



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 27, 2023 – 06:07 AM EDT

PDB ID : 3HPS
Title : Crystal structure of Mycobacterium tuberculosis LeuA complexed with ke-
toisocaproate (KIC)
Authors : Koon, N.; Squire, C.J.; Baker, E.N.
Deposited on : 2009-06-04
Resolution : 1.80 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.35
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.35

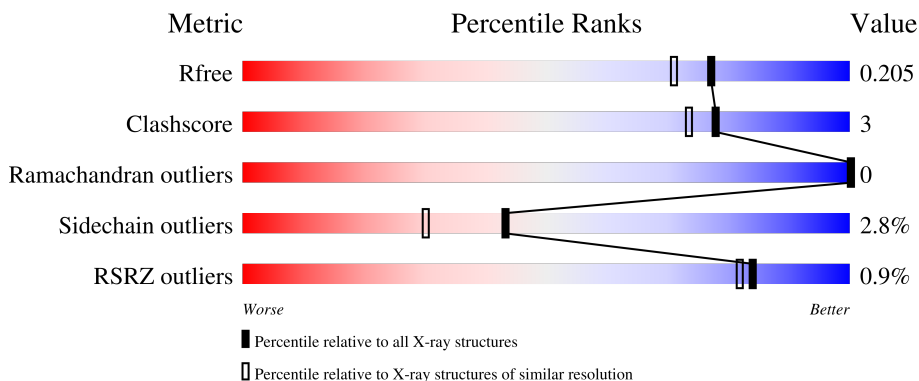
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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}	130704	5950 (1.80-1.80)
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)
RSRZ outliers	127900	5850 (1.80-1.80)

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	644	 83% 5% • 11%
1	B	644	 84% 5% 10%

2 Entry composition [i](#)

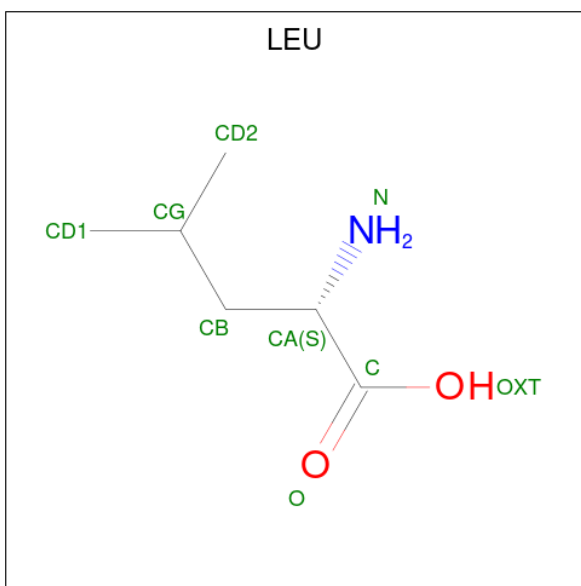
There are 6 unique types of molecules in this entry. The entry contains 9868 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 2-isopropylmalate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	575	Total 4369	C 2746	N 759	O 844	S 20	0	4	0
1	B	577	Total 4398	C 2765	N 769	O 844	S 20	0	6	0

- Molecule 2 is LEUCINE (three-letter code: LEU) (formula: C₆H₁₃NO₂).

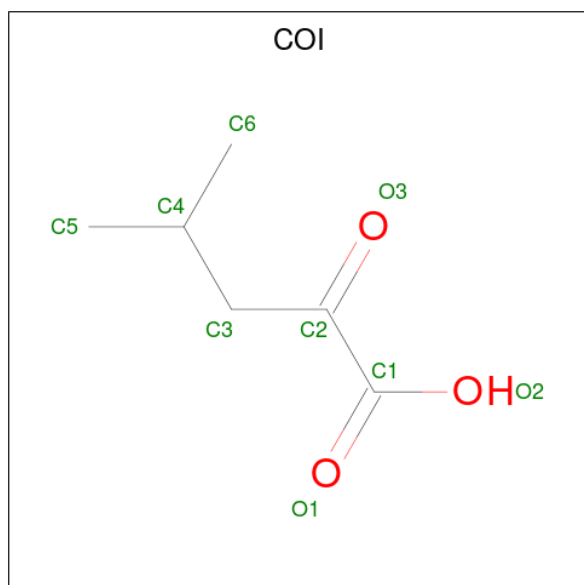


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	Total 9	C 6	N 1	O 2	0	0
2	B	1	Total 9	C 6	N 1	O 2	0	0

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Zn	0	0
			1	1		
3	B	1	Total	Zn	0	0
			1	1		

- Molecule 4 is 2-OXO-4-METHYLPENTANOIC ACID (three-letter code: COI) (formula: $C_6H_{10}O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			9	6	3		
4	B	1	Total	C	O	0	0
			9	6	3		

- Molecule 5 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



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

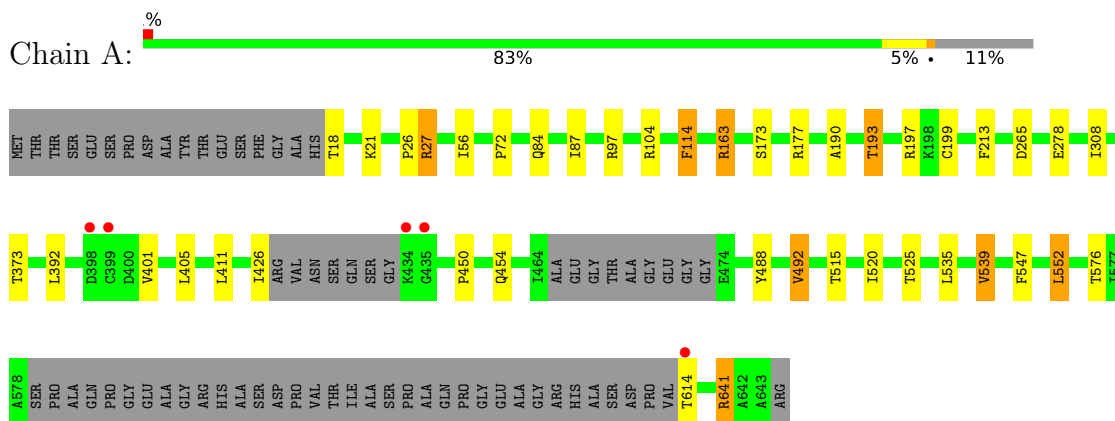
- Molecule 6 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	552	Total O 552 552	0	0
6	B	499	Total O 499 499	0	0

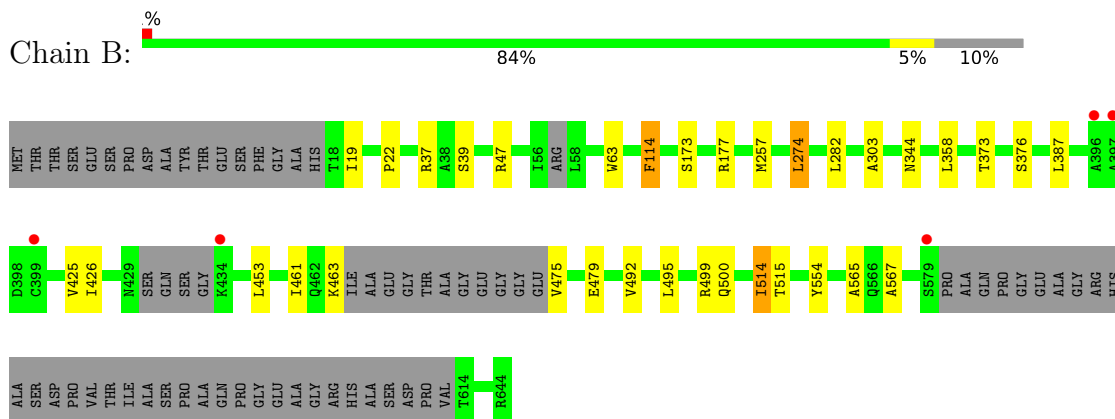
3 Residue-property plots i

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: 2-isopropylmalate synthase



- Molecule 1: 2-isopropylmalate synthase



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	54.41Å 154.85Å 68.88Å 90.00° 97.65° 90.00°	Depositor
Resolution (Å)	50.00 – 1.80 41.17 – 1.80	Depositor EDS
% Data completeness (in resolution range)	90.5 (50.00-1.80) 90.5 (41.17-1.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.50 (at 1.79Å)	Xtrriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.158 , 0.205 0.158 , 0.205	Depositor DCC
R_{free} test set	4754 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å ²)	16.8	Xtrriage
Anisotropy	0.295	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 47.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	9868	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.63% 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: GOL, COI, ZN

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	0.76	0/4476	0.73	4/6114 (0.1%)
1	B	0.72	0/4510	0.75	3/6154 (0.0%)
All	All	0.74	0/8986	0.74	7/12268 (0.1%)

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	257	MET	CG-SD-CE	-13.26	78.99	100.20
1	A	163	ARG	NE-CZ-NH1	-6.66	116.97	120.30
1	B	274	LEU	CA-CB-CG	6.07	129.27	115.30
1	A	163	ARG	NE-CZ-NH2	5.79	123.19	120.30
1	A	552	LEU	CB-CG-CD1	5.20	119.85	111.00
1	B	274	LEU	CB-CG-CD1	5.20	119.84	111.00
1	A	492	VAL	CG1-CB-CG2	5.16	119.16	110.90

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4369	0	4175	32	0
1	B	4398	0	4223	20	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	9	0	10	0	0
2	B	9	0	10	2	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	9	0	9	0	0
4	B	9	0	9	0	0
5	A	6	0	8	0	0
5	B	6	0	8	0	0
6	A	552	0	0	12	0
6	B	499	0	0	5	0
All	All	9868	0	8452	50	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 3.

All (50) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:27:ARG:HH11	1:A:27:ARG:HG3	1.15	1.09
1:A:193:THR:HG23	1:A:197:ARG:NH1	1.79	0.98
1:A:193:THR:HG23	1:A:197:ARG:HH12	1.25	0.98
1:B:114:PHE:HE2	6:B:964:HOH:O	1.66	0.79
1:A:26:PRO:HG3	6:A:987:HOH:O	1.85	0.74
1:B:426:ILE:HG21	1:B:461:ILE:HG21	1.69	0.71
1:A:488:TYR:CE1	1:A:641:ARG:HD3	2.26	0.70
1:A:27:ARG:HG3	1:A:27:ARG:NH1	1.93	0.70
1:A:373:THR:HB	6:A:798:HOH:O	1.91	0.69
1:A:520:ILE:HD12	1:A:547:PHE:HE1	1.56	0.68
1:B:500:GLN:HB2	1:B:514:ILE:HD11	1.75	0.68
1:A:193:THR:HG21	6:A:902:HOH:O	1.94	0.67
1:A:97:ARG:HD3	6:A:974:HOH:O	1.94	0.67
1:A:193:THR:CG2	1:A:197:ARG:HH12	2.06	0.63
1:A:104:ARG:HG3	6:A:1208:HOH:O	2.00	0.62
1:A:21:LYS:HE2	6:A:678:HOH:O	2.00	0.61
1:B:463:LYS:NZ	6:B:947:HOH:O	2.35	0.59
1:A:56:ILE:HD13	1:A:265:ASP:OD2	2.02	0.59
1:B:475:VAL:HG22	1:B:479:GLU:HB2	1.85	0.59
1:B:37:ARG:NE	6:B:1086:HOH:O	2.33	0.56
1:A:190:ALA:HA	1:A:193:THR:HG22	1.89	0.55
1:B:114:PHE:CE2	6:B:964:HOH:O	2.47	0.55
6:A:723:HOH:O	1:B:19:ILE:HG12	2.08	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:373:THR:HG23	1:B:425:VAL:HG23	1.93	0.51
1:A:535:LEU:O	1:A:539:VAL:HG13	2.12	0.50
1:A:576:THR:HG23	1:A:614:THR:HA	1.94	0.49
1:B:514:ILE:HD13	1:B:515:THR:N	2.28	0.48
1:B:63:TRP:HB3	1:B:303:ALA:HA	1.94	0.48
1:A:21:LYS:CE	6:A:678:HOH:O	2.60	0.48
1:A:488:TYR:CD1	1:A:641:ARG:HD3	2.48	0.48
1:B:453:LEU:HD23	1:B:453:LEU:O	2.14	0.48
1:A:405:LEU:HD11	1:B:47:ARG:HG3	1.95	0.47
1:A:84:GLN:HG3	1:A:84:GLN:O	2.14	0.47
1:B:565:ALA:O	2:B:703:LEU:HD13	2.16	0.46
1:A:163:ARG:NH1	6:A:737:HOH:O	2.49	0.45
1:A:114:PHE:HE2	6:A:1012:HOH:O	1.99	0.44
1:B:499:ARG:HD2	6:B:661:HOH:O	2.18	0.43
1:A:72:PRO:HG3	1:A:308:ILE:HD12	2.00	0.43
1:A:18:THR:HA	1:B:344:ASN:HD22	1.84	0.42
1:B:426:ILE:HG21	1:B:461:ILE:CG2	2.44	0.42
1:A:450:PRO:O	1:A:454:GLN:HG3	2.19	0.41
1:B:173:SER:O	1:B:177:ARG:HG3	2.20	0.41
1:A:27:ARG:CG	6:A:1000:HOH:O	2.68	0.41
1:A:199:CYS:HB3	1:A:213:PHE:CE2	2.55	0.41
1:A:173:SER:O	1:A:177:ARG:HG3	2.21	0.41
1:B:22:PRO:HB3	1:B:39:SER:HA	2.01	0.41
1:A:27:ARG:HA	1:A:27:ARG:HD2	1.74	0.40
1:A:426:ILE:HD12	6:A:856:HOH:O	2.20	0.40
1:B:567:ALA:HB2	2:B:703:LEU:HD12	2.03	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	571/644 (89%)	555 (97%)	16 (3%)	0	100	100
1	B	573/644 (89%)	562 (98%)	11 (2%)	0	100	100
All	All	1144/1288 (89%)	1117 (98%)	27 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	452/520 (87%)	439 (97%)	13 (3%)	42	29
1	B	456/520 (88%)	446 (98%)	10 (2%)	52	39
All	All	908/1040 (87%)	885 (98%)	23 (2%)	43	34

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	27	ARG
1	A	87	ILE
1	A	114	PHE
1	A	193	THR
1	A	392	LEU
1	A	401	VAL
1	A	411	LEU
1	A	492	VAL
1	A	515	THR
1	A	525	THR
1	A	539	VAL
1	A	552	LEU
1	A	641	ARG
1	B	114	PHE
1	B	274	LEU
1	B	282	LEU
1	B	358	LEU
1	B	376	SER

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Mol	Chain	Res	Type
1	B	387	LEU
1	B	492	VAL
1	B	495	LEU
1	B	514	ILE
1	B	554	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 2 are monoatomic - leaving 6 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	$\# Z > 2$
2	LEU	A	703	-	7,8,8	0.97	1 (14%)	9,10,10	1.54	2 (22%)
4	COI	B	702	3	8,8,8	1.91	1 (12%)	8,10,10	0.89	0
2	LEU	B	703	-	7,8,8	1.01	1 (14%)	9,10,10	1.16	1 (11%)
5	GOL	A	704	-	5,5,5	0.38	0	5,5,5	0.62	0
5	GOL	B	704	-	5,5,5	0.46	0	5,5,5	0.56	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	COI	A	702	3	8,8,8	1.75	1 (12%)	8,10,10	0.93	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	LEU	A	703	-	-	4/8/8/8	-
4	COI	B	702	3	-	2/8/8/8	-
2	LEU	B	703	-	-	4/8/8/8	-
5	GOL	A	704	-	-	0/4/4/4	-
5	GOL	B	704	-	-	0/4/4/4	-
4	COI	A	702	3	-	3/8/8/8	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	702	COI	C2-C1	-5.01	1.46	1.53
4	A	702	COI	C2-C1	-4.48	1.47	1.53
2	B	703	LEU	OXT-C	-2.38	1.22	1.30
2	A	703	LEU	OXT-C	-2.33	1.22	1.30

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	703	LEU	OXT-C-O	-2.84	117.64	124.09
2	A	703	LEU	CD1-CG-CB	2.41	119.96	111.11
2	B	703	LEU	OXT-C-O	-2.00	119.55	124.09

There are no chirality outliers.

All (13) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	703	LEU	N-CA-CB-CG
2	B	703	LEU	N-CA-CB-CG
4	A	702	COI	C1-C2-C3-C4
4	B	702	COI	C2-C3-C4-C5
2	A	703	LEU	CA-CB-CG-CD1
2	B	703	LEU	CA-CB-CG-CD1

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Mol	Chain	Res	Type	Atoms
4	A	702	COI	C2-C3-C4-C5
2	A	703	LEU	C-CA-CB-CG
2	A	703	LEU	CA-CB-CG-CD2
4	B	702	COI	C1-C2-C3-C4
2	B	703	LEU	C-CA-CB-CG
4	A	702	COI	O3-C2-C3-C4
2	B	703	LEU	CA-CB-CG-CD2

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	703	LEU	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	575/644 (89%)	-0.41	5 (0%) 84 82	7, 16, 31, 47	0
1	B	577/644 (89%)	-0.40	5 (0%) 84 82	7, 16, 31, 47	0
All	All	1152/1288 (89%)	-0.40	10 (0%) 84 82	7, 16, 31, 47	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	579	SER	4.4
1	A	434	LYS	3.4
1	A	398	ASP	3.3
1	B	396	ALA	3.2
1	B	399	CYS	2.8
1	A	399	CYS	2.6
1	A	614	THR	2.3
1	A	435	GLY	2.3
1	B	397	ALA	2.3
1	B	434	LYS	2.1

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 monosaccharides 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
4	COI	B	702	9/9	0.94	0.14	17,24,26,27	0
4	COI	A	702	9/9	0.95	0.09	20,21,23,24	0
2	LEU	A	703	9/9	0.96	0.09	12,12,14,15	0
2	LEU	B	703	9/9	0.97	0.07	11,12,13,15	0
5	GOL	B	704	6/6	0.97	0.09	11,14,16,16	0
5	GOL	A	704	6/6	0.98	0.07	14,15,16,17	0
3	ZN	A	701	1/1	1.00	0.02	18,18,18,18	0
3	ZN	B	701	1/1	1.00	0.01	16,16,16,16	0

6.5 Other polymers [i](#)

There are no such residues in this entry.