



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 18, 2026 – 11:17 AM UTC

PDB ID : 1ONF / pdb_00001onf
Title : Crystal structure of Plasmodium falciparum Glutathione reductase
Authors : Sarma, G.N.; Savvides, S.N.; Becker, K.; Schirmer, M.; Schirmer, R.H.;
Karplus, P.A.
Deposited on : 2003-02-27
Resolution : 2.60 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

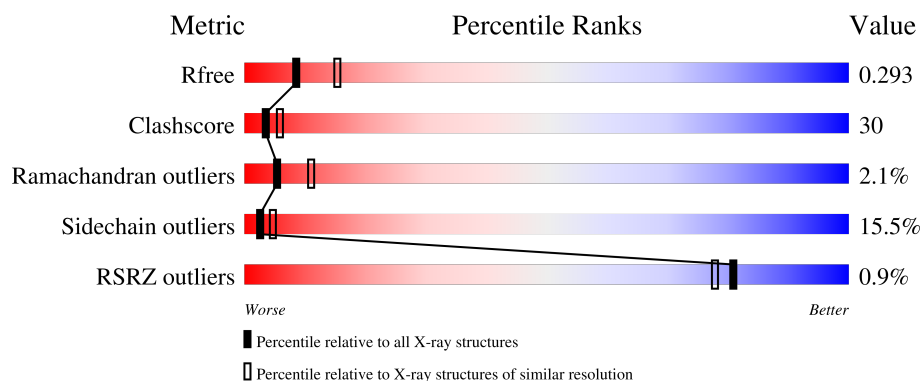
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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	500	

2 Entry composition [i](#)

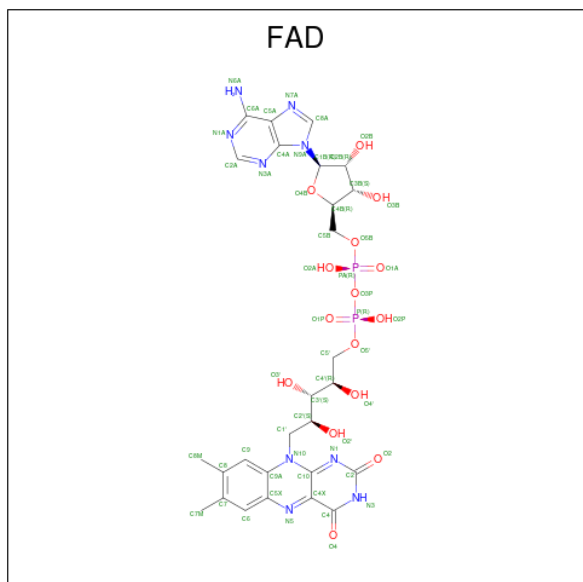
There are 3 unique types of molecules in this entry. The entry contains 3552 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Glutathione reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	439	Total	C	N	O	S	0	0	0
			3457	2209	596	641	11			

- 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	C	N	O	P	0	0
			52	27	8	15	2		

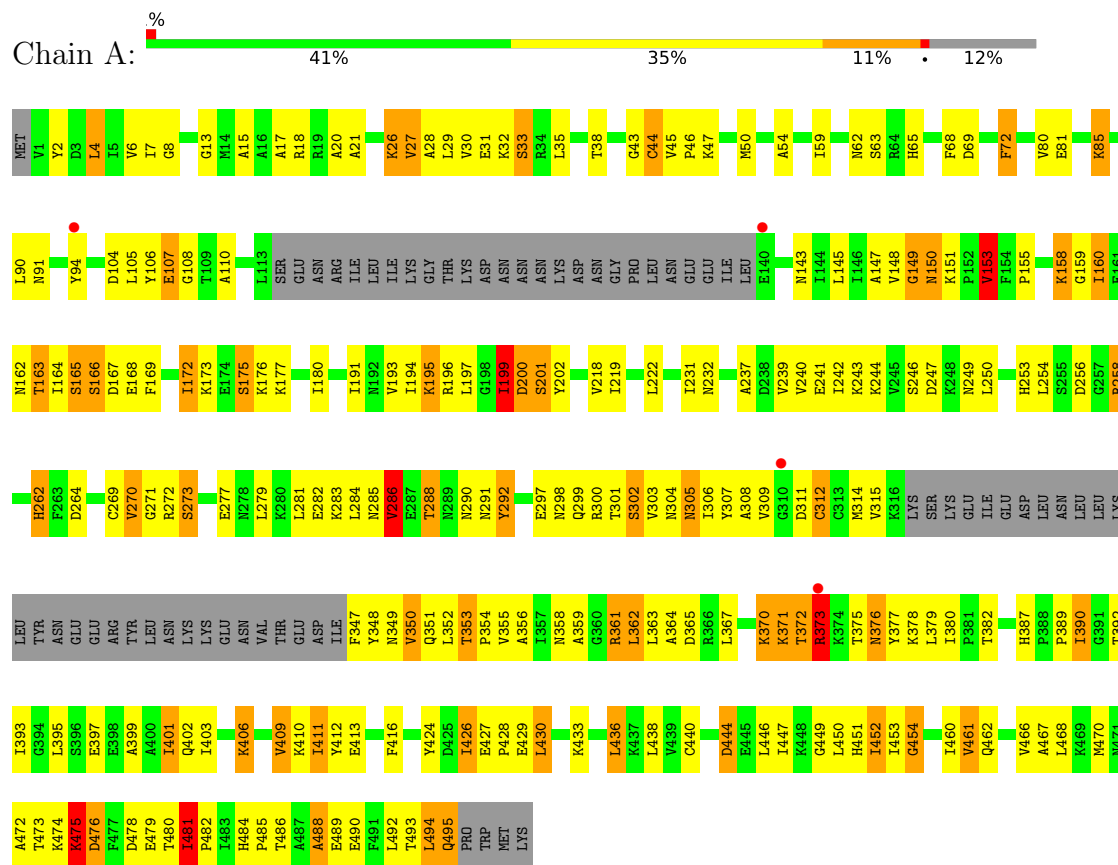
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	43	Total 43 O	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: Glutathione reductase



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 2 2	Depositor
Cell constants a, b, c, α , β , γ	90.64Å 90.64Å 123.32Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.36 – 2.60 29.36 – 2.60	Depositor EDS
% Data completeness (in resolution range)	95.8 (29.36-2.60) 95.3 (29.36-2.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.16 (at 2.61Å)	Xtriage
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.256 , 0.297 0.243 , 0.293	Depositor DCC
R_{free} test set	1661 reflections (10.19%)	wwPDB-VP
Wilson B-factor (Å ²)	62.8	Xtriage
Anisotropy	0.419	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 63.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	3552	wwPDB-VP
Average B, all atoms (Å ²)	80.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.77% 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: 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	1.15	9/3513 (0.3%)	1.41	29/4740 (0.6%)

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	269	CYS	CA-C	-6.33	1.47	1.53
1	A	475	LYS	CA-C	5.96	1.61	1.52
1	A	356	ALA	CA-CB	-5.90	1.43	1.53
1	A	80	VAL	CA-CB	5.82	1.61	1.54
1	A	476	ASP	N-CA	5.51	1.53	1.46
1	A	59	ILE	CA-CB	5.36	1.61	1.54
1	A	488	ALA	CA-C	5.18	1.59	1.52
1	A	355	VAL	CA-CB	-5.10	1.48	1.54
1	A	403	ILE	CA-CB	-5.03	1.49	1.55

All (29) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	461	VAL	N-CA-C	8.89	120.69	111.00
1	A	302	SER	N-CA-C	-8.75	101.82	111.36
1	A	153	VAL	N-CA-C	8.63	120.35	107.75
1	A	370	LYS	N-CA-C	8.09	122.67	109.72
1	A	444	ASP	N-CA-C	-6.76	105.01	112.72
1	A	85	LYS	N-CA-C	-6.55	104.07	111.07
1	A	199	ILE	N-CA-C	6.16	117.45	108.58
1	A	308	ALA	N-CA-C	6.12	118.66	108.13
1	A	262	HIS	N-CA-C	6.09	119.51	111.28
1	A	201	SER	N-CA-C	6.01	119.33	108.69
1	A	373	ARG	N-CA-C	5.93	118.31	109.59
1	A	27	VAL	N-CA-C	5.89	117.84	108.89

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	402	GLN	N-CA-C	-5.82	106.01	113.23
1	A	172	ILE	N-CA-C	5.61	115.64	108.12
1	A	151	LYS	N-CA-C	-5.56	97.53	109.81
1	A	286	VAL	N-CA-C	-5.56	101.55	108.89
1	A	454	GLY	N-CA-C	5.55	119.09	110.88
1	A	80	VAL	N-CA-CB	5.51	117.00	110.55
1	A	72	PHE	CA-C-N	-5.38	113.78	122.81
1	A	72	PHE	C-N-CA	-5.38	113.78	122.81
1	A	200	ASP	N-CA-C	-5.22	102.56	110.28
1	A	20	ALA	N-CA-C	-5.21	105.72	111.71
1	A	307	TYR	N-CA-C	5.20	117.77	109.81
1	A	390	ILE	CB-CA-C	-5.16	102.80	110.33
1	A	481	ILE	CB-CA-C	5.09	116.39	110.89
1	A	409	VAL	N-CA-C	5.09	115.18	107.80
1	A	145	LEU	N-CA-C	5.08	116.81	108.52
1	A	218	VAL	N-CA-C	-5.08	105.44	110.62
1	A	495	GLN	N-CA-C	-5.03	96.92	111.00

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3457	0	3532	209	0
2	A	52	0	30	6	0
3	A	43	0	0	5	0
All	All	3552	0	3562	210	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 30.

All (210) 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:311:ASP:HB2	1:A:351:GLN:HG2	1.24	1.20
1:A:311:ASP:CB	1:A:351:GLN:HG2	1.73	1.19
1:A:301:THR:HG22	1:A:302:SER:H	1.01	1.15
1:A:30:VAL:HG22	1:A:106:TYR:HB2	1.21	1.14
1:A:153:VAL:HG12	1:A:270:VAL:HG11	1.40	1.00
1:A:301:THR:HG22	1:A:302:SER:N	1.73	1.00
1:A:376:ASN:ND2	1:A:378:LYS:H	1.59	1.00
2:A:500:FAD:C2A	2:A:500:FAD:C6A	2.37	0.98
1:A:91:ASN:HB3	3:A:611:HOH:O	1.64	0.98
1:A:30:VAL:HG22	1:A:106:TYR:CB	1.99	0.93
1:A:427:GLU:HB3	1:A:430:LEU:HD22	1.51	0.92
1:A:301:THR:CG2	1:A:302:SER:H	1.84	0.91
1:A:8:GLY:HA3	1:A:147:ALA:O	1.73	0.88
1:A:18:ARG:O	1:A:21:ALA:HB3	1.74	0.87
1:A:376:ASN:HD22	1:A:376:ASN:C	1.82	0.86
1:A:304:ASN:O	1:A:305:ASN:HB3	1.74	0.85
1:A:286:VAL:HG22	1:A:301:THR:HG21	1.64	0.80
1:A:6:VAL:HG21	1:A:17:ALA:HB2	1.65	0.79
1:A:311:ASP:HB3	1:A:351:GLN:HG2	1.64	0.79
1:A:191:ILE:HD11	1:A:201:SER:HB3	1.64	0.78
1:A:493:THR:HG22	1:A:493:THR:O	1.84	0.77
1:A:376:ASN:HD22	1:A:378:LYS:H	1.27	0.76
1:A:397:GLU:O	1:A:401:ILE:HG13	1.85	0.76
1:A:30:VAL:CG2	1:A:106:TYR:HB2	2.11	0.75
1:A:416:PHE:CE1	1:A:490:GLU:HG3	2.22	0.75
1:A:15:ALA:HB1	1:A:361:ARG:HD3	1.68	0.75
1:A:466:VAL:HG12	1:A:470:MET:HE2	1.68	0.74
1:A:376:ASN:ND2	1:A:378:LYS:N	2.36	0.74
1:A:90:LEU:HB3	1:A:94:TYR:CE1	2.23	0.73
1:A:416:PHE:HE1	1:A:436:LEU:HD21	1.53	0.73
1:A:282:GLU:O	1:A:284:LEU:N	2.22	0.72
1:A:282:GLU:C	1:A:284:LEU:H	1.98	0.71
1:A:193:VAL:HG23	3:A:605:HOH:O	1.91	0.71
1:A:292:TYR:HE1	1:A:349:ASN:OD1	1.73	0.71
1:A:196:ARG:NH2	1:A:387:HIS:HB3	2.06	0.71
1:A:410:LYS:HE3	1:A:411:ILE:O	1.93	0.69
1:A:376:ASN:HD21	1:A:378:LYS:HB2	1.58	0.69
1:A:155:PRO:O	1:A:160:ILE:HD13	1.93	0.69
1:A:30:VAL:HA	1:A:106:TYR:O	1.94	0.67
1:A:395:LEU:HD12	1:A:399:ALA:HB1	1.77	0.67
1:A:300:ARG:HH21	1:A:304:ASN:HB2	1.59	0.67
1:A:177:LYS:HD2	1:A:262:HIS:O	1.94	0.66

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:309:VAL:CG1	1:A:359:ALA:HB1	2.25	0.66
1:A:447:ILE:HD13	1:A:447:ILE:N	2.09	0.66
1:A:493:THR:O	1:A:493:THR:CG2	2.44	0.66
1:A:237:ALA:HB1	1:A:254:LEU:HD13	1.78	0.66
1:A:196:ARG:O	1:A:197:LEU:HD23	1.96	0.65
1:A:270:VAL:HG12	1:A:271:GLY:N	2.11	0.65
1:A:395:LEU:HD12	1:A:399:ALA:CB	2.27	0.65
1:A:371:LYS:O	1:A:372:THR:C	2.40	0.64
1:A:243:LYS:HE3	1:A:253:HIS:CE1	2.32	0.64
1:A:62:ASN:HD22	1:A:65:HIS:CD2	2.16	0.63
1:A:389:PRO:HD2	1:A:454:GLY:O	1.98	0.63
1:A:300:ARG:NH2	1:A:304:ASN:HB2	2.14	0.63
1:A:315:VAL:O	1:A:347:PHE:CA	2.46	0.62
1:A:438:LEU:HD12	1:A:494:LEU:HD12	1.82	0.61
1:A:376:ASN:ND2	1:A:376:ASN:C	2.55	0.61
1:A:155:PRO:HD2	1:A:160:ILE:HD11	1.82	0.61
1:A:426:ILE:HG12	3:A:610:HOH:O	1.99	0.61
1:A:158:LYS:O	1:A:242:ILE:N	2.33	0.60
1:A:376:ASN:HD21	1:A:378:LYS:H	1.49	0.60
1:A:81:GLU:O	1:A:85:LYS:HB2	2.03	0.59
1:A:31:GLU:O	1:A:107:GLU:HA	2.02	0.59
1:A:158:LYS:O	1:A:241:GLU:HA	2.01	0.59
1:A:4:LEU:HA	1:A:143:ASN:O	2.03	0.58
1:A:281:LEU:O	1:A:284:LEU:HB2	2.04	0.58
1:A:315:VAL:HG21	1:A:377:TYR:CZ	2.38	0.58
1:A:486:THR:O	1:A:489:GLU:HG2	2.03	0.58
1:A:237:ALA:CB	1:A:254:LEU:HD13	2.34	0.58
1:A:8:GLY:HA2	2:A:500:FAD:O4B	2.04	0.57
1:A:47:LYS:HD2	1:A:47:LYS:C	2.30	0.57
1:A:376:ASN:HD22	1:A:377:TYR:N	2.01	0.57
1:A:222:LEU:HD22	1:A:390:ILE:HD11	1.87	0.57
1:A:159:GLY:HA3	1:A:242:ILE:O	2.05	0.57
1:A:352:LEU:HD22	2:A:500:FAD:C2	2.35	0.57
1:A:2:TYR:CE2	1:A:28:ALA:HB2	2.40	0.56
1:A:304:ASN:O	1:A:305:ASN:CB	2.46	0.56
1:A:282:GLU:C	1:A:284:LEU:N	2.61	0.56
1:A:298:ASN:O	1:A:363:LEU:HD11	2.05	0.56
1:A:362:LEU:O	1:A:365:ASP:HB2	2.05	0.56
1:A:493:THR:O	1:A:495:GLN:N	2.39	0.56
1:A:191:ILE:CD1	1:A:201:SER:HB3	2.33	0.56
1:A:176:LYS:HD2	1:A:176:LYS:O	2.07	0.55

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:412:TYR:HB2	1:A:438:LEU:HB2	1.88	0.55
1:A:202:TYR:CZ	1:A:232:ASN:ND2	2.74	0.55
1:A:244:LYS:HG3	1:A:246:SER:O	2.06	0.55
1:A:54:ALA:HB1	1:A:196:ARG:CB	2.37	0.55
1:A:153:VAL:HG12	1:A:270:VAL:CG1	2.26	0.55
1:A:175:SER:O	1:A:199:ILE:CG1	2.56	0.54
1:A:372:THR:HG23	1:A:373:ARG:HG3	1.90	0.54
1:A:472:ALA:HA	1:A:476:ASP:OD2	2.07	0.54
1:A:298:ASN:C	1:A:299:GLN:HG2	2.32	0.54
1:A:392:THR:HG1	1:A:451:HIS:CE1	2.24	0.54
1:A:484:HIS:CE1	1:A:485:PRO:HB3	2.43	0.54
1:A:155:PRO:HD2	1:A:160:ILE:CD1	2.37	0.54
1:A:54:ALA:HB1	1:A:196:ARG:HB3	1.88	0.54
1:A:309:VAL:HG11	1:A:359:ALA:HB1	1.89	0.54
1:A:104:ASP:HB3	1:A:106:TYR:HE1	1.73	0.54
1:A:353:THR:N	1:A:354:PRO:CD	2.71	0.53
1:A:461:VAL:O	1:A:462:GLN:C	2.48	0.53
1:A:376:ASN:HD22	1:A:378:LYS:N	2.01	0.53
1:A:202:TYR:CE1	1:A:232:ASN:ND2	2.76	0.53
1:A:90:LEU:O	1:A:94:TYR:CD1	2.62	0.52
1:A:480:THR:HB	1:A:492:LEU:HD13	1.91	0.52
1:A:292:TYR:HB2	1:A:314:MET:CE	2.40	0.52
1:A:27:VAL:HG12	1:A:28:ALA:N	2.25	0.52
1:A:395:LEU:N	1:A:395:LEU:HD22	2.24	0.52
1:A:440:CYS:SG	1:A:447:ILE:HD12	2.50	0.52
1:A:473:THR:O	1:A:474:LYS:C	2.51	0.52
1:A:195:LYS:HG3	1:A:231:ILE:HG12	1.92	0.51
1:A:395:LEU:O	1:A:449:GLY:HA3	2.10	0.51
1:A:460:ILE:HG12	1:A:488:ALA:HB2	1.92	0.51
1:A:484:HIS:ND1	1:A:485:PRO:HA	2.25	0.51
1:A:288:THR:HG22	1:A:288:THR:O	2.11	0.51
1:A:315:VAL:O	1:A:348:TYR:N	2.42	0.51
1:A:194:ILE:HG23	1:A:199:ILE:CG2	2.41	0.51
1:A:175:SER:O	1:A:199:ILE:HG12	2.12	0.50
1:A:413:GLU:HA	1:A:436:LEU:O	2.10	0.50
1:A:279:LEU:HB3	1:A:281:LEU:HG	1.92	0.50
1:A:480:THR:O	1:A:492:LEU:HD13	2.11	0.50
1:A:350:VAL:HG11	1:A:380:ILE:CD1	2.42	0.50
1:A:241:GLU:CD	1:A:243:LYS:HE2	2.37	0.50
1:A:8:GLY:O	1:A:13:GLY:HA3	2.12	0.49
1:A:148:VAL:O	1:A:149:GLY:O	2.31	0.49

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:436:LEU:HD23	1:A:436:LEU:N	2.27	0.49
1:A:409:VAL:HG12	1:A:411:ILE:HD12	1.95	0.49
1:A:429:GLU:OE1	1:A:429:GLU:HA	2.13	0.49
1:A:241:GLU:HB3	1:A:253:HIS:HB2	1.95	0.49
1:A:256:ASP:OD1	1:A:258:ARG:HD2	2.13	0.49
1:A:446:LEU:HD23	1:A:473:THR:HG22	1.93	0.49
1:A:466:VAL:HG12	1:A:470:MET:CE	2.41	0.48
1:A:30:VAL:HG13	1:A:106:TYR:O	2.13	0.48
1:A:31:GLU:HG3	1:A:32:LYS:N	2.28	0.48
1:A:162:ASN:ND2	1:A:242:ILE:O	2.46	0.48
1:A:150:ASN:HB2	1:A:272:ARG:HB3	1.96	0.48
1:A:165:SER:O	1:A:166:SER:C	2.56	0.48
1:A:311:ASP:HB3	1:A:351:GLN:CG	2.41	0.48
1:A:362:LEU:HA	1:A:362:LEU:HD12	1.41	0.48
1:A:165:SER:O	1:A:168:GLU:N	2.47	0.48
1:A:450:LEU:C	1:A:450:LEU:HD23	2.39	0.48
1:A:309:VAL:HG12	1:A:359:ALA:HB1	1.95	0.47
1:A:358:ASN:O	1:A:359:ALA:C	2.57	0.47
1:A:110:ALA:H	2:A:500:FAD:C2A	2.27	0.47
1:A:301:THR:CG2	1:A:302:SER:N	2.48	0.47
1:A:363:LEU:HA	1:A:363:LEU:HD12	1.48	0.47
1:A:481:ILE:HA	1:A:482:PRO:HD3	1.77	0.47
1:A:35:LEU:O	1:A:91:ASN:ND2	2.48	0.47
1:A:416:PHE:CE1	1:A:436:LEU:HD21	2.42	0.47
1:A:475:LYS:HA	1:A:478:ASP:HB2	1.97	0.47
1:A:475:LYS:O	1:A:479:GLU:HG3	2.14	0.47
1:A:26:LYS:HA	1:A:26:LYS:HD2	1.50	0.46
1:A:29:LEU:C	1:A:29:LEU:HD23	2.40	0.46
1:A:311:ASP:HB2	1:A:351:GLN:CG	2.18	0.46
1:A:406:LYS:H	1:A:406:LYS:HG2	1.52	0.46
1:A:446:LEU:C	1:A:447:ILE:HD13	2.40	0.46
1:A:176:LYS:O	1:A:176:LYS:CD	2.63	0.46
1:A:304:ASN:C	1:A:306:ILE:H	2.24	0.46
1:A:466:VAL:O	1:A:470:MET:HE2	2.14	0.46
1:A:65:HIS:CG	1:A:424:TYR:HA	2.50	0.46
1:A:284:LEU:HD23	1:A:284:LEU:HA	1.74	0.46
1:A:279:LEU:CB	1:A:281:LEU:HG	2.47	0.45
1:A:438:LEU:HD22	1:A:447:ILE:HG23	1.98	0.45
1:A:91:ASN:HA	1:A:94:TYR:HD1	1.81	0.44
1:A:149:GLY:N	1:A:312:CYS:HB3	2.31	0.44
1:A:150:ASN:HB3	1:A:273:SER:C	2.41	0.44

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:292:TYR:HB2	1:A:314:MET:HE2	2.00	0.44
1:A:196:ARG:CZ	1:A:387:HIS:HB3	2.47	0.44
1:A:350:VAL:HG11	1:A:380:ILE:HD12	1.98	0.44
1:A:177:LYS:HE2	1:A:200:ASP:OD2	2.17	0.44
1:A:163:THR:CG2	1:A:164:ILE:N	2.80	0.44
1:A:155:PRO:HG3	1:A:270:VAL:HG21	1.98	0.44
1:A:7:ILE:O	1:A:147:ALA:N	2.47	0.44
1:A:147:ALA:O	2:A:500:FAD:H52A	2.18	0.44
1:A:395:LEU:N	1:A:395:LEU:CD2	2.80	0.44
1:A:63:SER:HB2	1:A:68:PHE:HB2	1.99	0.43
1:A:292:TYR:CE1	1:A:349:ASN:OD1	2.63	0.43
1:A:395:LEU:HD12	1:A:399:ALA:HB3	2.00	0.43
1:A:30:VAL:CA	1:A:106:TYR:O	2.65	0.43
1:A:301:THR:HB	1:A:303:VAL:O	2.17	0.43
1:A:143:ASN:HA	1:A:305:ASN:HD22	1.82	0.43
1:A:197:LEU:HD23	1:A:197:LEU:HA	1.74	0.43
1:A:244:LYS:O	1:A:244:LYS:HG2	2.17	0.43
1:A:196:ARG:NH2	3:A:616:HOH:O	2.47	0.43
1:A:31:GLU:CG	1:A:32:LYS:N	2.82	0.43
1:A:46:PRO:O	1:A:50:MET:HG2	2.19	0.43
1:A:474:LYS:NZ	1:A:494:LEU:O	2.25	0.43
1:A:50:MET:HB3	1:A:193:VAL:HG11	2.01	0.43
1:A:476:ASP:O	1:A:480:THR:OG1	2.30	0.42
1:A:45:VAL:HB	1:A:46:PRO:HD3	2.01	0.42
1:A:430:LEU:HD23	3:A:610:HOH:O	2.18	0.42
1:A:38:THR:O	1:A:43:GLY:N	2.53	0.42
1:A:46:PRO:O	1:A:47:LYS:C	2.60	0.42
1:A:298:ASN:O	1:A:299:GLN:CB	2.67	0.42
1:A:72:PHE:CD1	1:A:72:PHE:C	2.96	0.42
1:A:298:ASN:O	1:A:363:LEU:CD1	2.68	0.42
1:A:352:LEU:HD22	2:A:500:FAD:O2	2.19	0.42
1:A:376:ASN:HD21	1:A:378:LYS:CB	2.29	0.42
1:A:31:GLU:CG	1:A:33:SER:O	2.68	0.41
1:A:436:LEU:HD13	1:A:452:ILE:HD12	2.01	0.41
1:A:292:TYR:N	1:A:292:TYR:CD2	2.88	0.41
1:A:31:GLU:O	1:A:108:GLY:N	2.52	0.41
1:A:298:ASN:O	1:A:299:GLN:HB2	2.21	0.41
1:A:165:SER:O	1:A:167:ASP:N	2.53	0.41
1:A:290:ASN:O	1:A:291:ASN:HB2	2.20	0.41
1:A:371:LYS:HG2	1:A:372:THR:N	2.35	0.40
1:A:379:LEU:HD12	1:A:379:LEU:HA	1.62	0.40

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:467:ALA:HA	1:A:470:MET:HE3	2.03	0.40
1:A:65:HIS:CD2	1:A:424:TYR:HA	2.57	0.40
1:A:169:PHE:HA	1:A:172:ILE:HG13	2.02	0.40
1:A:367:LEU:HD23	1:A:367:LEU:HA	1.85	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	433/500 (87%)	380 (88%)	44 (10%)	9 (2%)	5	11

All (9) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	149	GLY
1	A	166	SER
1	A	372	THR
1	A	494	LEU
1	A	283	LYS
1	A	297	GLU
1	A	364	ALA
1	A	44	CYS
1	A	350	VAL

5.3.2 Protein sidechains [i](#)

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	381/443 (86%)	322 (84%)	59 (16%)	2 5

All (59) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	LEU
1	A	26	LYS
1	A	33	SER
1	A	44	CYS
1	A	69	ASP
1	A	105	LEU
1	A	107	GLU
1	A	150	ASN
1	A	153	VAL
1	A	158	LYS
1	A	160	ILE
1	A	163	THR
1	A	165	SER
1	A	173	LYS
1	A	175	SER
1	A	180	ILE
1	A	195	LYS
1	A	199	ILE
1	A	219	ILE
1	A	239	VAL
1	A	240	VAL
1	A	247	ASP
1	A	249	ASN
1	A	250	LEU
1	A	258	ARG
1	A	264	ASP
1	A	270	VAL
1	A	273	SER
1	A	277	GLU
1	A	285	ASN
1	A	286	VAL
1	A	288	THR
1	A	292	TYR
1	A	305	ASN
1	A	312	CYS
1	A	353	THR

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	361	ARG
1	A	362	LEU
1	A	370	LYS
1	A	371	LYS
1	A	373	ARG
1	A	375	THR
1	A	376	ASN
1	A	382	THR
1	A	393	ILE
1	A	401	ILE
1	A	406	LYS
1	A	411	ILE
1	A	426	ILE
1	A	428	PRO
1	A	430	LEU
1	A	433	LYS
1	A	436	LEU
1	A	444	ASP
1	A	452	ILE
1	A	453	ILE
1	A	468	LEU
1	A	475	LYS
1	A	481	ILE

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	41	ASN
1	A	52	ASN
1	A	57	HIS
1	A	62	ASN
1	A	65	HIS
1	A	75	ASN
1	A	91	ASN
1	A	224	ASN
1	A	249	ASN
1	A	253	HIS
1	A	265	HIS
1	A	290	ASN
1	A	305	ASN
1	A	376	ASN
1	A	408	ASN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	456	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](#)

1 ligand is 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	A	500	-	54,56,58	1.41	6 (11%)	74,85,89	1.39	14 (18%)

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	A	500	-	-	8/34/50/50	0/5/5/6

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	500	FAD	C6A-C5A	-5.90	1.40	1.50
2	A	500	FAD	C4X-N5	3.42	1.38	1.30
2	A	500	FAD	C10-N1	2.77	1.38	1.33
2	A	500	FAD	C6A-N6A	-2.70	1.32	1.48
2	A	500	FAD	PA-O3P	2.30	1.62	1.59
2	A	500	FAD	C2'-C3'	-2.21	1.49	1.53

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	500	FAD	C4'-C3'-C2'	-3.75	107.32	113.57
2	A	500	FAD	C5A-C6A-N6A	3.58	120.91	113.08
2	A	500	FAD	C4-N3-C2	-3.42	119.56	125.64
2	A	500	FAD	C4X-C4-N3	2.86	120.53	113.25
2	A	500	FAD	N9A-C8A-N7A	-2.71	108.37	113.40
2	A	500	FAD	O3'-C3'-C4'	2.45	114.49	108.93
2	A	500	FAD	C5B-C4B-C3B	-2.27	107.03	115.21
2	A	500	FAD	O4B-C1B-C2B	-2.27	101.76	106.62
2	A	500	FAD	C2'-C1'-N10	-2.22	99.72	110.20
2	A	500	FAD	O4-C4-C4X	-2.17	120.82	126.53
2	A	500	FAD	C4X-C10-N10	2.13	119.53	116.48
2	A	500	FAD	C10-C4X-N5	-2.10	120.53	124.81
2	A	500	FAD	O3'-C3'-C2'	-2.08	104.20	108.93
2	A	500	FAD	C4X-C10-N1	-2.07	119.53	124.59

There are no chirality outliers.

All (8) torsion outliers are listed below:

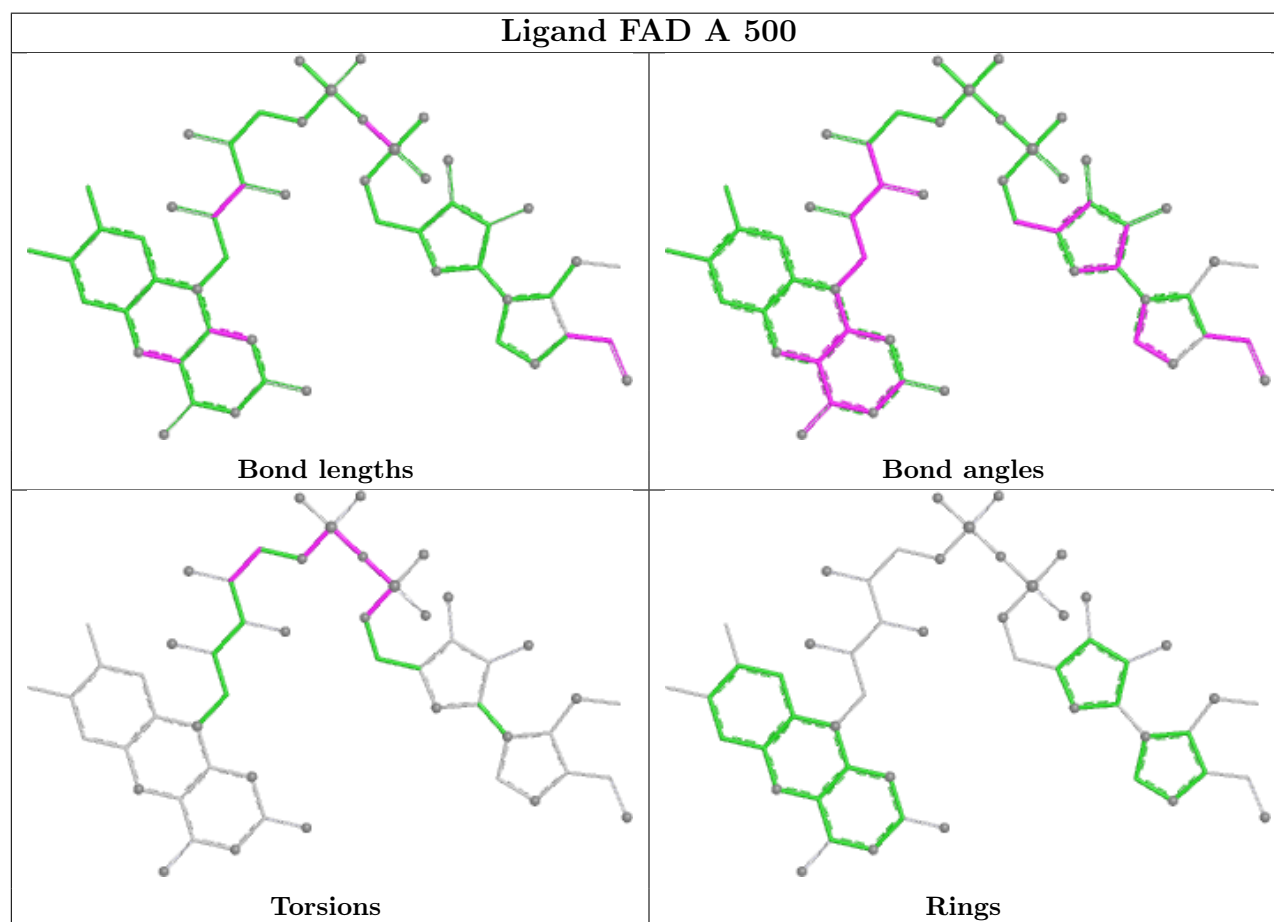
Mol	Chain	Res	Type	Atoms
2	A	500	FAD	O4'-C4'-C5'-O5'
2	A	500	FAD	C5'-O5'-P-O1P
2	A	500	FAD	C5'-O5'-P-O2P
2	A	500	FAD	C5'-O5'-P-O3P
2	A	500	FAD	C3'-C4'-C5'-O5'
2	A	500	FAD	PA-O3P-P-O5'
2	A	500	FAD	P-O3P-PA-O2A
2	A	500	FAD	C5B-O5B-PA-O1A

There are no ring outliers.

1 monomer is involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	500	FAD	6	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.



5.7 Other polymers [i](#)

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	439/500 (87%)	0.33	4 (0%) 81 78	52, 79, 110, 139	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	94	TYR	3.6
1	A	373	ARG	2.9
1	A	310	GLY	2.8
1	A	140	GLU	2.2

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.

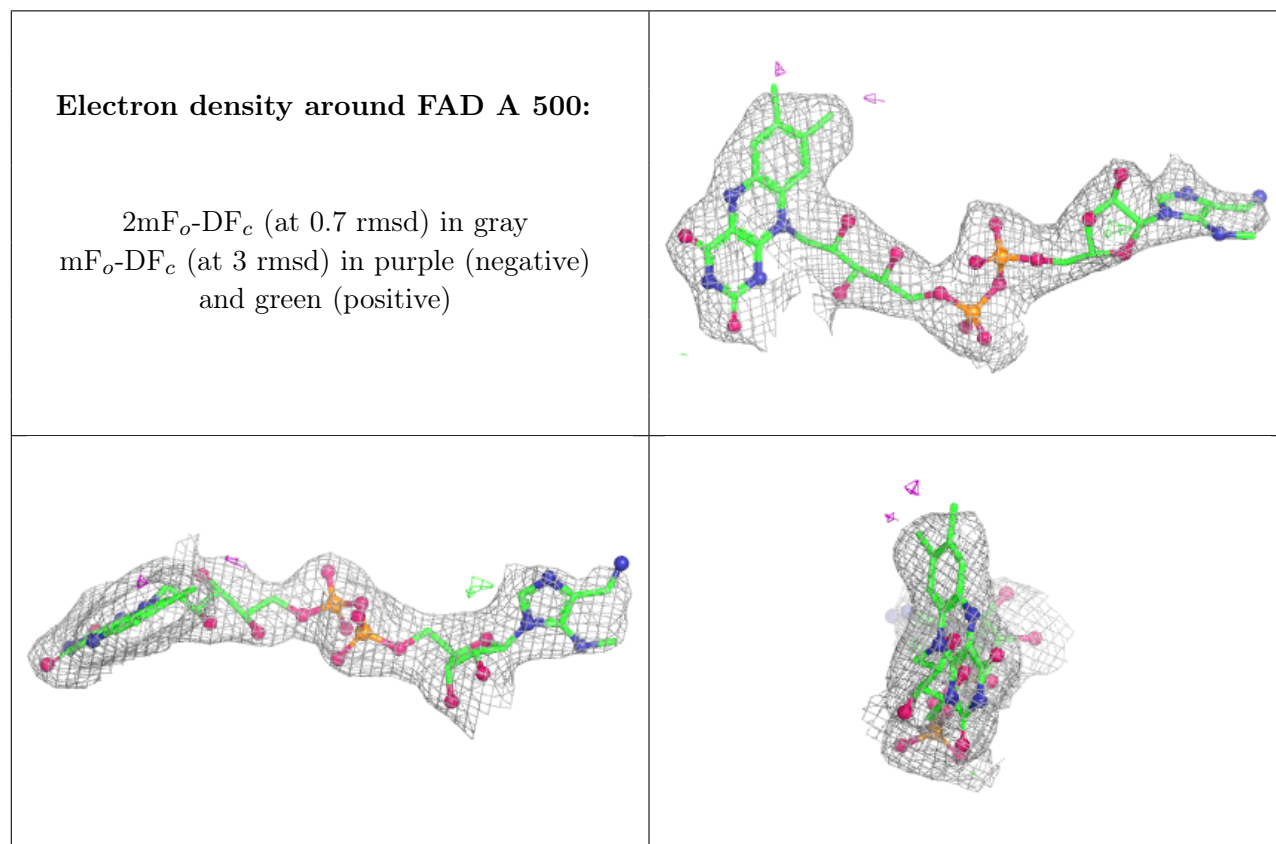
6.4 Ligands [i](#)

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(Å ²)	Q<0.9
2	FAD	A	500	52/53	0.92	0.09	63,75,82,82	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.



6.5 Other polymers [i](#)

There are no such residues in this entry.