W O R L D W I D E
wwPDB
P R O T E I N D A T A B A N K

Full wwPDB X-ray Structure Validation Report (i)

Jan 6, 2025 – 02:53 pm GMT

PDB ID	:	8S7P
Title	:	Vanillyl-alcohol dehydrogenase from Marinicaulis flavus
Authors	:	Guerriere, T.B.; Mattevi, A.
Deposited on	:	2024-03-04
Resolution	:	2.35 Å(reported)

The following versions of software and data (see references (i)) were used in the production of this report:

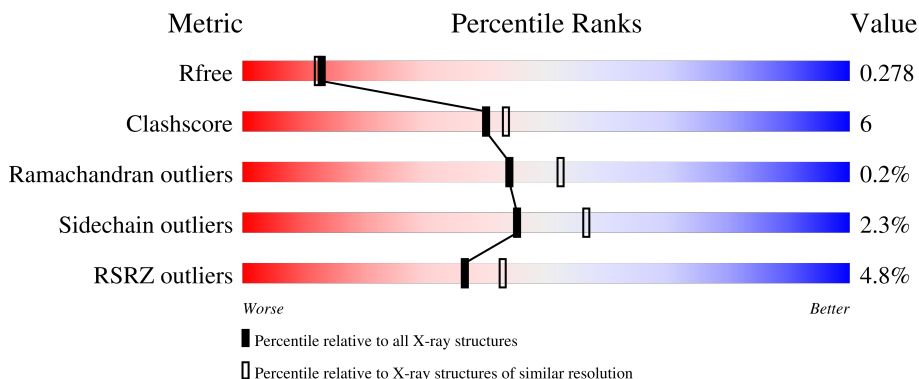|		
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.40

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 2.35 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	Percentile Ranks	Value
Rfree		0.278
Clashscore		6
Ramachandran outliers		0.2%
Sidechain outliers		2.3%
RSRZ outliers		4.8%

Worse .... *Better*

▌ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	164625	1460 (2.36-2.36)
Clashscore	180529	1571 (2.36-2.36)
Ramachandran outliers	177936	1559 (2.36-2.36)
Sidechain outliers	177891	1559 (2.36-2.36)
RSRZ outliers	164620	1460 (2.36-2.36)

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 <=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.

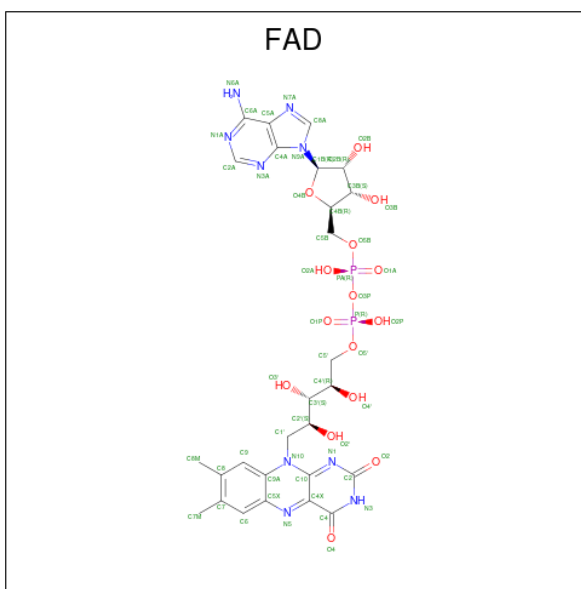| Mol	Chain	Length	Quality of chain
1	A	521	4% / 84% / 14% ·
1	B	521	5% / 83% / 16% ··
1	C	521	5% / 84% / 14% ··

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 12388 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 Oxidoreductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	518	Total	C	N	O	S	0	0	0
			4074	2611	681	761	21			
1	B	518	Total	C	N	O	S	0	0	0
			4052	2599	677	755	21			
1	C	517	Total	C	N	O	S	0	0	0
			4055	2598	680	756	21			

- Molecule 2 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula: $C_{27}H_{33}N_9O_{15}P_2$) (labeled as "Ligand of Interest" by depositor).

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

• Molecule 3 is water.

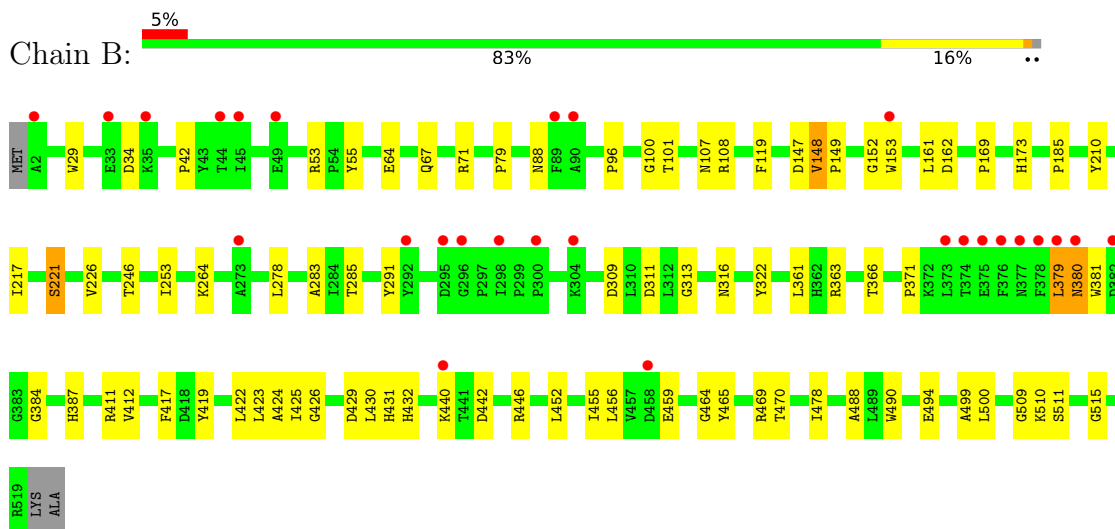| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	16	Total O 16 16		0	0
3	B	13	Total O 13 13		0	0
3	C	19	Total O 19 19		0	0

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: Oxidoreductase

- Molecule 1: Oxidoreductase

- Molecule 1: Oxidoreductase

A94 A95 P96 V97 T101 V102 D105 D147 W153 M194 G209 V225 V226 F247 I253 R261 P262 L263 K264 T274 P297 P325 P326 V345 H362 L373 T374 E375 F376 N377 F378 L379 G384 G385 G386 H387 T397 D400 R413

Y419 M420 G421 L422 L423 A424 I425 G426 W427 R428 D429 L430 H431 H432 V433 F453 H471 I472 R473 Y474 M475 S483 N487 W490 E494 I505 K510 K516 N517 R518 R519 LYS ALA
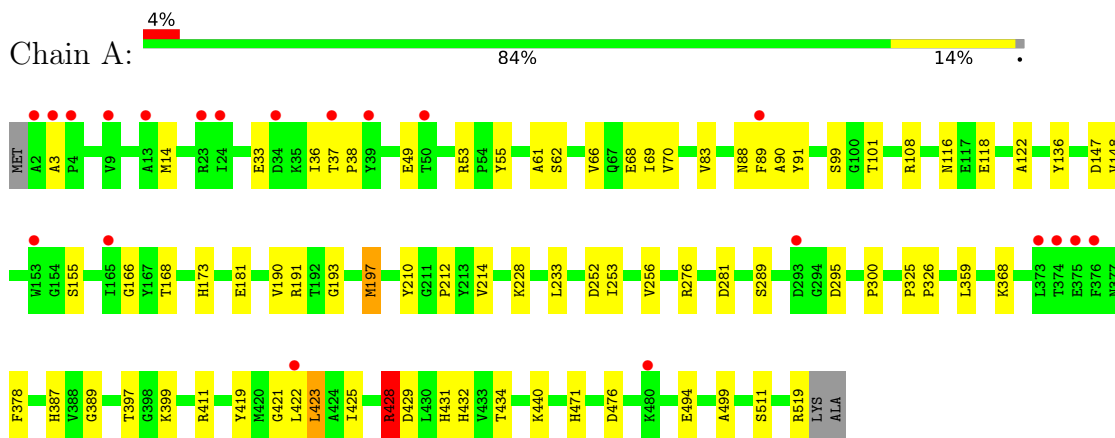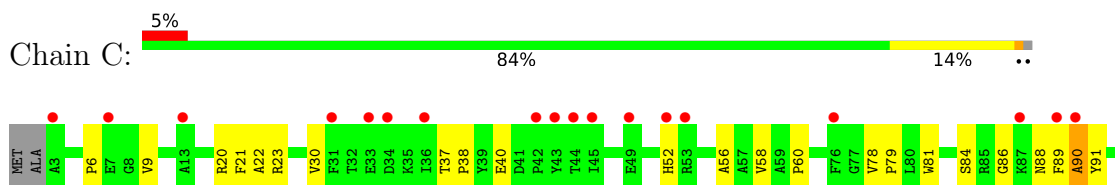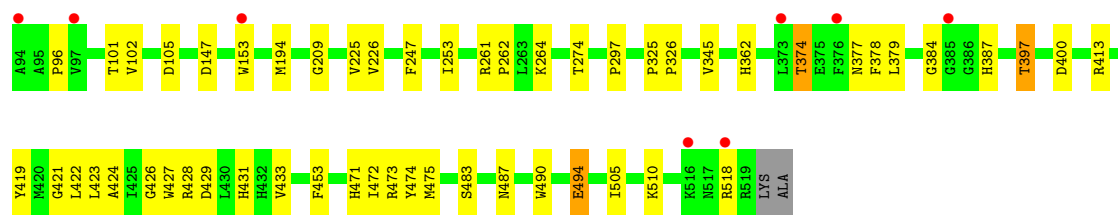
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	90.14Å 143.22Å 287.75Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	67.49 – 2.35 67.49 – 2.35	Depositor EDS
% Data completeness (in resolution range)	100.0 (67.49-2.35) 99.9 (67.49-2.35)	Depositor EDS
R_{merge}	0.17	Depositor
R_{sym}	(Not available)	Depositor
$<I/\sigma(I)>$ [1]	1.44 (at 2.34Å)	Xtriage
Refinement program	REFMAC 5.8.0403	Depositor
R, R_{free}	0.228 , 0.279 0.233 , 0.278	Depositor DCC
R_{free} test set	3964 reflections (5.10%)	wwPDB-VP
Wilson B-factor (Å²)	57.6	Xtriage
Anisotropy	0.017	Xtriage
Bulk solvent k_{sol}(e/Å³), B_{sol}(Å²)	0.32 , 21.4	EDS
L-test for twinning [2]	$<|L|>=0.50$, $<L^2>=0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	12388	wwPDB-VP
Average B, all atoms (Å²)	57.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.85% of the height of the origin peak. No significant pseudotranslation is detected.*

---

[1]Intensities estimated from amplitudes.
[2]Theoretical values of $<|L|>$, $<L^2>$ 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: 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	0.44	0/4190	0.79	3/5705 (0.1%)
1	B	0.43	0/4168	0.76	0/5679
1	C	0.46	1/4170 (0.0%)	0.81	0/5679
All	All	0.44	1/12528 (0.0%)	0.79	3/17063 (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	2
1	B	0	2
1	C	0	1
All	All	0	5

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	494	GLU	CD-OE1	5.08	1.31	1.25

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	428	ARG	NE-CZ-NH1	-6.93	116.84	120.30
1	A	191	ARG	NE-CZ-NH2	-6.03	117.28	120.30
1	A	191	ARG	NE-CZ-NH1	5.68	123.14	120.30

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	411	ARG	Sidechain
1	A	428	ARG	Sidechain
1	B	515	GLY	Peptide
1	B	71	ARG	Sidechain
1	C	147	ASP	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	4074	0	3929	53	0
1	B	4052	0	3895	56	0
1	C	4055	0	3909	56	0
2	A	53	0	31	7	0
2	B	53	0	31	5	0
2	C	53	0	31	14	0
3	A	16	0	0	1	0
3	B	13	0	0	0	0
3	C	19	0	0	0	0
All	All	12388	0	11826	156	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 6.

All (156) 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:387:HIS:NE2	2:B:601:FAD:HM82	1.58	1.19
1:C:387:HIS:NE2	2:C:601:FAD:HM82	1.68	1.06
1:A:387:HIS:NE2	2:A:601:FAD:HM82	1.69	1.06
1:C:397:THR:HG22	1:C:400:ASP:H	1.41	0.85
1:A:387:HIS:NE2	2:A:601:FAD:C8M	2.44	0.81
2:A:601:FAD:O5B	2:A:601:FAD:H8A	1.86	0.75
1:C:81:TRP:HB2	1:C:101:THR:HG21	1.68	0.74
1:C:253:ILE:HG12	1:C:423:LEU:HD13	1.71	0.73
1:B:148:VAL:HG21	1:B:371:PRO:HB3	1.71	0.73
1:C:225:VAL:HA	2:C:601:FAD:N6A	2.05	0.71

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:387:HIS:NE2	2:B:601:FAD:C8M	2.48	0.69
1:C:510:LYS:HE2	2:C:601:FAD:H2B	1.74	0.68
1:C:378:PHE:CZ	2:C:601:FAD:HM72	2.29	0.68
1:A:378:PHE:CZ	2:A:601:FAD:HM72	2.31	0.66
1:C:79:PRO:HG3	1:C:518:ARG:HH22	1.62	0.65
1:C:91:TYR:HA	1:C:471:HIS:HA	1.77	0.64
1:C:325:PRO:HB2	1:C:326:PRO:HD3	1.79	0.64
1:C:84:SER:OG	2:C:601:FAD:H2A	1.98	0.64
1:C:60:PRO:HD2	1:C:105:ASP:O	1.98	0.64
1:C:387:HIS:NE2	2:C:601:FAD:C8M	2.53	0.64
1:A:387:HIS:CD2	2:A:601:FAD:HM82	2.33	0.63
1:A:90:ALA:HB2	1:A:387:HIS:NE2	2.14	0.63
1:C:264:LYS:CE	1:C:426:GLY:O	2.48	0.62
1:C:429:ASP:OD2	1:C:431:HIS:HE1	1.83	0.62
1:B:246:THR:HG22	1:B:316:ASN:OD1	2.01	0.61
1:C:264:LYS:HE2	1:C:426:GLY:O	2.01	0.60
1:A:419:TYR:OH	1:A:432:HIS:HE1	1.85	0.58
1:C:226:VAL:H	2:C:601:FAD:H62A	1.51	0.58
1:B:253:ILE:HD11	1:B:423:LEU:HD12	1.86	0.58
1:A:91:TYR:HA	1:A:471:HIS:HA	1.85	0.58
1:A:197:MET:CE	1:B:464:GLY:C	2.73	0.57
1:A:428:ARG:HD3	1:B:119:PHE:O	2.05	0.57
1:C:81:TRP:HB2	1:C:101:THR:CG2	2.33	0.57
1:C:378:PHE:HZ	2:C:601:FAD:HM72	1.70	0.57
1:A:197:MET:HE1	1:B:464:GLY:C	2.27	0.55
1:B:253:ILE:CG1	1:B:423:LEU:HD12	2.36	0.55
1:C:427:TRP:O	1:C:428:ARG:HB2	2.05	0.55
1:A:197:MET:HE1	1:B:465:TYR:N	2.22	0.55
1:A:429:ASP:OD2	1:A:431:HIS:HE1	1.89	0.55
1:B:264:LYS:HG2	1:B:425:ILE:CG2	2.37	0.55
1:B:42:PRO:O	1:B:440:LYS:HD3	2.08	0.54
1:C:86:GLY:HA2	2:C:601:FAD:O1A	2.06	0.54
1:A:147:ASP:OD1	1:A:166:GLY:HA3	2.08	0.54
1:B:425:ILE:HA	1:B:429:ASP:O	2.08	0.53
1:A:276:ARG:HG2	1:A:422:LEU:HG	1.90	0.53
1:C:297:PRO:HB3	1:C:413:ARG:NH1	2.23	0.53
1:A:397:THR:HG22	1:A:399:LYS:H	1.74	0.52
1:B:291:TYR:OH	1:B:309:ASP:OD2	2.22	0.52
1:C:90:ALA:HB2	1:C:387:HIS:NE2	2.24	0.52
1:B:64:GLU:HA	1:B:67:GLN:HE21	1.74	0.51
1:C:397:THR:HG22	1:C:400:ASP:N	2.20	0.51

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:261:ARG:HB3	1:C:262:PRO:CD	2.40	0.51
1:B:253:ILE:CG1	1:B:423:LEU:CD1	2.88	0.51
1:C:225:VAL:HA	2:C:601:FAD:H62A	1.73	0.51
1:A:89:PHE:O	1:A:90:ALA:HB3	2.11	0.50
1:A:214:VAL:HG12	1:B:217:ILE:HG22	1.93	0.50
1:C:21:PHE:CD2	1:C:58:VAL:HG21	2.47	0.50
1:A:122:ALA:HB2	1:A:233:LEU:HD11	1.94	0.50
1:A:181:GLU:OE2	1:A:228:LYS:NZ	2.45	0.50
1:C:253:ILE:CG1	1:C:423:LEU:HD13	2.40	0.50
1:B:88:ASN:HB2	2:B:601:FAD:O1A	2.12	0.50
1:C:490:TRP:O	1:C:494:GLU:HG2	2.12	0.50
1:C:379:LEU:O	1:C:384:GLY:HA2	2.11	0.50
1:A:3:ALA:HB2	1:A:53:ARG:HB3	1.95	0.49
1:C:88:ASN:ND2	2:C:601:FAD:H51A	2.27	0.49
1:A:88:ASN:HB2	2:A:601:FAD:O1A	2.12	0.49
1:C:89:PHE:HB2	2:C:601:FAD:HM81	1.95	0.49
1:A:397:THR:HG22	1:A:399:LYS:N	2.29	0.48
1:B:425:ILE:HG12	1:B:430:LEU:HD12	1.95	0.48
1:C:471:HIS:ND1	1:C:473:ARG:HB3	2.29	0.48
1:B:149:PRO:HG2	1:B:152:GLY:HA2	1.94	0.48
1:C:422:LEU:CD2	1:C:424:ALA:HB2	2.44	0.47
1:B:147:ASP:OD1	1:B:173:HIS:NE2	2.48	0.47
1:A:61:ALA:HB2	1:A:108:ARG:NH1	2.29	0.47
1:A:295:ASP:OD1	1:C:23:ARG:NH2	2.48	0.47
2:B:601:FAD:O5B	2:B:601:FAD:H8A	2.14	0.47
1:C:419:TYR:CZ	1:C:421:GLY:HA3	2.50	0.47
1:B:283:ALA:HA	1:B:381:TRP:CE3	2.50	0.47
1:A:66:VAL:O	1:A:70:VAL:HG23	2.15	0.46
1:B:29:TRP:CE3	1:B:108:ARG:HD2	2.49	0.46
1:B:55:TYR:HB2	1:B:100:GLY:HA2	1.97	0.46
1:B:253:ILE:CD1	1:B:423:LEU:HD12	2.44	0.46
1:B:53:ARG:HH11	1:B:53:ARG:HG3	1.79	0.46
1:A:325:PRO:HB2	1:A:326:PRO:HD3	1.98	0.46
1:B:162:ASP:OD2	1:B:469:ARG:NE	2.47	0.46
1:C:422:LEU:HD21	1:C:424:ALA:HB2	1.98	0.46
1:C:453:PHE:CE2	1:C:474:TYR:CD2	3.03	0.46
1:C:247:PHE:CE1	1:C:345:VAL:HG23	2.51	0.46
1:A:37:THR:N	1:A:38:PRO:CD	2.78	0.46
1:A:419:TYR:OH	1:A:432:HIS:CE1	2.68	0.46
1:C:52:HIS:CD2	1:C:52:HIS:N	2.84	0.46
1:C:362:HIS:CE1	1:C:374:THR:CG2	2.99	0.46

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:422:LEU:HD21	1:B:424:ALA:HB2	1.98	0.46
1:A:253:ILE:CG1	1:A:423:LEU:HD13	2.46	0.45
1:B:509:GLY:O	1:B:510:LYS:C	2.55	0.45
1:C:56:ALA:HB3	1:C:102:VAL:HG13	1.99	0.45
1:B:253:ILE:HG12	1:B:423:LEU:HD12	1.98	0.45
1:B:412:VAL:HG13	1:B:417:PHE:HB2	1.98	0.45
1:B:161:LEU:HD11	1:B:226:VAL:HG21	1.99	0.45
1:A:155:SER:N	2:A:601:FAD:O1P	2.42	0.45
1:C:483:SER:HA	1:C:487:ASN:ND2	2.32	0.44
1:A:281:ASP:CG	1:A:359:LEU:HD13	2.37	0.44
1:A:116:ASN:OD1	1:A:118:GLU:HG2	2.17	0.44
1:A:33:GLU:O	1:A:36:ILE:HG22	2.17	0.44
1:B:387:HIS:CD2	2:B:601:FAD:HM82	2.45	0.44
1:A:253:ILE:HG12	1:A:423:LEU:HD13	2.00	0.44
1:B:470:THR:HG21	1:B:478:ILE:HG13	2.00	0.44
1:B:419:TYR:OH	1:B:432:HIS:HE1	2.01	0.44
1:B:452:LEU:O	1:B:456:LEU:HG	2.18	0.44
1:B:455:ILE:O	1:B:459:GLU:HG3	2.18	0.44
1:C:37:THR:N	1:C:38:PRO:CD	2.81	0.43
1:A:49:GLU:O	1:A:53:ARG:NH1	2.43	0.43
1:A:89:PHE:O	1:A:90:ALA:CB	2.67	0.43
1:C:472:ILE:HA	1:C:475:MET:HE3	2.01	0.43
1:A:68:GLU:O	1:A:69:ILE:C	2.56	0.43
1:A:425:ILE:HA	1:A:429:ASP:O	2.17	0.43
1:A:499:ALA:HB2	1:B:499:ALA:HB2	2.00	0.43
1:A:511:SER:HA	1:B:210:TYR:OH	2.17	0.43
1:C:37:THR:HA	1:C:40:GLU:HG2	2.01	0.43
1:A:190:VAL:HG12	1:B:488:ALA:HB1	2.01	0.43
1:A:14:MET:HG2	1:A:55:TYR:CE2	2.54	0.43
1:C:505:ILE:HD12	1:C:505:ILE:C	2.39	0.43
1:B:379:LEU:HD23	1:B:380:ASN:H	1.83	0.42
1:A:136:TYR:C	1:A:136:TYR:CD1	2.93	0.42
1:A:368:LYS:O	1:A:368:LYS:HG3	2.19	0.42
1:A:252:ASP:O	1:A:256:VAL:HG23	2.20	0.42
1:B:185:PRO:HB2	1:B:500:LEU:O	2.20	0.42
1:B:278:LEU:HB2	1:B:313:GLY:O	2.20	0.42
1:C:226:VAL:N	2:C:601:FAD:H62A	2.16	0.42
1:B:264:LYS:HG2	1:B:425:ILE:HG21	2.00	0.42
1:A:494:GLU:HB3	1:A:519:ARG:NH1	2.35	0.42
1:B:253:ILE:HD12	1:B:253:ILE:HA	1.88	0.42
1:C:387:HIS:CD2	2:C:601:FAD:HM82	2.51	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:22:ALA:HB2	1:C:30:VAL:HG21	2.01	0.42
1:A:212:PRO:HG3	1:B:221:SER:HB2	2.02	0.41
1:B:442:ASP:O	1:B:446:ARG:HG3	2.20	0.41
1:C:6:PRO:HG2	1:C:9:VAL:HG21	2.02	0.41
1:B:79:PRO:HG2	1:B:101:THR:HA	2.02	0.41
1:B:431:HIS:ND1	1:B:431:HIS:N	2.67	0.41
1:A:147:ASP:OD1	1:A:173:HIS:NE2	2.54	0.41
1:B:264:LYS:HG2	1:B:425:ILE:HG22	2.01	0.41
1:A:193:GLY:HA3	3:A:708:HOH:O	2.20	0.41
1:C:194:MET:SD	1:C:209:GLY:HA2	2.61	0.41
1:A:419:TYR:CZ	1:A:421:GLY:HA3	2.56	0.41
1:B:490:TRP:O	1:B:494:GLU:HG2	2.20	0.41
1:A:389:GLY:HA2	1:A:434:THR:O	2.21	0.41
1:C:52:HIS:HA	1:C:96:PRO:O	2.21	0.41
1:B:169:PRO:HD3	1:B:322:TYR:CZ	2.56	0.41
1:B:363:ARG:HD3	1:B:366:THR:HB	2.03	0.41
1:C:89:PHE:O	1:C:90:ALA:HB3	2.20	0.41
1:A:210:TYR:OH	1:B:511:SER:HA	2.21	0.40
1:A:422:LEU:HD23	1:A:423:LEU:N	2.36	0.40
1:B:148:VAL:HG22	1:B:149:PRO:HD2	2.03	0.40
1:C:422:LEU:HB3	1:C:433:VAL:HB	2.02	0.40
1:C:78:VAL:HA	1:C:79:PRO:HD3	1.86	0.40
1:B:411:ARG:HD2	1:B:455:ILE:HG21	2.03	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	516/521 (99%)	484 (94%)	32 (6%)	0	100	100
1	B	516/521 (99%)	485 (94%)	29 (6%)	2 (0%)	30	34

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	515/521 (99%)	489 (95%)	25 (5%)	1 (0%)	44	52
All	All	1547/1563 (99%)	1458 (94%)	86 (6%)	3 (0%)	44	52

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	90	ALA
1	B	384	GLY
1	B	426	GLY

5.3.2 Protein sidechains ⓘ

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	426/430 (99%)	414 (97%)	12 (3%)	38	49
1	B	421/430 (98%)	410 (97%)	11 (3%)	41	52
1	C	423/430 (98%)	417 (99%)	6 (1%)	62	75
All	All	1270/1290 (98%)	1241 (98%)	29 (2%)	45	56

All (29) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	62	SER
1	A	83	VAL
1	A	99	SER
1	A	101	THR
1	A	148	VAL
1	A	168	THR
1	A	197	MET
1	A	289	SER
1	A	300	PRO
1	A	423	LEU
1	A	440	LYS
1	A	476	ASP

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	B	34	ASP
1	B	96	PRO
1	B	107	ASN
1	B	148	VAL
1	B	153	TRP
1	B	221	SER
1	B	285	THR
1	B	311	ASP
1	B	361	LEU
1	B	379	LEU
1	B	380	ASN
1	C	20	ARG
1	C	153	TRP
1	C	274	THR
1	C	374	THR
1	C	377	ASN
1	C	397	THR

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	362	HIS
1	A	380	ASN
1	A	404	GLN
1	A	431	HIS
1	A	432	HIS
1	B	67	GLN
1	B	380	ASN
1	B	432	HIS
1	B	517	ASN
1	C	52	HIS
1	C	107	ASN
1	C	290	GLN
1	C	355	HIS
1	C	362	HIS
1	C	431	HIS
1	C	487	ASN

5.3.3 RNA (i)

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 ⓘ

3 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	B	601	-	53,58,58	0.63	0	68,89,89	0.77	3 (4%)
2	FAD	A	601	-	53,58,58	0.78	1 (1%)	68,89,89	0.86	2 (2%)
2	FAD	C	601	-	53,58,58	0.66	0	68,89,89	1.28	6 (8%)

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	B	601	-	-	6/30/50/50	0/6/6/6
2	FAD	A	601	-	-	9/30/50/50	0/6/6/6
2	FAD	C	601	-	-	14/30/50/50	0/6/6/6

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	601	FAD	C1'-C2'	2.62	1.56	1.52

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	601	FAD	C3B-C2B-C1B	-4.98	93.48	100.98
2	C	601	FAD	O4B-C1B-C2B	-4.75	99.98	106.93
2	C	601	FAD	C1B-N9A-C4A	-2.79	121.73	126.64
2	A	601	FAD	C4-N3-C2	-2.32	121.35	125.64
2	B	601	FAD	O2'-C2'-C1'	2.29	115.33	109.80
2	A	601	FAD	O2B-C2B-C3B	2.14	118.76	111.82
2	C	601	FAD	O2A-PA-O1A	2.12	122.73	112.24
2	C	601	FAD	O2B-C2B-C1B	2.09	118.56	110.85
2	C	601	FAD	C4-N3-C2	-2.07	121.81	125.64
2	B	601	FAD	C5A-C6A-N6A	2.01	123.41	120.35
2	B	601	FAD	C4-N3-C2	-2.01	121.94	125.64

There are no chirality outliers.

All (29) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	601	FAD	C3'-C4'-C5'-O5'
2	A	601	FAD	O4'-C4'-C5'-O5'
2	C	601	FAD	C5B-O5B-PA-O1A
2	C	601	FAD	C5B-O5B-PA-O2A
2	C	601	FAD	C3'-C4'-C5'-O5'
2	C	601	FAD	C5'-O5'-P-O1P
2	C	601	FAD	O4B-C4B-C5B-O5B
2	C	601	FAD	C3B-C4B-C5B-O5B
2	A	601	FAD	O3'-C3'-C4'-O4'
2	A	601	FAD	C2'-C3'-C4'-O4'
2	C	601	FAD	O4'-C4'-C5'-O5'
2	A	601	FAD	C2'-C3'-C4'-C5'
2	C	601	FAD	O3'-C3'-C4'-O4'
2	C	601	FAD	C2'-C3'-C4'-O4'
2	B	601	FAD	C3'-C4'-C5'-O5'
2	C	601	FAD	C2'-C3'-C4'-C5'
2	B	601	FAD	O4'-C4'-C5'-O5'
2	A	601	FAD	O3'-C3'-C4'-C5'
2	B	601	FAD	C2'-C3'-C4'-O4'
2	A	601	FAD	C5'-O5'-P-O3P
2	C	601	FAD	C5B-O5B-PA-O3P
2	C	601	FAD	C5'-O5'-P-O3P
2	B	601	FAD	PA-O3P-P-O2P
2	C	601	FAD	C5'-O5'-P-O2P
2	A	601	FAD	PA-O3P-P-O2P
2	B	601	FAD	O3'-C3'-C4'-O4'
2	C	601	FAD	O3'-C3'-C4'-C5'

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms
2	A	601	FAD	PA-O3P-P-O1P
2	B	601	FAD	PA-O3P-P-O1P

There are no ring outliers.

3 monomers are involved in 26 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	601	FAD	5	0
2	A	601	FAD	7	0
2	C	601	FAD	14	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 then 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 B 601

Bond lengths　　　Bond angles

Torsions　　　Rings

Ligand FAD A 601

Bond lengths

Bond angles

Torsions

Rings

Ligand FAD C 601

Bond lengths

Bond angles

Torsions

Rings
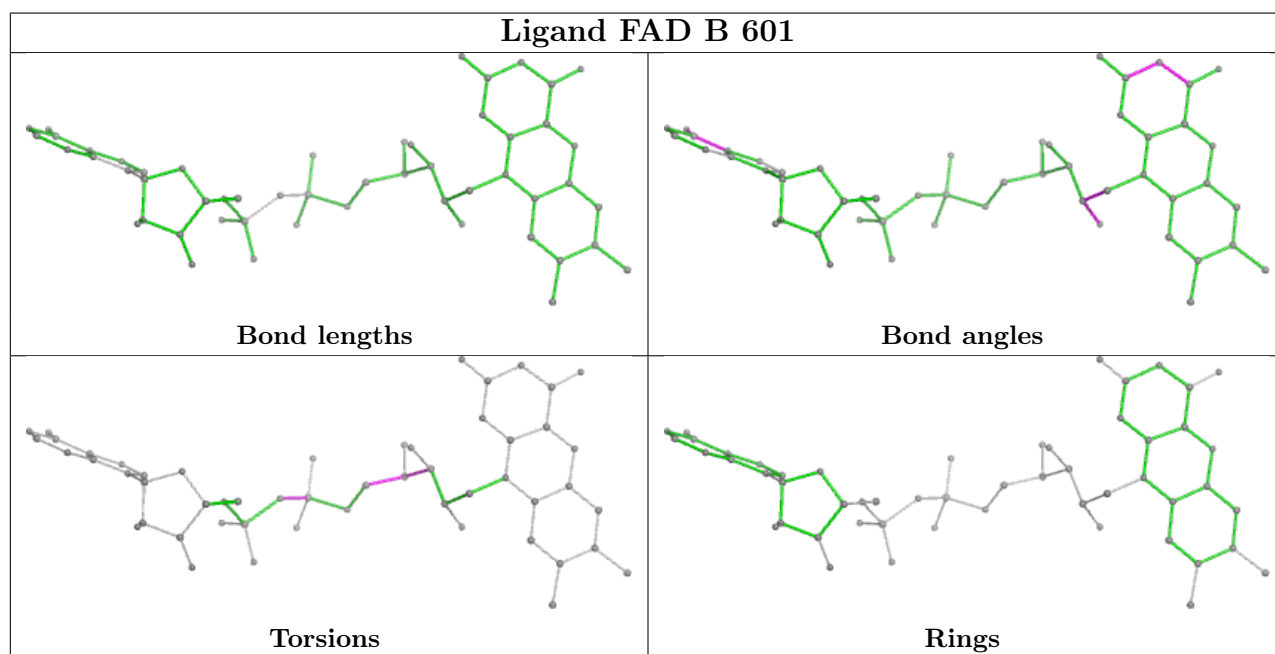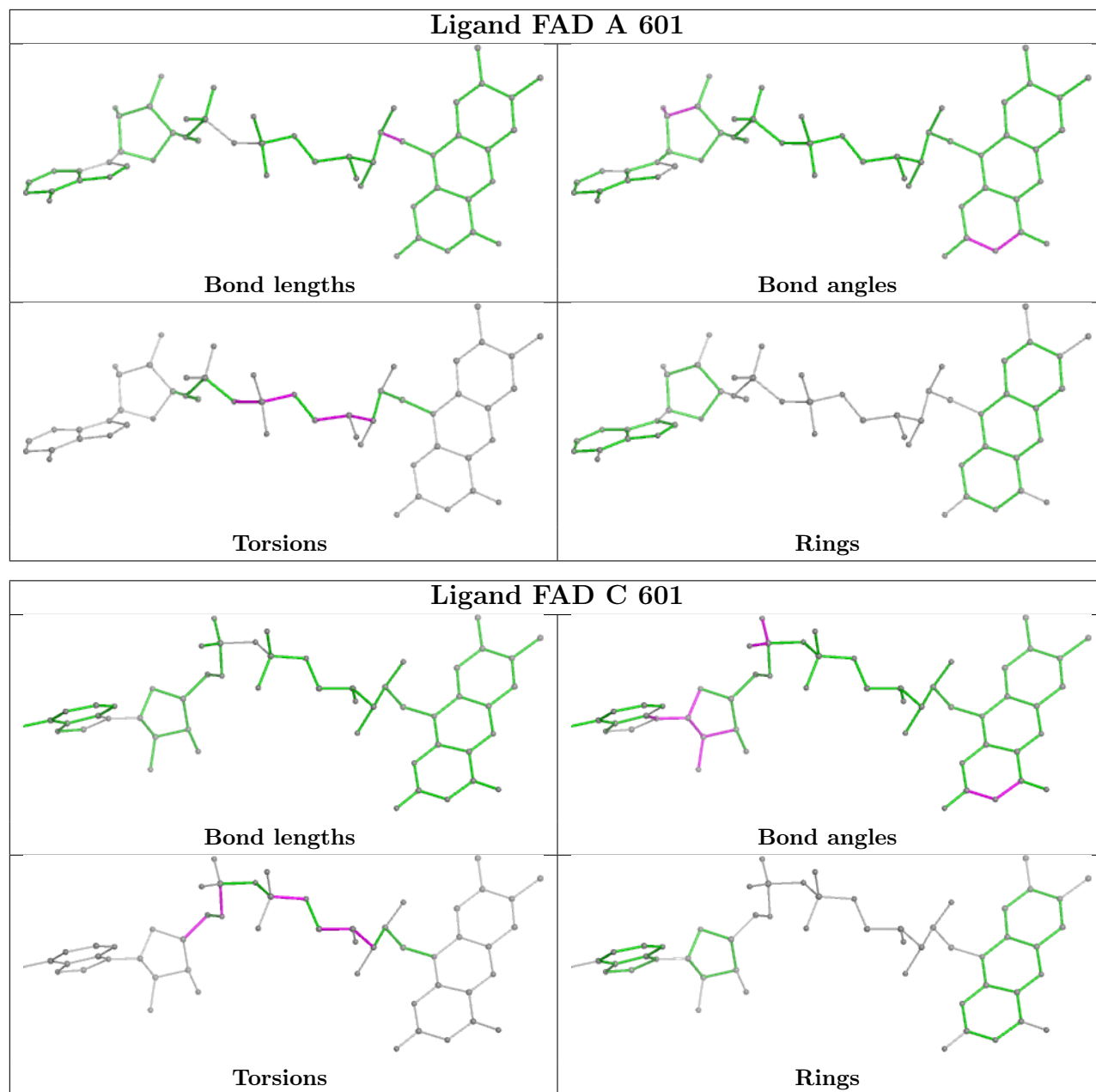
5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

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(Å²)	Q<0.9
1	A	518/521 (99%)	0.29	21 (4%)	42	48	32, 53, 91, 134	0
1	B	518/521 (99%)	0.41	27 (5%)	34	39	30, 57, 91, 127	0
1	C	517/521 (99%)	0.16	26 (5%)	35	41	29, 47, 98, 129	0
All	All	1553/1563 (99%)	0.29	74 (4%)	36	43	29, 53, 93, 134	0

All (74) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	378	PHE	5.9
1	B	379	LEU	5.8
1	B	295	ASP	4.8
1	C	94	ALA	4.7
1	C	373	LEU	4.5
1	C	44	THR	4.2
1	C	34	ASP	3.9
1	A	376	PHE	3.8
1	B	33	GLU	3.8
1	C	3	ALA	3.6
1	B	376	PHE	3.4
1	C	52	HIS	3.4
1	C	49	GLU	3.3
1	B	373	LEU	3.3
1	C	97	VAL	3.3
1	B	2	ALA	3.3
1	B	89	PHE	3.2
1	A	2	ALA	3.2
1	A	34	ASP	3.1
1	A	422	LEU	3.0
1	C	89	PHE	3.0
1	B	153	TRP	3.0
1	C	153	TRP	2.9

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	C	385	GLY	2.9
1	A	153	TRP	2.8
1	A	89	PHE	2.8
1	A	23	ARG	2.7
1	B	304	LYS	2.7
1	B	35	LYS	2.7
1	A	480	LYS	2.7
1	C	518	ARG	2.6
1	B	377	ASN	2.6
1	C	87	LYS	2.6
1	B	375	GLU	2.6
1	B	298	ILE	2.6
1	C	33	GLU	2.6
1	A	4	PRO	2.6
1	A	374	THR	2.5
1	B	296	GLY	2.5
1	C	42	PRO	2.5
1	C	43	TYR	2.4
1	C	90	ALA	2.4
1	C	76	PHE	2.4
1	A	13	ALA	2.4
1	C	45	ILE	2.4
1	A	293	ASP	2.4
1	A	375	GLU	2.3
1	B	49	GLU	2.3
1	B	374	THR	2.3
1	A	24	ILE	2.3
1	A	373	LEU	2.2
1	C	376	PHE	2.2
1	C	36	ILE	2.2
1	C	7	GLU	2.2
1	A	39	TYR	2.2
1	B	382	ASP	2.2
1	B	440	LYS	2.2
1	C	53	ARG	2.2
1	B	380	ASN	2.2
1	A	9	VAL	2.2
1	A	50	THR	2.1
1	B	44	THR	2.1
1	C	31	PHE	2.1
1	A	37	THR	2.1
1	B	90	ALA	2.1

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	292	TYR	2.1
1	A	165	ILE	2.1
1	B	300	PRO	2.1
1	B	45	ILE	2.1
1	C	13	ALA	2.1
1	B	458	ASP	2.0
1	A	3	ALA	2.0
1	B	273	ALA	2.0
1	C	516	LYS	2.0

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

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

6.3 Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4 Ligands ⓘ

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

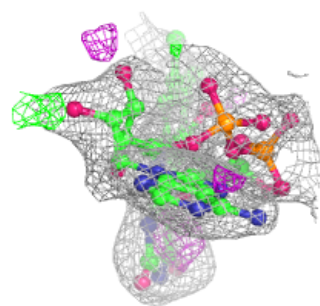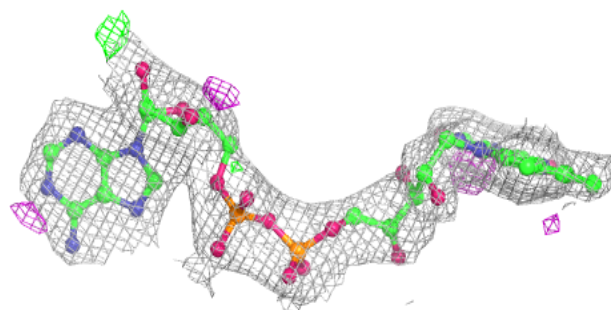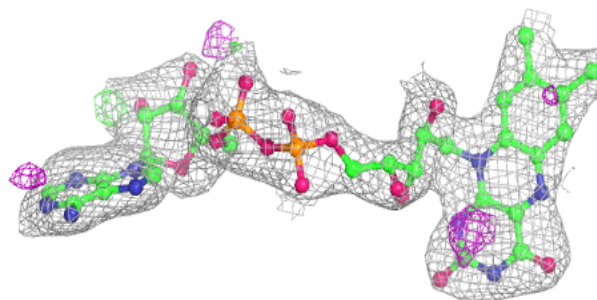| Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($Å^2$)	Q<0.9
2	FAD	C	601	53/53	0.86	0.16	48,91,111,119	0
2	FAD	A	601	53/53	0.89	0.11	49,68,83,89	0
2	FAD	B	601	53/53	0.94	0.09	55,65,77,84	0

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.
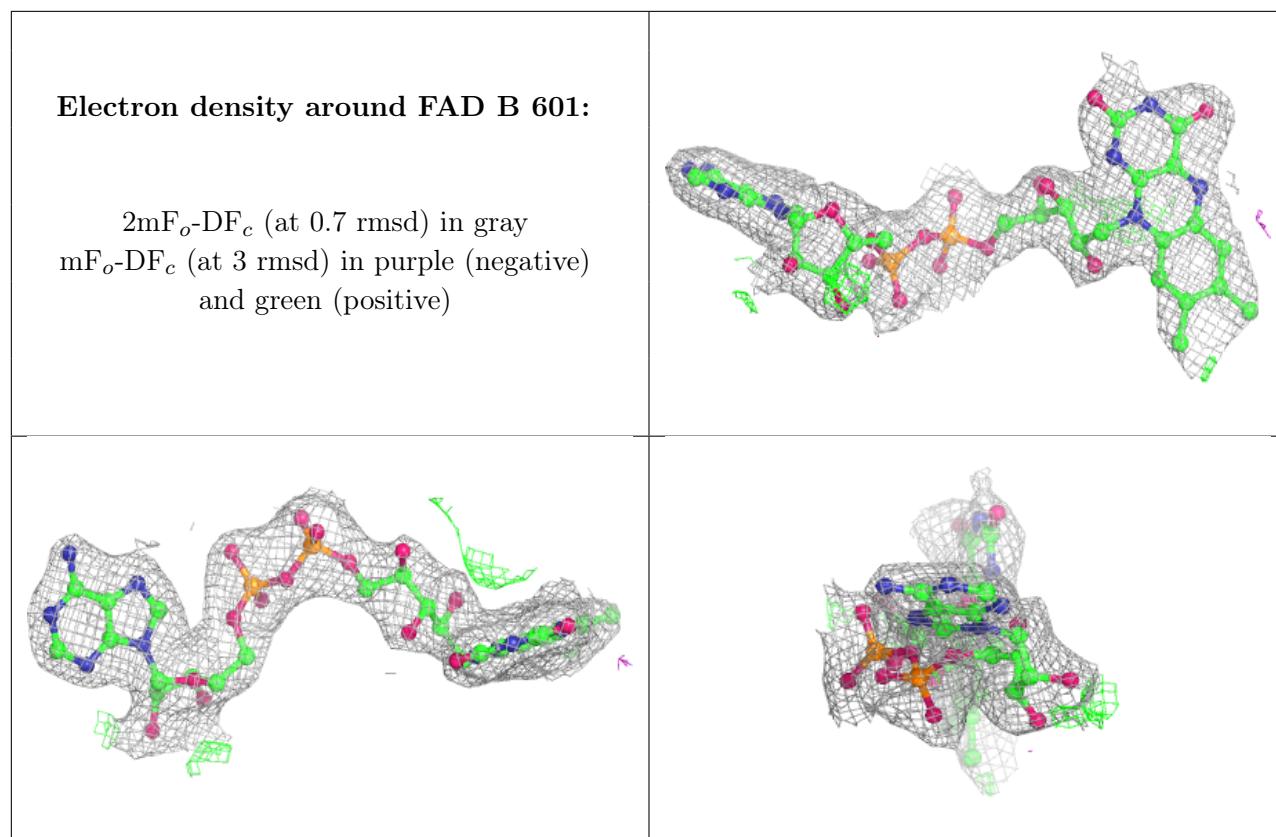
Electron density around FAD C 601:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
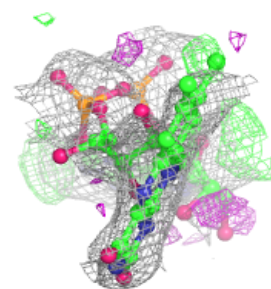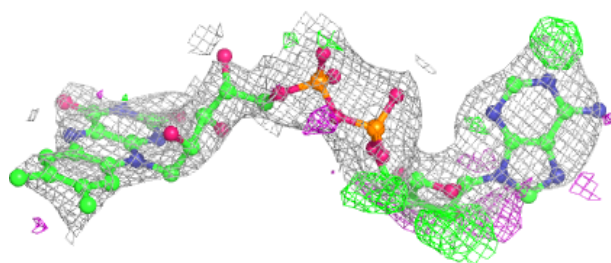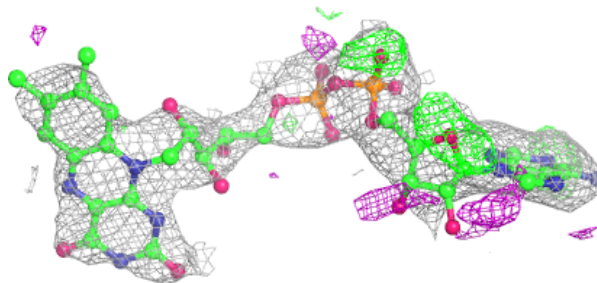
Electron density around FAD A 601:

$2mF_o$-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 601:

$2mF_o$-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 ⓘ

There are no such residues in this entry.