



Full wwPDB NMR Structure Validation Report ⓘ

Feb 13, 2017 – 12:15 am GMT

PDB ID : 2LNU
Title : Solution NMR Structure of the uncharacterized protein from gene locus rrnAC0354 of Haloarcula marismortui, Northeast Structural Genomics Consortium Target HmR11
Authors : Rossi, P.; Liu, G.; Lange, O.F.; Lee, H.; Janjua, H.; Ciccocanti, C.; Wang, H.; Acton, T.B.; Xiao, R.; Everett, J.K.; Montelione, G.T.; Northeast Structural Genomics Consortium (NESG)
Deposited on : 2012-01-05

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We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<http://wwpdb.org/validation/2016/NMRValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	trunk28760
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	recalc28949

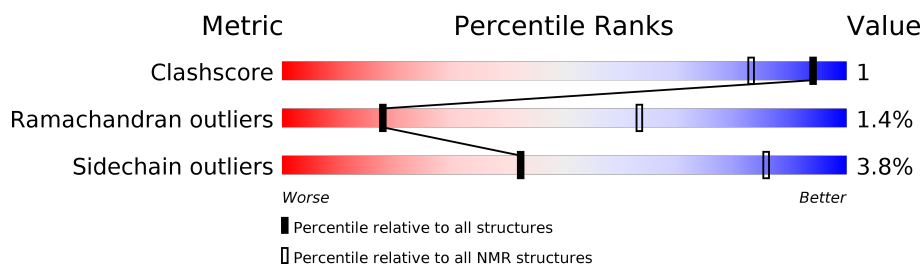
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 89%.

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)	NMR archive (#Entries)
Clashscore	125131	11601
Ramachandran outliers	121729	10391
Sidechain outliers	121581	10367

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and 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 $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	190	 91% • 5% •

2 Ensemble composition and analysis

This entry contains 20 models. Model 1 is the overall representative, medoid model (most similar to other models).

The following residues are included in the computation of the global validation metrics.

Well-defined (core) protein residues			
Well-defined core	Residue range (total)	Backbone RMSD (Å)	Medoid model
1	A:5-A:180 (176)	0.72	1

Ill-defined regions of proteins are excluded from the global statistics.

Ligands and non-protein polymers are included in the analysis.

The models can be grouped into 4 clusters and 2 single-model clusters were found.

Cluster number	Models
1	1, 5, 7, 9, 11, 13, 14, 16, 17, 19
2	3, 4, 12
3	2, 6, 18
4	10, 15
Single-model clusters	8; 20

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2854 atoms, of which 1347 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Uncharacterized protein.

Mol	Chain	Residues	Atoms						Trace
1	A	185	Total	C	H	N	O	S	0
			2854	928	1347	250	325	4	

There are 8 discrepancies between the modelled and reference sequences:

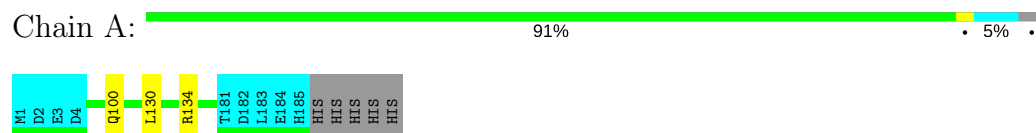
Chain	Residue	Modelled	Actual	Comment	Reference
A	183	LEU	-	EXPRESSION TAG	UNP Q5V502
A	184	GLU	-	EXPRESSION TAG	UNP Q5V502
A	185	HIS	-	EXPRESSION TAG	UNP Q5V502
A	186	HIS	-	EXPRESSION TAG	UNP Q5V502
A	187	HIS	-	EXPRESSION TAG	UNP Q5V502
A	188	HIS	-	EXPRESSION TAG	UNP Q5V502
A	189	HIS	-	EXPRESSION TAG	UNP Q5V502
A	190	HIS	-	EXPRESSION TAG	UNP Q5V502

4 Residue-property plots [i](#)

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA and DNA chains in the entry. The first graphic is the same as shown in the summary in section 1 of this report. The second graphic shows the sequence where residues are colour-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. Stretches of 2 or more consecutive residues without any outliers are shown as green connectors. Residues which are classified as ill-defined in the NMR ensemble, are shown in cyan with an underline colour-coded according to the previous scheme. Residues which were present in the experimental sample, but not modelled in the final structure are shown in grey.

- Molecule 1: Uncharacterized protein

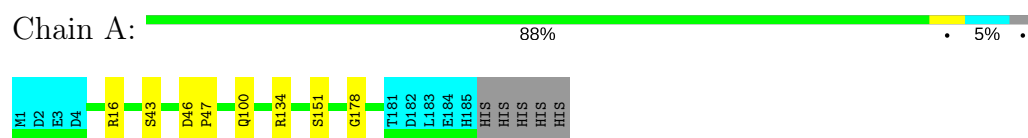


4.2 Scores per residue for each member of the ensemble

Colouring as in section [4.1](#) above.

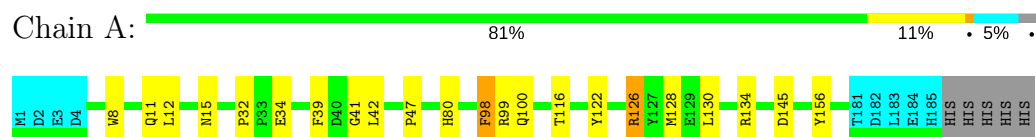
4.2.1 Score per residue for model 1 (medoid)

- Molecule 1: Uncharacterized protein



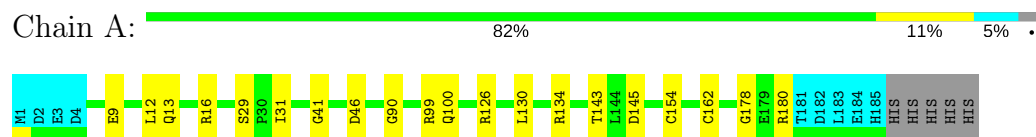
4.2.2 Score per residue for model 2

- Molecule 1: Uncharacterized protein



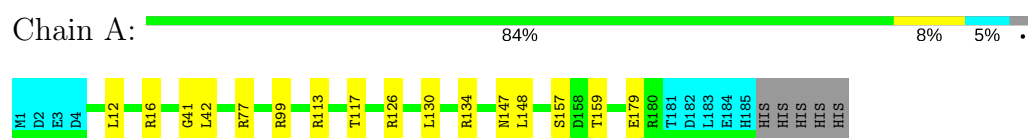
4.2.3 Score per residue for model 3

- Molecule 1: Uncharacterized protein



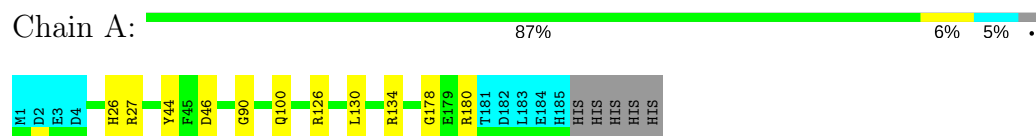
4.2.4 Score per residue for model 4

- Molecule 1: Uncharacterized protein



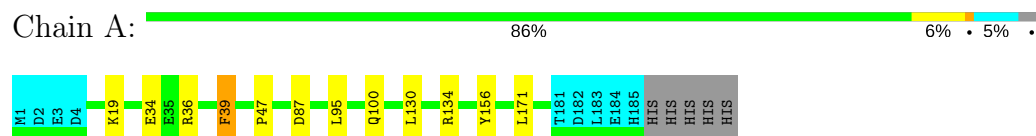
4.2.5 Score per residue for model 5

- Molecule 1: Uncharacterized protein



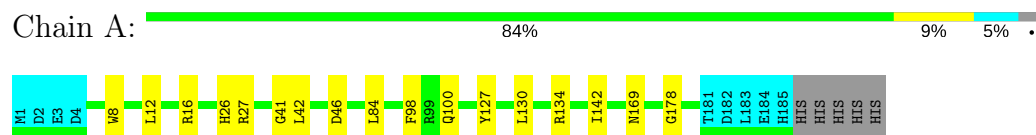
4.2.6 Score per residue for model 6

- Molecule 1: Uncharacterized protein



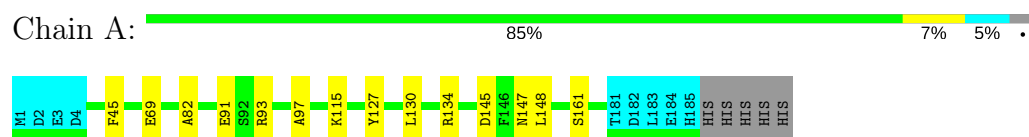
4.2.7 Score per residue for model 7

- Molecule 1: Uncharacterized protein



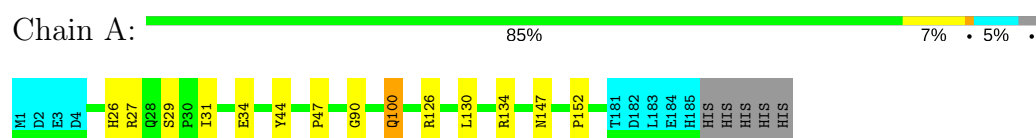
4.2.8 Score per residue for model 8

- Molecule 1: Uncharacterized protein



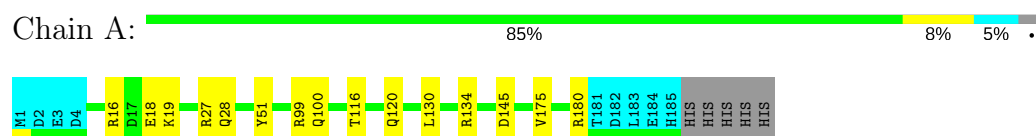
4.2.9 Score per residue for model 9

- Molecule 1: Uncharacterized protein



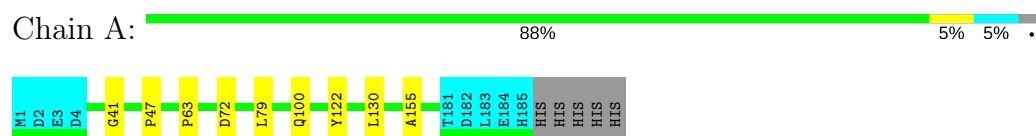
4.2.10 Score per residue for model 10

- Molecule 1: Uncharacterized protein



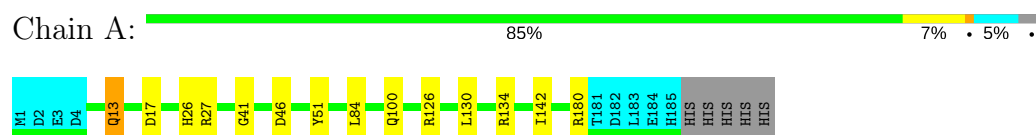
4.2.11 Score per residue for model 11

- Molecule 1: Uncharacterized protein



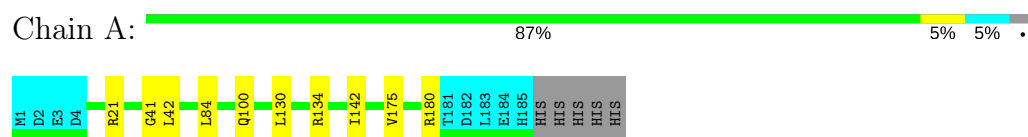
4.2.12 Score per residue for model 12

- Molecule 1: Uncharacterized protein



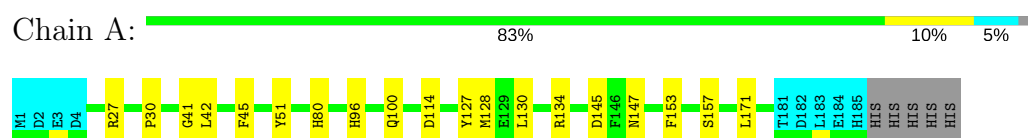
4.2.13 Score per residue for model 13

- Molecule 1: Uncharacterized protein



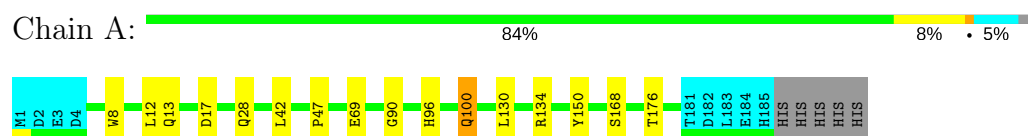
4.2.14 Score per residue for model 14

- Molecule 1: Uncharacterized protein



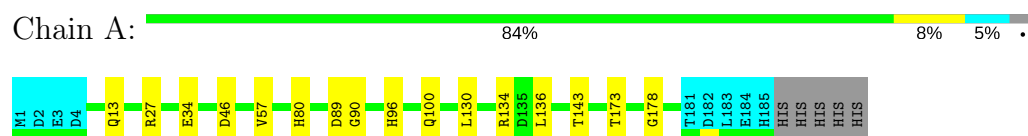
4.2.15 Score per residue for model 15

- Molecule 1: Uncharacterized protein



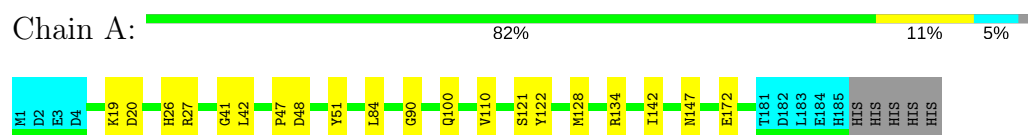
4.2.16 Score per residue for model 16

- Molecule 1: Uncharacterized protein



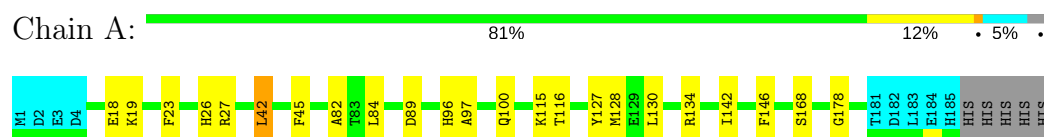
4.2.17 Score per residue for model 17

- Molecule 1: Uncharacterized protein



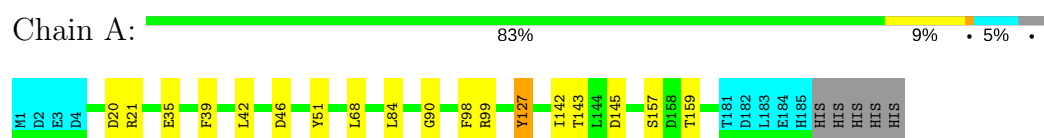
4.2.18 Score per residue for model 18

- Molecule 1: Uncharacterized protein



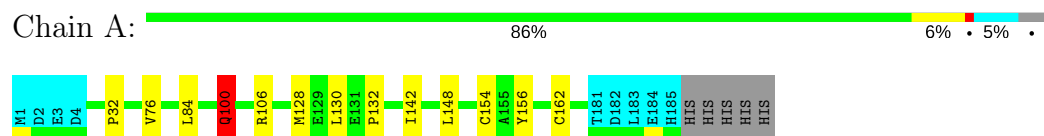
4.2.19 Score per residue for model 19

- Molecule 1: Uncharacterized protein



4.2.20 Score per residue for model 20

- Molecule 1: Uncharacterized protein



5 Refinement protocol and experimental data overview

The models were refined using the following method: *molecular dynamics*.

Of the 100 calculated structures, 20 were deposited, based on the following criterion: *structures with the lowest energy*.

The following table shows the software used for structure solution, optimisation and refinement.

Software name	Classification	Version
CNS	refinement	
CNS	structure solution	
CNS	geometry optimization	
CYANA	refinement	3.0
CYANA	geometry optimization	3.0
CYANA	structure solution	3.0
TALOS+	geometry optimization	
PALES	geometry optimization	

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 7 of this report.

Chemical shift file(s)	2lnu_cs.str
Number of chemical shift lists	1
Total number of shifts	2209
Number of shifts mapped to atoms	2209
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	89%

No validations of the models with respect to experimental NMR restraints is performed at this time.

6 Model quality [i](#)

6.1 Standard geometry [i](#)

There are no covalent bond-length or bond-angle outliers.

There are no bond-length outliers.

There are no bond-angle outliers.

There are no chirality outliers.

There are no planarity outliers.

6.2 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 each 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 averaged over the ensemble.

Mol	Chain	Non-H	H(model)	H(added)	Clashes
1	A	1432	1286	1285	4±2
All	All	28640	25720	25700	74

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 1.

All unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:126:ARG:HH22	1:A:152:PRO:HD3	0.62	1.55	9	1
1:A:128:MET:SD	1:A:148:LEU:HB2	0.59	2.37	20	1
1:A:23:PHE:HB2	1:A:42:LEU:HD11	0.57	1.76	18	1
1:A:154:CYS:SG	1:A:162:CYS:HB3	0.57	2.40	20	1
1:A:45:PHE:HB2	1:A:147:ASN:HA	0.56	1.77	14	2
1:A:154:CYS:SG	1:A:162:CYS:HA	0.54	2.43	3	1
1:A:32:PRO:HD3	1:A:156:TYR:HB3	0.51	1.80	2	2
1:A:96:HIS:HE2	1:A:168:SER:HB2	0.51	1.66	15	1
1:A:128:MET:SD	1:A:146:PHE:HA	0.51	2.46	18	1
1:A:128:MET:SD	1:A:145:ASP:O	0.50	2.70	14	1
1:A:122:TYR:HB3	1:A:126:ARG:HH22	0.49	1.67	2	1
1:A:122:TYR:HB3	1:A:155:ALA:HB1	0.49	1.85	11	1
1:A:46:ASP:H	1:A:178:GLY:HA3	0.49	1.67	3	3
1:A:26:HIS:ND1	1:A:27:ARG:HG2	0.48	2.23	12	6

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:48:ASP:H	1:A:147:ASN:HB2	0.47	1.69	17	1
1:A:46:ASP:HB3	1:A:178:GLY:HA3	0.47	1.86	16	1
1:A:20:ASP:HA	1:A:42:LEU:HB3	0.46	1.86	19	2
1:A:145:ASP:HB2	1:A:148:LEU:HG	0.46	1.88	8	1
1:A:19:LYS:HG2	1:A:42:LEU:HD13	0.45	1.86	17	1
1:A:36:ARG:HA	1:A:39:PHE:HB3	0.45	1.88	6	1
1:A:157:SER:HB3	1:A:159:THR:HG22	0.45	1.88	4	2
1:A:46:ASP:HB2	1:A:178:GLY:HA3	0.45	1.89	5	1
1:A:68:LEU:HD11	1:A:98:PHE:CD2	0.45	2.46	19	1
1:A:82:ALA:HB3	1:A:97:ALA:HB3	0.44	1.88	8	2
1:A:84:LEU:HD22	1:A:142:ILE:HG21	0.44	1.88	17	7
1:A:114:ASP:HA	1:A:171:LEU:O	0.44	2.12	14	1
1:A:57:VAL:HG21	1:A:136:LEU:HD13	0.44	1.88	16	1
1:A:63:PRO:HB2	1:A:79:LEU:HB3	0.44	1.89	11	1
1:A:8:TRP:O	1:A:12:LEU:HB2	0.44	2.13	15	2
1:A:12:LEU:HD21	1:A:47:PRO:HG3	0.43	1.90	2	1
1:A:30:PRO:O	1:A:157:SER:HB2	0.43	2.13	14	1
1:A:91:GLU:HG3	1:A:93:ARG:HG2	0.43	1.90	8	1
1:A:95:LEU:HD21	1:A:171:LEU:HD21	0.42	1.91	6	1
1:A:116:THR:HG22	1:A:120:GLN:NE2	0.42	2.29	10	1
1:A:16:ARG:HH22	1:A:47:PRO:HG3	0.42	1.74	1	1
1:A:69:GLU:HB3	1:A:161:SER:O	0.42	2.14	8	1
1:A:45:PHE:HB3	1:A:178:GLY:HA3	0.42	1.91	18	1
1:A:106:ARG:O	1:A:132:PRO:HD2	0.42	2.14	20	1
1:A:29:SER:HB3	1:A:31:ILE:HG12	0.42	1.92	9	1
1:A:43:SER:HB2	1:A:151:SER:HB3	0.42	1.92	1	1
1:A:80:HIS:HA	1:A:98:PHE:HB3	0.42	1.92	2	1
1:A:76:VAL:HB	1:A:100:GLN:HE22	0.42	1.75	20	1
1:A:110:VAL:HG23	1:A:128:MET:HB2	0.41	1.91	17	1
1:A:13:GLN:O	1:A:17:ASP:HB2	0.41	2.16	12	1
1:A:93:ARG:NE	1:A:93:ARG:HA	0.41	2.31	8	1
1:A:80:HIS:CE1	1:A:96:HIS:HD1	0.41	2.34	14	2
1:A:29:SER:HB2	1:A:31:ILE:HG12	0.41	1.93	3	1
1:A:89:ASP:HB2	1:A:173:THR:HB	0.41	1.92	16	1
1:A:12:LEU:HD13	1:A:148:LEU:HD22	0.41	1.93	4	1
1:A:127:TYR:CD1	1:A:127:TYR:N	0.41	2.89	19	1
1:A:12:LEU:O	1:A:16:ARG:HG2	0.40	2.17	3	1
1:A:96:HIS:NE2	1:A:168:SER:HB2	0.40	2.31	18	1
1:A:113:ARG:HG3	1:A:117:THR:HG21	0.40	1.92	4	1
1:A:8:TRP:HA	1:A:11:GLN:HE21	0.40	1.76	2	1

6.3 Torsion angles [i](#)

6.3.1 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 PDB entries followed by that with respect to all NMR entries. 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	176/190 (93%)	161±3 (92±2%)	12±3 (7±2%)	3±1 (1±1%)	18	63
All	All	3520/3800 (93%)	3224 (92%)	245 (7%)	51 (1%)	18	63

All 11 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	100	GLN	17
1	A	41	GLY	9
1	A	90	GLY	7
1	A	42	LEU	6
1	A	47	PRO	5
1	A	175	VAL	2
1	A	72	ASP	1
1	A	17	ASP	1
1	A	122	TYR	1
1	A	89	ASP	1
1	A	121	SER	1

6.3.2 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 PDB entries followed by that with respect to all NMR entries. 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	159/173 (92%)	153±3 (96±2%)	6±3 (4±2%)	42	86
All	All	3180/3460 (92%)	3058 (96%)	122 (4%)	42	86

All 40 unique residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	134	ARG	17
1	A	130	LEU	17
1	A	51	TYR	5
1	A	99	ARG	5
1	A	127	TYR	5
1	A	180	ARG	5
1	A	126	ARG	5
1	A	13	GLN	4
1	A	34	GLU	4
1	A	145	ASP	4
1	A	19	LYS	3
1	A	16	ARG	3
1	A	100	GLN	3
1	A	27	ARG	3
1	A	39	PHE	3
1	A	143	THR	3
1	A	46	ASP	2
1	A	18	GLU	2
1	A	147	ASN	2
1	A	116	THR	2
1	A	98	PHE	2
1	A	21	ARG	2
1	A	28	GLN	2
1	A	115	LYS	2
1	A	44	TYR	2
1	A	150	TYR	1
1	A	87	ASP	1
1	A	156	TYR	1
1	A	42	LEU	1
1	A	179	GLU	1
1	A	172	GLU	1
1	A	9	GLU	1
1	A	35	GLU	1
1	A	169	ASN	1
1	A	77	ARG	1
1	A	69	GLU	1
1	A	153	PHE	1
1	A	128	MET	1
1	A	15	ASN	1
1	A	176	THR	1

6.3.3 RNA [i](#)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

6.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

6.6 Ligand geometry [i](#)

There are no ligands in this entry.

6.7 Other polymers [i](#)

There are no such molecules in this entry.

6.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

7 Chemical shift validation

The completeness of assignment taking into account all chemical shift lists is 89% for the well-defined parts and 89% for the entire structure.

7.1 Chemical shift list 1

File name: 2lnu_cs.str

Chemical shift list name: *assigned_chem_shift_list_1*

7.1.1 Bookkeeping

The following table shows the results of parsing the chemical shift list and reports the number of nuclei with statistically unusual chemical shifts.

Total number of shifts	2209
Number of shifts mapped to atoms	2209
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	8

7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction \pm precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	183	-0.19 ± 0.13	None needed (< 0.5 ppm)
$^{13}\text{C}_\beta$	175	0.35 ± 0.08	None needed (< 0.5 ppm)
$^{13}\text{C}'$	179	-0.35 ± 0.05	None needed (< 0.5 ppm)
^{15}N	170	-0.20 ± 0.48	None needed (< 0.5 ppm)

7.1.3 Completeness of resonance assignments

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 89%, i.e. 1928 atoms were assigned a chemical shift out of a possible 2156. 21 out of 22 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	848/856 (99%)	338/340 (99%)	347/352 (99%)	163/164 (99%)
Sidechain	885/1089 (81%)	554/639 (87%)	312/397 (79%)	19/53 (36%)

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	Total	¹ H	¹³ C	¹⁵ N
Aromatic	195/211 (92%)	101/111 (91%)	86/90 (96%)	8/10 (80%)
Overall	1928/2156 (89%)	993/1090 (91%)	745/839 (89%)	190/227 (84%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 89%, i.e. 2007 atoms were assigned a chemical shift out of a possible 2259. 22 out of 23 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹ H	¹³ C	¹⁵ N
Backbone	885/901 (98%)	353/358 (99%)	362/370 (98%)	170/173 (98%)
Sidechain	925/1139 (81%)	579/667 (87%)	327/419 (78%)	19/53 (36%)
Aromatic	197/219 (90%)	102/115 (89%)	87/92 (95%)	8/12 (67%)
Overall	2007/2259 (89%)	1034/1140 (91%)	776/881 (88%)	197/238 (83%)

7.1.4 Statistically unusual chemical shifts ⓘ

The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, ppm	Expected range, ppm	Z-score
1	A	30	PRO	HG3	-0.06	3.56 – 0.26	-6.0
1	A	30	PRO	HG2	0.10	3.48 – 0.38	-5.9
1	A	41	GLY	H	4.59	11.63 – 5.03	-5.7
1	A	180	ARG	HD3	1.73	4.36 – 1.86	-5.5
1	A	167	GLU	HA	2.02	6.30 – 2.20	-5.4
1	A	155	ALA	HB2	0.02	2.61 – 0.11	-5.3
1	A	155	ALA	HB1	0.02	2.61 – 0.11	-5.3
1	A	155	ALA	HB3	0.02	2.61 – 0.11	-5.3

7.1.5 Random Coil Index (RCI) plots ⓘ

The image below reports *random coil index* values for the protein chains in the structure. The height of each bar gives a probability of a given residue to be disordered, as predicted from the available chemical shifts and the amino acid sequence. A value above 0.2 is an indication of significant predicted disorder. The colour of the bar shows whether the residue is in the well-defined core (black) or in the ill-defined residue ranges (cyan), as described in section 2 on ensemble composition.

Random coil index (RCI) for chain A:

