



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 25, 2026 – 12:30 PM EDT

PDB ID : 5BYV / pdb_00005byv
Title : Crystal structure of MSM-13, a putative T1-like thiolase from Mycobacterium smegmatis
Authors : Janardan, N.; Harijan, R.K.; Keima, T.R.; Wierenga, R.; Murthy, M.R.N.
Deposited on : 2015-06-11
Resolution : 2.16 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
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

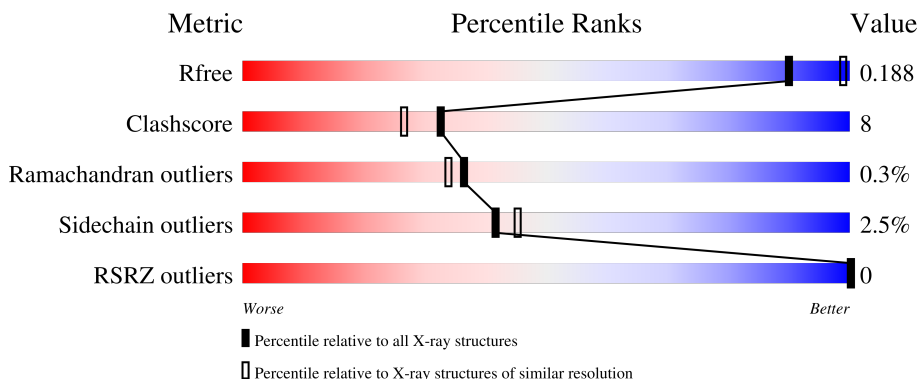
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.16 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	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (2.16-2.16)

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	407	78% 18% ..
1	B	407	80% 17% .
1	C	407	79% 17% ..
1	D	407	85% 11% ..
1	E	407	82% 14% ..

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Mol	Chain	Length	Quality of chain
1	F	407	 81% 15% ..
1	G	407	 79% 17% ..
1	H	407	 80% 17% ..
1	J	407	 81% 16% ..
1	K	407	 85% 12% ..
1	L	407	 73% 24% ..
1	M	407	 78% 17% ..

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 36700 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 Beta-ketothiolase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	396	Total 2895	C 1795	N 529	O 555	S 16	0	0	0
1	B	398	Total 2938	C 1819	N 540	O 563	S 16	0	0	0
1	C	398	Total 2933	C 1814	N 539	O 564	S 16	0	0	0
1	D	396	Total 2924	C 1811	N 538	O 559	S 16	0	0	0
1	E	396	Total 2925	C 1810	N 538	O 561	S 16	0	0	0
1	F	399	Total 2947	C 1824	N 542	O 565	S 16	0	0	0
1	G	398	Total 2940	C 1820	N 540	O 564	S 16	0	0	0
1	H	397	Total 2933	C 1816	N 540	O 561	S 16	0	0	0
1	J	396	Total 2925	C 1810	N 538	O 561	S 16	0	0	0
1	K	399	Total 2949	C 1825	N 542	O 566	S 16	0	0	0
1	L	398	Total 2932	C 1816	N 540	O 560	S 16	0	0	0
1	M	397	Total 2933	C 1816	N 540	O 561	S 16	0	0	0

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	125	Total 125	O 125	0	0
2	B	145	Total 145	O 145	0	0

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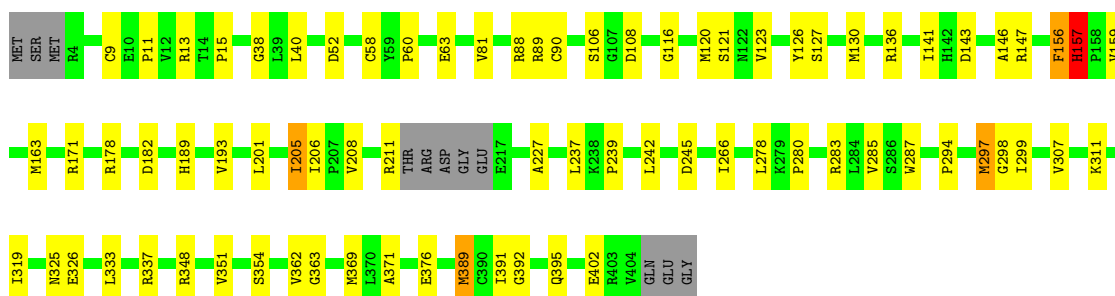
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	C	131	Total 131	O 131	0	0
2	D	156	Total 156	O 156	0	0
2	E	105	Total 105	O 105	0	0
2	F	129	Total 129	O 129	0	0
2	G	114	Total 114	O 114	0	0
2	H	154	Total 154	O 154	0	0
2	J	120	Total 120	O 120	0	0
2	K	142	Total 142	O 142	0	0
2	L	99	Total 99	O 99	0	0
2	M	106	Total 106	O 106	0	0

3 Residue-property plots [i](#)


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

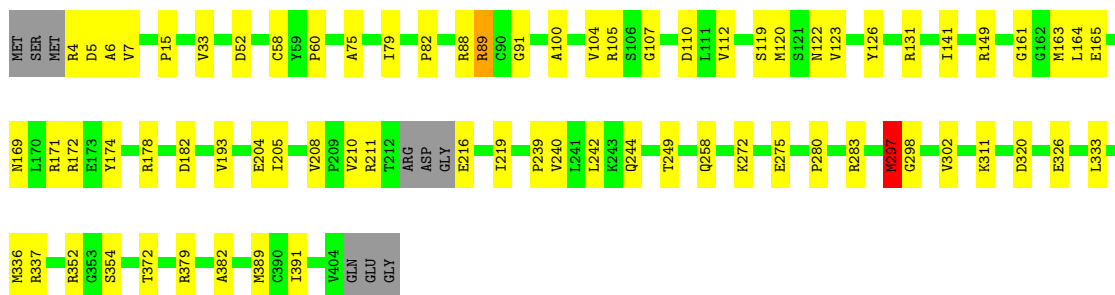
- Molecule 1: Beta-ketothiolase

Chain A: 




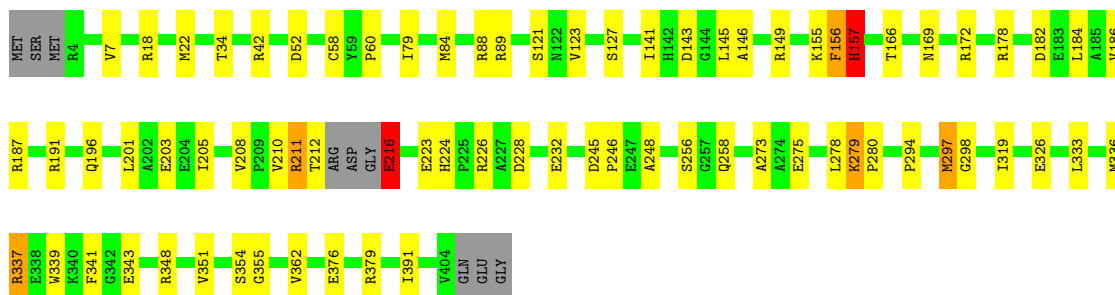
- Molecule 1: Beta-ketothiolase

Chain B: 




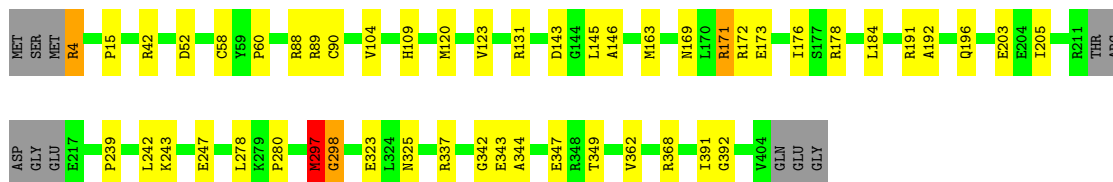
- Molecule 1: Beta-ketothiolase

Chain C: 




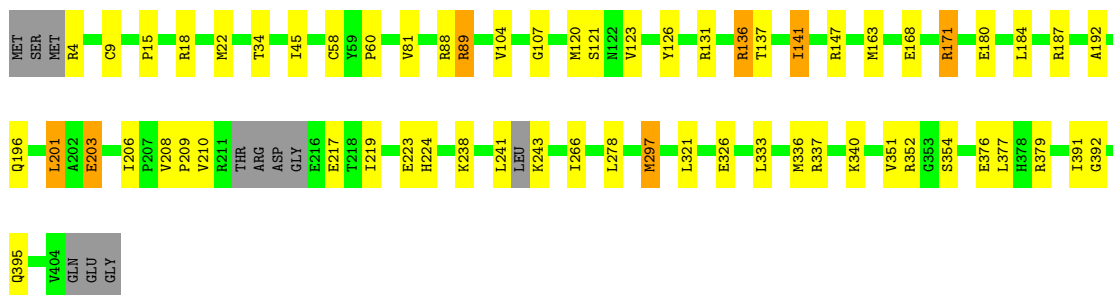
- Molecule 1: Beta-ketothiolase

Chain D:  85% 11%




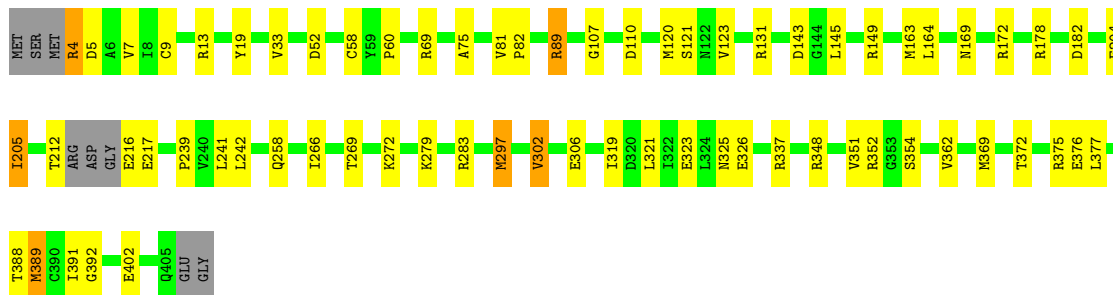
- Molecule 1: Beta-ketothiolase

Chain E:  82% 14%




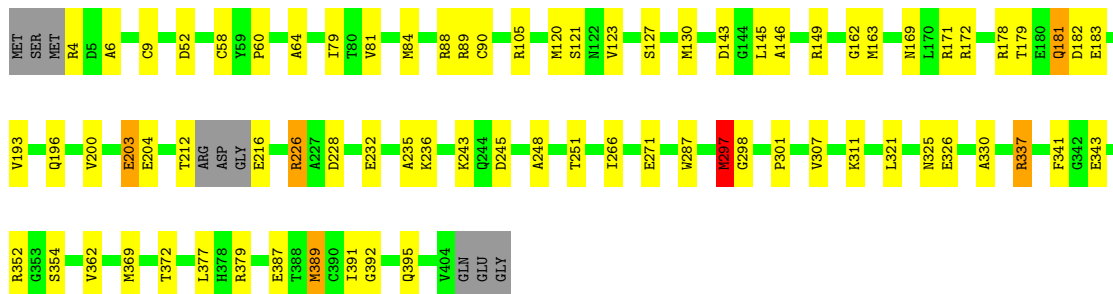
- Molecule 1: Beta-ketothiolase

Chain F:  81% 15%




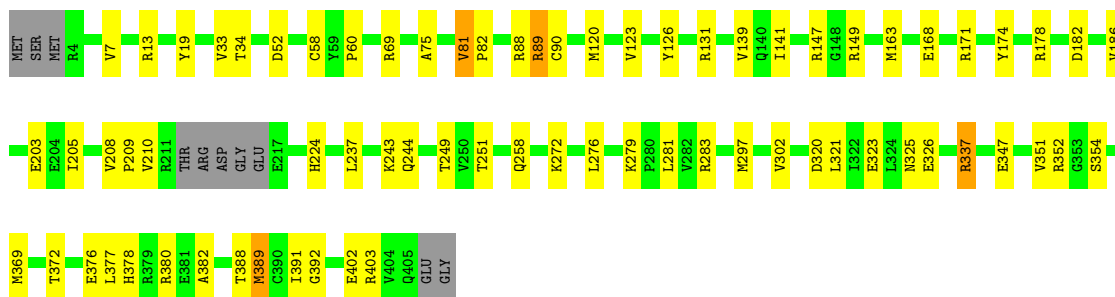
- Molecule 1: Beta-ketothiolase

Chain G:  79% 17%




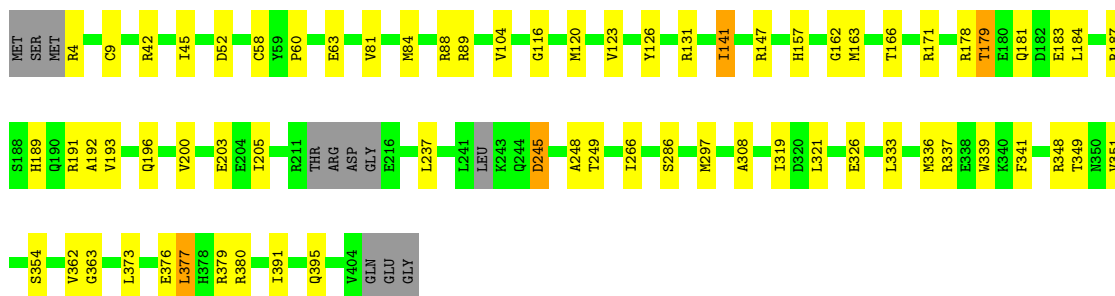
- Molecule 1: Beta-ketothiolase

Chain H:  80% 17% ..




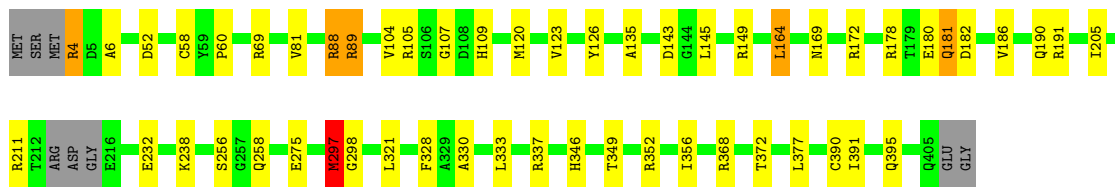
• Molecule 1: Beta-ketothiolase

Chain J:  81% 16% ..



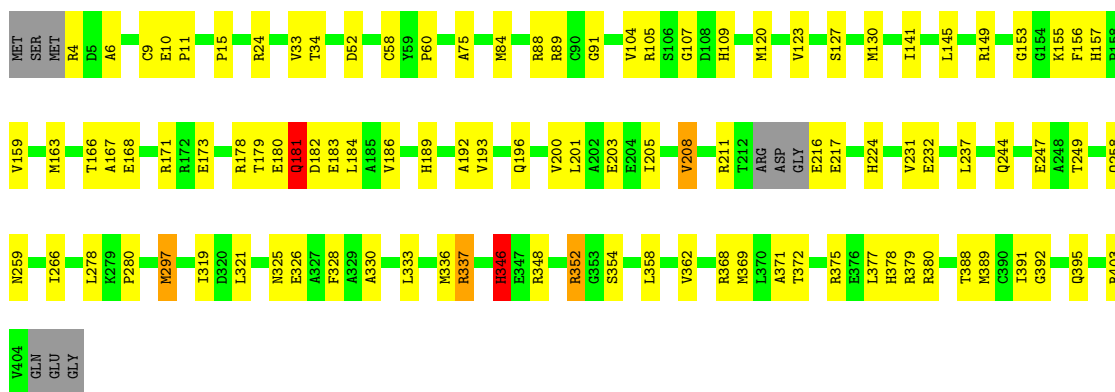
• Molecule 1: Beta-ketothiolase

Chain K:  85% 12% ..




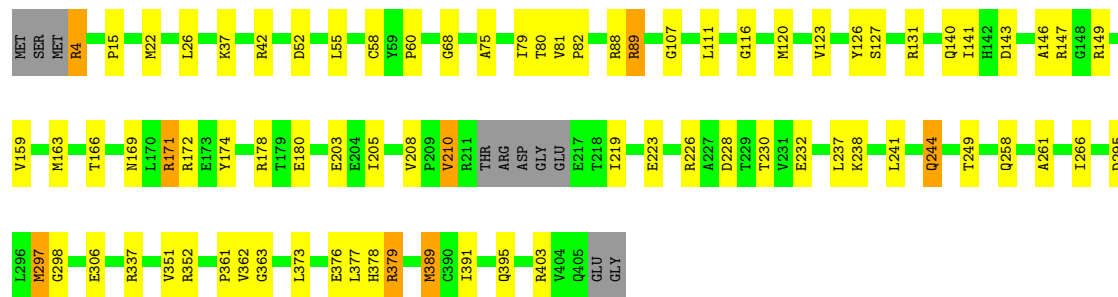
• Molecule 1: Beta-ketothiolase

Chain L:  73% 24% ..



- Molecule 1: Beta-ketothiolase

Chain M:  78% 17% ..



4 Data and refinement statistics

Property	Value	Source
Space group	P 61	Depositor
Cell constants a, b, c, α , β , γ	190.96Å 190.96Å 264.68Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	45.19 – 2.16 45.19 – 2.16	Depositor EDS
% Data completeness (in resolution range)	99.9 (45.19-2.16) 99.9 (45.19-2.16)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.32 (at 2.16Å)	Xtrriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.169 , 0.200 0.170 , 0.188	Depositor DCC
R_{free} test set	14680 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å ²)	28.6	Xtrriage
Anisotropy	0.047	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 36.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.28$	Xtrriage
Estimated twinning fraction	0.226 for h,-h-k,-l	Xtrriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	36700	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 25.40 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 3.1919e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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

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	0.56	0/2939	0.91	8/3990 (0.2%)
1	B	0.56	0/2982	0.90	4/4044 (0.1%)
1	C	0.65	3/2977 (0.1%)	1.04	17/4039 (0.4%)
1	D	0.60	0/2968	0.89	3/4025 (0.1%)
1	E	0.54	0/2968	0.90	4/4023 (0.1%)
1	F	0.56	0/2991	0.90	5/4056 (0.1%)
1	G	0.56	0/2984	0.91	3/4047 (0.1%)
1	H	0.58	1/2977 (0.0%)	0.91	10/4037 (0.2%)
1	J	0.54	0/2968	0.90	4/4023 (0.1%)
1	K	0.57	0/2993	0.89	4/4059 (0.1%)
1	L	0.52	0/2976	0.93	10/4037 (0.2%)
1	M	0.54	0/2977	0.91	5/4037 (0.1%)
All	All	0.57	4/35700 (0.0%)	0.92	77/48417 (0.2%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	216	GLU	CB-CG	11.03	1.85	1.52
1	C	216	GLU	CG-CD	8.36	1.73	1.52
1	C	216	GLU	CA-CB	6.95	1.67	1.53
1	H	389	MET	CG-SD	-5.24	1.67	1.80

The worst 5 of 77 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	216	GLU	CA-CB-CG	14.93	143.95	114.10
1	C	216	GLU	CB-CG-CD	11.62	132.36	112.60
1	C	210	VAL	CA-C-N	-9.13	106.66	122.37
1	C	210	VAL	C-N-CA	-9.13	106.66	122.37
1	C	224	HIS	CA-C-N	-8.56	111.21	119.85

There are no chirality outliers.

There are no planarity outliers.

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	2895	0	2889	54	0
1	B	2938	0	2947	47	1
1	C	2933	0	2932	64	0
1	D	2924	0	2939	39	1
1	E	2925	0	2933	43	0
1	F	2947	0	2955	46	0
1	G	2940	0	2952	58	0
1	H	2933	0	2947	51	0
1	J	2925	0	2933	45	0
1	K	2949	0	2960	41	0
1	L	2932	0	2944	68	0
1	M	2933	0	2947	51	0
2	A	125	0	0	2	0
2	B	145	0	0	0	0
2	C	131	0	0	2	0
2	D	156	0	0	4	0
2	E	105	0	0	1	0
2	F	129	0	0	2	0
2	G	114	0	0	7	0
2	H	154	0	0	1	0
2	J	120	0	0	1	0
2	K	142	0	0	2	0
2	L	99	0	0	2	0
2	M	106	0	0	1	0
All	All	36700	0	35278	558	1

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 8.

The worst 5 of 558 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:C:216:GLU:CG	1:C:216:GLU:CB	1.85	1.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:163:MET:HG2	1:E:297:MET:HE1	1.42	0.99
1:D:297:MET:HG3	1:D:298:GLY:N	1.77	0.96
1:C:211:ARG:HD2	1:C:212:THR:H	1.33	0.93
1:B:149:ARG:NH2	1:B:258:GLN:OE1	2.04	0.90

All (1) 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)
1:B:337:ARG:NH2	1:D:342:GLY:CA[5_554]	2.08	0.12

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	392/407 (96%)	381 (97%)	9 (2%)	2 (0%)	24	20
1	B	394/407 (97%)	382 (97%)	11 (3%)	1 (0%)	36	34
1	C	394/407 (97%)	384 (98%)	9 (2%)	1 (0%)	36	34
1	D	392/407 (96%)	380 (97%)	9 (2%)	3 (1%)	16	10
1	E	390/407 (96%)	382 (98%)	8 (2%)	0	100	100
1	F	395/407 (97%)	386 (98%)	8 (2%)	1 (0%)	36	34
1	G	394/407 (97%)	382 (97%)	10 (2%)	2 (0%)	24	20
1	H	393/407 (97%)	385 (98%)	8 (2%)	0	100	100
1	J	390/407 (96%)	378 (97%)	11 (3%)	1 (0%)	36	34
1	K	395/407 (97%)	384 (97%)	10 (2%)	1 (0%)	36	34
1	L	394/407 (97%)	381 (97%)	13 (3%)	0	100	100
1	M	393/407 (97%)	383 (98%)	8 (2%)	2 (0%)	24	20
All	All	4716/4884 (97%)	4588 (97%)	114 (2%)	14 (0%)	36	34

5 of 14 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	343	GLU
1	A	136	ARG
1	D	297	MET
1	G	297	MET
1	K	297	MET

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	A	294/309 (95%)	289 (98%)	5 (2%)	53 60
1	B	301/309 (97%)	295 (98%)	6 (2%)	48 54
1	C	300/309 (97%)	292 (97%)	8 (3%)	39 41
1	D	300/309 (97%)	294 (98%)	6 (2%)	48 54
1	E	300/309 (97%)	291 (97%)	9 (3%)	36 38
1	F	302/309 (98%)	299 (99%)	3 (1%)	68 75
1	G	302/309 (98%)	290 (96%)	12 (4%)	28 27
1	H	301/309 (97%)	297 (99%)	4 (1%)	61 68
1	J	300/309 (97%)	295 (98%)	5 (2%)	53 60
1	K	303/309 (98%)	296 (98%)	7 (2%)	44 49
1	L	300/309 (97%)	285 (95%)	15 (5%)	22 18
1	M	301/309 (97%)	290 (96%)	11 (4%)	30 30
All	All	3604/3708 (97%)	3513 (98%)	91 (2%)	42 45

5 of 91 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	J	377	LEU
1	L	217	GLU
1	K	104	VAL
1	L	141	ILE

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Mol	Chain	Res	Type
1	L	247	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 35 such sidechains are listed below:

Mol	Chain	Res	Type
1	K	346	HIS
1	L	142	HIS
1	M	157	HIS
1	D	103	GLN
1	D	99	GLN

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](#)

There are no ligands in this entry.

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	396/407 (97%)	-1.36	0 100 100	16, 31, 50, 66	0
1	B	398/407 (97%)	-1.40	0 100 100	14, 27, 49, 73	0
1	C	398/407 (97%)	-1.36	0 100 100	15, 30, 53, 73	0
1	D	396/407 (97%)	-1.43	0 100 100	15, 24, 45, 62	0
1	E	396/407 (97%)	-1.35	0 100 100	17, 32, 53, 70	0
1	F	399/407 (98%)	-1.40	0 100 100	16, 28, 50, 75	0
1	G	398/407 (97%)	-1.37	0 100 100	16, 30, 54, 72	0
1	H	397/407 (97%)	-1.44	0 100 100	16, 25, 45, 67	0
1	J	396/407 (97%)	-1.36	0 100 100	15, 31, 54, 68	0
1	K	399/407 (98%)	-1.42	0 100 100	15, 26, 50, 76	0
1	L	398/407 (97%)	-1.28	0 100 100	18, 36, 56, 76	0
1	M	397/407 (97%)	-1.35	0 100 100	20, 31, 53, 73	0
All	All	4768/4884 (97%)	-1.38	0 100 100	14, 29, 52, 76	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

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.