Full wwPDB X-ray Structure Validation Report

Apr 30, 2025 – 07:10 pm BST

PDB ID	:	9GEZ / pdb_00009gez
Title	:	Crystal structure of thioredoxin reductase from Cryptosporidium parvum in the "waiting" position
Authors	:	Gabriele, F.; Palerma, M.; Ardini, M.; Bogard, J.; Chen, X.M.; Williams, D.L.; Angelucci, F.
Deposited on	:	2024-08-08
Resolution	:	2.88 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:

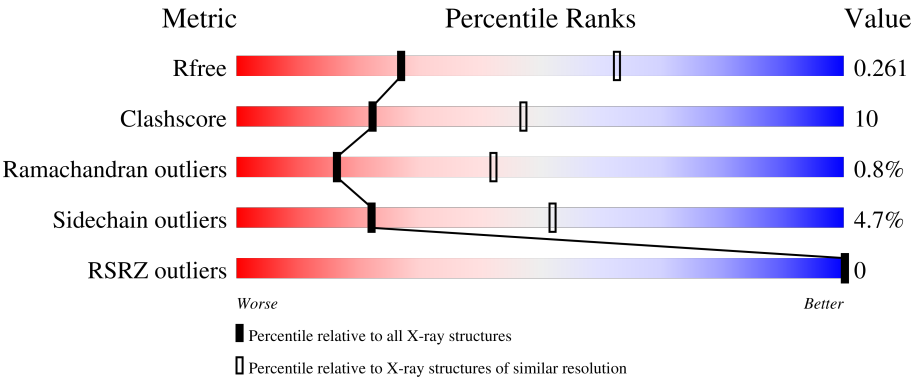
MolProbity	:	4-5-2 with Phenix2.0rc1
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0rc1
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.43.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.88 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}	164625	3316 (2.90-2.86)
Clashscore	180529	3609 (2.90-2.86)
Ramachandran outliers	177936	3529 (2.90-2.86)
Sidechain outliers	177891	3532 (2.90-2.86)
RSRZ outliers	164620	3319 (2.90-2.86)

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	71% 22% • 5%
1	B	521	69% 24% • 5%

2 Entry composition (i)

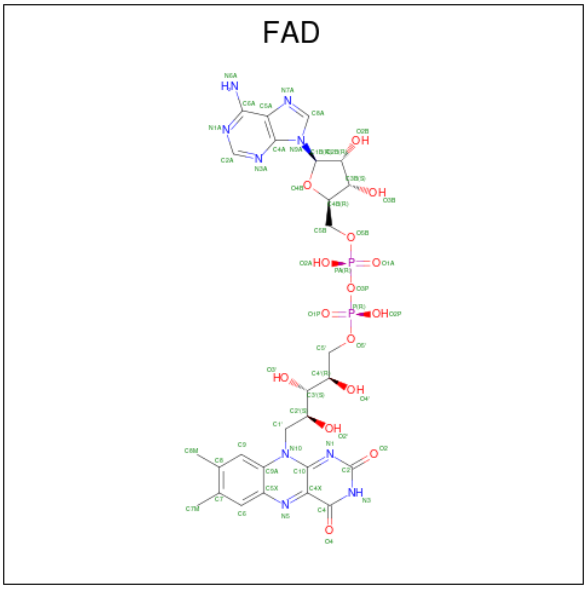
There are 3 unique types of molecules in this entry. The entry contains 7660 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Thioredoxin reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	495	Total	C	N	O	S	0	4	0
			3764	2401	625	723	15			
1	B	496	Total	C	N	O	S	0	5	0
			3776	2410	626	724	16			

- 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
			53	27	9	15	2		
2	B	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

- Molecule 3 is water.

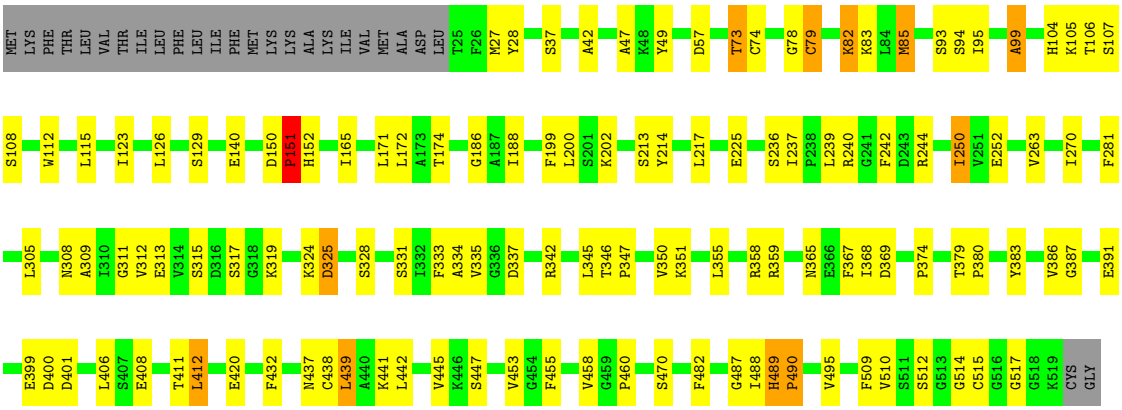
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	7	Total O 7 7	0	0
3	B	7	Total O 7 7	0	0

3 Residue-property plots (i)

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.

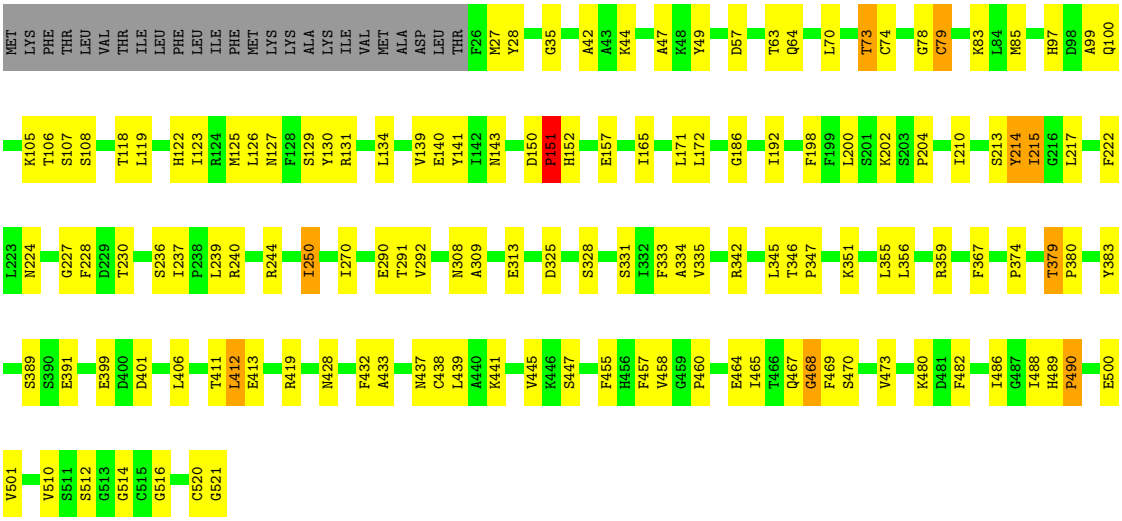
• Molecule 1: Thioredoxin reductase

Chain A:



• Molecule 1: Thioredoxin reductase

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	73.55Å 74.18Å 188.57Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.79 – 2.88 39.79 – 2.90	Depositor EDS
% Data completeness (in resolution range)	96.3 (39.79-2.88) 96.3 (39.79-2.90)	Depositor EDS
R_{merge}	0.50	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.15 (at 2.90Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.231 , 0.264 0.232 , 0.261	Depositor DCC
R_{free} test set	1199 reflections (5.15%)	wwPDB-VP
Wilson B-factor (Å^2)	54.4	Xtriage
Anisotropy	0.136	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.28 , 20.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.42$, $< L^2 > = 0.25$	Xtriage
Estimated twinning fraction	0.290 for k,h,-l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	7660	wwPDB-VP
Average B, all atoms (Å^2)	82.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.47% 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

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	1.13	2/3851 (0.1%)	1.54	17/5207 (0.3%)
1	B	1.14	1/3867 (0.0%)	1.52	16/5226 (0.3%)
All	All	1.14	3/7718 (0.0%)	1.53	33/10433 (0.3%)

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	B	0	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	369	ASP	C-O	5.48	1.30	1.23
1	B	118	THR	C-O	5.29	1.30	1.24
1	A	470	SER	C-O	5.20	1.30	1.24

All (33) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	490	PRO	N-CD-CG	-9.18	92.78	103.80
1	B	490	PRO	N-CD-CG	-7.42	94.90	103.80
1	A	252	GLU	CB-CG-CD	6.33	123.36	112.60
1	B	345	LEU	CA-C-N	6.08	126.58	119.83
1	B	345	LEU	C-N-CA	6.08	126.58	119.83
1	A	342	ARG	O-C-N	-6.05	117.61	121.85
1	A	460	PRO	CA-C-O	-5.80	114.78	121.86
1	B	389	SER	CA-C-O	-5.71	115.49	121.55

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	199	PHE	CB-CA-C	-5.69	100.88	110.44
1	B	460	PRO	N-CA-C	-5.69	102.92	111.57
1	A	345	LEU	CA-C-N	5.69	127.83	120.44
1	A	345	LEU	C-N-CA	5.69	127.83	120.44
1	B	42	ALA	CA-C-N	5.56	128.52	120.79
1	B	42	ALA	C-N-CA	5.56	128.52	120.79
1	B	482	PHE	CA-C-O	-5.55	114.67	120.55
1	A	42	ALA	CA-C-N	5.47	128.40	120.79
1	A	42	ALA	C-N-CA	5.47	128.40	120.79
1	A	213	SER	CA-C-O	-5.41	115.72	121.94
1	B	468	GLY	CA-C-N	5.32	127.40	120.28
1	B	468	GLY	C-N-CA	5.32	127.40	120.28
1	A	83	LYS	N-CA-C	-5.30	105.59	111.36
1	B	432	PHE	CA-C-N	5.28	128.26	120.82
1	B	432	PHE	C-N-CA	5.28	128.26	120.82
1	A	489	HIS	CB-CA-C	5.24	116.49	109.42
1	B	213	SER	CA-C-O	-5.22	116.04	121.99
1	A	214	TYR	CB-CA-C	5.21	119.43	110.79
1	A	94	SER	N-CA-C	-5.14	104.75	111.02
1	A	281	PHE	CA-C-N	5.13	128.11	120.31
1	A	281	PHE	C-N-CA	5.13	128.11	120.31
1	B	342	ARG	O-C-N	-5.08	118.27	121.88
1	A	242	PHE	CA-CB-CG	5.05	118.85	113.80
1	B	501	VAL	CA-C-O	-5.04	117.03	121.97
1	B	214	TYR	CB-CA-C	5.02	118.84	110.81

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	433	ALA	Peptide

5.2 Too-close contacts (i)

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3764	0	3773	84	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	3776	0	3783	86	0
2	A	53	0	31	6	0
2	B	53	0	31	2	0
3	A	7	0	0	1	0
3	B	7	0	0	1	0
All	All	7660	0	7618	158	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 10.

All (158) 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:495:VAL:HA	1:A:517:GLY:O	1.68	0.91
3:A:707:HOH:O	1:B:74[B]:CYS:SG	2.41	0.79
1:B:411:THR:HG22	1:B:437:ASN:HD21	1.47	0.78
1:B:44:LYS:NZ	3:B:701:HOH:O	2.17	0.76
1:A:315:SER:HG	1:A:317:SER:HG	1.31	0.73
1:B:411:THR:CG2	1:B:437:ASN:HD21	2.04	0.70
1:A:411:THR:HG22	1:A:437:ASN:HD21	1.53	0.70
1:A:93:SER:OG	1:A:225:GLU:OE2	2.12	0.68
1:A:151:PRO:O	1:A:331:SER:OG	2.11	0.66
1:A:186:GLY:HA3	1:A:270:ILE:O	1.95	0.66
1:B:151:PRO:O	1:B:331:SER:OG	2.14	0.65
1:A:442:LEU:HD11	1:A:482:PHE:CD2	2.32	0.65
1:A:411:THR:HG22	1:A:437:ASN:ND2	2.12	0.64
1:B:412:LEU:HB2	1:B:516:GLY:HA2	1.79	0.63
1:B:186:GLY:HA3	1:B:270:ILE:O	1.99	0.63
1:B:150:ASP:HB2	1:B:151:PRO:HD2	1.82	0.62
1:B:406:LEU:HD23	1:B:441:LYS:HD2	1.80	0.62
1:B:250:ILE:HD11	1:B:383:TYR:HB2	1.81	0.62
1:A:438:CYS:HA	1:A:458:VAL:O	2.01	0.61
1:B:464:GLU:HA	1:B:464:GLU:OE1	1.99	0.61
1:A:250:ILE:HD11	1:A:383:TYR:HB2	1.82	0.60
1:A:374:PRO:HB2	1:B:488:ILE:HD11	1.83	0.60
1:A:411:THR:CG2	1:A:437:ASN:HD21	2.14	0.60
1:A:37:SER:OG	1:A:74[B]:CYS:SG	2.59	0.60
1:B:412:LEU:CB	1:B:516:GLY:HA2	2.32	0.60
1:A:28:TYR:OH	1:A:140:GLU:OE1	2.18	0.60
1:B:204:PRO:O	1:B:291:THR:OG1	2.20	0.59
1:A:150:ASP:HB2	1:A:151:PRO:HD2	1.85	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:438:CYS:HA	1:B:458:VAL:O	2.04	0.58
1:A:37:SER:HA	1:B:520:CYS:O	2.04	0.58
1:A:82:LYS:NZ	2:A:601:FAD:N5	2.49	0.57
1:A:488:ILE:CG1	1:B:374:PRO:HB2	2.34	0.57
1:B:411:THR:HG22	1:B:437:ASN:ND2	2.17	0.57
1:B:457:PHE:CE2	1:B:465:ILE:HD12	2.40	0.57
1:B:172:LEU:O	1:B:334:ALA:HA	2.05	0.57
1:B:35:GLY:HA3	1:B:57:ASP:OD2	2.05	0.57
1:B:35:GLY:CA	1:B:57:ASP:OD2	2.53	0.57
1:A:359:ARG:NH2	1:A:367:PHE:CE2	2.72	0.57
1:B:412:LEU:HB2	1:B:516:GLY:CA	2.35	0.57
1:A:351:LYS:HB2	1:A:368:ILE:HD11	1.86	0.56
1:A:85:MET:HE2	1:A:115:LEU:HD21	1.88	0.56
1:B:171:LEU:HD11	1:B:335:VAL:HG22	1.87	0.56
1:B:28:TYR:OH	1:B:140:GLU:OE1	2.26	0.54
1:A:172:LEU:O	1:A:334:ALA:HA	2.07	0.54
1:A:108:SER:HA	1:B:105:LYS:O	2.08	0.53
1:A:79:CYS:HA	1:A:82:LYS:HE2	1.90	0.53
1:B:64:GLN:HG3	1:B:192:ILE:HG22	1.90	0.53
1:A:236:SER:OG	1:A:237:ILE:N	2.42	0.53
1:B:346:THR:HB	1:B:347:PRO:HD3	1.89	0.53
1:B:359:ARG:NH2	1:B:367:PHE:CE1	2.77	0.53
1:A:79:CYS:SG	2:A:601:FAD:C10	2.98	0.51
1:A:99:ALA:O	1:A:104:HIS:HB2	2.10	0.51
1:A:442:LEU:HD21	1:A:482:PHE:CE2	2.45	0.51
1:A:105:LYS:O	1:B:108:SER:HA	2.11	0.51
1:B:85:MET:HE3	1:B:198:PHE:HD1	1.75	0.51
1:A:351:LYS:O	1:A:355:LEU:HG	2.11	0.51
1:B:85:MET:HG2	1:B:222[A]:PHE:CD1	2.47	0.50
1:B:122:HIS:O	1:B:125:MET:HB3	2.12	0.50
1:A:126:LEU:HA	1:A:129:SER:HB3	1.94	0.50
1:A:412:LEU:HD23	1:B:83:LYS:HG2	1.93	0.50
1:A:171:LEU:HD11	1:A:335:VAL:HG22	1.94	0.50
1:A:79:CYS:SG	2:A:601:FAD:C4X	3.00	0.50
1:A:79:CYS:HA	1:A:82:LYS:CE	2.42	0.49
1:B:236:SER:OG	1:B:237:ILE:N	2.41	0.49
1:A:325:ASP:O	1:A:333:PHE:HB3	2.12	0.49
1:A:406:LEU:HB3	1:A:441:LYS:HG3	1.94	0.49
1:A:488:ILE:HG12	1:B:374:PRO:HB2	1.93	0.49
1:B:217:LEU:HD12	1:B:239:LEU:HG	1.95	0.49
1:A:406:LEU:HD11	1:A:509:PHE:CD2	2.47	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:413:GLU:OE1	1:B:413:GLU:N	2.45	0.49
1:B:401:ASP:OD2	1:B:447:SER:OG	2.24	0.48
1:A:346:THR:HB	1:A:347:PRO:HD3	1.96	0.48
1:B:351:LYS:O	1:B:355:LEU:HG	2.14	0.47
1:A:351:LYS:HG3	1:B:486:ILE:HD13	1.95	0.47
1:B:70:LEU:O	1:B:127:ASN:ND2	2.43	0.47
1:B:214:TYR:CE1	1:B:215:ILE:HD12	2.50	0.47
1:A:401:ASP:OD2	1:A:447:SER:OG	2.24	0.47
1:A:379:THR:O	1:A:380:PRO:C	2.57	0.47
1:A:350:VAL:HG22	1:B:521:GLY:HA2	1.97	0.46
1:B:150:ASP:O	1:B:152:HIS:N	2.49	0.46
1:B:126:LEU:HA	1:B:129:SER:HB3	1.96	0.46
1:A:319:LYS:HE3	1:A:337:ASP:O	2.15	0.46
1:A:171:LEU:HD12	1:A:172:LEU:O	2.16	0.45
1:A:399:GLU:O	1:A:399:GLU:HG2	2.16	0.45
1:B:374:PRO:HG3	1:B:470:SER:HB2	1.98	0.45
1:B:141:TYR:OH	1:B:143:ASN:HB2	2.16	0.45
1:B:85:MET:HE1	1:B:198:PHE:HA	1.97	0.45
1:A:79:CYS:O	1:A:82:LYS:HB3	2.15	0.45
1:B:35:GLY:N	1:B:57:ASP:OD2	2.49	0.45
1:A:73:THR:O	1:A:78:GLY:N	2.50	0.45
1:A:85:MET:HE2	1:A:115:LEU:CD2	2.47	0.45
1:A:150:ASP:O	1:A:152:HIS:N	2.50	0.45
1:A:401:ASP:OD1	1:A:447:SER:HB3	2.18	0.44
1:B:57:ASP:HA	2:B:601:FAD:N3A	2.32	0.44
1:A:236:SER:OG	1:A:240:ARG:NH2	2.41	0.44
1:A:406:LEU:CD1	1:A:509:PHE:CD2	3.01	0.44
1:A:355:LEU:O	1:A:358:ARG:N	2.51	0.44
1:A:236:SER:HG	1:A:240:ARG:HH21	1.64	0.44
1:B:325:ASP:O	1:B:333:PHE:HB3	2.17	0.44
1:A:47:ALA:C	1:A:49:TYR:H	2.26	0.44
1:A:312:VAL:HA	1:A:328[B]:SER:OG	2.17	0.44
1:B:202:LYS:HE2	1:B:290:GLU:OE1	2.18	0.44
1:B:455:PHE:C	1:B:455:PHE:CD1	2.95	0.44
1:A:455:PHE:C	1:A:455:PHE:CD1	2.96	0.44
1:A:495:VAL:CA	1:A:517:GLY:O	2.55	0.44
1:A:37:SER:HB3	1:A:346:THR:HG23	2.00	0.44
1:B:47:ALA:C	1:B:49:TYR:H	2.26	0.44
1:A:200:LEU:C	1:A:202:LYS:H	2.26	0.43
1:A:495:VAL:HB	1:A:517:GLY:HA3	2.00	0.43
1:B:228:PHE:O	1:B:230:THR:OG1	2.34	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:57:ASP:HA	2:A:601:FAD:N3A	2.33	0.43
1:A:420:GLU:HA	1:A:432:PHE:O	2.18	0.43
1:A:386:VAL:HG22	1:A:387:GLY:N	2.34	0.43
1:B:134:LEU:HD22	1:B:139:VAL:HG11	2.01	0.43
1:A:324:LYS:HB3	1:A:367:PHE:CE2	2.54	0.43
1:A:374:PRO:HB2	1:B:488:ILE:CG1	2.49	0.43
1:B:97:HIS:HB3	1:B:419:ARG:HG2	1.99	0.43
1:B:379:THR:O	1:B:380:PRO:C	2.60	0.43
1:A:313:GLU:HB2	1:A:328[A]:SER:OG	2.18	0.43
1:B:313:GLU:H	1:B:328[B]:SER:HG	1.62	0.43
1:B:401:ASP:OD1	1:B:447:SER:HB3	2.17	0.43
1:B:100:GLN:HE22	1:B:105:LYS:HD3	1.84	0.42
1:A:174:THR:HG21	1:A:305:LEU:HD21	2.01	0.42
1:A:311:GLY:O	1:A:328[B]:SER:OG	2.22	0.42
1:A:401:ASP:O	1:A:445:VAL:HA	2.19	0.42
1:B:401:ASP:O	1:B:445:VAL:HA	2.20	0.42
1:A:374:PRO:HB2	1:B:488:ILE:CD1	2.50	0.42
2:A:601:FAD:O5'	2:A:601:FAD:O2A	2.37	0.42
1:B:308:ASN:OD1	1:B:309:ALA:N	2.53	0.42
1:A:487:GLY:O	1:B:347:PRO:HG2	2.19	0.41
1:A:509:PHE:CD1	1:A:509:PHE:C	2.98	0.41
1:A:174:THR:O	2:A:601:FAD:H8A	2.20	0.41
1:B:210:ILE:HD11	1:B:292:VAL:CG1	2.50	0.41
1:B:236:SER:OG	1:B:240:ARG:NH2	2.43	0.41
1:B:399:GLU:O	1:B:399:GLU:HG3	2.20	0.41
1:B:428:ASN:C	1:B:428:ASN:OD1	2.64	0.41
1:A:217:LEU:HD12	1:A:239:LEU:HG	2.02	0.41
1:B:210:ILE:HD11	1:B:292:VAL:HG13	2.03	0.41
1:B:244:ARG:HB2	1:B:391:GLU:OE2	2.20	0.41
1:B:313:GLU:HB2	1:B:328[A]:SER:OG	2.21	0.41
1:B:85:MET:CE	1:B:119:LEU:HD11	2.50	0.41
1:A:406:LEU:C	1:A:406:LEU:HD12	2.46	0.41
1:A:408:GLU:HB2	1:A:439:LEU:HD12	2.02	0.41
1:A:489:HIS:HA	1:A:490:PRO:HA	1.85	0.41
1:B:27:MET:SD	1:B:165:ILE:HA	2.61	0.41
1:B:489:HIS:HA	1:B:490:PRO:HA	1.86	0.41
1:A:74[B]:CYS:SG	1:B:520:CYS:HB3	2.61	0.41
1:B:73:THR:O	1:B:78:GLY:N	2.54	0.41
1:B:469:PHE:O	1:B:473:VAL:HG23	2.21	0.41
1:A:27:MET:SD	1:A:165:ILE:HA	2.61	0.40
1:A:308:ASN:OD1	1:A:309:ALA:N	2.55	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:79:CYS:SG	2:B:601:FAD:C4X	3.09	0.40
1:B:224:ASN:O	1:B:227:GLY:N	2.38	0.40
1:B:333:PHE:CD2	1:B:356:LEU:HD11	2.56	0.40
1:A:244:ARG:HB2	1:A:391:GLU:OE2	2.22	0.40
1:B:130:TYR:O	1:B:131:ARG:C	2.65	0.40
1:B:467:GLN:O	1:B:468:GLY:C	2.64	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	497/521 (95%)	425 (86%)	68 (14%)	4 (1%)	16	42
1	B	499/521 (96%)	417 (84%)	78 (16%)	4 (1%)	16	42
All	All	996/1042 (96%)	842 (84%)	146 (15%)	8 (1%)	16	42

All (8) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	99	ALA
1	A	112	TRP
1	A	151	PRO
1	B	63	THR
1	B	151	PRO
1	B	514	GLY
1	B	99	ALA
1	A	514	GLY

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	408/427 (96%)	387 (95%)	21 (5%)	20 48
1	B	409/427 (96%)	392 (96%)	17 (4%)	25 56
All	All	817/854 (96%)	779 (95%)	38 (5%)	22 52

All (38) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	73	THR
1	A	79	CYS
1	A	82	LYS
1	A	85	MET
1	A	95	ILE
1	A	106	THR
1	A	107	SER
1	A	123	ILE
1	A	151	PRO
1	A	188	ILE
1	A	250	ILE
1	A	263	VAL
1	A	325	ASP
1	A	365	ASN
1	A	400	ASP
1	A	412	LEU
1	A	439	LEU
1	A	453	VAL
1	A	510	VAL
1	A	512	SER
1	A	515	CYS
1	B	73	THR
1	B	79	CYS
1	B	106	THR
1	B	107	SER
1	B	123	ILE
1	B	151	PRO

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Mol	Chain	Res	Type
1	B	157	GLU
1	B	200	LEU
1	B	215	ILE
1	B	250	ILE
1	B	379	THR
1	B	412	LEU
1	B	439	LEU
1	B	480	LYS
1	B	500	GLU
1	B	510	VAL
1	B	512	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	64	GLN
1	A	189	GLN
1	A	224	ASN
1	A	269	ASN
1	A	274	ASN
1	B	86	HIS
1	B	189	GLN
1	B	224	ASN
1	B	269	ASN
1	B	274	ASN
1	B	276	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)

2 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	0.79	1 (1%)	68,89,89	1.01	4 (5%)
2	FAD	A	601	-	53,58,58	0.82	2 (3%)	68,89,89	0.88	3 (4%)

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	-	-	4/30/50/50	0/6/6/6

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	601	FAD	C1'-C2'	-2.21	1.49	1.52
2	B	601	FAD	C4X-C4	-2.17	1.36	1.44
2	A	601	FAD	C4X-C4	-2.08	1.36	1.44

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	601	FAD	O4B-C1B-C2B	-3.33	102.05	106.93
2	B	601	FAD	C5A-C6A-N6A	2.51	124.16	120.35
2	A	601	FAD	C3B-C2B-C1B	2.43	104.64	100.98
2	A	601	FAD	C5A-C6A-N6A	2.23	123.74	120.35
2	B	601	FAD	O4-C4-C4X	-2.19	120.79	126.60
2	A	601	FAD	C4-N3-C2	-2.14	121.69	125.64
2	B	601	FAD	C9-C9A-N10	2.04	124.59	121.84

There are no chirality outliers.

All (10) torsion outliers are listed below:

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

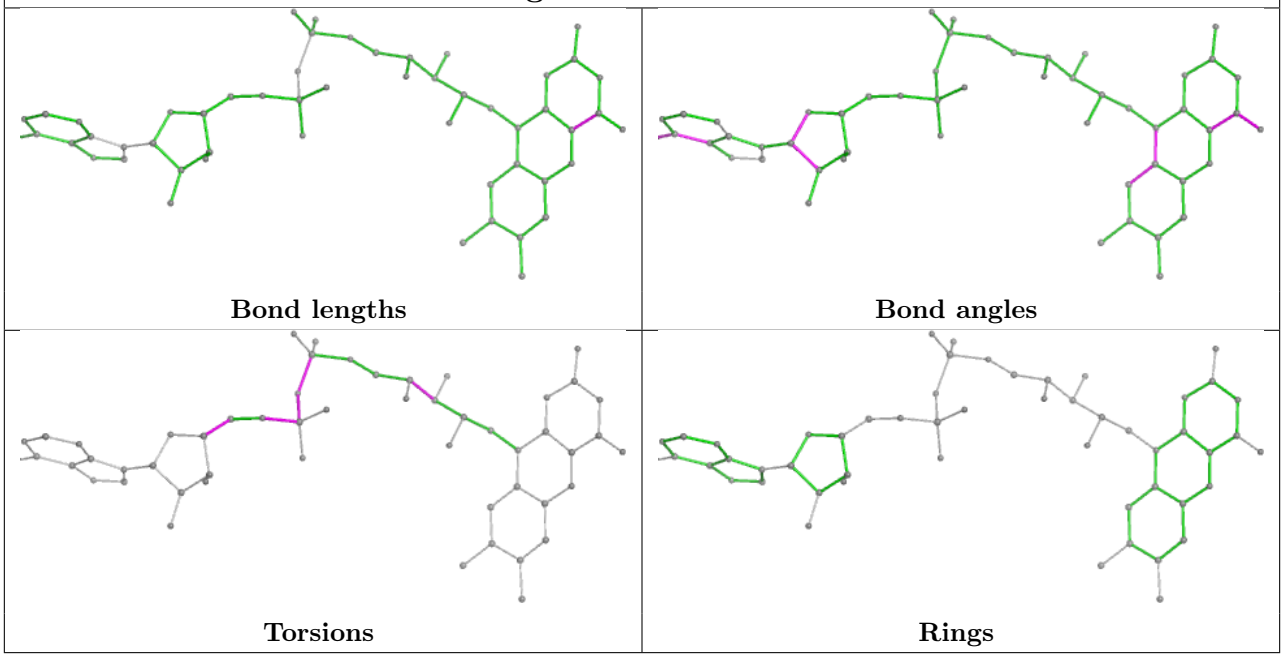
There are no ring outliers.

2 monomers are involved in 8 short contacts:

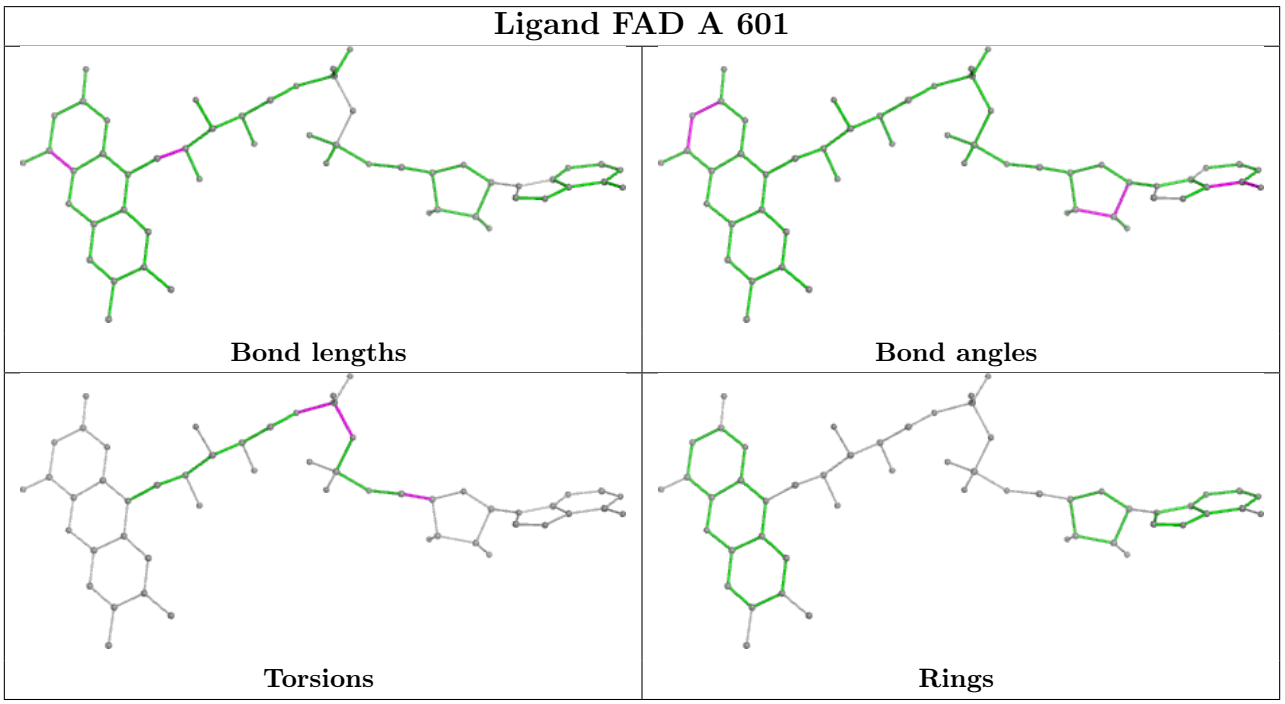
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	601	FAD	2	0
2	A	601	FAD	6	0

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 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



Ligand FAD A 601



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, 95^{th} 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	495/521 (95%)	-1.65	0	100	100	39, 74, 117, 177	4 (0%)
1	B	496/521 (95%)	-1.63	0	100	100	34, 80, 131, 161	5 (1%)
All	All	991/1042 (95%)	-1.64	0	100	100	34, 77, 129, 177	9 (0%)

There are no RSRZ outliers to report.

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

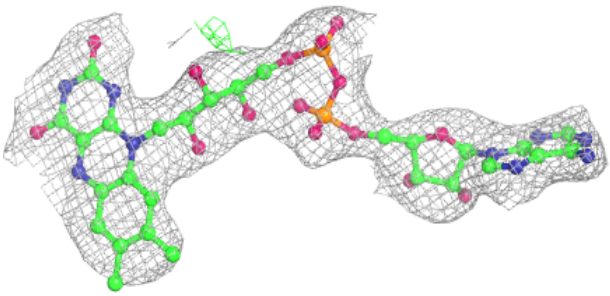
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9'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

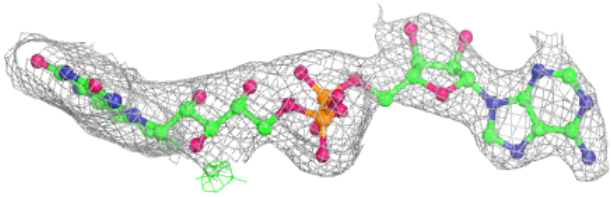
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	FAD	A	601	53/53	0.99	0.03	47,55,82,85	0
2	FAD	B	601	53/53	0.99	0.03	53,61,80,85	0

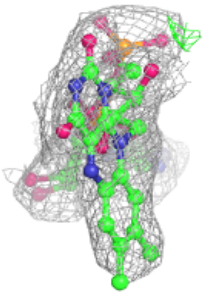
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around FAD 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)

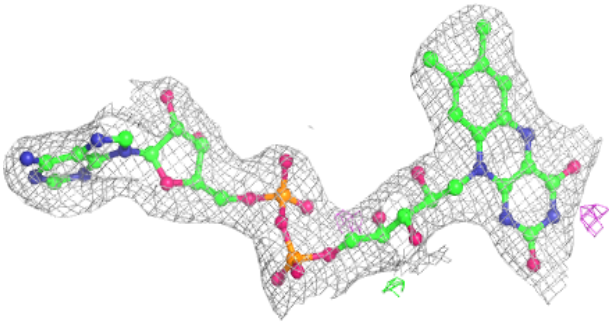


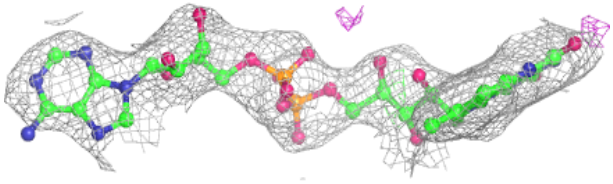


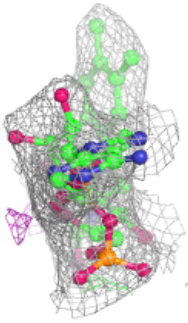


Electron density around FAD B 601:

$2mF_o$-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 (i)

There are no such residues in this entry.