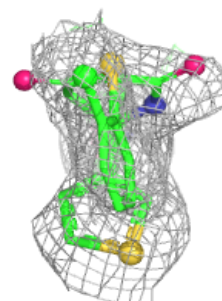
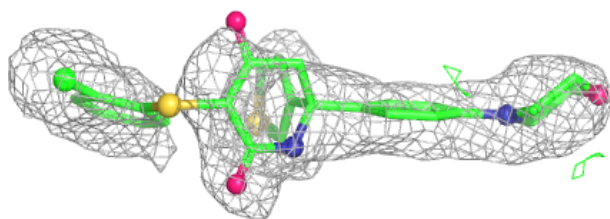
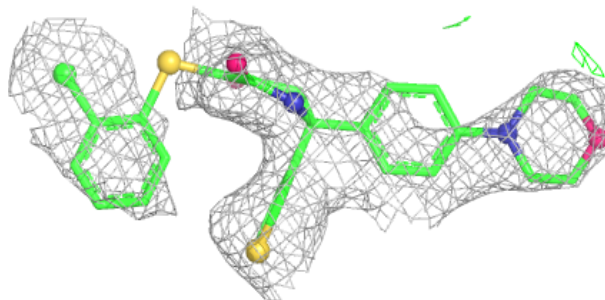
**Electron density around NAD D 401:**

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

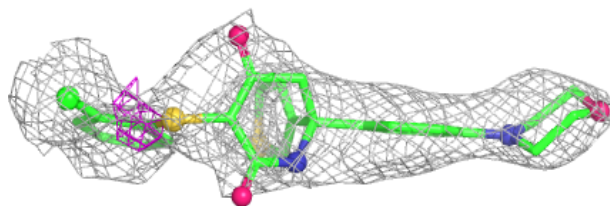
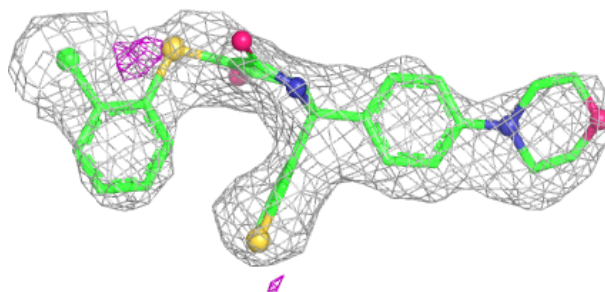


Electron density around GN2 C 404:

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

**Electron density around GN2 D 402:**

$2mF_o-DF_c$ (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.