



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 05:31 AM UTC

PDB ID : 2PGN / pdb_00002pgn
Title : The crystal structure of FAD and ThDP-dependent Cyclohexane-1,2-dione Hydrolase in Complex with Cyclohexane-1,2-dione
Authors : Fraas, S.; Warkentin, E.; Ermler, U.
Deposited on : 2007-04-10
Resolution : 1.20 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

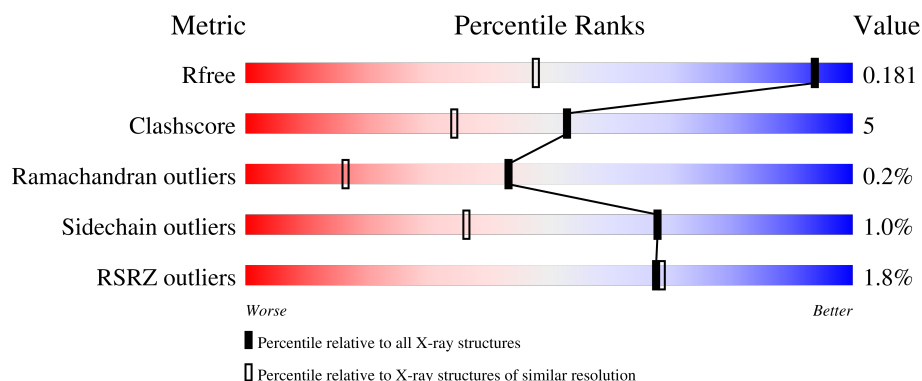
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.20 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	1216 (1.20-1.20)
Clashscore	190562	1265 (1.20-1.20)
Ramachandran outliers	187476	1226 (1.20-1.20)
Sidechain outliers	187428	1226 (1.20-1.20)
RSRZ outliers	180081	1214 (1.20-1.20)

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	589	2% 92% 7%
1	B	589	2% 91% 8%

2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 10748 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.

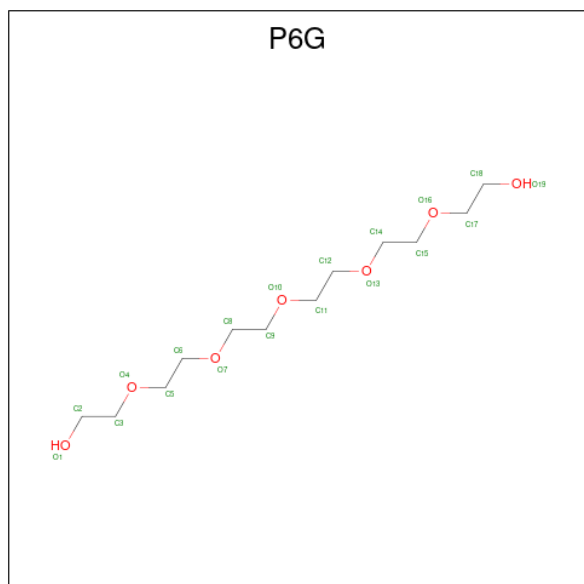
- Molecule 1 is a protein called Cyclohexane-1,2-dione Hydrolase (Cdh).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	587	Total	C	N	O	S	0	32	0
			4581	2906	809	844	22			
1	B	587	Total	C	N	O	S	0	41	0
			4609	2921	812	854	22			

- Molecule 2 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

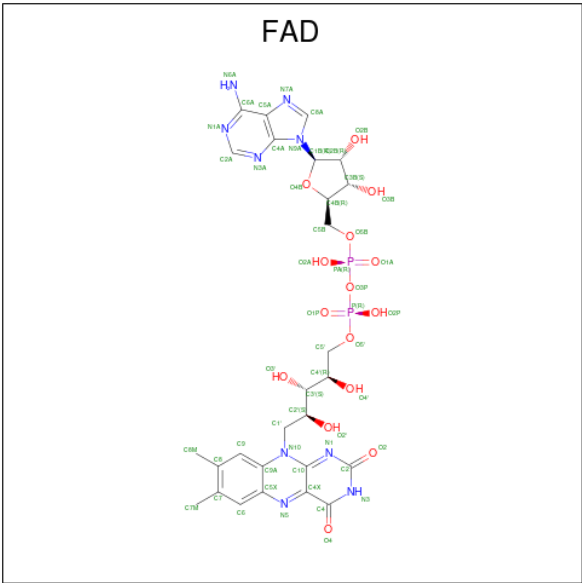
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Mg	0	0
			1	1		
2	B	1	Total	Mg	0	0
			1	1		

- Molecule 3 is HEXAETHYLENE GLYCOL (CCD ID: P6G) (formula: C₁₂H₂₆O₇).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			16	10	6		
3	A	1	Total	C	O	0	0
			10	6	4		
3	A	1	Total	C	O	0	0
			7	4	3		
3	A	1	Total	C	O	0	0
			10	6	4		
3	A	1	Total	C	O	0	0
			17	11	6		
3	B	1	Total	C	O	0	0
			10	6	4		
3	B	1	Total	C	O	0	0
			10	6	4		
3	B	1	Total	C	O	0	0
			17	11	6		
3	B	1	Total	C	O	0	0
			17	11	6		

- Molecule 4 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula: C₂₇H₃₃N₉O₁₅P₂).



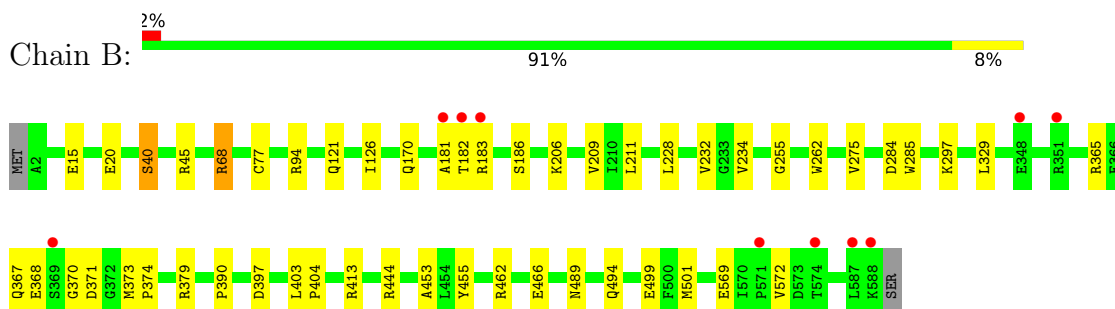
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total 53	C 27	N 9	O 15	P 2	0	0
4	B	1	Total 53	C 27	N 9	O 15	P 2	0	0

- Molecule 5 is THIAMINE DIPHOSPHATE (CCD ID: TPP) (formula: C₁₂H₁₉N₄O₇P₂S).

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	626	Total 626	O 626	0	0
7	B	642	Total 642	O 642	0	0

- Molecule 1: Cyclohexane-1,2-dione Hydrolase (Cdh)



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	123.60Å 123.60Å 144.30Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 1.20 10.00 – 1.20	Depositor EDS
% Data completeness (in resolution range)	97.2 (10.00-1.20) 97.0 (10.00-1.20)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.60 (at 1.10Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.149 , 0.176 0.158 , 0.181	Depositor DCC
R_{free} test set	19355 reflections (4.33%)	wwPDB-VP
Wilson B-factor (Å ²)	9.2	Xtriage
Anisotropy	0.337	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.48 , 75.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	10748	wwPDB-VP
Average B, all atoms (Å ²)	15.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.13% 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: TPP, MG, CXO, FAD, P6G

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	1.10	0/4816	1.06	2/6528 (0.0%)
1	B	1.12	3/4873 (0.1%)	1.08	4/6606 (0.1%)
All	All	1.11	3/9689 (0.0%)	1.07	6/13134 (0.0%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1
1	B	0	1
All	All	0	2

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	370[A]	GLY	N-CA	-6.89	1.35	1.45
1	B	370[B]	GLY	N-CA	-6.89	1.35	1.45
1	B	126	ILE	CA-CB	5.22	1.59	1.55

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	370	GLY	N-CA-C	-7.17	104.27	112.29
1	B	94	ARG	CB-CG-CD	5.93	124.93	111.30
1	B	68	ARG	NE-CZ-NH1	-5.49	116.02	121.50
1	B	68	ARG	NE-CZ-NH2	5.36	124.02	119.20
1	A	588	LYS	CB-CA-C	5.29	120.15	110.10
1	B	284	ASP	CA-CB-CG	5.02	117.62	112.60

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	372	GLY	Peptide
1	B	181[A]	ALA	Peptide

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	4581	0	4524	47	1
1	B	4609	0	4553	46	1
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	60	0	76	5	0
3	B	54	0	68	6	0
4	A	53	0	31	0	0
4	B	53	0	31	0	0
5	A	26	0	16	1	0
5	B	26	0	16	2	0
6	A	8	0	8	3	0
6	B	8	0	8	2	0
7	A	626	0	0	20	0
7	B	642	0	0	27	1
All	All	10748	0	9331	94	2

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 5.

All (94) 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:468[A]:LYS:NZ	7:A:1972:HOH:O	1.57	1.27
1:B:494[B]:GLN:OE1	7:B:1190:HOH:O	1.72	1.05
1:A:183:ARG:NH1	7:A:1830:HOH:O	1.90	1.02
1:B:466[B]:GLU:OE1	7:B:877:HOH:O	1.80	0.99
1:B:365[B]:ARG:NE	1:B:368[B]:GLU:OE2	1.95	0.99

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:367:GLN:HE22	3:B:649:P6G:H61	1.26	0.99
1:A:501[B]:MET:SD	7:B:1000:HOH:O	2.20	0.97
3:A:647:P6G:H61	7:A:1760:HOH:O	1.65	0.95
1:A:379[A]:ARG:HD3	7:A:2184:HOH:O	1.66	0.93
3:B:648:P6G:H61	7:B:997:HOH:O	1.71	0.89
1:A:501[B]:MET:CE	7:B:1000:HOH:O	2.21	0.87
3:B:649:P6G:H62	7:B:929:HOH:O	1.75	0.85
1:B:489[A]:ASN:OD1	7:B:1025:HOH:O	1.95	0.83
1:B:170[A]:GLN:HG3	7:B:970:HOH:O	1.81	0.79
1:B:170[B]:GLN:CD	7:B:970:HOH:O	2.25	0.79
1:B:390:PRO:O	1:B:413:ARG:HD3	1.87	0.74
1:A:20:GLU:OE1	7:A:2189:HOH:O	2.06	0.73
1:A:496[B]:ASN:OD1	7:A:1890:HOH:O	2.07	0.72
1:A:21:GLN:OE1	1:A:45[A]:ARG:NH2	2.22	0.71
1:B:413:ARG:HD2	7:B:882:HOH:O	1.91	0.71
1:B:170[A]:GLN:NE2	7:B:1062:HOH:O	2.22	0.70
1:A:297[B]:LYS:CE	7:A:2166:HOH:O	2.39	0.69
1:A:370:GLY:O	7:A:2184:HOH:O	2.11	0.69
1:B:371[A]:ASP:OD1	7:B:1281:HOH:O	2.11	0.69
3:B:649:P6G:O10	7:B:929:HOH:O	2.11	0.69
1:B:444:ARG:HH12	3:B:648:P6G:H91	1.57	0.68
1:B:45[A]:ARG:NE	7:B:1102:HOH:O	2.26	0.67
1:A:45[A]:ARG:HH11	1:A:45[A]:ARG:HG3	1.58	0.67
1:A:16:GLU:OE1	7:A:2078:HOH:O	2.12	0.66
1:B:15:GLU:OE1	7:B:1201:HOH:O	2.14	0.66
1:A:297[B]:LYS:HE3	7:A:2166:HOH:O	1.96	0.66
1:A:371:ASP:OD1	1:A:379[B]:ARG:NH2	2.29	0.65
1:B:297:LYS:NZ	7:B:1148:HOH:O	2.29	0.65
1:B:489[B]:ASN:HB2	7:B:1085:HOH:O	1.97	0.63
1:A:465[B]:VAL:CG2	1:B:501[B]:MET:SD	2.86	0.63
1:A:3:ILE:HD12	7:B:1073:HOH:O	2.00	0.62
1:A:340[B]:LYS:HG2	1:A:342:VAL:HG13	1.82	0.61
5:A:614:TPP:H2	6:B:601:CXO:C1	2.30	0.61
1:A:465[B]:VAL:HG23	1:B:501[B]:MET:SD	2.41	0.61
1:B:170[B]:GLN:NE2	7:B:970:HOH:O	2.32	0.59
1:A:501[B]:MET:HE3	7:B:1000:HOH:O	1.94	0.59
1:B:489[A]:ASN:CG	7:B:1085:HOH:O	2.48	0.57
1:B:232[A]:VAL:HG12	1:B:234:VAL:HG23	1.85	0.56
1:A:183:ARG:CZ	7:A:1931:HOH:O	2.53	0.56
1:A:227:LYS:NZ	7:A:1990:HOH:O	2.38	0.55
1:B:569:GLU:HG3	7:B:1073:HOH:O	2.06	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:B:648:P6G:H122	7:B:1113:HOH:O	2.06	0.54
1:B:228:LEU:O	1:B:232[B]:VAL:HG22	2.07	0.54
1:A:45[A]:ARG:HG3	1:A:45[A]:ARG:NH1	2.23	0.53
1:B:397:ASP:CG	1:B:453:ALA:HB1	2.34	0.53
1:A:370:GLY:O	1:A:371:ASP:OD1	2.27	0.52
1:B:209[B]:VAL:CG1	1:B:275:VAL:HG22	2.40	0.52
1:B:20:GLU:OE1	1:B:68:ARG:NH1	2.43	0.52
6:A:1601:CXO:H62	1:B:285:TRP:CH2	2.46	0.51
1:A:490:HIS:HE1	7:A:2052:HOH:O	1.95	0.50
1:A:128:ARG:HA	3:A:645:P6G:H21	1.94	0.49
1:B:413:ARG:CG	7:B:882:HOH:O	2.60	0.48
1:A:232[A]:VAL:HG12	1:A:234:VAL:HG23	1.96	0.48
1:A:467:HIS:O	1:A:468[B]:LYS:HG2	2.13	0.48
1:B:121:GLN:NE2	7:B:897:HOH:O	2.19	0.47
1:A:121:GLN:NE2	7:A:1895:HOH:O	2.43	0.46
6:A:1601:CXO:C1	5:B:615:TPP:H2	2.45	0.46
1:A:501[A]:MET:HE2	1:B:466[A]:GLU:HB2	1.96	0.46
3:A:647:P6G:C6	7:A:1760:HOH:O	2.43	0.46
1:A:403:LEU:HB3	1:A:404:PRO:HD3	1.96	0.46
1:B:232[A]:VAL:HG12	1:B:234:VAL:CG2	2.44	0.46
1:A:537:LYS:NZ	7:A:2083:HOH:O	2.31	0.46
1:B:365[A]:ARG:NH2	7:B:934:HOH:O	2.48	0.46
6:A:1601:CXO:H62	1:B:285:TRP:HH2	1.80	0.45
1:B:413:ARG:CD	7:B:882:HOH:O	2.59	0.45
1:A:183:ARG:NH2	7:A:1931:HOH:O	2.50	0.45
1:A:27:GLY:HA3	1:A:76:HIS:CG	2.52	0.45
1:A:455:TYR:CZ	1:B:462[A]:ARG:HD3	2.52	0.45
1:A:125:PRO:HA	3:A:645:P6G:H62	1.99	0.45
1:A:205:ALA:O	7:A:1992:HOH:O	2.21	0.44
1:B:255:GLY:HA3	1:B:262:TRP:CE3	2.52	0.44
1:B:368[B]:GLU:O	1:B:379:ARG:HD3	2.17	0.44
1:A:462:ARG:HD3	1:B:455:TYR:CZ	2.53	0.43
1:B:232[A]:VAL:CG1	1:B:234:VAL:HG23	2.48	0.43
1:A:171:ILE:CG1	1:B:572[B]:VAL:HG12	2.49	0.43
1:A:365[B]:ARG:NH2	7:A:1920:HOH:O	2.51	0.43
1:B:15:GLU:OE2	1:B:40[A]:SER:OG	2.37	0.42
1:A:228:LEU:O	1:A:232[B]:VAL:HG22	2.19	0.42
1:A:346:GLU:CD	7:A:1996:HOH:O	2.63	0.42
1:A:232[A]:VAL:HG12	1:A:234:VAL:CG2	2.50	0.41
1:A:285:TRP:CH2	6:B:601:CXO:H62	2.55	0.41
1:B:373:MET:HA	1:B:374:PRO:C	2.45	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:403:LEU:HB3	1:B:404:PRO:HD3	2.01	0.41
1:A:79:GLY:HA2	5:B:615:TPP:HM22	2.03	0.41
1:A:455:TYR:CZ	1:B:462[B]:ARG:HD3	2.56	0.41
1:B:211:LEU:C	1:B:211:LEU:HD23	2.47	0.40
3:A:647:P6G:H32	1:B:499:GLU:HB2	2.03	0.40
1:A:361:ASP:O	1:A:365[B]:ARG:HG2	2.22	0.40

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:121:GLN:NE2	1:B:121:GLN:NE2[8_665]	2.13	0.07
7:B:997:HOH:O	7:B:1097:HOH:O[4_554]	2.16	0.04

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	617/589 (105%)	606 (98%)	10 (2%)	1 (0%)	43	16
1	B	626/589 (106%)	614 (98%)	11 (2%)	1 (0%)	43	16
All	All	1243/1178 (106%)	1220 (98%)	21 (2%)	2 (0%)	43	16

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	77	CYS
1	B	77	CYS

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	482/453 (106%)	477 (99%)	5 (1%)	68	36
1	B	489/453 (108%)	478 (98%)	11 (2%)	45	10
All	All	971/906 (107%)	955 (98%)	16 (2%)	68	19

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	44	LYS
1	A	45[A]	ARG
1	A	45[B]	ARG
1	A	468[A]	LYS
1	A	468[B]	LYS
1	B	40[A]	SER
1	B	40[B]	SER
1	B	182[A]	THR
1	B	182[B]	THR
1	B	183[A]	ARG
1	B	183[B]	ARG
1	B	186[A]	SER
1	B	186[B]	SER
1	B	206[A]	LYS
1	B	206[B]	LYS
1	B	329	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	121	GLN
1	A	207	ASN
1	A	494	GLN
1	A	495	ASN
1	B	201	GLN
1	B	207	ASN

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Mol	Chain	Res	Type
1	B	367	GLN
1	B	491	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 17 ligands modelled in this entry, 2 are monoatomic - leaving 15 for Mogul analysis.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
5	TPP	B	615	-	26,27,27	1.76	5 (19%)	38,40,40	1.67	6 (15%)
3	P6G	B	642	-	9,9,18	0.40	0	8,8,17	0.49	0
3	P6G	B	643	-	9,9,18	0.40	0	8,8,17	0.60	0
5	TPP	A	614	-	26,27,27	1.46	4 (15%)	38,40,40	1.61	8 (21%)
3	P6G	B	649	-	16,16,18	0.46	0	15,15,17	1.10	1 (6%)
4	FAD	B	613	-	58,58,58	1.53	8 (13%)	85,89,89	1.14	6 (7%)
4	FAD	A	612	-	58,58,58	1.58	5 (8%)	85,89,89	1.31	10 (11%)
3	P6G	A	646	-	15,15,18	0.68	0	14,14,17	0.25	0
3	P6G	A	644	-	6,6,18	0.34	0	5,5,17	0.43	0
3	P6G	B	648	-	16,16,18	0.49	0	15,15,17	1.28	2 (13%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	P6G	A	645	-	9,9,18	0.29	0	8,8,17	0.73	0
6	CXO	A	1601	-	8,8,8	5.87	4 (50%)	10,10,10	2.36	4 (40%)
3	P6G	A	641	-	9,9,18	0.41	0	8,8,17	0.97	0
3	P6G	A	647	-	16,16,18	0.28	0	15,15,17	0.94	1 (6%)
6	CXO	B	601	-	8,8,8	5.83	3 (37%)	10,10,10	2.52	5 (50%)

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
5	TPP	B	615	-	-	0/17/17/17	0/2/2/2
3	P6G	B	642	-	-	3/7/7/16	-
3	P6G	B	643	-	-	0/7/7/16	-
5	TPP	A	614	-	-	0/17/17/17	0/2/2/2
3	P6G	B	649	-	-	9/14/14/16	-
4	FAD	B	613	-	-	3/34/50/50	0/6/6/6
4	FAD	A	612	-	-	7/34/50/50	0/6/6/6
3	P6G	A	646	-	-	7/13/13/16	-
3	P6G	A	644	-	-	2/4/4/16	-
3	P6G	B	648	-	-	8/14/14/16	-
3	P6G	A	645	-	-	0/7/7/16	-
6	CXO	A	1601	-	-	-	0/1/1/1
3	P6G	A	641	-	-	1/7/7/16	-
3	P6G	A	647	-	-	4/14/14/16	-
6	CXO	B	601	-	-	-	0/1/1/1

All (29) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	1601	CXO	C2-C1	-11.57	1.39	1.54
6	B	601	CXO	C2-C1	-11.17	1.40	1.54
6	B	601	CXO	C6-C1	-10.17	1.37	1.50
6	A	1601	CXO	C6-C1	-10.03	1.37	1.50
4	A	612	FAD	PA-O3P	6.85	1.66	1.59
4	B	613	FAD	PA-O3P	6.72	1.66	1.59
6	B	601	CXO	O1-C1	6.37	1.36	1.23
4	A	612	FAD	P-O3P	5.99	1.66	1.59
6	A	1601	CXO	O1-C1	5.78	1.34	1.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	614	TPP	C5-C4	4.96	1.45	1.35
5	B	615	TPP	C5-C4	4.16	1.44	1.35
5	B	615	TPP	C5'-C4'	4.05	1.49	1.42
5	B	615	TPP	C6'-C5'	-3.66	1.30	1.37
4	B	613	FAD	C4X-N5	3.09	1.37	1.30
5	B	615	TPP	C4'-N3'	3.06	1.39	1.35
4	B	613	FAD	C2A-N1A	3.06	1.39	1.33
5	A	614	TPP	C5'-C4'	3.04	1.47	1.42
4	A	612	FAD	C6-C7	2.88	1.43	1.39
4	B	613	FAD	C9-C8	2.61	1.43	1.39
6	A	1601	CXO	C3-C2	2.57	1.54	1.50
4	B	613	FAD	P-O3P	2.53	1.62	1.59
4	A	612	FAD	PA-O2A	-2.50	1.43	1.55
4	B	613	FAD	O4B-C1B	2.33	1.47	1.42
4	B	613	FAD	C1'-C2'	2.32	1.55	1.52
4	B	613	FAD	PA-O2A	-2.22	1.45	1.55
5	B	615	TPP	PA-O3A	2.18	1.61	1.59
5	A	614	TPP	C6'-C5'	-2.18	1.33	1.37
5	A	614	TPP	C4'-N3'	2.16	1.37	1.35
4	A	612	FAD	C2A-N1A	2.14	1.37	1.33

All (43) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	1601	CXO	C5-C6-C1	5.67	124.47	113.57
6	B	601	CXO	C5-C6-C1	4.73	122.67	113.57
6	B	601	CXO	O2-C2-C3	-4.67	113.21	120.87
5	A	614	TPP	C5'-C6'-N1'	4.41	131.02	123.83
5	B	615	TPP	C5'-C6'-N1'	4.40	131.00	123.83
5	B	615	TPP	S1-C2-N3	4.27	117.71	112.30
5	B	615	TPP	C7'-C5'-C6'	4.08	128.38	120.69
5	B	615	TPP	C6'-C5'-C4'	-3.59	111.14	115.55
5	A	614	TPP	CM4-C4-N3	3.35	128.31	120.57
4	A	612	FAD	N3A-C2A-N1A	-3.30	123.58	128.58
5	A	614	TPP	C7'-C5'-C6'	3.29	126.90	120.69
4	B	613	FAD	C5X-C9A-N10	3.25	120.90	117.97
4	A	612	FAD	O3P-P-O1P	-3.23	101.00	110.70
4	A	612	FAD	C6-C7-C8	-3.20	114.99	119.69
4	A	612	FAD	C4X-C10-N10	3.19	121.05	116.48
3	B	649	P6G	C5-O4-C3	2.99	126.34	113.26
4	B	613	FAD	O3P-P-O1P	-2.77	102.36	110.70
4	A	612	FAD	C2B-C3B-C4B	-2.77	97.27	102.61

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	615	TPP	C2-S1-C5	-2.76	89.39	91.22
5	A	614	TPP	C6'-C5'-C4'	-2.75	112.17	115.55
4	A	612	FAD	C9A-C9-C8	2.68	124.61	119.22
6	B	601	CXO	O2-C2-C1	2.67	125.34	120.47
5	A	614	TPP	CM2-C2'-N1'	2.66	120.03	117.20
4	B	613	FAD	C9A-C5X-N5	-2.65	119.64	122.45
3	B	648	P6G	O7-C6-C5	2.63	122.33	110.35
6	A	1601	CXO	O2-C2-C3	-2.62	116.56	120.87
5	A	614	TPP	CM4-C4-C5	-2.59	121.11	127.75
5	A	614	TPP	N4'-C4'-N3'	2.48	120.38	117.03
6	A	1601	CXO	O1-C1-C6	-2.45	116.86	120.87
4	B	613	FAD	C5'-C4'-C3'	-2.33	107.83	112.22
4	A	612	FAD	O4B-C4B-C3B	2.28	109.68	105.15
6	A	1601	CXO	C6-C1-C2	2.26	121.29	118.10
5	A	614	TPP	O3B-PB-O2B	2.24	116.22	107.80
6	B	601	CXO	C3-C2-C1	2.22	121.23	118.10
3	A	647	P6G	C8-O7-C6	2.22	122.98	113.26
4	B	613	FAD	C4X-C10-N10	2.21	119.65	116.48
4	A	612	FAD	C5X-C6-C7	2.21	124.92	120.83
4	A	612	FAD	C7M-C7-C6	2.15	123.36	119.57
4	B	613	FAD	N9A-C8A-N7A	-2.13	110.92	113.94
5	B	615	TPP	C2-N3-C4	-2.09	111.23	114.06
3	B	648	P6G	O10-C9-C8	2.07	119.80	110.35
4	A	612	FAD	O2A-PA-O1A	2.02	121.84	112.44
6	B	601	CXO	O1-C1-C6	-2.02	117.56	120.87

There are no chirality outliers.

All (44) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	612	FAD	PA-O3P-P-O5'
4	B	613	FAD	PA-O3P-P-O5'
3	B	649	P6G	C6-C5-O4-C3
3	A	646	P6G	O1-C2-C3-O4
3	A	646	P6G	O4-C5-C6-O7
3	A	646	P6G	O10-C11-C12-O13
3	A	646	P6G	O7-C8-C9-O10
3	B	649	P6G	C14-C15-O16-C17
3	A	641	P6G	O7-C8-C9-O10
3	A	644	P6G	O4-C5-C6-O7
3	B	642	P6G	O1-C2-C3-O4
3	B	642	P6G	O7-C8-C9-O10

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Mol	Chain	Res	Type	Atoms
3	B	649	P6G	O7-C8-C9-O10
3	B	648	P6G	C15-C14-O13-C12
3	B	649	P6G	O13-C14-C15-O16
3	B	649	P6G	O10-C11-C12-O13
3	B	649	P6G	O1-C2-C3-O4
3	B	648	P6G	O1-C2-C3-O4
3	A	644	P6G	O1-C2-C3-O4
3	B	649	P6G	C2-C3-O4-C5
3	B	648	P6G	C2-C3-O4-C5
3	A	646	P6G	C8-C9-O10-C11
3	A	646	P6G	C9-C8-O7-C6
3	A	647	P6G	C15-C14-O13-C12
3	B	648	P6G	O4-C5-C6-O7
3	B	649	P6G	O4-C5-C6-O7
3	A	647	P6G	O7-C8-C9-O10
3	B	649	P6G	C8-C9-O10-C11
3	A	646	P6G	C6-C5-O4-C3
4	A	612	FAD	C4B-C5B-O5B-PA
3	B	648	P6G	C9-C8-O7-C6
3	A	647	P6G	C9-C8-O7-C6
3	A	647	P6G	C14-C15-O16-C17
4	B	613	FAD	C4B-C5B-O5B-PA
3	B	648	P6G	O13-C14-C15-O16
4	A	612	FAD	C2'-C3'-C4'-O4'
3	B	648	P6G	O10-C11-C12-O13
4	A	612	FAD	O4B-C4B-C5B-O5B
4	A	612	FAD	O3'-C3'-C4'-C5'
4	A	612	FAD	C2B-C1B-N9A-C8A
3	B	648	P6G	O7-C8-C9-O10
4	B	613	FAD	O4B-C4B-C5B-O5B
3	B	642	P6G	C5-C6-O7-C8
4	A	612	FAD	O3'-C3'-C4'-O4'

There are no ring outliers.

8 monomers are involved in 17 short contacts:

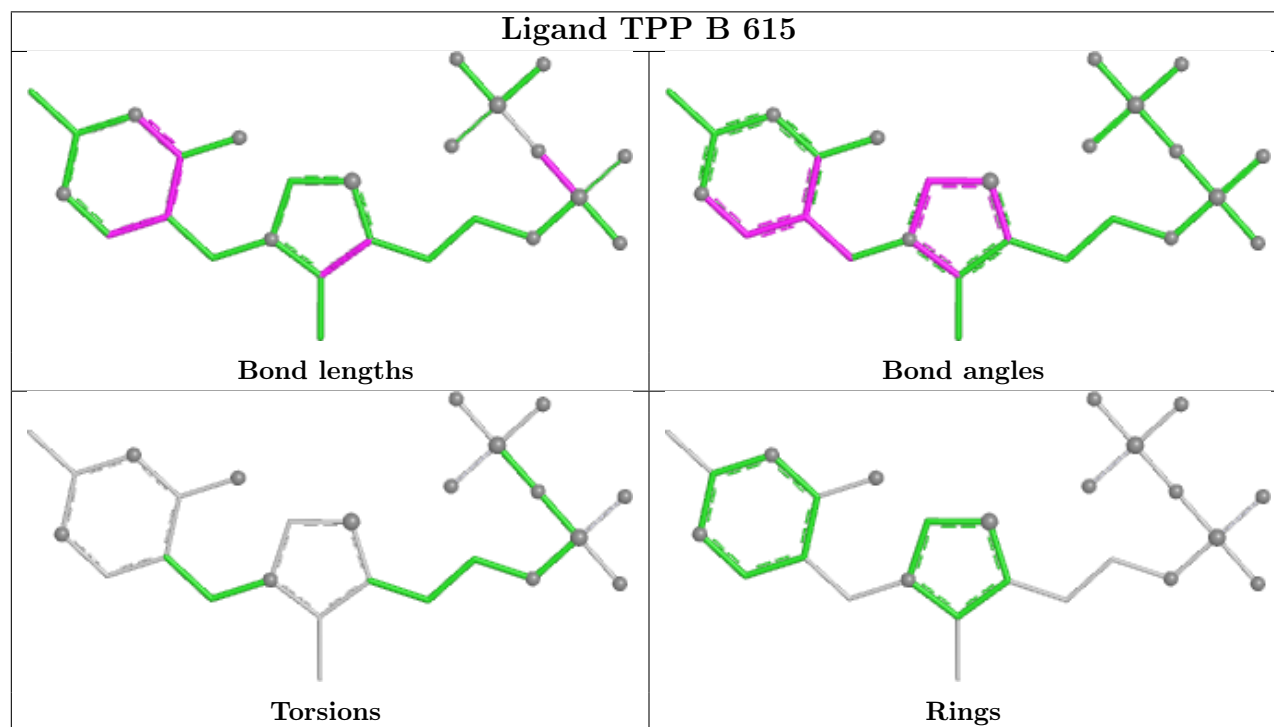
Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	615	TPP	2	0
5	A	614	TPP	1	0
3	B	649	P6G	3	0
3	B	648	P6G	3	0
3	A	645	P6G	2	0

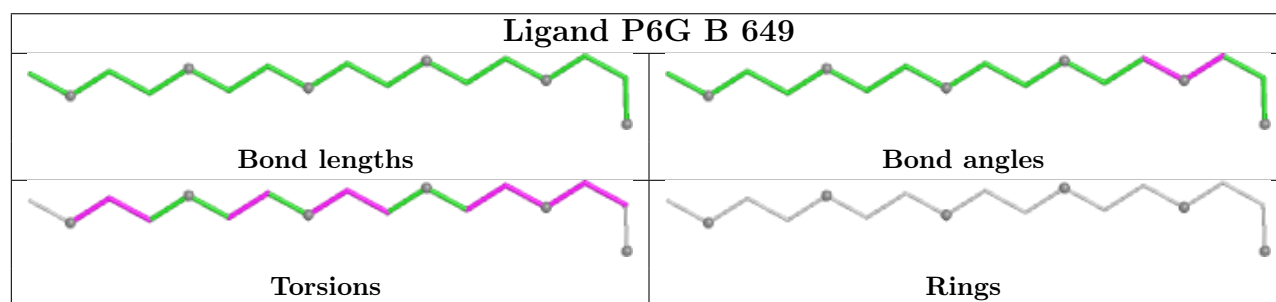
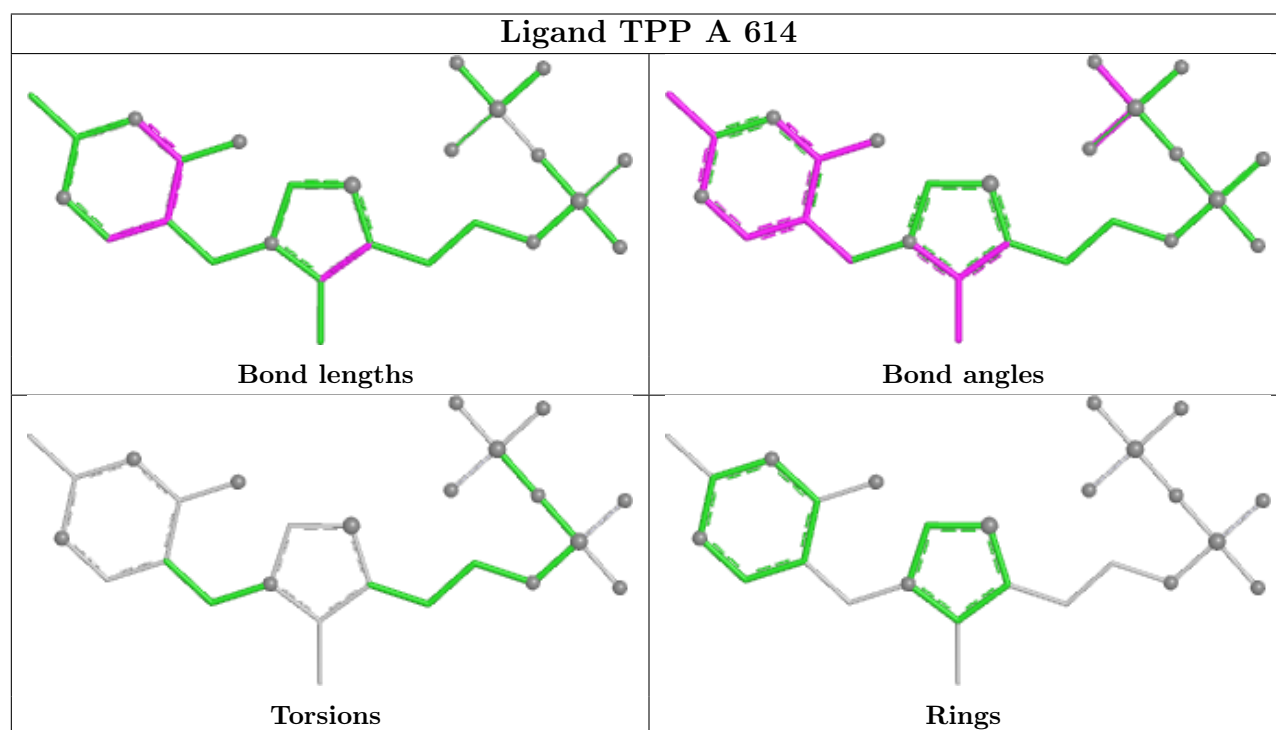
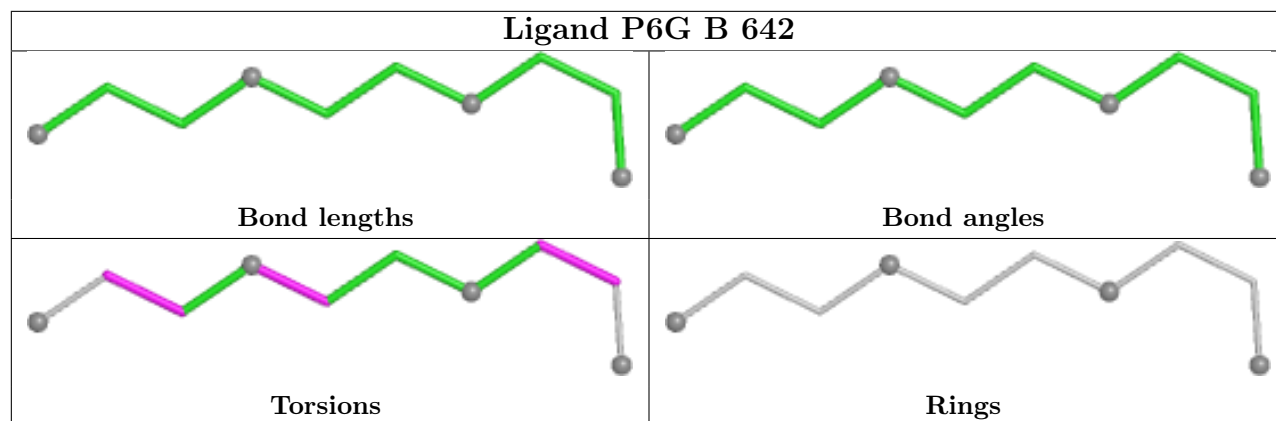
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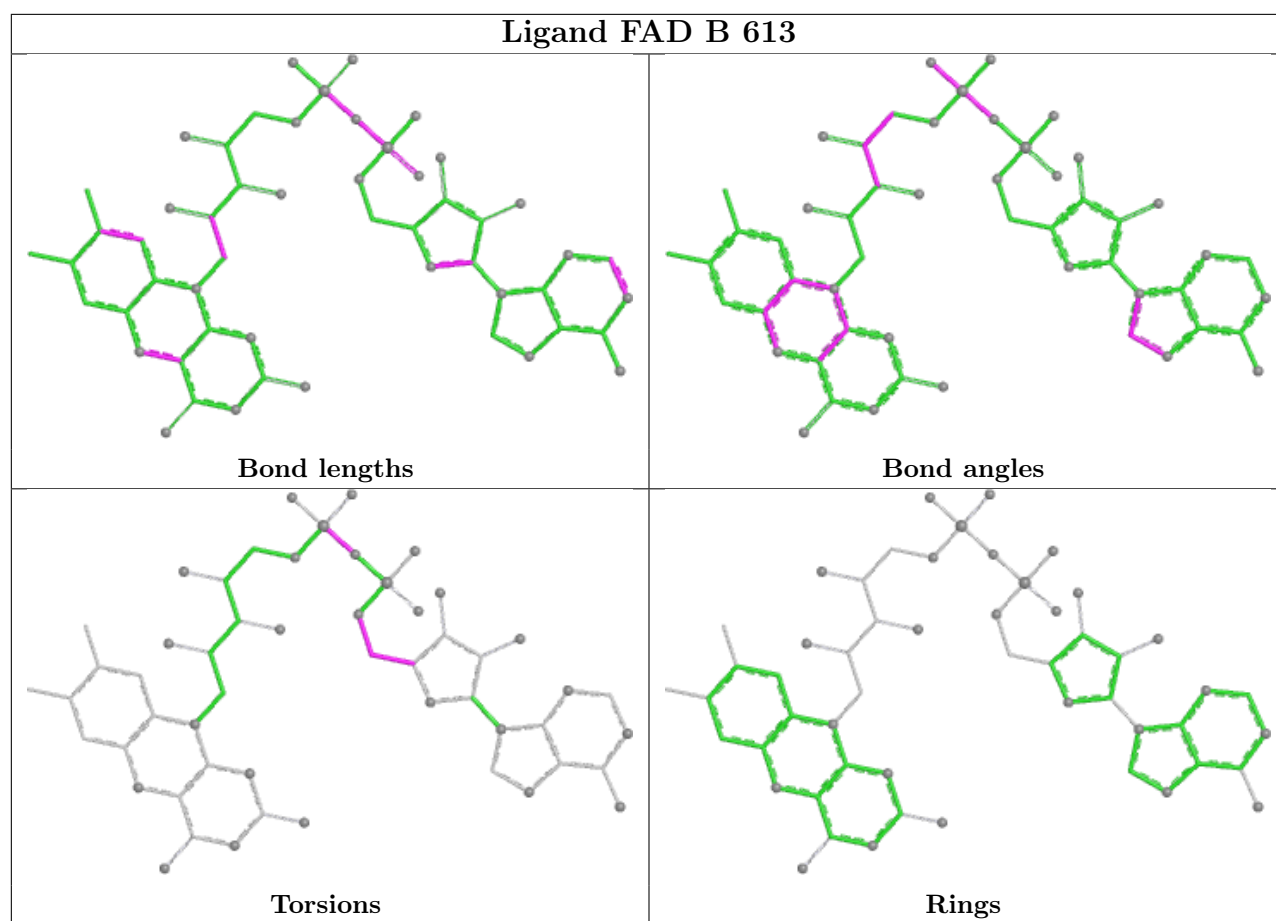
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Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	1601	CXO	3	0
3	A	647	P6G	3	0
6	B	601	CXO	2	0

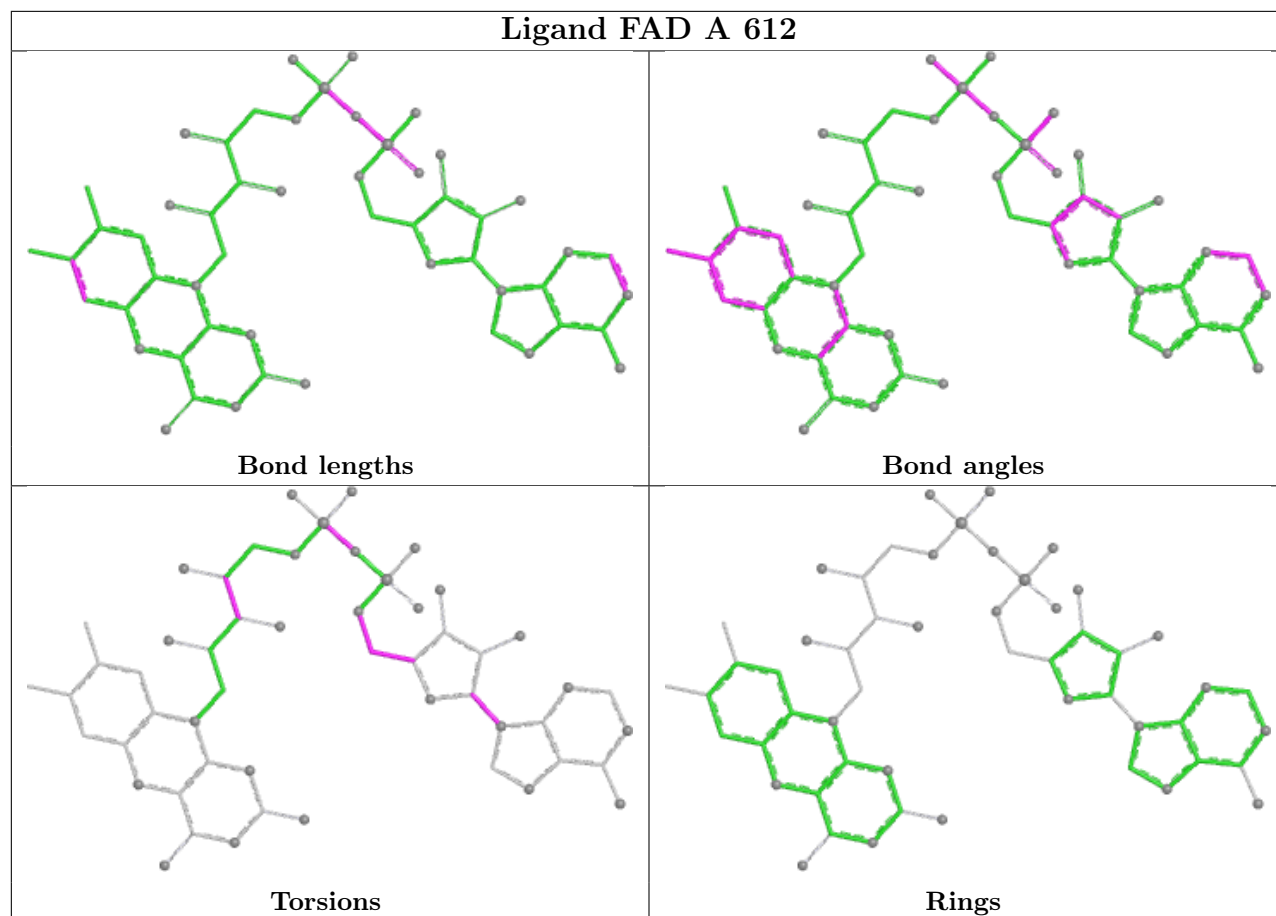
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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



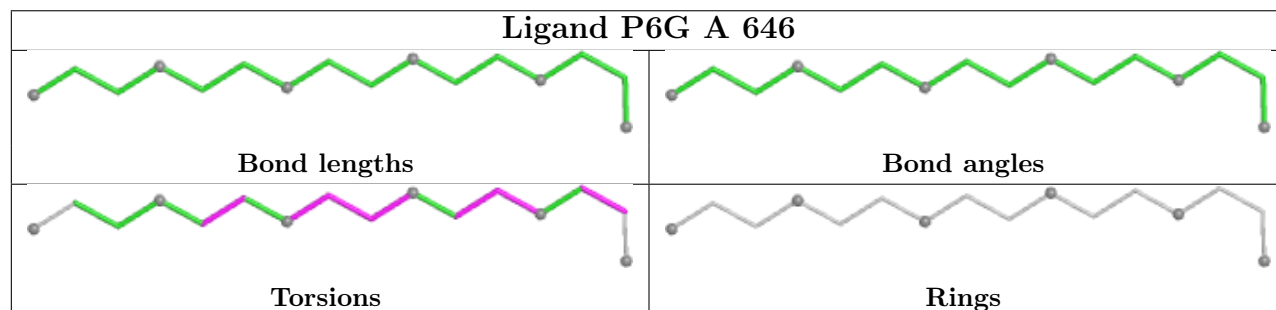




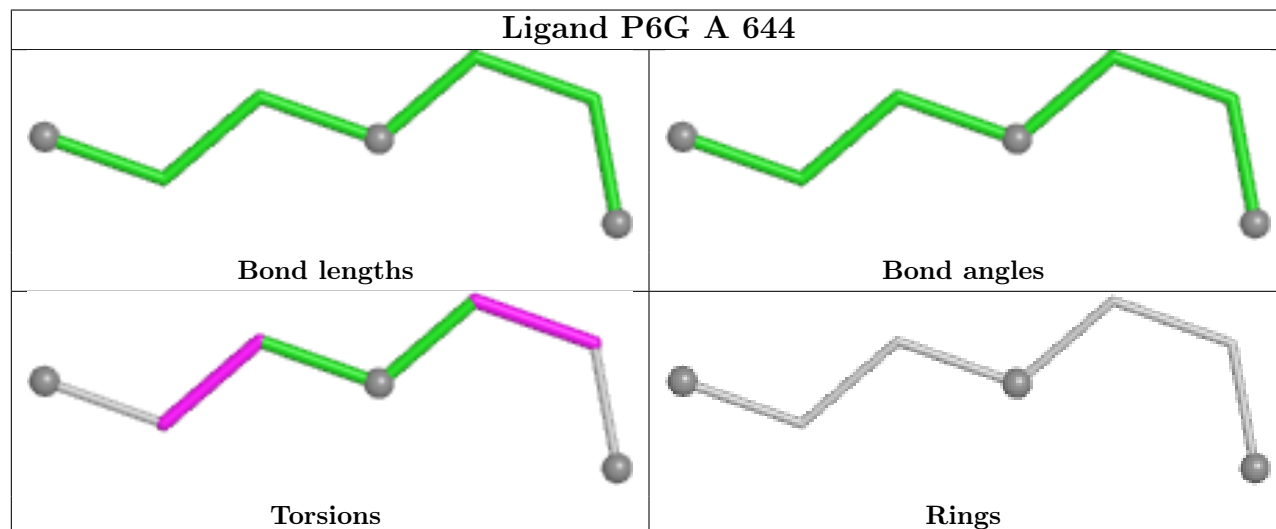
Ligand FAD A 612

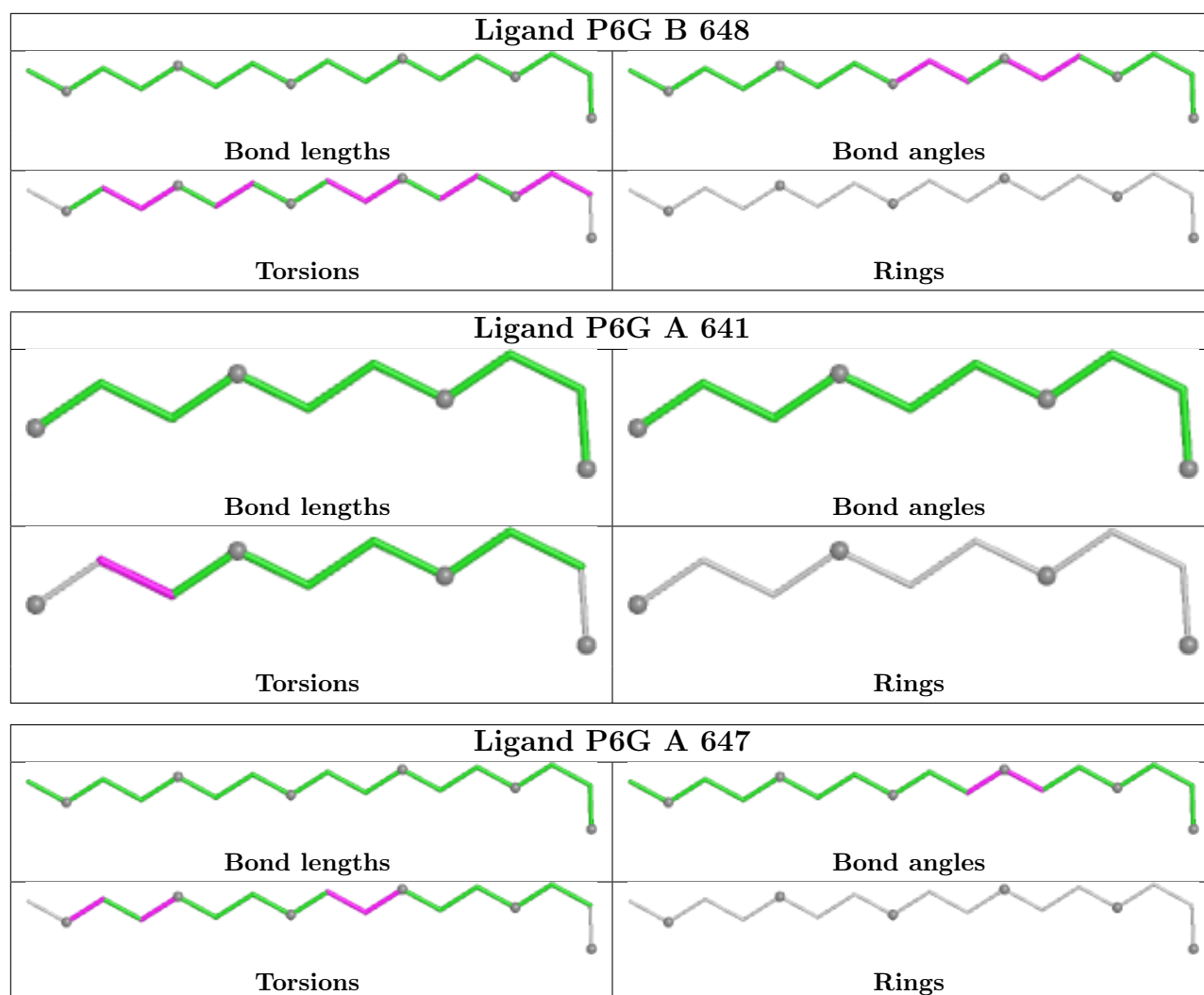


Ligand P6G A 646



Ligand P6G A 644





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	587/589 (99%)	-0.36	11 (1%) 66 67	6, 12, 24, 43	32 (5%)
1	B	587/589 (99%)	-0.44	10 (1%) 69 70	6, 11, 20, 41	42 (7%)
All	All	1174/1178 (99%)	-0.40	21 (1%) 67 68	6, 12, 22, 43	74 (6%)

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	182[A]	THR	6.6
1	B	588	LYS	5.0
1	B	369[A]	SER	3.4
1	A	371	ASP	3.3
1	A	370	GLY	3.1
1	B	571[A]	PRO	2.9
1	B	183[A]	ARG	2.8
1	B	587	LEU	2.8
1	B	574	THR	2.7
1	A	183	ARG	2.7
1	A	3	ILE	2.7
1	B	348	GLU	2.6
1	A	45[A]	ARG	2.6
1	A	2	ALA	2.5
1	B	181[A]	ALA	2.5
1	A	41	HIS	2.4
1	A	44	LYS	2.4
1	A	574	THR	2.3
1	B	351	ARG	2.1
1	A	521	GLU	2.1
1	A	348	GLU	2.1

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](#)

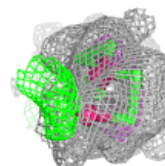
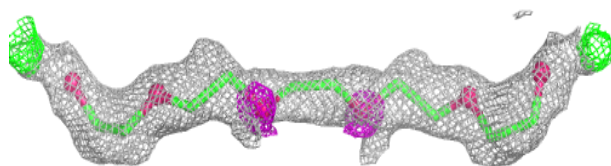
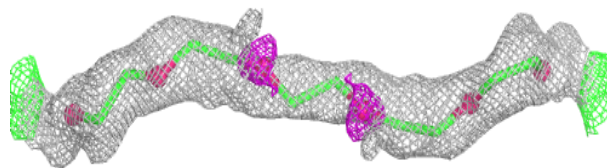
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists 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	P6G	A	646	16/19	0.73	0.11	36,37,38,38	16
3	P6G	A	645	10/19	0.75	0.14	38,42,47,49	0
3	P6G	B	649	17/19	0.76	0.12	29,37,43,45	0
3	P6G	A	644	7/19	0.80	0.10	49,49,50,50	0
3	P6G	A	647	17/19	0.83	0.10	31,36,45,50	0
3	P6G	B	642	10/19	0.85	0.10	38,41,48,50	0
3	P6G	B	648	17/19	0.88	0.10	16,27,36,37	0
3	P6G	A	641	10/19	0.89	0.09	17,20,31,34	0
3	P6G	B	643	10/19	0.94	0.06	16,21,28,36	0
6	CXO	A	1601	8/8	0.96	0.05	10,10,13,16	0
6	CXO	B	601	8/8	0.97	0.05	13,15,16,17	0
5	TPP	A	614	26/26	0.99	0.03	8,10,11,12	0
5	TPP	B	615	26/26	0.99	0.03	7,8,10,10	0
4	FAD	A	612	53/53	0.99	0.03	7,9,11,12	0
4	FAD	B	613	53/53	0.99	0.03	7,8,10,10	0
2	MG	B	611	1/1	1.00	0.04	7,7,7,7	0
2	MG	A	610	1/1	1.00	0.03	8,8,8,8	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.

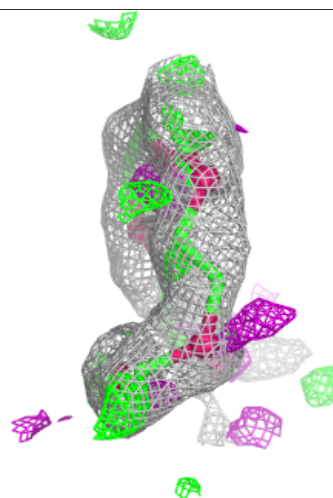
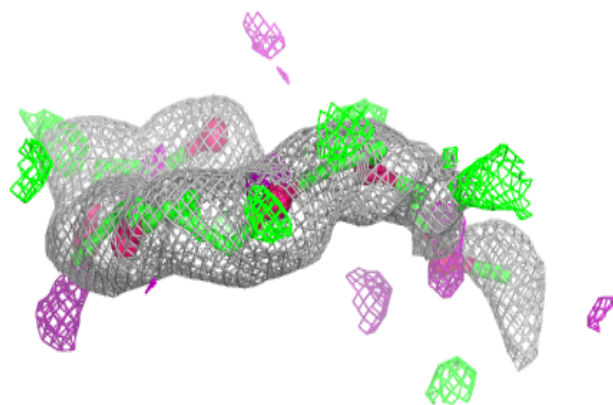
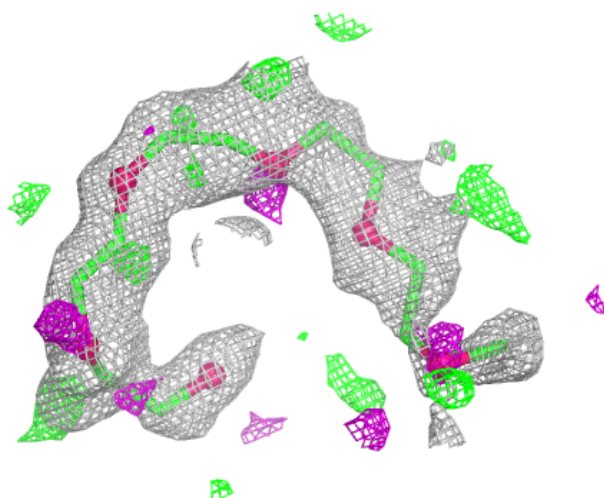
Electron density around P6G A 646:

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



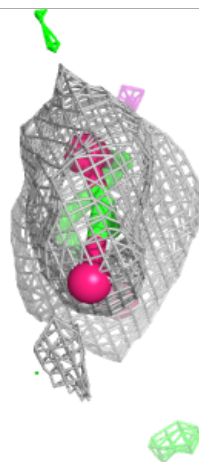
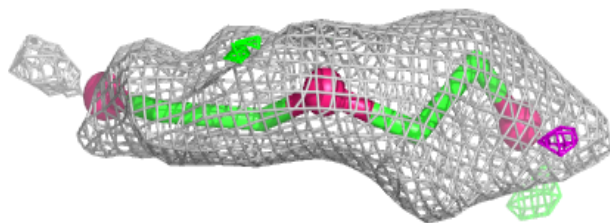
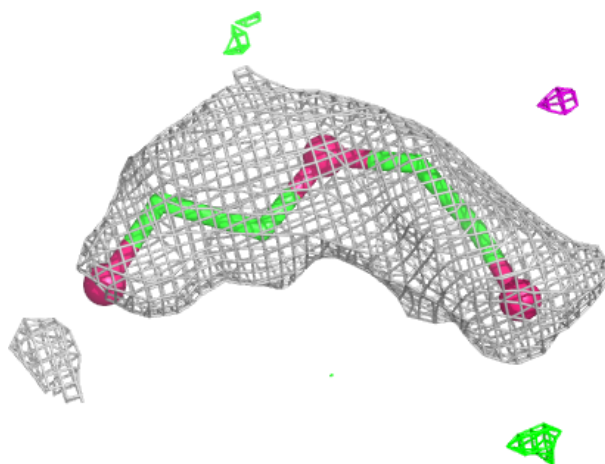
Electron density around P6G B 649:

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



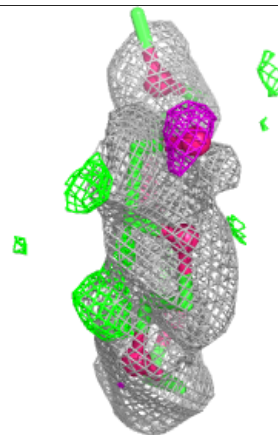
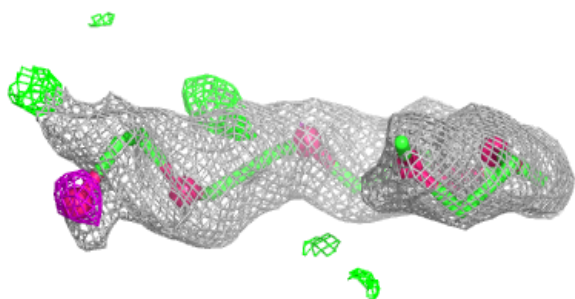
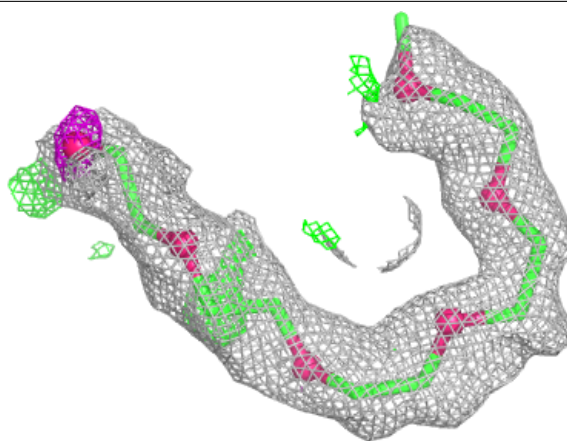
Electron density around P6G A 644:

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



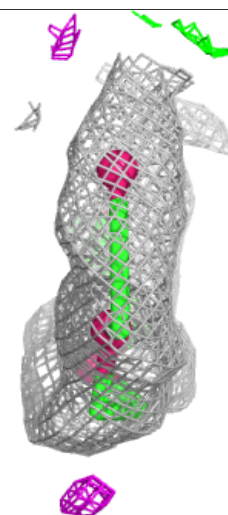
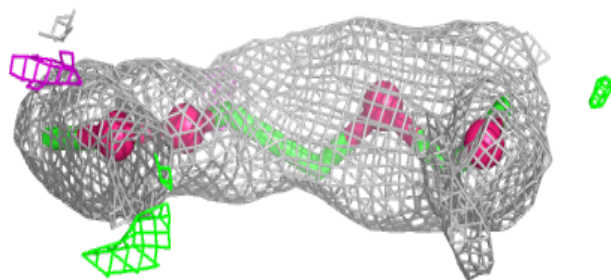
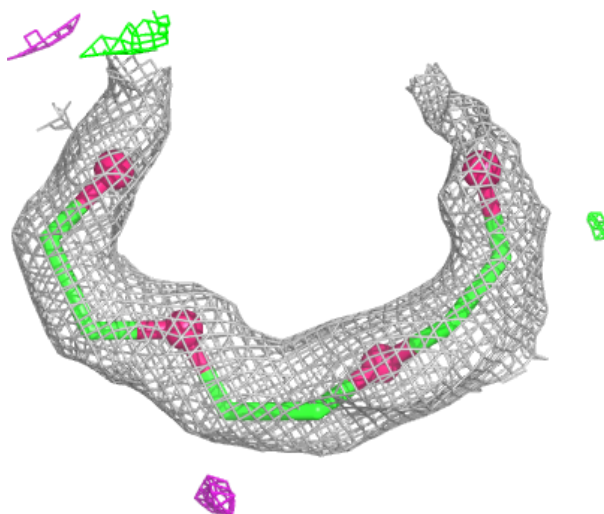
Electron density around P6G A 647:

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



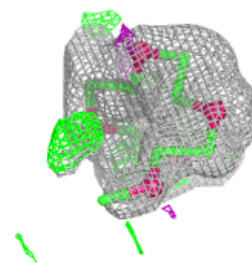
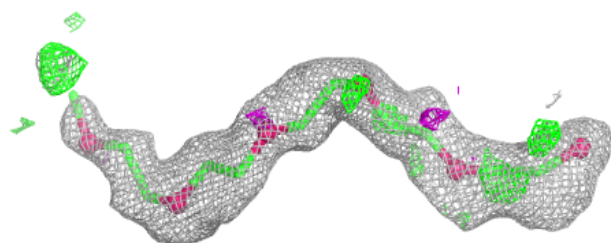
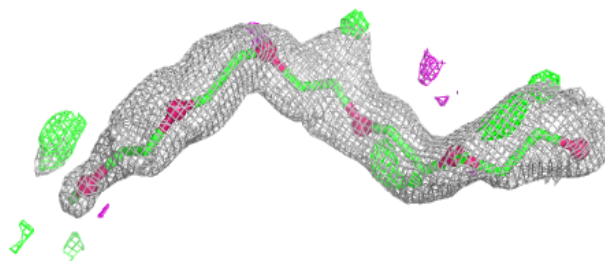
Electron density around P6G B 642:

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

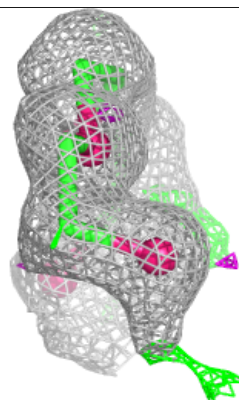
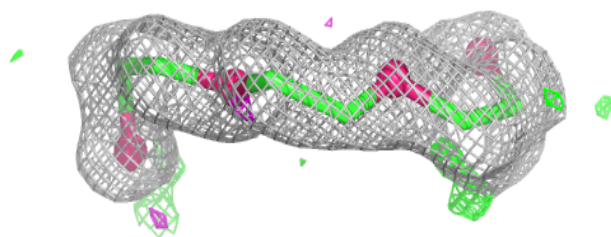
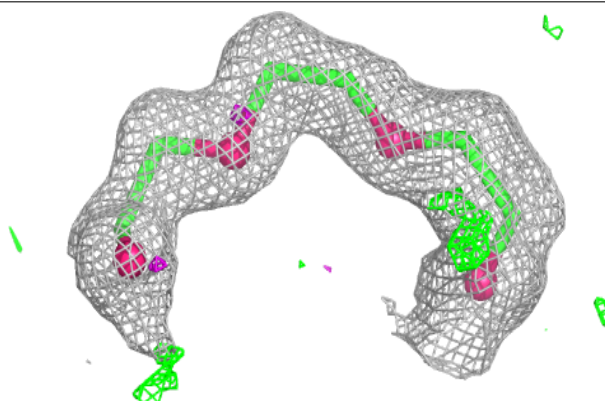


Electron density around P6G B 648:

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

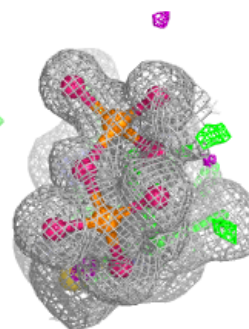
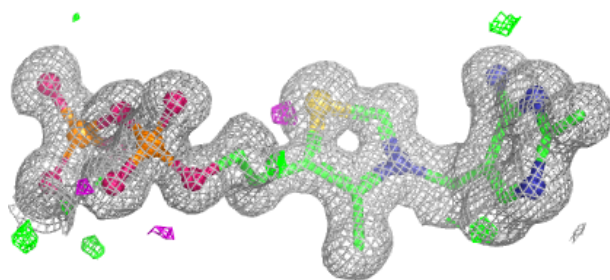
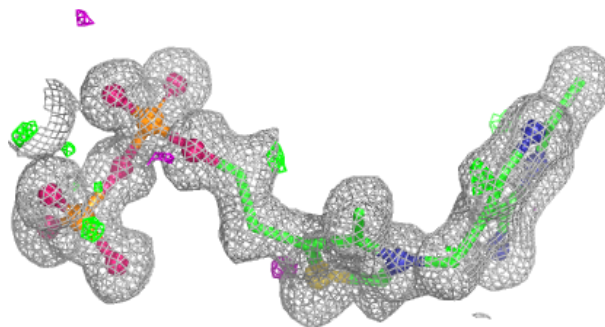
**Electron density around P6G A 641:**

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

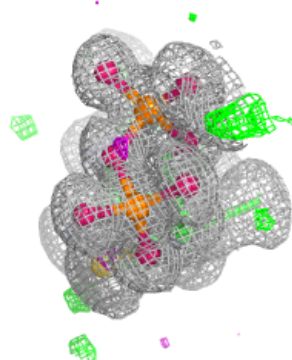
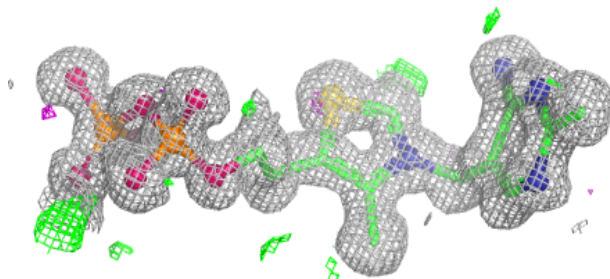
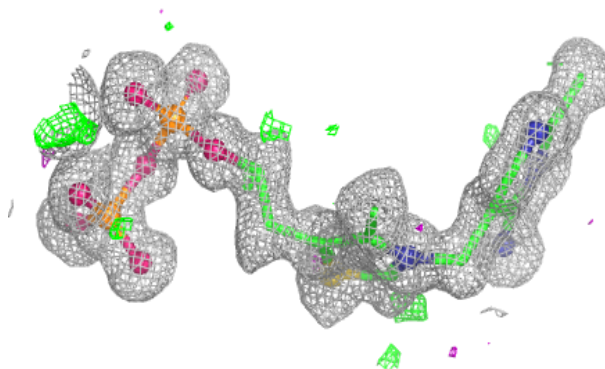


Electron density around TPP A 614:

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

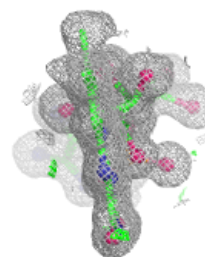
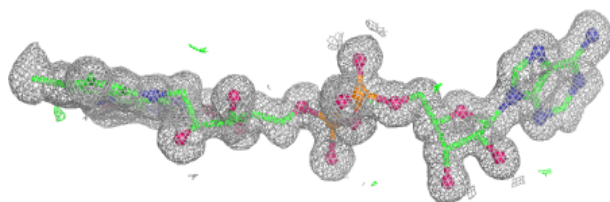
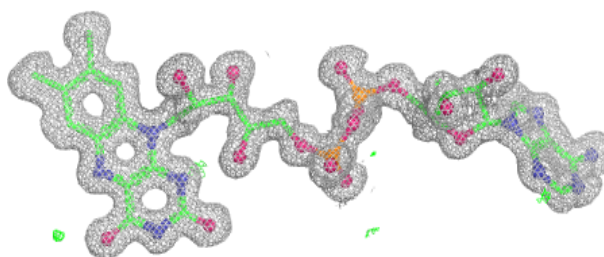
**Electron density around TPP B 615:**

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

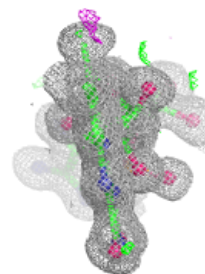
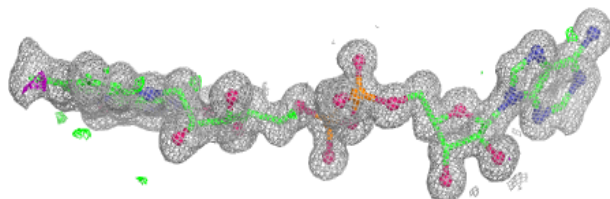
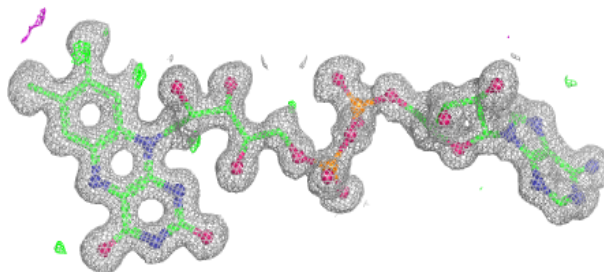


Electron density around FAD A 612:

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

**Electron density around FAD B 613:**

$2mF_o-DF_c$ (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.