



Full wwPDB X-ray Structure Validation Report ⓘ

Jul 22, 2026 – 07:19 pm BST

PDB ID : 28MB / pdb_000028mb
Title : Structure of Human Aldehyde oxidase under TCEP-reducing conditions
Authors : Videira, C.; Esmaeeli, M.; Leimkuhler, S.; Romao, M.J.; Mota, C.
Deposited on : 2026-02-06
Resolution : 2.31 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 1.8.4, CSD as541be (2020)
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 : 9.0.015 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.50

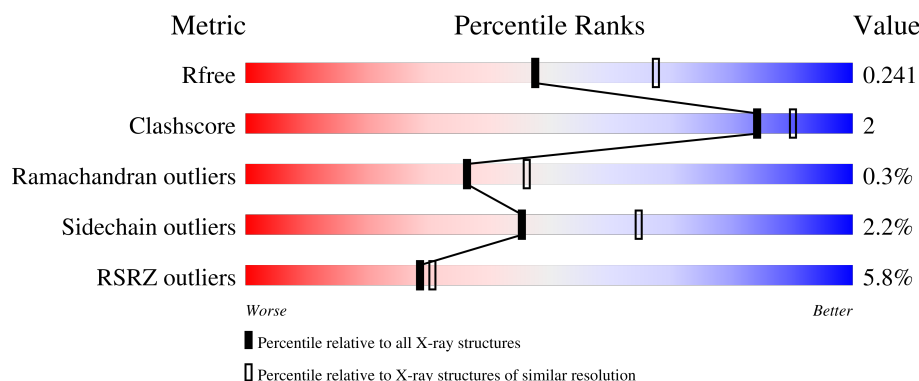
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.31 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	1338	5% 89% 7% .
1	B	1338	6% 90% 6% ..

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 20291 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.

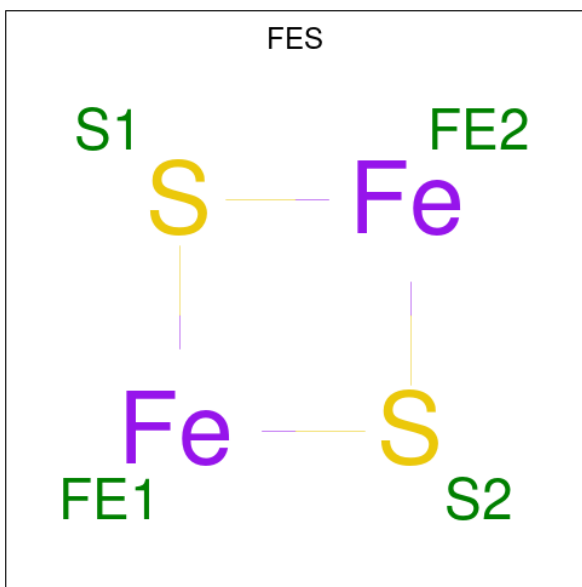
- Molecule 1 is a protein called Aldehyde oxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	1290	Total	C	N	O	S	0	0	0
			10009	6361	1722	1848	78			
1	B	1293	Total	C	N	O	S	0	0	0
			10041	6382	1730	1851	78			

There are 12 discrepancies between the modelled and reference sequences:

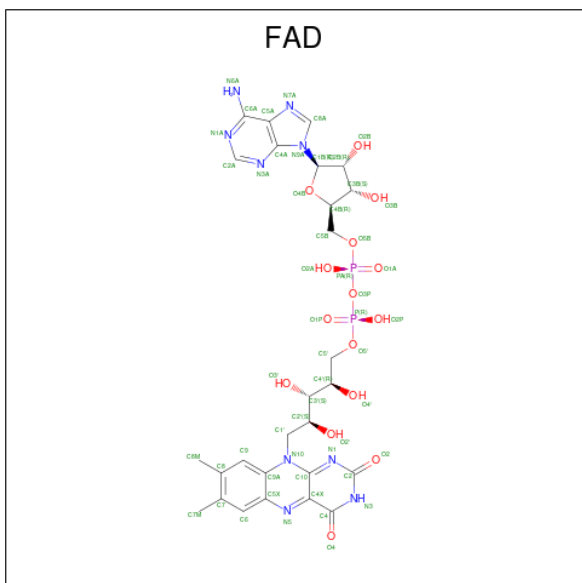
Chain	Residue	Modelled	Actual	Comment	Reference
A	161	ALA	CYS	engineered mutation	UNP Q06278
A	165	ALA	CYS	engineered mutation	UNP Q06278
A	170	ALA	CYS	engineered mutation	UNP Q06278
A	171	ALA	CYS	engineered mutation	UNP Q06278
A	179	ALA	CYS	engineered mutation	UNP Q06278
A	180	ALA	CYS	engineered mutation	UNP Q06278
B	161	ALA	CYS	engineered mutation	UNP Q06278
B	165	ALA	CYS	engineered mutation	UNP Q06278
B	170	ALA	CYS	engineered mutation	UNP Q06278
B	171	ALA	CYS	engineered mutation	UNP Q06278
B	179	ALA	CYS	engineered mutation	UNP Q06278
B	180	ALA	CYS	engineered mutation	UNP Q06278

- Molecule 2 is FE2/S2 (INORGANIC) CLUSTER (CCD ID: FES) (formula: Fe₂S₂) (labeled as "Ligand of Interest" by depositor).



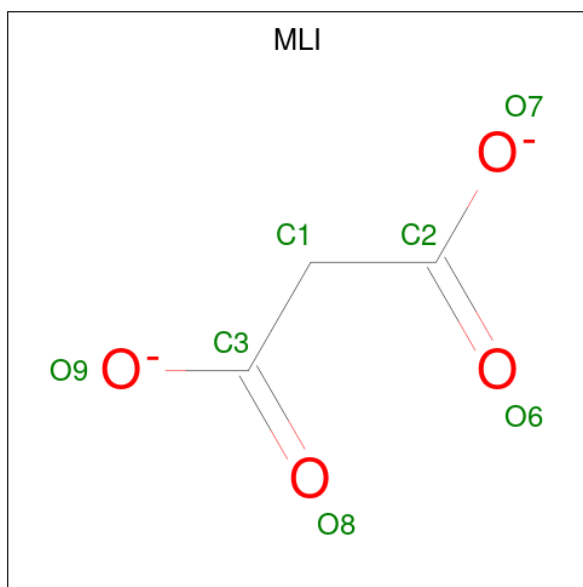
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total 4	Fe 2	S 2	0	0
2	A	1	Total 4	Fe 2	S 2	0	0
2	B	1	Total 4	Fe 2	S 2	0	0
2	B	1	Total 4	Fe 2	S 2	0	0

- Molecule 3 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula: $\text{C}_{27}\text{H}_{33}\text{N}_9\text{O}_{15}\text{P}_2$) (labeled as "Ligand of Interest" by depositor).



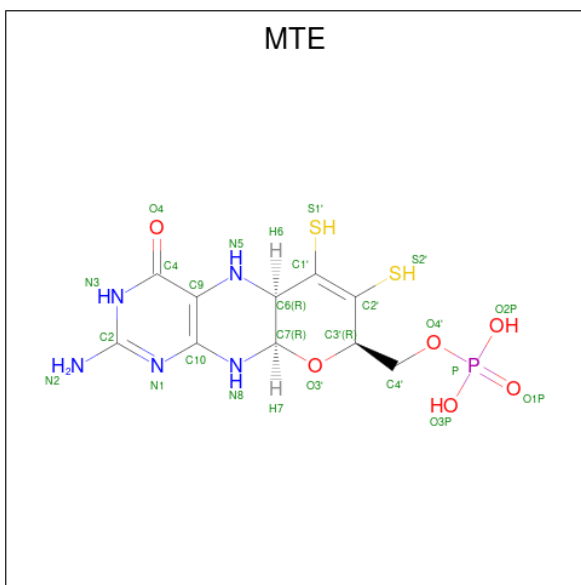
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
3	B	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

- Molecule 4 is MALONATE ION (CCD ID: MLI) (formula: $C_3H_2O_4$).



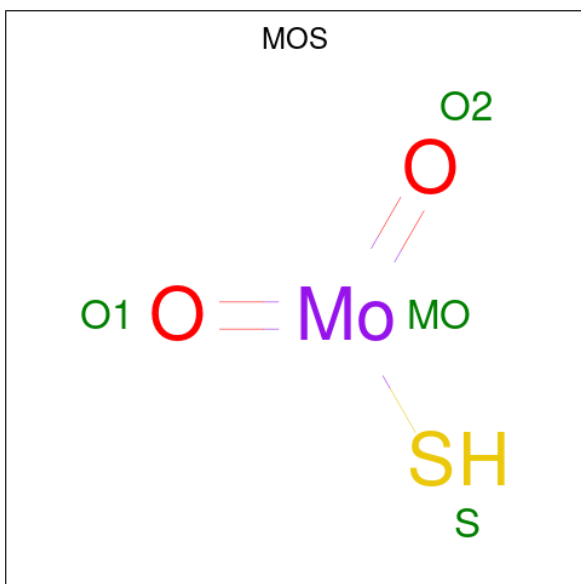
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			7	3	4		
4	A	1	Total	C	O	0	0
			7	3	4		
4	A	1	Total	C	O	0	0
			7	3	4		
4	B	1	Total	C	O	0	0
			7	3	4		

- Molecule 5 is PHOSPHONIC ACIDMONO-(2-AMINO-5,6-DIMERCAPTO-4-OXO-3,7,8A,9,10,10A-HEXAHYDRO-4H-8-OXA-1,3,9,10-TETRAAZA-ANTHRACEN-7-YLMETHYL)ESTER (CCD ID: MTE) (formula: $C_{10}H_{14}N_5O_6PS_2$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	S	0	0
			24	10	5	6	1	2		
5	B	1	Total	C	N	O	P	S	0	0
			24	10	5	6	1	2		

- Molecule 6 is DIOXOTHIOMOLYBDENUM(VI) ION (CCD ID: MOS) (formula: HMoO_2S) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	A	1	Total	Mo	O	S	0	0
			4	1	2	1		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	B	1	Total	Mo	O	S	0	0
			4	1	2	1		

- Molecule 7 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	B	1	Total	C	O	0	0
			6	3	3		

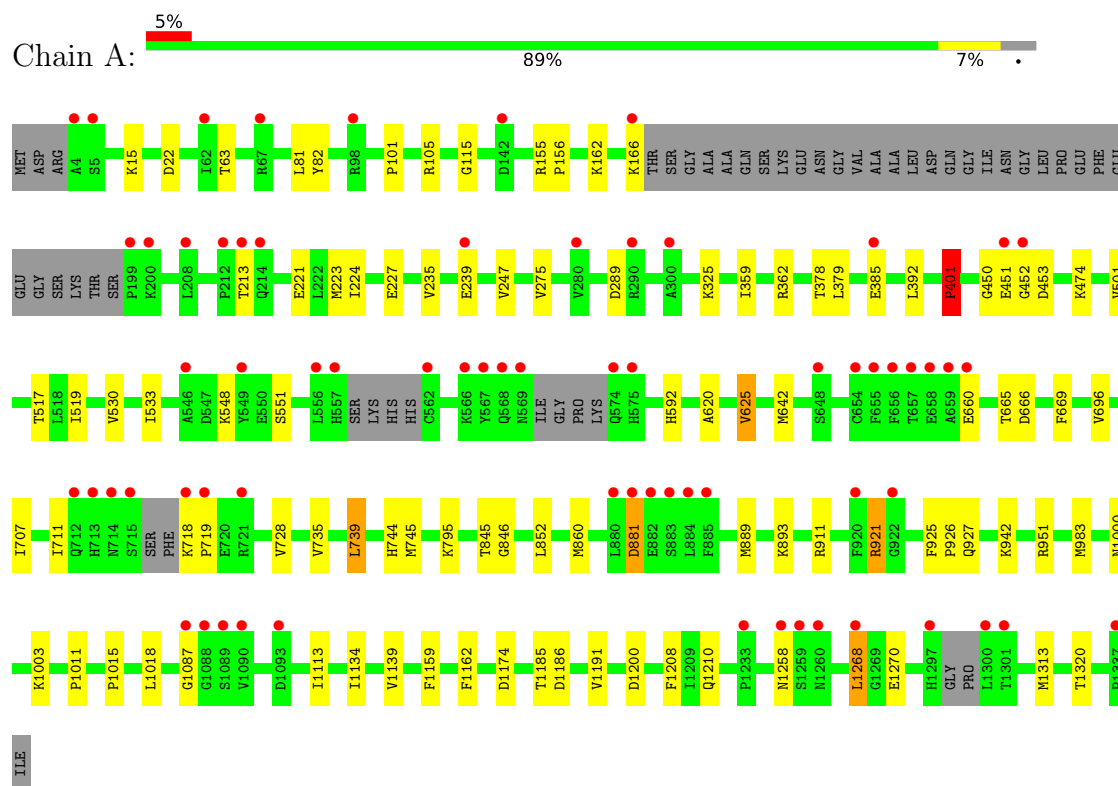
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	14	Total	O	0	0
			14	14		
8	B	15	Total	O	0	0
			15	15		

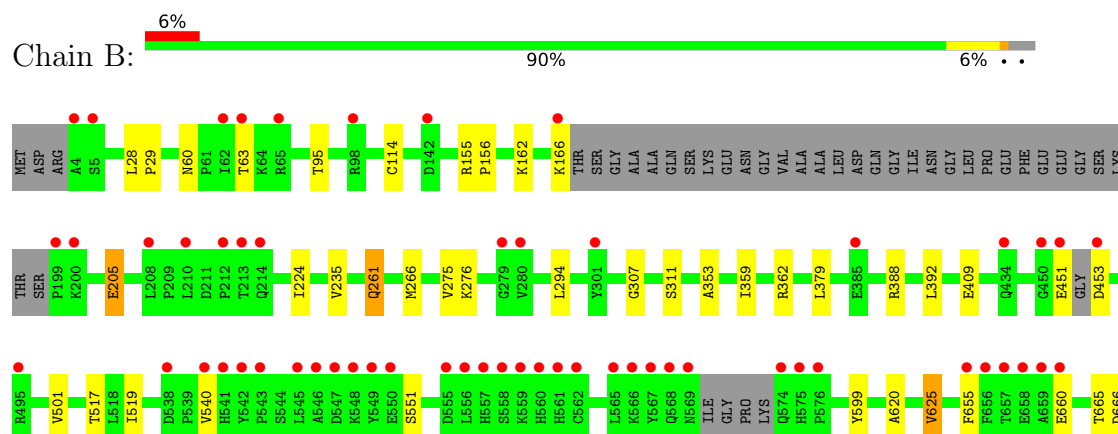
3 Residue-property plots [i](#)

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: Aldehyde oxidase



• Molecule 1: Aldehyde oxidase





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	191.20Å 273.12Å 77.88Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	95.60 – 2.31 95.60 – 2.31	Depositor EDS
% Data completeness (in resolution range)	55.7 (95.60-2.31) 55.7 (95.60-2.31)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.57 (at 2.32Å)	Xtriage
Refinement program	REFMAC 5.8.0425	Depositor
R, R_{free}	0.209 , 0.241 0.210 , 0.241	Depositor DCC
R_{free} test set	5135 reflections (2.85%)	wwPDB-VP
Wilson B-factor (Å ²)	28.7	Xtriage
Anisotropy	0.195	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 24.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	20291	wwPDB-VP
Average B, all atoms (Å ²)	31.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.12% 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: MTE, FAD, MOS, MLI, GOL, FES

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	0.47	0/10218	0.88	2/13817 (0.0%)
1	B	0.47	0/10253	0.87	1/13864 (0.0%)
All	All	0.47	0/20471	0.88	3/27681 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	734	VAL	N-CA-CB	-6.00	104.56	112.36
1	A	401	PRO	N-CA-CB	-5.63	97.34	103.25
1	A	22	ASP	CA-CB-CG	5.14	117.74	112.60

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	10009	0	10058	52	0
1	B	10041	0	10090	44	0
2	A	8	0	0	0	0
2	B	8	0	0	0	0
3	A	53	0	31	0	0
3	B	53	0	31	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	21	0	6	0	0
4	B	7	0	2	0	0
5	A	24	0	11	1	0
5	B	24	0	10	1	0
6	A	4	0	0	0	0
6	B	4	0	0	0	0
7	B	6	0	8	0	0
8	A	14	0	0	0	0
8	B	15	0	0	0	0
All	All	20291	0	20247	94	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 2.

All (94) 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:1087:GLY:HA2	5:A:1407:MTE:S2'	2.23	0.79
1:B:1191:VAL:HG11	1:B:1268:LEU:HD23	1.74	0.69
1:A:501:VAL:HG23	1:A:501:VAL:O	1.97	0.64
1:B:501:VAL:O	1:B:501:VAL:HG23	1.97	0.63
1:B:744:HIS:CD2	1:B:852:LEU:HD13	2.34	0.62
1:A:1191:VAL:HG11	1:A:1268:LEU:HD23	1.84	0.59
1:A:718:LYS:N	1:A:719:PRO:CD	2.69	0.55
1:B:551:SER:HB3	1:B:1000:ASN:OD1	2.08	0.54
1:A:889:MET:HE3	1:A:893:LYS:HE3	1.88	0.53
1:B:739:LEU:C	1:B:739:LEU:HD23	2.34	0.53
1:A:735:VAL:HA	1:A:860:MET:HE1	1.91	0.53
1:A:739:LEU:C	1:A:739:LEU:HD23	2.34	0.53
1:A:166:LYS:HD2	1:A:166:LYS:C	2.34	0.52
1:B:28:LEU:HB3	1:B:29:PRO:HD3	1.92	0.52
1:B:388:ARG:NH1	1:B:409:GLU:OE1	2.42	0.52
1:B:60:ASN:CG	1:B:63:THR:HG22	2.36	0.51
1:A:1191:VAL:CG1	1:A:1268:LEU:HD23	2.41	0.51
1:A:1139:VAL:HG11	1:B:1135:ASN:HD21	1.76	0.50
1:A:501:VAL:HG23	1:A:519:ILE:HD13	1.93	0.50
1:A:517:THR:HG21	1:A:1313:MET:HE1	1.92	0.50
1:B:517:THR:HG21	1:B:1313:MET:HE1	1.92	0.50
1:A:620:ALA:O	1:A:669:PHE:C	2.55	0.50
1:A:921:ARG:HG2	1:A:1270:GLU:HA	1.93	0.50
1:A:625:VAL:HG22	1:A:696:VAL:HB	1.95	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:501:VAL:O	1:A:501:VAL:CG2	2.60	0.49
1:B:745:MET:SD	1:B:927:GLN:HA	2.53	0.49
1:B:1087:GLY:HA2	5:B:1406:MTE:S2'	2.53	0.49
1:A:379:LEU:HD21	1:A:392:LEU:HD12	1.95	0.48
1:A:893:LYS:HG2	1:A:1015:PRO:HG2	1.94	0.48
1:A:1185:THR:HG21	1:A:1208:PHE:CZ	2.48	0.48
1:B:205:GLU:H	1:B:205:GLU:CD	2.21	0.48
1:A:745:MET:SD	1:A:927:GLN:HA	2.54	0.47
1:A:15:LYS:HE2	1:A:221:GLU:OE1	2.14	0.47
1:B:1200:ASP:HB3	1:B:1268:LEU:HD21	1.97	0.47
1:B:501:VAL:O	1:B:501:VAL:CG2	2.63	0.47
1:B:1111:GLU:HB3	1:B:1112:PRO:HD3	1.97	0.47
1:A:223:MET:O	1:A:227:GLU:HG2	2.15	0.46
1:A:983:MET:HE3	1:A:1186:ASP:HB3	1.97	0.46
1:B:625:VAL:HG22	1:B:696:VAL:HB	1.96	0.46
1:A:247:VAL:HG12	1:A:289:ASP:HB3	1.97	0.46
1:A:1268:LEU:HD12	1:A:1268:LEU:H	1.80	0.46
1:B:501:VAL:HG23	1:B:519:ILE:HD13	1.96	0.46
1:A:551:SER:HB2	1:A:1000:ASN:OD1	2.15	0.46
1:A:889:MET:HE3	1:A:893:LYS:CE	2.47	0.45
1:A:707:ILE:O	1:A:711:ILE:HG13	2.16	0.45
1:A:1003:LYS:HD3	1:A:1174:ASP:HA	1.99	0.45
1:A:530:VAL:HA	1:A:533:ILE:HG22	1.98	0.45
1:B:294:LEU:O	1:B:307:GLY:HA3	2.16	0.45
1:A:1113:ILE:HD11	1:A:1134:ILE:HD12	1.98	0.45
1:A:665:THR:OG1	1:A:666:ASP:N	2.49	0.45
1:B:921:ARG:HG2	1:B:1270:GLU:HA	1.97	0.45
1:A:359:ILE:O	1:A:362:ARG:HG3	2.17	0.44
1:B:983:MET:HE3	1:B:1186:ASP:HB3	2.00	0.44
1:B:1191:VAL:CG1	1:B:1268:LEU:HD23	2.43	0.44
1:B:451:GLU:O	1:B:453:ASP:N	2.51	0.44
1:B:951:ARG:HD3	1:B:1011:PRO:HD3	1.99	0.44
1:A:925:PHE:HB3	1:A:926:PRO:HD3	2.00	0.44
1:A:101:PRO:O	1:A:105:ARG:HG3	2.18	0.44
1:B:60:ASN:HB3	1:B:63:THR:CG2	2.48	0.44
1:A:744:HIS:CD2	1:A:852:LEU:HD13	2.53	0.43
1:B:379:LEU:HD21	1:B:392:LEU:HD12	1.99	0.43
1:A:845:THR:HG22	1:A:846:GLY:O	2.17	0.43
1:B:261:GLN:H	1:B:261:GLN:CD	2.27	0.43
1:B:665:THR:OG1	1:B:666:ASP:N	2.51	0.43
1:A:921:ARG:HD3	1:A:1210:GLN:OE1	2.19	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:155:ARG:N	1:B:156:PRO:HD2	2.34	0.43
1:B:925:PHE:HB3	1:B:926:PRO:HD3	2.01	0.43
1:B:1185:THR:HG21	1:B:1208:PHE:CZ	2.53	0.43
1:A:115:GLY:HA3	1:A:592:HIS:CG	2.55	0.42
1:A:155:ARG:N	1:A:156:PRO:HD2	2.34	0.42
1:A:1015:PRO:HB2	1:A:1159:PHE:CG	2.54	0.42
1:B:1051:VAL:O	1:B:1055:MET:HG2	2.19	0.42
1:A:893:LYS:HG2	1:A:1015:PRO:CG	2.49	0.42
1:B:732:PHE:CZ	1:B:856:LYS:HG2	2.55	0.42
1:B:707:ILE:O	1:B:711:ILE:HG13	2.20	0.41
1:B:845:THR:HG22	1:B:846:GLY:O	2.19	0.41
1:B:620:ALA:O	1:B:669:PHE:C	2.64	0.41
1:B:1006:GLY:HA3	1:B:1282:ALA:O	2.20	0.41
1:B:680:ALA:HB3	1:B:686:ALA:HB2	2.02	0.41
1:B:114:CYS:O	1:B:599:TYR:OH	2.33	0.41
1:A:1139:VAL:HG23	1:B:1139:VAL:HG23	2.03	0.41
1:A:660:GLU:N	1:A:660:GLU:OE1	2.54	0.41
1:A:450:GLY:O	1:A:452:GLY:N	2.48	0.41
1:A:660:GLU:OE2	1:A:881:ASP:OD1	2.38	0.41
1:A:1015:PRO:HB3	1:A:1162:PHE:CE2	2.56	0.41
1:B:655:PHE:HD2	1:B:780:TYR:CE1	2.38	0.41
1:B:718:LYS:N	1:B:719:PRO:HD3	2.36	0.41
1:A:81:LEU:O	1:A:82:TYR:C	2.64	0.41
1:A:1200:ASP:HB3	1:A:1268:LEU:HD21	2.03	0.40
1:B:359:ILE:O	1:B:362:ARG:HG3	2.21	0.40
1:A:501:VAL:CG2	1:A:519:ILE:HD13	2.51	0.40
1:A:739:LEU:HD12	1:A:942:LYS:HG3	2.03	0.40
1:A:951:ARG:HD3	1:A:1011:PRO:HD3	2.02	0.40
1:B:311:SER:HA	1:B:353:ALA:O	2.22	0.40

There are no symmetry-related clashes.

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	1278/1338 (96%)	1239 (97%)	35 (3%)	4 (0%)	36	46
1	B	1281/1338 (96%)	1237 (97%)	41 (3%)	3 (0%)	43	55
All	All	2559/2676 (96%)	2476 (97%)	76 (3%)	7 (0%)	36	46

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	881	ASP
1	B	881	ASP
1	A	401	PRO
1	A	921	ARG
1	A	1258	ASN
1	B	921	ARG
1	B	540	VAL

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	1093/1130 (97%)	1069 (98%)	24 (2%)	45	65
1	B	1097/1130 (97%)	1073 (98%)	24 (2%)	45	65
All	All	2190/2260 (97%)	2142 (98%)	48 (2%)	45	65

All (48) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	63	THR
1	A	162	LYS
1	A	213	THR
1	A	224	ILE
1	A	235	VAL
1	A	239	GLU
1	A	275	VAL
1	A	325	LYS
1	A	378	THR

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Mol	Chain	Res	Type
1	A	385	GLU
1	A	401	PRO
1	A	451	GLU
1	A	453	ASP
1	A	474	LYS
1	A	548	LYS
1	A	625	VAL
1	A	642	MET
1	A	728	VAL
1	A	739	LEU
1	A	795	LYS
1	A	911	ARG
1	A	1018	LEU
1	A	1268	LEU
1	A	1320	THR
1	B	95	THR
1	B	162	LYS
1	B	166	LYS
1	B	205	GLU
1	B	224	ILE
1	B	235	VAL
1	B	261	GLN
1	B	266	MET
1	B	275	VAL
1	B	276	LYS
1	B	625	VAL
1	B	660	GLU
1	B	718	LYS
1	B	728	VAL
1	B	734	VAL
1	B	739	LEU
1	B	795	LYS
1	B	975	GLN
1	B	1018	LEU
1	B	1089	SER
1	B	1152	GLU
1	B	1244	MET
1	B	1268	LEU
1	B	1320	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (21) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	268	ASN
1	A	582	HIS
1	A	767	GLN
1	A	1084	ASN
1	A	1095	ASN
1	A	1127	GLN
1	A	1157	GLN
1	A	1235	GLN
1	A	1297	HIS
1	B	96	HIS
1	B	132	HIS
1	B	268	ASN
1	B	324	GLN
1	B	351	ASN
1	B	582	HIS
1	B	744	HIS
1	B	861	ASN
1	B	1084	ASN
1	B	1095	ASN
1	B	1135	ASN
1	B	1221	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

15 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The

Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	FES	A	1401	1	0,4,4	-	-	-		
4	MLI	A	1405	-	6,6,6	1.21	0	7,7,7	0.98	0
4	MLI	B	1405	-	6,6,6	1.31	0	7,7,7	0.98	0
5	MTE	A	1407	6	21,26,26	0.51	0	19,40,40	1.21	2 (10%)
6	MOS	A	1408	5	0,3,3	-	-	-		
6	MOS	B	1407	5	0,3,3	-	-	-		
2	FES	B	1401	1	0,4,4	-	-	-		
2	FES	B	1402	1	0,4,4	-	-	-		
3	FAD	B	1403	-	56,58,58	0.51	0	81,89,89	0.47	0
4	MLI	A	1406	-	6,6,6	1.38	0	7,7,7	1.06	0
7	GOL	B	1404	-	5,5,5	0.14	0	5,5,5	0.43	0
5	MTE	B	1406	6	21,26,26	0.55	0	19,40,40	1.21	1 (5%)
3	FAD	A	1403	-	56,58,58	0.50	0	81,89,89	0.57	1 (1%)
4	MLI	A	1404	-	6,6,6	1.36	0	7,7,7	1.01	0
2	FES	A	1402	1	0,4,4	-	-	-		

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	MLI	A	1405	-	-	2/4/4/4	-
4	MLI	B	1405	-	-	2/4/4/4	-
5	MTE	A	1407	6	-	3/6/34/34	0/3/3/3
2	FES	A	1401	1	-	-	0/1/1/1
4	MLI	A	1406	-	-	0/4/4/4	-
2	FES	B	1401	1	-	-	0/1/1/1
3	FAD	B	1403	-	-	0/34/50/50	0/6/6/6
2	FES	B	1402	1	-	-	0/1/1/1
7	GOL	B	1404	-	-	3/4/4/4	-
5	MTE	B	1406	6	-	2/6/34/34	0/3/3/3
3	FAD	A	1403	-	-	0/34/50/50	0/6/6/6
4	MLI	A	1404	-	-	2/4/4/4	-
2	FES	A	1402	1	-	-	0/1/1/1

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
5	A	1407	MTE	C2-N1-C10	3.01	118.86	113.43
5	B	1406	MTE	C2-N1-C10	2.99	118.83	113.43
3	A	1403	FAD	C2B-C1B-N9A	2.35	119.25	113.30
5	A	1407	MTE	O3'-C7-C6	2.06	110.34	108.96

There are no chirality outliers.

All (14) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	1407	MTE	C3'-C4'-O4'-P
5	A	1407	MTE	C4'-O4'-P-O2P
5	A	1407	MTE	C4'-O4'-P-O3P
5	B	1406	MTE	C3'-C4'-O4'-P
7	B	1404	GOL	C1-C2-C3-O3
7	B	1404	GOL	O2-C2-C3-O3
7	B	1404	GOL	O1-C1-C2-C3
5	B	1406	MTE	C4'-O4'-P-O3P
4	A	1404	MLI	C3-C1-C2-O6
4	A	1404	MLI	C3-C1-C2-O7
4	A	1405	MLI	C2-C1-C3-O8
4	B	1405	MLI	C2-C1-C3-O9
4	B	1405	MLI	C2-C1-C3-O8
4	A	1405	MLI	C2-C1-C3-O9

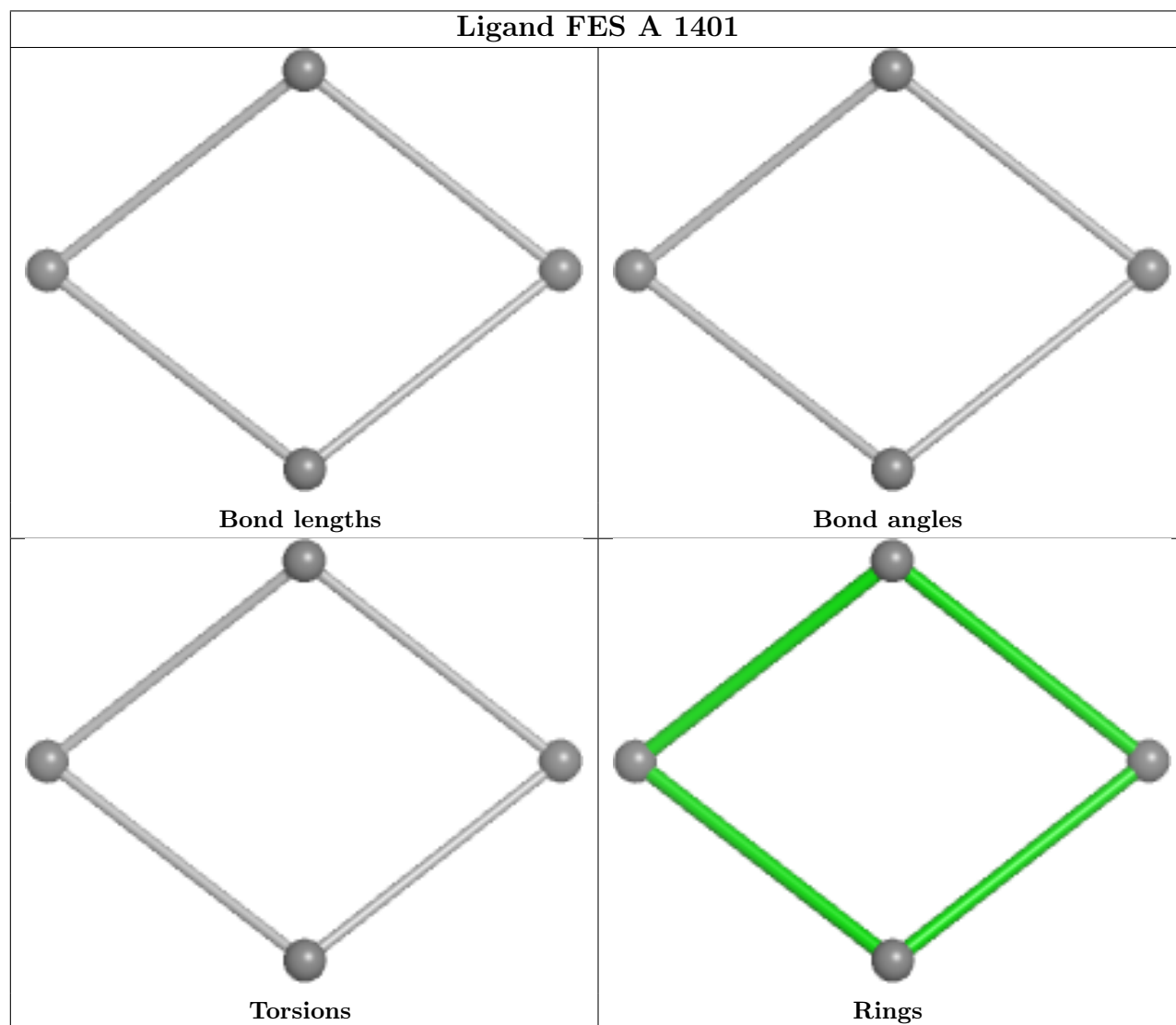
There are no ring outliers.

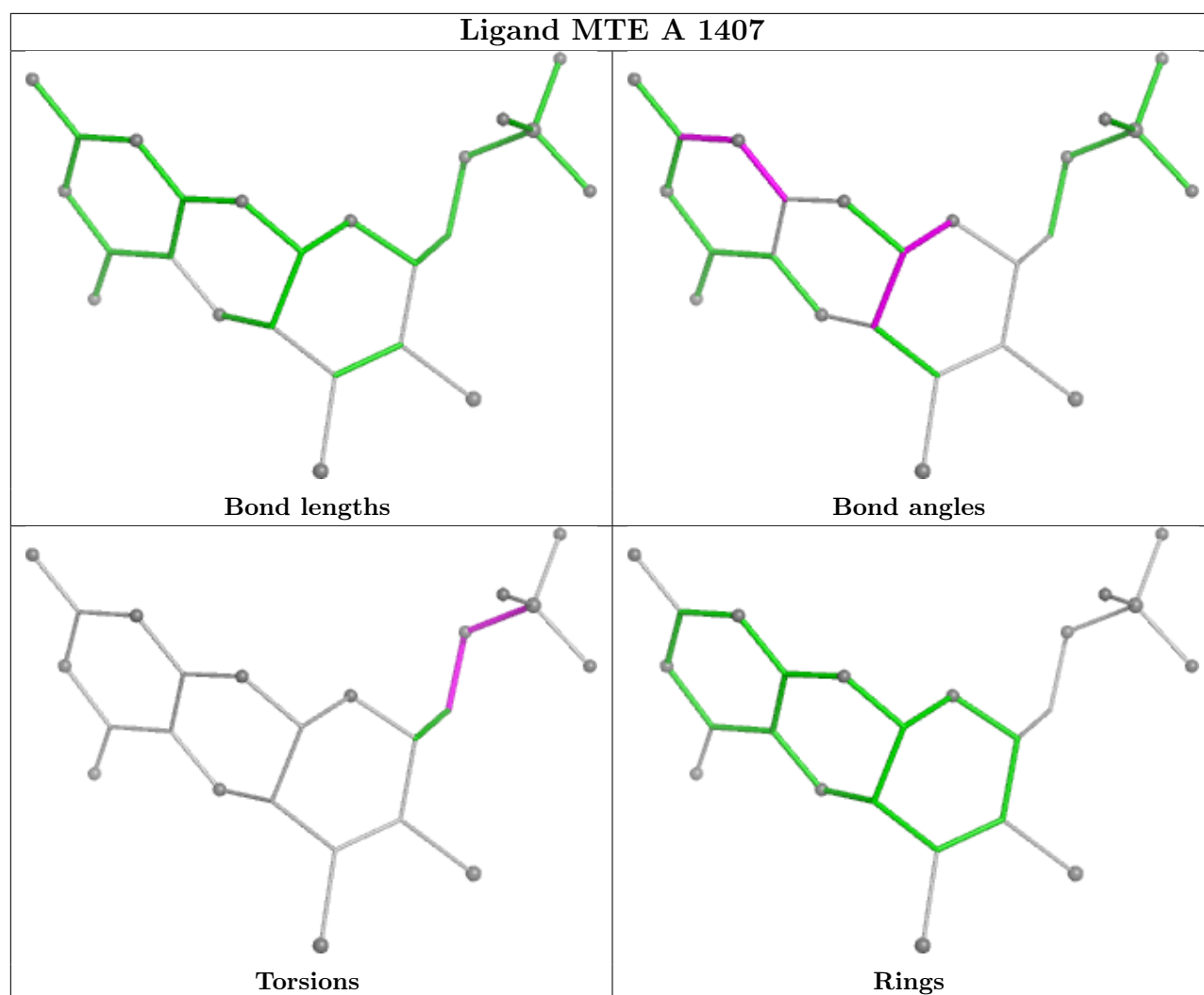
2 monomers are involved in 2 short contacts:

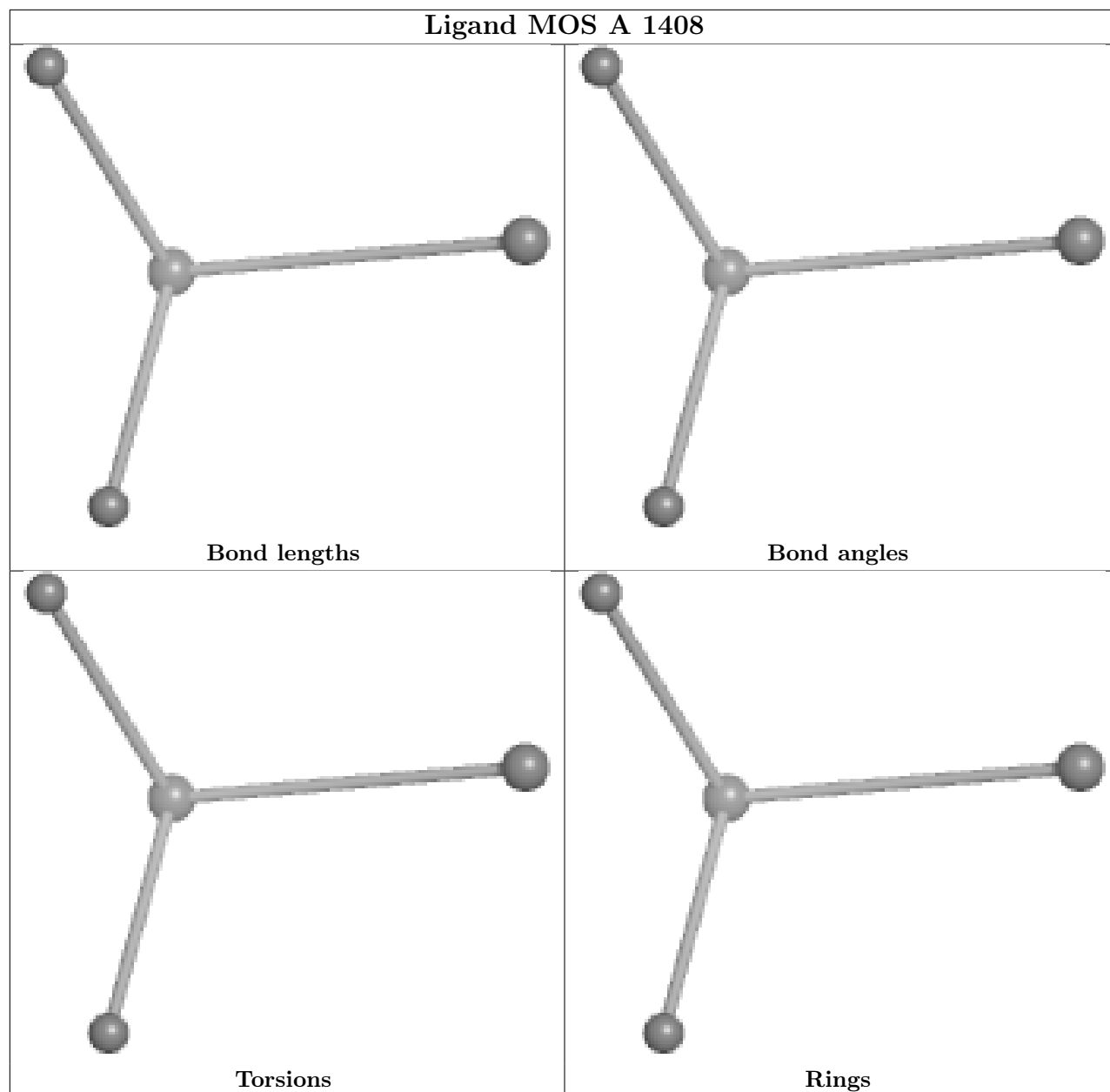
Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	1407	MTE	1	0
5	B	1406	MTE	1	0

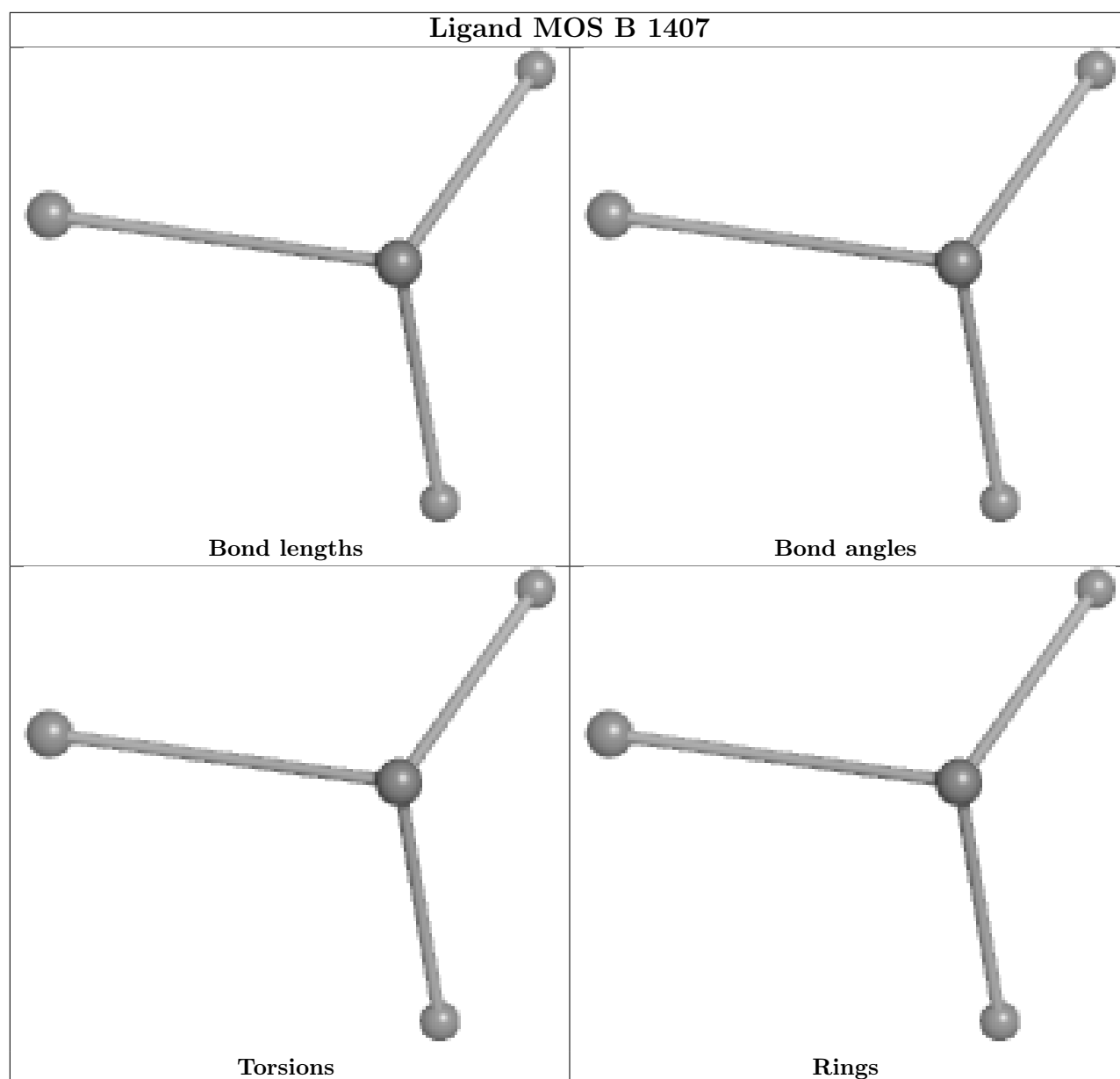
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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

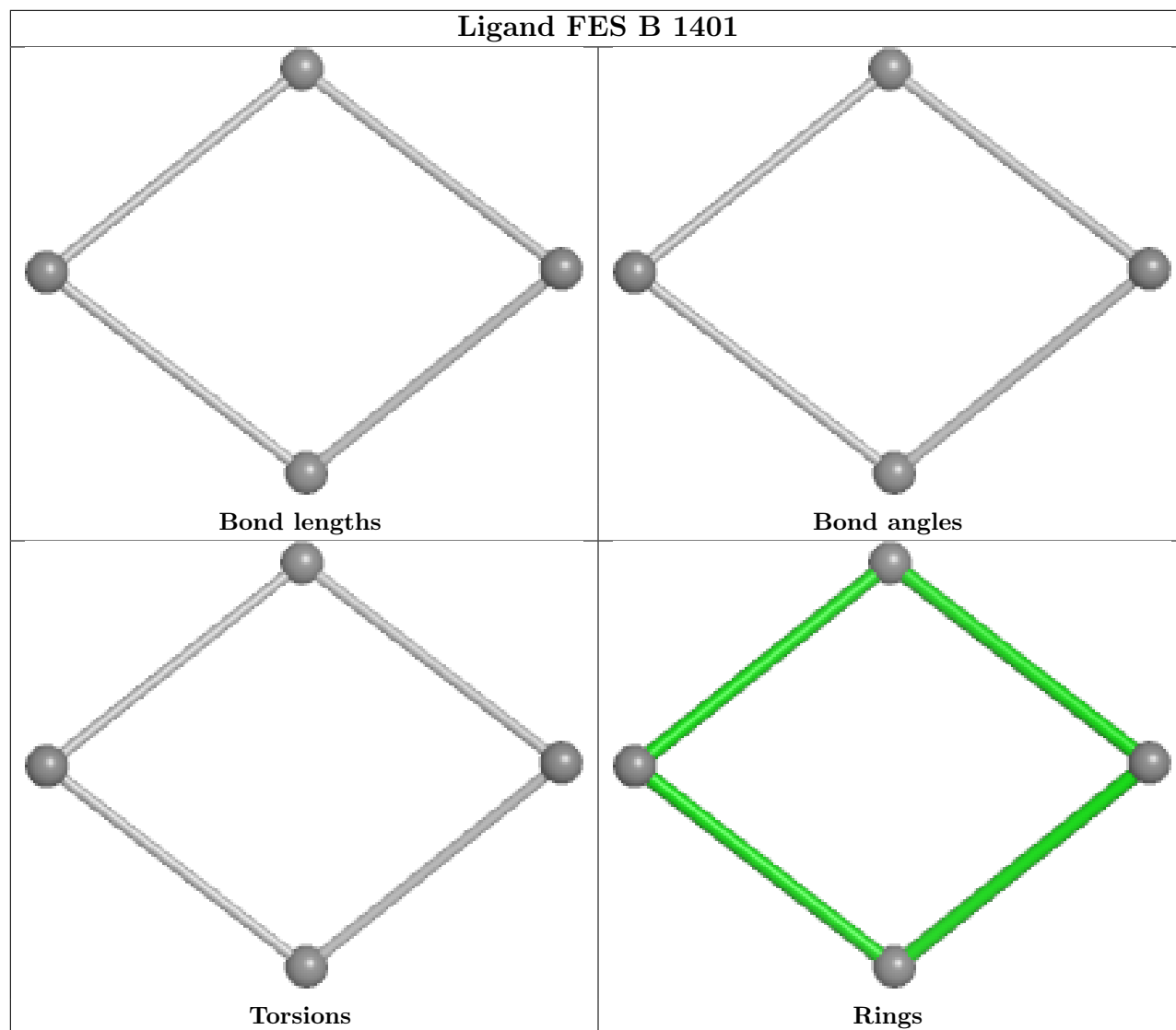
average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

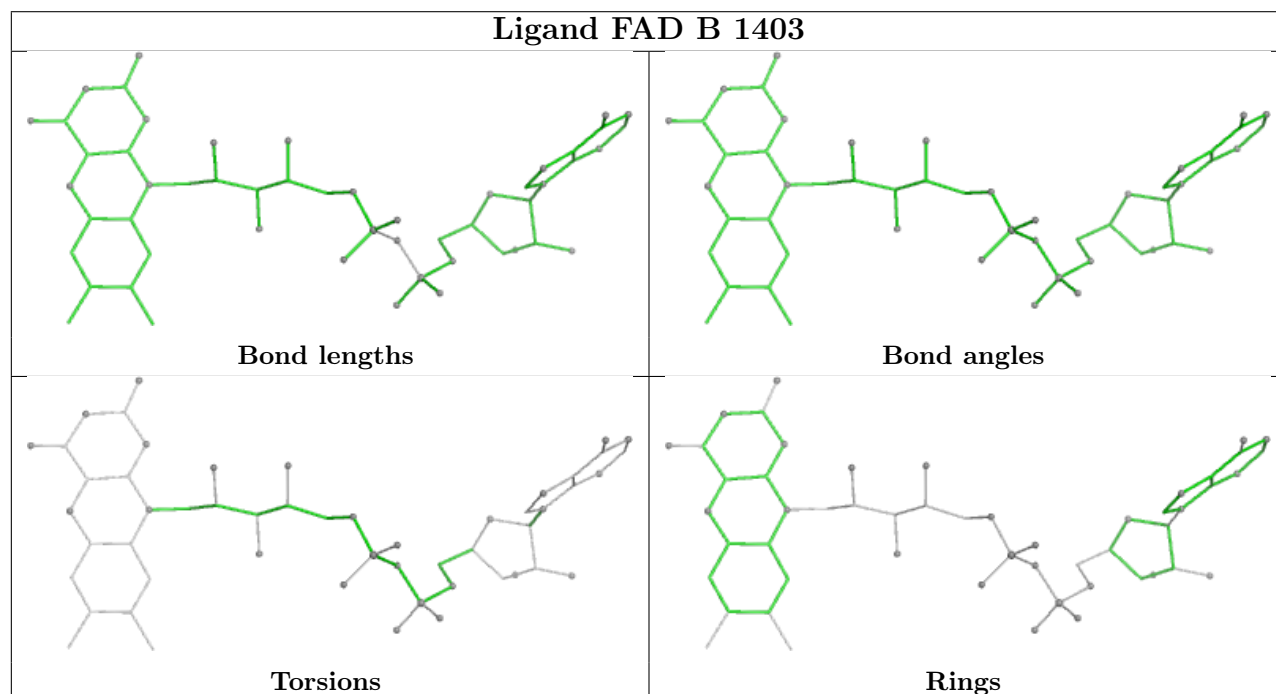
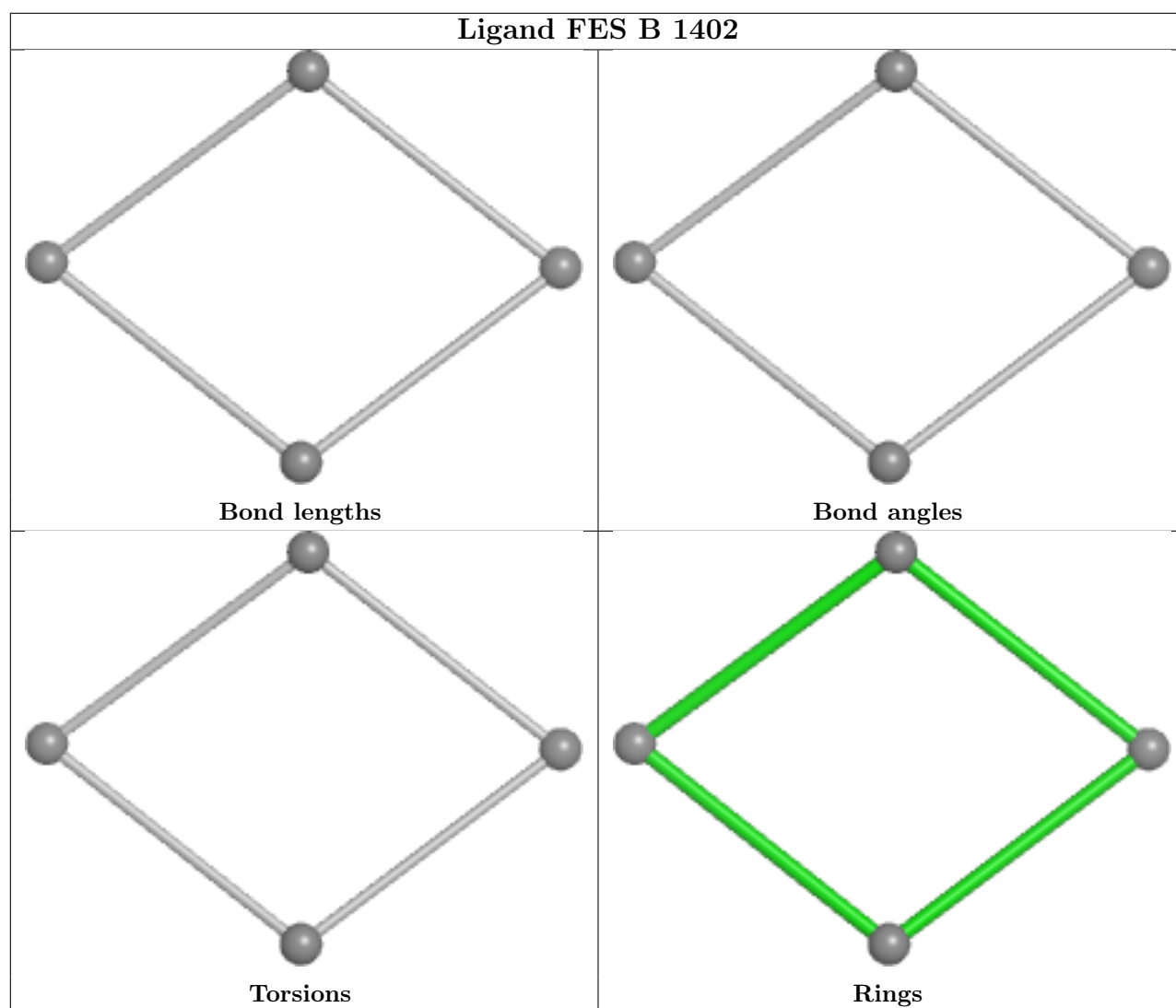




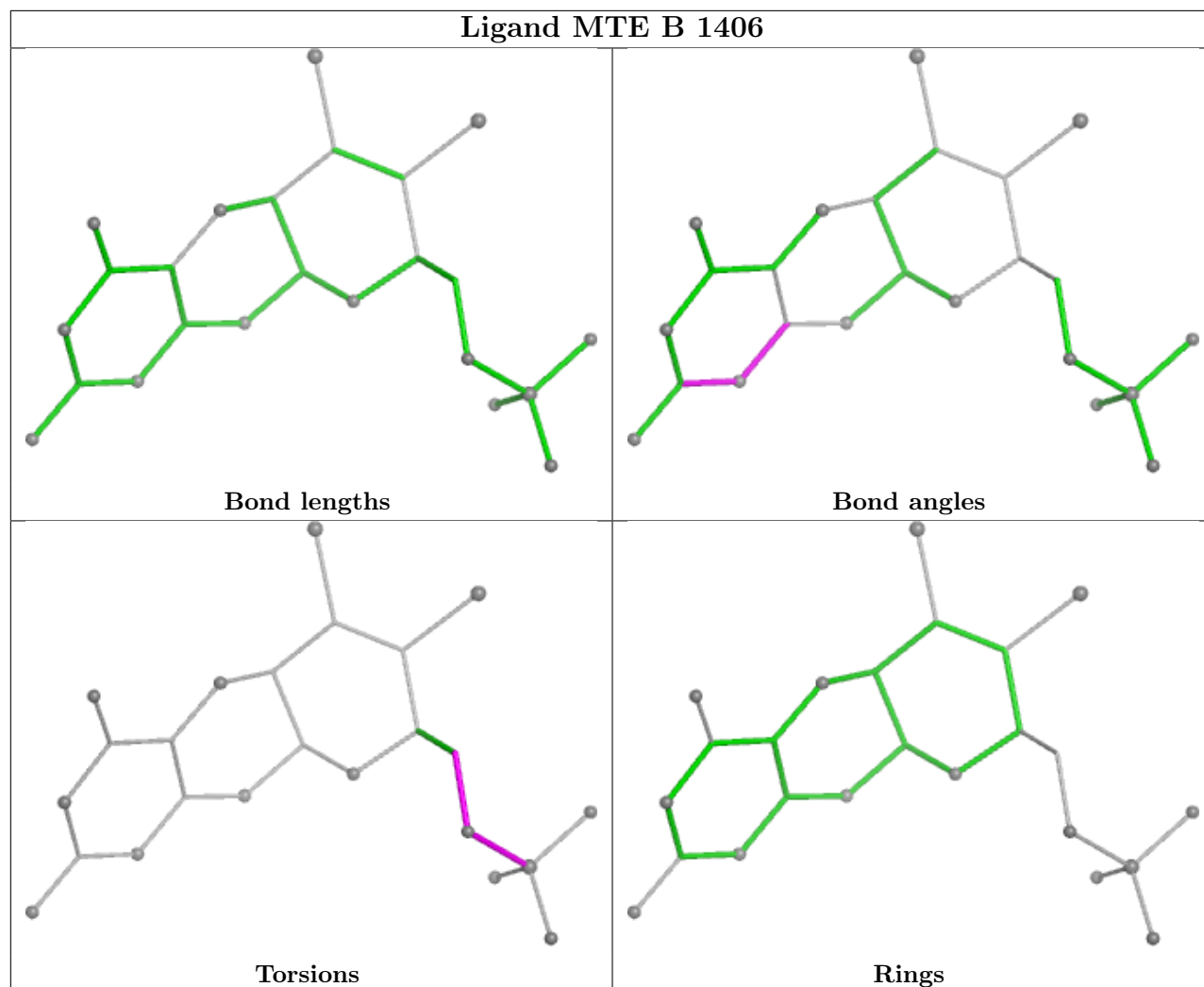




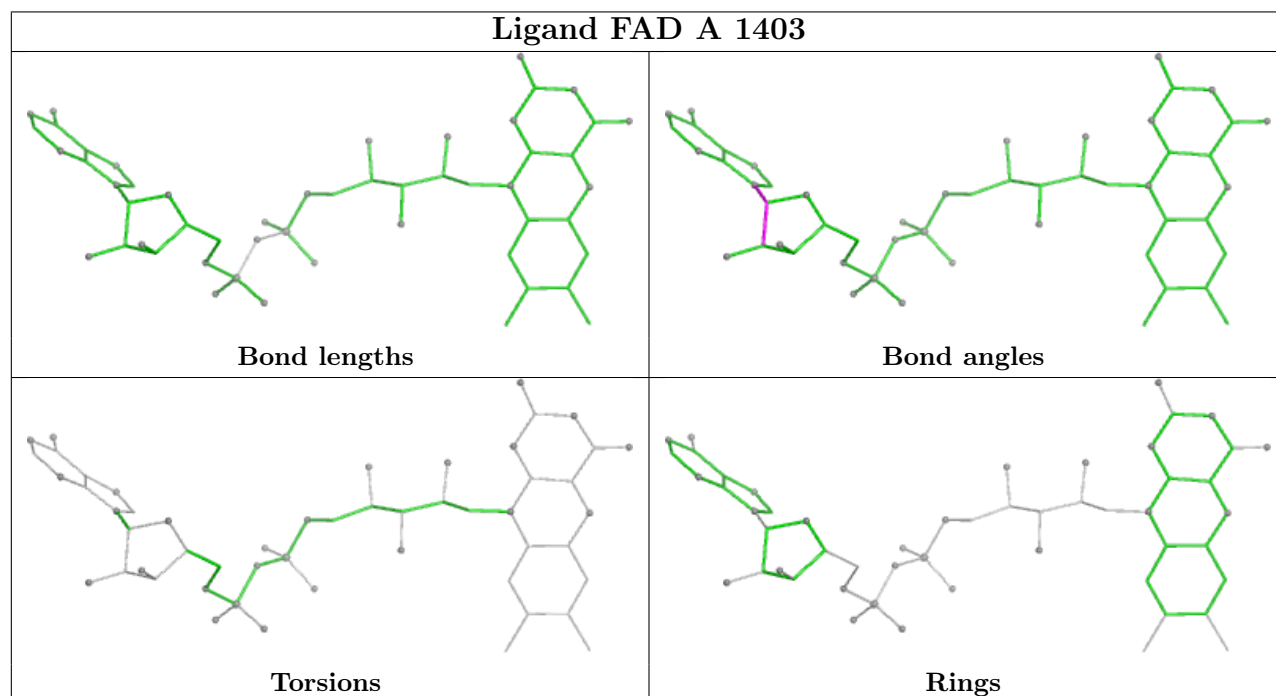


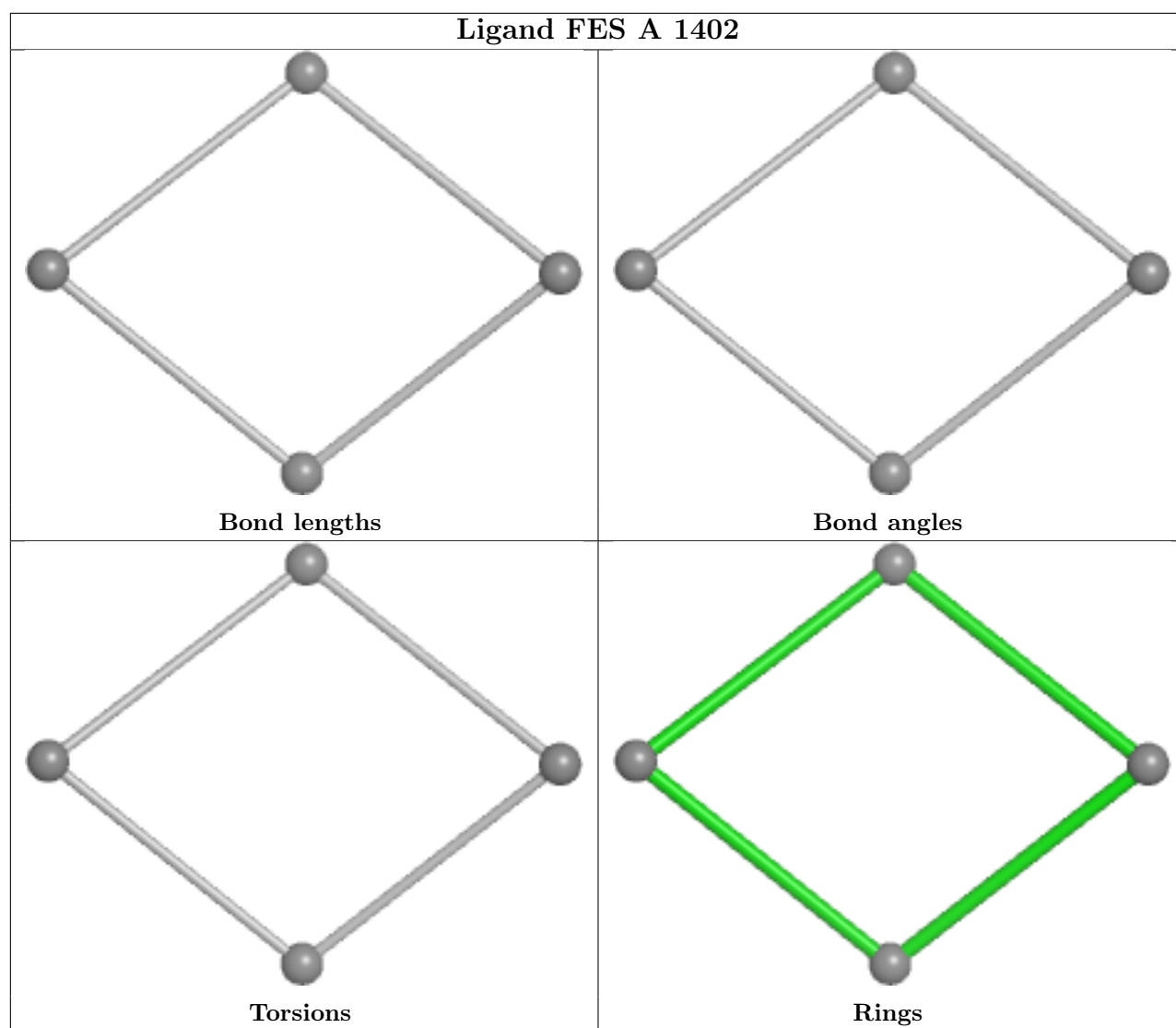


Ligand MTE B 1406



Ligand FAD A 1403





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	1290/1338 (96%)	0.25	68 (5%)	32	34	13, 29, 57, 95	0
1	B	1293/1338 (96%)	0.20	81 (6%)	26	28	14, 27, 59, 109	0
All	All	2583/2676 (96%)	0.23	149 (5%)	29	31	13, 28, 58, 109	0

All (149) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	4	ALA	9.8
1	A	4	ALA	8.1
1	A	199	PRO	7.5
1	A	719	PRO	7.4
1	B	199	PRO	7.2
1	A	557	HIS	6.9
1	A	1088	GLY	6.0
1	A	718	LYS	5.9
1	A	657	THR	5.9
1	A	655	PHE	5.9
1	B	540	VAL	5.8
1	B	1299	PRO	5.5
1	B	656	PHE	5.3
1	A	1337	PRO	5.3
1	B	559	LYS	5.3
1	A	1297	HIS	5.2
1	A	562	CYS	5.1
1	B	719	PRO	5.0
1	B	546	ALA	5.0
1	B	557	HIS	5.0
1	B	560	HIS	4.8
1	B	1297	HIS	4.7
1	A	714	ASN	4.7
1	B	569	ASN	4.5

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Mol	Chain	Res	Type	RSRZ
1	B	655	PHE	4.5
1	B	558	SER	4.5
1	A	715	SER	4.4
1	A	568	GLN	4.4
1	A	885	PHE	4.4
1	B	556	LEU	4.3
1	B	63	THR	4.3
1	A	569	ASN	4.2
1	A	556	LEU	4.1
1	B	659	ALA	4.1
1	A	452	GLY	4.1
1	B	575	HIS	4.0
1	A	62	ILE	4.0
1	B	562	CYS	4.0
1	A	884	LEU	4.0
1	A	1268	LEU	4.0
1	B	657	THR	4.0
1	B	200	LYS	3.9
1	A	880	LEU	3.8
1	A	1300	LEU	3.8
1	A	656	PHE	3.8
1	B	718	LYS	3.8
1	B	541	HIS	3.8
1	B	208	LEU	3.7
1	B	1300	LEU	3.7
1	A	660	GLU	3.7
1	A	166	LYS	3.6
1	B	451	GLU	3.6
1	B	574	GLN	3.6
1	A	1258	ASN	3.6
1	B	166	LYS	3.5
1	A	1301	THR	3.5
1	B	1337	PRO	3.5
1	B	561	HIS	3.5
1	A	658	GLU	3.5
1	A	1089	SER	3.5
1	A	451	GLU	3.5
1	B	1260	ASN	3.5
1	B	1301	THR	3.4
1	B	545	LEU	3.4
1	A	1260	ASN	3.3
1	A	208	LEU	3.2

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Mol	Chain	Res	Type	RSRZ
1	A	213	THR	3.2
1	A	654	CYS	3.1
1	B	301	TYR	3.1
1	B	385	GLU	3.1
1	A	575	HIS	3.1
1	A	549	TYR	3.0
1	A	713	HIS	3.0
1	A	882	GLU	3.0
1	A	1259	SER	3.0
1	B	555	ASP	3.0
1	B	547	ASP	2.9
1	B	1087	GLY	2.9
1	B	881	ASP	2.9
1	B	713	HIS	2.9
1	A	1087	GLY	2.8
1	B	568	GLN	2.8
1	B	62	ILE	2.8
1	B	142	ASP	2.8
1	B	450	GLY	2.8
1	B	1088	GLY	2.8
1	B	1268	LEU	2.8
1	B	279	GLY	2.8
1	B	565	LEU	2.7
1	A	659	ALA	2.7
1	A	712	GLN	2.7
1	B	453	ASP	2.7
1	A	142	ASP	2.7
1	B	566	LYS	2.7
1	A	300	ALA	2.6
1	A	214	GLN	2.6
1	B	1256	SER	2.6
1	A	574	GLN	2.6
1	A	567	TYR	2.6
1	A	98	ARG	2.6
1	A	881	ASP	2.6
1	B	213	THR	2.6
1	B	549	TYR	2.6
1	B	884	LEU	2.5
1	B	543	PRO	2.5
1	A	200	LYS	2.5
1	A	239	GLU	2.5
1	A	566	LYS	2.5

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Mol	Chain	Res	Type	RSRZ
1	B	885	PHE	2.5
1	B	542	TYR	2.5
1	B	567	TYR	2.5
1	B	538	ASP	2.5
1	A	280	VAL	2.5
1	B	1327	GLU	2.4
1	A	1090	VAL	2.4
1	B	548	LYS	2.4
1	A	212	PRO	2.4
1	A	922	GLY	2.4
1	A	1233	PRO	2.4
1	B	883	SER	2.4
1	B	880	LEU	2.4
1	A	290	ARG	2.4
1	B	212	PRO	2.3
1	A	721	ARG	2.3
1	B	576	PRO	2.3
1	B	922	GLY	2.3
1	B	5	SER	2.2
1	B	660	GLU	2.2
1	B	1292	GLN	2.2
1	B	65	ARG	2.2
1	A	385	GLU	2.2
1	B	550	GLU	2.2
1	A	920	PHE	2.2
1	B	434	GLN	2.2
1	A	67	ARG	2.1
1	B	1328	PRO	2.1
1	A	883	SER	2.1
1	A	1093	ASP	2.1
1	B	658	GLU	2.1
1	B	280	VAL	2.1
1	A	546	ALA	2.1
1	B	210	LEU	2.1
1	A	648	SER	2.1
1	B	495	ARG	2.1
1	B	882	GLU	2.0
1	B	214	GLN	2.0
1	A	5	SER	2.0
1	B	1258	ASN	2.0
1	B	98	ARG	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](#)

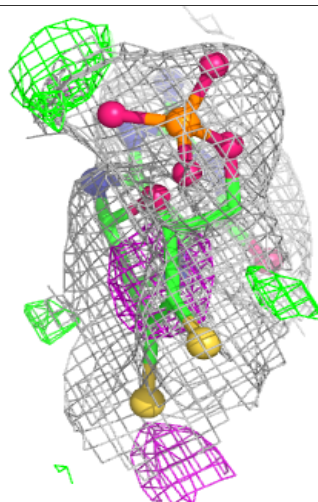
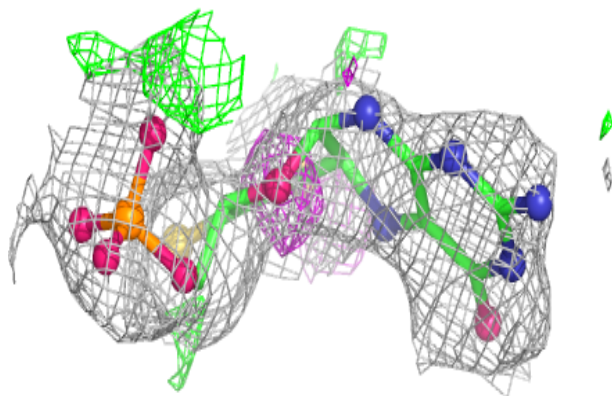
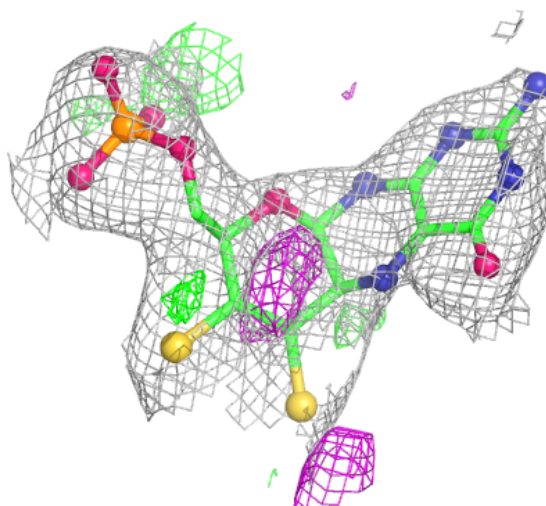
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
7	GOL	B	1404	6/6	0.81	0.19	38,41,43,43	0
5	MTE	A	1407	24/24	0.84	0.16	53,67,71,72	0
4	MLI	B	1405	7/7	0.86	0.14	35,37,40,41	0
5	MTE	B	1406	24/24	0.88	0.13	42,53,61,67	0
4	MLI	A	1406	7/7	0.90	0.15	45,49,52,54	0
4	MLI	A	1404	7/7	0.92	0.12	51,52,53,53	0
6	MOS	A	1408	4/4	0.93	0.14	123,124,124,124	0
4	MLI	A	1405	7/7	0.93	0.10	36,37,40,43	0
6	MOS	B	1407	4/4	0.95	0.12	103,104,104,105	0
3	FAD	B	1403	53/53	0.98	0.05	15,16,18,18	0
3	FAD	A	1403	53/53	0.98	0.05	16,17,22,23	0
2	FES	B	1402	4/4	0.99	0.02	16,17,18,18	0
2	FES	A	1401	4/4	0.99	0.05	38,38,39,39	0
2	FES	B	1401	4/4	0.99	0.04	38,39,39,40	0
2	FES	A	1402	4/4	1.00	0.01	16,16,16,17	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.

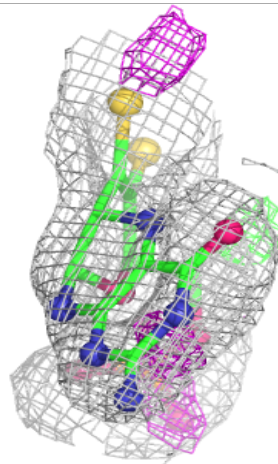
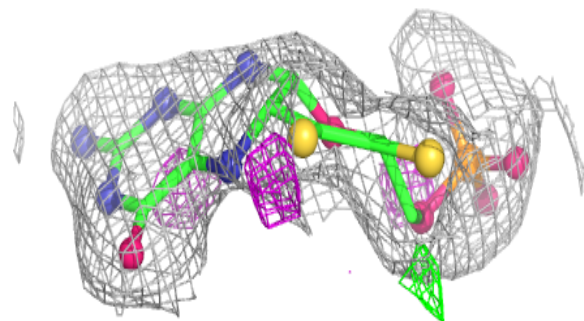
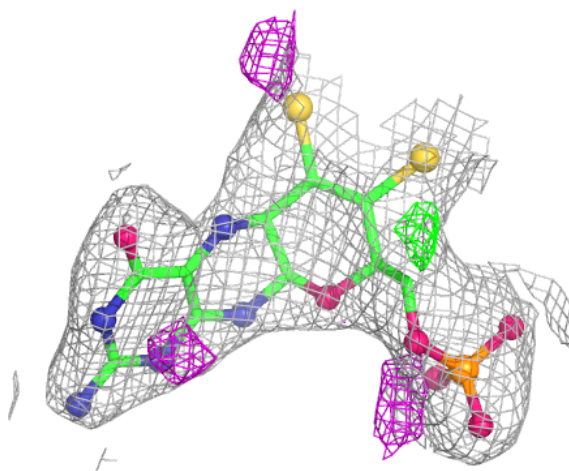
Electron density around MTE A 1407:

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



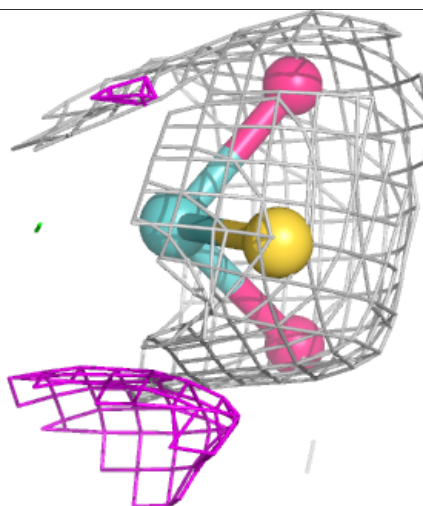
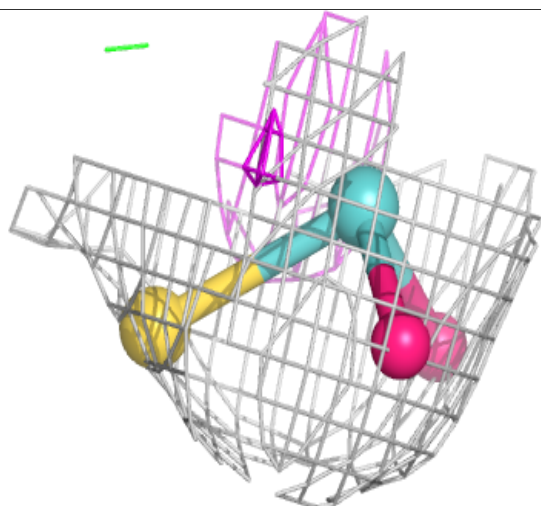
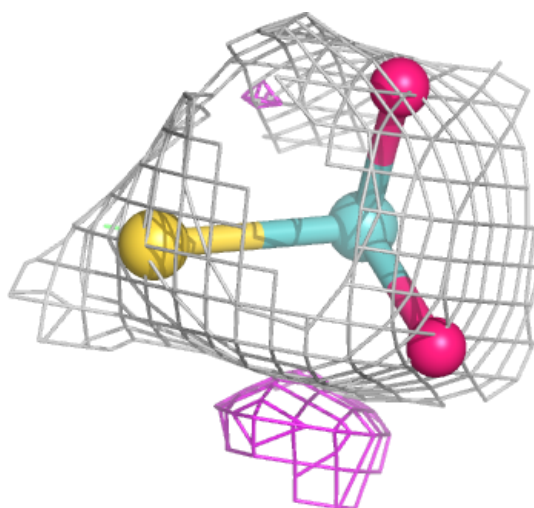
Electron density around MTE B 1406:

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



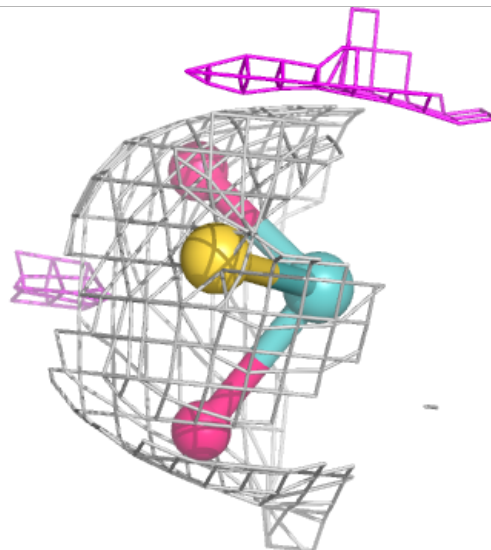
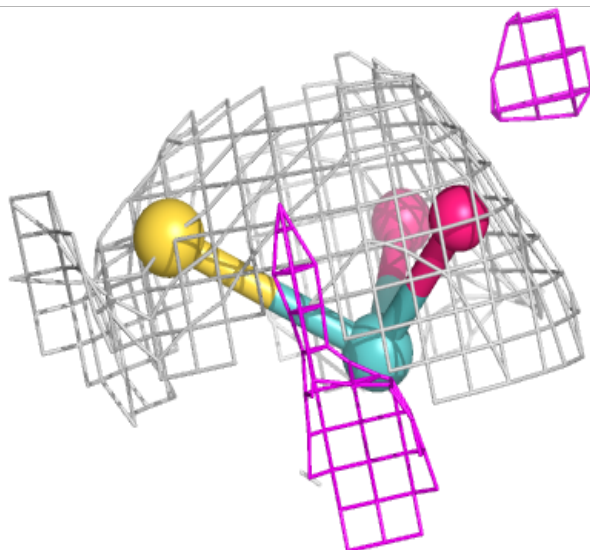
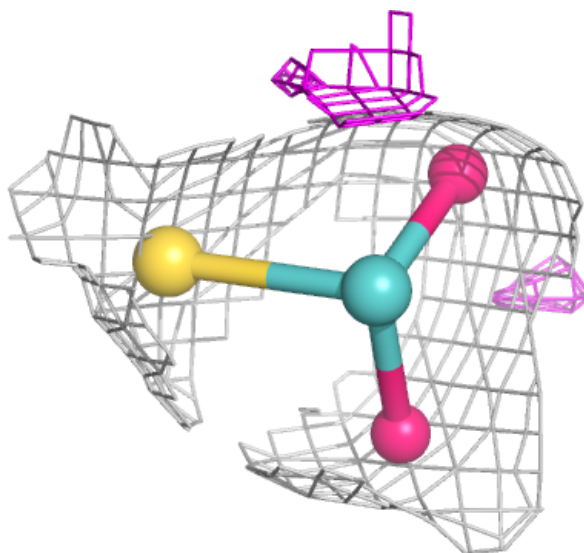
Electron density around MOS A 1408:

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



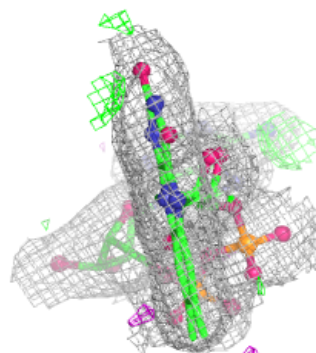
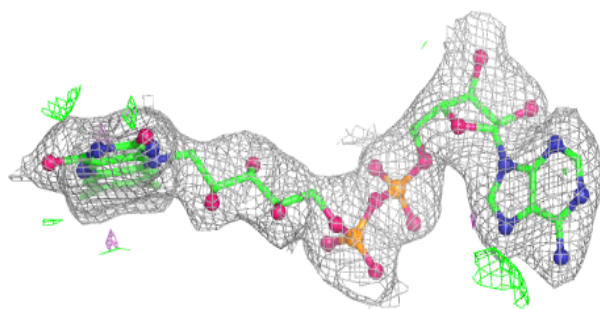
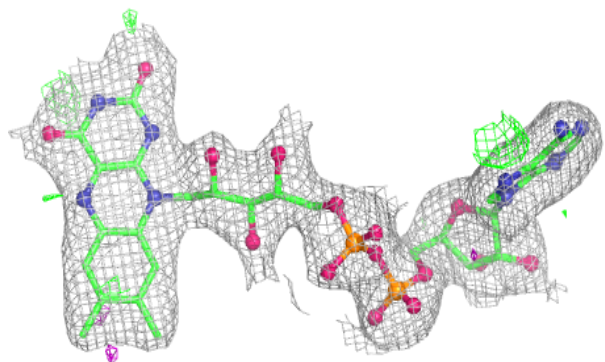
Electron density around MOS B 1407:

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

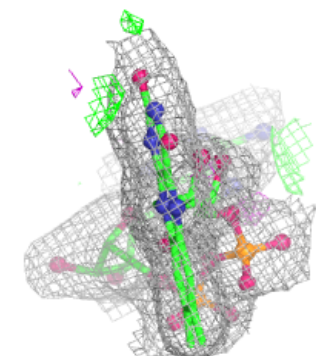
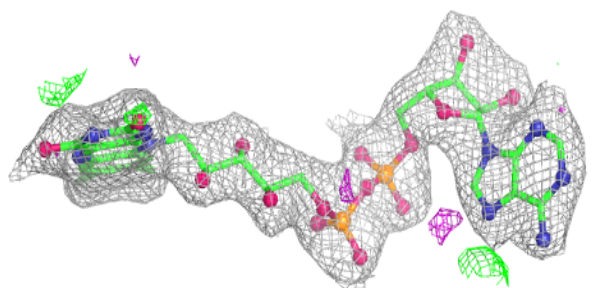
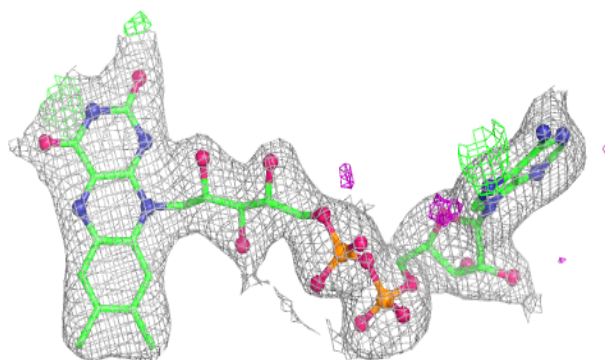


Electron density around FAD B 1403:

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

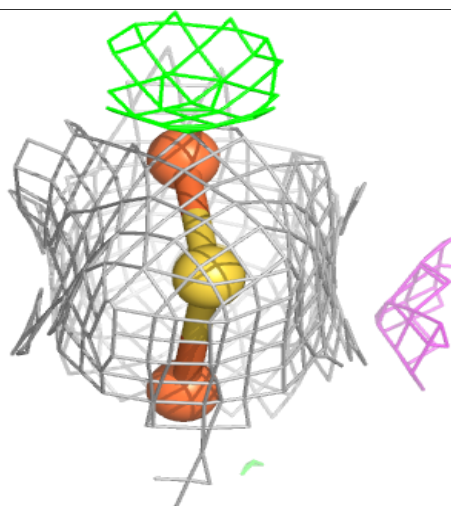
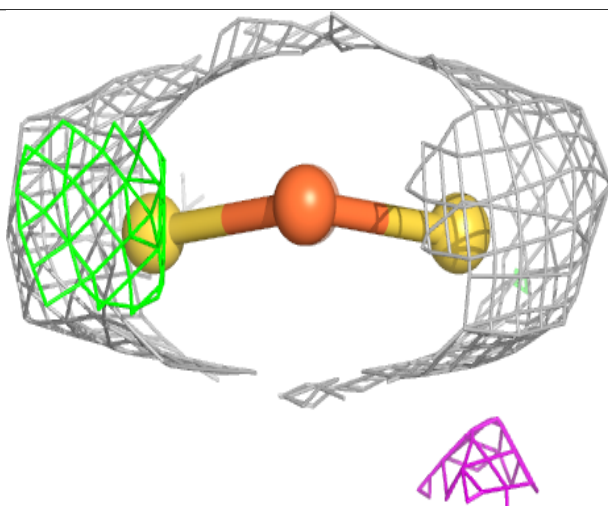
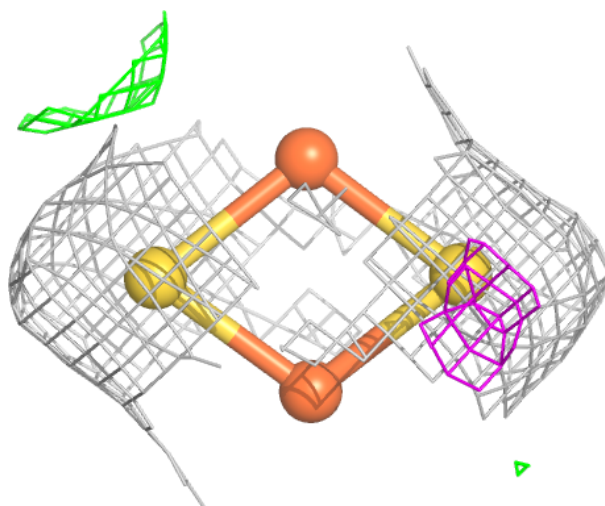
**Electron density around FAD A 1403:**

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



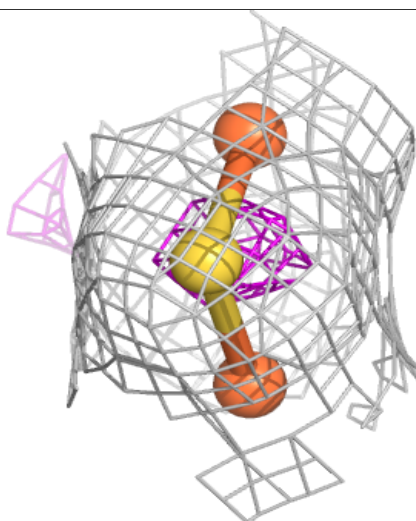
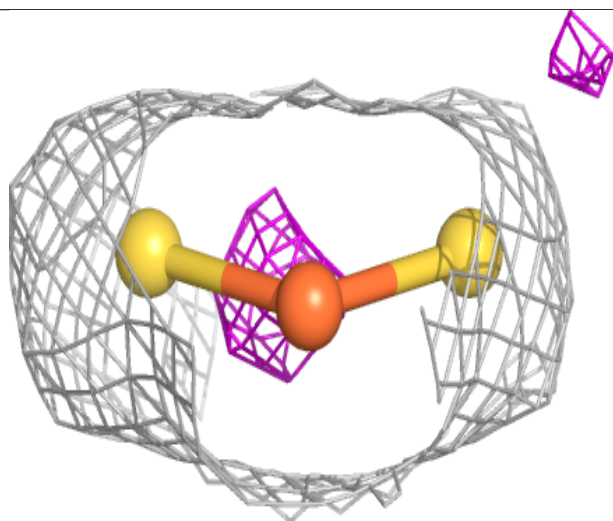
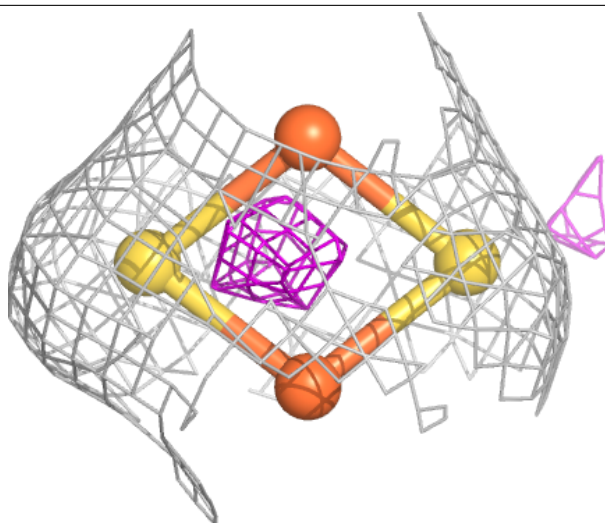
Electron density around FES B 1402:

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



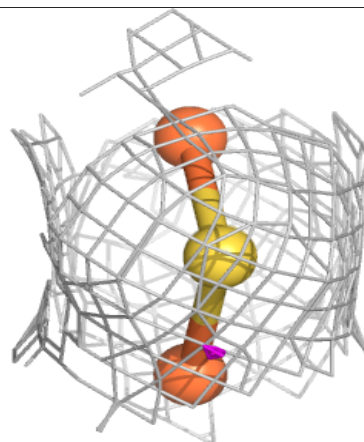
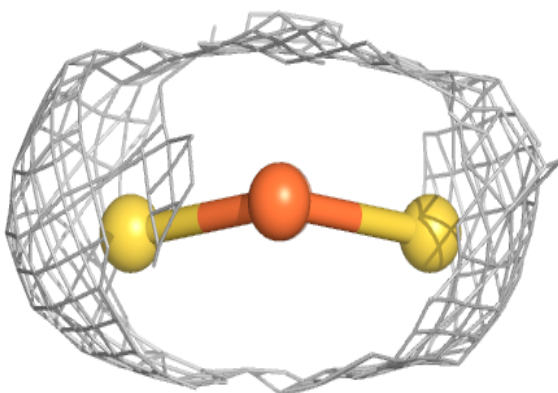
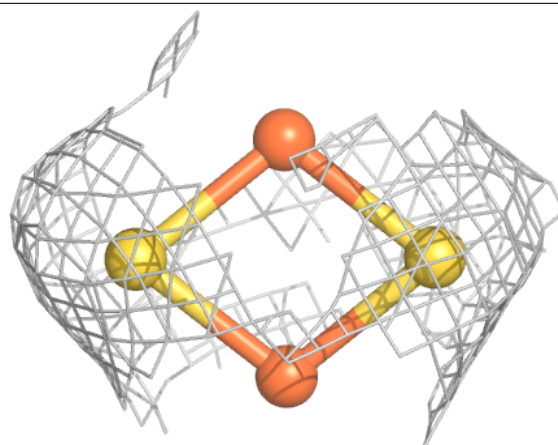
Electron density around FES A 1401:

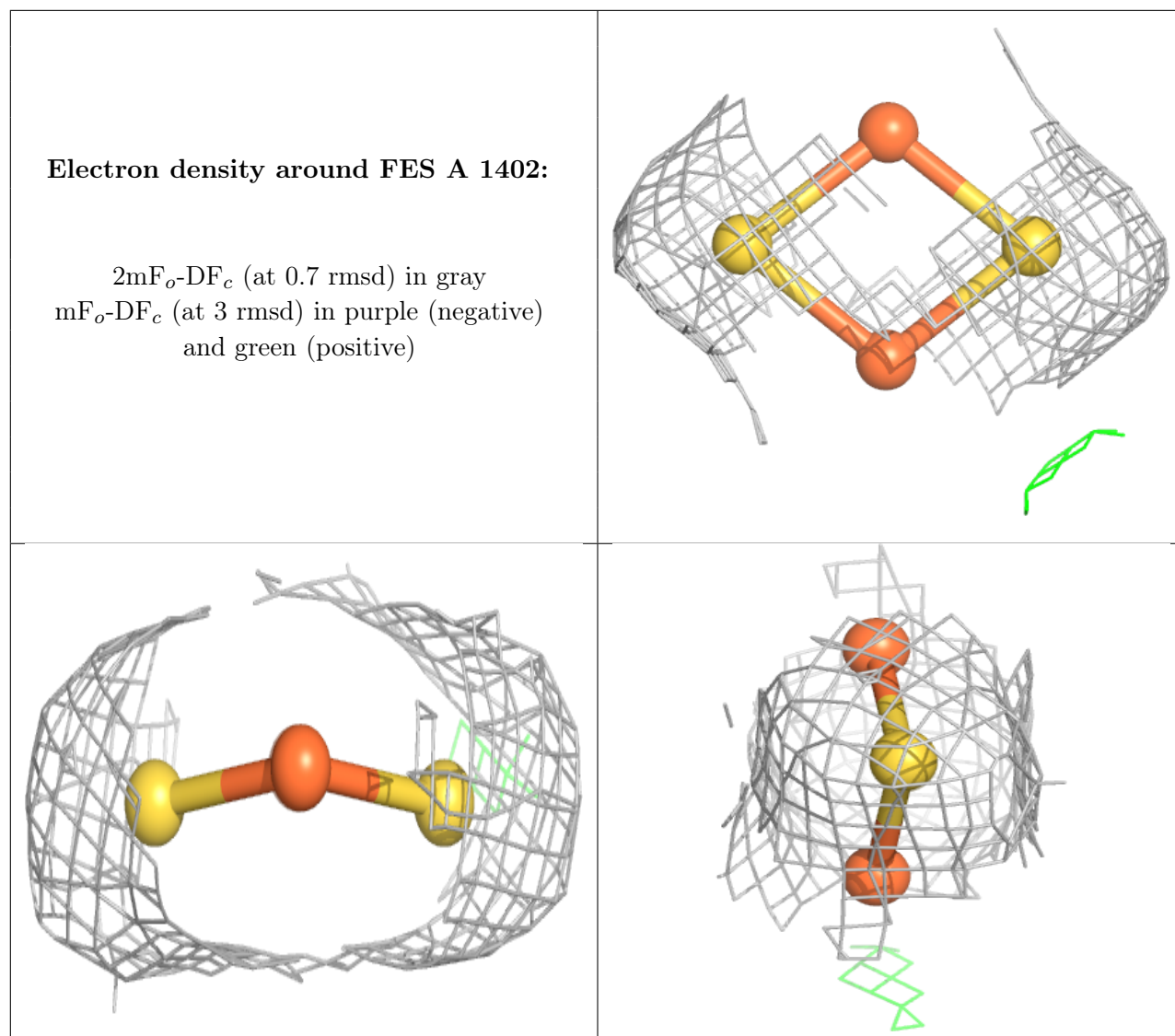
$2mF_o - DF_c$ (at 0.7 rmsd) in gray
 $mF_o - DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around FES B 1401:

$2mF_o - DF_c$ (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.