



Full wwPDB X-ray Structure Validation Report

Jun 25, 2024 – 12:30 PM EDT

PDB ID : 5XF9
Title : Crystal structure of NAD⁺-reducing [NiFe]-hydrogenase in the air-oxidized state
Authors : Shomura, Y.; Taketa, M.; Nakashima, H.; Tai, H.; Nakagawa, H.; Ikeda, Y.; Ishii, M.; Igarashi, Y.; Nishihara, H.; Yoon, K.S.; Ogo, S.; Hirota, S.; Higuchi, Y.
Deposited on : 2017-04-09
Resolution : 2.58 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](#) ①) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtrriage (Phenix) : 1.13
EDS : 2.37.1
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) : 2.37.1

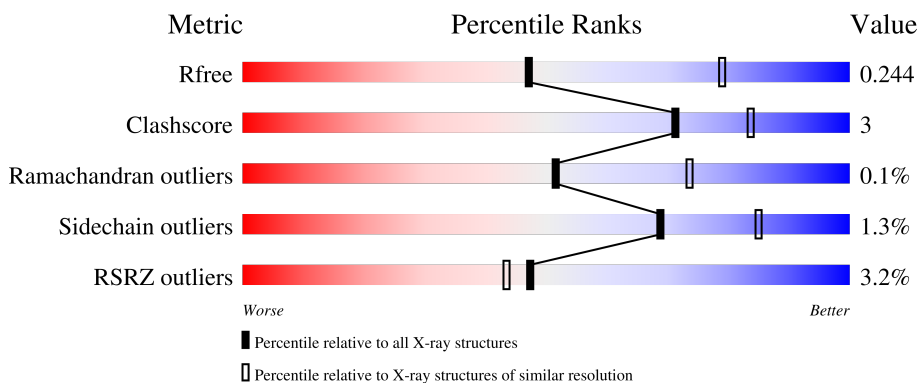
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.58 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.



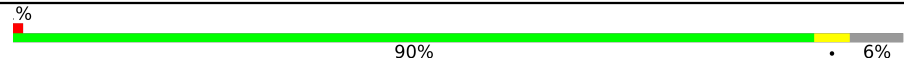


Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	3676 (2.60-2.56)
Clashscore	141614	4049 (2.60-2.56)
Ramachandran outliers	138981	3979 (2.60-2.56)
Sidechain outliers	138945	3979 (2.60-2.56)
RSRZ outliers	127900	3614 (2.60-2.56)

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	591	
1	E	591	
2	B	242	
2	F	242	
3	C	189	

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
3	G	189	 <p>% 90% 6%</p>
4	D	468	 <p>% 84% 12%</p>
4	H	468	 <p>2% 86% 10%</p>

2 Entry composition

There are 11 unique types of molecules in this entry. The entry contains 23140 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 NAD-reducing hydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	576	Total	C	N	O	S	0	2	0
			4430	2826	790	797	17			
1	E	567	Total	C	N	O	S	0	0	0
			4337	2763	773	784	17			

- Molecule 2 is a protein called NAD-reducing hydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	234	Total	C	N	O	S	0	0	0
			1769	1103	326	325	15			
2	F	233	Total	C	N	O	S	0	0	0
			1764	1100	325	324	15			

- Molecule 3 is a protein called NAD-reducing hydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	C	178	Total	C	N	O	S	0	0	0
			1404	894	253	250	7			
3	G	178	Total	C	N	O	S	0	0	0
			1404	894	253	250	7			

- Molecule 4 is a protein called NAD-reducing hydrogenase.

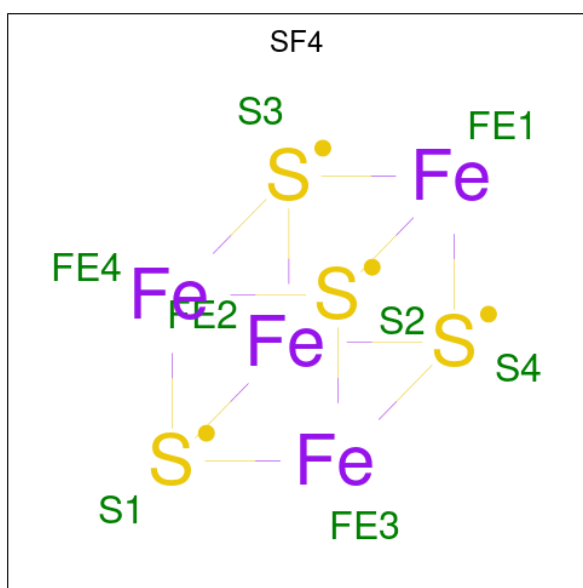
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	D	455	Total	C	N	O	S	0	0	0
			3559	2255	648	641	15			
4	H	454	Total	C	N	O	S	0	0	0
			3553	2252	647	639	15			

- Molecule 5 is FLAVIN MONONUCLEOTIDE (three-letter code: FMN) (formula: C₁₇H₂₁N₄O₉P).



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

- Molecule 6 is IRON/SULFUR CLUSTER (three-letter code: SF4) (formula: Fe₄S₄).



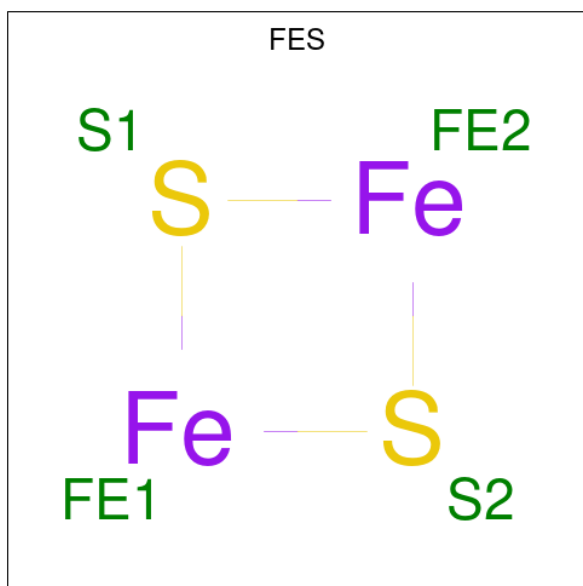
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf	
6	A	1	Total	Fe	S	0	0
			8	4	4		
6	B	1	Total	Fe	S	0	0
			8	4	4		

Continued on next page...

Continued from previous page...

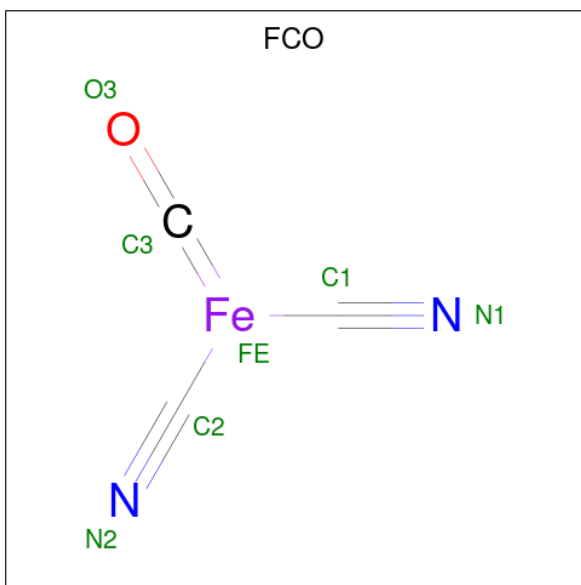
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	Fe	S		
6	B	1	8	4	4	0	0
6	C	1	8	4	4	0	0
6	E	1	8	4	4	0	0
6	F	1	8	4	4	0	0
6	F	1	8	4	4	0	0
6	G	1	8	4	4	0	0

- Molecule 7 is FE2/S2 (INORGANIC) CLUSTER (three-letter code: FES) (formula: Fe₂S₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	Fe	S		
7	B	1	4	2	2	0	0
7	F	1	4	2	2	0	0

- Molecule 8 is CARBONMONOXIDE-(DICYANO) IRON (three-letter code: FCO) (formula: C₃FeN₂O).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
8	D	1	Total	C	Fe	N	O	0	0
			7	3	1	2	1		
8	H	1	Total	C	Fe	N	O	0	0
			7	3	1	2	1		

- Molecule 9 is NICKEL (III) ION (three-letter code: 3NI) (formula: Ni).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	D	1	Total	Ni	0	0
			1	1		
9	H	1	Total	Ni	0	0
			1	1		

- Molecule 10 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	D	1	Total	Mg	0	0
			1	1		
10	H	1	Total	Mg	0	0
			1	1		

- Molecule 11 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	A	186	Total	O	0	0
			186	186		

Continued on next page...

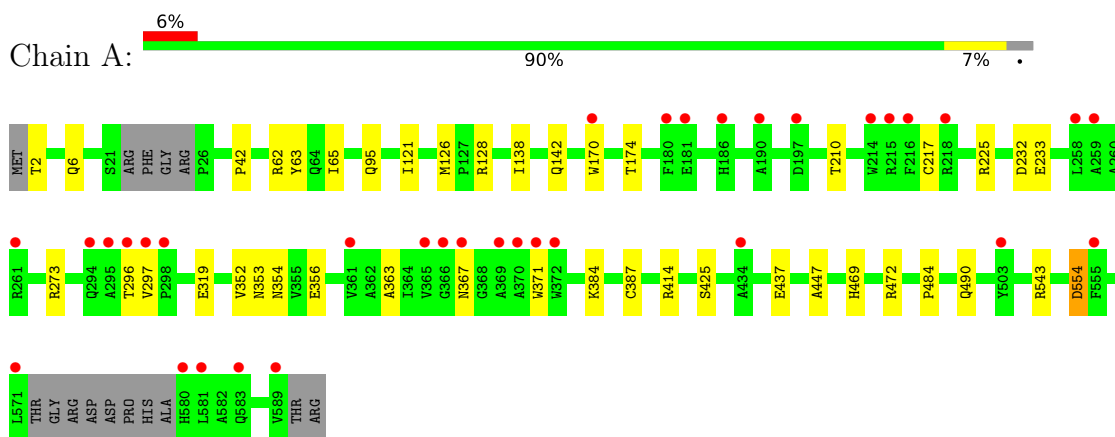
Continued from previous page...

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	B	112	Total 112	O 112	0	0
11	C	62	Total 62	O 62	0	0
11	D	137	Total 137	O 137	0	0
11	E	56	Total 56	O 56	0	0
11	F	88	Total 88	O 88	0	0
11	G	29	Total 29	O 29	0	0
11	H	98	Total 98	O 98	0	0

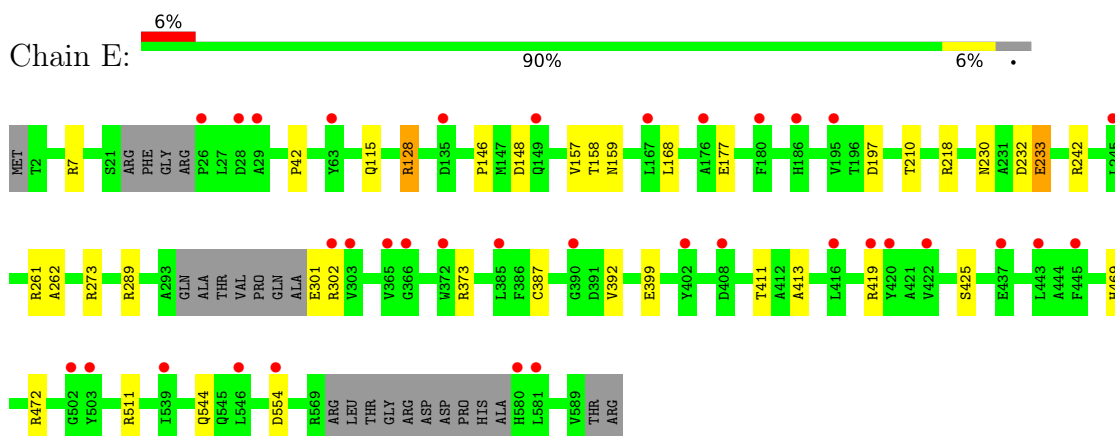
3 Residue-property plots [i](#)

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.

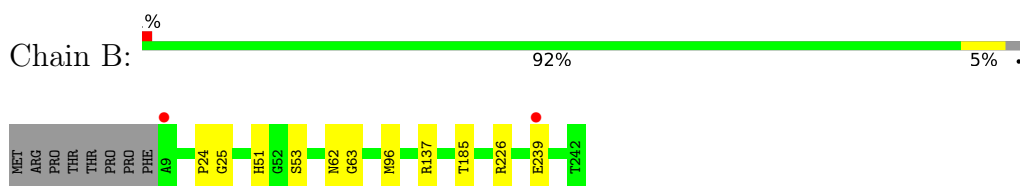
- Molecule 1: NAD-reducing hydrogenase



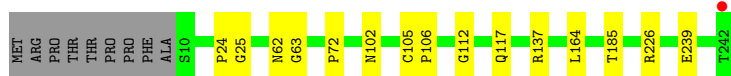
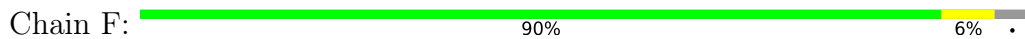
- Molecule 1: NAD-reducing hydrogenase



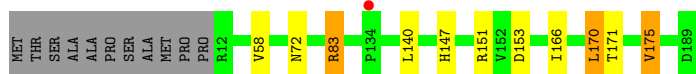
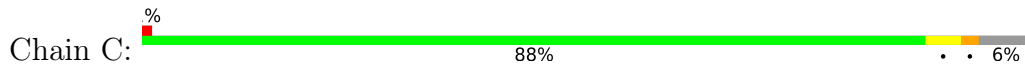
- Molecule 2: NAD-reducing hydrogenase



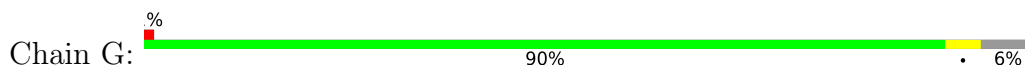
- Molecule 2: NAD-reducing hydrogenase



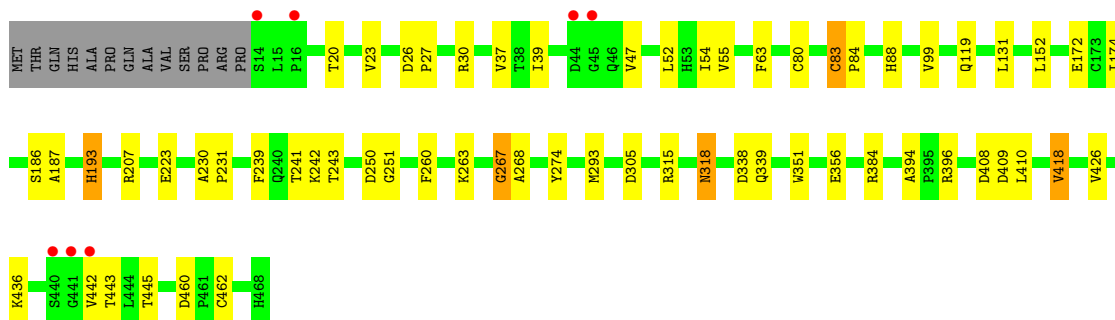
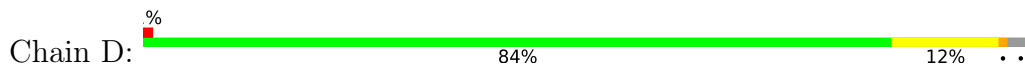
• Molecule 3: NAD-reducing hydrogenase



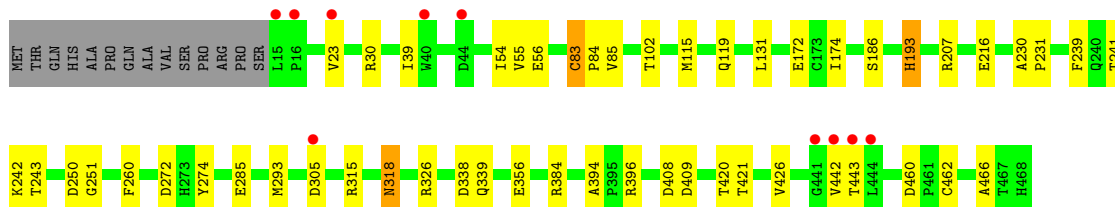
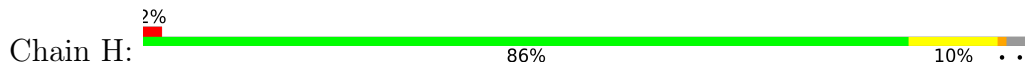
• Molecule 3: NAD-reducing hydrogenase



• Molecule 4: NAD-reducing hydrogenase



• Molecule 4: NAD-reducing hydrogenase



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	131.59Å 190.09Å 124.58Å 90.00° 109.44° 90.00°	Depositor
Resolution (Å)	95.04 – 2.58 95.05 – 2.58	Depositor EDS
% Data completeness (in resolution range)	99.8 (95.04-2.58) 99.9 (95.05-2.58)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.00 (at 2.58Å)	Xtrriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.197 , 0.244 0.200 , 0.244	Depositor DCC
R_{free} test set	4487 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å ²)	41.1	Xtrriage
Anisotropy	0.472	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 43.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	23140	wwPDB-VP
Average B, all atoms (Å ²)	49.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.63% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: FES, FMN, FCO, SF4, MG, 3NI

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	0.36	0/4555	0.57	0/6222
1	E	0.33	0/4453	0.55	0/6078
2	B	0.37	0/1808	0.59	0/2450
2	F	0.34	0/1803	0.58	0/2443
3	C	0.34	0/1440	0.63	1/1966 (0.1%)
3	G	0.34	0/1440	0.60	1/1966 (0.1%)
4	D	0.34	0/3641	0.63	1/4943 (0.0%)
4	H	0.34	0/3635	0.61	1/4935 (0.0%)
All	All	0.35	0/22775	0.59	4/31003 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
3	C	0	1
4	D	0	1
4	H	0	1
All	All	0	3

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	G	170	LEU	CA-CB-CG	6.48	130.20	115.30
3	C	83	ARG	CG-CD-NE	5.94	124.27	111.80
4	H	83	CYS	CB-CA-C	-5.89	98.62	110.40
4	D	83	CYS	CB-CA-C	-5.71	98.98	110.40

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
3	C	58	VAL	Peptide
4	D	80	CYS	Peptide
4	H	272	ASP	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	4430	0	4344	34	0
1	E	4337	0	4251	24	0
2	B	1769	0	1739	7	0
2	F	1764	0	1734	11	0
3	C	1404	0	1392	7	0
3	G	1404	0	1392	4	0
4	D	3559	0	3520	35	0
4	H	3553	0	3515	36	0
5	A	31	0	19	4	0
5	E	31	0	19	3	0
6	A	8	0	0	0	0
6	B	16	0	0	0	0
6	C	8	0	0	0	0
6	E	8	0	0	0	0
6	F	16	0	0	0	0
6	G	8	0	0	0	0
7	B	4	0	0	0	0
7	F	4	0	0	0	0
8	D	7	0	0	1	0
8	H	7	0	0	0	0
9	D	1	0	0	0	0
9	H	1	0	0	0	0
10	D	1	0	0	0	0
10	H	1	0	0	0	0
11	A	186	0	0	4	0
11	B	112	0	0	1	0
11	C	62	0	0	0	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
11	D	137	0	0	0	0
11	E	56	0	0	3	0
11	F	88	0	0	2	0
11	G	29	0	0	0	0
11	H	98	0	0	2	0
All	All	23140	0	21925	153	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 (153) 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:170[A]:TRP:CH2	1:A:367:ASN:HB2	2.10	0.87
4:H:293:MET:HE2	4:H:421:THR:N	1.92	0.85
4:H:293:MET:HE2	4:H:420:THR:C	1.98	0.84
4:H:293:MET:HE1	4:H:466:ALA:HB2	1.67	0.76
1:A:296:THR:HB	1:A:297:VAL:HG22	1.71	0.73
4:H:85:VAL:HG22	4:H:115:MET:HE3	1.71	0.73
4:H:396:ARG:HD2	4:H:462:CYS:SG	2.29	0.72
4:D:396:ARG:HD2	4:D:462:CYS:SG	2.30	0.71
1:E:511:ARG:NH2	3:G:148:GLU:OE2	2.25	0.69
2:F:102:ASN:HD21	3:G:104:GLN:HE22	1.43	0.67
4:D:418:VAL:HG13	8:D:501:FCO:N1	2.10	0.67
4:D:315:ARG:NH2	4:D:394:ALA:O	2.30	0.65
4:H:315:ARG:NH2	4:H:394:ALA:O	2.31	0.63
4:D:442:VAL:HB	4:D:443:THR:HA	1.81	0.62
4:H:442:VAL:HB	4:H:443:THR:HA	1.82	0.61
1:E:301:GLU:HB3	1:E:302:ARG:HA	1.82	0.60
1:A:371[A]:TRP:HA	1:A:371[A]:TRP:CE3	2.37	0.59
1:A:296:THR:CB	1:A:297:VAL:HG22	2.33	0.59
4:D:267:GLY:HA2	4:D:268:ALA:HB3	1.85	0.58
1:E:177:GLU:OE2	1:E:289:ARG:NH2	2.37	0.57
1:A:371[A]:TRP:HA	1:A:371[A]:TRP:HE3	1.69	0.56
4:H:250:ASP:N	4:H:251:GLY:HA2	2.21	0.55
1:A:170[A]:TRP:CZ3	1:A:371[A]:TRP:CD1	2.95	0.55
4:D:186:SER:HA	4:D:193:HIS:CE1	2.41	0.55
4:D:250:ASP:N	4:D:251:GLY:HA2	2.22	0.55
4:D:338:ASP:N	4:D:339:GLN:HA	2.22	0.55
4:H:338:ASP:N	4:H:339:GLN:HA	2.23	0.54
4:D:47:VAL:HG22	4:D:436:LYS:HB3	1.89	0.54

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:D:83:CYS:HA	4:D:119:GLN:HE21	1.73	0.54
4:H:186:SER:HA	4:H:193:HIS:CE1	2.43	0.54
4:H:83:CYS:HA	4:H:119:GLN:HE21	1.73	0.54
2:B:137:ARG:NH1	11:B:402:HOH:O	2.41	0.53
4:D:23:VAL:HG13	4:D:39:ILE:HB	1.91	0.53
4:H:293:MET:CE	4:H:420:THR:HG22	2.38	0.53
2:F:62:ASN:N	2:F:63:GLY:HA2	2.23	0.53
1:A:232:ASP:O	5:A:601:FMN:O4	2.27	0.52
4:H:23:VAL:HG13	4:H:39:ILE:HB	1.91	0.52
1:E:159:ASN:OD1	1:E:242:ARG:NH1	2.42	0.52
2:B:62:ASN:N	2:B:63:GLY:HA2	2.24	0.52
4:D:263:LYS:HB3	4:D:267:GLY:HA3	1.91	0.51
4:H:260:PHE:HB2	4:H:274:TYR:HB3	1.93	0.51
4:H:384:ARG:NH2	4:H:409:ASP:OD1	2.43	0.51
4:D:260:PHE:HB2	4:D:274:TYR:HB3	1.92	0.51
2:F:112:GLY:H	2:F:117:GLN:HE22	1.59	0.51
1:E:128:ARG:HH21	1:E:158:THR:HG23	1.76	0.50
1:A:354:ASN:N	5:A:601:FMN:O3P	2.41	0.50
3:G:125:ALA:N	4:H:285:GLU:O	2.42	0.50
1:A:233:GLU:O	1:A:273:ARG:NH1	2.45	0.50
1:E:233:GLU:O	1:E:273:ARG:NH1	2.45	0.50
2:F:137:ARG:HD2	11:F:416:HOH:O	2.11	0.50
1:E:232:ASP:HA	1:E:273:ARG:HB3	1.94	0.50
4:H:102:THR:HG23	11:H:608:HOH:O	2.12	0.49
3:C:166:ILE:O	3:C:170:LEU:HG	2.12	0.49
1:E:168:LEU:HD23	1:E:399:GLU:OE1	2.11	0.49
4:H:315:ARG:HD2	4:H:356:GLU:OE2	2.12	0.49
1:A:42:PRO:HB2	2:B:185:THR:HB	1.93	0.49
1:A:128:ARG:HD3	11:A:797:HOH:O	2.12	0.49
4:D:384:ARG:NH2	4:D:409:ASP:OD1	2.45	0.49
1:E:233:GLU:HG3	11:E:715:HOH:O	2.11	0.49
4:H:216:GLU:OE1	4:H:326:ARG:HD3	2.13	0.49
4:D:37:VAL:HG12	4:D:52:LEU:HA	1.94	0.49
1:E:168:LEU:HD23	1:E:399:GLU:HB2	1.95	0.49
1:A:232:ASP:HA	1:A:273:ARG:HB3	1.94	0.48
4:H:243:THR:OG1	4:H:318:ASN:ND2	2.47	0.48
4:D:408:ASP:HB3	4:D:410:LEU:HG	1.95	0.48
4:D:243:THR:OG1	4:D:318:ASN:ND2	2.47	0.47
1:E:301:GLU:CB	1:E:302:ARG:HA	2.40	0.47
1:A:170[A]:TRP:CZ2	1:A:367:ASN:HB2	2.50	0.47
1:E:411:THR:OG1	1:E:419:ARG:NH2	2.41	0.47

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:65:ILE:HG12	1:A:121:ILE:HG13	1.97	0.47
5:E:601:FMN:C3'	5:E:601:FMN:N1	2.78	0.47
1:E:115:GLN:HE22	1:E:157:VAL:HA	1.81	0.46
4:D:315:ARG:HD2	4:D:356:GLU:OE2	2.14	0.46
2:F:72:PRO:HB3	11:F:462:HOH:O	2.14	0.46
1:A:353:ASN:HA	5:A:601:FMN:O3P	2.15	0.46
2:B:51:HIS:HD2	2:B:53:SER:OG	1.98	0.46
1:E:146:PRO:HB2	1:E:148:ASP:OD1	2.15	0.46
1:A:138:ILE:O	1:A:142:GLN:HG3	2.15	0.45
1:E:230:ASN:ND2	5:E:601:FMN:O3'	2.48	0.45
4:D:54:ILE:CG1	4:D:293:MET:HB2	2.46	0.45
3:G:72:ASN:HA	3:G:140:LEU:HD13	1.98	0.45
1:E:7:ARG:HD2	2:F:164:LEU:HD22	1.98	0.45
1:E:42:PRO:HB2	2:F:185:THR:HB	1.97	0.45
4:H:54:ILE:CG1	4:H:293:MET:HB2	2.46	0.45
1:E:197:ASP:O	1:E:373:ARG:NH2	2.47	0.45
3:C:72:ASN:HA	3:C:140:LEU:HD13	1.98	0.45
1:A:170[A]:TRP:CZ2	1:A:367:ASN:ND2	2.85	0.45
1:A:414:ARG:HD3	11:A:836:HOH:O	2.15	0.45
1:A:469:HIS:HD2	1:A:472:ARG:HH21	1.65	0.44
2:F:226:ARG:HD2	2:F:239:GLU:O	2.17	0.44
4:H:230:ALA:N	4:H:231:PRO:HD2	2.32	0.44
4:D:230:ALA:N	4:D:231:PRO:HD2	2.32	0.44
5:E:601:FMN:HO3'	5:E:601:FMN:C2	2.30	0.44
4:H:119:GLN:HG3	11:H:661:HOH:O	2.17	0.44
1:A:554:ASP:O	3:C:151:ARG:HD3	2.18	0.44
1:A:354:ASN:OD1	1:A:356:GLU:N	2.49	0.43
4:H:23:VAL:CG1	4:H:39:ILE:HB	2.48	0.43
4:H:172:GLU:OE1	4:H:207:ARG:NH1	2.47	0.43
4:H:239:PHE:HB3	4:H:241:THR:HG22	2.00	0.43
3:C:171:THR:O	3:C:175:VAL:HG23	2.18	0.43
4:D:23:VAL:CG1	4:D:39:ILE:HB	2.48	0.43
4:D:83:CYS:HA	4:D:119:GLN:NE2	2.33	0.43
4:D:83:CYS:N	4:D:84:PRO:CD	2.82	0.43
4:D:172:GLU:OE1	4:D:207:ARG:NH1	2.47	0.43
1:A:95:GLN:HB2	11:A:865:HOH:O	2.18	0.43
1:A:170[A]:TRP:HD1	1:A:174:THR:HG1	1.66	0.43
3:C:83:ARG:NH1	3:C:153:ASP:OD2	2.52	0.43
2:B:226:ARG:HD2	2:B:239:GLU:O	2.18	0.43
4:D:30:ARG:NH1	4:D:131:LEU:O	2.48	0.43
1:A:62:ARG:NH1	1:A:63:TYR:OH	2.52	0.43

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:170[A]:TRP:CZ3	1:A:371[A]:TRP:HD1	2.37	0.43
4:H:83:CYS:HA	4:H:119:GLN:NE2	2.33	0.43
1:A:484:PRO:HA	2:B:96:MET:SD	2.59	0.42
4:D:223:GLU:HG2	4:D:351:TRP:CZ2	2.54	0.42
1:E:261:ARG:HH21	1:E:301:GLU:HG3	1.83	0.42
1:A:319:GLU:HG3	1:A:352:VAL:HB	2.01	0.42
3:C:83:ARG:HD2	3:C:83:ARG:HA	1.75	0.42
4:D:239:PHE:HB3	4:D:241:THR:HG22	2.01	0.42
4:H:85:VAL:HG22	4:H:115:MET:CE	2.44	0.42
4:H:396:ARG:HD3	4:H:460:ASP:O	2.18	0.42
4:D:408:ASP:O	4:D:409:ASP:HB2	2.20	0.42
4:H:293:MET:HE1	4:H:466:ALA:CB	2.41	0.42
3:C:151:ARG:NH1	3:C:153:ASP:OD1	2.52	0.42
1:E:218:ARG:NH1	1:E:262:ALA:O	2.53	0.42
2:F:24:PRO:HA	2:F:25:GLY:HA2	1.78	0.42
2:F:112:GLY:H	2:F:117:GLN:NE2	2.17	0.42
4:D:119:GLN:HA	4:D:174:ILE:HD11	2.02	0.42
1:A:121:ILE:HG21	1:A:126:MET:CE	2.50	0.42
5:A:601:FMN:H3'	5:A:601:FMN:N1	2.35	0.42
4:H:83:CYS:N	4:H:84:PRO:CD	2.83	0.42
1:A:356:GLU:OE1	1:A:384:LYS:NZ	2.53	0.42
4:H:408:ASP:O	4:H:409:ASP:HB2	2.19	0.42
1:E:469:HIS:HD2	1:E:472:ARG:HH21	1.68	0.41
4:D:396:ARG:HD3	4:D:460:ASP:O	2.19	0.41
4:H:242:LYS:NZ	4:H:305:ASP:O	2.49	0.41
1:A:170[A]:TRP:CH2	1:A:363:ALA:O	2.73	0.41
1:A:296:THR:HB	1:A:297:VAL:CG2	2.46	0.41
2:B:24:PRO:HA	2:B:25:GLY:HA2	1.78	0.41
1:E:210:THR:HG22	11:E:701:HOH:O	2.20	0.41
1:E:392:VAL:HG11	1:E:413:ALA:HB1	2.03	0.41
1:E:544:GLN:NE2	11:E:706:HOH:O	2.53	0.41
4:D:26:ASP:HA	4:D:27:PRO:HA	1.89	0.41
4:D:88:HIS:CD2	4:D:187:ALA:HB3	2.56	0.41
4:D:242:LYS:NZ	4:D:305:ASP:O	2.49	0.41
1:A:447:ALA:HB1	11:A:852:HOH:O	2.20	0.41
4:D:267:GLY:CA	4:D:268:ALA:HB3	2.50	0.41
2:F:105:CYS:N	2:F:106:PRO:CD	2.84	0.40
1:A:217:CYS:O	1:A:225:ARG:NH2	2.54	0.40
4:D:54:ILE:HG13	4:D:293:MET:HB2	2.03	0.40
4:H:30:ARG:NH1	4:H:131:LEU:O	2.47	0.40
1:A:2:THR:HA	1:A:6:GLN:OE1	2.21	0.40

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:H:55:VAL:HG23	4:H:56:GLU:HG3	2.03	0.40
4:H:119:GLN:HA	4:H:174:ILE:HD11	2.02	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	572/591 (97%)	549 (96%)	23 (4%)	0	100	100
1	E	559/591 (95%)	538 (96%)	20 (4%)	1 (0%)	47	69
2	B	232/242 (96%)	225 (97%)	7 (3%)	0	100	100
2	F	231/242 (96%)	224 (97%)	7 (3%)	0	100	100
3	C	176/189 (93%)	171 (97%)	5 (3%)	0	100	100
3	G	176/189 (93%)	171 (97%)	5 (3%)	0	100	100
4	D	453/468 (97%)	433 (96%)	19 (4%)	1 (0%)	47	69
4	H	452/468 (97%)	432 (96%)	20 (4%)	0	100	100
All	All	2851/2980 (96%)	2743 (96%)	106 (4%)	2 (0%)	51	73

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	233	GLU
4	D	267	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	445/455 (98%)	438 (98%)	7 (2%)	62	81
1	E	436/455 (96%)	432 (99%)	4 (1%)	78	90
2	B	184/192 (96%)	184 (100%)	0	100	100
2	F	184/192 (96%)	184 (100%)	0	100	100
3	C	149/157 (95%)	146 (98%)	3 (2%)	55	76
3	G	149/157 (95%)	147 (99%)	2 (1%)	69	85
4	D	366/377 (97%)	356 (97%)	10 (3%)	44	68
4	H	365/377 (97%)	362 (99%)	3 (1%)	81	92
All	All	2278/2362 (96%)	2249 (99%)	29 (1%)	69	85

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

Mol	Chain	Res	Type
1	A	210	THR
1	A	387	CYS
1	A	425	SER
1	A	437	GLU
1	A	490	GLN
1	A	543	ARG
1	A	554	ASP
3	C	147	HIS
3	C	170	LEU
3	C	175	VAL
4	D	20	THR
4	D	55	VAL
4	D	63	PHE
4	D	99	VAL
4	D	152	LEU
4	D	193	HIS
4	D	318	ASN
4	D	418	VAL
4	D	426	VAL
4	D	445	THR
1	E	128	ARG
1	E	387	CYS
1	E	425	SER
1	E	554	ASP

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
3	G	147	HIS
3	G	174	LEU
4	H	193	HIS
4	H	318	ASN
4	H	426	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (34) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	18	GLN
1	A	83	ASN
1	A	84	HIS
1	A	149	GLN
1	A	367	ASN
1	A	469	HIS
1	A	549	GLN
1	A	551	GLN
2	B	51	HIS
2	B	66	GLN
2	B	102	ASN
3	C	75	ASN
3	C	104	GLN
3	C	123	HIS
4	D	229	HIS
4	D	318	ASN
1	E	83	ASN
1	E	115	GLN
1	E	142	GLN
1	E	354	ASN
1	E	468	HIS
1	E	469	HIS
1	E	544	GLN
1	E	549	GLN
1	E	551	GLN
2	F	66	GLN
2	F	117	GLN
2	F	212	ASN
3	G	75	ASN
3	G	104	GLN
4	H	124	HIS
4	H	168	GLN
4	H	318	ASN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
4	H	402	HIS

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](#)

Of 18 ligands modelled in this entry, 4 are monoatomic - leaving 14 for Mogul analysis.

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
6	SF4	G	201	3	0,12,12	-	-	-		
7	FES	B	303	2	0,4,4	-	-	-		
6	SF4	F	301	2	0,12,12	-	-	-		
8	FCO	D	501	4	0,6,6	-	-	-		
8	FCO	H	501	4	0,6,6	-	-	-		
6	SF4	B	302	2	0,12,12	-	-	-		
7	FES	F	303	2	0,4,4	-	-	-		
5	FMN	A	601	-	33,33,33	1.44	4 (12%)	48,50,50	1.52	9 (18%)
6	SF4	C	201	3	0,12,12	-	-	-		
5	FMN	E	601	-	33,33,33	1.49	5 (15%)	48,50,50	1.45	9 (18%)
6	SF4	E	602	1	0,12,12	-	-	-		
6	SF4	A	602	1	0,12,12	-	-	-		

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
6	SF4	F	302	2	0,12,12	-	-	-		
6	SF4	B	301	2	0,12,12	-	-	-		

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. '2' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
6	SF4	G	201	3	-	-	0/6/5/5
7	FES	B	303	2	-	-	0/1/1/1
6	SF4	F	301	2	-	-	0/6/5/5
6	SF4	B	302	2	-	-	0/6/5/5
7	FES	F	303	2	-	-	0/1/1/1
5	FMN	A	601	-	-	10/18/18/18	0/3/3/3
6	SF4	C	201	3	-	-	0/6/5/5
5	FMN	E	601	-	-	9/18/18/18	0/3/3/3
6	SF4	E	602	1	-	-	0/6/5/5
6	SF4	A	602	1	-	-	0/6/5/5
6	SF4	F	302	2	-	-	0/6/5/5
6	SF4	B	301	2	-	-	0/6/5/5

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	E	601	FMN	C9A-C5A	5.27	1.50	1.41
5	A	601	FMN	C9A-C5A	5.10	1.49	1.41
5	E	601	FMN	C8-C7	3.46	1.49	1.40
5	A	601	FMN	C8-C7	2.81	1.47	1.40
5	E	601	FMN	C4-N3	-2.38	1.34	1.38
5	A	601	FMN	C4-N3	-2.34	1.34	1.38
5	A	601	FMN	C4A-N5	2.31	1.35	1.30
5	E	601	FMN	C4A-N5	2.19	1.35	1.30
5	E	601	FMN	C10-N10	2.11	1.41	1.37

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	E	601	FMN	C4-C4A-N5	3.18	122.75	118.23
5	E	601	FMN	C4A-C10-N1	-3.16	117.39	124.73
5	E	601	FMN	C10-N1-C2	3.12	123.15	116.90
5	A	601	FMN	C4-C4A-N5	3.11	122.65	118.23

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	601	FMN	O4'-C4'-C5'	3.08	116.83	109.92
5	A	601	FMN	C5'-C4'-C3'	-3.00	106.41	112.20
5	A	601	FMN	C10-N1-C2	2.94	122.79	116.90
5	A	601	FMN	C4A-C10-N1	-2.87	118.06	124.73
5	E	601	FMN	C4A-C10-N10	2.48	120.11	116.48
5	A	601	FMN	C4A-C4-N3	2.43	119.37	113.19
5	E	601	FMN	C4A-C4-N3	2.34	119.14	113.19
5	E	601	FMN	O2P-P-O5'	-2.30	100.62	106.73
5	A	601	FMN	O4-C4-C4A	-2.28	120.55	126.60
5	E	601	FMN	C5'-C4'-C3'	-2.21	107.93	112.20
5	E	601	FMN	O4-C4-C4A	-2.21	120.74	126.60
5	A	601	FMN	C4A-C10-N10	2.20	119.69	116.48
5	A	601	FMN	O3'-C3'-C2'	2.11	113.91	108.81
5	E	601	FMN	C4-N3-C2	-2.03	121.90	125.64

There are no chirality outliers.

All (19) torsion outliers are listed below:

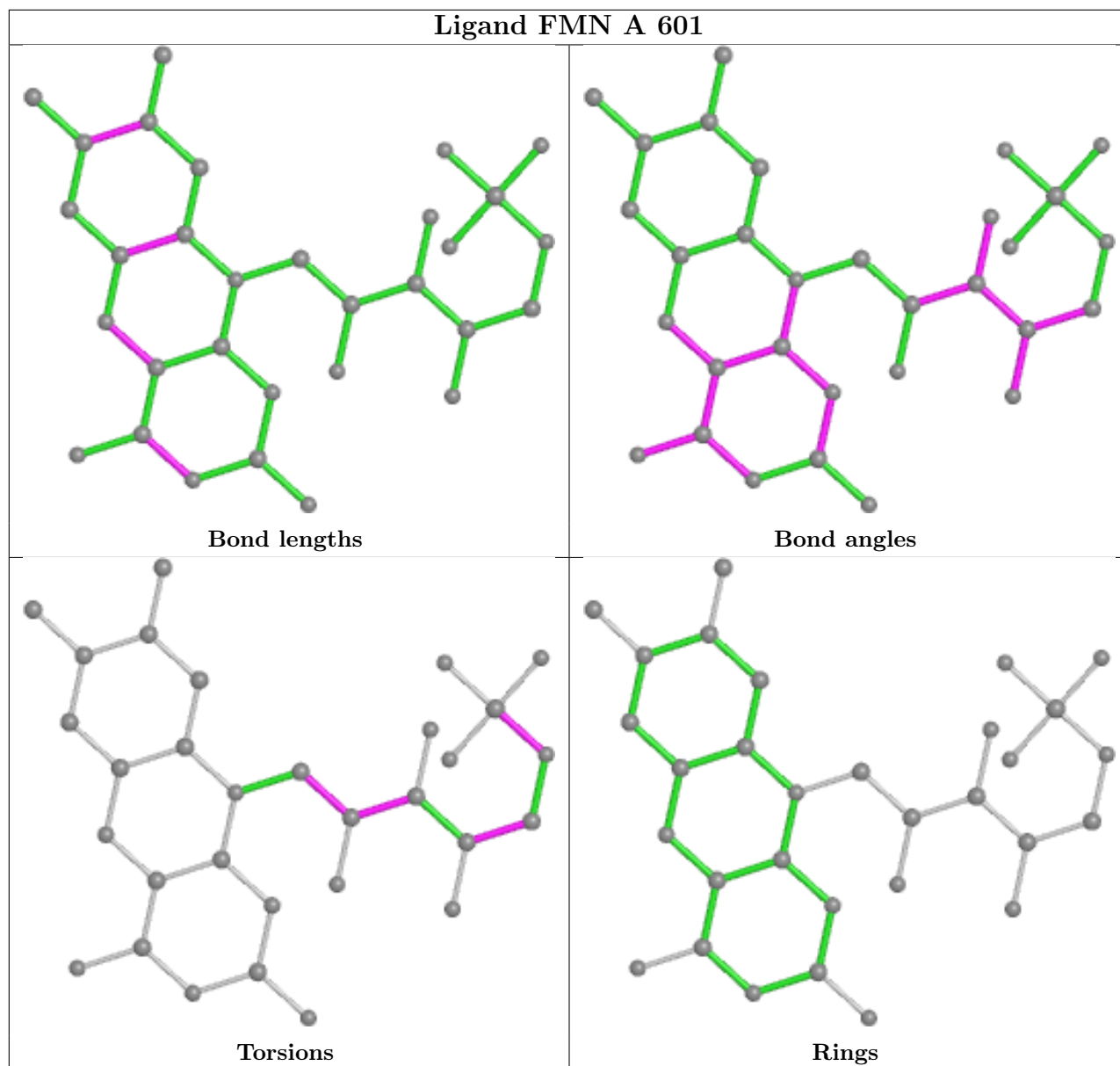
Mol	Chain	Res	Type	Atoms
5	A	601	FMN	N10-C1'-C2'-O2'
5	A	601	FMN	N10-C1'-C2'-C3'
5	A	601	FMN	C1'-C2'-C3'-O3'
5	A	601	FMN	C1'-C2'-C3'-C4'
5	A	601	FMN	O2'-C2'-C3'-O3'
5	A	601	FMN	O2'-C2'-C3'-C4'
5	A	601	FMN	C3'-C4'-C5'-O5'
5	A	601	FMN	O4'-C4'-C5'-O5'
5	A	601	FMN	C5'-O5'-P-O1P
5	E	601	FMN	N10-C1'-C2'-O2'
5	E	601	FMN	N10-C1'-C2'-C3'
5	E	601	FMN	C1'-C2'-C3'-O3'
5	E	601	FMN	C1'-C2'-C3'-C4'
5	E	601	FMN	O2'-C2'-C3'-O3'
5	E	601	FMN	O2'-C2'-C3'-C4'
5	E	601	FMN	O4'-C4'-C5'-O5'
5	E	601	FMN	C3'-C4'-C5'-O5'
5	A	601	FMN	C5'-O5'-P-O2P
5	E	601	FMN	C2'-C1'-N10-C10

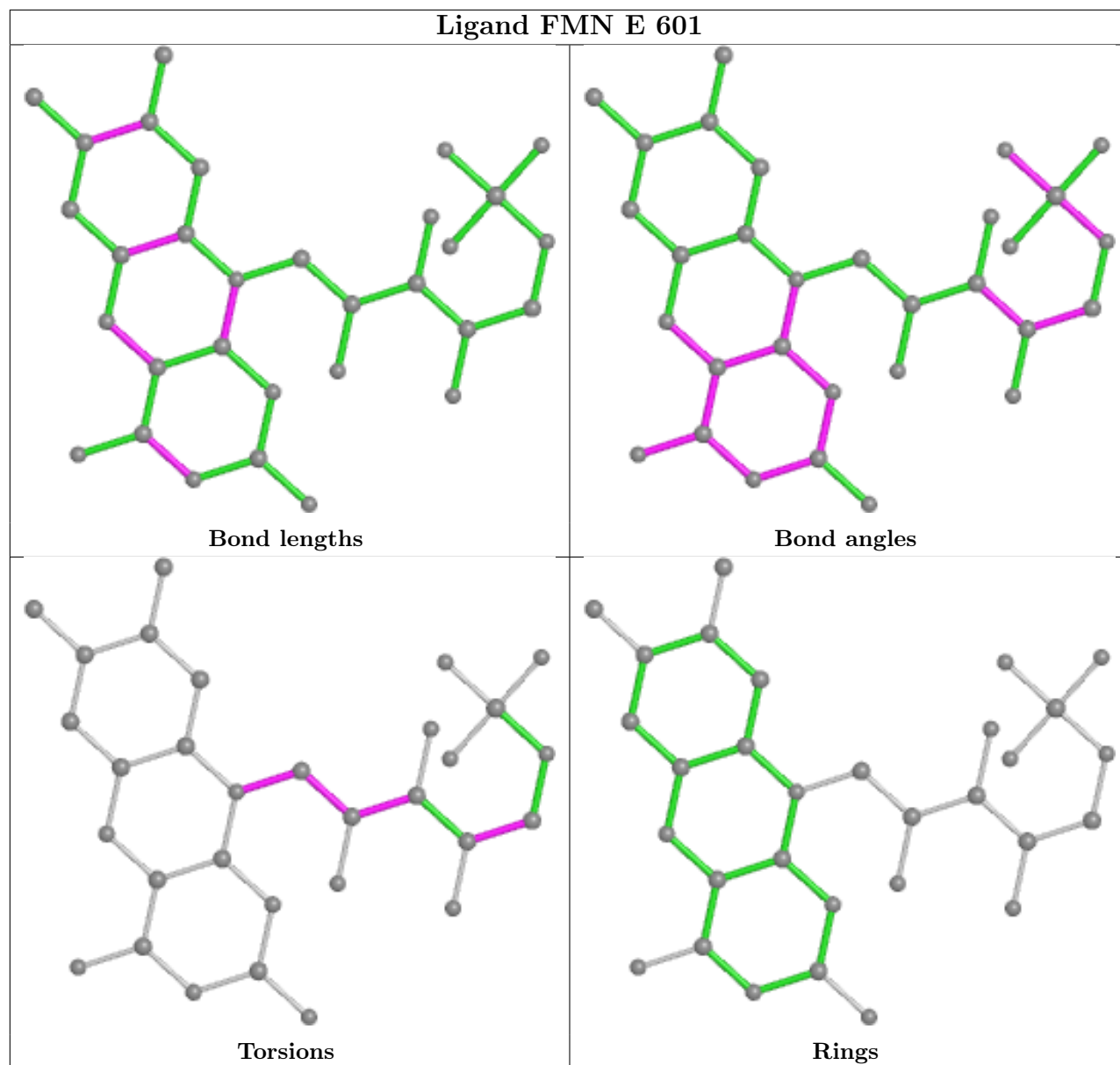
There are no ring outliers.

3 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
8	D	501	FCO	1	0
5	A	601	FMN	4	0
5	E	601	FMN	3	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	576/591 (97%)	0.32	34 (5%) 22 19	21, 47, 92, 130	0
1	E	567/591 (95%)	0.67	35 (6%) 20 17	30, 66, 100, 121	0
2	B	234/242 (96%)	-0.18	2 (0%) 84 83	19, 30, 58, 73	0
2	F	233/242 (96%)	-0.03	1 (0%) 92 92	23, 36, 68, 89	0
3	C	178/189 (94%)	0.01	1 (0%) 89 89	24, 43, 71, 108	0
3	G	178/189 (94%)	0.07	1 (0%) 89 89	25, 45, 70, 97	0
4	D	455/468 (97%)	0.05	7 (1%) 73 71	20, 42, 76, 130	0
4	H	454/468 (97%)	0.12	10 (2%) 62 58	21, 43, 81, 114	0
All	All	2875/2980 (96%)	0.21	91 (3%) 47 43	19, 46, 87, 130	0

All (91) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	296	THR	9.0
1	E	402	TYR	4.7
4	H	444	LEU	4.7
4	D	16	PRO	4.6
1	E	581	LEU	4.5
1	A	180	PHE	4.5
1	E	28	ASP	4.4
1	A	186	HIS	4.3
1	E	26	PRO	4.2
1	A	365	VAL	3.9
1	E	186	HIS	3.8
1	E	385	LEU	3.8
1	E	422	VAL	3.8
1	A	371[A]	TRP	3.7
1	E	419	ARG	3.7
1	E	416	LEU	3.7

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	E	554	ASP	3.6
1	A	580	HIS	3.5
4	D	14	SER	3.5
1	A	197	ASP	3.4
1	A	215	ARG	3.4
1	E	443	LEU	3.4
1	A	361	VAL	3.3
1	E	372	TRP	3.3
1	A	555	PHE	3.2
1	E	176	ALA	3.0
1	A	366	GLY	2.9
2	F	242	THR	2.9
1	A	295	ALA	2.9
1	A	214	TRP	2.9
1	A	372	TRP	2.9
1	E	63	TYR	2.9
1	A	298	PRO	2.8
1	E	167	LEU	2.8
1	E	580	HIS	2.8
4	H	23	VAL	2.7
1	A	369	ALA	2.7
1	E	503	TYR	2.7
2	B	239	GLU	2.6
1	A	367	ASN	2.6
1	A	434	ALA	2.5
1	A	294	GLN	2.5
1	A	583	GLN	2.5
4	H	44	ASP	2.5
1	E	195	VAL	2.5
4	D	441	GLY	2.5
1	E	303	VAL	2.5
1	A	190	ALA	2.4
4	D	45	GLY	2.4
1	A	581	LEU	2.4
4	H	442	VAL	2.4
1	A	170[A]	TRP	2.4
1	E	149	GLN	2.4
4	D	440	SER	2.4
1	E	365	VAL	2.4
1	E	366	GLY	2.4
1	E	445	PHE	2.4
1	E	302	ARG	2.4

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	E	437	GLU	2.3
1	A	370	ALA	2.3
4	H	305	ASP	2.3
4	D	442	VAL	2.3
1	E	180	PHE	2.3
1	E	539	ILE	2.3
1	A	258	LEU	2.3
1	E	390	GLY	2.2
1	E	29	ALA	2.2
1	A	503	TYR	2.2
1	A	259	ALA	2.2
1	A	571	LEU	2.2
1	A	218	ARG	2.2
1	E	546	LEU	2.2
3	G	134	PRO	2.2
4	H	15	LEU	2.2
2	B	9	ALA	2.2
1	E	245	LEU	2.2
4	H	16	PRO	2.2
4	H	40	TRP	2.1
1	A	216	PHE	2.1
1	E	135	ASP	2.1
4	H	441	GLY	2.1
3	C	134	PRO	2.1
1	A	261	ARG	2.1
4	D	44	ASP	2.1
1	E	408	ASP	2.1
1	A	181	GLU	2.1
1	A	297	VAL	2.0
4	H	443	THR	2.0
1	E	420	TYR	2.0
1	E	502	GLY	2.0
1	A	589	VAL	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

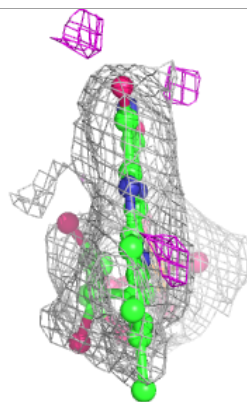
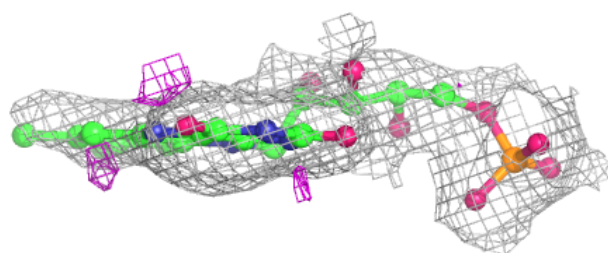
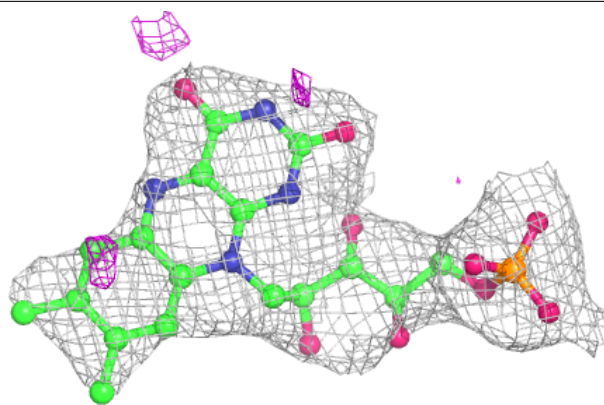
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
5	FMN	E	601	31/31	0.92	0.20	50,60,65,69	0
9	3NI	H	502	1/1	0.92	0.06	44,44,44,44	0
9	3NI	D	502	1/1	0.94	0.08	43,43,43,43	0
5	FMN	A	601	31/31	0.94	0.18	38,44,51,54	0
10	MG	H	503	1/1	0.95	0.06	36,36,36,36	0
10	MG	D	503	1/1	0.96	0.07	29,29,29,29	0
7	FES	F	303	4/4	0.98	0.09	34,36,36,37	0
6	SF4	F	302	8/8	0.99	0.10	21,22,23,23	0
6	SF4	G	201	8/8	0.99	0.10	22,23,24,24	0
7	FES	B	303	4/4	0.99	0.09	23,25,27,28	0
6	SF4	A	602	8/8	0.99	0.10	18,20,21,21	0
8	FCO	D	501	7/7	0.99	0.15	31,31,32,33	0
8	FCO	H	501	7/7	0.99	0.18	31,34,36,37	0
6	SF4	B	302	8/8	0.99	0.10	17,18,19,19	0
6	SF4	C	201	8/8	0.99	0.10	20,21,22,23	0
6	SF4	E	602	8/8	0.99	0.09	29,31,32,34	0
6	SF4	F	301	8/8	0.99	0.11	20,21,22,22	0
6	SF4	B	301	8/8	1.00	0.11	17,18,19,19	0

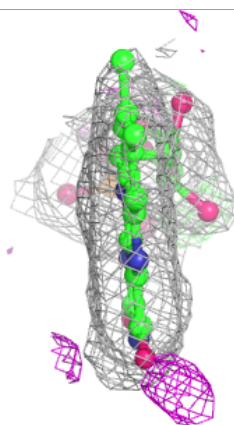
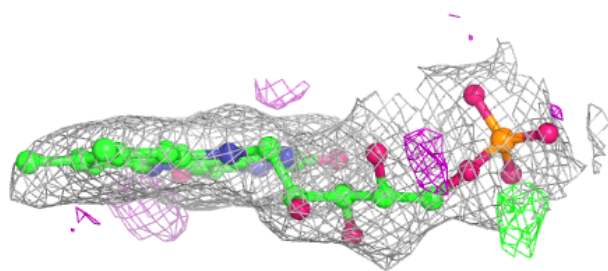
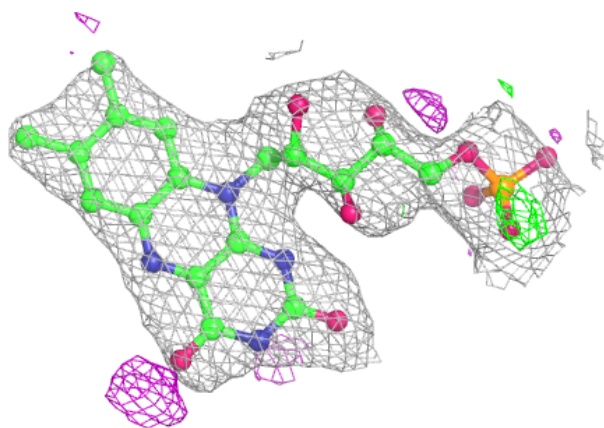
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around FMN E 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 FMN 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)



6.5 Other polymers [i](#)

There are no such residues in this entry.