



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 07:43 PM UTC

PDB ID : 4E2D / pdb\_00004e2d  
Title : Structure of the old yellow enzyme from Trypanosoma cruzi  
Authors : Murakami, M.T.; Rodrigues, N.C.; Gava, L.M.; Canduri, F.; Oliva, G.; Barbosa, L.R.S.; Borgers, J.C.  
Deposited on : 2012-03-08  
Resolution : 2.00 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](mailto: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>.

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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

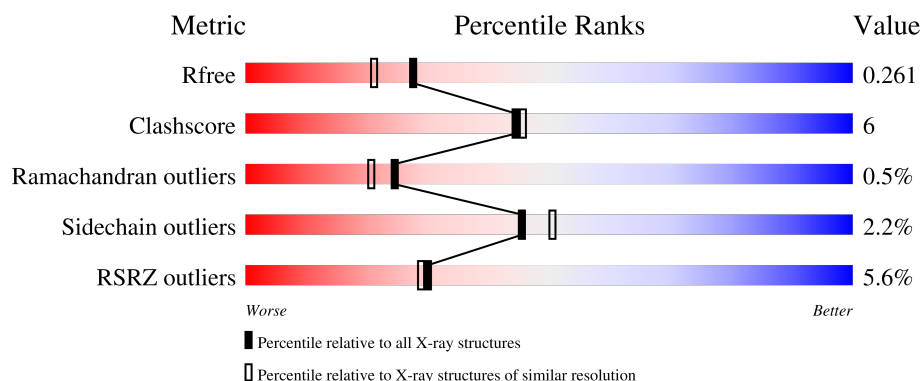
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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  $\geq 3$ , 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	382	<div> <div>4%</div> <div>84%</div> <div>13%</div> <div>..</div> </div>
1	B	382	<div> <div>6%</div> <div>84%</div> <div>13%</div> <div>..</div> </div>
1	C	382	<div> <div>6%</div> <div>86%</div> <div>12%</div> <div>..</div> </div>
1	D	382	<div> <div>6%</div> <div>84%</div> <div>13%</div> <div>..</div> </div>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 12421 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.

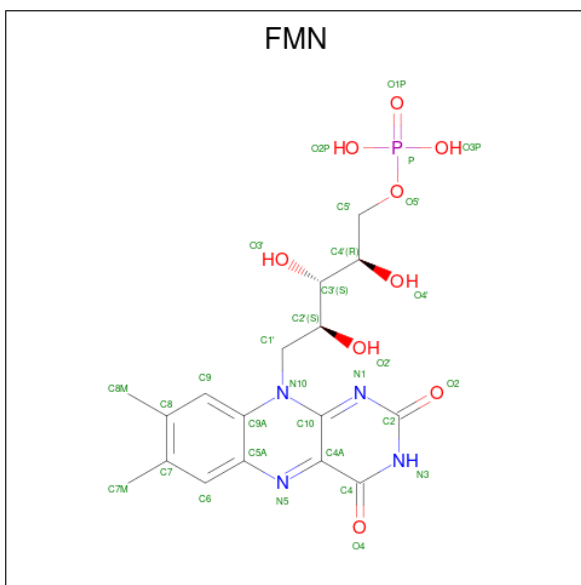
- Molecule 1 is a protein called Old Yellow Protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	377	Total	C	N	O	S	0	2	0
			2976	1886	523	558	9			
1	B	377	Total	C	N	O	S	3	2	0
			2971	1883	520	559	9			
1	C	377	Total	C	N	O	S	5	2	0
			2973	1885	520	558	10			
1	D	376	Total	C	N	O	S	0	0	0
			2952	1872	515	556	9			

There are 12 discrepancies between the modelled and reference sequences:

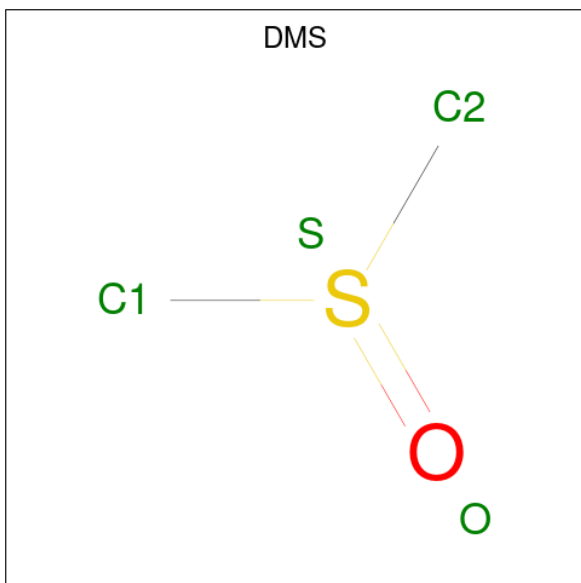
Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	expression tag	UNP Q2TJB8
A	-1	SER	-	expression tag	UNP Q2TJB8
A	0	HIS	-	expression tag	UNP Q2TJB8
B	-2	GLY	-	expression tag	UNP Q2TJB8
B	-1	SER	-	expression tag	UNP Q2TJB8
B	0	HIS	-	expression tag	UNP Q2TJB8
C	-2	GLY	-	expression tag	UNP Q2TJB8
C	-1	SER	-	expression tag	UNP Q2TJB8
C	0	HIS	-	expression tag	UNP Q2TJB8
D	-2	GLY	-	expression tag	UNP Q2TJB8
D	-1	SER	-	expression tag	UNP Q2TJB8
D	0	HIS	-	expression tag	UNP Q2TJB8

- Molecule 2 is FLAVIN MONONUCLEOTIDE (CCD ID: FMN) (formula: C<sub>17</sub>H<sub>21</sub>N<sub>4</sub>O<sub>9</sub>P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total 31	C 17	N 4	O 9	P 1	0	0
2	B	1	Total 31	C 17	N 4	O 9	P 1	0	0
2	C	1	Total 31	C 17	N 4	O 9	P 1	0	0
2	D	1	Total 31	C 17	N 4	O 9	P 1	0	0

- Molecule 3 is DIMETHYL SULFOXIDE (CCD ID: DMS) (formula:  $\text{C}_2\text{H}_6\text{OS}$ ).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O S 4 2 1 1	0	0
3	B	1	Total C O S 4 2 1 1	0	0
3	C	1	Total C O S 4 2 1 1	0	0
3	D	1	Total C O S 4 2 1 1	0	0

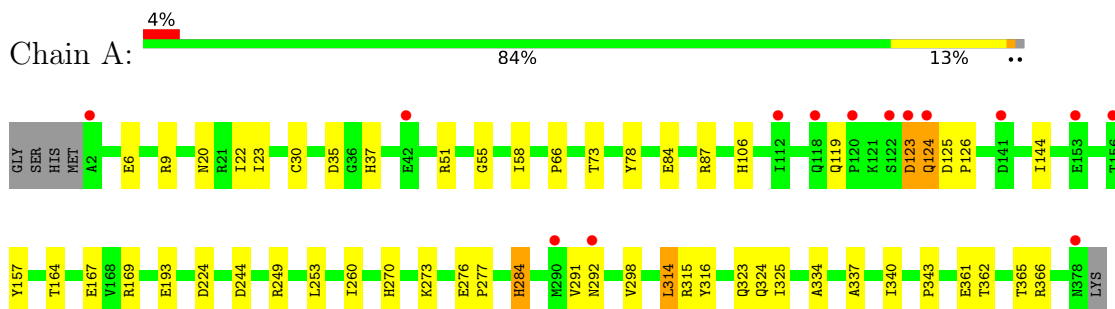
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	109	Total O 109 109	0	0
4	B	91	Total O 91 91	0	0
4	C	107	Total O 107 107	0	0
4	D	102	Total O 102 102	0	0

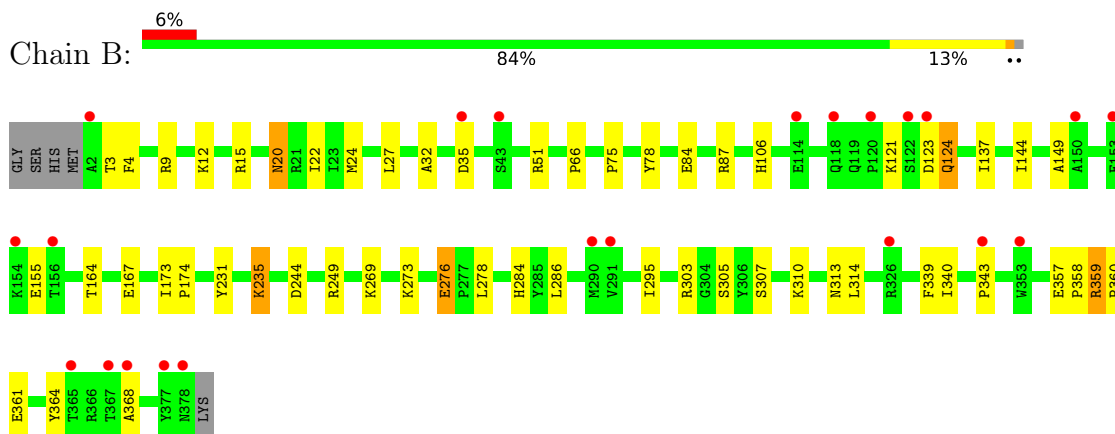
### 3 Residue-property plots [i](#)

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.

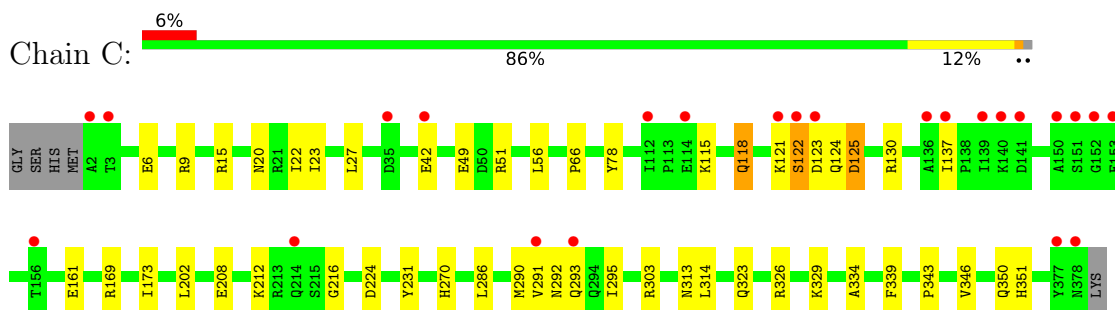
- Molecule 1: Old Yellow Protein



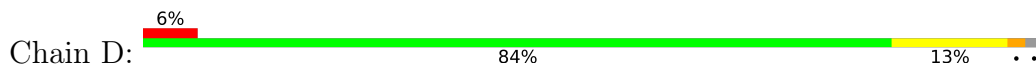
- Molecule 1: Old Yellow Protein

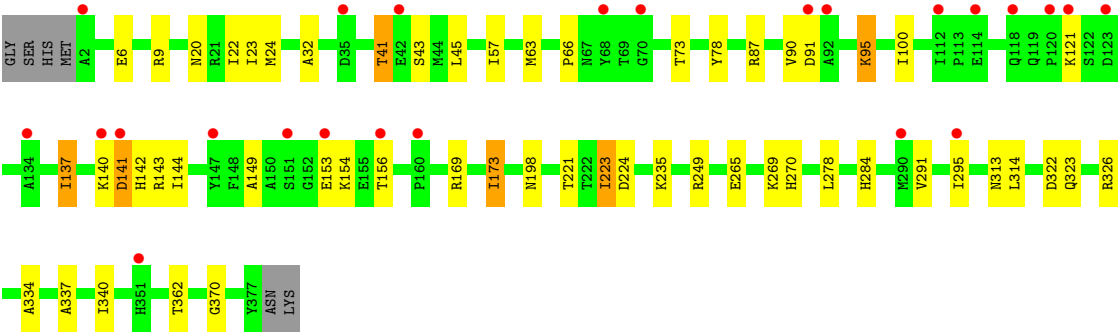


- Molecule 1: Old Yellow Protein



- Molecule 1: Old Yellow Protein





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	50.77Å 118.47Å 111.12Å 90.00° 90.09° 90.00°	Depositor
Resolution (Å)	40.00 – 2.00 40.00 – 2.00	Depositor EDS
% Data completeness (in resolution range)	90.1 (40.00-2.00) 91.2 (40.00-2.00)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.63 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.6.0117	Depositor
R, $R_{free}$	0.194 , 0.242 0.208 , 0.261	Depositor DCC
$R_{free}$ test set	11700 reflections (13.13%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	23.9	Xtriage
Anisotropy	0.036	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 33.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.53$ , $\langle L^2 \rangle = 0.37$	Xtriage
Estimated twinning fraction	0.006 for h,-k,-l	Xtriage
Reported twinning fraction	0.911 for H, K, L 0.089 for -h,-k,l	Depositor
Outliers	0 of 81443 reflections	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	12421	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 31.52 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.0920e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: FMN, DMS

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	1.06	3/3049 (0.1%)	1.05	2/4135 (0.0%)
1	B	0.99	2/3044 (0.1%)	1.04	2/4130 (0.0%)
1	C	1.02	1/3046 (0.0%)	1.08	7/4132 (0.2%)
1	D	0.98	0/3019	1.07	8/4096 (0.2%)
All	All	1.01	6/12158 (0.0%)	1.06	19/16493 (0.1%)

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	2

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	284	HIS	ND1-CE1	5.76	1.38	1.32
1	A	106	HIS	ND1-CE1	5.54	1.38	1.32
1	A	37	HIS	CG-CD2	5.32	1.41	1.35
1	B	106	HIS	CG-CD2	5.06	1.41	1.35
1	B	4	PHE	N-CA	5.03	1.51	1.46
1	C	173	ILE	CA-CB	5.03	1.56	1.54

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	198	ASN	N-CA-C	7.04	121.25	112.24
1	C	216	GLY	CA-C-N	-6.37	113.18	120.89
1	C	216	GLY	C-N-CA	-6.37	113.18	120.89

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	121	LYS	N-CA-C	6.32	120.91	111.81
1	C	125	ASP	CA-C-N	6.07	126.19	119.87
1	C	125	ASP	C-N-CA	6.07	126.19	119.87
1	C	208	GLU	N-CA-C	5.96	118.54	111.33
1	D	221	THR	N-CA-C	5.84	118.59	111.82
1	A	123	ASP	N-CA-C	5.49	116.99	110.19
1	C	292	ASN	N-CA-C	5.42	119.18	112.24
1	D	223	ILE	CB-CA-C	5.39	118.87	111.97
1	B	276	GLU	CA-C-N	-5.25	114.41	119.87
1	B	276	GLU	C-N-CA	-5.25	114.41	119.87
1	D	137	ILE	CA-C-N	-5.18	114.90	120.03
1	D	137	ILE	C-N-CA	-5.18	114.90	120.03
1	D	173	ILE	N-CA-CB	5.07	113.92	110.52
1	D	100	ILE	N-CA-C	5.05	115.55	108.17
1	D	90	VAL	N-CA-C	5.05	115.27	110.42
1	A	119	GLN	N-CA-C	-5.02	103.32	109.65

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	123	ASP	Peptide
1	B	124	GLN	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	2976	0	2950	32	1
1	B	2971	0	2942	37	0
1	C	2973	0	2946	34	1
1	D	2952	0	2918	37	0
2	A	31	0	19	2	0
2	B	31	0	19	4	0
2	C	31	0	19	2	0
2	D	31	0	19	1	0
3	A	4	0	6	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	4	0	6	2	0
3	C	4	0	6	0	0
3	D	4	0	6	0	0
4	A	109	0	0	6	0
4	B	91	0	0	8	0
4	C	107	0	0	3	0
4	D	102	0	0	5	0
All	All	12421	0	11856	142	1

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 (142) 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:D:295:ILE:HB	4:D:576:HOH:O	1.38	1.23
1:B:295:ILE:HB	4:B:555:HOH:O	1.37	1.19
1:B:358:PRO:O	1:B:360:PRO:HD3	1.46	1.16
1:C:122:SER:HB2	1:C:123:ASP:HA	1.30	1.09
1:D:235:LYS:HE3	4:D:582:HOH:O	1.56	1.05
1:C:122:SER:CB	1:C:123:ASP:HA	1.98	0.94
1:C:169:ARG:HD2	4:C:563:HOH:O	1.70	0.90
1:B:20:ASN:HD22	1:B:22:ILE:H	1.22	0.88
1:A:20:ASN:HD22	1:A:22:ILE:H	1.25	0.85
1:D:91:ASP:HB2	4:D:562:HOH:O	1.79	0.83
1:B:75:PRO:HA	4:B:560:HOH:O	1.79	0.82
1:D:323:GLN:OE1	1:D:326:ARG:NH1	2.13	0.82
1:C:20:ASN:HD22	1:C:22:ILE:H	1.31	0.78
1:D:20:ASN:HD22	1:D:22:ILE:H	1.33	0.77
1:B:32:ALA:CB	4:B:560:HOH:O	2.34	0.76
1:B:32:ALA:HB1	4:B:560:HOH:O	1.87	0.75
1:D:6:GLU:HG3	1:D:326:ARG:HB2	1.71	0.72
1:C:351:HIS:HE1	4:C:588:HOH:O	1.73	0.71
1:B:84:GLU:OE1	1:B:87:ARG:NH1	2.26	0.69
1:A:273:LYS:CE	4:A:598:HOH:O	2.39	0.69
1:C:123:ASP:C	1:C:125:ASP:H	2.01	0.69
1:A:361:GLU:HG2	1:A:362:THR:HG23	1.78	0.64
1:D:224:ASP:OD1	1:D:270:HIS:HE1	1.81	0.64
1:A:84:GLU:OE1	1:A:87:ARG:NH1	2.28	0.63
1:B:357:GLU:H	1:C:293:GLN:HE22	1.47	0.62
1:B:66:PRO:HA	1:B:78:TYR:CZ	2.35	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:45:LEU:C	1:D:45:LEU:HD23	2.24	0.62
1:C:224:ASP:OD1	1:C:270:HIS:HE1	1.82	0.62
1:B:20:ASN:ND2	1:B:22:ILE:H	1.96	0.61
1:C:122:SER:CB	1:C:123:ASP:CA	2.76	0.61
1:D:23:ILE:HB	1:D:334:ALA:HA	1.83	0.60
1:D:140:LYS:O	1:D:141:ASP:C	2.45	0.59
1:C:291:VAL:HG12	1:C:291:VAL:O	2.02	0.59
1:B:149:ALA:HB1	1:B:155:GLU:HG3	1.84	0.59
2:B:401:FMN:C5A	3:B:402:DMS:H23	2.33	0.59
1:C:6:GLU:O	1:C:9:ARG:HG2	2.03	0.58
1:A:244:ASP:CB	4:A:586:HOH:O	2.52	0.58
1:D:169:ARG:HA	1:D:173:ILE:HD12	1.86	0.58
1:D:235:LYS:HD3	1:D:278:LEU:CD2	2.34	0.57
1:A:224:ASP:OD1	1:A:270:HIS:HE1	1.87	0.57
2:A:401:FMN:N5	3:A:402:DMS:H21	2.20	0.56
1:A:20:ASN:ND2	1:A:22:ILE:H	1.99	0.56
1:C:323:GLN:HG3	1:C:326:ARG:HH12	1.70	0.56
1:A:244:ASP:CG	4:A:586:HOH:O	2.48	0.56
1:B:235:LYS:HG2	1:B:278:LEU:HD21	1.87	0.56
1:B:15:ARG:HB3	1:B:244:ASP:OD2	2.06	0.56
1:C:20:ASN:ND2	1:C:22:ILE:H	2.01	0.55
2:B:401:FMN:C9A	3:B:402:DMS:H23	2.36	0.55
1:D:291:VAL:HG12	1:D:291:VAL:O	2.06	0.55
1:C:303:ARG:HD3	1:C:329:LYS:HA	1.88	0.55
1:A:273:LYS:CD	4:A:598:HOH:O	2.55	0.55
1:A:276:GLU:HB3	1:A:277:PRO:HD3	1.89	0.55
1:B:295:ILE:HD12	1:B:295:ILE:O	2.07	0.54
1:A:244:ASP:HB3	4:A:586:HOH:O	2.07	0.54
1:A:273:LYS:HD3	4:A:598:HOH:O	2.07	0.54
1:C:23:ILE:HD12	1:C:56:LEU:HB3	1.90	0.54
1:D:337:ALA:HA	1:D:340:ILE:HD12	1.90	0.54
1:C:351:HIS:CD2	1:D:137:ILE:HD11	2.43	0.53
1:B:24:MET:HA	1:B:339:PHE:CD2	2.44	0.53
1:C:224:ASP:OD1	1:C:270:HIS:CE1	2.62	0.53
1:A:6:GLU:OE2	1:A:9:ARG:NE	2.38	0.52
1:C:291:VAL:O	1:C:291:VAL:CG1	2.55	0.52
1:B:27:LEU:HD13	1:B:340:ILE:HG13	1.90	0.52
1:A:66:PRO:HA	1:A:78:TYR:CZ	2.44	0.52
1:C:351:HIS:CE1	4:C:588:HOH:O	2.55	0.51
1:A:249:ARG:HA	1:A:284:HIS:O	2.10	0.51
1:B:235:LYS:HG2	1:B:278:LEU:CD2	2.41	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:276:GLU:OE2	1:B:307:SER:N	2.43	0.50
1:A:144:ILE:HG12	1:A:157:TYR:CE2	2.46	0.50
1:D:144:ILE:O	1:D:154:LYS:HG2	2.13	0.48
1:B:269:LYS:HG2	1:B:305[B]:SER:OG	2.13	0.48
1:C:115:LYS:O	1:C:118:GLN:HB2	2.13	0.48
1:B:313:ASN:ND2	2:B:401:FMN:O3'	2.46	0.48
1:B:368:ALA:HB1	4:B:553:HOH:O	2.12	0.48
1:B:32:ALA:HB2	4:B:560:HOH:O	2.04	0.48
1:B:149:ALA:CB	1:B:155:GLU:HG3	2.44	0.48
1:A:314:LEU:HG	1:A:315[B]:ARG:HG3	1.97	0.47
1:C:42:GLU:HA	1:C:42:GLU:OE1	2.14	0.47
1:B:303:ARG:HD3	1:B:310:LYS:HE3	1.97	0.47
1:D:291:VAL:O	1:D:291:VAL:CG1	2.62	0.47
1:A:20:ASN:HD21	1:A:55:GLY:H	1.63	0.47
1:B:364:TYR:CE1	2:B:401:FMN:HM71	2.49	0.47
1:D:66:PRO:HA	1:D:78:TYR:CZ	2.50	0.47
1:D:224:ASP:OD1	1:D:270:HIS:CE1	2.66	0.47
1:A:51:ARG:HG2	1:A:343:PRO:HA	1.97	0.46
1:A:316:TYR:OH	1:A:324:GLN:NE2	2.48	0.46
1:C:123:ASP:C	1:C:125:ASP:N	2.67	0.46
1:A:58:ILE:HD13	1:A:193:GLU:OE2	2.15	0.46
1:C:123:ASP:CG	1:C:124:GLN:H	2.22	0.46
1:A:30:CYS:HB3	1:A:73:THR:OG1	2.16	0.46
1:C:23:ILE:HB	1:C:334:ALA:HA	1.98	0.46
1:C:286:LEU:HG	1:C:313:ASN:HD22	1.80	0.46
1:D:41:THR:O	1:D:45:LEU:HB3	2.16	0.46
1:A:23:ILE:HB	1:A:334:ALA:HA	1.97	0.46
1:A:365:THR:O	1:A:366:ARG:HB2	2.15	0.46
1:D:24:MET:HB3	1:D:57:ILE:HA	1.97	0.45
1:C:9:ARG:HB2	1:C:9:ARG:NH1	2.31	0.45
1:B:273:LYS:HA	1:B:273:LYS:HD3	1.67	0.45
1:D:95:LYS:HE3	1:D:95:LYS:HB2	1.72	0.45
1:D:149:ALA:HB3	1:D:153:GLU:O	2.17	0.45
1:B:12:LYS:HE2	4:B:551:HOH:O	2.17	0.44
1:B:149:ALA:HB1	1:B:155:GLU:CG	2.47	0.44
1:B:173:ILE:HB	1:B:174:PRO:HD3	1.98	0.44
1:C:51:ARG:HG2	1:C:343:PRO:HA	1.99	0.44
1:A:164:THR:OG1	1:A:167:GLU:HG3	2.18	0.44
1:D:235:LYS:HD3	1:D:278:LEU:HD21	1.98	0.44
1:D:6:GLU:HB2	1:D:322:ASP:OD2	2.18	0.44
1:D:362:THR:HB	1:D:370:GLY:HA3	1.98	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:313:ASN:HD21	2:C:401:FMN:H5'2	1.82	0.44
1:D:149:ALA:CB	1:D:153:GLU:O	2.65	0.44
1:B:249:ARG:HA	1:B:284:HIS:O	2.17	0.43
1:C:66:PRO:HA	1:C:78:TYR:CZ	2.53	0.43
1:D:87:ARG:NE	4:D:568:HOH:O	2.44	0.43
1:A:253:LEU:HD12	1:A:298:VAL:HG23	2.01	0.43
1:C:346:VAL:O	1:C:350:GLN:HG3	2.18	0.43
1:D:313:ASN:HB2	1:D:334:ALA:HB3	2.01	0.43
1:D:265:GLU:HG3	1:D:269:LYS:HE3	2.01	0.43
1:B:51:ARG:HG3	1:B:343:PRO:HA	2.01	0.42
1:A:123:ASP:O	1:A:124:GLN:CB	2.68	0.42
1:D:313:ASN:ND2	2:D:401:FMN:O3'	2.51	0.42
1:C:130:ARG:HE	1:C:161:GLU:CD	2.28	0.42
1:B:358:PRO:C	1:B:360:PRO:HD3	2.32	0.42
1:D:45:LEU:HD23	1:D:45:LEU:O	2.20	0.42
1:A:125:ASP:HA	1:A:126:PRO:HD2	1.93	0.42
1:C:231:TYR:CD1	1:C:231:TYR:C	2.97	0.42
1:D:63:MET:HB3	4:D:602:HOH:O	2.19	0.42
1:D:249:ARG:HA	1:D:284:HIS:O	2.20	0.42
1:A:20:ASN:ND2	1:A:20:ASN:C	2.78	0.41
1:B:164:THR:OG1	1:B:167:GLU:HG3	2.20	0.41
1:B:359:ARG:HD2	4:B:552:HOH:O	2.20	0.41
1:D:140:LYS:O	1:D:142:HIS:HB2	2.21	0.41
1:A:224:ASP:OD1	1:A:270:HIS:CE1	2.72	0.41
1:A:291:VAL:O	1:A:292:ASN:HB2	2.21	0.41
1:C:137:ILE:HD11	1:C:212:LYS:HG3	2.03	0.41
1:A:337:ALA:HA	1:A:340:ILE:HD12	2.03	0.41
2:A:401:FMN:C5A	3:A:402:DMS:H11	2.51	0.41
1:B:286:LEU:HG	1:B:313:ASN:HD22	1.85	0.41
1:C:27:LEU:HA	2:C:401:FMN:C5A	2.51	0.40
1:D:32:ALA:O	1:D:73:THR:HB	2.21	0.40
1:B:231:TYR:O	1:B:235:LYS:HB2	2.20	0.40
1:D:6:GLU:CD	1:D:9:ARG:HH12	2.28	0.40

All (1) 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:325:ILE:O	1:C:15:ARG:NH2[2_546]	2.14	0.06

## 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	377/382 (99%)	362 (96%)	13 (3%)	2 (0%)	24	21
1	B	377/382 (99%)	365 (97%)	10 (3%)	2 (0%)	24	21
1	C	377/382 (99%)	360 (96%)	15 (4%)	2 (0%)	24	21
1	D	374/382 (98%)	356 (95%)	16 (4%)	2 (0%)	24	21
All	All	1505/1528 (98%)	1443 (96%)	54 (4%)	8 (0%)	24	21

All (8) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	314	LEU
1	B	314	LEU
1	C	122	SER
1	C	314	LEU
1	D	314	LEU
1	B	359	ARG
1	D	141	ASP
1	A	124	GLN

### 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	313/315 (99%)	309 (99%)	4 (1%)	61	68
1	B	313/315 (99%)	302 (96%)	11 (4%)	32	32

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	313/315 (99%)	306 (98%)	7 (2%)	45	50
1	D	310/315 (98%)	303 (98%)	7 (2%)	44	49
All	All	1249/1260 (99%)	1220 (98%)	29 (2%)	45	49

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

Mol	Chain	Res	Type
1	A	35	ASP
1	A	169	ARG
1	A	260	ILE
1	A	323	GLN
1	B	3	THR
1	B	9[A]	ARG
1	B	9[B]	ARG
1	B	20	ASN
1	B	35	ASP
1	B	121	LYS
1	B	124	GLN
1	B	137	ILE
1	B	144	ILE
1	B	235	LYS
1	B	361	GLU
1	C	49	GLU
1	C	118	GLN
1	C	202	LEU
1	C	290[A]	MET
1	C	290[B]	MET
1	C	295	ILE
1	C	339	PHE
1	D	41	THR
1	D	43	SER
1	D	95	LYS
1	D	121	LYS
1	D	143	ARG
1	D	156	THR
1	D	223	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (26) such sidechains are listed below:



Mol	Chain	Res	Type
1	A	20	ASN
1	A	198	ASN
1	A	270	HIS
1	A	313	ASN
1	A	324	GLN
1	A	351	HIS
1	B	20	ASN
1	B	270	HIS
1	B	313	ASN
1	B	324	GLN
1	C	20	ASN
1	C	124	GLN
1	C	198	ASN
1	C	254	ASN
1	C	270	HIS
1	C	293	GLN
1	C	324	GLN
1	C	350	GLN
1	C	351	HIS
1	C	378	ASN
1	D	20	ASN
1	D	198	ASN
1	D	254	ASN
1	D	270	HIS
1	D	313	ASN
1	D	324	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

8 ligands are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
3	DMS	A	402	-	3,3,3	0.64	0	3,3,3	0.68	0
2	FMN	B	401	-	33,33,33	1.59	6 (18%)	48,50,50	1.55	13 (27%)
3	DMS	C	402	-	3,3,3	0.53	0	3,3,3	0.75	0
2	FMN	A	401	-	33,33,33	1.49	6 (18%)	48,50,50	1.61	12 (25%)
3	DMS	B	402	-	3,3,3	0.59	0	3,3,3	1.00	0
2	FMN	C	401	-	33,33,33	1.60	4 (12%)	48,50,50	2.98	18 (37%)
2	FMN	D	401	-	33,33,33	1.80	5 (15%)	48,50,50	1.47	9 (18%)
3	DMS	D	402	-	3,3,3	0.52	0	3,3,3	0.58	0

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	FMN	C	401	-	-	4/18/18/18	0/3/3/3
2	FMN	D	401	-	-	1/18/18/18	0/3/3/3
2	FMN	B	401	-	-	1/18/18/18	0/3/3/3
2	FMN	A	401	-	-	1/18/18/18	0/3/3/3

All (21) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	401	FMN	C9A-C5A	5.54	1.50	1.41
2	B	401	FMN	C9A-C5A	5.49	1.50	1.41
2	C	401	FMN	C9A-C5A	5.18	1.49	1.41
2	D	401	FMN	C1'-C2'	4.70	1.59	1.52
2	A	401	FMN	C9A-C5A	4.00	1.47	1.41
2	D	401	FMN	C8-C7	3.71	1.49	1.40
2	C	401	FMN	C8-C7	3.59	1.49	1.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	FMN	C1'-C2'	3.47	1.57	1.52
2	A	401	FMN	C8-C7	3.29	1.48	1.40
2	C	401	FMN	C4A-N5	3.12	1.37	1.30
2	B	401	FMN	C8-C7	2.95	1.48	1.40
2	B	401	FMN	C5'-C4'	2.92	1.55	1.51
2	B	401	FMN	C4A-N5	2.81	1.36	1.30
2	B	401	FMN	C10-N10	2.76	1.43	1.37
2	A	401	FMN	C4-N3	-2.73	1.33	1.38
2	D	401	FMN	C4A-N5	2.41	1.36	1.30
2	A	401	FMN	C4A-N5	2.32	1.35	1.30
2	D	401	FMN	C10-N1	2.21	1.37	1.33
2	B	401	FMN	C1'-C2'	2.14	1.55	1.52
2	A	401	FMN	C10-N1	2.09	1.37	1.33
2	C	401	FMN	O5'-C5'	-2.08	1.36	1.44

All (52) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	401	FMN	C5'-C4'-C3'	-15.77	82.48	112.22
2	C	401	FMN	O2-C2-N1	-4.55	114.25	121.80
2	C	401	FMN	C4-C4A-N5	4.28	124.12	118.21
2	C	401	FMN	O5'-P-O1P	-4.04	95.51	106.44
2	D	401	FMN	C9A-C5A-N5	-3.87	118.35	122.45
2	A	401	FMN	O2-C2-N1	-3.83	115.44	121.80
2	C	401	FMN	O4'-C4'-C5'	-3.76	101.70	109.99
2	A	401	FMN	O4-C4-C4A	-3.57	117.11	126.53
2	B	401	FMN	C4-C4A-N5	3.27	122.73	118.21
2	A	401	FMN	C9A-C5A-N5	-3.21	119.05	122.45
2	C	401	FMN	O5'-C5'-C4'	3.06	117.54	109.36
2	A	401	FMN	C4-C4A-N5	3.02	122.38	118.21
2	B	401	FMN	C4-N3-C2	-3.00	120.32	125.64
2	C	401	FMN	O2-C2-N3	2.96	124.25	118.58
2	C	401	FMN	O4-C4-C4A	-2.94	118.78	126.53
2	D	401	FMN	C5A-C9A-N10	2.93	120.62	117.97
2	D	401	FMN	O4-C4-C4A	-2.83	119.05	126.53
2	A	401	FMN	C5A-N5-C4A	2.82	122.65	118.09
2	B	401	FMN	C4'-C3'-C2'	-2.82	108.89	113.57
2	B	401	FMN	O4-C4-C4A	-2.77	119.22	126.53
2	B	401	FMN	C4A-C10-N1	-2.72	117.91	124.59
2	C	401	FMN	C10-N1-C2	2.66	122.60	116.85
2	B	401	FMN	O2-C2-N1	-2.65	117.39	121.80
2	B	401	FMN	O5'-P-O1P	-2.60	99.42	106.44

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	401	FMN	C10-C4A-N5	-2.58	119.55	124.81
2	B	401	FMN	C5A-N5-C4A	2.54	122.19	118.09
2	B	401	FMN	C10-N1-C2	2.52	122.31	116.85
2	D	401	FMN	C4'-C3'-C2'	-2.51	109.39	113.57
2	C	401	FMN	O3'-C3'-C2'	2.46	114.51	108.93
2	C	401	FMN	C4A-C10-N10	2.43	119.96	116.48
2	B	401	FMN	C4A-C4-N3	2.38	119.30	113.25
2	B	401	FMN	C4A-C10-N10	2.37	119.88	116.48
2	A	401	FMN	C4A-C10-N1	-2.37	118.78	124.59
2	D	401	FMN	O5'-P-O1P	-2.35	100.08	106.44
2	C	401	FMN	C9A-C5A-N5	-2.35	119.96	122.45
2	C	401	FMN	C10-C4A-N5	-2.32	120.07	124.81
2	A	401	FMN	C4A-C4-N3	2.28	119.06	113.25
2	D	401	FMN	N3-C2-N1	2.24	124.26	119.50
2	B	401	FMN	O3P-P-O1P	2.24	119.56	110.83
2	A	401	FMN	C4-N3-C2	-2.24	121.67	125.64
2	C	401	FMN	O3P-P-O1P	2.23	119.52	110.83
2	C	401	FMN	C4A-C10-N1	-2.23	119.13	124.59
2	C	401	FMN	C4A-C4-N3	2.22	118.90	113.25
2	D	401	FMN	C4A-C4-N3	2.18	118.80	113.25
2	D	401	FMN	C4-N3-C2	-2.13	121.86	125.64
2	A	401	FMN	C10-C4A-N5	-2.12	120.47	124.81
2	C	401	FMN	C5A-N5-C4A	2.12	121.52	118.09
2	A	401	FMN	O2-C2-N3	2.07	122.56	118.58
2	C	401	FMN	C4-N3-C2	-2.06	121.98	125.64
2	D	401	FMN	C4A-C10-N1	-2.03	119.61	124.59
2	A	401	FMN	O4'-C4'-C5'	-2.03	105.51	109.99
2	A	401	FMN	C10-N1-C2	2.01	121.19	116.85

There are no chirality outliers.

All (7) torsion outliers are listed below:

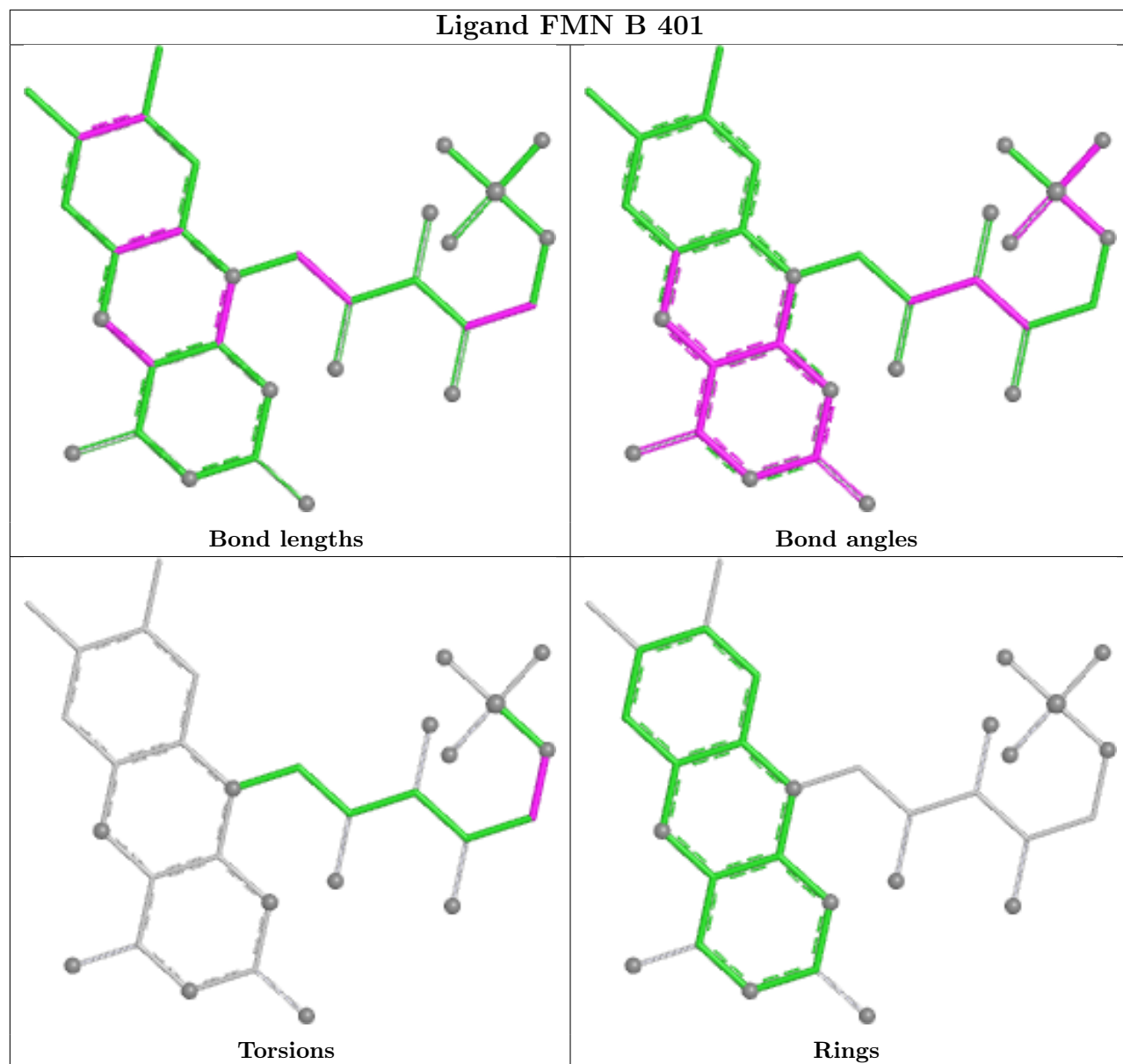
Mol	Chain	Res	Type	Atoms
2	C	401	FMN	C2'-C3'-C4'-C5'
2	C	401	FMN	O3'-C3'-C4'-C5'
2	C	401	FMN	O4'-C4'-C5'-O5'
2	C	401	FMN	C4'-C5'-O5'-P
2	D	401	FMN	C4'-C5'-O5'-P
2	B	401	FMN	C4'-C5'-O5'-P
2	A	401	FMN	C4'-C5'-O5'-P

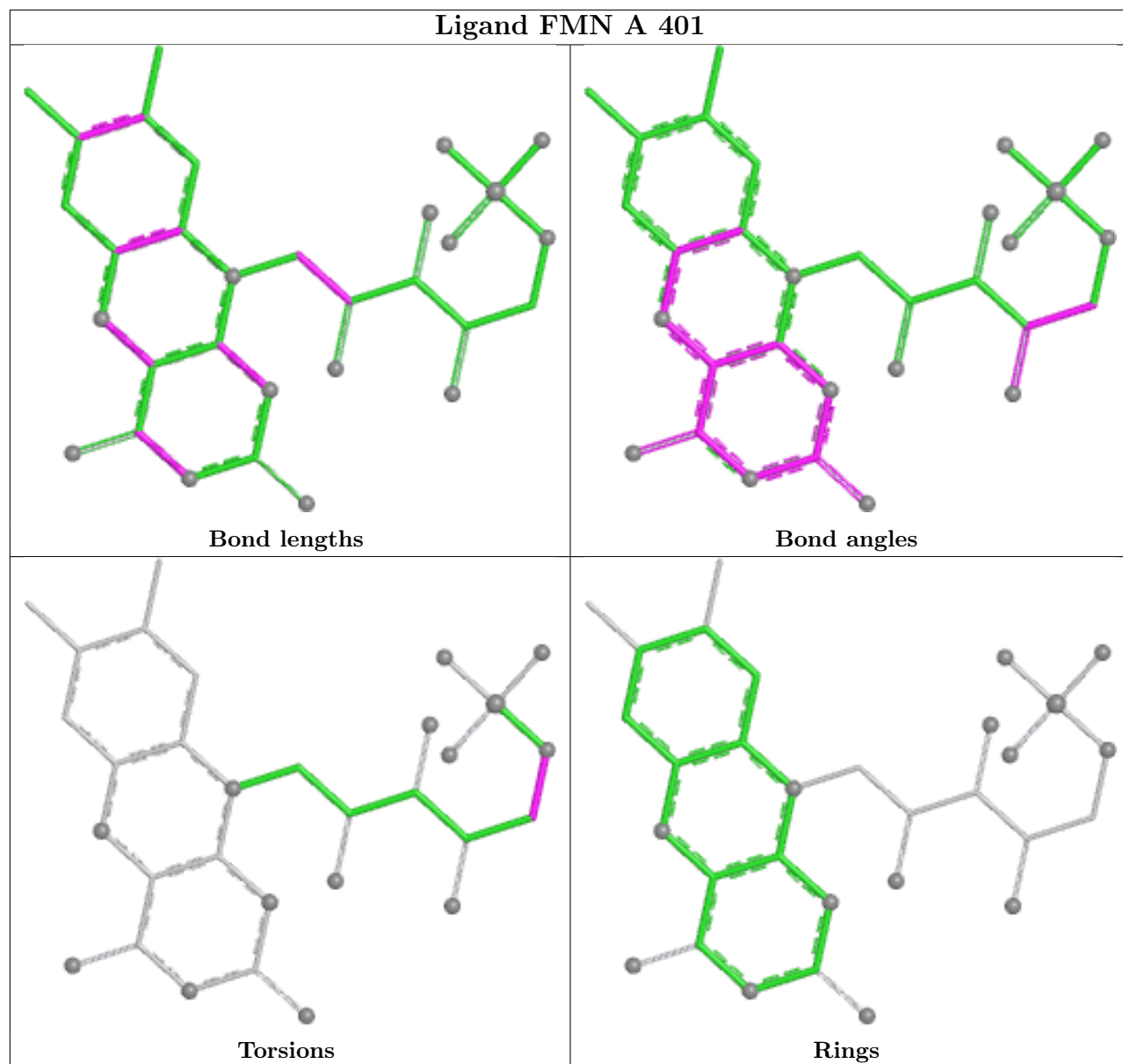
There are no ring outliers.

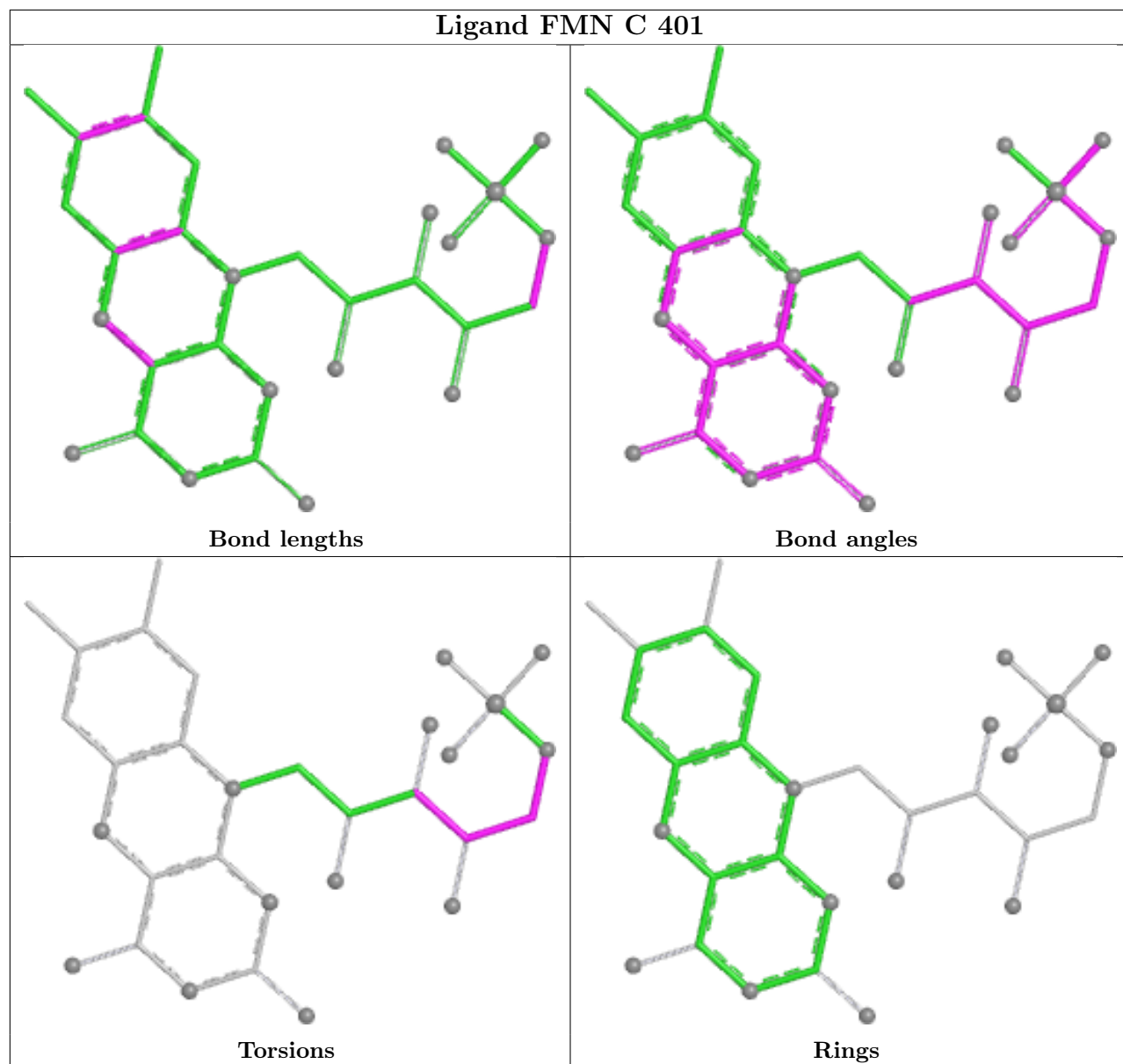
6 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	402	DMS	2	0
2	B	401	FMN	4	0
2	A	401	FMN	2	0
3	B	402	DMS	2	0
2	C	401	FMN	2	0
2	D	401	FMN	1	0

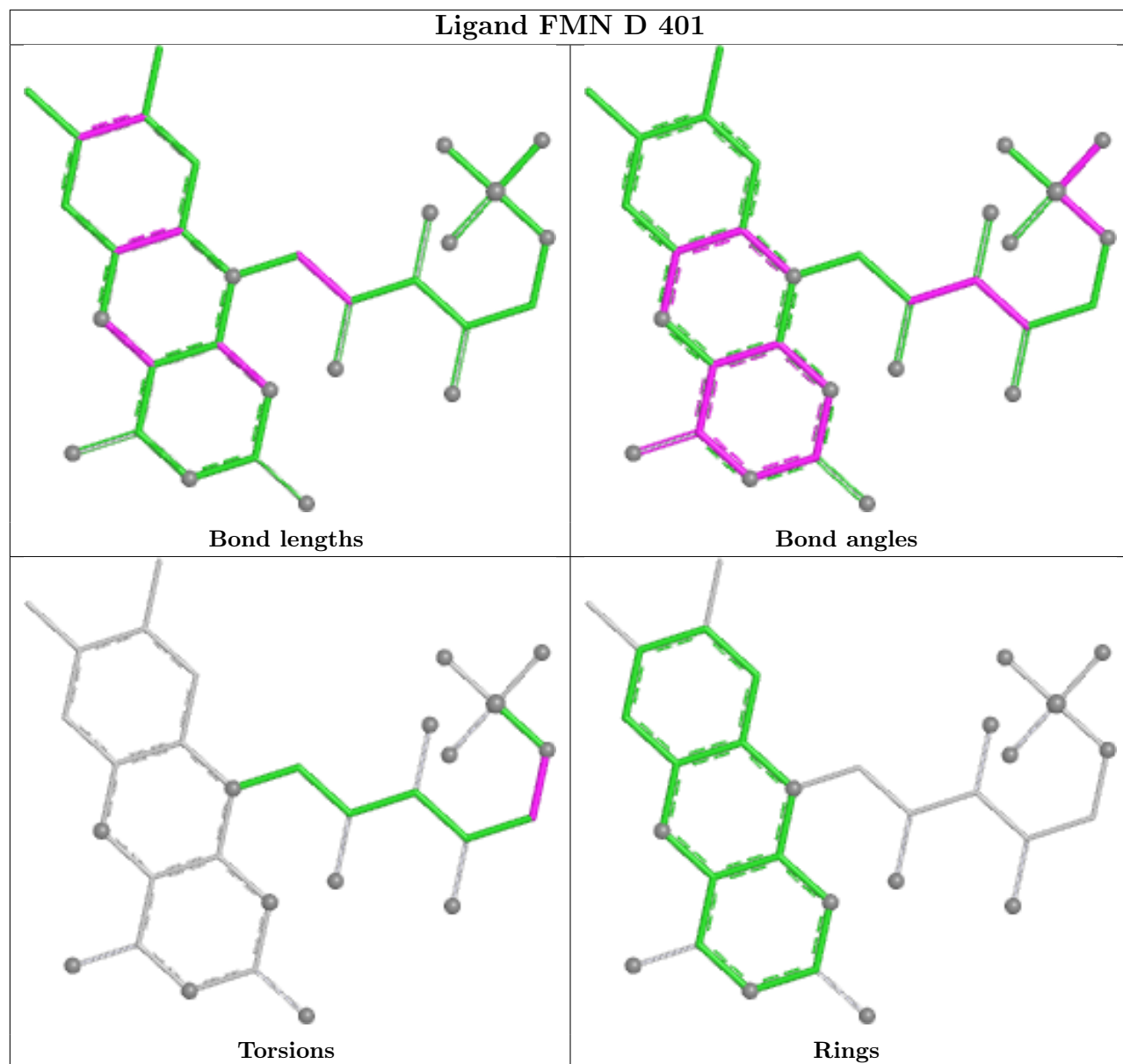
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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











## 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<sup>th</sup> 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 <sup>2</sup> )	Q < 0.9
1	A	377/382 (98%)	0.23	14 (3%)	45 44	9, 19, 35, 74	30 (7%)
1	B	377/382 (98%)	0.48	22 (5%)	29 27	11, 23, 38, 66	30 (7%)
1	C	377/382 (98%)	0.56	24 (6%)	25 24	11, 23, 41, 67	35 (9%)
1	D	376/382 (98%)	0.53	24 (6%)	25 24	13, 23, 42, 68	30 (7%)
All	All	1507/1528 (98%)	0.45	84 (5%)	30 29	9, 22, 39, 74	125 (8%)

All (84) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	121	LYS	9.0
1	D	118	GLN	8.1
1	D	153	GLU	7.1
1	D	68	TYR	7.0
1	C	378	ASN	5.8
1	C	2	ALA	5.1
1	A	123	ASP	4.9
1	B	35	ASP	4.8
1	C	156	THR	4.7
1	A	378	ASN	4.7
1	B	118	GLN	4.3
1	C	3	THR	4.1
1	C	42	GLU	4.1
1	B	291	VAL	4.0
1	B	2	ALA	4.0
1	C	141	ASP	3.8
1	B	378	ASN	3.8
1	C	153	GLU	3.8
1	A	122	SER	3.8
1	C	35	ASP	3.7
1	C	112	ILE	3.6

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Mol	Chain	Res	Type	RSRZ
1	D	120	PRO	3.6
1	A	2	ALA	3.5
1	D	112	ILE	3.4
1	C	123	ASP	3.4
1	B	122	SER	3.3
1	C	137	ILE	3.2
1	C	122	SER	3.0
1	A	156	THR	3.0
1	D	123	ASP	3.0
1	B	290	MET	2.9
1	B	154	LYS	2.9
1	A	112	ILE	2.9
1	B	353	TRP	2.8
1	B	120	PRO	2.8
1	C	140	LYS	2.8
1	C	152	GLY	2.7
1	C	114	GLU	2.7
1	D	114	GLU	2.7
1	D	35	ASP	2.6
1	D	151	SER	2.6
1	D	2	ALA	2.6
1	A	118	GLN	2.6
1	A	292	ASN	2.5
1	C	293	GLN	2.5
1	D	156	THR	2.5
1	A	290	MET	2.5
1	B	156	THR	2.5
1	D	351	HIS	2.4
1	D	140	LYS	2.4
1	B	114	GLU	2.3
1	D	290	MET	2.3
1	A	42	GLU	2.3
1	A	120	PRO	2.3
1	B	368	ALA	2.3
1	D	160	PRO	2.3
1	B	367	THR	2.2
1	B	123	ASP	2.2
1	D	91	ASP	2.2
1	C	291	VAL	2.2
1	D	70	GLY	2.2
1	B	150	ALA	2.2
1	D	134	ALA	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	153	GLU	2.1
1	D	42	GLU	2.1
1	C	139	ILE	2.1
1	D	141	ASP	2.1
1	D	92	ALA	2.1
1	A	124	GLN	2.1
1	C	150	ALA	2.1
1	C	214	GLN	2.1
1	B	377	TYR	2.1
1	C	151	SER	2.1
1	C	121	LYS	2.1
1	B	326	ARG	2.1
1	C	377	TYR	2.0
1	B	343	PRO	2.0
1	C	136	ALA	2.0
1	A	141	ASP	2.0
1	A	153	GLU	2.0
1	B	43	SER	2.0
1	D	295	ILE	2.0
1	B	365	THR	2.0
1	D	147	TYR	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

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

## 6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	DMS	C	402	4/4	0.80	0.14	39,43,45,50	0
3	DMS	D	402	4/4	0.89	0.12	44,47,48,48	0

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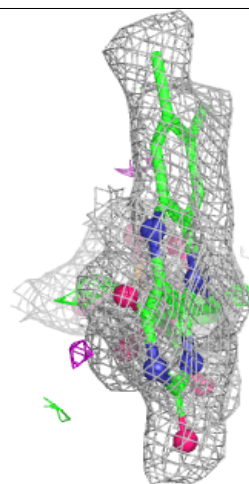
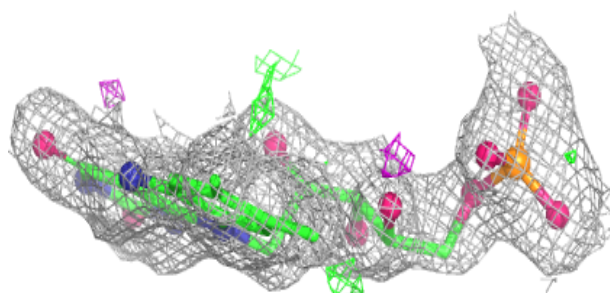
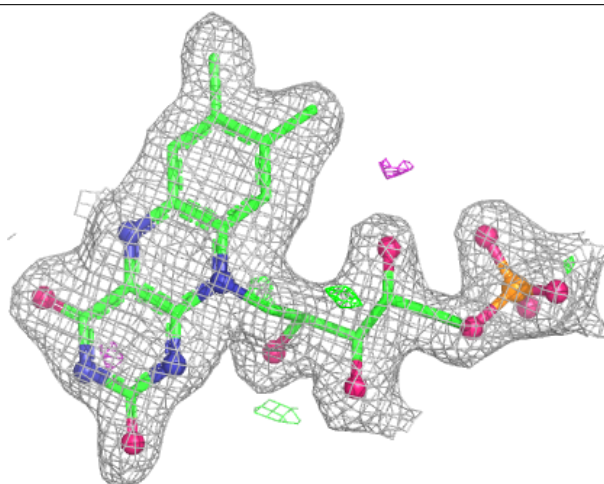
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	DMS	A	402	4/4	0.92	0.11	34,36,41,47	0
3	DMS	B	402	4/4	0.92	0.09	36,38,40,41	0
2	FMN	B	401	31/31	0.94	0.08	17,20,22,23	0
2	FMN	C	401	31/31	0.94	0.07	15,19,21,23	0
2	FMN	D	401	31/31	0.95	0.07	15,18,19,21	0
2	FMN	A	401	31/31	0.96	0.07	12,14,17,18	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.

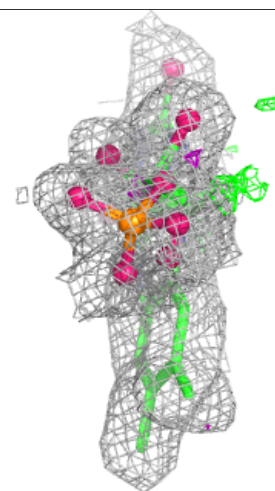
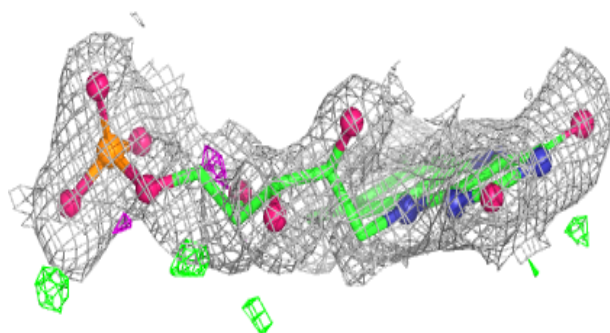
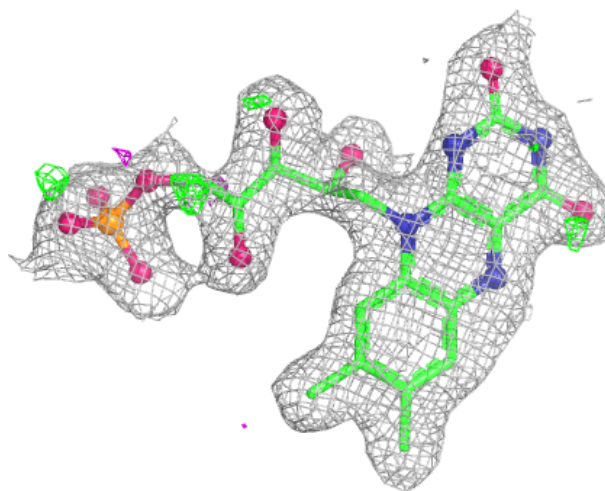
**Electron density around FMN B 401:**

2mF<sub>o</sub>-DF<sub>c</sub> (at 0.7 rmsd) in gray  
mF<sub>o</sub>-DF<sub>c</sub> (at 3 rmsd) in purple (negative)  
and green (positive)



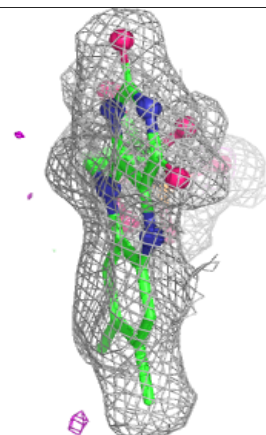
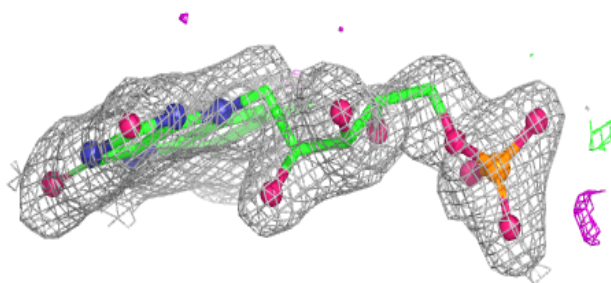
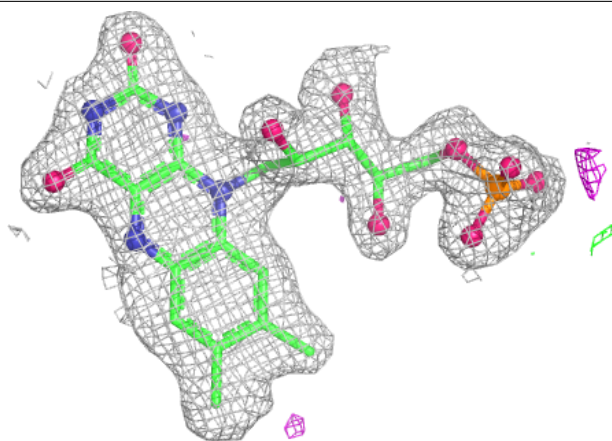
**Electron density around FMN C 401:**

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



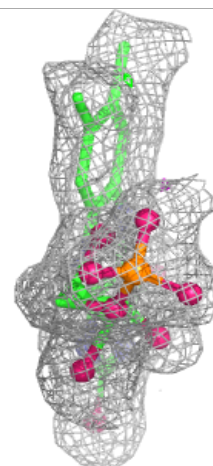
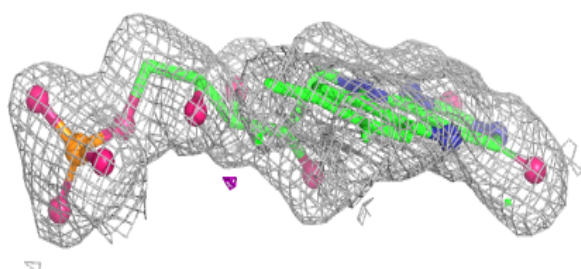
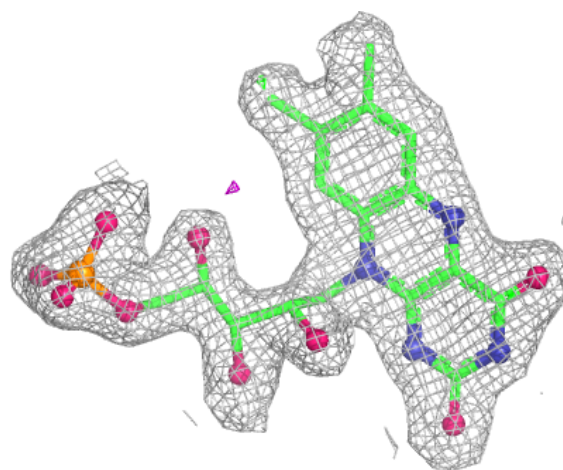
**Electron density around FMN D 401:**

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



**Electron density around FMN A 401:**

$2mF_o-DF_c$  (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.