



wwPDB X-ray Structure Validation Summary Report ⓘ

May 7, 2026 – 09:51 AM EDT

PDB ID : 5LP7 / pdb_00005lp7
Title : Crystal structure of 3-Ketoacyl-CoA Thiolase (MmgA) from *Bacillus subtilis*.
Authors : Baker, G.E.; Race, P.R.
Deposited on : 2016-08-11
Resolution : 2.20 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

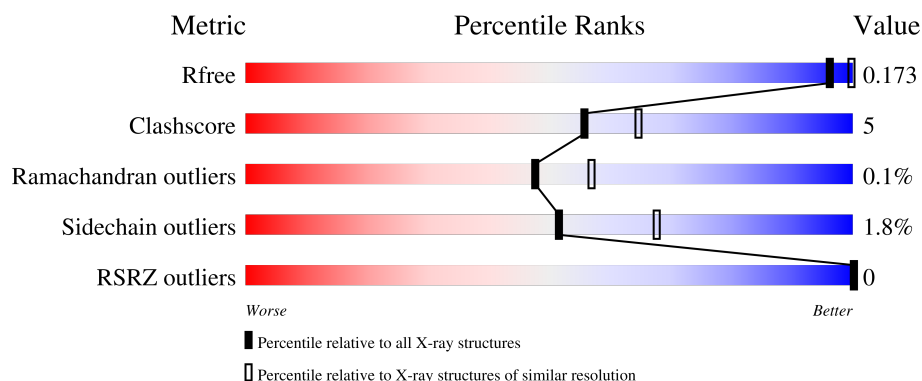
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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.



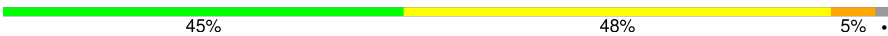
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	6164 (2.20-2.20)
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (2.20-2.20)

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	393	
1	B	393	
1	C	393	
1	D	393	
1	E	393	

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Mol	Chain	Length	Quality of chain
1	F	393	
1	G	393	
1	H	393	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	GOL	B	401	-	X	-	-

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 22740 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 Acetyl-CoA acetyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	386	Total	C	N	O	S	0	0	0
			2733	1707	484	524	18			
1	E	386	Total	C	N	O	S	0	0	0
			2740	1702	490	531	17			
1	A	386	Total	C	N	O	S	0	0	0
			2730	1703	486	523	18			
1	B	388	Total	C	N	O	S	0	0	0
			2753	1716	491	528	18			
1	C	387	Total	C	N	O	S	0	0	0
			2749	1713	497	522	17			
1	F	380	Total	C	N	O	S	0	0	0
			2641	1648	468	507	18			
1	G	385	Total	C	N	O	S	0	0	0
			2728	1702	482	528	16			
1	D	386	Total	C	N	O	S	0	0	0
			2740	1710	491	521	18			

- Molecule 2 is GLYCEROL (CCD ID: GOL) (formula: C₃H₈O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	E	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	B	1	Total	C	O	0	0
			6	3	3		
2	B	1	Total	C	O	0	0
			6	3	3		
2	C	1	Total	C	O	0	0
			6	3	3		
2	F	1	Total	C	O	0	0
			6	3	3		
2	G	1	Total	C	O	0	0
			6	3	3		
2	D	1	Total	C	O	0	0
			6	3	3		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	H	82	Total	O	0	0
			82	82		
3	E	80	Total	O	0	0
			80	80		
3	A	110	Total	O	0	0
			110	110		
3	B	146	Total	O	0	0
			146	146		

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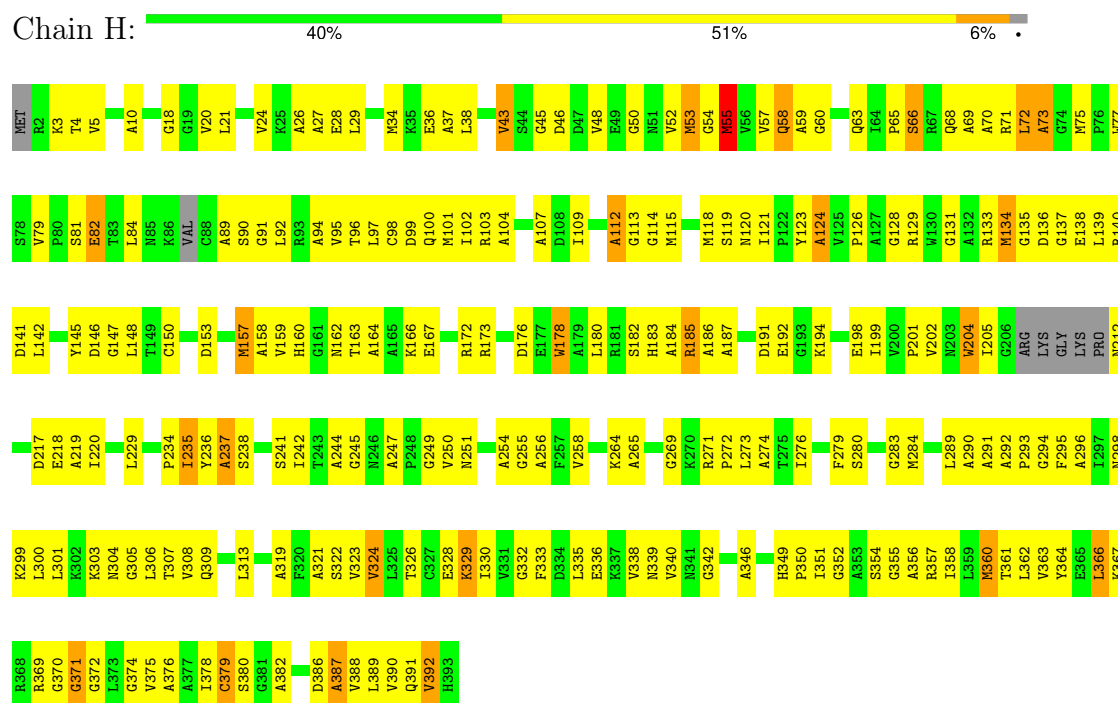
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	C	136	Total 136	O 136	0	0
3	F	80	Total 80	O 80	0	0
3	G	119	Total 119	O 119	0	0
3	D	125	Total 125	O 125	0	0

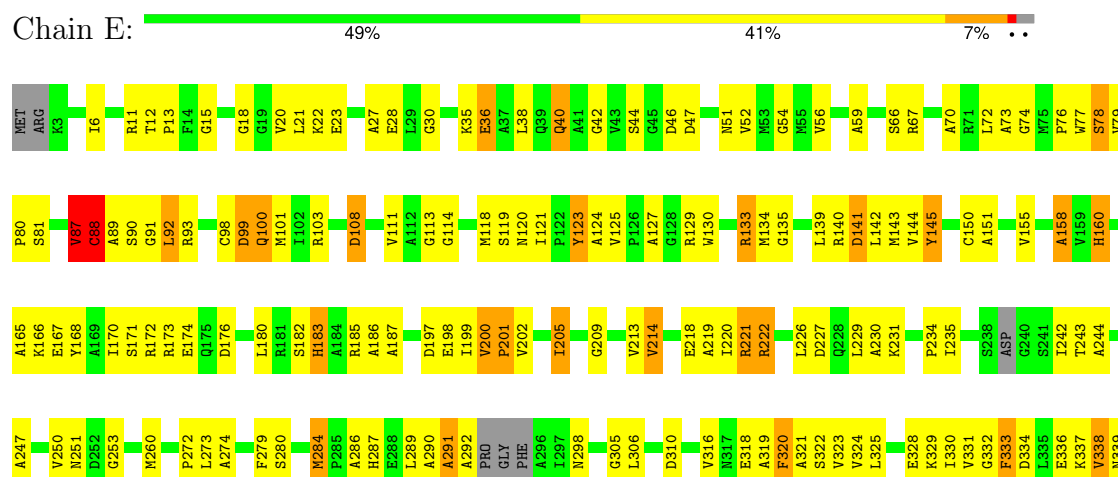
3 Residue-property plots

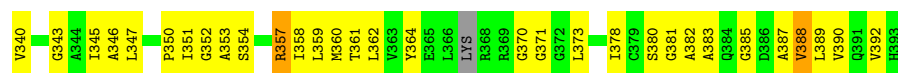
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

• Molecule 1: Acetyl-CoA acetyltransferase



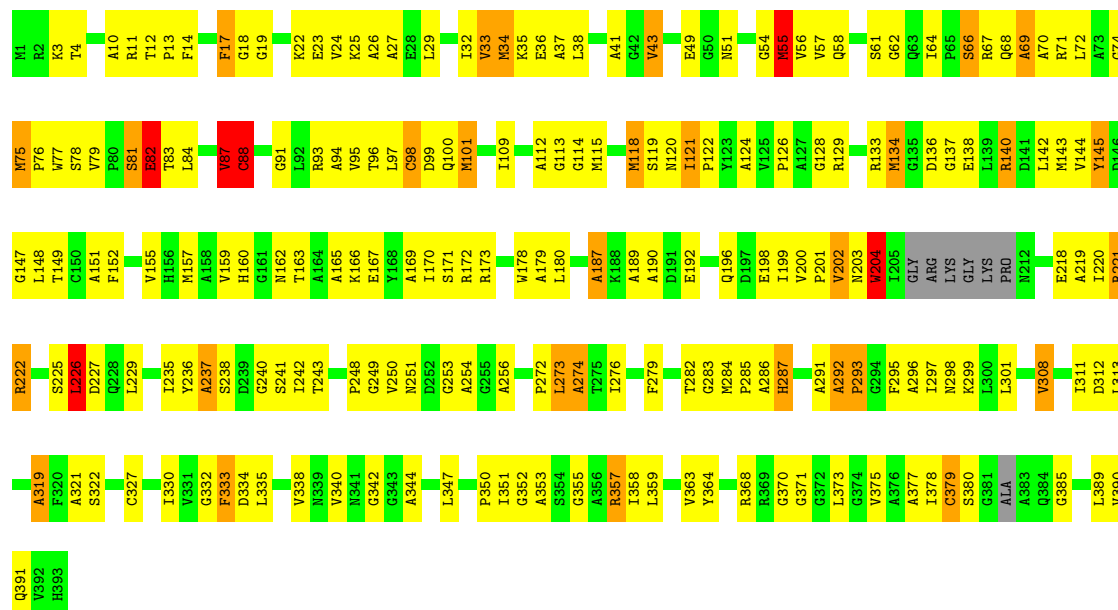
• Molecule 1: Acetyl-CoA acetyltransferase





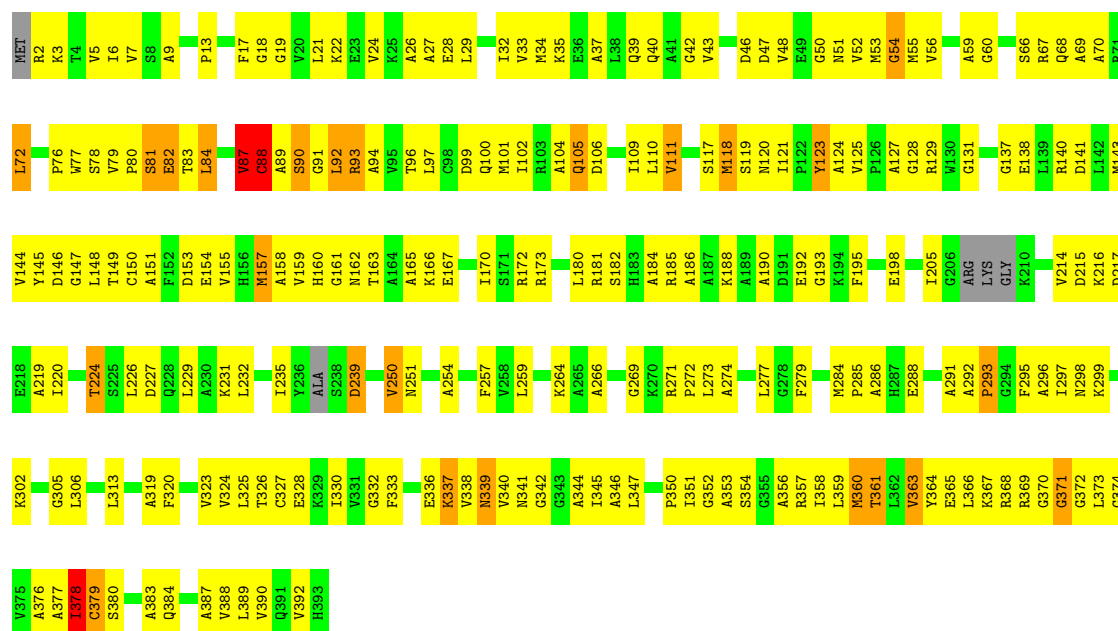
• Molecule 1: Acetyl-CoA acetyltransferase

Chain A: 45% 44% 8% ..



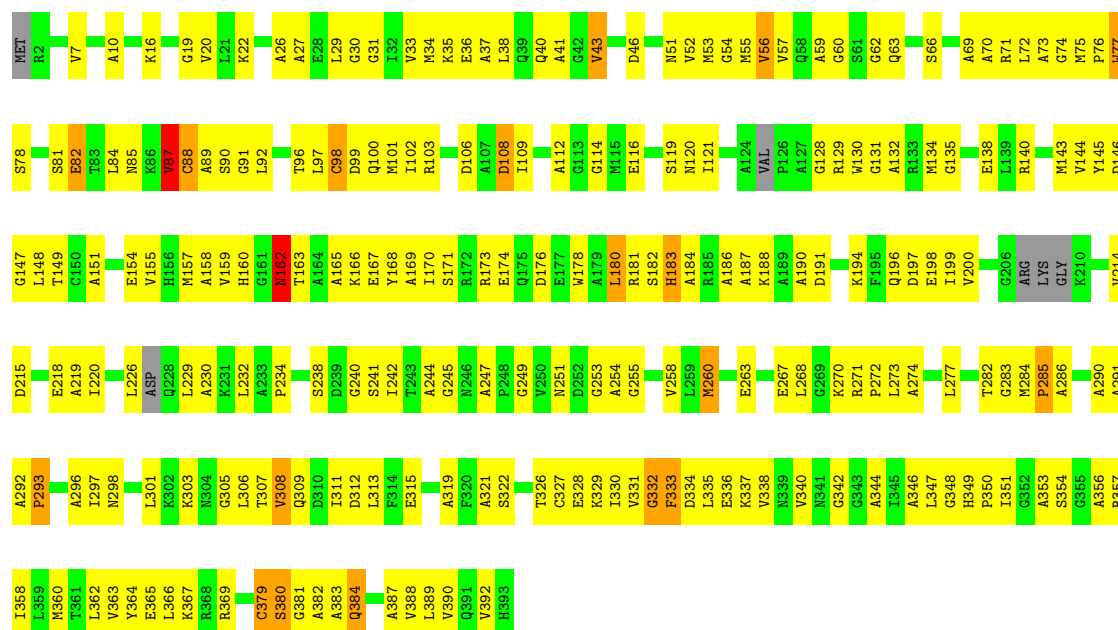
• Molecule 1: Acetyl-CoA acetyltransferase

Chain B: 41% 51% 6% ..



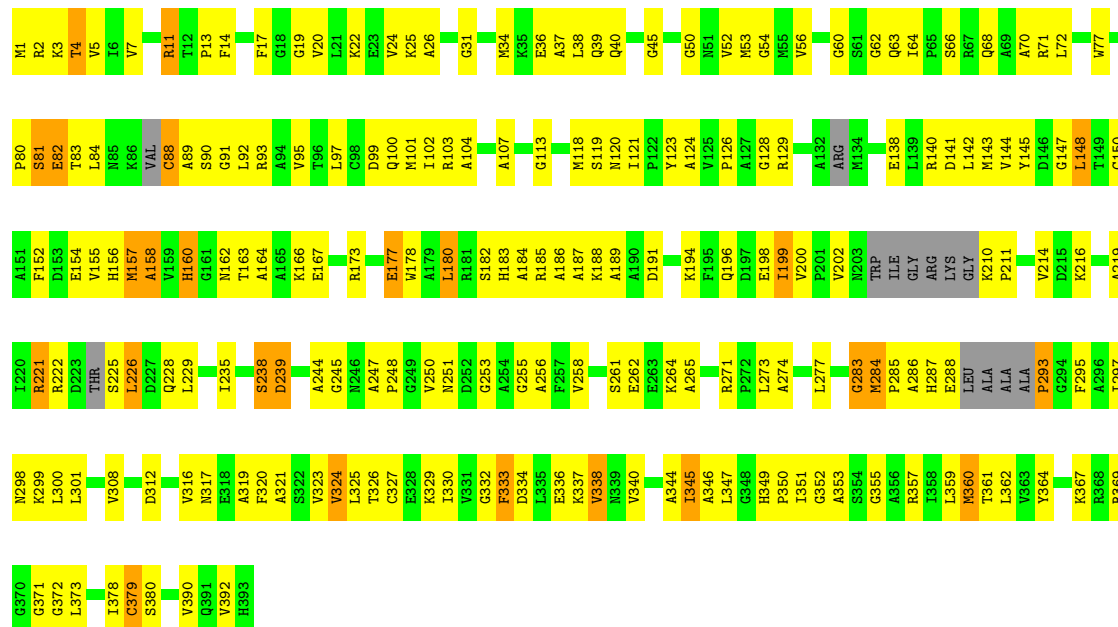
• Molecule 1: Acetyl-CoA acetyltransferase

Chain C: 41% 53% 5% ..



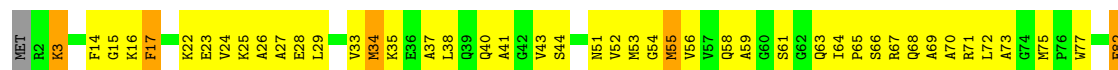
• Molecule 1: Acetyl-CoA acetyltransferase

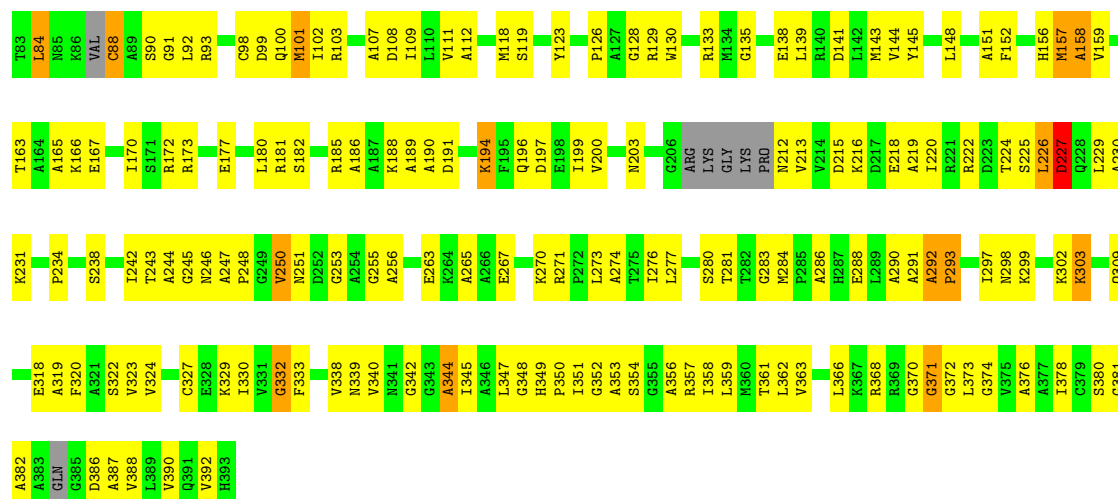
Chain F: 45% 45% 6% .



• Molecule 1: Acetyl-CoA acetyltransferase

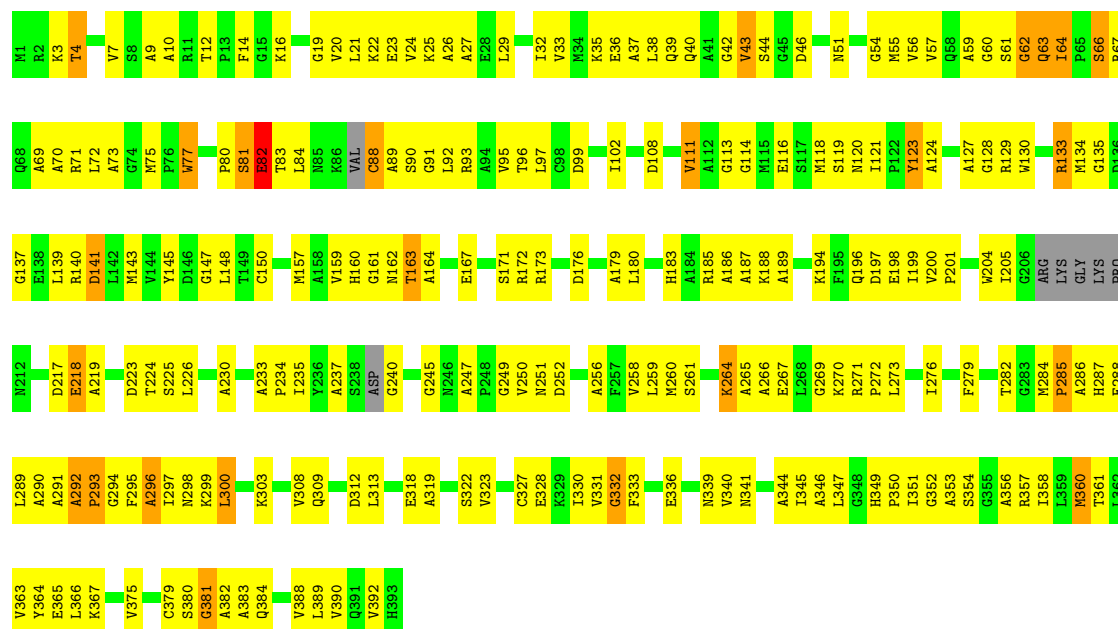
Chain G: 45% 48% 5% .





• Molecule 1: Acetyl-CoA acetyltransferase

Chain D: 41% 51% 6%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	55.18Å 141.12Å 211.46Å 90.00° 89.98° 90.00°	Depositor
Resolution (Å)	31.92 – 2.20 31.92 – 2.20	Depositor EDS
% Data completeness (in resolution range)	98.3 (31.92-2.20) 98.3 (31.92-2.20)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.93 (at 2.20Å)	Xtriage
Refinement program	REFMAC 5.8.0103	Depositor
R, R_{free}	0.150 , 0.205 0.169 , 0.173	Depositor DCC
R_{free} test set	7962 reflections (4.86%)	wwPDB-VP
Wilson B-factor (Å ²)	19.3	Xtriage
Anisotropy	0.139	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 8.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.40$, $\langle L^2 \rangle = 0.23$	Xtriage
Estimated twinning fraction	0.426 for h,-k,-l	Xtriage
Reported twinning fraction	0.425 for H, K, L 0.575 for -h,-k,l	Depositor
Outliers	5 of 161152 reflections (0.003%)	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	22740	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.99% 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:
GOL

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	2.85	179/2769 (6.5%)	2.22	110/3742 (2.9%)
1	B	2.78	201/2792 (7.2%)	1.99	97/3773 (2.6%)
1	C	2.70	205/2787 (7.4%)	1.85	84/3762 (2.2%)
1	D	2.75	187/2778 (6.7%)	1.92	79/3753 (2.1%)
1	E	2.72	169/2777 (6.1%)	1.95	73/3756 (1.9%)
1	F	2.68	163/2675 (6.1%)	1.98	92/3614 (2.5%)
1	G	2.70	178/2766 (6.4%)	1.89	75/3733 (2.0%)
1	H	2.58	193/2772 (7.0%)	1.96	80/3741 (2.1%)
All	All	2.72	1475/22116 (6.7%)	1.97	690/29874 (2.3%)

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	A	0	9
1	B	0	6
1	C	0	4
1	D	0	6
1	E	0	4
1	F	0	4
1	G	0	3
1	H	0	2
All	All	0	38

The worst 5 of 1475 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	307	THR	C-N	-40.01	0.90	1.34
1	B	87	VAL	C-N	-33.82	0.91	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	G	101	MET	C-N	-32.61	0.92	1.33
1	A	87	VAL	C-N	-31.64	0.93	1.33
1	E	99	ASP	C-N	-31.29	0.93	1.33

The worst 5 of 690 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	222	ARG	O-C-N	-34.59	76.58	122.59
1	D	82	GLU	O-C-N	-25.01	98.70	123.46
1	A	371	GLY	N-CA-C	22.28	136.83	112.33
1	D	332	GLY	O-C-N	-22.02	100.83	122.41
1	G	101	MET	CA-C-O	-20.69	98.49	120.42

There are no chirality outliers.

5 of 38 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	E	221	ARG	Mainchain
1	E	222	ARG	Mainchain
1	E	88	CYS	Mainchain
1	H	134	MET	Mainchain
1	H	55	MET	Mainchain

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	2730	0	2591	35	0
1	B	2753	0	2631	22	0
1	C	2749	0	2636	20	0
1	D	2740	0	2642	22	0
1	E	2740	0	2625	30	0
1	F	2641	0	2480	32	0
1	G	2728	0	2603	24	0
1	H	2733	0	2622	24	0
2	A	6	0	8	0	0
2	B	12	0	16	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	6	0	8	0	0
2	D	6	0	8	0	0
2	E	6	0	8	0	0
2	F	6	0	8	0	0
2	G	6	0	8	0	0
3	A	110	0	0	0	0
3	B	146	0	0	0	0
3	C	136	0	0	0	0
3	D	125	0	0	0	0
3	E	80	0	0	0	0
3	F	80	0	0	0	0
3	G	119	0	0	0	0
3	H	82	0	0	0	0
All	All	22740	0	20894	201	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 201 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:D:62:GLY:C	1:D:63:GLN:N	1.70	1.50
1:A:66:SER:OG	1:A:82:GLU:O	1.62	1.15
1:F:333:PHE:CD1	1:F:338:VAL:HG21	1.90	1.05
1:F:333:PHE:CE1	1:F:338:VAL:HG21	1.93	1.03
1:E:333:PHE:CD1	1:E:338:VAL:HG21	1.95	1.01

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	380/393 (97%)	375 (99%)	4 (1%)	1 (0%)	36	42
1	B	382/393 (97%)	374 (98%)	7 (2%)	1 (0%)	36	42
1	C	379/393 (96%)	373 (98%)	5 (1%)	1 (0%)	36	42
1	D	378/393 (96%)	370 (98%)	8 (2%)	0	100	100
1	E	378/393 (96%)	370 (98%)	7 (2%)	1 (0%)	36	42
1	F	368/393 (94%)	361 (98%)	7 (2%)	0	100	100
1	G	377/393 (96%)	370 (98%)	7 (2%)	0	100	100
1	H	380/393 (97%)	374 (98%)	6 (2%)	0	100	100
All	All	3022/3144 (96%)	2967 (98%)	51 (2%)	4 (0%)	48	57

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	87	VAL
1	B	87	VAL
1	C	87	VAL
1	A	87	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	256/291 (88%)	254 (99%)	2 (1%)	73	85
1	B	259/291 (89%)	251 (97%)	8 (3%)	35	48
1	C	255/291 (88%)	252 (99%)	3 (1%)	63	78
1	D	255/291 (88%)	250 (98%)	5 (2%)	48	64
1	E	259/291 (89%)	255 (98%)	4 (2%)	57	73
1	F	239/291 (82%)	236 (99%)	3 (1%)	61	76
1	G	256/291 (88%)	250 (98%)	6 (2%)	44	59
1	H	257/291 (88%)	252 (98%)	5 (2%)	50	66
All	All	2036/2328 (88%)	2000 (98%)	36 (2%)	51	68

5 of 36 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	G	84	LEU
1	D	345	ILE
1	G	224	THR
1	D	88	CYS
1	B	87	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 17 such sidechains are listed below:

Mol	Chain	Res	Type
1	G	203	ASN
1	D	317	ASN
1	B	175	GLN
1	C	120	ASN
1	C	212	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](#)

8 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	GOL	C	401	-	5,5,5	0.36	0	5,5,5	0.92	0
2	GOL	G	401	-	5,5,5	0.48	0	5,5,5	1.06	0
2	GOL	D	401	-	5,5,5	0.47	0	5,5,5	0.86	0
2	GOL	B	401	-	5,5,5	0.46	0	5,5,5	1.81	2 (40%)
2	GOL	F	401	-	5,5,5	0.24	0	5,5,5	0.55	0
2	GOL	E	401	-	5,5,5	0.84	0	5,5,5	0.68	0
2	GOL	A	401	-	5,5,5	0.62	0	5,5,5	1.04	0
2	GOL	B	402	-	5,5,5	0.43	0	5,5,5	0.39	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	GOL	C	401	-	-	0/4/4/4	-
2	GOL	G	401	-	-	0/4/4/4	-
2	GOL	D	401	-	-	0/4/4/4	-
2	GOL	B	401	-	-	4/4/4/4	-
2	GOL	F	401	-	-	4/4/4/4	-
2	GOL	E	401	-	-	2/4/4/4	-
2	GOL	A	401	-	-	2/4/4/4	-
2	GOL	B	402	-	-	2/4/4/4	-

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	401	GOL	O3-C3-C2	3.14	124.53	110.38
2	B	401	GOL	O2-C2-C3	2.26	118.54	109.18

There are no chirality outliers.

5 of 14 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	E	401	GOL	C1-C2-C3-O3
2	B	401	GOL	O1-C1-C2-C3
2	B	402	GOL	C1-C2-C3-O3
2	B	402	GOL	O2-C2-C3-O3
2	F	401	GOL	O1-C1-C2-C3

There are no ring outliers.

No monomer is involved in short contacts.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	A	17
1	E	16
1	D	13
1	F	13
1	G	13
1	H	11
1	B	11
1	C	11

The worst 5 of 105 chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	D	62:GLY	C	63:GLN	N	1.70
1	H	204:TRP	C	205:ILE	N	1.20
1	F	82:GLU	C	83:THR	N	1.20
1	H	363:VAL	C	364:TYR	N	1.19
1	B	217:ASP	C	218:GLU	N	1.19

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	386/393 (98%)	-1.44	0 100 100	11, 21, 36, 58	0
1	B	388/393 (98%)	-1.50	0 100 100	10, 18, 32, 48	0
1	C	387/393 (98%)	-1.49	0 100 100	9, 17, 30, 62	0
1	D	386/393 (98%)	-1.49	0 100 100	10, 19, 37, 53	0
1	E	386/393 (98%)	-1.46	0 100 100	11, 21, 37, 51	0
1	F	380/393 (96%)	-1.44	0 100 100	12, 22, 40, 62	0
1	G	385/393 (97%)	-1.48	0 100 100	11, 19, 34, 58	0
1	H	386/393 (98%)	-1.50	0 100 100	10, 19, 33, 49	0
All	All	3084/3144 (98%)	-1.48	0 100 100	9, 19, 35, 62	0

There are no RSRZ outliers to report.

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
2	GOL	B	402	6/6	0.98	0.05	36,37,40,42	0
2	GOL	C	401	6/6	0.98	0.06	35,43,45,50	0
2	GOL	F	401	6/6	0.98	0.06	49,52,56,63	0
2	GOL	E	401	6/6	0.99	0.05	25,29,35,38	0
2	GOL	A	401	6/6	0.99	0.05	28,32,34,36	0
2	GOL	B	401	6/6	0.99	0.05	25,25,28,32	0
2	GOL	G	401	6/6	0.99	0.04	14,16,17,18	0
2	GOL	D	401	6/6	0.99	0.03	31,35,36,38	0

6.5 Other polymers [i](#)

There are no such residues in this entry.