



Full wwPDB NMR Structure Validation Report ⓘ

Feb 13, 2017 – 12:29 am GMT

PDB ID : 2LWJ
Title : NMR solution structure Myxococcus xanthus CdnL
Authors : Jimenez, M.; Padmanabhan, S.; Mirassou, Y.
Deposited on : 2012-08-01

This is a Full wwPDB NMR Structure Validation Report for a publicly released PDB entry.

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

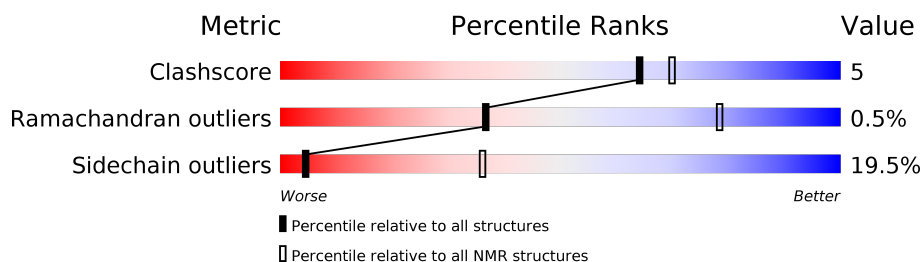
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 76%.

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	167	

2 Ensemble composition and analysis ⓘ

This entry contains 20 models. Model 18 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *lowest energy*.

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:7-A:57, A:63-A:167 (156)	0.61	18

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 1 clusters and 3 single-model clusters were found.

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

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2693 atoms, of which 1361 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Transcriptional regulator, CarD family.

Mol	Chain	Residues	Atoms						Trace
1	A	167	Total	C	H	N	O	S	0
			2693	839	1361	226	260	7	

There are 3 discrepancies between the modelled and reference sequences:

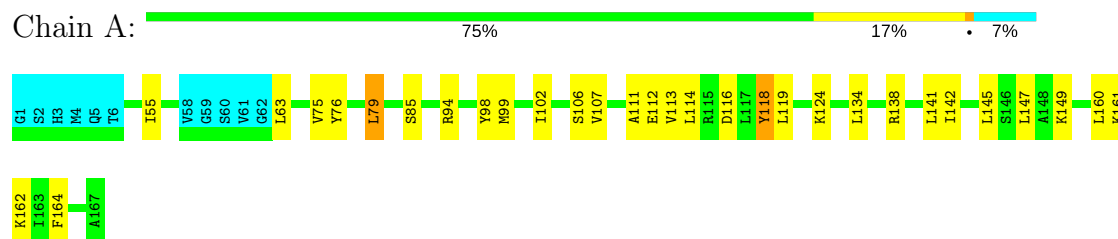
Chain	Residue	Modelled	Actual	Comment	Reference
A	1	GLY	-	EXPRESSION TAG	UNP Q1D927
A	2	SER	-	EXPRESSION TAG	UNP Q1D927
A	3	HIS	-	EXPRESSION TAG	UNP Q1D927

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: Transcriptional regulator, CarD family

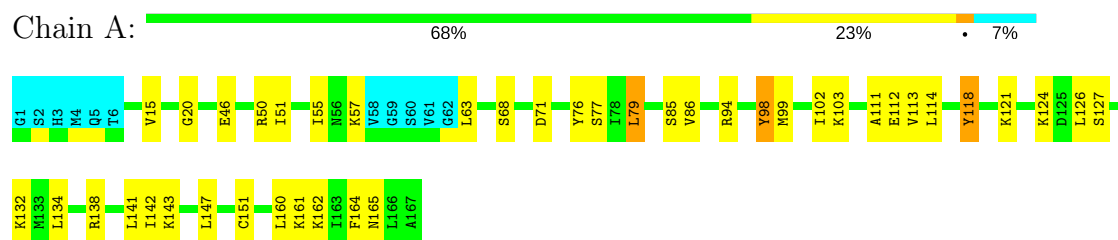


4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

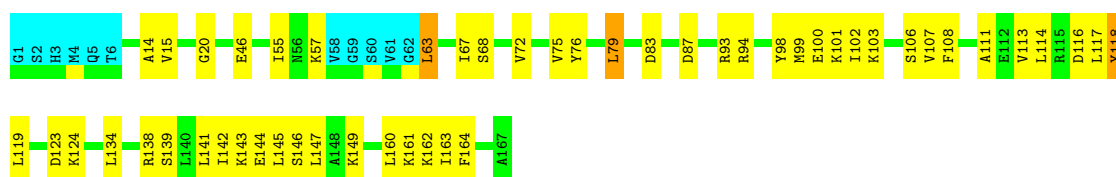
- Molecule 1: Transcriptional regulator, CarD family



4.2.2 Score per residue for model 2

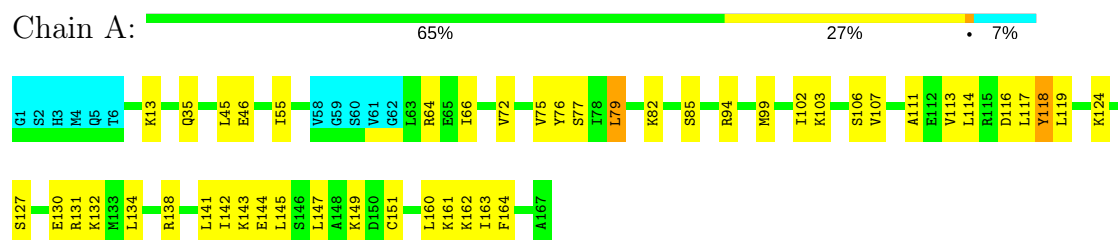
- Molecule 1: Transcriptional regulator, CarD family





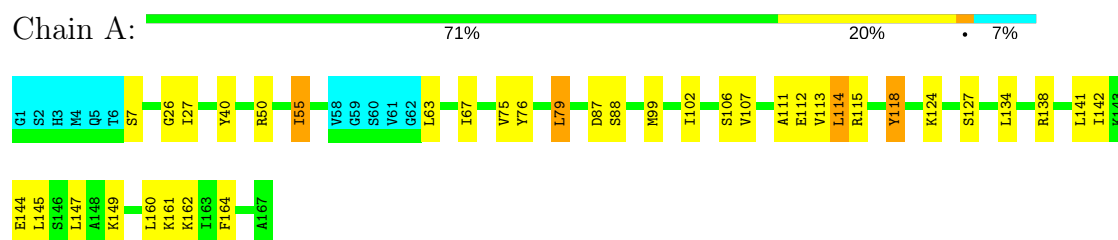
4.2.3 Score per residue for model 3

- Molecule 1: Transcriptional regulator, CarD family



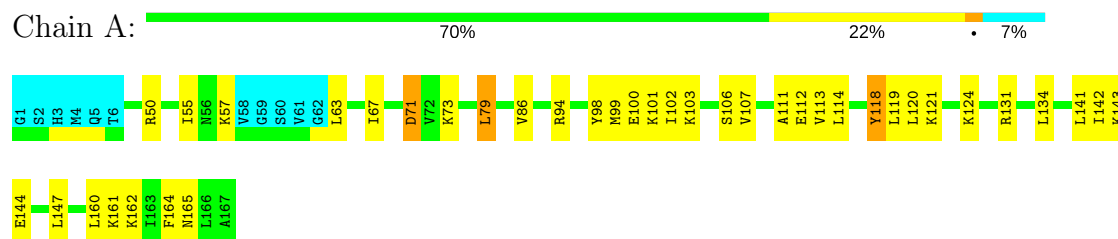
4.2.4 Score per residue for model 4

- Molecule 1: Transcriptional regulator, CarD family



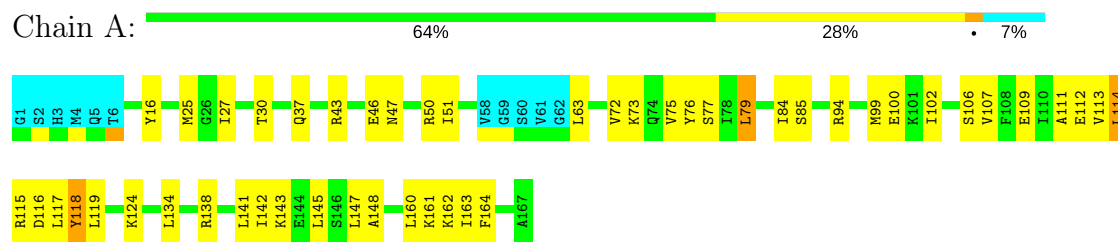
4.2.5 Score per residue for model 5

- Molecule 1: Transcriptional regulator, CarD family



4.2.6 Score per residue for model 6

- Molecule 1: Transcriptional regulator, CarD family



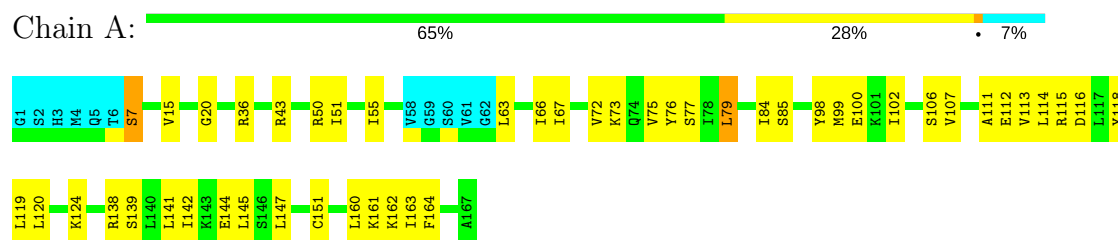
4.2.7 Score per residue for model 7

- Molecule 1: Transcriptional regulator, CarD family



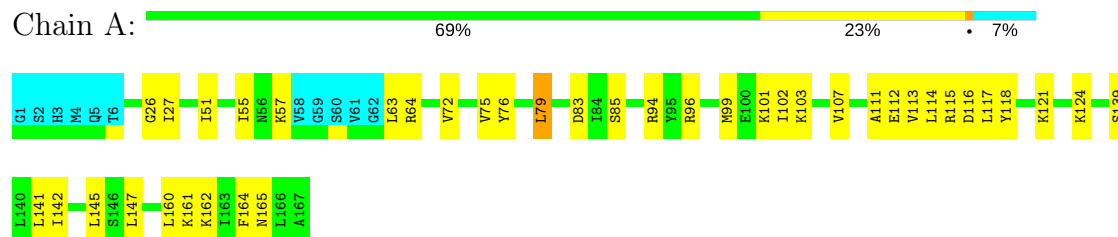
4.2.8 Score per residue for model 8

- Molecule 1: Transcriptional regulator, CarD family



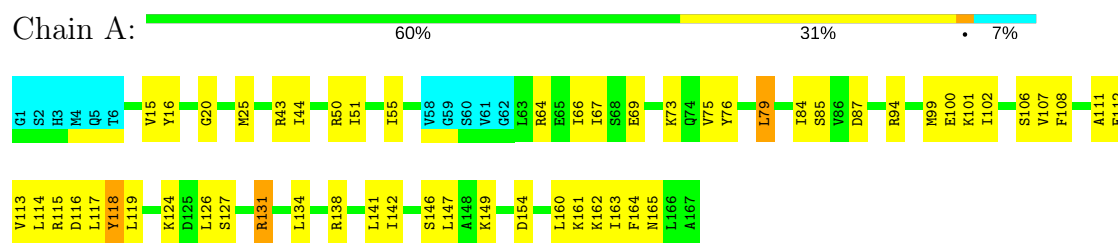
4.2.9 Score per residue for model 9

- Molecule 1: Transcriptional regulator, CarD family



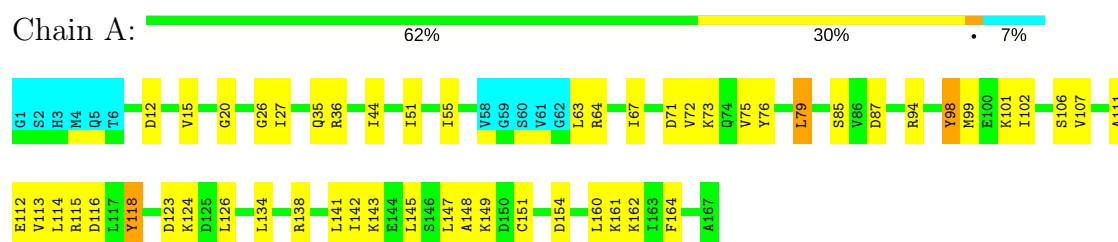
4.2.10 Score per residue for model 10

- Molecule 1: Transcriptional regulator, CarD family



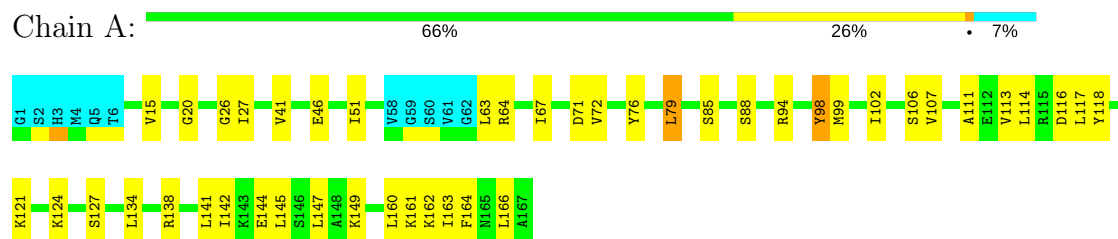
4.2.11 Score per residue for model 11

- Molecule 1: Transcriptional regulator, CarD family



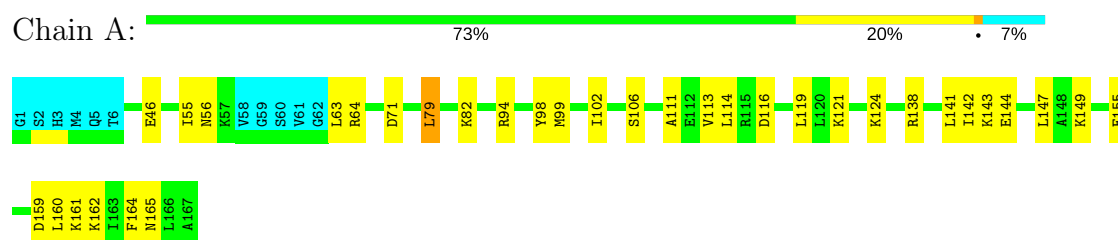
4.2.12 Score per residue for model 12

- Molecule 1: Transcriptional regulator, CarD family



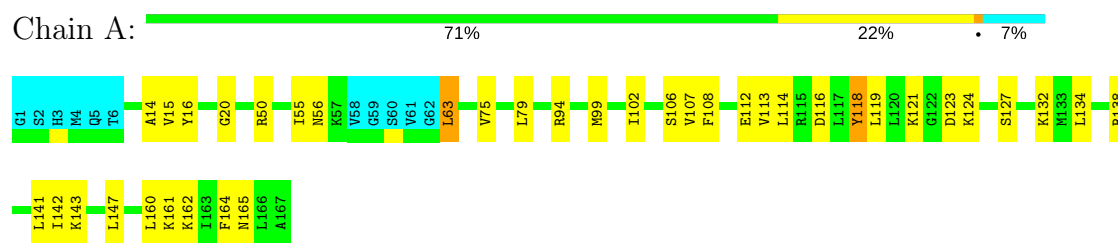
4.2.13 Score per residue for model 13

- Molecule 1: Transcriptional regulator, CarD family



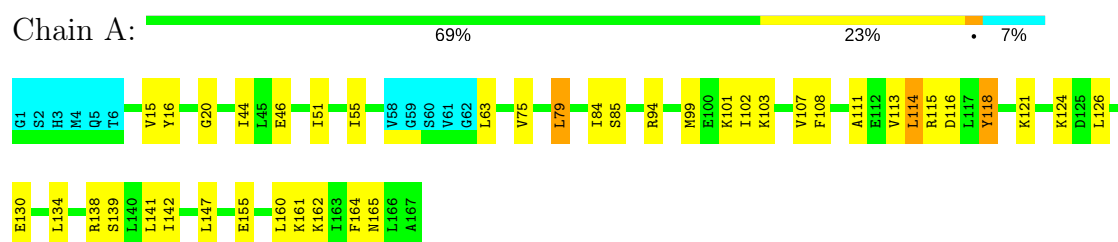
4.2.14 Score per residue for model 14

- Molecule 1: Transcriptional regulator, CarD family



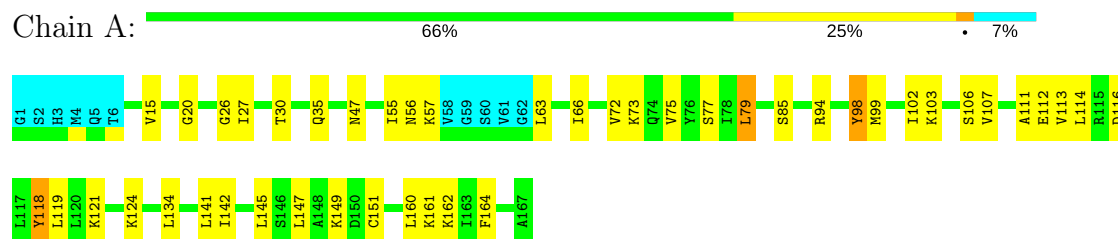
4.2.15 Score per residue for model 15

- Molecule 1: Transcriptional regulator, CarD family



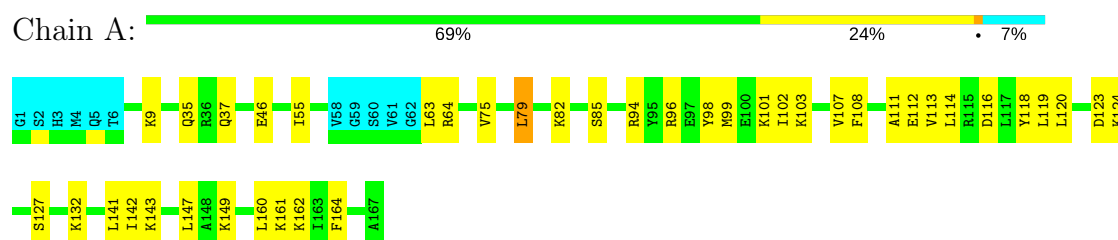
4.2.16 Score per residue for model 16

- Molecule 1: Transcriptional regulator, CarD family



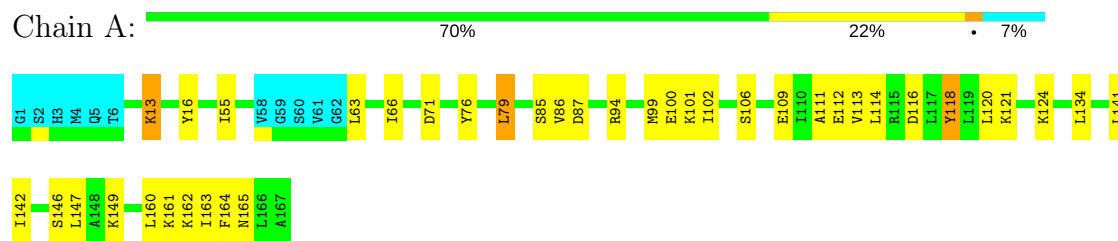
4.2.17 Score per residue for model 17

- Molecule 1: Transcriptional regulator, CarD family



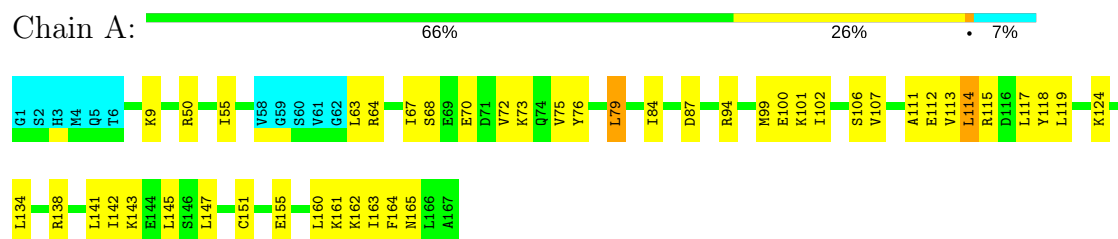
4.2.18 Score per residue for model 18 (medoid)

- Molecule 1: Transcriptional regulator, CarD family



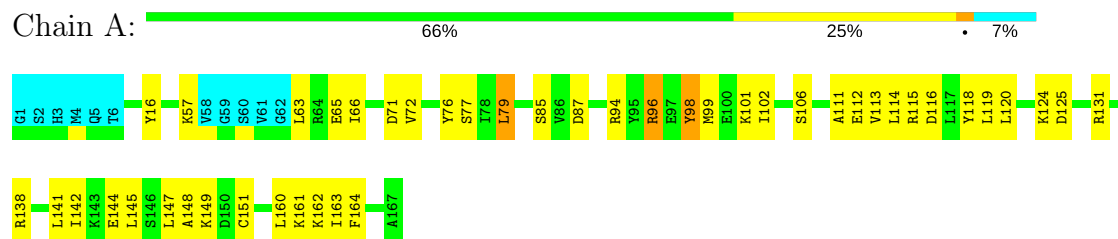
4.2.19 Score per residue for model 19

- Molecule 1: Transcriptional regulator, CarD family



4.2.20 Score per residue for model 20

- Molecule 1: Transcriptional regulator, CarD family



5 Refinement protocol and experimental data overview

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

Of the 100 calculated structures, 20 were deposited, based on the following criterion: *target function*.

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

Software name	Classification	Version
CYANA	structure solution	
AMBER	refinement	
CYANA	refinement	

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)	2lwj_cs.str
Number of chemical shift lists	1
Total number of shifts	1787
Number of shifts mapped to atoms	1787
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	76%

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

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 (average) 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	0.69±0.00	0±0/1275 (0.0±0.0%)	0.97±0.01	1±1/1705 (0.0±0.0%)
All	All	0.69	0/25500 (0.0%)	0.97	17/34100 (0.0%)

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	Planarity
1	A	0.0±0.0	0.5±0.6
All	All	0	9

There are no bond-length outliers.

All unique angle outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	115	ARG	NE-CZ-NH1	6.53	123.57	120.30	8	9
1	A	93	ARG	NE-CZ-NH1	5.59	123.09	120.30	2	2
1	A	98	TYR	CB-CG-CD2	-5.45	117.73	121.00	12	4
1	A	131	ARG	NE-CZ-NH1	5.34	122.97	120.30	10	1
1	A	96	ARG	NE-CZ-NH1	5.25	122.93	120.30	20	1

There are no chirality outliers.

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

Mol	Chain	Res	Type	Group	Models (Total)
1	A	98	TYR	Sidechain	5
1	A	76	TYR	Sidechain	4

6.2 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 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	1260	1290	1289	12±3
All	All	25200	25800	25780	249

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.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:102:ILE:HD11	1:A:113:VAL:HG11	0.81	1.51	8	20
1:A:141:LEU:HD21	1:A:160:LEU:HD21	0.71	1.62	1	20
1:A:75:VAL:HG21	1:A:107:VAL:HG22	0.67	1.65	4	13
1:A:44:ILE:HD11	1:A:51:ILE:HD12	0.67	1.67	15	2
1:A:160:LEU:HD22	1:A:164:PHE:CE2	0.64	2.28	1	20
1:A:15:VAL:HG13	1:A:20:GLY:HA3	0.60	1.72	1	8
1:A:76:TYR:CE2	1:A:163:ILE:HD11	0.53	2.38	10	10
1:A:114:LEU:CD1	1:A:141:LEU:HD22	0.53	2.34	7	3
1:A:72:VAL:HG11	1:A:148:ALA:HB3	0.53	1.79	20	3
1:A:67:ILE:HG21	1:A:107:VAL:HG11	0.51	1.82	11	8
1:A:107:VAL:HG23	1:A:144:GLU:HG3	0.51	1.83	8	2
1:A:26:GLY:C	1:A:27:ILE:HD12	0.51	2.26	12	6
1:A:72:VAL:HG13	1:A:145:LEU:HD22	0.51	1.82	20	10
1:A:79:LEU:HD21	1:A:111:ALA:HB1	0.51	1.83	6	19
1:A:114:LEU:HD11	1:A:141:LEU:HD22	0.51	1.82	7	4
1:A:84:ILE:HD11	1:A:119:LEU:HD12	0.50	1.84	10	1
1:A:15:VAL:HG13	1:A:20:GLY:HA2	0.49	1.83	2	1
1:A:98:TYR:HB3	1:A:113:VAL:HG13	0.49	1.84	16	6
1:A:160:LEU:HD22	1:A:164:PHE:CZ	0.48	2.43	9	10
1:A:124:LYS:HE3	1:A:166:LEU:HD13	0.48	1.85	12	1
1:A:86:VAL:HG11	1:A:94:ARG:HG3	0.48	1.86	5	2
1:A:14:ALA:HB1	1:A:63:LEU:HD12	0.47	1.86	2	1
1:A:118:TYR:CD2	1:A:134:LEU:HD11	0.47	2.45	3	14
1:A:15:VAL:HG21	1:A:66:ILE:HG23	0.47	1.87	7	3
1:A:126:LEU:HD22	1:A:134:LEU:HD22	0.46	1.86	11	4
1:A:15:VAL:HG13	1:A:20:GLY:CA	0.46	2.40	2	2
1:A:79:LEU:HD12	1:A:163:ILE:HD13	0.46	1.87	6	4

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:14:ALA:HB1	1:A:63:LEU:HD11	0.46	1.88	14	1
1:A:118:TYR:CE2	1:A:134:LEU:HD11	0.45	2.46	3	3
1:A:114:LEU:HD22	1:A:141:LEU:HD13	0.45	1.88	4	2
1:A:84:ILE:HD11	1:A:119:LEU:HD13	0.45	1.88	8	2
1:A:141:LEU:CD2	1:A:160:LEU:HD21	0.45	2.39	4	13
1:A:113:VAL:O	1:A:117:LEU:HD12	0.45	2.12	19	7
1:A:67:ILE:HG21	1:A:107:VAL:CG1	0.44	2.43	10	1
1:A:86:VAL:HG21	1:A:94:ARG:HG3	0.44	1.88	1	1
1:A:13:LYS:CB	1:A:66:ILE:HD11	0.43	2.43	3	1
1:A:75:VAL:HG11	1:A:145:LEU:HD21	0.43	1.89	6	2
1:A:75:VAL:HG22	1:A:108:PHE:CD1	0.43	2.49	15	5
1:A:72:VAL:HG11	1:A:148:ALA:CB	0.42	2.44	6	1
1:A:67:ILE:HD13	1:A:71:ASP:OD1	0.42	2.14	5	1
1:A:79:LEU:CD2	1:A:111:ALA:HB1	0.42	2.45	15	3
1:A:19:GLN:CG	1:A:21:VAL:HG12	0.42	2.45	7	1
1:A:84:ILE:CD1	1:A:119:LEU:HD12	0.42	2.44	19	1
1:A:40:TYR:CD2	1:A:55:ILE:HG22	0.41	2.50	4	1
1:A:13:LYS:HB3	1:A:66:ILE:HD11	0.41	1.91	18	1
1:A:84:ILE:C	1:A:84:ILE:HD12	0.41	2.36	10	1
1:A:84:ILE:HD12	1:A:84:ILE:C	0.41	2.36	15	1
1:A:44:ILE:CG1	1:A:51:ILE:HD13	0.41	2.45	11	1
1:A:26:GLY:C	1:A:41:VAL:HG12	0.40	2.37	12	1
1:A:19:GLN:HG3	1:A:21:VAL:HG12	0.40	1.92	7	1

6.3 Torsion angles ⓘ

6.3.1 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 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	155/167 (93%)	141±2 (91±1%)	14±2 (9±1%)	1±1 (0±0%)	37	78
All	All	3100/3340 (93%)	2813 (91%)	272 (9%)	15 (0%)	37	78

All 3 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	85	SER	12
1	A	7	SER	2
1	A	19	GLN	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	140/148 (95%)	113±3 (80±2%)	27±3 (20±2%)	4	36
All	All	2800/2960 (95%)	2254 (80%)	546 (20%)	4	36

All 73 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	99	MET	20
1	A	114	LEU	20
1	A	147	LEU	20
1	A	142	ILE	20
1	A	161	LYS	20
1	A	162	LYS	20
1	A	79	LEU	20
1	A	124	LYS	19
1	A	55	ILE	17
1	A	63	LEU	17
1	A	118	TYR	16
1	A	106	SER	16
1	A	116	ASP	16
1	A	138	ARG	15
1	A	112	GLU	15
1	A	94	ARG	14
1	A	149	LYS	11
1	A	101	LYS	10
1	A	121	LYS	10
1	A	165	ASN	10
1	A	143	LYS	10
1	A	46	GLU	9
1	A	119	LEU	9

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Mol	Chain	Res	Type	Models (Total)
1	A	127	SER	8
1	A	50	ARG	8
1	A	64	ARG	8
1	A	151	CYS	8
1	A	100	GLU	8
1	A	103	LYS	8
1	A	71	ASP	8
1	A	57	LYS	7
1	A	77	SER	7
1	A	16	TYR	7
1	A	87	ASP	7
1	A	73	LYS	7
1	A	144	GLU	6
1	A	139	SER	5
1	A	131	ARG	5
1	A	51	ILE	5
1	A	120	LEU	5
1	A	123	ASP	4
1	A	35	GLN	4
1	A	82	LYS	4
1	A	132	LYS	4
1	A	83	ASP	3
1	A	68	SER	3
1	A	130	GLU	3
1	A	56	ASN	3
1	A	146	SER	3
1	A	96	ARG	3
1	A	109	GLU	3
1	A	43	ARG	3
1	A	155	GLU	3
1	A	47	ASN	2
1	A	13	LYS	2
1	A	125	ASP	2
1	A	88	SER	2
1	A	9	LYS	2
1	A	154	ASP	2
1	A	66	ILE	2
1	A	30	THR	2
1	A	25	MET	2
1	A	70	GLU	2
1	A	37	GLN	2
1	A	36	ARG	2

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Mol	Chain	Res	Type	Models (Total)
1	A	69	GLU	1
1	A	45	LEU	1
1	A	85	SER	1
1	A	7	SER	1
1	A	65	GLU	1
1	A	12	ASP	1
1	A	159	ASP	1
1	A	67	ILE	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 76% for the well-defined parts and 75% for the entire structure.

7.1 Chemical shift list 1

File name: 2lwj_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	1787
Number of shifts mapped to atoms	1787
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	1

7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction \pm precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	155	-0.33 ± 0.10	None needed (< 0.5 ppm)
$^{13}\text{C}_\beta$	84	0.21 ± 0.10	None needed (< 0.5 ppm)
$^{13}\text{C}'$	145	-0.26 ± 0.14	None needed (< 0.5 ppm)
^{15}N	152	0.35 ± 0.35	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 76%, i.e. 1526 atoms were assigned a chemical shift out of a possible 1997. 0 out of 26 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	729/776 (94%)	295/310 (95%)	288/312 (92%)	146/154 (95%)
Sidechain	742/1108 (67%)	503/647 (78%)	227/408 (56%)	12/53 (23%)

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	Total	¹ H	¹³ C	¹⁵ N
Aromatic	55/113 (49%)	54/59 (92%)	0/51 (0%)	1/3 (33%)
Overall	1526/1997 (76%)	852/1016 (84%)	515/771 (67%)	159/210 (76%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 75%, i.e. 1584 atoms were assigned a chemical shift out of a possible 2103. 0 out of 28 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹ H	¹³ C	¹⁵ N
Backbone	759/831 (91%)	307/332 (92%)	300/334 (90%)	152/165 (92%)
Sidechain	768/1151 (67%)	519/672 (77%)	236/425 (56%)	13/54 (24%)
Aromatic	57/121 (47%)	56/63 (89%)	0/53 (0%)	1/5 (20%)
Overall	1584/2103 (75%)	882/1067 (83%)	536/812 (66%)	166/224 (74%)

7.1.4 Statistically unusual chemical shifts [i](#)

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	91	TRP	CD2	139.10	134.55 – 120.45	8.2

7.1.5 Random Coil Index (RCI) plots [i](#)

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:

