



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 04:24 AM UTC

PDB ID : 5EXK / pdb_00005exk
Title : Crystal structure of M. tuberculosis lipoyl synthase with 6-thiooctanoyl peptide intermediate
Authors : McLaughlin, M.I.; Lanz, N.D.; Goldman, P.J.; Lee, K.-H.; Booker, S.J.; Drennan, C.L.
Deposited on : 2015-11-23
Resolution : 1.86 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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
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

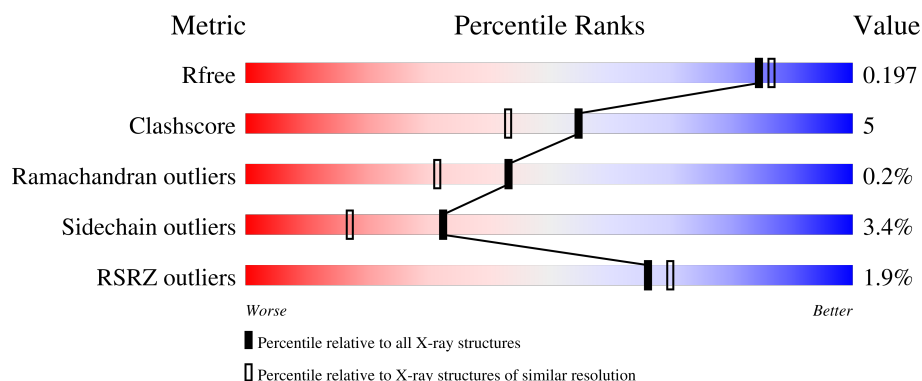
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.86 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	3428 (1.86-1.86)
Clashscore	190562	3579 (1.86-1.86)
Ramachandran outliers	187476	3553 (1.86-1.86)
Sidechain outliers	187428	3553 (1.86-1.86)
RSRZ outliers	180081	3429 (1.86-1.86)

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	331	2% 87% 5% • 8%
1	C	331	82% 8% 9%
1	E	331	% 84% 7% • 9%
1	G	331	3% 73% 14% • 11%
1	I	331	% 83% 5% • 11%

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Mol	Chain	Length	Quality of chain
1	K	331	2% 82% 6% 11%
2	B	8	75% 25%
2	D	8	75% 25%
2	F	8	50% 25% 25%
2	H	8	25% 38% 38% 25%
2	J	8	38% 12% 12% 12% 25%
2	L	8	38% 25% 12% 25%

2 Entry composition

There are 10 unique types of molecules in this entry. The entry contains 16721 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 Lipoyl synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	306	Total	C	N	O	S	0	4	0
			2381	1493	435	445	8			
1	C	300	Total	C	N	O	S	0	7	0
			2346	1476	422	440	8			
1	E	302	Total	C	N	O	S	0	7	0
			2385	1497	432	448	8			
1	G	296	Total	C	N	O	S	0	6	0
			2282	1438	402	434	8			
1	I	296	Total	C	N	O	S	0	4	0
			2290	1440	408	434	8			
1	K	296	Total	C	N	O	S	0	4	0
			2300	1442	416	434	8			

There are 120 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	initiating methionine	UNP P9WK91
A	-18	GLY	-	expression tag	UNP P9WK91
A	-17	SER	-	expression tag	UNP P9WK91
A	-16	SER	-	expression tag	UNP P9WK91
A	-15	HIS	-	expression tag	UNP P9WK91
A	-14	HIS	-	expression tag	UNP P9WK91
A	-13	HIS	-	expression tag	UNP P9WK91
A	-12	HIS	-	expression tag	UNP P9WK91
A	-11	HIS	-	expression tag	UNP P9WK91
A	-10	HIS	-	expression tag	UNP P9WK91
A	-9	SER	-	expression tag	UNP P9WK91
A	-8	SER	-	expression tag	UNP P9WK91
A	-7	GLY	-	expression tag	UNP P9WK91
A	-6	LEU	-	expression tag	UNP P9WK91
A	-5	VAL	-	expression tag	UNP P9WK91
A	-4	PRO	-	expression tag	UNP P9WK91
A	-3	ARG	-	expression tag	UNP P9WK91

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Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	expression tag	UNP P9WK91
A	-1	SER	-	expression tag	UNP P9WK91
A	0	HIS	-	expression tag	UNP P9WK91
C	-19	MET	-	initiating methionine	UNP P9WK91
C	-18	GLY	-	expression tag	UNP P9WK91
C	-17	SER	-	expression tag	UNP P9WK91
C	-16	SER	-	expression tag	UNP P9WK91
C	-15	HIS	-	expression tag	UNP P9WK91
C	-14	HIS	-	expression tag	UNP P9WK91
C	-13	HIS	-	expression tag	UNP P9WK91
C	-12	HIS	-	expression tag	UNP P9WK91
C	-11	HIS	-	expression tag	UNP P9WK91
C	-10	HIS	-	expression tag	UNP P9WK91
C	-9	SER	-	expression tag	UNP P9WK91
C	-8	SER	-	expression tag	UNP P9WK91
C	-7	GLY	-	expression tag	UNP P9WK91
C	-6	LEU	-	expression tag	UNP P9WK91
C	-5	VAL	-	expression tag	UNP P9WK91
C	-4	PRO	-	expression tag	UNP P9WK91
C	-3	ARG	-	expression tag	UNP P9WK91
C	-2	GLY	-	expression tag	UNP P9WK91
C	-1	SER	-	expression tag	UNP P9WK91
C	0	HIS	-	expression tag	UNP P9WK91
E	-19	MET	-	initiating methionine	UNP P9WK91
E	-18	GLY	-	expression tag	UNP P9WK91
E	-17	SER	-	expression tag	UNP P9WK91
E	-16	SER	-	expression tag	UNP P9WK91
E	-15	HIS	-	expression tag	UNP P9WK91
E	-14	HIS	-	expression tag	UNP P9WK91
E	-13	HIS	-	expression tag	UNP P9WK91
E	-12	HIS	-	expression tag	UNP P9WK91
E	-11	HIS	-	expression tag	UNP P9WK91
E	-10	HIS	-	expression tag	UNP P9WK91
E	-9	SER	-	expression tag	UNP P9WK91
E	-8	SER	-	expression tag	UNP P9WK91
E	-7	GLY	-	expression tag	UNP P9WK91
E	-6	LEU	-	expression tag	UNP P9WK91
E	-5	VAL	-	expression tag	UNP P9WK91
E	-4	PRO	-	expression tag	UNP P9WK91
E	-3	ARG	-	expression tag	UNP P9WK91
E	-2	GLY	-	expression tag	UNP P9WK91
E	-1	SER	-	expression tag	UNP P9WK91

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Chain	Residue	Modelled	Actual	Comment	Reference
E	0	HIS	-	expression tag	UNP P9WK91
G	-19	MET	-	initiating methionine	UNP P9WK91
G	-18	GLY	-	expression tag	UNP P9WK91
G	-17	SER	-	expression tag	UNP P9WK91
G	-16	SER	-	expression tag	UNP P9WK91
G	-15	HIS	-	expression tag	UNP P9WK91
G	-14	HIS	-	expression tag	UNP P9WK91
G	-13	HIS	-	expression tag	UNP P9WK91
G	-12	HIS	-	expression tag	UNP P9WK91
G	-11	HIS	-	expression tag	UNP P9WK91
G	-10	HIS	-	expression tag	UNP P9WK91
G	-9	SER	-	expression tag	UNP P9WK91
G	-8	SER	-	expression tag	UNP P9WK91
G	-7	GLY	-	expression tag	UNP P9WK91
G	-6	LEU	-	expression tag	UNP P9WK91
G	-5	VAL	-	expression tag	UNP P9WK91
G	-4	PRO	-	expression tag	UNP P9WK91
G	-3	ARG	-	expression tag	UNP P9WK91
G	-2	GLY	-	expression tag	UNP P9WK91
G	-1	SER	-	expression tag	UNP P9WK91
G	0	HIS	-	expression tag	UNP P9WK91
I	-19	MET	-	initiating methionine	UNP P9WK91
I	-18	GLY	-	expression tag	UNP P9WK91
I	-17	SER	-	expression tag	UNP P9WK91
I	-16	SER	-	expression tag	UNP P9WK91
I	-15	HIS	-	expression tag	UNP P9WK91
I	-14	HIS	-	expression tag	UNP P9WK91
I	-13	HIS	-	expression tag	UNP P9WK91
I	-12	HIS	-	expression tag	UNP P9WK91
I	-11	HIS	-	expression tag	UNP P9WK91
I	-10	HIS	-	expression tag	UNP P9WK91
I	-9	SER	-	expression tag	UNP P9WK91
I	-8	SER	-	expression tag	UNP P9WK91
I	-7	GLY	-	expression tag	UNP P9WK91
I	-6	LEU	-	expression tag	UNP P9WK91
I	-5	VAL	-	expression tag	UNP P9WK91
I	-4	PRO	-	expression tag	UNP P9WK91
I	-3	ARG	-	expression tag	UNP P9WK91
I	-2	GLY	-	expression tag	UNP P9WK91
I	-1	SER	-	expression tag	UNP P9WK91
I	0	HIS	-	expression tag	UNP P9WK91
K	-19	MET	-	initiating methionine	UNP P9WK91

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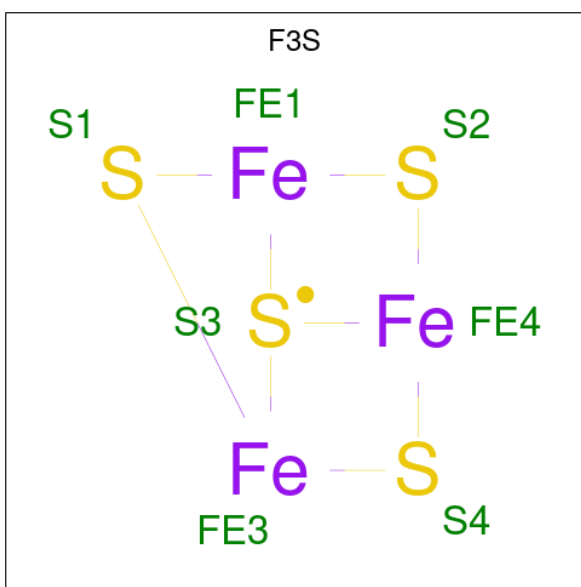
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Chain	Residue	Modelled	Actual	Comment	Reference
K	-18	GLY	-	expression tag	UNP P9WK91
K	-17	SER	-	expression tag	UNP P9WK91
K	-16	SER	-	expression tag	UNP P9WK91
K	-15	HIS	-	expression tag	UNP P9WK91
K	-14	HIS	-	expression tag	UNP P9WK91
K	-13	HIS	-	expression tag	UNP P9WK91
K	-12	HIS	-	expression tag	UNP P9WK91
K	-11	HIS	-	expression tag	UNP P9WK91
K	-10	HIS	-	expression tag	UNP P9WK91
K	-9	SER	-	expression tag	UNP P9WK91
K	-8	SER	-	expression tag	UNP P9WK91
K	-7	GLY	-	expression tag	UNP P9WK91
K	-6	LEU	-	expression tag	UNP P9WK91
K	-5	VAL	-	expression tag	UNP P9WK91
K	-4	PRO	-	expression tag	UNP P9WK91
K	-3	ARG	-	expression tag	UNP P9WK91
K	-2	GLY	-	expression tag	UNP P9WK91
K	-1	SER	-	expression tag	UNP P9WK91
K	0	HIS	-	expression tag	UNP P9WK91

- Molecule 2 is a protein called Octanoylated peptide from M. tuberculosis H protein.

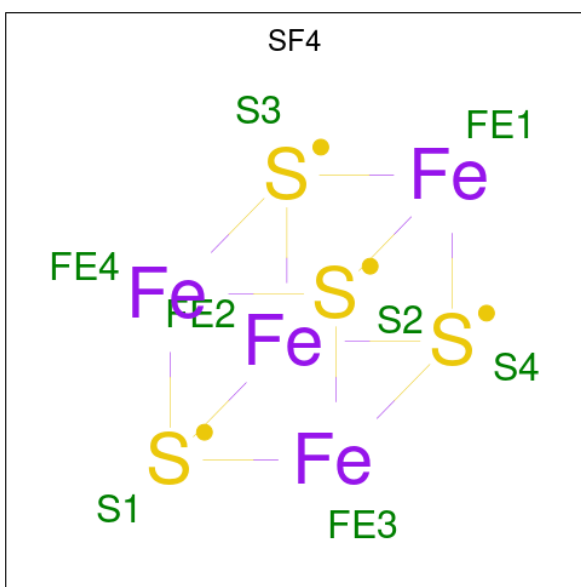
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	8	Total	C	N	O	S	0	0	0
			66	40	9	16	1			
2	D	8	Total	C	N	O	S	0	0	0
			69	41	9	18	1			
2	F	6	Total	C	N	O	S	0	0	0
			51	32	7	11	1			
2	H	6	Total	C	N	O	S	0	0	0
			51	32	7	11	1			
2	J	6	Total	C	N	O	S	0	0	0
			48	31	7	9	1			
2	L	6	Total	C	N	O	S	0	0	0
			51	32	7	11	1			

- Molecule 3 is FE3-S4 CLUSTER (CCD ID: F3S) (formula: Fe₃S₄).



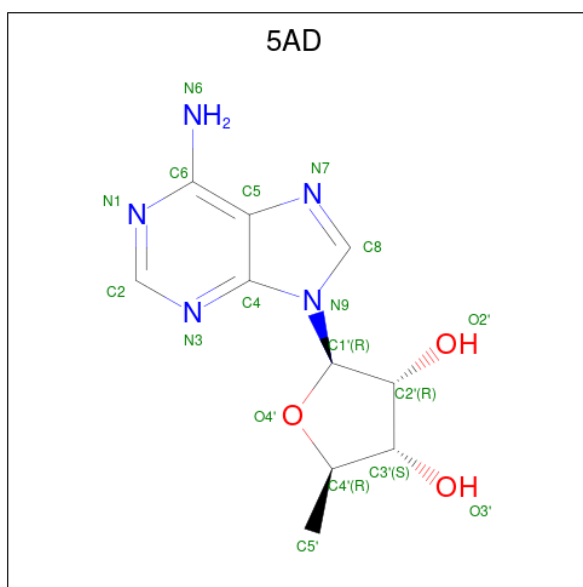
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	Fe	S	0	0
			6	3	3		
3	C	1	Total	Fe	S	0	0
			6	3	3		
3	E	1	Total	Fe	S	0	0
			6	3	3		
3	G	1	Total	Fe	S	0	0
			6	3	3		
3	I	1	Total	Fe	S	0	0
			6	3	3		
3	K	1	Total	Fe	S	0	0
			6	3	3		

- Molecule 4 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4).



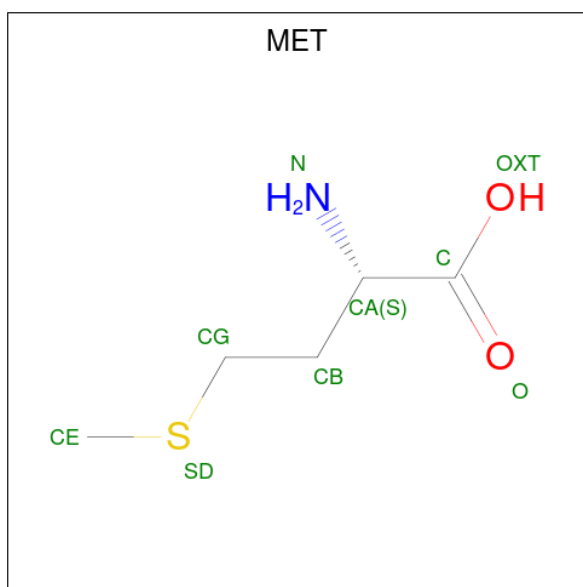
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	Fe	S	0	0
			8	4	4		
4	C	1	Total	Fe	S	0	0
			8	4	4		
4	E	1	Total	Fe	S	0	0
			8	4	4		
4	G	1	Total	Fe	S	0	0
			8	4	4		
4	I	1	Total	Fe	S	0	0
			8	4	4		
4	K	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 5 is 5'-DEOXYADENOSINE (CCD ID: 5AD) (formula: C₁₀H₁₃N₅O₃).



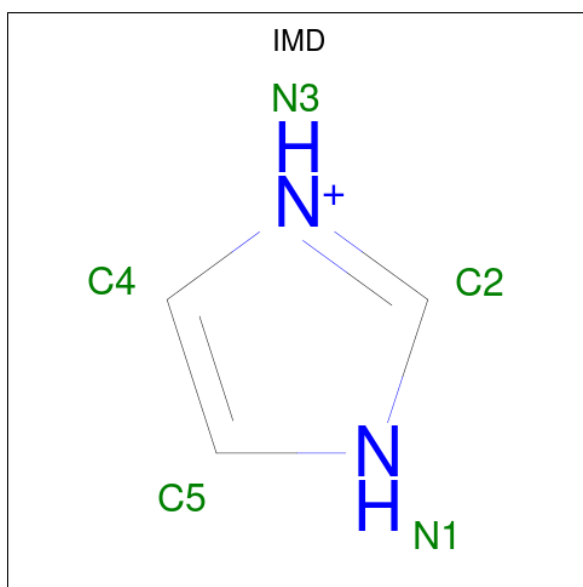
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	N	O	0	0
			18	10	5	3		
5	C	1	Total	C	N	O	0	0
			18	10	5	3		
5	E	1	Total	C	N	O	0	0
			18	10	5	3		
5	G	1	Total	C	N	O	0	0
			18	10	5	3		
5	I	1	Total	C	N	O	0	0
			18	10	5	3		
5	K	1	Total	C	N	O	0	0
			18	10	5	3		

- Molecule 6 is METHIONINE (CCD ID: MET) (formula: C₅H₁₁NO₂S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
6	A	1	Total	C	N	O	S	0	0
			9	5	1	2	1		
6	C	1	Total	C	N	O	S	0	0
			9	5	1	2	1		
6	E	1	Total	C	N	O	S	0	0
			9	5	1	2	1		
6	G	1	Total	C	N	O	S	0	0
			9	5	1	2	1		
6	I	1	Total	C	N	O	S	0	0
			9	5	1	2	1		
6	K	1	Total	C	N	O	S	0	0
			9	5	1	2	1		

- Molecule 7 is IMIDAZOLE (CCD ID: IMD) (formula: C₃H₅N₂).

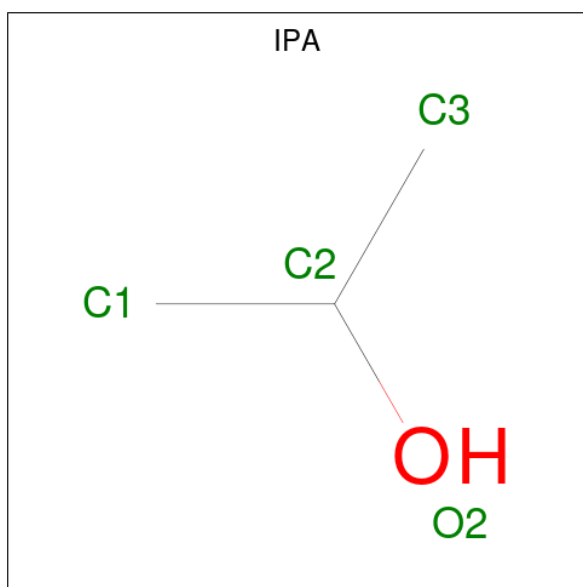


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	N	0	0
			5	3	2		
7	E	1	Total	C	N	0	0
			5	3	2		

- Molecule 8 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	1	Total	Cl	0	0
			1	1		
8	K	1	Total	Cl	0	0
			1	1		

- Molecule 9 is ISOPROPYL ALCOHOL (CCD ID: IPA) (formula: C₃H₈O).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	C	1	Total	C	O	0	0
			4	3	1		

- Molecule 10 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	401	Total	O	0	0
			401	401		
10	B	6	Total	O	0	0
			6	6		
10	C	357	Total	O	0	0
			357	357		
10	D	17	Total	O	0	0
			17	17		
10	E	348	Total	O	0	0
			348	348		
10	F	10	Total	O	0	0
			10	10		
10	G	265	Total	O	0	0
			265	265		
10	H	9	Total	O	0	0
			9	9		
10	I	364	Total	O	0	0
			364	364		
10	J	6	Total	O	0	0
			6	6		
10	K	348	Total	O	0	0
			348	348		

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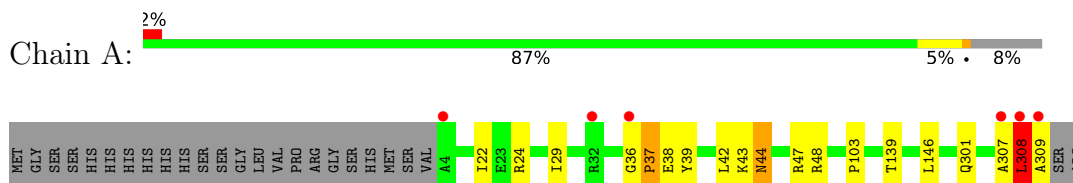
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	L	8	Total	O	0	0
			8	8		

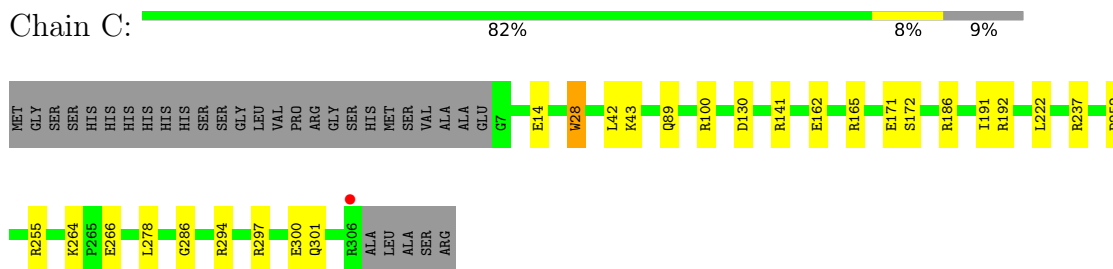
3 Residue-property plots [i](#)

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.

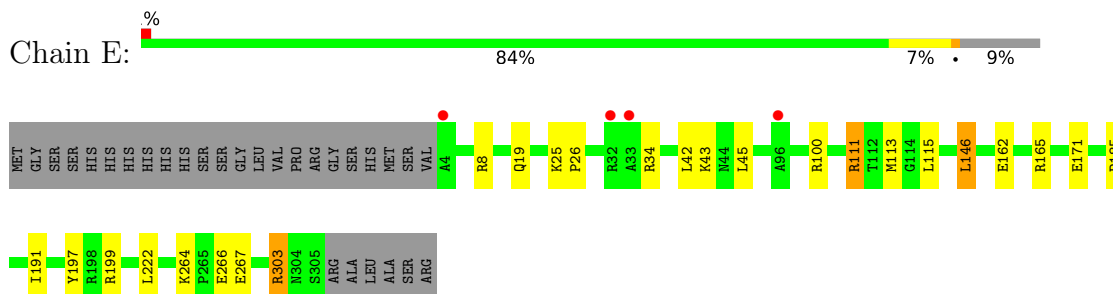
- Molecule 1: Lipoyl synthase



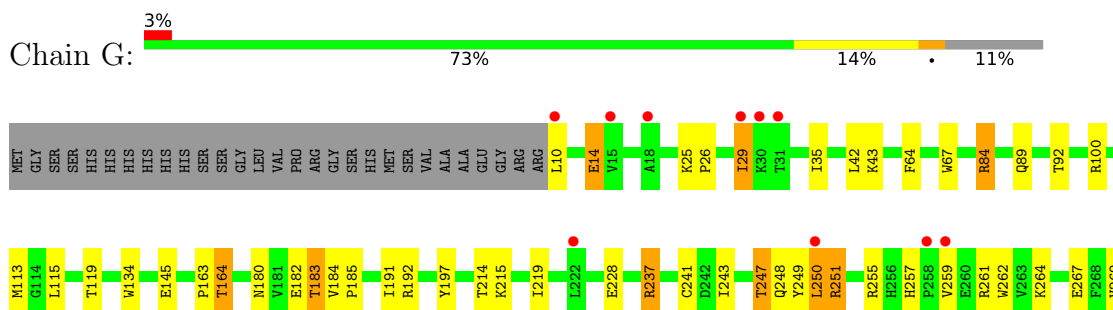
- Molecule 1: Lipoyl synthase

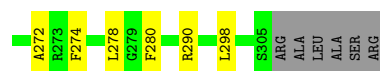


- Molecule 1: Lipoyl synthase

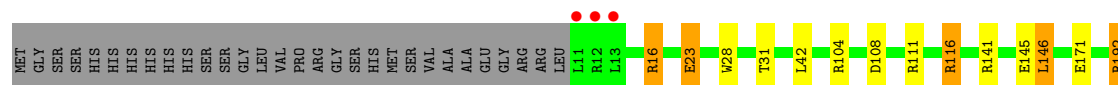
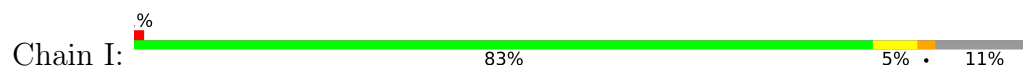


- Molecule 1: Lipoyl synthase

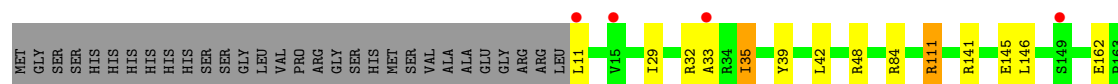
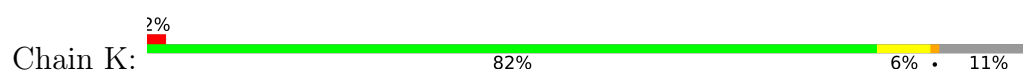




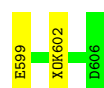
- Molecule 1: Lipoyl synthase



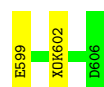
- Molecule 1: Lipoyl synthase



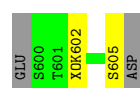
- Molecule 2: Octanoylated peptide from M. tuberculosis H protein



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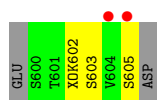


- Molecule 2: Octanoylated peptide from M. tuberculosis H protein

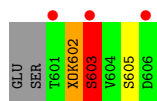
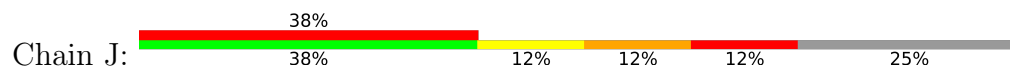


- Molecule 2: Octanoylated peptide from M. tuberculosis H protein

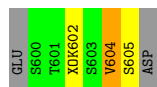




- Molecule 2: Octanoylated peptide from *M. tuberculosis* H protein



- Molecule 2: Octanoylated peptide from *M. tuberculosis* H protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	81.77Å 95.97Å 114.33Å 90.00° 90.46° 90.00°	Depositor
Resolution (Å)	47.03 – 1.86 47.03 – 1.86	Depositor EDS
% Data completeness (in resolution range)	96.8 (47.03-1.86) 90.3 (47.03-1.86)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.66 (at 1.86Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.160 , 0.201 0.158 , 0.197	Depositor DCC
R_{free} test set	7130 reflections (4.82%)	wwPDB-VP
Wilson B-factor (Å ²)	14.1	Xtriage
Anisotropy	0.366	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 43.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.026 for h,-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	16721	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.71% 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: CL, F3S, 5AD, IPA, SF4, IMD, XOK

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	0.62	3/2437 (0.1%)	0.81	1/3312 (0.0%)
1	C	0.53	0/2405	0.79	1/3270 (0.0%)
1	E	0.61	1/2438 (0.0%)	0.80	0/3315
1	G	0.55	0/2338	0.82	2/3188 (0.1%)
1	I	0.55	0/2349	0.80	2/3197 (0.1%)
1	K	0.58	1/2350 (0.0%)	0.79	0/3198
2	B	0.36	0/45	0.59	0/57
2	D	0.38	0/48	0.52	0/61
2	F	0.38	0/30	0.57	0/38
2	H	0.31	0/30	0.42	0/38
2	J	0.44	0/27	0.58	0/34
2	L	0.50	0/30	1.12	0/38
All	All	0.57	5/14527 (0.0%)	0.80	6/19746 (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
1	C	0	1
1	I	0	1
All	All	0	2

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	K	35	ILE	C-O	-6.39	1.16	1.24
1	A	44	ASN	C-O	-5.48	1.17	1.24
1	A	39	TYR	C-O	-5.38	1.17	1.24
1	A	36	GLY	C-N	5.34	1.40	1.34

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	34	ARG	C-O	-5.14	1.18	1.24

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	28	TRP	O-C-N	-7.25	112.46	122.46
1	G	183	THR	N-CA-C	5.73	115.67	108.45
1	I	192	ARG	CA-C-N	5.53	125.36	119.28
1	I	192	ARG	C-N-CA	5.53	125.36	119.28
1	A	37	PRO	CA-N-CD	-5.30	104.58	112.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	28	TRP	Mainchain
1	I	28	TRP	Mainchain

5.2 Too-close contacts

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	2381	0	2328	16	0
1	C	2346	0	2282	19	0
1	E	2385	0	2324	29	0
1	G	2282	0	2203	45	0
1	I	2290	0	2226	14	0
1	K	2300	0	2217	18	0
2	B	66	0	38	1	0
2	D	69	0	40	1	0
2	F	51	0	30	1	0
2	H	51	0	30	2	0
2	J	48	0	22	2	0
2	L	51	0	30	2	0
3	A	6	0	0	0	0
3	C	6	0	0	0	0
3	E	6	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	G	6	0	0	0	0
3	I	6	0	0	0	0
3	K	6	0	0	0	0
4	A	8	0	0	0	0
4	C	8	0	0	0	0
4	E	8	0	0	0	0
4	G	8	0	0	0	0
4	I	8	0	0	0	0
4	K	8	0	0	0	0
5	A	18	0	13	0	0
5	C	18	0	13	0	0
5	E	18	0	13	0	0
5	G	18	0	13	0	0
5	I	18	0	13	0	0
5	K	18	0	13	0	0
6	A	9	0	8	0	0
6	C	9	0	8	0	0
6	E	9	0	8	0	0
6	G	9	0	8	0	0
6	I	9	0	8	0	0
6	K	9	0	8	0	0
7	A	5	0	5	1	0
7	E	5	0	5	0	0
8	A	1	0	0	0	0
8	K	1	0	0	0	0
9	C	4	0	8	2	0
10	A	401	0	0	2	0
10	B	6	0	0	0	0
10	C	357	0	0	4	0
10	D	17	0	0	0	0
10	E	348	0	0	7	0
10	F	10	0	0	0	0
10	G	265	0	0	8	0
10	H	9	0	0	0	0
10	I	364	0	0	8	0
10	J	6	0	0	1	0
10	K	348	0	0	6	0
10	L	8	0	0	0	0
All	All	16721	0	13914	138	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 5.

The worst 5 of 138 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:E:162[B]:GLU:OE2	1:E:165:ARG:CZ	1.83	1.24
1:E:162[B]:GLU:OE2	1:E:165:ARG:NH1	1.88	1.06
1:G:247[A]:THR:HG21	10:G:583:HOH:O	1.57	1.02
1:A:308:LEU:HG	1:A:309:ALA:H	1.32	0.94
1:G:248:GLN:NE2	10:G:501:HOH:O	2.06	0.87

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	308/331 (93%)	303 (98%)	4 (1%)	1 (0%)	36	25
1	C	305/331 (92%)	301 (99%)	4 (1%)	0	100	100
1	E	308/331 (93%)	302 (98%)	6 (2%)	0	100	100
1	G	300/331 (91%)	293 (98%)	7 (2%)	0	100	100
1	I	298/331 (90%)	294 (99%)	4 (1%)	0	100	100
1	K	298/331 (90%)	291 (98%)	6 (2%)	1 (0%)	36	25
2	B	5/8 (62%)	4 (80%)	1 (20%)	0	100	100
2	D	5/8 (62%)	4 (80%)	1 (20%)	0	100	100
2	F	3/8 (38%)	2 (67%)	1 (33%)	0	100	100
2	H	3/8 (38%)	2 (67%)	1 (33%)	0	100	100
2	J	3/8 (38%)	2 (67%)	0	1 (33%)	0	0
2	L	3/8 (38%)	3 (100%)	0	0	100	100
All	All	1839/2034 (90%)	1801 (98%)	35 (2%)	3 (0%)	43	31

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	308	LEU
1	K	33	ALA
2	J	603	SER

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	242/272 (89%)	238 (98%)	4 (2%)	53	42
1	C	239/272 (88%)	234 (98%)	5 (2%)	47	33
1	E	243/272 (89%)	233 (96%)	10 (4%)	27	12
1	G	233/272 (86%)	216 (93%)	17 (7%)	13	3
1	I	236/272 (87%)	225 (95%)	11 (5%)	23	9
1	K	233/272 (86%)	230 (99%)	3 (1%)	61	51
2	B	6/7 (86%)	6 (100%)	0	100	100
2	D	7/7 (100%)	7 (100%)	0	100	100
2	F	5/7 (71%)	5 (100%)	0	100	100
2	H	5/7 (71%)	5 (100%)	0	100	100
2	J	3/7 (43%)	1 (33%)	2 (67%)	0	0
2	L	5/7 (71%)	4 (80%)	1 (20%)	1	0
All	All	1457/1674 (87%)	1404 (96%)	53 (4%)	32	16

5 of 53 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	G	164[B]	THR
1	G	298	LEU
1	K	42	LEU
1	G	192	ARG
1	G	247[B]	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	C	80	GLN
1	C	301	GLN
1	E	19	GLN
1	K	304	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](#)

6 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	XOK	L	602	2,3	16,18,19	1.16	1 (6%)	12,20,22	1.82	1 (8%)
2	XOK	H	602	2,3	16,18,19	1.27	1 (6%)	12,20,22	1.67	1 (8%)
2	XOK	D	602	2,3	16,18,19	1.16	1 (6%)	12,20,22	1.74	1 (8%)
2	XOK	J	602	2,3	16,18,19	1.19	1 (6%)	12,20,22	1.83	3 (25%)
2	XOK	B	602	2,3	16,18,19	1.09	1 (6%)	12,20,22	1.45	1 (8%)
2	XOK	F	602	2,3	16,18,19	1.22	1 (6%)	12,20,22	1.83	2 (16%)

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	XOK	L	602	2,3	-	0/17/19/21	-
2	XOK	H	602	2,3	-	2/17/19/21	-
2	XOK	D	602	2,3	-	1/17/19/21	-
2	XOK	J	602	2,3	-	3/17/19/21	-
2	XOK	B	602	2,3	-	1/17/19/21	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	XOK	F	602	2,3	-	0/17/19/21	-

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	H	602	XOK	C1-NZ	3.73	1.42	1.33
2	L	602	XOK	C1-NZ	3.62	1.42	1.33
2	D	602	XOK	C1-NZ	3.51	1.41	1.33
2	F	602	XOK	C1-NZ	3.36	1.41	1.33
2	J	602	XOK	C1-NZ	3.30	1.41	1.33

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	602	XOK	CE-NZ-C1	-5.51	112.57	122.82
2	L	602	XOK	CE-NZ-C1	-5.39	112.79	122.82
2	F	602	XOK	CE-NZ-C1	-5.32	112.92	122.82
2	H	602	XOK	CE-NZ-C1	-5.20	113.14	122.82
2	B	602	XOK	CE-NZ-C1	-4.42	114.58	122.82

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	J	602	XOK	N-CA-CB-CG
2	J	602	XOK	C-CA-CB-CG
2	J	602	XOK	CA-CB-CG-CD
2	H	602	XOK	C4-C5-C6-C7
2	B	602	XOK	CG-CD-CE-NZ

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	J	602	XOK	1	0

5.5 Carbohydrates

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 29 ligands modelled in this entry, 2 are monoatomic - leaving 27 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$
3	F3S	K	401	1,2	0,7,9	-	-	-		
3	F3S	G	401	1,2	0,7,9	-	-	-		
3	F3S	I	401	1,2	0,7,9	-	-	-		
7	IMD	A	405	-	5,5,5	0.56	0	5,5,5	0.48	0
6	MET	E	404	4	7,8,8	0.92	1 (14%)	5,9,9	1.30	1 (20%)
5	5AD	A	403	-	20,20,20	0.12	0	28,30,30	0.32	0
5	5AD	K	403	-	20,20,20	0.15	0	28,30,30	0.39	0
6	MET	K	404	4	7,8,8	0.94	1 (14%)	5,9,9	1.24	1 (20%)
6	MET	C	404	4	7,8,8	0.93	1 (14%)	5,9,9	1.52	1 (20%)
4	SF4	I	402	1,6	0,12,12	-	-	-		
4	SF4	E	402	1,6	0,12,12	-	-	-		
9	IPA	C	405	-	3,3,3	0.53	0	3,3,3	0.40	0
6	MET	A	404	4	7,8,8	0.90	1 (14%)	5,9,9	1.48	1 (20%)
7	IMD	E	405	-	5,5,5	0.62	0	5,5,5	0.45	0
4	SF4	C	402	1,6	0,12,12	-	-	-		
5	5AD	E	403	-	20,20,20	0.15	0	28,30,30	0.31	0
4	SF4	K	402	1,6	0,12,12	-	-	-		
4	SF4	A	402	1,6	0,12,12	-	-	-		
3	F3S	E	401	1,2	0,7,9	-	-	-		
5	5AD	I	403	-	20,20,20	0.15	0	28,30,30	0.35	0
5	5AD	C	403	-	20,20,20	0.13	0	28,30,30	0.29	0
6	MET	G	404	4	7,8,8	0.99	1 (14%)	5,9,9	1.83	1 (20%)
5	5AD	G	403	-	20,20,20	0.12	0	28,30,30	0.37	0
6	MET	I	404	4	7,8,8	0.96	1 (14%)	5,9,9	1.24	1 (20%)
3	F3S	A	401	1,2	0,7,9	-	-	-		
3	F3S	C	401	1,2	0,7,9	-	-	-		
4	SF4	G	402	1,6	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.
'-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	F3S	K	401	1,2	-	-	0/2/2/3
3	F3S	G	401	1,2	-	-	0/2/2/3
3	F3S	I	401	1,2	-	-	0/2/2/3
7	IMD	A	405	-	-	-	0/1/1/1
6	MET	E	404	4	-	3/8/8/8	-
5	5AD	A	403	-	-	0/4/20/20	0/3/3/3
5	5AD	K	403	-	-	0/4/20/20	0/3/3/3
6	MET	K	404	4	-	1/8/8/8	-
6	MET	C	404	4	-	1/8/8/8	-
4	SF4	E	402	1,6	-	-	0/6/5/5
4	SF4	I	402	1,6	-	-	0/6/5/5
6	MET	A	404	4	-	1/8/8/8	-
7	IMD	E	405	-	-	-	0/1/1/1
4	SF4	C	402	1,6	-	-	0/6/5/5
5	5AD	E	403	-	-	0/4/20/20	0/3/3/3
4	SF4	K	402	1,6	-	-	0/6/5/5
4	SF4	A	402	1,6	-	-	0/6/5/5
3	F3S	E	401	1,2	-	-	0/2/2/3
5	5AD	I	403	-	-	0/4/20/20	0/3/3/3
5	5AD	C	403	-	-	0/4/20/20	0/3/3/3
6	MET	G	404	4	-	0/8/8/8	-
5	5AD	G	403	-	-	0/4/20/20	0/3/3/3
6	MET	I	404	4	-	1/8/8/8	-
3	F3S	A	401	1,2	-	-	0/2/2/3
3	F3S	C	401	1,2	-	-	0/2/2/3
4	SF4	G	402	1,6	-	-	0/6/5/5

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	K	404	MET	OXT-C	-2.34	1.23	1.30
6	E	404	MET	OXT-C	-2.17	1.23	1.30
6	C	404	MET	OXT-C	-2.12	1.23	1.30
6	A	404	MET	OXT-C	-2.10	1.23	1.30
6	G	404	MET	OXT-C	-2.09	1.24	1.30

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	G	404	MET	OXT-C-O	-4.03	114.93	124.08

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	C	404	MET	OXT-C-O	-3.36	116.45	124.08
6	A	404	MET	OXT-C-O	-3.20	116.82	124.08
6	E	404	MET	OXT-C-O	-2.89	117.52	124.08
6	K	404	MET	OXT-C-O	-2.76	117.82	124.08

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	E	404	MET	C-CA-CB-CG
6	A	404	MET	C-CA-CB-CG
6	C	404	MET	C-CA-CB-CG
6	I	404	MET	C-CA-CB-CG
6	K	404	MET	C-CA-CB-CG

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	A	405	IMD	1	0
9	C	405	IPA	2	0

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	306/331 (92%)	-0.48	6 (1%) 65 68	6, 14, 33, 53	4 (1%)
1	C	300/331 (90%)	-0.56	1 (0%) 90 92	6, 13, 32, 56	7 (2%)
1	E	302/331 (91%)	-0.41	4 (1%) 75 79	4, 15, 34, 47	7 (2%)
1	G	296/331 (89%)	0.26	10 (3%) 48 52	8, 22, 39, 62	6 (2%)
1	I	296/331 (89%)	-0.47	3 (1%) 79 83	7, 15, 32, 44	4 (1%)
1	K	296/331 (89%)	-0.38	5 (1%) 69 73	7, 16, 37, 50	4 (1%)
2	B	7/8 (87%)	0.68	0 100 100	26, 27, 43, 51	0
2	D	7/8 (87%)	0.34	0 100 100	20, 23, 37, 43	0
2	F	5/8 (62%)	0.65	0 100 100	24, 27, 34, 42	0
2	H	5/8 (62%)	1.90	2 (40%) 1 0	33, 40, 46, 51	0
2	J	5/8 (62%)	2.40	3 (60%) 0 0	44, 50, 51, 53	0
2	L	5/8 (62%)	0.79	0 100 100	27, 29, 39, 44	0
All	All	1830/2034 (89%)	-0.31	34 (1%) 66 70	4, 16, 37, 62	32 (1%)

The worst 5 of 34 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	309	ALA	4.2
1	E	33	ALA	4.2
1	A	308	LEU	3.8
1	I	11	LEU	3.6
1	K	11	LEU	3.5

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	XOK	H	602	19/20	0.96	0.07	13,20,28,34	0
2	XOK	F	602	19/20	0.97	0.05	6,10,20,24	0
2	XOK	B	602	19/20	0.97	0.07	5,11,24,25	0
2	XOK	J	602	19/20	0.97	0.08	7,10,45,48	0
2	XOK	D	602	19/20	0.98	0.05	6,10,16,19	0
2	XOK	L	602	19/20	0.98	0.05	10,12,22,24	0

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
9	IPA	C	405	4/4	0.74	0.29	30,37,40,44	0
7	IMD	E	405	5/5	0.91	0.08	13,14,17,17	5
5	5AD	G	403	18/18	0.94	0.07	12,22,32,34	0
6	MET	G	404	9/9	0.95	0.08	10,11,13,14	0
4	SF4	G	402	8/8	0.96	0.05	12,14,16,16	0
5	5AD	A	403	18/18	0.97	0.05	7,9,12,13	0
5	5AD	E	403	18/18	0.97	0.04	6,9,11,12	0
5	5AD	K	403	18/18	0.98	0.04	8,11,12,13	0
6	MET	E	404	9/9	0.98	0.04	6,8,10,12	0
3	F3S	G	401	6/7	0.98	0.04	17,17,17,18	0
6	MET	I	404	9/9	0.98	0.05	8,9,10,10	0
6	MET	K	404	9/9	0.98	0.05	9,11,13,14	0
7	IMD	A	405	5/5	0.98	0.05	10,12,15,16	0
5	5AD	C	403	18/18	0.98	0.04	6,9,10,11	0
8	CL	K	405	1/1	0.98	0.05	22,22,22,22	0
5	5AD	I	403	18/18	0.98	0.04	5,9,11,12	0
6	MET	A	404	9/9	0.99	0.05	5,8,10,11	0
6	MET	C	404	9/9	0.99	0.04	5,7,10,10	0
3	F3S	K	401	6/7	0.99	0.02	11,12,13,13	0
8	CL	A	406	1/1	0.99	0.05	27,27,27,27	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	SF4	I	402	8/8	0.99	0.03	10,11,13,14	0
4	SF4	K	402	8/8	0.99	0.02	12,13,14,14	0
4	SF4	E	402	8/8	1.00	0.02	9,10,11,11	0
3	F3S	E	401	6/7	1.00	0.02	10,12,13,14	0
3	F3S	A	401	6/7	1.00	0.02	10,11,11,12	0
3	F3S	I	401	6/7	1.00	0.02	9,10,11,12	0
3	F3S	C	401	6/7	1.00	0.01	9,10,11,11	0
4	SF4	A	402	8/8	1.00	0.02	9,10,11,11	0
4	SF4	C	402	8/8	1.00	0.02	8,9,10,10	0

6.5 Other polymers ⓘ

There are no such residues in this entry.