



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 20, 2026 – 07:50 AM UTC

PDB ID : 6FPO / pdb_00006fpo
Title : High resolution structure of native Hydrogenase (Hyd-1)
Authors : Carr, S.B.; Armstrong, F.A.; Evans, R.M.
Deposited on : 2018-02-11
Resolution : 1.05 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 : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

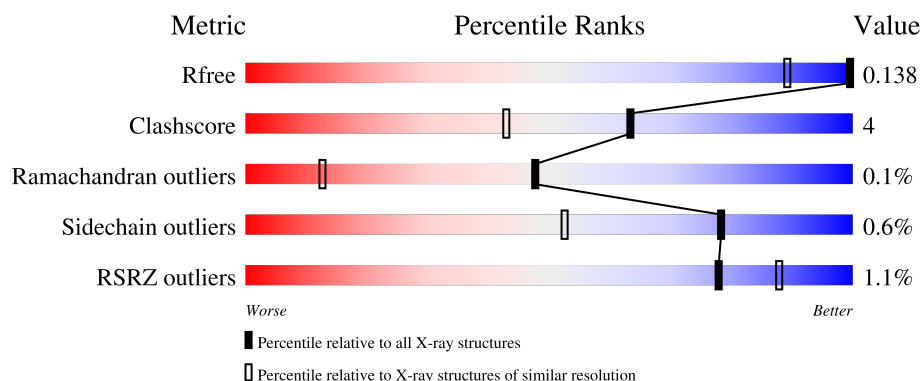
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.05 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	1182 (1.08-1.04)
Clashscore	190562	1204 (1.08-1.04)
Ramachandran outliers	187476	1175 (1.08-1.04)
Sidechain outliers	187428	1176 (1.08-1.04)
RSRZ outliers	180081	1181 (1.08-1.04)

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	S	335	% 72% 5% .. 21%
1	T	335	% 71% 7% . 21%
2	L	582	% 93% 6%
2	M	582	% 92% 7% .

2 Entry composition

There are 13 unique types of molecules in this entry. The entry contains 15620 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 Hydrogenase-1 small chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	S	264	Total	C	N	O	S	0	18	0
			2136	1358	365	393	20			
1	T	264	Total	C	N	O	S	0	20	0
			2162	1374	373	394	21			

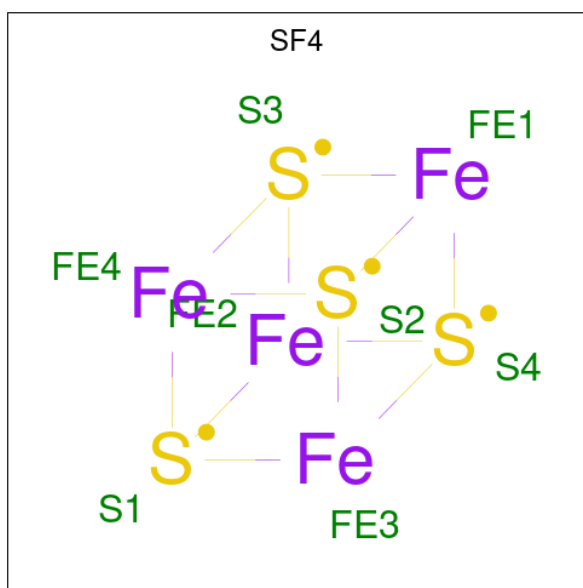
There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
S	328	ARG	-	expression tag	UNP P69740
S	329	SER	-	expression tag	UNP P69740
S	330	HIS	-	expression tag	UNP P69740
S	331	HIS	-	expression tag	UNP P69740
S	332	HIS	-	expression tag	UNP P69740
S	333	HIS	-	expression tag	UNP P69740
S	334	HIS	-	expression tag	UNP P69740
S	335	HIS	-	expression tag	UNP P69740
T	328	ARG	-	expression tag	UNP P69740
T	329	SER	-	expression tag	UNP P69740
T	330	HIS	-	expression tag	UNP P69740
T	331	HIS	-	expression tag	UNP P69740
T	332	HIS	-	expression tag	UNP P69740
T	333	HIS	-	expression tag	UNP P69740
T	334	HIS	-	expression tag	UNP P69740
T	335	HIS	-	expression tag	UNP P69740

- Molecule 2 is a protein called Hydrogenase-1 large chain.

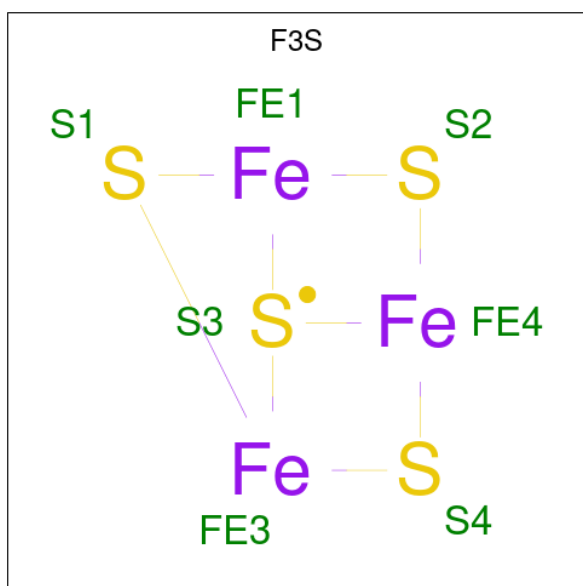
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	581	Total	C	N	O	S	0	30	0
			4722	3009	823	861	29			
2	M	581	Total	C	N	O	S	0	36	0
			4739	3032	810	864	33			

- Molecule 3 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	S	1	Total	Fe	S	0	0
			8	4	4		
3	T	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 4 is FE3-S4 CLUSTER (CCD ID: F3S) (formula: Fe_3S_4).



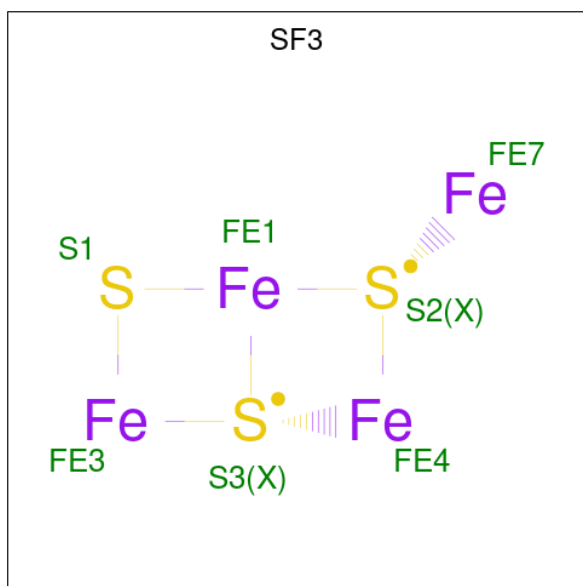
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	S	1	Total	Fe	S	0	0
			7	3	4		

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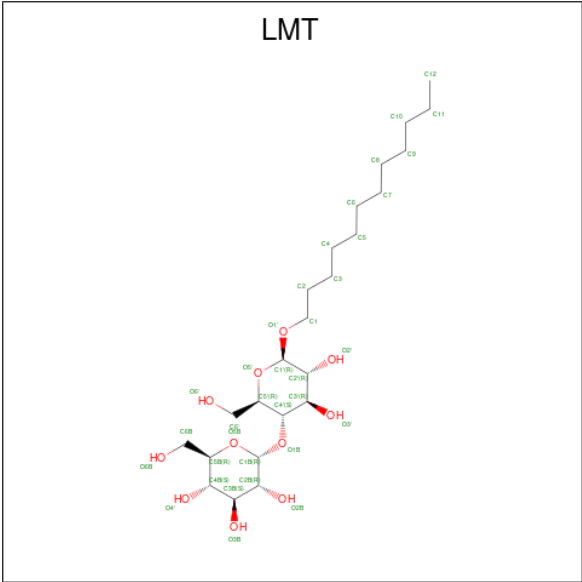
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	T	1	Total	Fe	S	0	0
			7	3	4		

- Molecule 5 is FE4-S3 CLUSTER (CCD ID: SF3) (formula: Fe_4S_3).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	S	1	Total	Fe	S	0	0
			7	4	3		
5	T	1	Total	Fe	S	0	0
			7	4	3		

- Molecule 6 is DODECYL-BETA-D-MALTOSIDE (CCD ID: LMT) (formula: $\text{C}_{24}\text{H}_{46}\text{O}_{11}$).

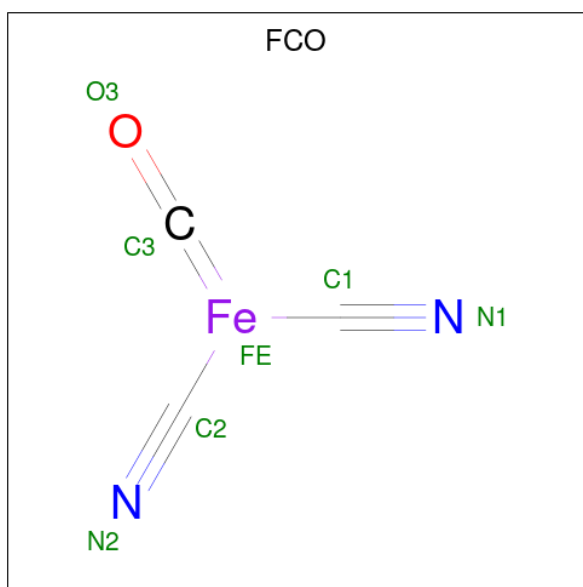


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	S	1	Total	C	O	0	0
			24	18	6		
6	T	1	Total	C	O	0	0
			14	13	1		

- Molecule 7 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	S	1	Total	Cl	0	0
			1	1		
7	T	1	Total	Cl	0	0
			1	1		

- Molecule 8 is CARBONMONOXIDE-(DICYANO) IRON (CCD ID: FCO) (formula: C₃FeN₂O).



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

- Molecule 9 is NICKEL (II) ION (CCD ID: NI) (formula: Ni).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	L	1	Total	Ni	0	0
			1	1		
9	M	1	Total	Ni	0	0
			1	1		

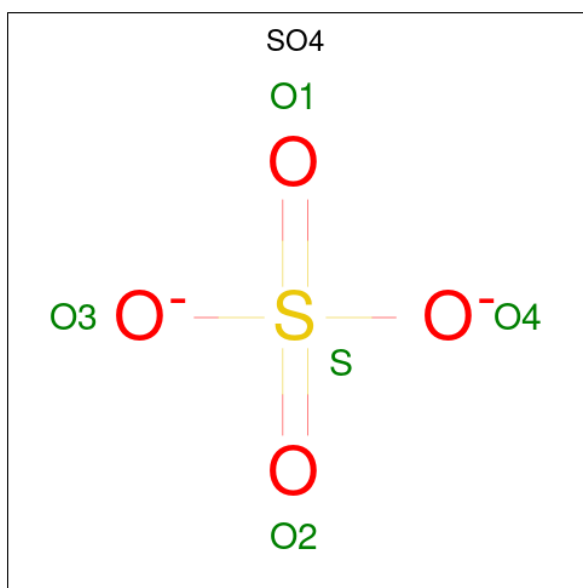
- Molecule 10 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	L	1	Total	Mg	0	0
			1	1		
10	M	1	Total	Mg	0	0
			1	1		

- Molecule 11 is LITHIUM ION (CCD ID: LI) (formula: Li).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	L	1	Total	Li	0	0
			1	1		

- Molecule 12 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
12	L	1	Total	O	S	0	0
			5	4	1		
12	M	1	Total	O	S	0	0
			5	4	1		

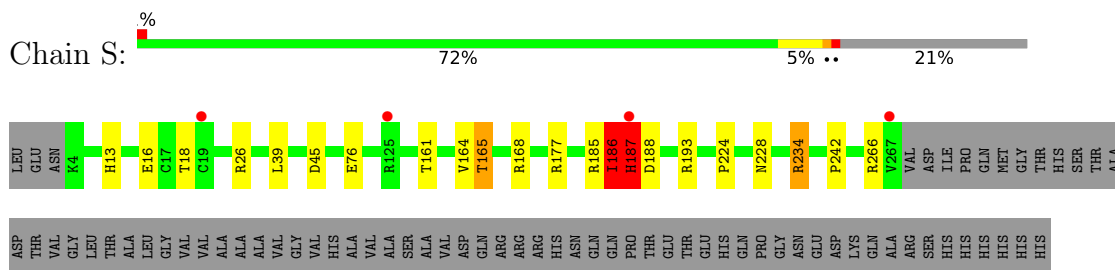
- Molecule 13 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
13	S	270	Total	O	0	0
			270	270		
13	L	594	Total	O	0	0
			594	594		
13	T	256	Total	O	0	0
			256	256		
13	M	628	Total	O	0	0
			628	628		

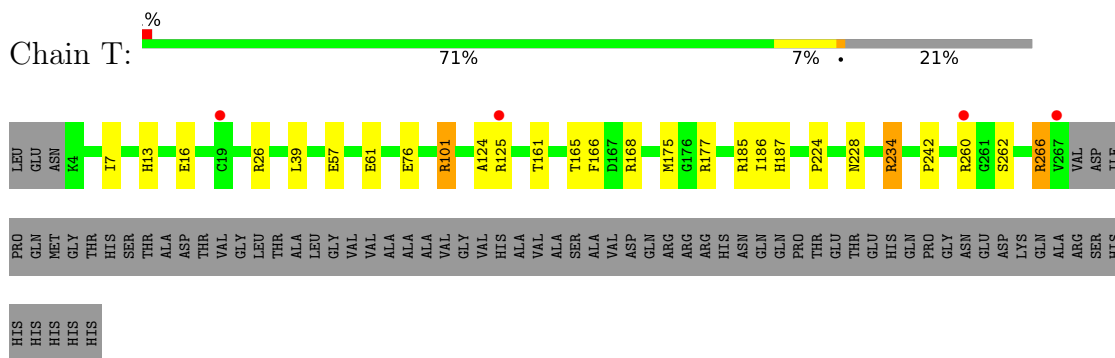
3 Residue-property plots [i](#)

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.

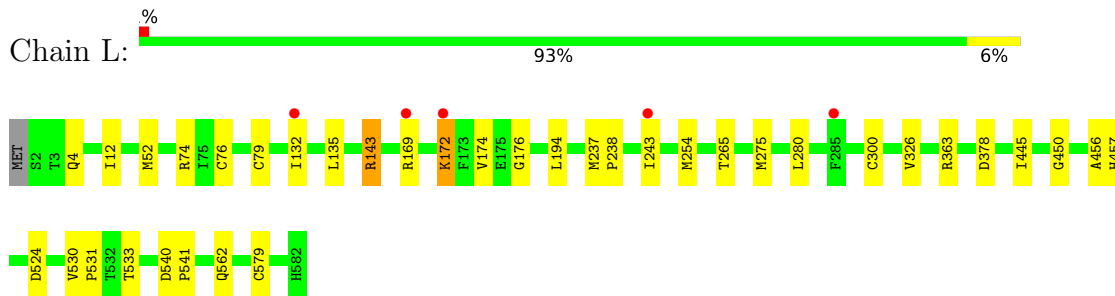
- Molecule 1: Hydrogenase-1 small chain



- Molecule 1: Hydrogenase-1 small chain

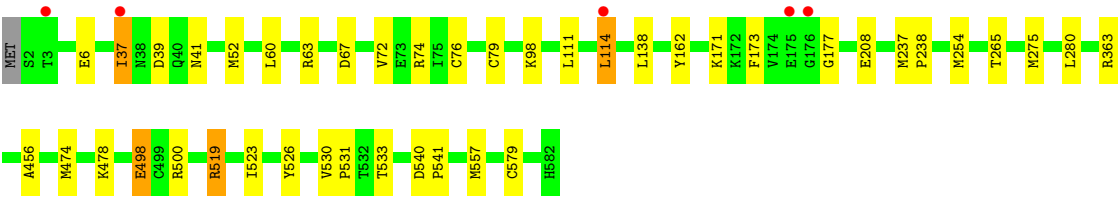


- Molecule 2: Hydrogenase-1 large chain



- Molecule 2: Hydrogenase-1 large chain





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	93.79Å 97.73Å 183.10Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	91.55 – 1.05 91.55 – 1.05	Depositor EDS
% Data completeness (in resolution range)	99.7 (91.55-1.05) 99.7 (91.55-1.05)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.52 (at 1.05Å)	Xtriage
Refinement program	REFMAC 5.8.0155	Depositor
R, R_{free}	0.115 , 0.134 0.119 , 0.138	Depositor DCC
R_{free} test set	38607 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å ²)	9.4	Xtriage
Anisotropy	0.170	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 44.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	0.000 for k,h,-l	Xtriage
F_o, F_c correlation	0.98	EDS
Total number of atoms	15620	wwPDB-VP
Average B, all atoms (Å ²)	12.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.96% 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: CL, LMT, NI, LI, SF4, MG, SF3, CSO, FCO, F3S, SO4

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	S	1.02	5/2239 (0.2%)	1.04	4/3039 (0.1%)
1	T	1.03	4/2266 (0.2%)	1.02	7/3075 (0.2%)
2	L	1.01	8/4921 (0.2%)	0.94	0/6688
2	M	1.05	13/4956 (0.3%)	0.98	12/6736 (0.2%)
All	All	1.03	30/14382 (0.2%)	0.98	23/19538 (0.1%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
1	S	0	2
1	T	0	2
2	L	0	1
2	M	0	1
All	All	0	6

All (30) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	S	187	HIS	C-N	11.66	1.50	1.33
1	S	266	ARG	C-N	10.07	1.47	1.33
2	M	39	ASP	CA-CB	7.26	1.66	1.53
2	M	37[A]	ILE	CA-C	6.80	1.61	1.52
2	M	37[B]	ILE	CA-C	6.80	1.61	1.52
2	M	173	PHE	C-O	6.75	1.32	1.24
2	M	39	ASP	CA-C	-6.20	1.44	1.52
2	L	562	GLN	CA-CB	-6.18	1.45	1.53
2	L	174	VAL	CA-CB	-5.83	1.47	1.54
2	M	500	ARG	CZ-NH1	5.68	1.40	1.32

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	M	177	GLY	C-O	-5.66	1.16	1.24
1	S	266	ARG	CA-C	-5.48	1.45	1.52
1	S	18	THR	C-N	5.45	1.41	1.34
1	S	165	THR	CA-CB	5.41	1.61	1.53
2	M	519	ARG	CZ-NH2	-5.29	1.26	1.33
2	M	114[A]	LEU	CA-C	5.23	1.59	1.52
2	M	114[B]	LEU	CA-C	5.23	1.59	1.52
2	M	519	ARG	CD-NE	-5.22	1.39	1.46
2	L	135[A]	LEU	CA-C	5.20	1.59	1.52
2	L	135[B]	LEU	CA-C	5.20	1.59	1.52
2	L	143[A]	ARG	CA-C	5.10	1.59	1.52
2	L	143[B]	ARG	CA-C	5.10	1.59	1.52
2	L	378	ASP	N-CA	5.10	1.52	1.46
1	T	165	THR	CB-OG1	-5.08	1.35	1.43
2	M	498[A]	GLU	CA-C	5.06	1.58	1.52
2	M	498[B]	GLU	CA-C	5.06	1.58	1.52
1	T	57	GLU	CD-OE1	-5.04	1.15	1.25
1	T	13[A]	HIS	CA-C	5.04	1.58	1.52
1	T	13[B]	HIS	CA-C	5.04	1.58	1.52
2	L	176	GLY	N-CA	5.02	1.52	1.45

All (23) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	S	186	ILE	CA-C-N	12.61	145.62	121.54
1	S	186	ILE	C-N-CA	12.61	145.62	121.54
1	S	186	ILE	O-C-N	-11.97	107.60	122.57
1	T	266	ARG	CA-C-N	11.64	142.65	121.70
1	T	266	ARG	C-N-CA	11.64	142.65	121.70
2	M	37[A]	ILE	CA-C-O	10.43	131.23	120.39
2	M	37[B]	ILE	CA-C-O	10.43	131.23	120.39
2	M	363	ARG	NE-CZ-NH2	9.46	127.72	119.20
2	M	500	ARG	NE-CZ-NH2	-6.97	112.92	119.20
2	M	37[A]	ILE	N-CA-C	6.66	117.71	108.12
2	M	37[B]	ILE	N-CA-C	6.66	117.71	108.12
1	S	234	ARG	NE-CZ-NH1	-6.10	115.40	121.50
1	T	187	HIS	CA-CB-CG	6.08	119.88	113.80
2	M	500	ARG	NH1-CZ-NH2	5.64	126.64	119.30
1	T	260	ARG	NE-CZ-NH1	-5.40	116.10	121.50
2	M	37[A]	ILE	CA-C-N	-5.30	112.06	121.29
2	M	37[A]	ILE	C-N-CA	-5.30	112.06	121.29
2	M	37[B]	ILE	CA-C-N	-5.30	112.06	121.29

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	M	37[B]	ILE	C-N-CA	-5.30	112.06	121.29
2	M	519	ARG	CG-CD-NE	5.30	123.66	112.00
1	T	234	ARG	NE-CZ-NH1	-5.19	116.31	121.50
1	T	101[A]	ARG	CA-C-O	5.06	125.92	120.55
1	T	101[B]	ARG	CA-C-O	5.06	125.92	120.55

There are no chirality outliers.

All (6) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	L	74	ARG	Sidechain
2	M	74	ARG	Sidechain
1	S	186	ILE	Mainchain
1	S	26	ARG	Sidechain
1	T	26	ARG	Sidechain
1	T	266	ARG	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	S	2136	0	2102	22	0
1	T	2162	0	2130	22	0
2	L	4722	0	4689	41	1
2	M	4739	0	4731	35	0
3	S	8	0	0	0	0
3	T	8	0	0	0	0
4	S	7	0	0	0	0
4	T	7	0	0	0	0
5	S	7	0	0	0	0
5	T	7	0	0	0	0
6	S	24	0	35	0	0
6	T	14	0	25	0	0
7	S	1	0	0	0	0
7	T	1	0	0	0	0
8	L	7	0	0	0	0
8	M	7	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
9	L	1	0	0	0	0
9	M	1	0	0	0	0
10	L	1	0	0	0	0
10	M	1	0	0	0	0
11	L	1	0	0	0	0
12	L	5	0	0	0	0
12	M	5	0	0	0	0
13	L	594	0	0	19	2
13	M	628	0	0	8	2
13	S	270	0	0	8	0
13	T	256	0	0	6	1
All	All	15620	0	13712	111	3

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 4.

All (111) 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)
2:L:143[B]:ARG:HG3	13:L:713:HOH:O	1.53	1.08
2:M:37[B]:ILE:CD1	2:M:557[B]:MET:HE2	1.84	1.07
2:L:280:LEU:HG	13:L:1147:HOH:O	1.61	1.01
2:M:37[B]:ILE:HD12	2:M:557[B]:MET:HE2	1.40	0.99
2:L:132[B]:ILE:HD13	2:L:194:LEU:HD12	1.45	0.97
2:M:98:LYS:HE2	13:M:996:HOH:O	1.64	0.95
2:M:265[B]:THR:HG22	13:M:889:HOH:O	1.66	0.94
1:S:161[A]:THR:HG22	2:M:254[A]:MET:HE2	1.50	0.91
2:L:275[A]:MET:HE2	2:L:456:ALA:HA	1.54	0.90
2:M:265[B]:THR:CG2	13:M:889:HOH:O	2.19	0.86
1:T:101[B]:ARG:HH21	1:T:101[B]:ARG:HG3	1.37	0.85
2:L:238:PRO:HD2	13:L:741:HOH:O	1.77	0.82
2:M:111:LEU:HD12	2:M:114[B]:LEU:HD11	1.65	0.78
2:L:254[A]:MET:CE	13:L:1043:HOH:O	2.32	0.77
1:S:161[A]:THR:HG22	2:M:254[A]:MET:CE	2.15	0.76
2:M:37[B]:ILE:HD12	2:M:557[B]:MET:CE	2.14	0.76
2:M:238:PRO:HD2	13:M:716:HOH:O	1.86	0.75
2:L:169:ARG:CD	13:L:707:HOH:O	2.34	0.75
2:M:530[B]:VAL:HG21	2:M:579:CYS:O	1.86	0.75
2:M:138:LEU:HD22	2:M:171[A]:LYS:HG2	1.67	0.74
1:S:13:HIS:HD2	1:S:16[B]:GLU:OE1	1.71	0.74
2:L:169:ARG:HD2	13:L:707:HOH:O	1.90	0.70

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:M:280[B]:LEU:HG	13:M:1155:HOH:O	1.92	0.70
2:L:280:LEU:CG	13:L:1147:HOH:O	2.29	0.69
2:L:169:ARG:NE	13:L:707:HOH:O	2.26	0.68
2:M:37[B]:ILE:CD1	2:M:557[B]:MET:CE	2.67	0.67
2:L:132[B]:ILE:HD13	2:L:194:LEU:CD1	2.21	0.66
2:L:254[C]:MET:HA	2:L:254[C]:MET:HE2	1.76	0.66
2:M:275[B]:MET:HE2	2:M:456:ALA:HA	1.77	0.66
2:L:172[A]:LYS:HD2	13:L:733:HOH:O	1.95	0.65
2:L:265[B]:THR:HG21	13:L:995:HOH:O	1.98	0.64
2:M:530[B]:VAL:HG21	2:M:579:CYS:C	2.22	0.64
2:M:76:CYS:HB3	2:M:79:CSO:OD	1.98	0.64
2:L:132[B]:ILE:CD1	2:L:194:LEU:HD12	2.23	0.64
2:L:76:CYS:HB3	2:L:79:CSO:OD	1.96	0.63
1:S:165:THR:HG21	13:S:512:HOH:O	1.97	0.63
2:M:237:MET:HE3	13:M:716:HOH:O	1.98	0.63
2:M:37[B]:ILE:HG12	2:M:41:ASN:HA	1.81	0.63
2:M:498[B]:GLU:HG2	2:M:519:ARG:HG3	1.81	0.62
2:L:169:ARG:O	2:L:172[A]:LYS:HE3	2.00	0.62
1:T:61:GLU:OE1	1:T:101[A]:ARG:NH2	2.27	0.62
2:M:79:CSO:OD	2:M:79:CSO:N	2.34	0.61
1:T:101[B]:ARG:HG3	1:T:101[B]:ARG:NH2	2.11	0.61
2:L:143[B]:ARG:NH1	13:L:713:HOH:O	2.35	0.59
1:S:13:HIS:CD2	1:S:16[B]:GLU:OE1	2.55	0.59
1:S:76[B]:GLU:HG3	13:S:516:HOH:O	2.03	0.59
2:M:52:MET:HG2	13:M:915:HOH:O	2.04	0.57
1:T:76:GLU:HG3	13:T:572:HOH:O	2.04	0.57
2:L:280:LEU:CD2	13:L:1147:HOH:O	2.49	0.56
2:L:457[B]:HIS:HE1	13:L:1147:HOH:O	1.89	0.56
2:L:52:MET:HG2	13:L:977:HOH:O	2.07	0.55
1:S:234:ARG:NH1	1:T:234:ARG:NH1	2.54	0.55
2:L:457[B]:HIS:CE1	13:L:1147:HOH:O	2.61	0.54
1:T:101[B]:ARG:HH21	1:T:101[B]:ARG:CG	2.09	0.54
2:M:60[B]:LEU:HD11	2:M:72:VAL:CG1	2.37	0.54
2:L:237:MET:HE3	13:L:741:HOH:O	2.08	0.53
2:L:530[B]:VAL:HG21	2:L:579:CYS:C	2.33	0.53
2:L:76:CYS:CB	2:L:79:CSO:OD	2.44	0.53
1:S:16[B]:GLU:HG2	13:S:616:HOH:O	2.08	0.52
1:T:168:ARG:CZ	13:T:526:HOH:O	2.59	0.51
1:T:39[B]:LEU:HD11	13:T:564:HOH:O	2.11	0.51
2:L:132[B]:ILE:CD1	2:L:194:LEU:CD1	2.86	0.51
2:L:169:ARG:NH1	13:L:714:HOH:O	2.39	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:L:530[B]:VAL:HG22	2:L:533:THR:OG1	2.12	0.50
1:S:193[A]:ARG:NH2	13:S:508:HOH:O	2.40	0.50
1:S:165:THR:CG2	13:S:512:HOH:O	2.55	0.50
1:T:101[B]:ARG:NH2	1:T:101[B]:ARG:CG	2.71	0.49
2:M:76:CYS:CB	2:M:79:CSO:OD	2.55	0.49
2:M:37[B]:ILE:HD11	2:M:41:ASN:C	2.37	0.49
2:M:265[B]:THR:HG21	13:M:889:HOH:O	2.00	0.49
2:M:162:TYR:OH	2:M:208[B]:GLU:OE2	2.31	0.48
2:L:530[B]:VAL:HG21	2:L:579:CYS:O	2.14	0.48
13:S:512:HOH:O	2:M:474[B]:MET:HE3	2.14	0.48
2:L:243[B]:ILE:HD12	1:T:166:PHE:CZ	2.49	0.47
2:L:275[A]:MET:HE2	2:L:456:ALA:CA	2.36	0.46
2:L:243[B]:ILE:HG21	2:L:243[B]:ILE:HD13	1.62	0.46
2:M:530[B]:VAL:HG22	2:M:533:THR:OG1	2.15	0.46
1:S:187:HIS:CE1	1:S:193[B]:ARG:HD3	2.52	0.45
1:S:13:HIS:HD2	1:S:16[B]:GLU:CD	2.25	0.45
2:M:37[B]:ILE:CG1	2:M:41:ASN:HA	2.47	0.44
1:S:39[B]:LEU:HG	1:S:164:VAL:HG21	1.99	0.44
1:S:177:ARG:NH1	13:S:515:HOH:O	2.51	0.44
1:S:234:ARG:CZ	1:T:234:ARG:CZ	2.95	0.44
1:T:16[B]:GLU:HG2	13:T:648:HOH:O	2.16	0.44
1:S:234:ARG:NH1	1:T:234:ARG:HH11	2.15	0.44
1:S:185[B]:ARG:HD2	1:S:224:PRO:O	2.18	0.44
2:L:530[A]:VAL:CG1	2:L:531:PRO:HD2	2.48	0.44
2:M:63:ARG:HB2	2:M:523[B]:ILE:HD12	2.00	0.43
1:S:76[B]:GLU:CG	13:S:516:HOH:O	2.64	0.43
1:T:186:ILE:HD11	1:T:228:ASN:HB3	2.01	0.43
2:L:169:ARG:NH2	13:L:719:HOH:O	2.52	0.43
2:L:4:GLN:HA	2:L:12:ILE:O	2.18	0.43
1:T:161[A]:THR:HG22	13:T:564:HOH:O	2.19	0.43
2:L:172[A]:LYS:CD	13:L:733:HOH:O	2.62	0.43
2:M:60[B]:LEU:HD13	2:M:526:TYR:CG	2.54	0.42
2:M:530[A]:VAL:CG1	2:M:531:PRO:HD2	2.49	0.42
1:S:186:ILE:HD11	1:S:228:ASN:HB3	2.01	0.42
2:L:445:ILE:O	2:L:450:GLY:HA3	2.19	0.42
1:T:262:SER:HA	2:M:67[B]:ASP:OD2	2.19	0.42
1:T:124:ALA:O	1:T:125[B]:ARG:C	2.63	0.42
1:S:185[B]:ARG:HB2	1:S:188[B]:ASP:CG	2.45	0.41
2:L:243[B]:ILE:HD12	1:T:166:PHE:CE2	2.55	0.41
1:S:234:ARG:HH11	1:T:234:ARG:HH11	1.66	0.41
1:T:175[A]:MET:HE1	1:T:177:ARG:NH2	2.35	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:M:540:ASP:HB2	2:M:541:PRO:CD	2.49	0.41
1:T:185[B]:ARG:HD2	1:T:224:PRO:O	2.21	0.41
1:S:13:HIS:HE1	1:S:45[A]:ASP:OD1	2.04	0.41
2:L:530[B]:VAL:HG21	2:L:579:CYS:HB3	2.02	0.40
1:T:125[B]:ARG:NH2	13:T:516:HOH:O	2.55	0.40
2:L:300:CYS:HA	2:L:326:VAL:O	2.21	0.40
2:L:540:ASP:HB2	2:L:541:PRO:CD	2.51	0.40

All (3) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:L:363[B]:ARG:NH1	13:M:714:HOH:O[2_575]	1.89	0.31
13:L:998:HOH:O	13:M:1265:HOH:O[2_675]	2.07	0.13
13:L:1231:HOH:O	13:T:734:HOH:O[2_575]	2.13	0.07

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	S	280/335 (84%)	263 (94%)	16 (6%)	1 (0%)	30	8
1	T	282/335 (84%)	267 (95%)	15 (5%)	0	100	100
2	L	609/582 (105%)	590 (97%)	19 (3%)	0	100	100
2	M	615/582 (106%)	598 (97%)	17 (3%)	0	100	100
All	All	1786/1834 (97%)	1718 (96%)	67 (4%)	1 (0%)	48	13

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	S	187	HIS

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	S	234/274 (85%)	231 (99%)	3 (1%)	61	24
1	T	236/274 (86%)	234 (99%)	2 (1%)	73	42
2	L	510/480 (106%)	507 (99%)	3 (1%)	78	52
2	M	516/480 (108%)	514 (100%)	2 (0%)	84	64
All	All	1496/1508 (99%)	1486 (99%)	10 (1%)	78	49

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	S	168[A]	ARG
1	S	168[C]	ARG
1	S	242	PRO
2	L	172[A]	LYS
2	L	172[B]	LYS
2	L	524	ASP
1	T	7	ILE
1	T	242	PRO
2	M	6	GLU
2	M	478	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	S	13	HIS
1	S	55	GLN
2	L	328	ASN
2	L	332	ASN
2	L	421	HIS
2	L	460	GLN
1	T	55	GLN
1	T	68	ASN
1	T	244	GLN

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Mol	Chain	Res	Type
2	M	261	GLN
2	M	460	GLN
2	M	467	GLN
2	M	544	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

2 non-standard protein/DNA/RNA residues 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	CSO	L	79	9,8,2	3,6,7	0.72	0	1,6,8	0.90	0
2	CSO	M	79	9,2	3,6,7	1.03	0	1,6,8	0.08	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	CSO	L	79	9,8,2	-	0/1/5/7	-
2	CSO	M	79	9,2	-	0/1/5/7	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	L	79	CSO	2	0
2	M	79	CSO	3	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 19 ligands modelled in this entry, 7 are monoatomic - leaving 12 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
5	SF3	S	403	1,13	0,8,8	-	-	-		
3	SF4	S	401	1	0,12,12	-	-	-		
8	FCO	M	601	13,2	0,6,6	-	-	-		
4	F3S	S	402	1	0,9,9	-	-	-		
4	F3S	T	402	1	0,9,9	-	-	-		
8	FCO	L	601	13,2	0,6,6	-	-	-		
12	SO4	M	604	-	4,4,4	0.42	0	6,6,6	0.60	0
12	SO4	L	605	-	4,4,4	0.36	0	6,6,6	0.47	0
3	SF4	T	401	1	0,12,12	-	-	-		
6	LMT	S	404	-	24,24,36	0.90	1 (4%)	29,29,47	2.36	7 (24%)
5	SF3	T	403	1,13	0,8,8	-	-	-		
6	LMT	T	404	-	13,13,36	0.80	0	12,12,47	1.64	3 (25%)

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
5	SF3	S	403	1,13	-	-	0/2/2/2

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	SF4	S	401	1	-	-	0/6/5/5
4	F3S	S	402	1	-	-	0/3/3/3
4	F3S	T	402	1	-	-	0/3/3/3
3	SF4	T	401	1	-	-	0/6/5/5
6	LMT	S	404	-	-	4/15/35/61	0/1/1/2
5	SF3	T	403	1,13	-	-	0/2/2/2
6	LMT	T	404	-	-	5/11/11/61	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	S	404	LMT	O1'-C1'	2.90	1.45	1.40

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	S	404	LMT	C1-O1'-C1'	9.21	129.41	113.68
6	S	404	LMT	C3-C2-C1	4.22	131.81	113.47
6	T	404	LMT	C4-C3-C2	-3.68	95.76	114.37
6	S	404	LMT	C3'-C4'-C5'	-3.12	104.58	110.23
6	T	404	LMT	C5-C4-C3	-2.86	99.92	114.37
6	S	404	LMT	O5'-C1'-C2'	-2.79	104.64	110.37
6	S	404	LMT	O5'-C5'-C6'	2.78	113.33	106.44
6	S	404	LMT	O5'-C5'-C4'	2.69	114.55	109.70
6	T	404	LMT	C3-C2-C1	-2.09	104.38	113.47
6	S	404	LMT	O3'-C3'-C2'	2.06	115.23	110.38

There are no chirality outliers.

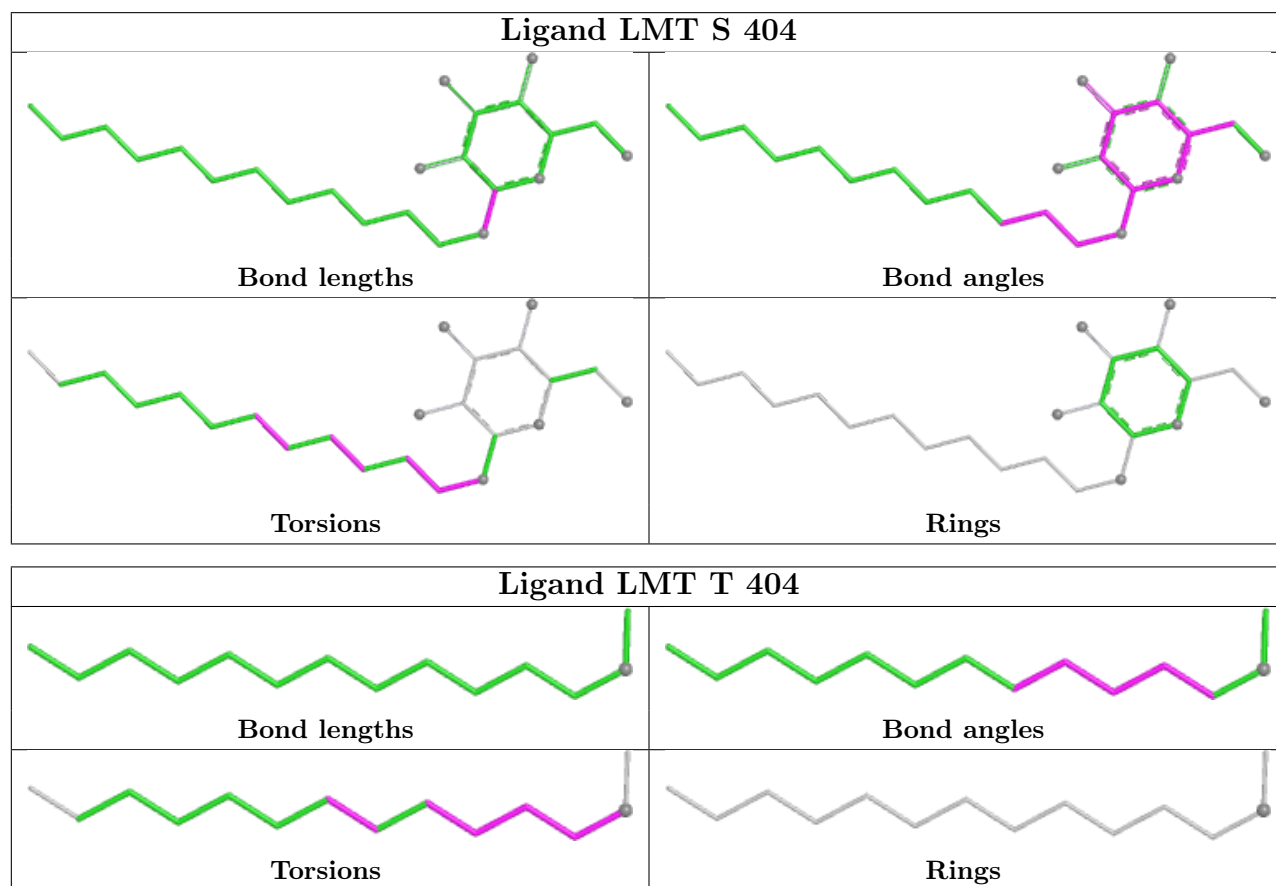
All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	S	404	LMT	O1'-C1-C2-C3
6	T	404	LMT	O1'-C1-C2-C3
6	S	404	LMT	C2-C1-O1'-C1'
6	T	404	LMT	C2-C1-O1'-C1'
6	T	404	LMT	C2-C3-C4-C5
6	S	404	LMT	C2-C3-C4-C5
6	T	404	LMT	C1-C2-C3-C4
6	T	404	LMT	C4-C5-C6-C7
6	S	404	LMT	C4-C5-C6-C7

There are no ring outliers.

No monomer is involved in short contacts.

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 ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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	S	264/335 (78%)	-0.24	4 (1%) 72 81	5, 9, 17, 44	18 (6%)
1	T	264/335 (78%)	-0.14	4 (1%) 72 81	5, 10, 17, 37	21 (7%)
2	L	580/582 (99%)	-0.22	5 (0%) 81 90	4, 10, 22, 38	32 (5%)
2	M	580/582 (99%)	-0.26	5 (0%) 81 90	4, 10, 19, 43	37 (6%)
All	All	1688/1834 (92%)	-0.23	18 (1%) 78 88	4, 10, 20, 44	108 (6%)

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	T	267	VAL	10.7
1	S	267	VAL	8.2
1	S	19	CYS	6.9
1	T	19	CYS	5.9
2	M	37[A]	ILE	5.8
2	M	114[A]	LEU	4.4
2	L	132[A]	ILE	3.8
1	T	125[A]	ARG	3.4
2	L	172[A]	LYS	3.3
2	L	285	PHE	3.3
2	L	243[A]	ILE	2.8
2	M	175	GLU	2.8
1	T	260	ARG	2.5
1	S	187	HIS	2.2
2	M	176	GLY	2.2
1	S	125[A]	ARG	2.1
2	L	169	ARG	2.1
2	M	3	THR	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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
2	CSO	M	79	7/8	0.71	0.19	8,9,12,13	1
2	CSO	L	79	7/8	0.99	0.06	8,9,12,14	1

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

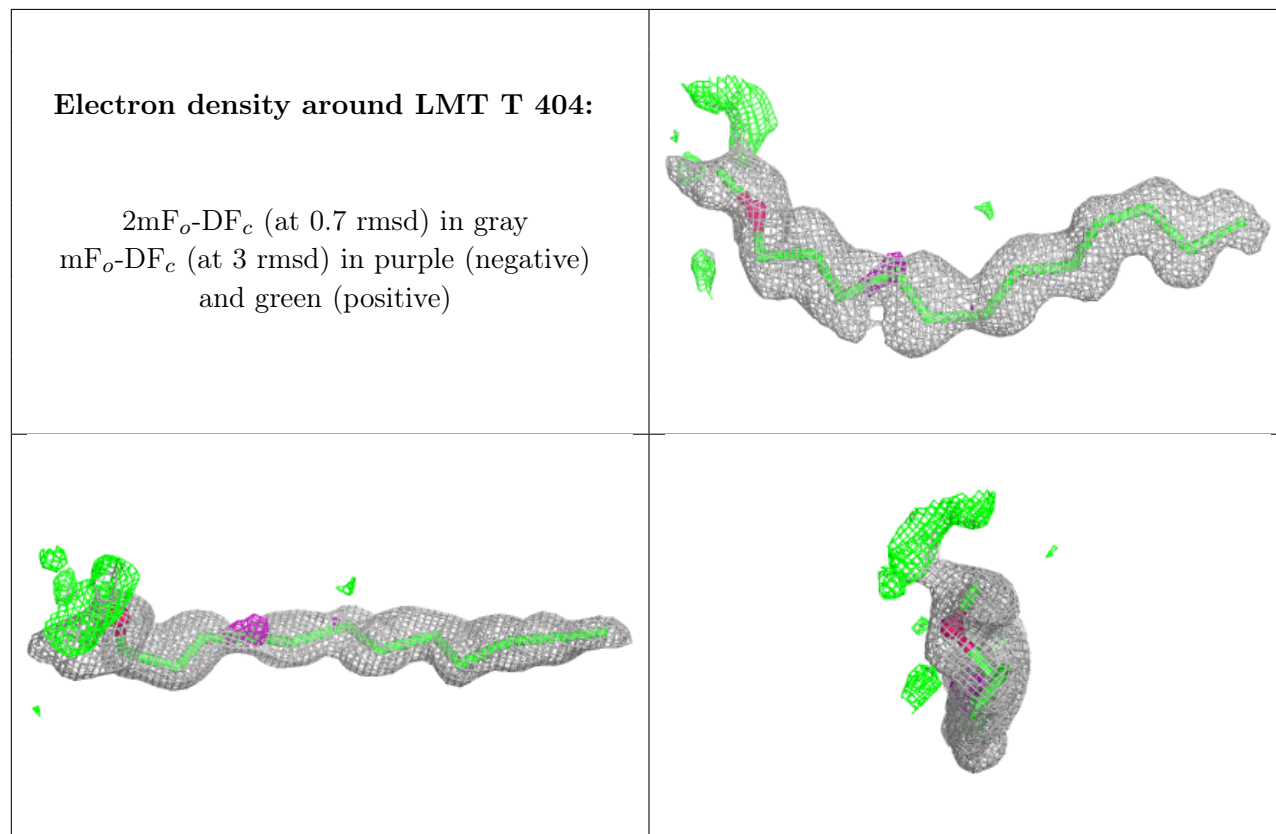
6.4 Ligands [i](#)

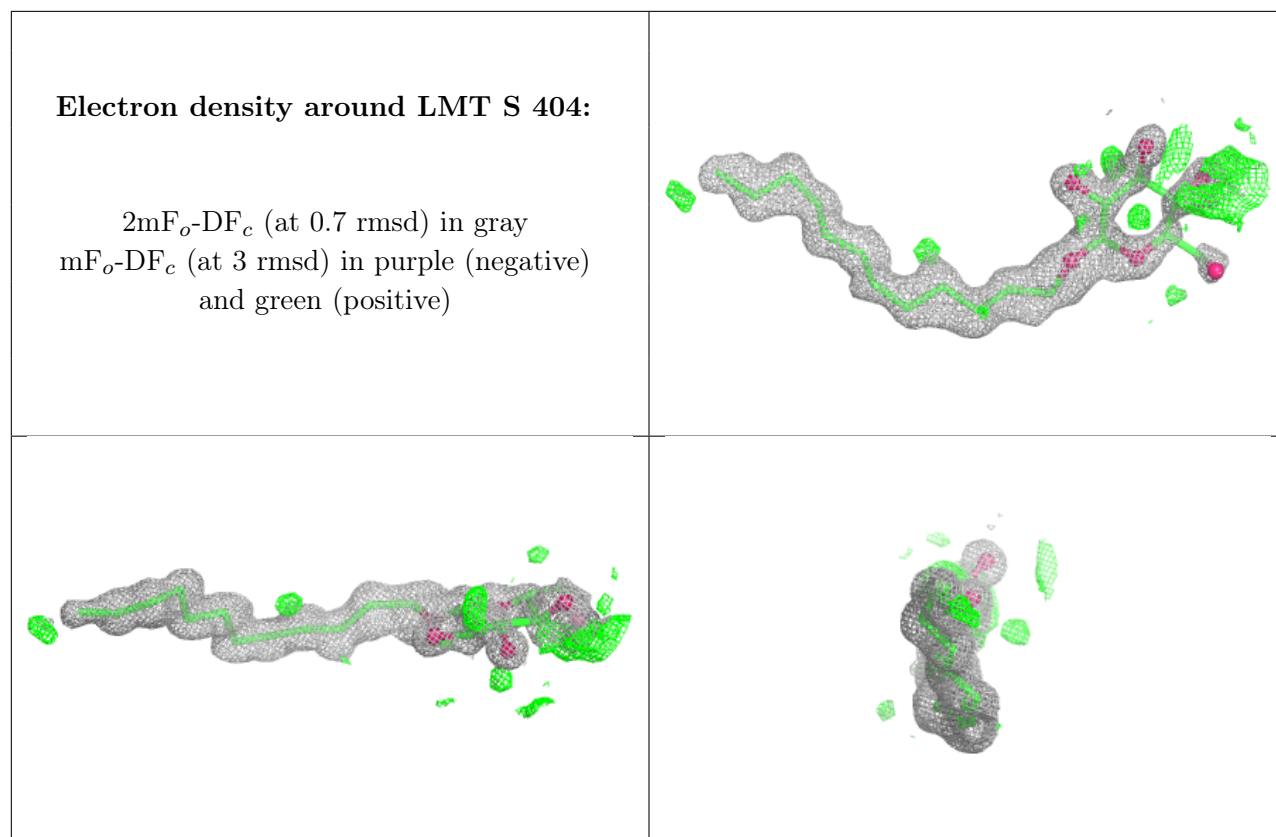
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
6	LMT	T	404	14/35	0.90	0.12	20,25,40,43	0
6	LMT	S	404	24/35	0.91	0.12	16,22,29,38	10
12	SO4	M	604	5/5	0.91	0.13	23,25,29,29	5
11	LI	L	604	1/1	0.97	0.08	14,14,14,14	0
12	SO4	L	605	5/5	0.98	0.07	15,15,18,21	5
5	SF3	S	403	7/7	0.99	0.03	6,8,10,12	7
5	SF3	T	403	7/7	0.99	0.03	7,8,11,12	7
9	NI	L	602	1/1	0.99	0.04	14,14,14,14	1
7	CL	S	405	1/1	1.00	0.04	11,11,11,11	0
7	CL	T	405	1/1	1.00	0.05	13,13,13,13	0
8	FCO	L	601	7/7	1.00	0.02	7,8,8,8	0
8	FCO	M	601	7/7	1.00	0.02	7,8,8,8	0
3	SF4	S	401	8/8	1.00	0.01	7,7,7,7	0
9	NI	M	602	1/1	1.00	0.04	14,14,14,14	1
10	MG	L	603	1/1	1.00	0.01	6,6,6,6	0
10	MG	M	603	1/1	1.00	0.01	6,6,6,6	0
3	SF4	T	401	8/8	1.00	0.01	7,7,7,7	0
4	F3S	S	402	7/7	1.00	0.03	7,7,8,8	0
4	F3S	T	402	7/7	1.00	0.03	7,8,8,8	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.





6.5 Other polymers [i](#)

There are no such residues in this entry.