



Full wwPDB X-ray Structure Validation Report ⓘ

Jul 13, 2026 – 01:58 pm BST

PDB ID : 9HYK / pdb_00009hyk
Title : Crystal structure of Trypanosoma brucei trypanothione reductase (TbTR)
bound to PROTAC-1
Authors : Exertier, C.; Ilari, C.; Fiorillo, A.
Deposited on : 2025-01-10
Resolution : 2.09 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	:	1.8.4, CSD as541be (2020)
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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

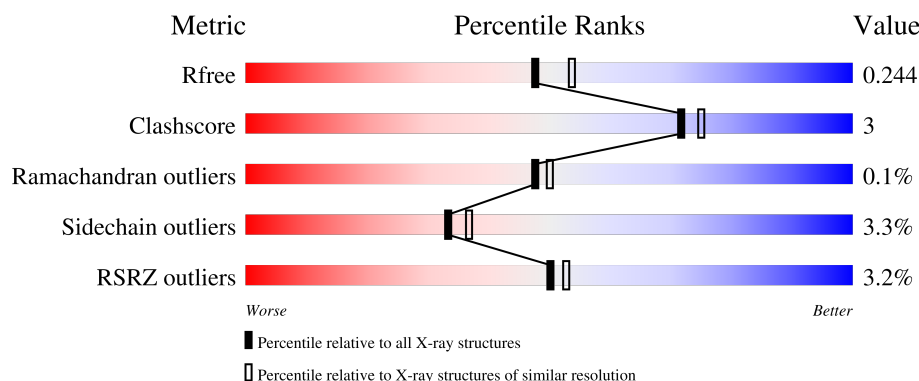
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.09 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	6658 (2.10-2.10)
Clashscore	190562	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)
RSRZ outliers	180081	6662 (2.10-2.10)

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	495	87% 11% ..
1	B	495	88% 10% ..
1	C	495	88% 10% .
1	D	495	89% 9% ..

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 15884 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.

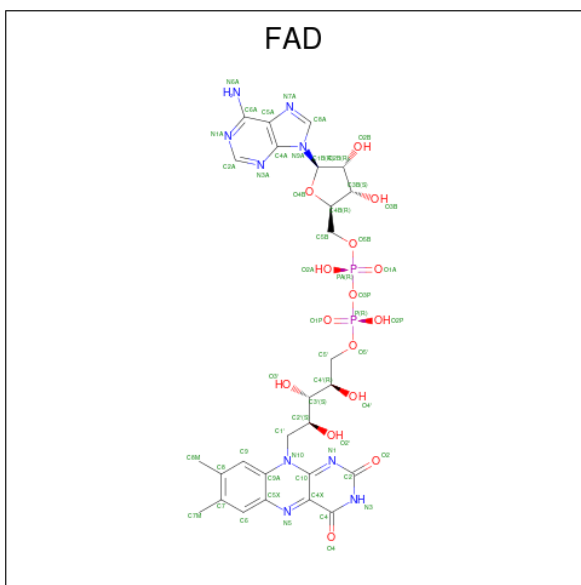
- Molecule 1 is a protein called Trypanothione reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	489	Total	C	N	O	S	0	9	0
			3765	2401	641	702	21			
1	B	488	Total	C	N	O	S	0	4	0
			3729	2373	632	705	19			
1	C	490	Total	C	N	O	S	0	3	0
			3744	2381	639	704	20			
1	D	490	Total	C	N	O	S	0	2	0
			3730	2372	634	704	20			

There are 12 discrepancies between the modelled and reference sequences:

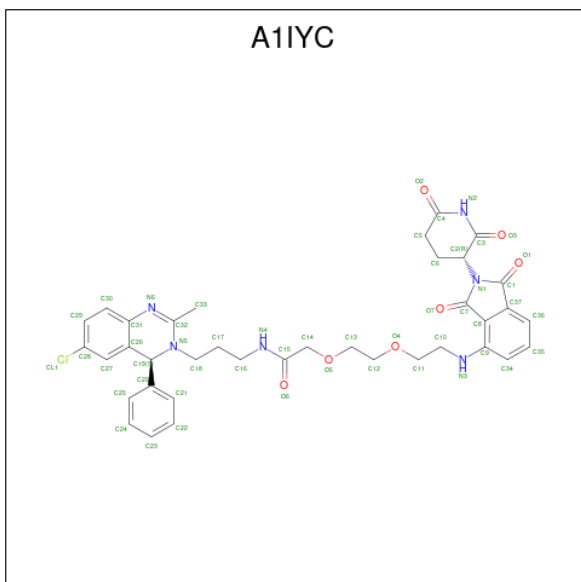
Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	expression tag	UNP Q389T8
A	-1	SER	-	expression tag	UNP Q389T8
A	0	HIS	-	expression tag	UNP Q389T8
B	-2	GLY	-	expression tag	UNP Q389T8
B	-1	SER	-	expression tag	UNP Q389T8
B	0	HIS	-	expression tag	UNP Q389T8
C	-2	GLY	-	expression tag	UNP Q389T8
C	-1	SER	-	expression tag	UNP Q389T8
C	0	HIS	-	expression tag	UNP Q389T8
D	-2	GLY	-	expression tag	UNP Q389T8
D	-1	SER	-	expression tag	UNP Q389T8
D	0	HIS	-	expression tag	UNP Q389T8

- Molecule 2 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula: $C_{27}H_{33}N_9O_{15}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total 53	C 27	N 9	O 15	P 2	0	0
2	B	1	Total 53	C 27	N 9	O 15	P 2	0	0
2	C	1	Total 53	C 27	N 9	O 15	P 2	0	0
2	D	1	Total 53	C 27	N 9	O 15	P 2	0	0

- Molecule 3 is N-(3-((S)-6-chloro-2-methyl-4-phenylquinazolin-3(4H)-yl)propyl)-2-(2-(2-((2-(3 {R}))-2,6-dioxopiperidin-3-yl)-1,3-dioxoisindolin-4-yl)amino)ethoxy)ethoxy)acetamide (CCD ID: A1IYC) (formula: C₃₇H₃₉ClN₆O₇) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	Cl	N	O	0	0
			51	37	1	6	7		
3	B	1	Total	C	Cl	N	O	0	0
			51	37	1	6	7		
3	C	1	Total	C	Cl	N	O	0	0
			51	37	1	6	7		
3	D	1	Total	C	Cl	N	O	0	0
			51	37	1	6	7		

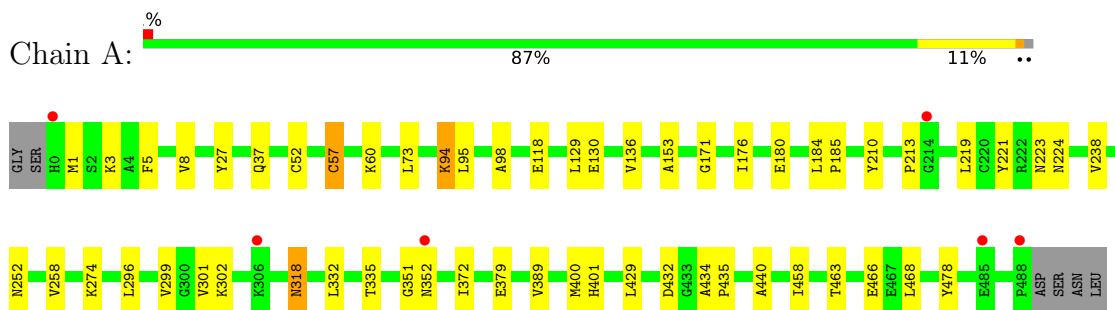
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	152	Total	O	0	0
			152	152		
4	B	162	Total	O	0	0
			162	162		
4	C	114	Total	O	0	0
			114	114		
4	D	72	Total	O	0	0
			72	72		

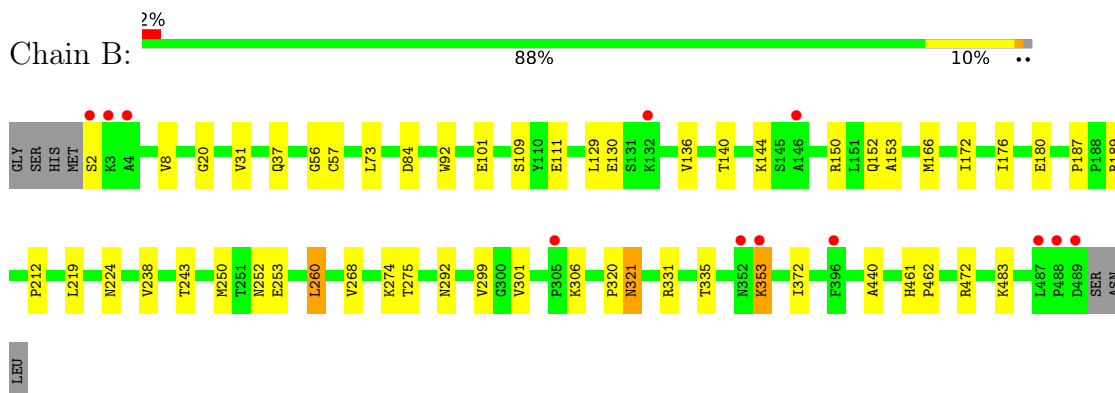
3 Residue-property plots

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.

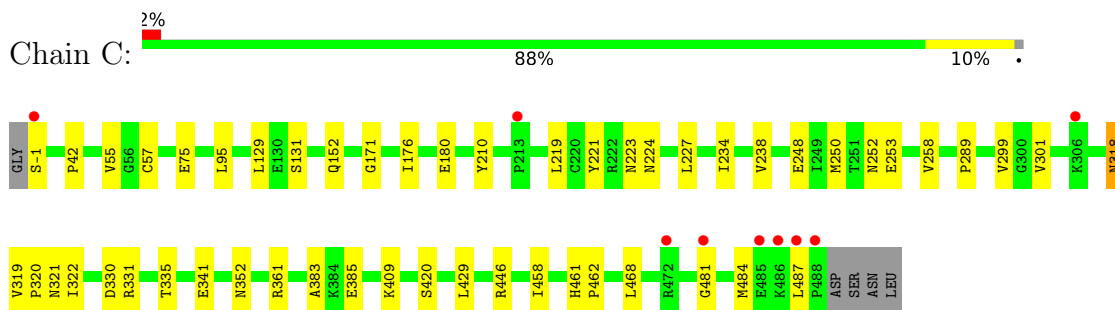
• Molecule 1: Trypanothione reductase



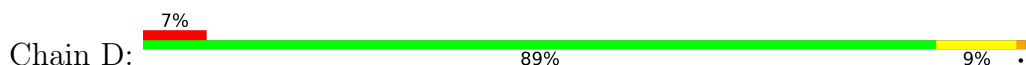
• Molecule 1: Trypanothione reductase

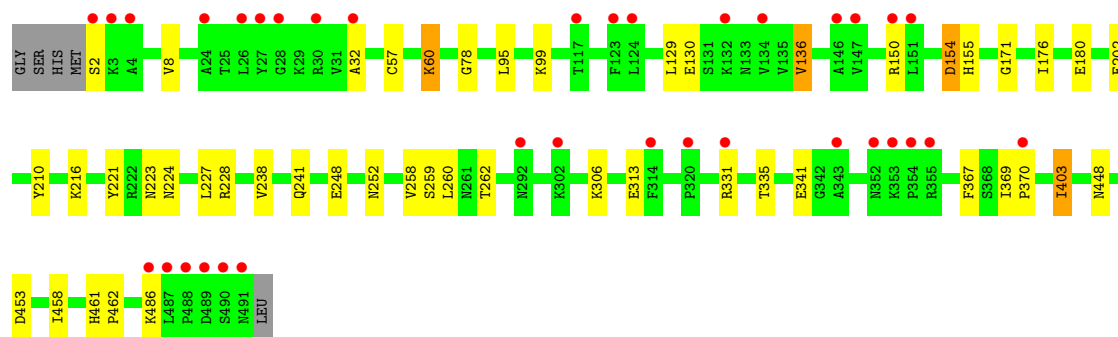


• Molecule 1: Trypanothione reductase



• Molecule 1: Trypanothione reductase





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	101.70Å 63.82Å 169.91Å 90.00° 98.10° 90.00°	Depositor
Resolution (Å)	168.22 – 2.09 168.22 – 2.09	Depositor EDS
% Data completeness (in resolution range)	97.0 (168.22-2.09) 97.0 (168.22-2.09)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.36 (at 2.08Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.197 , 0.243 0.204 , 0.244	Depositor DCC
R_{free} test set	6209 reflections (4.84%)	wwPDB-VP
Wilson B-factor (Å ²)	30.5	Xtriage
Anisotropy	0.007	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 22.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	15884	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.07% 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: A1IYC, FAD

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	1.05	0/3871	1.37	5/5245 (0.1%)
1	B	1.05	0/3819	1.37	7/5180 (0.1%)
1	C	1.06	0/3832	1.35	6/5196 (0.1%)
1	D	1.09	0/3814	1.36	3/5173 (0.1%)
All	All	1.06	0/15336	1.37	21/20794 (0.1%)

There are no bond length outliers.

All (21) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	458	ILE	CA-C-N	5.74	125.80	120.34
1	A	458	ILE	C-N-CA	5.74	125.80	120.34
1	B	111	GLU	CA-C-N	5.71	126.43	120.03
1	B	111	GLU	C-N-CA	5.71	126.43	120.03
1	C	458	ILE	CA-C-N	5.57	125.39	120.10
1	C	458	ILE	C-N-CA	5.57	125.39	120.10
1	C	352	ASN	CB-CA-C	5.48	119.94	111.28
1	A	296	LEU	CA-C-N	5.48	126.17	120.03
1	A	296	LEU	C-N-CA	5.48	126.17	120.03
1	B	243	THR	CA-CB-OG1	-5.46	101.41	109.60
1	D	458	ILE	CA-C-N	5.28	125.11	120.10
1	D	458	ILE	C-N-CA	5.28	125.11	120.10
1	D	367	PHE	CB-CA-C	5.21	118.22	111.50
1	C	42	PRO	O-C-N	-5.18	118.93	121.31
1	A	379	GLU	CA-C-O	-5.10	115.14	120.55
1	C	484	MET	CA-C-N	5.06	127.57	120.28
1	C	484	MET	C-N-CA	5.06	127.57	120.28
1	B	56	GLY	CA-C-N	5.06	127.37	120.54
1	B	56	GLY	C-N-CA	5.06	127.37	120.54
1	B	84	ASP	CA-C-N	5.06	125.59	119.98

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	84	ASP	C-N-CA	5.06	125.59	119.98

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3765	0	3822	32	0
1	B	3729	0	3745	26	0
1	C	3744	0	3764	25	0
1	D	3730	0	3741	22	0
2	A	53	0	31	1	0
2	B	53	0	31	0	0
2	C	53	0	31	0	0
2	D	53	0	31	0	0
3	A	51	0	0	0	0
3	B	51	0	0	0	0
3	C	51	0	0	0	0
3	D	51	0	0	0	0
4	A	152	0	0	0	0
4	B	162	0	0	2	0
4	C	114	0	0	0	0
4	D	72	0	0	0	0
All	All	15884	0	15196	101	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 (101) 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:B:320:PRO:O	1:B:321:ASN:ND2	2.03	0.92
1:A:224:ASN:HD22	1:A:252:ASN:HD21	1.21	0.84
1:C:318:ASN:H	1:C:318:ASN:HD22	1.30	0.77

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:400:MET:HE3	4:B:689:HOH:O	1.85	0.76
1:B:224:ASN:HD22	1:B:252:ASN:HD21	1.38	0.70
1:B:299:VAL:HG23	1:B:301:VAL:HG23	1.73	0.70
1:A:129:LEU:HD23	1:A:299:VAL:HG21	1.75	0.68
1:B:250:MET:HE2	1:B:253:GLU:HG3	1.79	0.64
1:A:52:CYS:HG	1:A:57:CYS:CB	2.11	0.63
1:A:8:VAL:HG23	1:A:153:ALA:HB2	1.83	0.61
1:D:224:ASN:HD22	1:D:252:ASN:HD21	1.49	0.59
1:B:130:GLU:OE1	1:B:150:ARG:NH2	2.30	0.59
1:A:224:ASN:HD22	1:A:252:ASN:ND2	1.96	0.59
1:A:429:LEU:HD21	1:A:468:LEU:HD21	1.84	0.58
1:C:320:PRO:O	1:C:321:ASN:CG	2.47	0.58
1:C:250:MET:HE2	1:C:253:GLU:HG3	1.86	0.57
1:B:130:GLU:HB2	1:B:136:VAL:CG2	2.34	0.57
1:D:154:ASP:HB3	1:D:155:HIS:CD2	2.41	0.56
1:A:318:ASN:HD22	1:A:318:ASN:H	1.53	0.56
1:C:227:LEU:HD12	1:C:238:VAL:HG11	1.86	0.56
1:A:8:VAL:CG2	1:A:153:ALA:HB2	2.36	0.55
1:C:221:TYR:CE2	1:C:223:ASN:HB2	2.42	0.55
1:B:152:GLN:NE2	4:B:605:HOH:O	2.40	0.55
1:B:166:MET:HE3	1:B:172:ILE:HD11	1.89	0.54
1:D:8:VAL:HG22	1:D:32:ALA:HB3	1.90	0.53
1:D:130:GLU:OE2	1:D:150:ARG:NH1	2.40	0.53
1:C:320:PRO:O	1:C:321:ASN:ND2	2.41	0.53
1:D:130:GLU:HB2	1:D:136:VAL:CG2	2.39	0.52
1:B:8:VAL:HG23	1:B:153:ALA:HB2	1.91	0.52
1:D:78:GLY:O	1:D:403:ILE:HD12	2.10	0.51
1:B:130:GLU:HB2	1:B:136:VAL:HG23	1.92	0.51
1:A:221:TYR:CE2	1:A:223:ASN:HB2	2.45	0.51
1:C:171:GLY:HA3	1:C:258:VAL:O	2.11	0.51
1:B:260:LEU:H	1:C:152:GLN:NE2	2.09	0.51
1:C:318:ASN:HD22	1:C:318:ASN:N	2.05	0.50
1:C:446:ARG:NH2	1:D:453:ASP:OD1	2.44	0.50
1:A:95:LEU:HD22	1:A:210:TYR:CZ	2.46	0.50
1:C:95:LEU:HD22	1:C:210:TYR:CZ	2.47	0.50
1:A:238:VAL:HG21	1:A:372:ILE:HD11	1.94	0.49
1:A:440:ALA:HB3	1:B:440:ALA:HB3	1.95	0.49
1:A:302:LYS:H	1:A:318:ASN:ND2	2.10	0.48
1:D:331[A]:ARG:NH2	1:D:341:GLU:OE2	2.46	0.48
1:C:224:ASN:HD22	1:C:252:ASN:HD21	1.59	0.48
1:C:331[A]:ARG:NH1	1:C:341:GLU:OE2	2.47	0.48

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:129:LEU:HD23	1:C:299:VAL:HG21	1.96	0.48
1:D:227:LEU:HD12	1:D:238:VAL:HG11	1.95	0.48
1:A:434:ALA:HB3	1:A:435:PRO:HD3	1.95	0.47
1:B:219:LEU:C	1:B:219:LEU:HD23	2.40	0.47
1:A:94[B]:LYS:HE2	1:A:98:ALA:HB2	1.97	0.47
1:B:189:ARG:HA	1:B:212:PRO:HD2	1.97	0.46
1:B:238:VAL:HG21	1:B:372:ILE:HD11	1.96	0.46
1:B:253:GLU:OE2	1:B:274:LYS:HE3	2.15	0.46
1:B:299:VAL:CG2	1:B:301:VAL:HG23	2.44	0.46
1:A:401:HIS:HE1	1:A:432:ASP:OD2	1.99	0.46
1:B:130:GLU:CD	1:B:150:ARG:HH12	2.23	0.46
1:D:241:GLN:OE1	1:D:370:PRO:HG3	2.14	0.46
1:A:60:LYS:HD2	1:A:60:LYS:C	2.42	0.46
1:C:75:GLU:OE2	1:C:409:LYS:NZ	2.40	0.45
1:A:176:ILE:HB	1:A:180:GLU:HB2	1.98	0.45
1:D:171:GLY:HA3	1:D:258:VAL:O	2.16	0.45
1:A:301:VAL:HA	1:A:318:ASN:HD21	1.81	0.45
1:C:289:PRO:HG3	1:C:330:ASP:HB2	1.99	0.44
1:C:234:ILE:O	1:C:238:VAL:HG12	2.18	0.44
1:A:299:VAL:HG23	1:A:301:VAL:HG23	1.99	0.44
1:A:130:GLU:HB2	1:A:136[A]:VAL:HG23	1.99	0.44
1:B:353:LYS:HB2	1:B:353:LYS:HE2	1.54	0.44
1:D:99:LYS:HD2	1:D:99:LYS:C	2.42	0.44
1:A:27:TYR:CE1	1:A:351:GLY:HA2	2.53	0.44
1:B:20:GLY:HA2	1:B:31:VAL:HG11	2.00	0.44
1:C:219:LEU:C	1:C:219:LEU:HD23	2.43	0.44
1:D:369:ILE:HA	1:D:370:PRO:HA	1.85	0.44
1:C:319:VAL:HG11	1:C:322:ILE:HD12	2.01	0.43
1:D:331[A]:ARG:HE	1:D:331[A]:ARG:HB2	1.59	0.43
1:D:461:HIS:HA	1:D:462:PRO:HA	1.79	0.43
1:B:8:VAL:CG2	1:B:153:ALA:HB2	2.49	0.42
1:A:389:VAL:HB	1:A:478:TYR:HB2	2.02	0.42
1:D:176:ILE:HB	1:D:180:GLU:HB2	2.00	0.42
1:D:221:TYR:CE2	1:D:223:ASN:HB2	2.55	0.42
1:A:463:THR:O	1:A:466:GLU:HG2	2.20	0.42
1:B:176:ILE:HB	1:B:180:GLU:HB2	2.02	0.42
1:A:302:LYS:H	1:A:318:ASN:HD21	1.68	0.42
2:A:501:FAD:H9	2:A:501:FAD:H1'1	1.87	0.42
1:C:299:VAL:HG23	1:C:301:VAL:HG23	2.01	0.42
1:D:216:LYS:HE3	1:D:248:GLU:HB2	2.01	0.42
1:A:171:GLY:HA3	1:A:258:VAL:O	2.19	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:461:HIS:HA	1:B:462:PRO:HA	1.79	0.41
1:D:95:LEU:HD22	1:D:210:TYR:CZ	2.54	0.41
1:A:73:LEU:CD2	1:B:73:LEU:CD2	2.98	0.41
1:A:219:LEU:C	1:A:219:LEU:HD23	2.46	0.41
1:C:429:LEU:HD21	1:C:468:LEU:HD21	2.03	0.41
1:A:3:LYS:HB2	1:A:5:PHE:CE2	2.56	0.41
1:C:446:ARG:NH2	1:D:453:ASP:HA	2.36	0.41
1:C:383:ALA:HB1	1:C:481:GLY:HA2	2.02	0.41
1:C:461:HIS:HA	1:C:462:PRO:HA	1.81	0.41
1:B:268:VAL:O	1:B:275:THR:HA	2.20	0.40
1:D:60:LYS:NZ	1:D:202:GLU:OE1	2.45	0.40
1:B:92:TRP:HB3	1:B:187:PRO:HD3	2.03	0.40
1:C:176:ILE:HB	1:C:180:GLU:HB2	2.04	0.40
1:D:130:GLU:HB2	1:D:136:VAL:HG22	2.02	0.40
1:A:184:LEU:HA	1:A:185:PRO:HD3	1.98	0.40
1:A:332:LEU:HD23	1:A:332:LEU:HA	1.93	0.40

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	496/495 (100%)	482 (97%)	14 (3%)	0	100	100
1	B	490/495 (99%)	476 (97%)	14 (3%)	0	100	100
1	C	491/495 (99%)	476 (97%)	14 (3%)	1 (0%)	43	44
1	D	490/495 (99%)	470 (96%)	20 (4%)	0	100	100
All	All	1967/1980 (99%)	1904 (97%)	62 (3%)	1 (0%)	48	50

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	55	VAL

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	411/407 (101%)	400 (97%)	11 (3%)	39	45
1	B	405/407 (100%)	388 (96%)	17 (4%)	26	28
1	C	406/407 (100%)	396 (98%)	10 (2%)	42	48
1	D	404/407 (99%)	388 (96%)	16 (4%)	28	29
All	All	1626/1628 (100%)	1572 (97%)	54 (3%)	33	37

All (54) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	37	GLN
1	A	57	CYS
1	A	94[A]	LYS
1	A	94[B]	LYS
1	A	118	GLU
1	A	213	PRO
1	A	274	LYS
1	A	318	ASN
1	A	335	THR
1	A	352	ASN
1	B	2	SER
1	B	37	GLN
1	B	57	CYS
1	B	101	GLU
1	B	109	SER
1	B	129	LEU
1	B	140	THR
1	B	144	LYS
1	B	260	LEU
1	B	292	ASN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	B	306	LYS
1	B	321	ASN
1	B	331	ARG
1	B	335	THR
1	B	353	LYS
1	B	472	ARG
1	B	483	LYS
1	C	-1	SER
1	C	57	CYS
1	C	131	SER
1	C	248	GLU
1	C	318	ASN
1	C	335	THR
1	C	361	ARG
1	C	385	GLU
1	C	420	SER
1	C	487	LEU
1	D	2	SER
1	D	57	CYS
1	D	60	LYS
1	D	129	LEU
1	D	136	VAL
1	D	154	ASP
1	D	228	ARG
1	D	259	SER
1	D	260	LEU
1	D	262	THR
1	D	306	LYS
1	D	313	GLU
1	D	335	THR
1	D	403	ILE
1	D	448	ASN
1	D	486	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (27) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	107	ASN
1	A	223	ASN
1	A	224	ASN
1	A	252	ASN
1	A	318	ASN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	401	HIS
1	B	152	GLN
1	B	223	ASN
1	B	224	ASN
1	B	310	GLN
1	B	340	ASN
1	C	0	HIS
1	C	107	ASN
1	C	115	ASN
1	C	152	GLN
1	C	223	ASN
1	C	252	ASN
1	C	295	GLN
1	C	318	ASN
1	C	321	ASN
1	C	359	HIS
1	C	448	ASN
1	D	174	HIS
1	D	223	ASN
1	D	252	ASN
1	D	267	HIS
1	D	321	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 [i](#)

8 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	FAD	D	501	-	56,58,58	0.58	1 (1%)	81,89,89	0.72	2 (2%)
3	A1IYC	C	502	-	56,56,56	0.96	2 (3%)	74,78,78	1.29	7 (9%)
2	FAD	A	501	-	56,58,58	0.71	2 (3%)	81,89,89	0.71	1 (1%)
3	A1IYC	D	502	-	56,56,56	0.83	1 (1%)	74,78,78	0.91	4 (5%)
2	FAD	B	501	-	56,58,58	0.54	0	81,89,89	0.74	0
3	A1IYC	A	502	-	56,56,56	0.89	1 (1%)	74,78,78	0.96	4 (5%)
2	FAD	C	501	-	56,58,58	0.65	0	81,89,89	0.79	4 (4%)
3	A1IYC	B	502	-	56,56,56	1.01	1 (1%)	74,78,78	1.12	4 (5%)

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	FAD	D	501	-	-	3/34/50/50	0/6/6/6
3	A1IYC	C	502	-	-	14/26/71/71	0/6/6/6
2	FAD	A	501	-	-	5/34/50/50	0/6/6/6
3	A1IYC	D	502	-	-	8/26/71/71	0/6/6/6
2	FAD	B	501	-	-	3/34/50/50	0/6/6/6
3	A1IYC	A	502	-	-	14/26/71/71	0/6/6/6
2	FAD	C	501	-	-	4/34/50/50	0/6/6/6
3	A1IYC	B	502	-	-	10/26/71/71	0/6/6/6

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	502	A1IYC	C32-N6	6.88	1.38	1.29
3	C	502	A1IYC	C32-N6	5.86	1.37	1.29
3	A	502	A1IYC	C32-N6	5.79	1.37	1.29
3	D	502	A1IYC	C32-N6	5.38	1.36	1.29
2	A	501	FAD	C9-C8	-2.70	1.35	1.39
3	C	502	A1IYC	C19-N5	-2.62	1.46	1.48

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	501	FAD	C1'-C2'	-2.19	1.49	1.52
2	D	501	FAD	C1'-C2'	-2.10	1.49	1.52

All (26) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	502	A1IYC	C3-C2-N1	6.72	115.20	109.08
3	B	502	A1IYC	C3-C2-N1	5.70	114.28	109.08
3	B	502	A1IYC	C33-C32-N6	-4.49	113.55	119.34
3	D	502	A1IYC	C33-C32-N6	-4.46	113.58	119.34
3	C	502	A1IYC	C33-C32-N6	-4.41	113.65	119.34
3	A	502	A1IYC	C33-C32-N6	-4.30	113.79	119.34
3	A	502	A1IYC	C37-C8-C9	-3.61	119.42	121.91
3	B	502	A1IYC	C37-C8-C9	-3.19	119.72	121.91
3	D	502	A1IYC	C37-C8-C9	-3.08	119.79	121.91
3	C	502	A1IYC	C37-C8-C9	-3.03	119.82	121.91
3	D	502	A1IYC	C3-C2-N1	2.97	111.78	109.08
3	A	502	A1IYC	C3-C2-N1	2.91	111.73	109.08
3	C	502	A1IYC	C9-C8-C7	2.57	132.83	129.21
3	C	502	A1IYC	C1-N1-C7	-2.55	108.60	111.53
2	D	501	FAD	O2P-P-O1P	2.43	124.24	112.24
2	C	501	FAD	C2B-C1B-N9A	2.39	119.36	113.30
3	A	502	A1IYC	C9-C8-C7	2.34	132.51	129.21
3	C	502	A1IYC	C20-C19-C26	2.32	116.77	112.78
2	C	501	FAD	O2P-P-O1P	2.32	123.70	112.24
2	A	501	FAD	C2B-C1B-N9A	2.29	119.09	113.30
3	B	502	A1IYC	C9-C8-C7	2.17	132.26	129.21
3	D	502	A1IYC	C9-C8-C7	2.12	132.20	129.21
2	C	501	FAD	O2A-PA-O1A	2.06	122.44	112.24
2	D	501	FAD	C4-N3-C2	-2.05	121.86	125.64
3	C	502	A1IYC	C6-C2-N1	-2.04	108.91	113.85
2	C	501	FAD	C4-N3-C2	-2.02	121.91	125.64

There are no chirality outliers.

All (61) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	501	FAD	PA-O3P-P-O5'
3	A	502	A1IYC	C8-C9-N3-C10
3	A	502	A1IYC	C14-C15-N4-C16
3	A	502	A1IYC	C11-C10-N3-C9
3	A	502	A1IYC	C3-C2-N1-C7

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms
3	A	502	A1IYC	C3-C2-N1-C1
3	B	502	A1IYC	C14-C15-N4-C16
3	C	502	A1IYC	C8-C9-N3-C10
3	C	502	A1IYC	C14-C15-N4-C16
3	C	502	A1IYC	O6-C15-N4-C16
3	D	502	A1IYC	C15-C14-O5-C13
3	D	502	A1IYC	C14-C15-N4-C16
3	D	502	A1IYC	O6-C15-N4-C16
3	A	502	A1IYC	C34-C9-N3-C10
3	C	502	A1IYC	C34-C9-N3-C10
3	C	502	A1IYC	C12-C13-O5-C14
3	C	502	A1IYC	C13-C12-O4-C11
3	B	502	A1IYC	O6-C15-N4-C16
3	A	502	A1IYC	O6-C15-N4-C16
3	C	502	A1IYC	N4-C16-C17-C18
2	A	501	FAD	O4B-C4B-C5B-O5B
3	B	502	A1IYC	O4-C12-C13-O5
3	D	502	A1IYC	C16-C17-C18-N5
3	C	502	A1IYC	C16-C17-C18-N5
3	B	502	A1IYC	O5-C14-C15-O6
3	B	502	A1IYC	O5-C14-C15-N4
3	D	502	A1IYC	O5-C14-C15-N4
2	B	501	FAD	O4B-C4B-C5B-O5B
3	D	502	A1IYC	O5-C14-C15-O6
3	A	502	A1IYC	O4-C12-C13-O5
2	A	501	FAD	P-O3P-PA-O1A
3	D	502	A1IYC	N4-C16-C17-C18
3	B	502	A1IYC	C3-C2-N1-C7
3	B	502	A1IYC	C3-C2-N1-C1
3	D	502	A1IYC	C3-C2-N1-C1
3	A	502	A1IYC	N3-C10-C11-O4
2	B	501	FAD	PA-O3P-P-O5'
2	C	501	FAD	PA-O3P-P-O5'
2	D	501	FAD	PA-O3P-P-O5'
2	D	501	FAD	O4B-C4B-C5B-O5B
3	B	502	A1IYC	N3-C10-C11-O4
3	A	502	A1IYC	C12-C13-O5-C14
2	A	501	FAD	C3B-C4B-C5B-O5B
3	A	502	A1IYC	C10-C11-O4-C12
3	A	502	A1IYC	N4-C16-C17-C18
3	B	502	A1IYC	C12-C13-O5-C14
3	C	502	A1IYC	C11-C10-N3-C9

Continued on next page...

Continued from previous page...

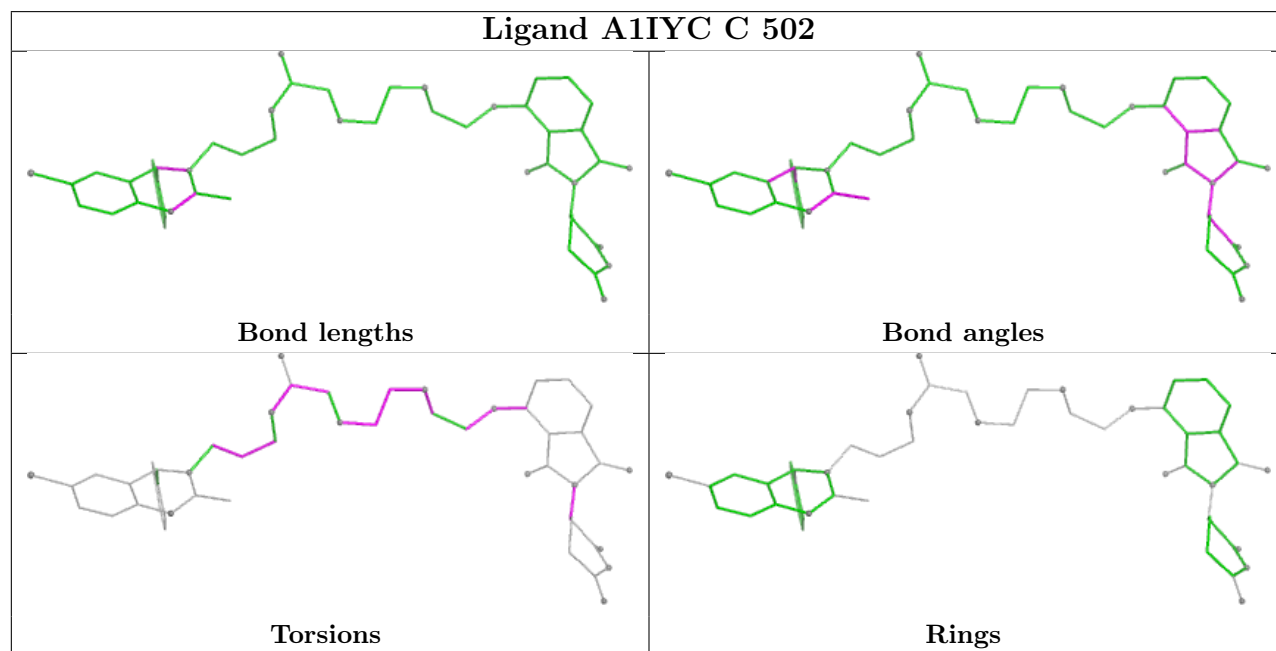
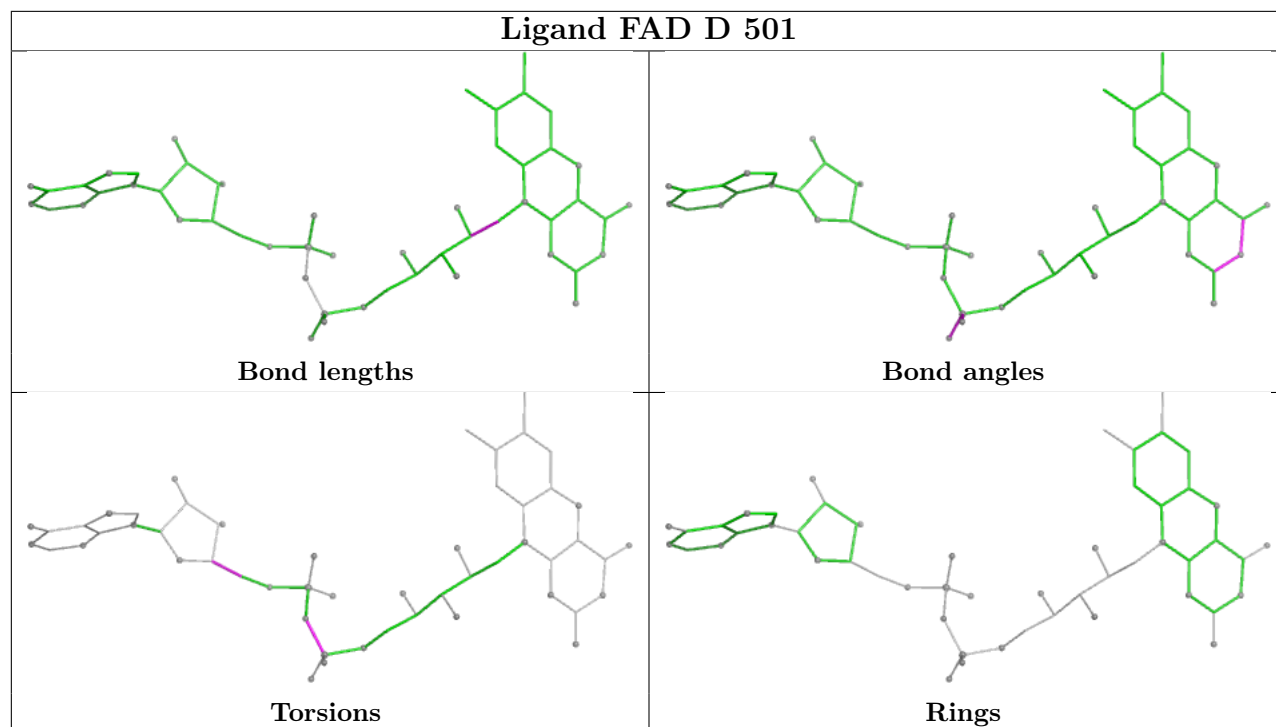
Mol	Chain	Res	Type	Atoms
2	A	501	FAD	P-O3P-PA-O2A
2	C	501	FAD	P-O3P-PA-O2A
3	C	502	A1IYC	O4-C12-C13-O5
3	C	502	A1IYC	O5-C14-C15-O6
3	C	502	A1IYC	O5-C14-C15-N4
2	C	501	FAD	O4B-C4B-C5B-O5B
3	C	502	A1IYC	C10-C11-O4-C12
2	B	501	FAD	C3B-C4B-C5B-O5B
3	A	502	A1IYC	O5-C14-C15-O6
2	C	501	FAD	P-O3P-PA-O1A
3	A	502	A1IYC	O5-C14-C15-N4
3	C	502	A1IYC	C6-C2-N1-C1
2	D	501	FAD	C3B-C4B-C5B-O5B
3	B	502	A1IYC	C8-C9-N3-C10

There are no ring outliers.

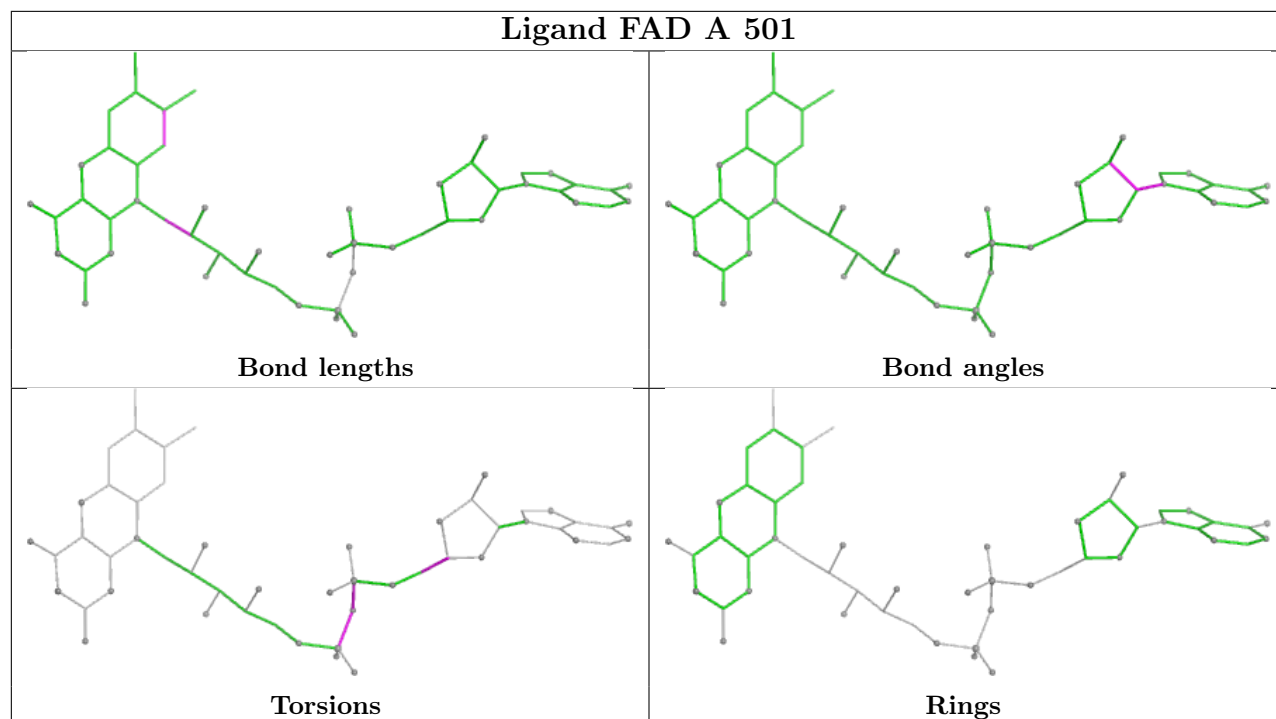
1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	501	FAD	1	0

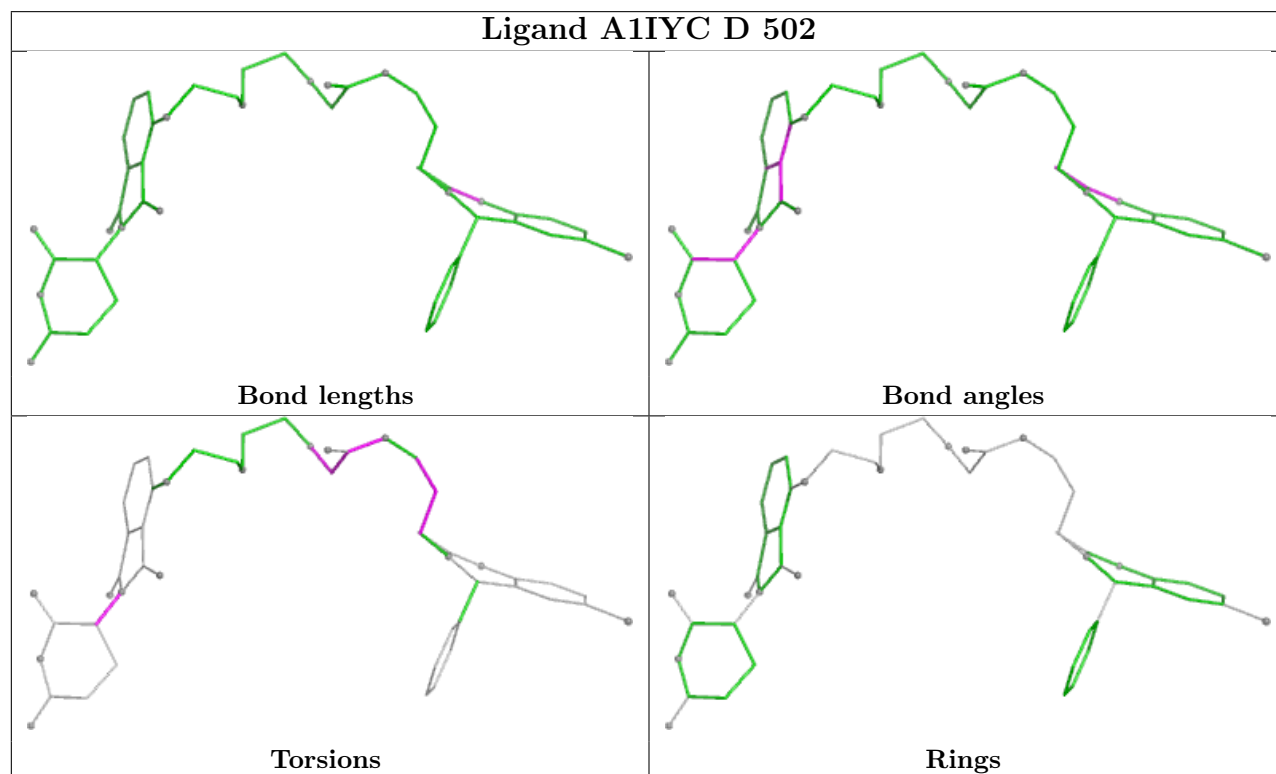
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

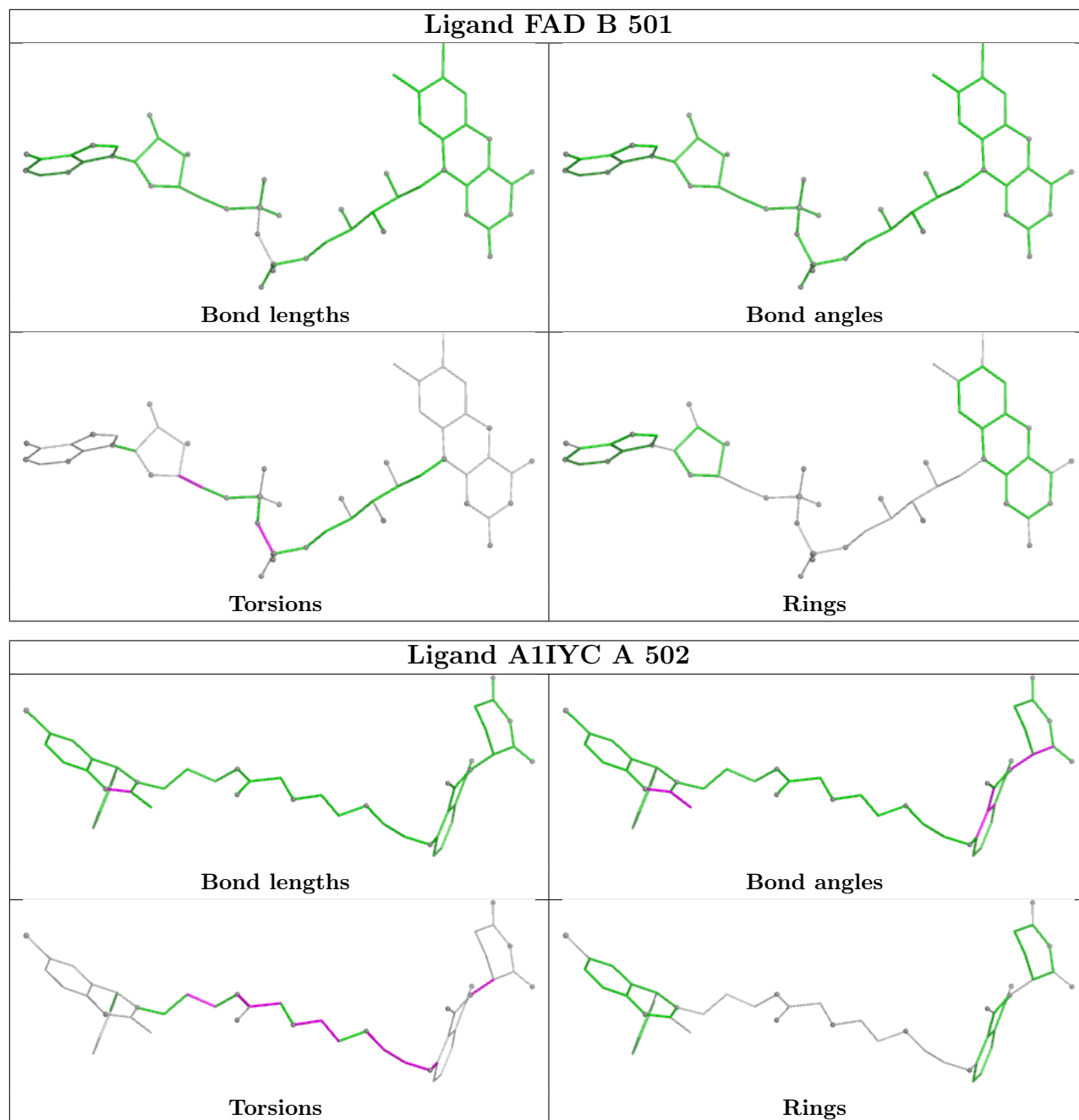


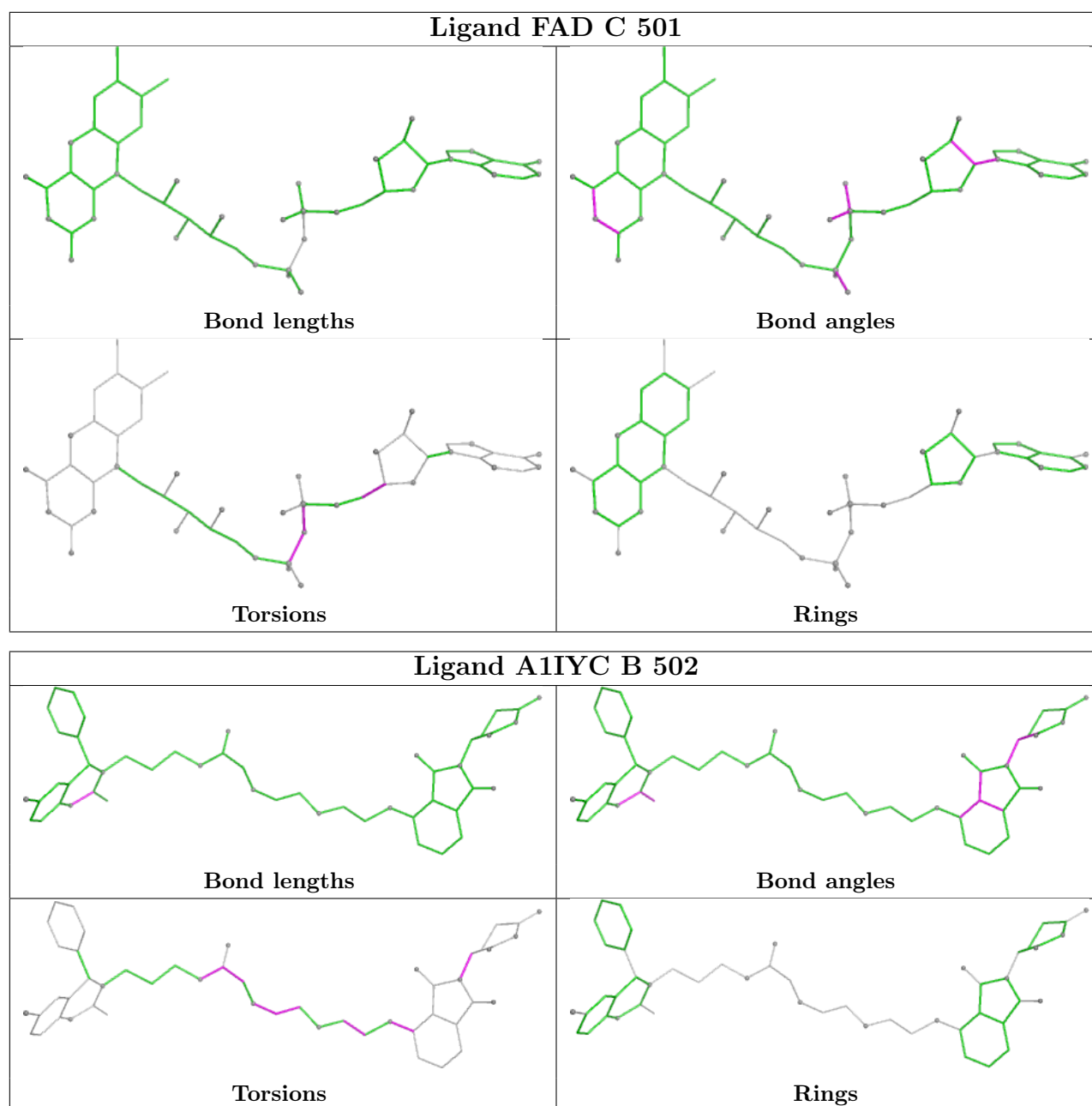
Ligand FAD A 501



Ligand A1IYC D 502







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	489/495 (98%)	0.05	6 (1%) 76 78	16, 31, 50, 76	9 (1%)
1	B	488/495 (98%)	0.10	12 (2%) 58 61	14, 32, 53, 94	4 (0%)
1	C	490/495 (98%)	0.11	9 (1%) 67 70	18, 31, 51, 113	3 (0%)
1	D	490/495 (98%)	0.51	35 (7%) 22 23	22, 37, 70, 103	2 (0%)
All	All	1957/1980 (98%)	0.20	62 (3%) 50 53	14, 33, 59, 113	18 (0%)

All (62) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	488	PRO	5.1
1	D	2	SER	4.9
1	D	491	ASN	4.8
1	D	490	SER	4.5
1	C	487	LEU	4.3
1	B	488	PRO	4.2
1	D	3	LYS	3.9
1	A	488	PRO	3.9
1	D	354	PRO	3.9
1	B	2	SER	3.8
1	A	0	HIS	3.6
1	D	24	ALA	3.6
1	D	489	ASP	3.5
1	D	353	LYS	3.4
1	D	146	ALA	3.1
1	B	4	ALA	3.0
1	D	352	ASN	3.0
1	D	132	LYS	3.0
1	C	472	ARG	2.9
1	D	331[A]	ARG	2.9
1	D	4	ALA	2.9

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	D	26	LEU	2.8
1	B	489	ASP	2.8
1	D	343	ALA	2.8
1	D	370	PRO	2.8
1	C	486	LYS	2.7
1	D	28	GLY	2.7
1	B	353	LYS	2.7
1	D	486	LYS	2.7
1	D	150	ARG	2.7
1	D	292	ASN	2.6
1	D	320	PRO	2.6
1	A	214	GLY	2.6
1	B	352	ASN	2.6
1	C	213	PRO	2.6
1	D	124	LEU	2.6
1	C	485	GLU	2.5
1	D	117	THR	2.5
1	D	488	PRO	2.5
1	C	306	LYS	2.5
1	D	32	ALA	2.4
1	D	314	PHE	2.3
1	D	147	VAL	2.3
1	B	305	PRO	2.3
1	B	487	LEU	2.3
1	D	151	LEU	2.3
1	D	27	TYR	2.3
1	D	30	ARG	2.2
1	D	134	VAL	2.2
1	D	487	LEU	2.2
1	C	-1	SER	2.2
1	D	302	LYS	2.2
1	B	396	PHE	2.1
1	B	132	LYS	2.1
1	C	481	GLY	2.1
1	A	306	LYS	2.1
1	B	3	LYS	2.1
1	B	146	ALA	2.1
1	D	355	ARG	2.1
1	A	485	GLU	2.0
1	D	123	PHE	2.0
1	A	352	ASN	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](#)

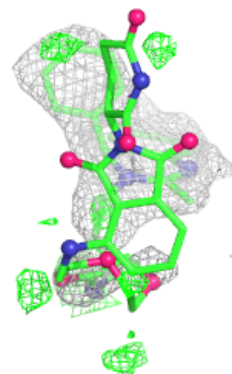
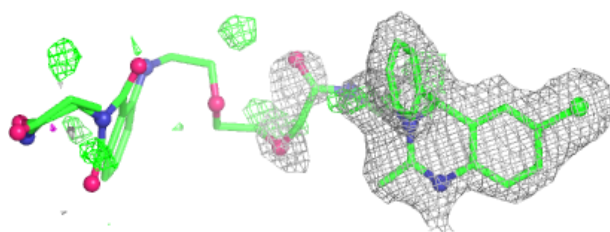
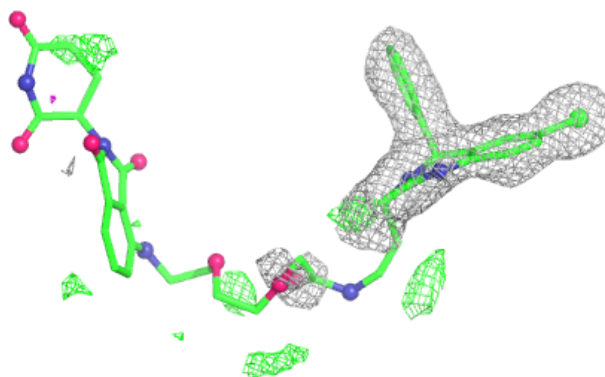
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists 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	A1IYC	D	502	51/51	0.83	0.30	38,71,105,108	51
3	A1IYC	A	502	51/51	0.86	0.26	28,77,102,105	28
3	A1IYC	B	502	51/51	0.88	0.25	30,56,80,82	32
3	A1IYC	C	502	51/51	0.90	0.21	19,61,83,85	51
2	FAD	D	501	53/53	0.96	0.07	25,32,39,41	0
2	FAD	B	501	53/53	0.97	0.06	20,25,32,36	0
2	FAD	A	501	53/53	0.97	0.06	21,25,28,29	0
2	FAD	C	501	53/53	0.98	0.04	18,22,24,25	0

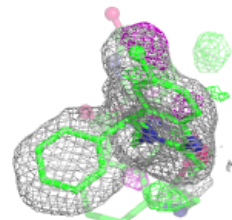
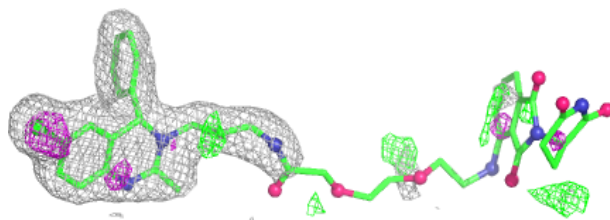
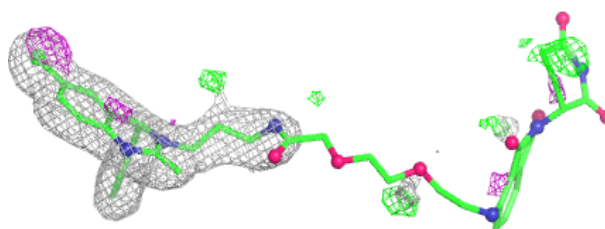
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around A1IYC D 502:

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

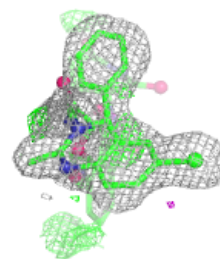
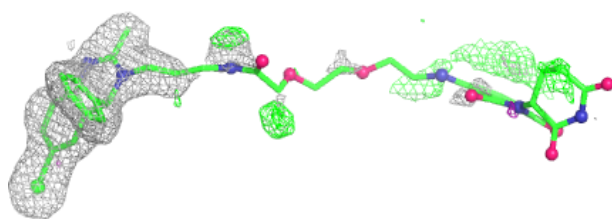
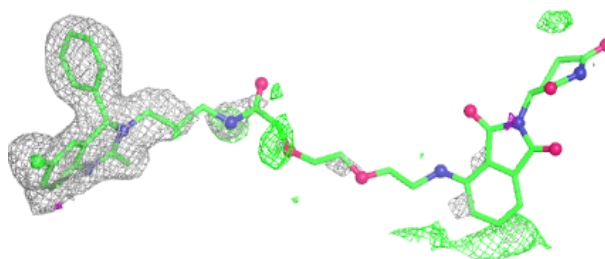
**Electron density around A1IYC A 502:**

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

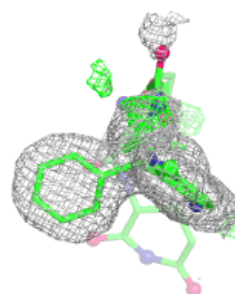
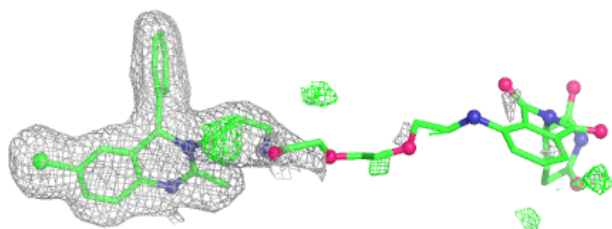
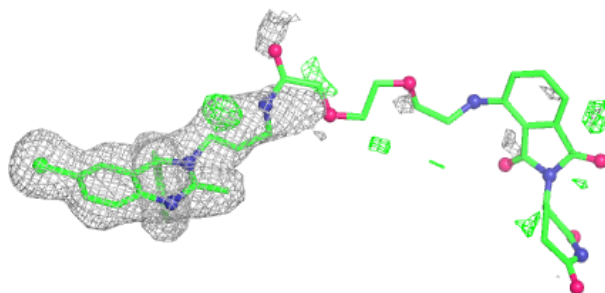


Electron density around A1IYC B 502:

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

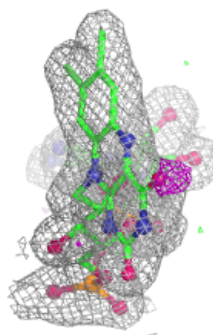
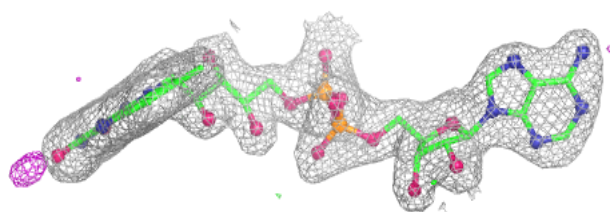
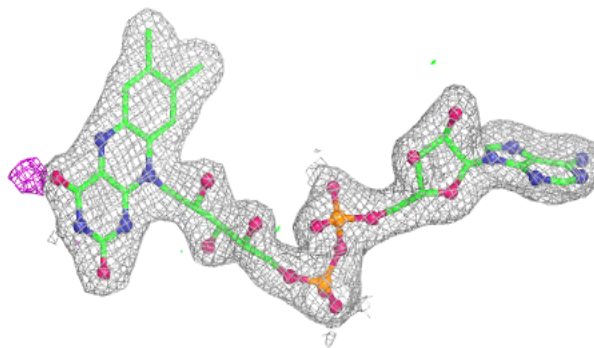
**Electron density around A1IYC C 502:**

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

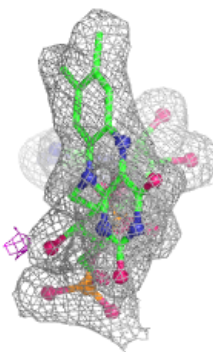
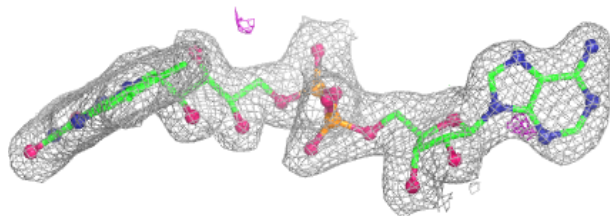
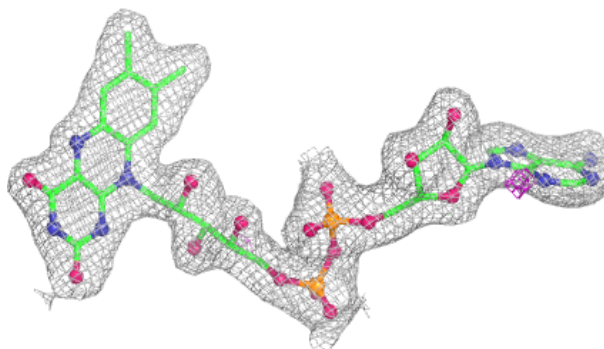


Electron density around FAD D 501:

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

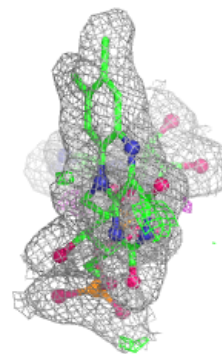
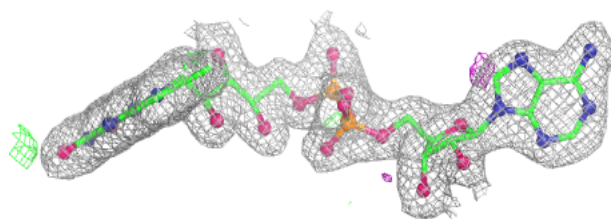
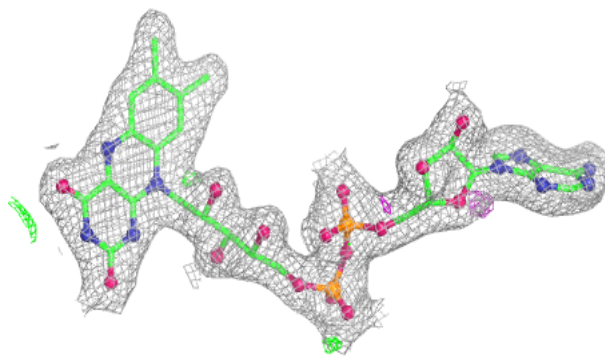
**Electron density around FAD B 501:**

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

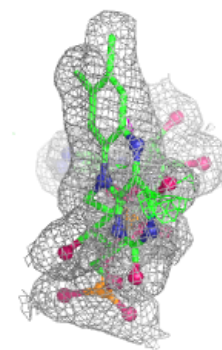
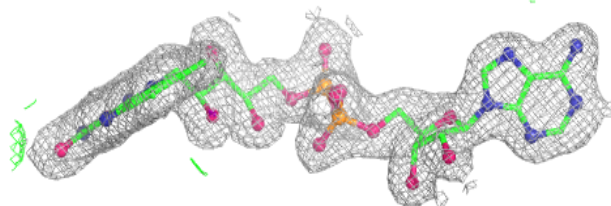
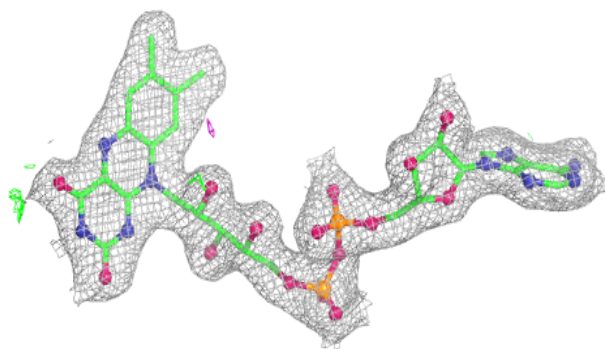


Electron density around FAD A 501:

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

**Electron density around FAD C 501:**

$2mF_o-DF_c$ (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.