



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 08:23 AM UTC

PDB ID : 4M78 / pdb_00004m78
Title : Crystal structure of Lsm2-8 complex, space group P21
Authors : Zhou, L.; Hang, J.; Zhou, Y.; Wan, R.; Lu, G.; Yan, C.; Shi, Y.
Deposited on : 2013-08-12
Resolution : 2.79 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

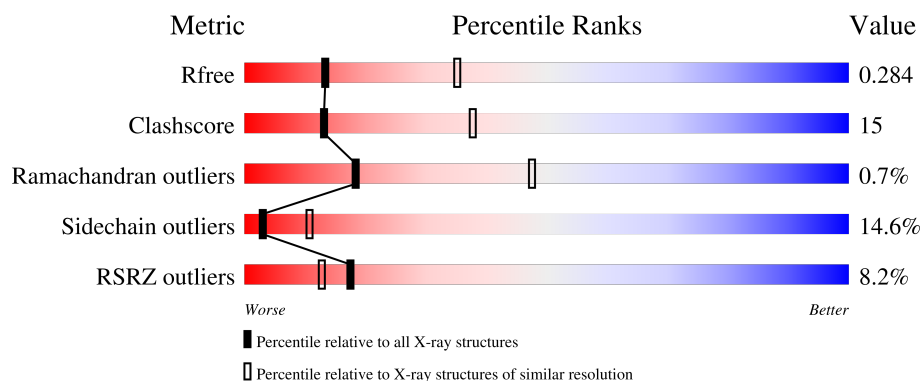
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.79 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	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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	96	5% 40% 26% • 30%
1	H	96	8% 41% 27% • 30%
2	B	95	13% 55% 31% 6% 8%
2	I	95	9% 51% 34% 5% 11%
3	C	89	7% 39% 39% 8% 13%

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Mol	Chain	Length	Quality of chain
3	J	89	
4	D	86	
4	K	86	
5	E	93	
5	L	93	
6	F	115	
6	M	115	
7	G	93	
7	N	93	

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 8165 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 U6 snRNA-associated Sm-like protein LSm8.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	67	Total	C	N	O	S	0	0	0
			522	337	88	96	1			
1	H	67	Total	C	N	O	S	0	0	0
			522	337	88	96	1			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	17	LEU	LYS	engineered mutation	UNP P47093
A	22	SER	CYS	engineered mutation	UNP P47093
A	38	LEU	ILE	engineered mutation	UNP P47093
A	51	SER	CYS	engineered mutation	UNP P47093
H	17	LEU	LYS	engineered mutation	UNP P47093
H	22	SER	CYS	engineered mutation	UNP P47093
H	38	LEU	ILE	engineered mutation	UNP P47093
H	51	SER	CYS	engineered mutation	UNP P47093

- Molecule 2 is a protein called U6 snRNA-associated Sm-like protein LSm2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	87	Total	C	N	O	S	0	0	0
			708	453	119	133	3			
2	I	85	Total	C	N	O	S	0	0	0
			689	440	117	129	3			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	45	SER	CYS	engineered mutation	UNP P38203
I	45	SER	CYS	engineered mutation	UNP P38203

- Molecule 3 is a protein called U6 snRNA-associated Sm-like protein LSm3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	77	Total 611	C 382	N 105	O 123	S 1	0	0	0
3	J	77	Total 611	C 382	N 105	O 123	S 1	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	37	SER	CYS	engineered mutation	UNP P57743
C	63	SER	CYS	engineered mutation	UNP P57743
J	37	SER	CYS	engineered mutation	UNP P57743
J	63	SER	CYS	engineered mutation	UNP P57743

- Molecule 4 is a protein called U6 snRNA-associated Sm-like protein LSm6.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	75	Total 578	C 364	N 95	O 117	S 2	0	0	0
4	K	74	Total 564	C 356	N 93	O 113	S 2	0	0	0

- Molecule 5 is a protein called U6 snRNA-associated Sm-like protein LSm5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	E	73	Total 578	C 372	N 96	O 108	S 2	0	0	0
5	L	75	Total 590	C 380	N 98	O 110	S 2	0	0	0

- Molecule 6 is a protein called U6 snRNA-associated Sm-like protein LSm7.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	F	65	Total 499	C 322	N 84	O 90	S 3	0	0	0
6	M	65	Total 499	C 322	N 84	O 90	S 3	0	0	0

- Molecule 7 is a protein called U6 snRNA-associated Sm-like protein LSm4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	G	70	Total 568	C 369	N 92	O 104	S 3	0	0	0

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	N	71	Total	C	N	O	S	0	0	0
			573	372	93	105	3			

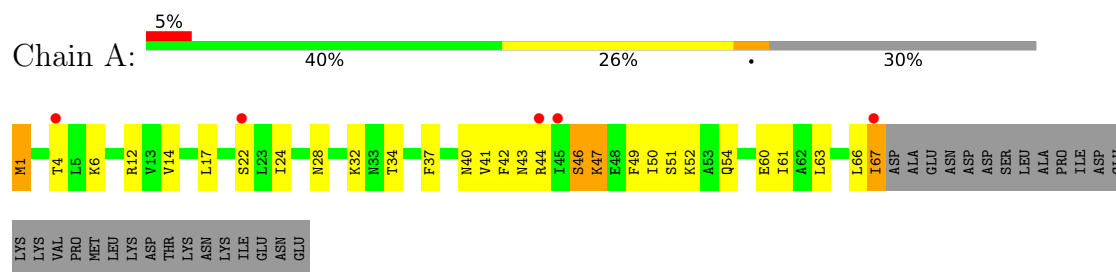
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	6	Total	O	0	0
			6	6		
8	B	2	Total	O	0	0
			2	2		
8	C	7	Total	O	0	0
			7	7		
8	D	3	Total	O	0	0
			3	3		
8	E	3	Total	O	0	0
			3	3		
8	F	4	Total	O	0	0
			4	4		
8	G	3	Total	O	0	0
			3	3		
8	H	4	Total	O	0	0
			4	4		
8	I	3	Total	O	0	0
			3	3		
8	J	6	Total	O	0	0
			6	6		
8	K	2	Total	O	0	0
			2	2		
8	L	4	Total	O	0	0
			4	4		
8	M	3	Total	O	0	0
			3	3		
8	N	3	Total	O	0	0
			3	3		

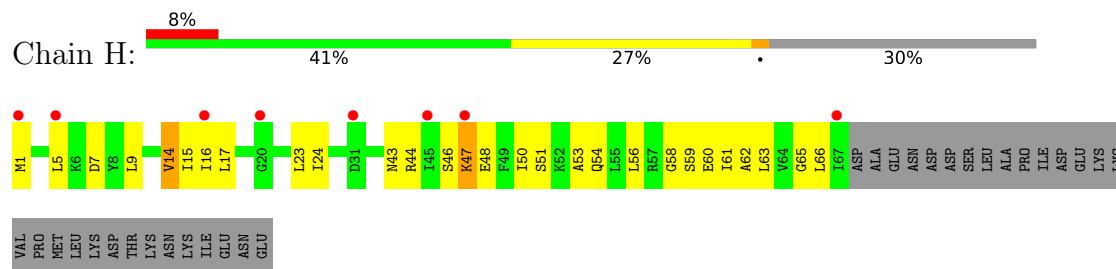
3 Residue-property plots [i](#)

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.

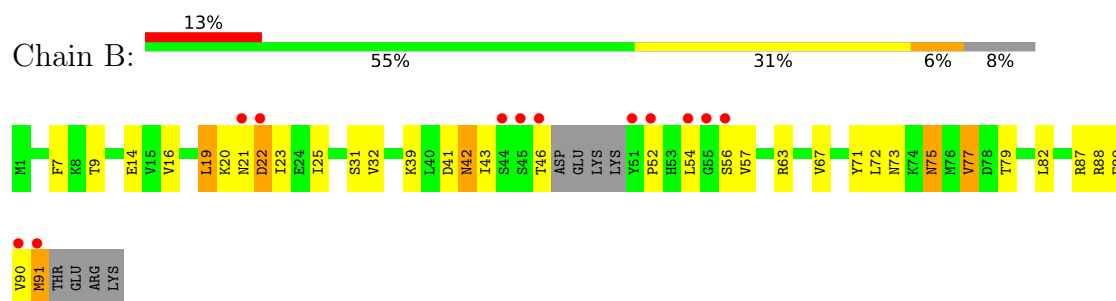
• Molecule 1: U6 snRNA-associated Sm-like protein LSm8



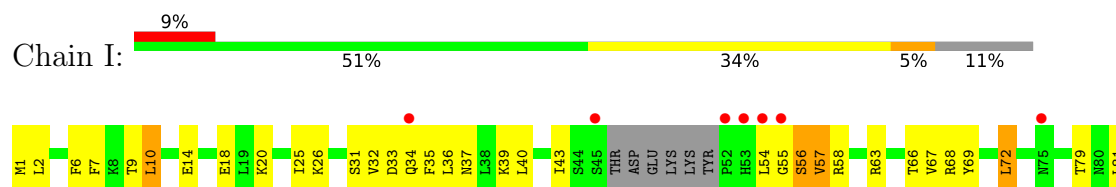
• Molecule 1: U6 snRNA-associated Sm-like protein LSm8

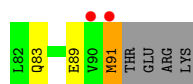


• Molecule 2: U6 snRNA-associated Sm-like protein LSm2

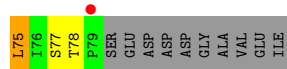


• Molecule 2: U6 snRNA-associated Sm-like protein LSm2

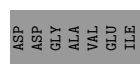




- Molecule 3: U6 snRNA-associated Sm-like protein LSm3



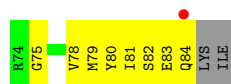
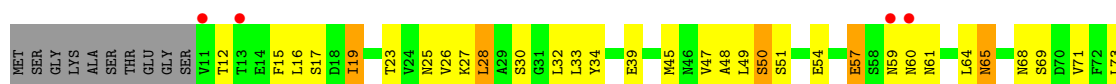
- Molecule 3: U6 snRNA-associated Sm-like protein LSm3



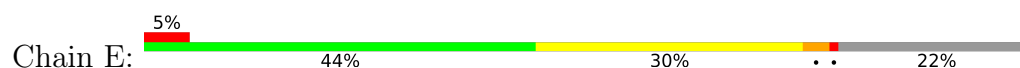
- Molecule 4: U6 snRNA-associated Sm-like protein LSm6

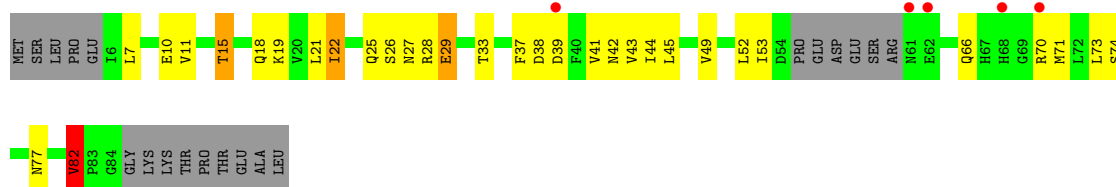


- Molecule 4: U6 snRNA-associated Sm-like protein LSm6

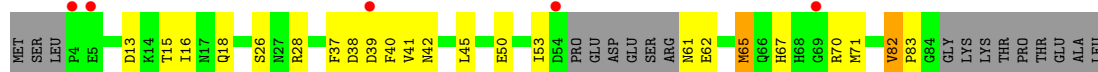


- Molecule 5: U6 snRNA-associated Sm-like protein LSm5

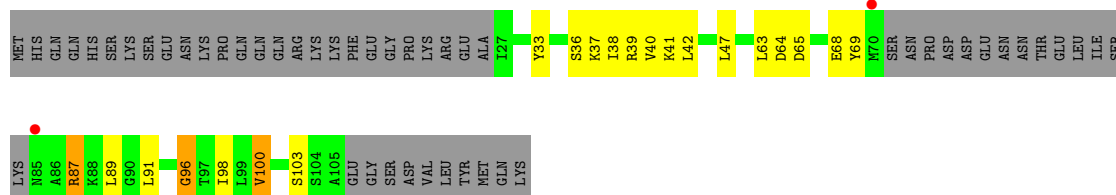
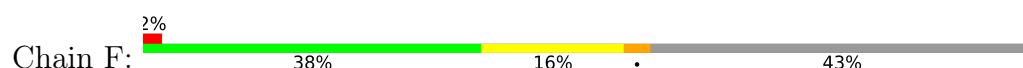




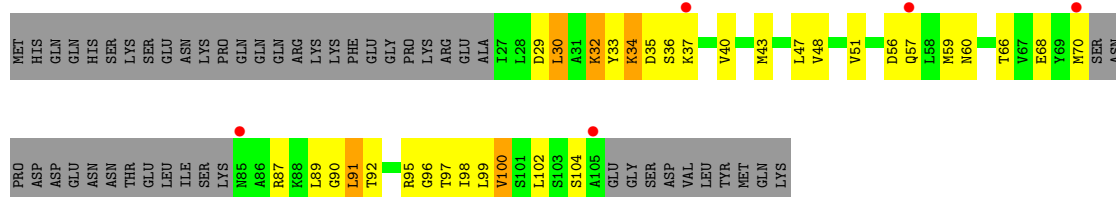
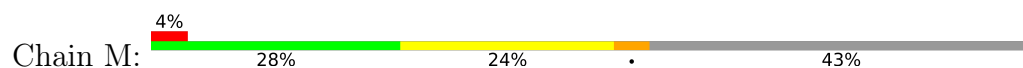
- Molecule 5: U6 snRNA-associated Sm-like protein LSm5



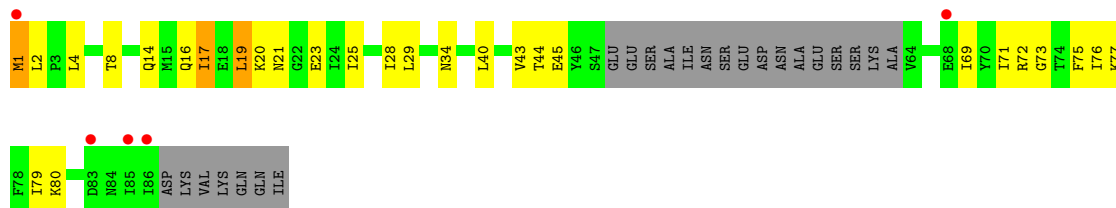
- Molecule 6: U6 snRNA-associated Sm-like protein LSm7



- Molecule 6: U6 snRNA-associated Sm-like protein LSm7



- Molecule 7: U6 snRNA-associated Sm-like protein LSm4



- Molecule 7: U6 snRNA-associated Sm-like protein LSm4





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	79.72Å 76.64Å 113.55Å 90.00° 97.00° 90.00°	Depositor
Resolution (Å)	29.07 – 2.79 29.07 – 2.79	Depositor EDS
% Data completeness (in resolution range)	98.7 (29.07-2.79) 98.6 (29.07-2.79)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.57 (at 2.80Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7.3_928)	Depositor
R, R_{free}	0.254 , 0.294 0.247 , 0.284	Depositor DCC
R_{free} test set	1703 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	63.4	Xtriage
Anisotropy	0.209	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 48.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	8165	wwPDB-VP
Average B, all atoms (Å ²)	61.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.09% 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

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	0.64	0/526	0.96	0/707
1	H	0.69	0/526	1.10	0/707
2	B	0.54	0/717	0.87	0/967
2	I	0.57	0/697	0.94	1/938 (0.1%)
3	C	0.64	0/617	0.98	4/836 (0.5%)
3	J	0.67	0/617	1.05	2/836 (0.2%)
4	D	0.74	1/585 (0.2%)	1.06	1/790 (0.1%)
4	K	0.67	0/571	1.03	0/771
5	E	0.73	0/585	0.95	3/792 (0.4%)
5	L	0.58	0/598	0.97	2/810 (0.2%)
6	F	0.64	0/500	0.99	2/668 (0.3%)
6	M	0.67	0/500	1.00	2/668 (0.3%)
7	G	0.64	0/574	0.95	0/774
7	N	0.71	0/579	0.96	0/781
All	All	0.65	1/8192 (0.0%)	0.99	17/11045 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	78	VAL	CA-CB	5.45	1.60	1.53

The worst 5 of 17 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	L	40	PHE	N-CA-C	-6.26	105.42	114.12
3	C	73	VAL	N-CA-C	5.98	117.45	109.37
3	C	36	HIS	N-CA-C	-5.77	105.44	112.88
3	C	66	VAL	N-CA-C	5.73	116.32	107.78
2	I	2	LEU	N-CA-C	5.61	117.07	111.07

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	522	0	560	21	1
1	H	522	0	560	18	0
2	B	708	0	716	24	0
2	I	689	0	701	24	1
3	C	611	0	620	31	0
3	J	611	0	620	25	0
4	D	578	0	563	29	0
4	K	564	0	546	26	0
5	E	578	0	590	21	1
5	L	590	0	600	15	1
6	F	499	0	552	15	0
6	M	499	0	552	24	0
7	G	568	0	594	16	0
7	N	573	0	596	9	0
8	A	6	0	0	1	0
8	B	2	0	0	0	0
8	C	7	0	0	1	0
8	D	3	0	0	0	0
8	E	3	0	0	0	0
8	F	4	0	0	0	0
8	G	3	0	0	0	0
8	H	4	0	0	0	0
8	I	3	0	0	0	0
8	J	6	0	0	0	0
8	K	2	0	0	1	0
8	L	4	0	0	0	0
8	M	3	0	0	1	0
8	N	3	0	0	1	0
All	All	8165	0	8370	246	2

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 15.

The worst 5 of 246 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)
3:J:51:LEU:HD12	3:J:56:LEU:CD2	1.43	1.46
3:J:51:LEU:HD12	3:J:56:LEU:HD21	1.06	1.03
3:J:51:LEU:HD12	3:J:56:LEU:HD23	1.36	1.03
3:J:51:LEU:CD1	3:J:56:LEU:HD21	1.88	1.02
3:J:51:LEU:CD1	3:J:56:LEU:CD2	2.40	0.99

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

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:I:34:GLN:NE2	5:L:13:ASP:OD1[2_845]	1.79	0.41
1:A:1:MET:N	5:E:10:GLU:OE2[2_756]	2.11	0.09

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	65/96 (68%)	61 (94%)	3 (5%)	1 (2%)	8	28
1	H	65/96 (68%)	62 (95%)	2 (3%)	1 (2%)	8	28
2	B	83/95 (87%)	78 (94%)	5 (6%)	0	100	100
2	I	81/95 (85%)	72 (89%)	6 (7%)	3 (4%)	2	9
3	C	75/89 (84%)	69 (92%)	6 (8%)	0	100	100
3	J	75/89 (84%)	72 (96%)	3 (4%)	0	100	100
4	D	73/86 (85%)	71 (97%)	2 (3%)	0	100	100
4	K	72/86 (84%)	66 (92%)	5 (7%)	1 (1%)	9	30
5	E	69/93 (74%)	64 (93%)	5 (7%)	0	100	100
5	L	71/93 (76%)	67 (94%)	4 (6%)	0	100	100
6	F	61/115 (53%)	58 (95%)	3 (5%)	0	100	100
6	M	61/115 (53%)	58 (95%)	2 (3%)	1 (2%)	7	27

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
7	G	66/93 (71%)	64 (97%)	2 (3%)	0	100	100
7	N	67/93 (72%)	61 (91%)	6 (9%)	0	100	100
All	All	984/1334 (74%)	923 (94%)	54 (6%)	7 (1%)	18	47

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	I	57	VAL
2	I	55	GLY
1	A	47	LYS
2	I	56	SER
4	K	68	ASN

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	59/86 (69%)	51 (86%)	8 (14%)	3	13
1	H	59/86 (69%)	53 (90%)	6 (10%)	7	23
2	B	82/91 (90%)	64 (78%)	18 (22%)	1	3
2	I	80/91 (88%)	71 (89%)	9 (11%)	5	19
3	C	71/81 (88%)	55 (78%)	16 (22%)	1	3
3	J	71/81 (88%)	58 (82%)	13 (18%)	2	6
4	D	65/75 (87%)	55 (85%)	10 (15%)	2	10
4	K	62/75 (83%)	48 (77%)	14 (23%)	1	3
5	E	66/84 (79%)	56 (85%)	10 (15%)	3	10
5	L	67/84 (80%)	63 (94%)	4 (6%)	17	47
6	F	56/103 (54%)	52 (93%)	4 (7%)	13	39
6	M	56/103 (54%)	46 (82%)	10 (18%)	2	6
7	G	64/85 (75%)	56 (88%)	8 (12%)	4	15
7	N	64/85 (75%)	59 (92%)	5 (8%)	11	35

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	922/1210 (76%)	787 (85%)	135 (15%)	3 11

5 of 135 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	K	84	GLN
5	L	82	VAL
7	N	1	MET
4	D	73	LEU
4	D	65	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 23 such sidechains are listed below:

Mol	Chain	Res	Type
1	H	33	ASN
4	K	60	ASN
3	J	52	ASN
4	K	84	GLN
4	D	55	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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

6.1 Protein, DNA and RNA chains

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	67/96 (69%)	0.44	5 (7%) 20 15	26, 51, 111, 127	0
1	H	67/96 (69%)	0.76	8 (11%) 9 7	28, 64, 124, 148	0
2	B	87/95 (91%)	0.71	12 (13%) 6 5	30, 63, 123, 208	0
2	I	85/95 (89%)	0.80	9 (10%) 11 8	28, 66, 134, 173	0
3	C	77/89 (86%)	0.38	6 (7%) 19 14	29, 51, 97, 106	0
3	J	77/89 (86%)	0.47	8 (10%) 11 8	22, 51, 93, 123	0
4	D	75/86 (87%)	0.52	6 (8%) 18 13	27, 58, 112, 164	0
4	K	74/86 (86%)	0.45	5 (6%) 23 17	25, 51, 87, 137	0
5	E	73/93 (78%)	0.40	5 (6%) 23 17	33, 57, 96, 139	0
5	L	75/93 (80%)	0.38	5 (6%) 24 17	27, 50, 98, 160	0
6	F	65/115 (56%)	0.24	2 (3%) 51 41	22, 51, 84, 165	0
6	M	65/115 (56%)	0.46	5 (7%) 19 14	29, 52, 93, 145	0
7	G	70/93 (75%)	0.35	5 (7%) 22 16	22, 47, 97, 147	0
7	N	71/93 (76%)	0.25	3 (4%) 40 32	24, 54, 106, 163	0
All	All	1028/1334 (77%)	0.48	84 (8%) 17 13	22, 55, 111, 208	0

The worst 5 of 84 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	H	67	ILE	6.5
2	I	55	GLY	5.9
6	M	105	ALA	5.8
6	F	70	MET	5.5
5	L	4	PRO	5.1

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 oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.