



Full wwPDB X-ray Structure Validation Report ⓘ

Jul 29, 2021 – 12:26 am BST

PDB ID : 6S32
Title : Crystal structure of ene-reductase CtOYE from *Chroococcidiopsis thermalis*.
Authors : Robescu, M.R.; Niero, M.; Hall, M.; Bergantino, E.; Cendron, L.
Deposited on : 2019-06-24
Resolution : 1.35 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.22
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.22

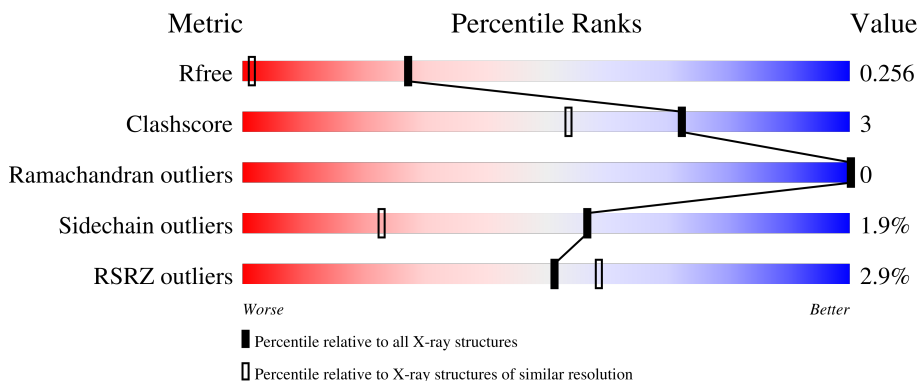
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.35 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1509 (1.38-1.34)
Clashscore	141614	1551 (1.38-1.34)
Ramachandran outliers	138981	1530 (1.38-1.34)
Sidechain outliers	138945	1530 (1.38-1.34)
RSRZ outliers	127900	1487 (1.38-1.34)

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	390	 4% 79% 10% 10%
1	B	390	 3% 84% 5% 10%
1	C	390	 2% 83% 7% 11%
1	D	390	 % 83% 7% 10%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard

residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	FMN	B	402	-	X	-	-

2 Entry composition i

There are 5 unique types of molecules in this entry. The entry contains 12468 atoms, of which 9 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 NADH:flavin oxidoreductase/NADH oxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	350	Total 2718	C 1719	N 473	O 522	S 4	0	1	0
1	B	350	Total 2749	C 1739	N 479	O 527	S 4	0	6	0
1	C	349	Total 2713	C 1716	N 474	O 519	S 4	0	1	0
1	D	352	Total 2738	C 1730	N 480	O 523	S 5	0	1	0

There are 80 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	initiating methionine	UNP K9TVC9
A	-18	GLY	-	expression tag	UNP K9TVC9
A	-17	SER	-	expression tag	UNP K9TVC9
A	-16	SER	-	expression tag	UNP K9TVC9
A	-15	HIS	-	expression tag	UNP K9TVC9
A	-14	HIS	-	expression tag	UNP K9TVC9
A	-13	HIS	-	expression tag	UNP K9TVC9
A	-12	HIS	-	expression tag	UNP K9TVC9
A	-11	HIS	-	expression tag	UNP K9TVC9
A	-10	HIS	-	expression tag	UNP K9TVC9
A	-9	SER	-	expression tag	UNP K9TVC9
A	-8	SER	-	expression tag	UNP K9TVC9
A	-7	GLY	-	expression tag	UNP K9TVC9
A	-6	LEU	-	expression tag	UNP K9TVC9
A	-5	VAL	-	expression tag	UNP K9TVC9
A	-4	PRO	-	expression tag	UNP K9TVC9
A	-3	ARG	-	expression tag	UNP K9TVC9
A	-2	GLY	-	expression tag	UNP K9TVC9
A	-1	SER	-	expression tag	UNP K9TVC9
A	0	HIS	-	expression tag	UNP K9TVC9
B	-19	MET	-	initiating methionine	UNP K9TVC9

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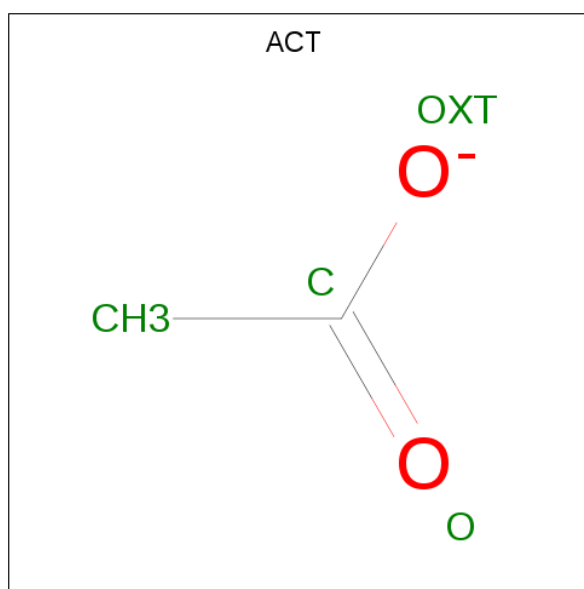
Chain	Residue	Modelled	Actual	Comment	Reference
B	-18	GLY	-	expression tag	UNP K9TVC9
B	-17	SER	-	expression tag	UNP K9TVC9
B	-16	SER	-	expression tag	UNP K9TVC9
B	-15	HIS	-	expression tag	UNP K9TVC9
B	-14	HIS	-	expression tag	UNP K9TVC9
B	-13	HIS	-	expression tag	UNP K9TVC9
B	-12	HIS	-	expression tag	UNP K9TVC9
B	-11	HIS	-	expression tag	UNP K9TVC9
B	-10	HIS	-	expression tag	UNP K9TVC9
B	-9	SER	-	expression tag	UNP K9TVC9
B	-8	SER	-	expression tag	UNP K9TVC9
B	-7	GLY	-	expression tag	UNP K9TVC9
B	-6	LEU	-	expression tag	UNP K9TVC9
B	-5	VAL	-	expression tag	UNP K9TVC9
B	-4	PRO	-	expression tag	UNP K9TVC9
B	-3	ARG	-	expression tag	UNP K9TVC9
B	-2	GLY	-	expression tag	UNP K9TVC9
B	-1	SER	-	expression tag	UNP K9TVC9
B	0	HIS	-	expression tag	UNP K9TVC9
C	-19	MET	-	initiating methionine	UNP K9TVC9
C	-18	GLY	-	expression tag	UNP K9TVC9
C	-17	SER	-	expression tag	UNP K9TVC9
C	-16	SER	-	expression tag	UNP K9TVC9
C	-15	HIS	-	expression tag	UNP K9TVC9
C	-14	HIS	-	expression tag	UNP K9TVC9
C	-13	HIS	-	expression tag	UNP K9TVC9
C	-12	HIS	-	expression tag	UNP K9TVC9
C	-11	HIS	-	expression tag	UNP K9TVC9
C	-10	HIS	-	expression tag	UNP K9TVC9
C	-9	SER	-	expression tag	UNP K9TVC9
C	-8	SER	-	expression tag	UNP K9TVC9
C	-7	GLY	-	expression tag	UNP K9TVC9
C	-6	LEU	-	expression tag	UNP K9TVC9
C	-5	VAL	-	expression tag	UNP K9TVC9
C	-4	PRO	-	expression tag	UNP K9TVC9
C	-3	ARG	-	expression tag	UNP K9TVC9
C	-2	GLY	-	expression tag	UNP K9TVC9
C	-1	SER	-	expression tag	UNP K9TVC9
C	0	HIS	-	expression tag	UNP K9TVC9
D	-19	MET	-	initiating methionine	UNP K9TVC9
D	-18	GLY	-	expression tag	UNP K9TVC9
D	-17	SER	-	expression tag	UNP K9TVC9

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Chain	Residue	Modelled	Actual	Comment	Reference
D	-16	SER	-	expression tag	UNP K9TVC9
D	-15	HIS	-	expression tag	UNP K9TVC9
D	-14	HIS	-	expression tag	UNP K9TVC9
D	-13	HIS	-	expression tag	UNP K9TVC9
D	-12	HIS	-	expression tag	UNP K9TVC9
D	-11	HIS	-	expression tag	UNP K9TVC9
D	-10	HIS	-	expression tag	UNP K9TVC9
D	-9	SER	-	expression tag	UNP K9TVC9
D	-8	SER	-	expression tag	UNP K9TVC9
D	-7	GLY	-	expression tag	UNP K9TVC9
D	-6	LEU	-	expression tag	UNP K9TVC9
D	-5	VAL	-	expression tag	UNP K9TVC9
D	-4	PRO	-	expression tag	UNP K9TVC9
D	-3	ARG	-	expression tag	UNP K9TVC9
D	-2	GLY	-	expression tag	UNP K9TVC9
D	-1	SER	-	expression tag	UNP K9TVC9
D	0	HIS	-	expression tag	UNP K9TVC9

- Molecule 2 is ACETATE ION (three-letter code: ACT) (formula: C₂H₃O₂).



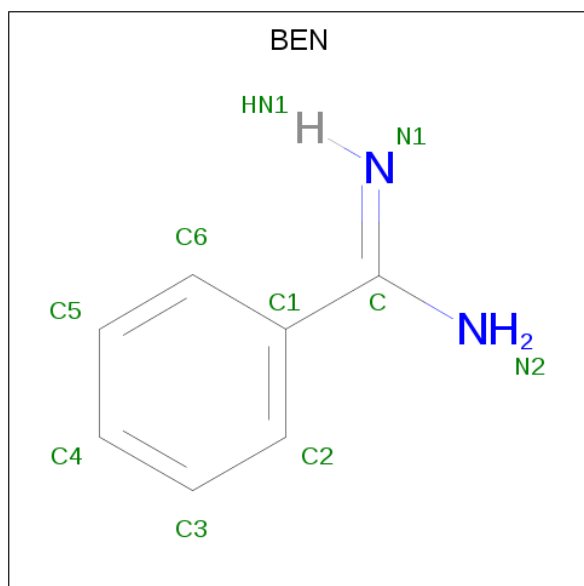
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			4	2	2		
2	B	1	Total	C	O	0	0
			4	2	2		
2	C	1	Total	C	O	0	0
			4	2	2		

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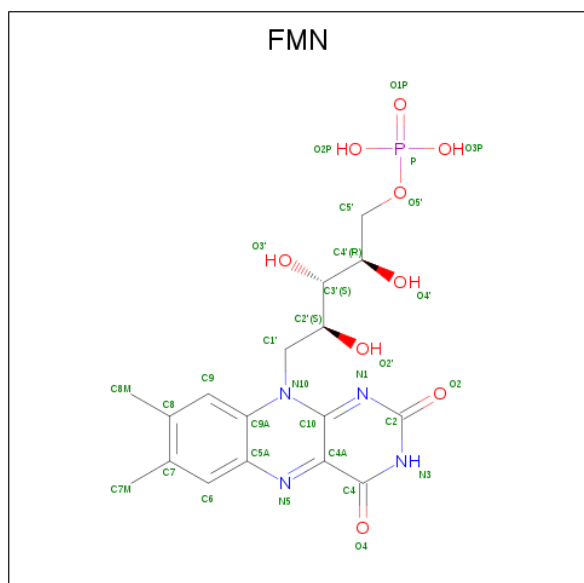
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	D	1	Total	C	O	0	0
			4	2	2		

- Molecule 3 is BENZAMIDINE (three-letter code: BEN) (formula: C₇H₈N₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	H	N	0	0
			18	7	9	2		

- Molecule 4 is FLAVIN MONONUCLEOTIDE (three-letter code: FMN) (formula: C₁₇H₂₁N₄O₉P) (labeled as "Ligand of Interest" by depositor).



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

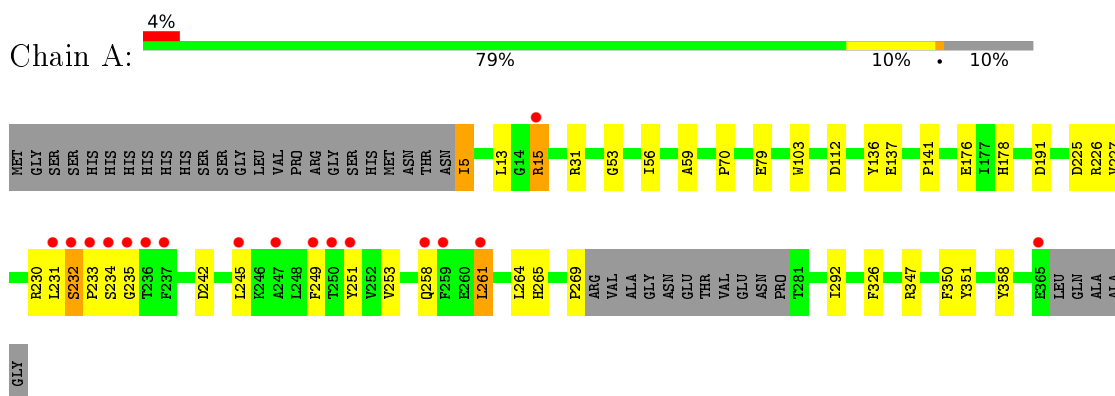
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	426	Total	O	0	0
			426	426		
5	B	356	Total	O	0	0
			356	356		
5	C	296	Total	O	0	0
			296	296		
5	D	314	Total	O	0	0
			314	314		

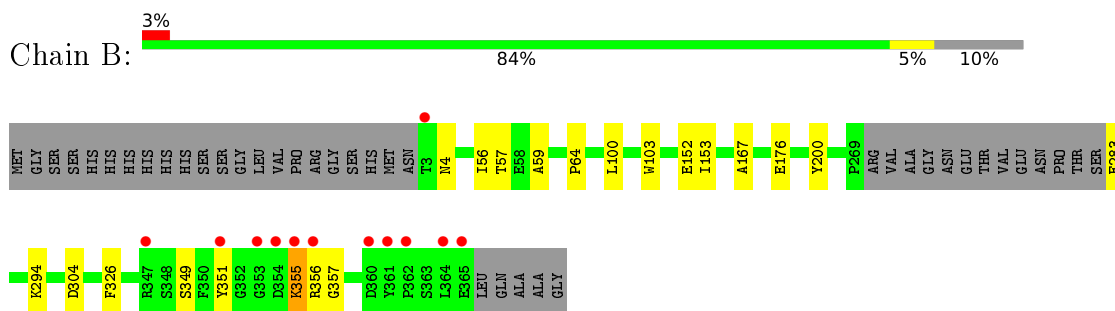
3 Residue-property plots

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.

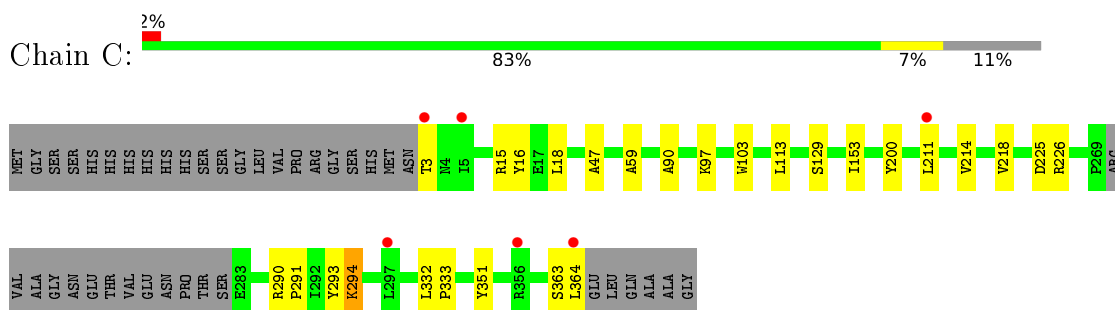
- Molecule 1: NADH:flavin oxidoreductase/NADH oxidase



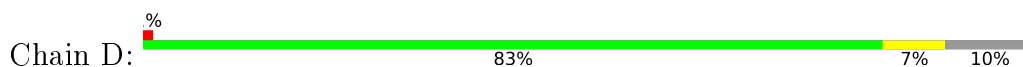
- Molecule 1: NADH:flavin oxidoreductase/NADH oxidase

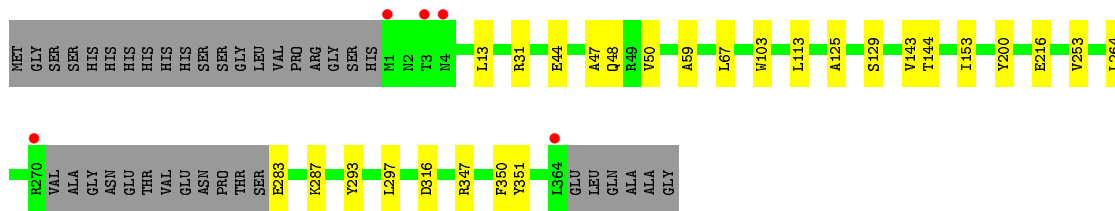


- Molecule 1: NADH:flavin oxidoreductase/NADH oxidase



- Molecule 1: NADH:flavin oxidoreductase/NADH oxidase





4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	49.66Å 78.17Å 108.69Å 104.23° 99.98° 90.04°	Depositor
Resolution (Å)	48.86 – 1.35 54.94 – 1.35	Depositor EDS
% Data completeness (in resolution range)	90.9 (48.86-1.35) 90.9 (54.94-1.35)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.08 (at 1.35Å)	Xtrriage
Refinement program	REFMAC 5.8.0238	Depositor
R, R_{free}	0.206 , 0.255 0.211 , 0.256	Depositor DCC
R_{free} test set	15465 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	14.4	Xtrriage
Anisotropy	0.102	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 34.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.45$, $\langle L^2 \rangle = 0.28$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	12468	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 12.90% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: BEN, FMN, ACT

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
1	A	0.72	0/2783	0.97	0/3784
1	B	0.71	1/2814 (0.0%)	0.98	0/3825
1	C	0.59	0/2778	0.94	0/3778
1	D	0.59	0/2803	0.91	1/3811 (0.0%)
All	All	0.65	1/11178 (0.0%)	0.95	1/15198 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	152	GLU	CD-OE2	-6.71	1.18	1.25

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	31	ARG	NE-CZ-NH1	6.11	123.36	120.30

There are no chirality outliers.

There are no planarity outliers.

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	2718	0	2631	29	0
1	B	2749	0	2662	15	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	2713	0	2627	15	0
1	D	2738	0	2658	17	0
2	A	4	0	3	0	0
2	B	4	0	3	0	0
2	C	4	0	3	0	0
2	D	4	0	3	0	0
3	A	9	9	7	0	0
4	A	31	0	19	1	0
4	B	31	0	19	1	0
4	C	31	0	19	2	0
4	D	31	0	19	3	0
5	A	426	0	0	6	0
5	B	356	0	0	4	0
5	C	296	0	0	0	0
5	D	314	0	0	3	0
All	All	12459	9	10673	73	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 3.

All (73) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:355:LYS:HE2	1:D:143:VAL:HA	1.46	0.97
1:C:351:TYR:CE1	4:C:402:FMN:HM72	2.12	0.84
1:A:15:ARG:O	1:A:15:ARG:HG3	1.97	0.65
1:C:18:LEU:CD2	1:C:97:LYS:HD2	2.29	0.63
1:A:53:GLY:HA3	5:A:647:HOH:O	2.00	0.61
1:B:304:ASP:HB2	5:B:751:HOH:O	2.01	0.60
1:D:347:ARG:HG2	1:D:350:PHE:CE2	2.37	0.60
1:C:15:ARG:HD2	1:C:226:ARG:HD3	1.85	0.59
1:A:232:SER:HB2	1:A:235:GLY:HA3	1.85	0.58
1:B:59:ALA:HB1	1:B:103:TRP:CD2	2.39	0.58
1:A:70:PRO:HB3	1:A:136:TYR:CE1	2.40	0.57
1:D:59:ALA:HB1	1:D:103:TRP:CD2	2.40	0.56
1:A:79:GLU:HG2	5:A:883:HOH:O	2.04	0.56
1:B:356:ARG:HD3	1:D:125:ALA:O	2.07	0.55
1:B:355:LYS:CE	1:D:143:VAL:HA	2.29	0.55
1:C:15:ARG:HB3	1:C:225:ASP:OD2	2.08	0.54
1:A:59:ALA:HB1	1:A:103:TRP:CD2	2.43	0.54
1:A:31:ARG:HD3	1:A:358:TYR:CD2	2.43	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:16:TYR:HB3	1:C:97:LYS:HE3	1.90	0.54
1:D:287:LYS:HE2	1:D:316:ASP:OD2	2.08	0.54
1:A:347:ARG:HG2	1:A:347:ARG:HH21	1.74	0.53
1:A:230:ARG:HA	1:A:265:HIS:O	2.10	0.51
1:A:15:ARG:HD2	1:A:226:ARG:HD3	1.92	0.51
1:C:59:ALA:HB1	1:C:103:TRP:CD2	2.46	0.50
1:A:253:VAL:HG12	1:A:292:ILE:HG22	1.94	0.50
1:A:351:TYR:CZ	4:A:403:FMN:HM72	2.47	0.49
1:A:233:PRO:HA	1:A:249:PHE:CE2	2.47	0.49
1:B:100[A]:LEU:HD23	1:B:167:ALA:HB2	1.94	0.49
1:B:57:THR:OG1	1:B:100[A]:LEU:HD12	2.13	0.49
1:C:363:SER:O	1:C:364:LEU:C	2.51	0.49
1:C:351:TYR:CZ	4:C:402:FMN:HM72	2.48	0.49
1:B:351:TYR:CE1	4:B:402:FMN:HM72	2.49	0.48
1:D:351:TYR:CE1	4:D:402:FMN:HM72	2.49	0.48
1:D:216:GLU:HG2	5:D:736:HOH:O	2.14	0.47
1:A:258:GLN:HB3	5:A:540:HOH:O	2.15	0.46
1:A:347:ARG:HG3	1:A:350:PHE:CD2	2.50	0.46
1:D:283:GLU:N	5:D:506:HOH:O	2.49	0.46
1:D:351:TYR:CZ	4:D:402:FMN:HM72	2.51	0.46
1:C:332:LEU:HB3	1:C:333:PRO:HD3	1.98	0.46
1:A:70:PRO:HB3	1:A:136:TYR:CD1	2.51	0.45
1:A:137:GLU:HG3	5:A:703:HOH:O	2.15	0.45
1:A:245:LEU:HD11	5:A:517:HOH:O	2.15	0.45
1:B:355:LYS:CE	5:B:542:HOH:O	2.64	0.45
1:B:355:LYS:HB3	1:D:144:THR:OG1	2.16	0.45
1:A:15:ARG:HB3	1:A:225:ASP:OD1	2.16	0.45
1:A:234:SER:OG	1:A:269:PRO:HA	2.16	0.45
1:A:56:ILE:HD13	1:A:176:GLU:OE2	2.17	0.45
1:A:5:ILE:HD13	1:A:5:ILE:N	2.32	0.44
1:B:4:ASN:CB	5:B:563:HOH:O	2.66	0.44
1:C:293:TYR:C	1:C:294:LYS:HD3	2.37	0.44
1:A:347:ARG:HG2	1:A:347:ARG:NH2	2.32	0.43
1:B:56:ILE:HD13	1:B:176:GLU:OE2	2.18	0.43
1:A:191:ASP:OD1	1:A:242:ASP:HA	2.19	0.43
1:D:253:VAL:CG1	1:D:293:TYR:HB2	2.49	0.43
1:A:233:PRO:HA	1:A:249:PHE:CD2	2.54	0.42
1:A:227:VAL:O	1:A:261:LEU:HB3	2.20	0.42
1:B:349:SER:OG	1:B:357:GLY:HA3	2.20	0.42
1:A:112:ASP:O	5:A:501:HOH:O	2.20	0.42
1:A:31:ARG:HD3	1:A:358:TYR:CG	2.54	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:214:VAL:O	1:C:218:VAL:HG23	2.19	0.42
1:D:44:GLU:O	1:D:48:GLN:HG3	2.19	0.41
1:A:231:LEU:HD12	1:A:264:LEU:HD11	2.02	0.41
1:C:211:LEU:HD12	1:C:211:LEU:O	2.21	0.41
1:D:153:ILE:HG21	1:D:200:TYR:CZ	2.55	0.41
1:B:153:ILE:HG21	1:B:200:TYR:CZ	2.56	0.41
1:D:67:LEU:HD11	5:D:501:HOH:O	2.20	0.41
1:B:355:LYS:HE3	5:B:542:HOH:O	2.21	0.41
1:D:47:ALA:HA	1:D:50:VAL:HG13	2.02	0.41
4:D:402:FMN:C9	4:D:402:FMN:H2'	2.51	0.41
1:C:47:ALA:HB2	1:C:90:ALA:HB1	2.03	0.41
1:D:264:LEU:HD23	1:D:297:LEU:HD21	2.03	0.40
1:C:153:ILE:HG21	1:C:200:TYR:CZ	2.57	0.40
1:C:290:ARG:HB3	1:C:291:PRO:HD3	2.04	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	347/390 (89%)	333 (96%)	14 (4%)	0	100	100
1	B	350/390 (90%)	336 (96%)	14 (4%)	0	100	100
1	C	346/390 (89%)	332 (96%)	14 (4%)	0	100	100
1	D	349/390 (90%)	335 (96%)	14 (4%)	0	100	100
All	All	1392/1560 (89%)	1336 (96%)	56 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	283/314 (90%)	274 (97%)	9 (3%)	39 8
1	B	286/314 (91%)	281 (98%)	5 (2%)	60 28
1	C	282/314 (90%)	278 (99%)	4 (1%)	67 36
1	D	285/314 (91%)	282 (99%)	3 (1%)	73 45
All	All	1136/1256 (90%)	1115 (98%)	21 (2%)	57 25

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	5	ILE
1	A	13	LEU
1	A	15	ARG
1	A	141	PRO
1	A	178	HIS
1	A	232	SER
1	A	251	TYR
1	A	261	LEU
1	A	326	PHE
1	B	64	PRO
1	B	283	GLU
1	B	294	LYS
1	B	326	PHE
1	B	355	LYS
1	C	3	THR
1	C	113	LEU
1	C	129	SER
1	C	294	LYS
1	D	13	LEU
1	D	113	LEU
1	D	129	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	78	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

9 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	BEN	A	402	-	9,9,9	0.64	0	7,11,11	0.83	1 (14%)
4	FMN	B	402	-	31,33,33	2.41	13 (41%)	40,50,50	3.88	19 (47%)
4	FMN	D	402	-	31,33,33	2.14	8 (25%)	40,50,50	3.22	15 (37%)
4	FMN	A	403	-	31,33,33	1.89	10 (32%)	40,50,50	2.75	11 (27%)
4	FMN	C	402	-	31,33,33	1.76	5 (16%)	40,50,50	3.07	18 (45%)
2	ACT	C	401	-	1,3,3	5.25	1 (100%)	0,3,3	0.00	-
2	ACT	A	401	-	1,3,3	0.70	0	0,3,3	0.00	-
2	ACT	B	401	-	1,3,3	3.44	1 (100%)	0,3,3	0.00	-
2	ACT	D	401	-	1,3,3	2.39	1 (100%)	0,3,3	0.00	-

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
3	BEN	A	402	-	-	0/4/4/4	0/1/1/1
4	FMN	B	402	-	-	12/18/18/18	0/3/3/3
4	FMN	D	402	-	-	5/18/18/18	0/3/3/3
4	FMN	A	403	-	-	2/18/18/18	0/3/3/3
4	FMN	C	402	-	-	2/18/18/18	0/3/3/3

All (39) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	402	FMN	C4A-C10	6.74	1.45	1.38
4	B	402	FMN	C4A-C10	6.45	1.45	1.38
4	C	402	FMN	C4A-C10	6.40	1.45	1.38
4	B	402	FMN	C5'-C4'	5.91	1.60	1.51
4	D	402	FMN	C10-N1	5.32	1.40	1.33
2	C	401	ACT	CH3-C	5.25	1.55	1.48
4	B	402	FMN	C4-C4A	4.47	1.49	1.41
4	D	402	FMN	C8-C7	3.85	1.50	1.40
4	A	403	FMN	C4A-C10	3.62	1.42	1.38
4	A	403	FMN	C4-C4A	3.51	1.47	1.41
2	B	401	ACT	CH3-C	3.44	1.53	1.48
4	B	402	FMN	O2'-C2'	3.44	1.50	1.43
4	C	402	FMN	C4-C4A	3.30	1.47	1.41
4	A	403	FMN	O5'-C5'	-3.28	1.32	1.44
4	A	403	FMN	C9A-C5A	3.27	1.49	1.42
4	B	402	FMN	C9A-C5A	3.21	1.49	1.42
4	B	402	FMN	O3'-C3'	3.19	1.50	1.43
4	D	402	FMN	C4-C4A	3.18	1.46	1.41
4	A	403	FMN	C10-N1	3.10	1.37	1.33
4	D	402	FMN	C9A-C5A	3.05	1.48	1.42
4	A	403	FMN	C4A-N5	3.02	1.37	1.33
4	B	402	FMN	C1'-N10	-2.84	1.45	1.48
4	D	402	FMN	C4A-N5	2.77	1.37	1.33
4	D	402	FMN	O5'-C5'	-2.61	1.34	1.44
4	A	403	FMN	O3'-C3'	-2.58	1.36	1.43
4	B	402	FMN	C9A-N10	2.57	1.42	1.38
4	B	402	FMN	C2'-C3'	2.49	1.58	1.53
4	B	402	FMN	C8-C7	2.48	1.47	1.40
4	B	402	FMN	P-O5'	2.44	1.68	1.60
4	A	403	FMN	C6-C5A	-2.43	1.38	1.41
4	C	402	FMN	C5'-C4'	2.42	1.55	1.51

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	402	FMN	C9A-C5A	2.41	1.47	1.42
4	C	402	FMN	C1'-N10	-2.39	1.45	1.48
2	D	401	ACT	CH3-C	2.39	1.51	1.48
4	A	403	FMN	C2-N1	-2.34	1.33	1.38
4	A	403	FMN	C5'-C4'	2.23	1.55	1.51
4	B	402	FMN	C4'-C3'	-2.20	1.49	1.53
4	D	402	FMN	C5A-N5	2.05	1.38	1.35
4	B	402	FMN	O4-C4	2.00	1.29	1.24

All (64) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	402	FMN	C4-N3-C2	12.74	125.90	115.14
4	A	403	FMN	C4-N3-C2	11.13	124.54	115.14
4	B	402	FMN	C4-N3-C2	11.05	124.47	115.14
4	C	402	FMN	C4-N3-C2	10.10	123.67	115.14
4	A	403	FMN	C4-C4A-C10	-8.42	114.38	119.95
4	C	402	FMN	C1'-N10-C9A	8.17	124.72	118.29
4	D	402	FMN	C4-C4A-C10	-7.73	114.83	119.95
4	B	402	FMN	P-O5'-C5'	7.32	138.47	118.30
4	B	402	FMN	C10-C4A-N5	6.97	126.08	121.26
4	B	402	FMN	C4-C4A-C10	-6.79	115.45	119.95
4	B	402	FMN	C1'-N10-C9A	6.61	123.50	118.29
4	C	402	FMN	C4-C4A-C10	-6.39	115.72	119.95
4	B	402	FMN	O4'-C4'-C3'	-5.97	94.59	109.10
4	B	402	FMN	O4'-C4'-C5'	5.91	123.21	109.92
4	B	402	FMN	O2'-C2'-C3'	5.50	122.46	109.10
4	B	402	FMN	C5A-C9A-N10	5.46	121.67	117.72
4	D	402	FMN	O2'-C2'-C3'	-5.43	95.90	109.10
4	D	402	FMN	C5'-C4'-C3'	-5.43	101.72	112.20
4	B	402	FMN	O5'-C5'-C4'	5.21	123.26	109.36
4	B	402	FMN	C4A-C4-N3	-5.09	116.46	123.43
4	C	402	FMN	C5A-C9A-N10	4.97	121.32	117.72
4	D	402	FMN	C4-C4A-N5	4.64	123.90	118.60
4	A	403	FMN	C5'-C4'-C3'	-4.62	103.27	112.20
4	B	402	FMN	C4A-C10-N10	-4.55	115.63	120.30
4	C	402	FMN	C4A-N5-C5A	4.46	121.22	116.77
4	D	402	FMN	C4A-C4-N3	-4.25	117.62	123.43
4	C	402	FMN	C4A-C4-N3	-4.05	117.89	123.43
4	B	402	FMN	C6-C5A-N5	3.98	123.43	119.05
4	B	402	FMN	O3'-C3'-C4'	3.81	118.01	108.81
4	D	402	FMN	C6-C5A-N5	-3.60	115.09	119.05

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	402	FMN	O3'-C3'-C2'	3.53	117.35	108.81
4	C	402	FMN	C4-C4A-N5	3.52	122.62	118.60
4	A	403	FMN	C4A-C4-N3	-3.45	118.72	123.43
4	A	403	FMN	C1'-C2'-C3'	3.33	119.11	109.79
4	B	402	FMN	C9A-C5A-N5	-3.31	117.18	122.36
4	C	402	FMN	C1'-C2'-C3'	3.20	118.73	109.79
4	A	403	FMN	C4-C4A-N5	3.10	122.14	118.60
4	C	402	FMN	C6-C5A-C9A	3.00	122.99	119.05
4	C	402	FMN	O2'-C2'-C3'	-2.96	101.90	109.10
4	D	402	FMN	C1'-C2'-C3'	2.92	117.94	109.79
4	D	402	FMN	C7-C6-C5A	-2.83	117.21	121.22
4	D	402	FMN	C5A-C9A-N10	-2.77	115.71	117.72
4	B	402	FMN	C4A-N5-C5A	2.75	119.52	116.77
4	C	402	FMN	C5'-C4'-C3'	-2.72	106.94	112.20
4	C	402	FMN	C9A-C5A-N5	-2.70	118.14	122.36
4	A	403	FMN	C1'-N10-C9A	2.67	120.39	118.29
4	C	402	FMN	C7M-C7-C6	-2.64	114.02	120.34
4	C	402	FMN	C9A-N10-C10	-2.60	118.50	121.91
4	C	402	FMN	C7M-C7-C8	2.57	126.01	120.74
4	D	402	FMN	P-O5'-C5'	-2.54	111.29	118.30
4	B	402	FMN	C9A-N10-C10	-2.47	118.67	121.91
4	D	402	FMN	O2P-P-O5'	-2.40	100.35	106.73
4	A	403	FMN	C4'-C3'-C2'	2.33	118.22	113.36
4	D	402	FMN	C8M-C8-C9	-2.29	114.86	120.34
4	B	402	FMN	C8M-C8-C9	-2.28	114.89	120.34
4	C	402	FMN	O3P-P-O5'	2.26	112.74	106.73
4	A	403	FMN	O3P-P-O5'	-2.25	100.76	106.73
4	D	402	FMN	C9-C8-C7	2.22	123.66	119.91
4	C	402	FMN	C9-C9A-C5A	-2.21	116.11	119.88
4	A	403	FMN	C4A-C10-N10	-2.14	118.10	120.30
4	D	402	FMN	C6-C5A-C9A	2.12	121.82	119.05
3	A	402	BEN	C1-C-N2	2.09	121.20	118.05
4	C	402	FMN	C1'-N10-C10	-2.06	116.56	118.41
4	A	403	FMN	O5'-C5'-C4'	-2.01	103.99	109.36

There are no chirality outliers.

All (21) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	B	402	FMN	N10-C1'-C2'-C3'
4	B	402	FMN	C1'-C2'-C3'-O3'
4	B	402	FMN	C1'-C2'-C3'-C4'

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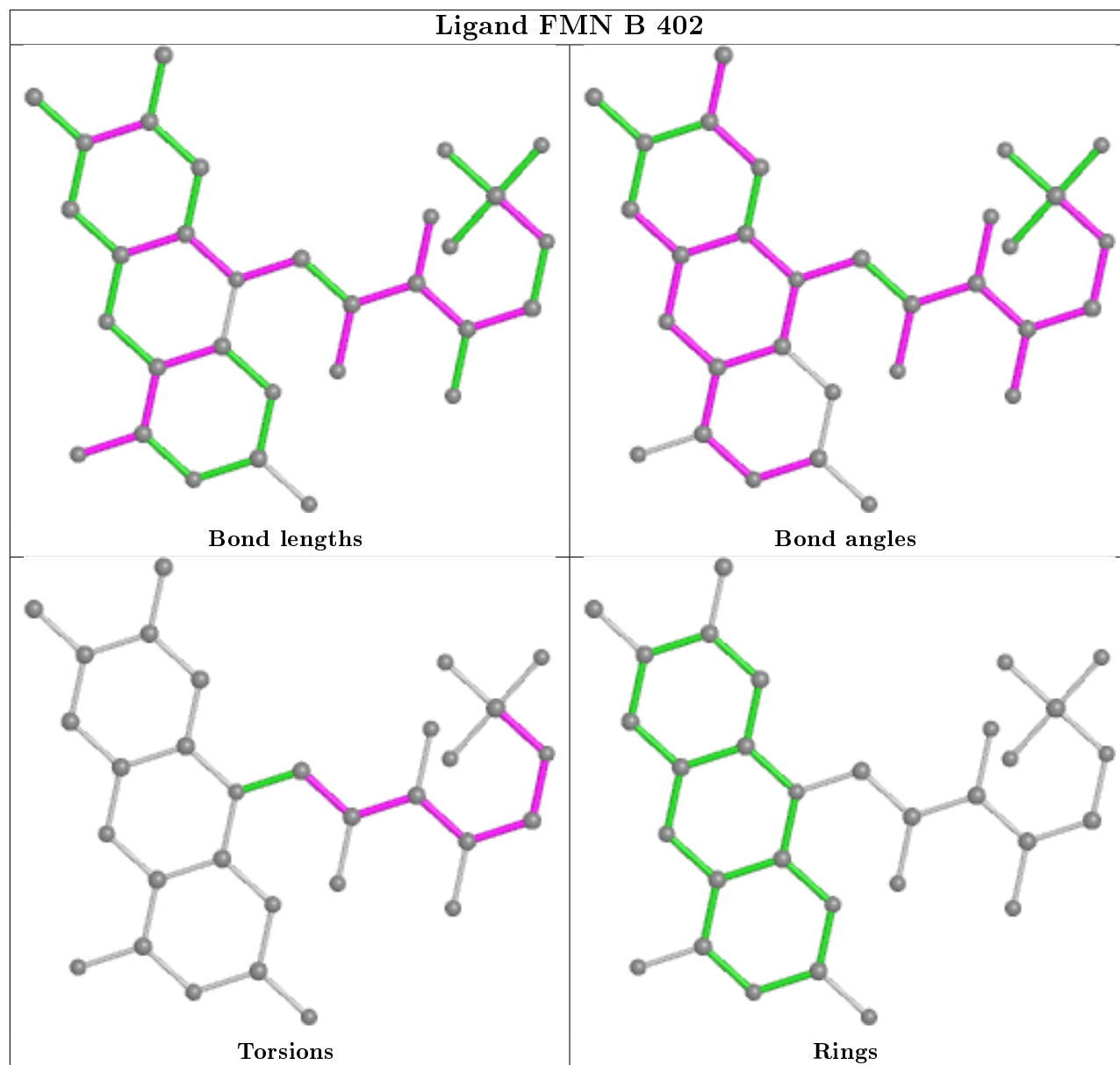
Mol	Chain	Res	Type	Atoms
4	B	402	FMN	O2'-C2'-C3'-O3'
4	B	402	FMN	O2'-C2'-C3'-C4'
4	B	402	FMN	C3'-C4'-C5'-O5'
4	B	402	FMN	O4'-C4'-C5'-O5'
4	B	402	FMN	C5'-O5'-P-O2P
4	B	402	FMN	C5'-O5'-P-O3P
4	D	402	FMN	C2'-C3'-C4'-C5'
4	D	402	FMN	C2'-C3'-C4'-O4'
4	B	402	FMN	O3'-C3'-C4'-C5'
4	B	402	FMN	C5'-O5'-P-O1P
4	A	403	FMN	O2'-C2'-C3'-C4'
4	D	402	FMN	O3'-C3'-C4'-C5'
4	C	402	FMN	O2'-C2'-C3'-C4'
4	A	403	FMN	C4'-C5'-O5'-P
4	C	402	FMN	C4'-C5'-O5'-P
4	B	402	FMN	C4'-C5'-O5'-P
4	D	402	FMN	C4'-C5'-O5'-P
4	D	402	FMN	O3'-C3'-C4'-O4'

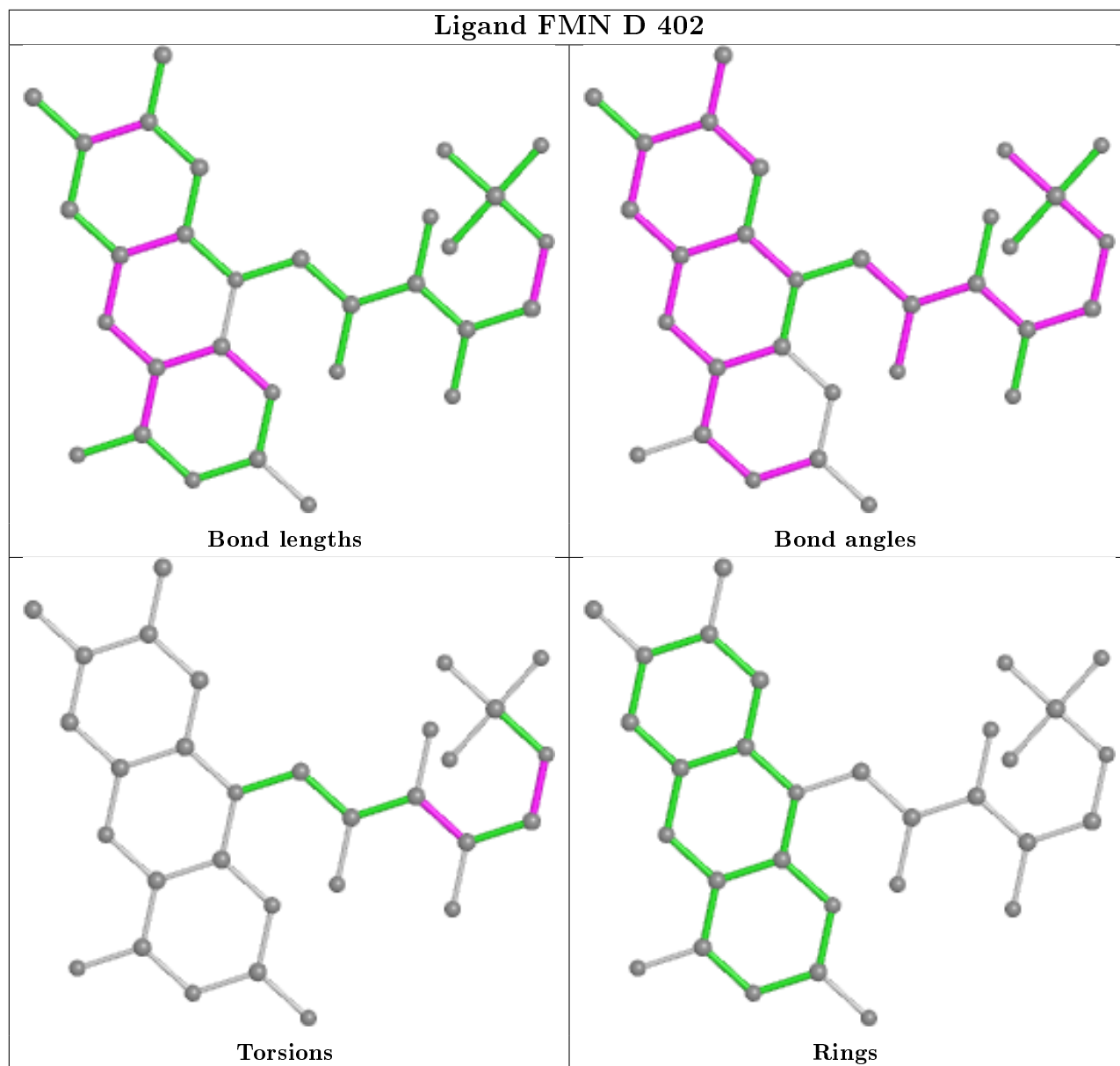
There are no ring outliers.

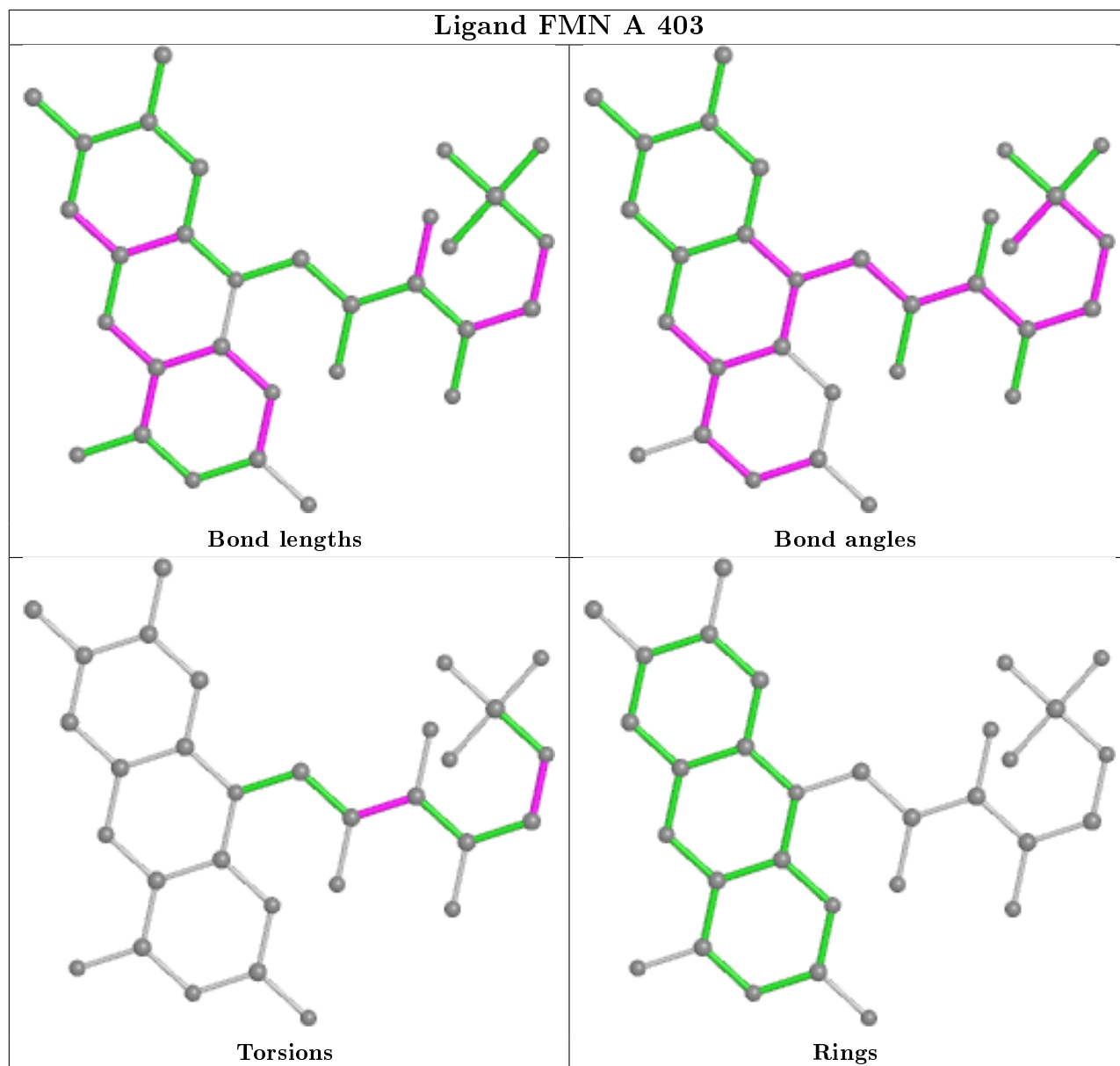
4 monomers are involved in 7 short contacts:

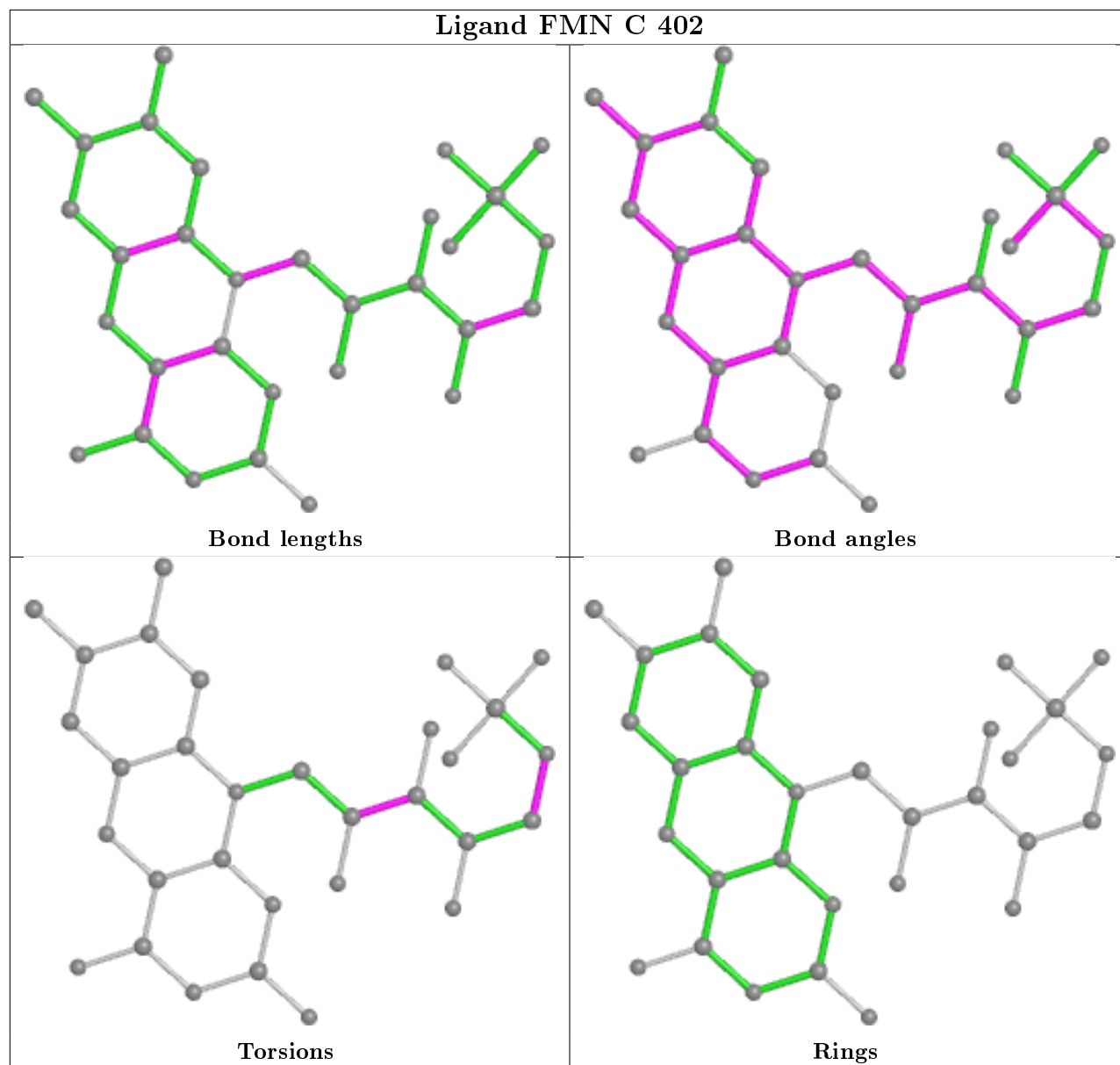
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	402	FMN	1	0
4	D	402	FMN	3	0
4	A	403	FMN	1	0
4	C	402	FMN	2	0

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









5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

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

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	350/390 (89%)	0.08	17 (4%) 29 33	9, 13, 23, 48	0
1	B	350/390 (89%)	0.09	12 (3%) 45 51	9, 14, 34, 72	0
1	C	349/390 (89%)	-0.03	6 (1%) 70 74	12, 17, 30, 41	0
1	D	352/390 (90%)	0.00	5 (1%) 75 80	13, 18, 29, 47	0
All	All	1401/1560 (89%)	0.04	40 (2%) 51 59	9, 16, 30, 72	0

All (40) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	235	GLY	7.0
1	B	3	THR	6.1
1	A	261	LEU	4.7
1	D	1	MET	4.4
1	B	365	GLU	4.2
1	D	270	ARG	4.0
1	D	3	THR	4.0
1	B	364	LEU	4.0
1	A	233	PRO	3.7
1	A	249	PHE	3.5
1	B	362	PRO	3.3
1	A	234	SER	3.3
1	A	232	SER	3.3
1	C	3	THR	3.2
1	A	236	THR	3.2
1	A	245	LEU	3.1
1	A	247	ALA	3.1
1	A	259	PHE	3.1
1	B	361	TYR	3.0
1	C	211	LEU	3.0
1	B	360	ASP	2.9

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Mol	Chain	Res	Type	RSRZ
1	C	364	LEU	2.8
1	D	364	LEU	2.6
1	B	351	TYR	2.6
1	A	237	PHE	2.6
1	B	356	ARG	2.5
1	A	258	GLN	2.4
1	C	356	ARG	2.3
1	A	15	ARG	2.3
1	B	355	LYS	2.3
1	A	250	THR	2.3
1	A	365	GLU	2.2
1	D	4	ASN	2.2
1	A	251	TYR	2.2
1	B	347	ARG	2.2
1	C	297	LEU	2.1
1	C	5	ILE	2.1
1	B	353	GLY	2.1
1	B	354	ASP	2.1
1	A	231	LEU	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 monosaccharides 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
3	BEN	A	402	9/9	0.88	0.18	20,20,20,20	0
2	ACT	C	401	4/4	0.96	0.10	15,17,21,21	0
4	FMN	B	402	31/31	0.96	0.10	11,15,25,26	0
2	ACT	B	401	4/4	0.97	0.08	15,19,20,24	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
4	FMN	C	402	31/31	0.97	0.07	10,14,18,20	0
4	FMN	D	402	31/31	0.97	0.07	11,14,21,26	0
4	FMN	A	403	31/31	0.98	0.06	8,11,16,17	0
2	ACT	A	401	4/4	0.98	0.05	11,13,16,19	0
2	ACT	D	401	4/4	0.99	0.04	15,17,19,22	0

6.5 Other polymers [i](#)

There are no such residues in this entry.