wwPDB NMR Structure Validation Summary Report

Apr 21, 2024 – 01:41 AM EDT

PDB ID	:	2LMN
BMRB ID	:	18127
Title	:	Structural Model for a 40-Residue Beta-Amyloid Fibril with Two-Fold Symmetry, Positive Stagger
Authors	:	Tycko, R.; Petkova, A.
Deposited on	:	2011-12-08

This is a wwPDB NMR 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/NMRValidationReportHelp
with specific help available everywhere you see the (i) 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 (i)) were used in the production of this report:

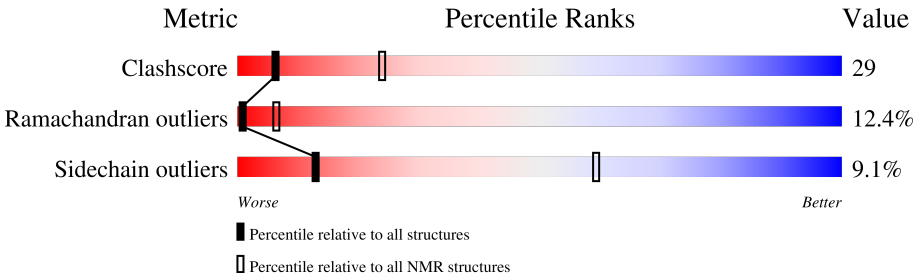
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
SOLID-STATE NMR

The overall completeness of chemical shifts assignment is 2%.

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	158937	12864
Ramachandran outliers	154571	11451
Sidechain outliers	154315	11428

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 <=5%

Mol	Chain	Length	Quality of chain
1	A	40	40% 28% · 10% 20%
1	B	40	40% 28% 5% 8% 20%
1	C	40	40% 32% 8% 20%
1	D	40	30% 30% 12% 8% 20%
1	E	40	40% 35% 5% 20%
1	F	40	35% 28% 18% 20%
1	G	40	48% 30% · 20%
1	H	40	48% 30% · 20%
1	I	40	30% 32% 10% 8% 20%

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Mol	Chain	Length	Quality of chain
1	J	40	35% 38% 8% 20%
1	K	40	48% 28% 5% 20%
1	L	40	42% 35% 20%

2 Ensemble composition and analysis

This entry contains 10 models. Model 8 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:12-A:39, B:12-B:40, C:9-C:40, D:12-D:40, E:9-E:40, F:12-F:23, F:28-F:40, G:9-G:40, H:9-H:40, I:12-I:40, J:9-J:40, K:9-K:40, L:9-L:40 (364)	2.62	8

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 2 clusters and 1 single-model cluster was found.

Cluster number	Models
1	3, 4, 6, 8, 9, 10
2	1, 5, 7
Single-model clusters	2

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 5700 atoms, of which 2844 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Beta-amyloid protein 40.

Mol	Chain	Residues	Atoms						Trace
1	A	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	B	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	C	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	D	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	E	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	F	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	G	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	H	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	I	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	J	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	K	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	
1	L	32	Total	C	H	N	O	S	0
			475	154	237	40	43	1	

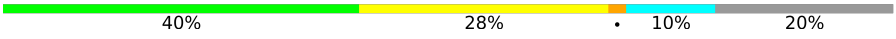
4 Residue-property plots

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA, DNA and oligosaccharide 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.

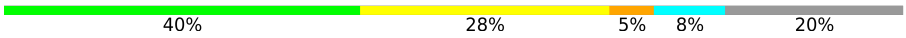
• Molecule 1: Beta-amyloid protein 40

Chain A:



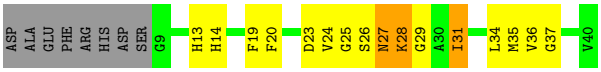
• Molecule 1: Beta-amyloid protein 40

Chain B:



• Molecule 1: Beta-amyloid protein 40

Chain C:



• Molecule 1: Beta-amyloid protein 40

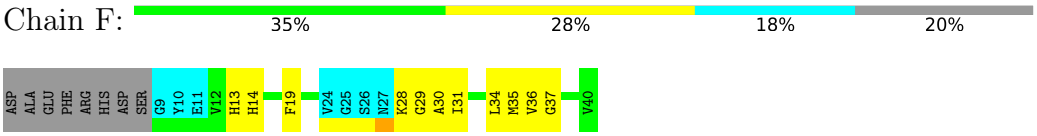
Chain D:

• Molecule 1: Beta-amyloid protein 40

Chain E:

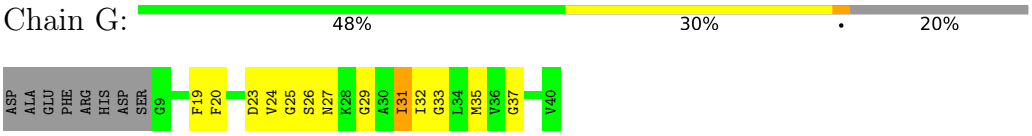
• Molecule 1: Beta-amyloid protein 40

Chain F:



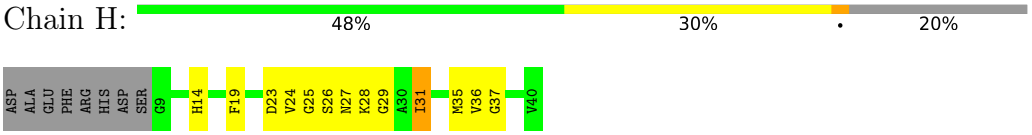
• Molecule 1: Beta-amyloid protein 40

Chain G:



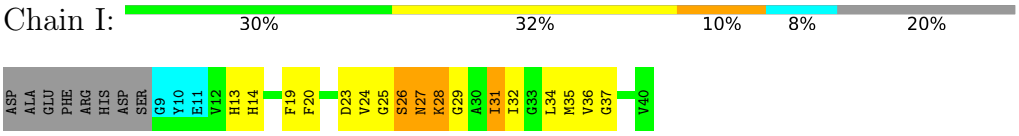
• Molecule 1: Beta-amyloid protein 40

Chain H:



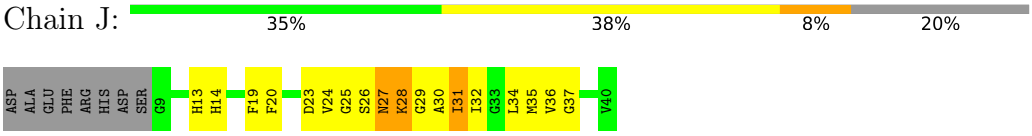
• Molecule 1: Beta-amyloid protein 40

Chain I:



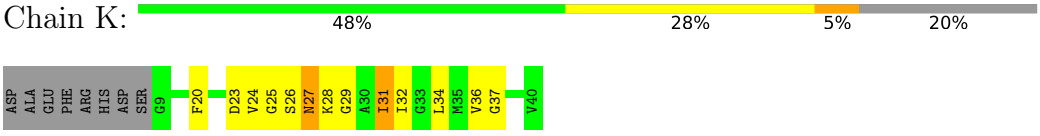
• Molecule 1: Beta-amyloid protein 40

Chain J:



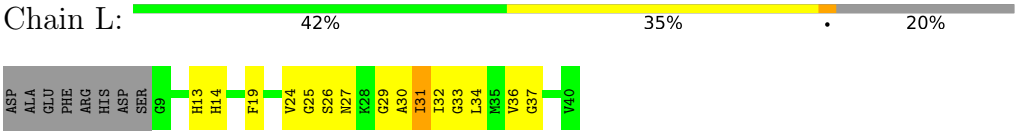
• Molecule 1: Beta-amyloid protein 40

Chain K:



• Molecule 1: Beta-amyloid protein 40

Chain L:

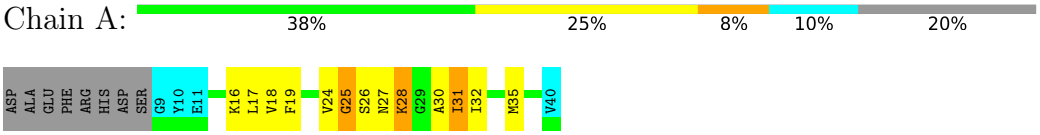


4.2 Residue scores for the representative (medoid) model from the NMR ensemble

The representative model is number 8. Colouring as in section 4.1 above.

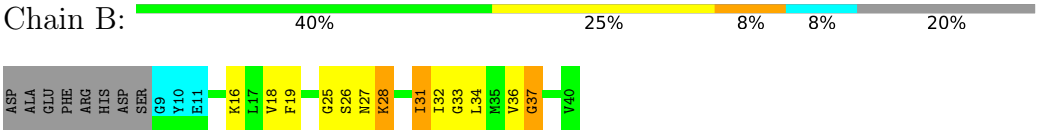
• Molecule 1: Beta-amyloid protein 40

Chain A:



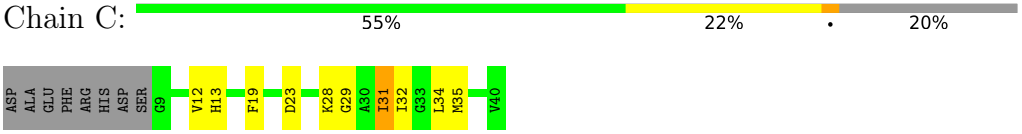
• Molecule 1: Beta-amyloid protein 40

Chain B:



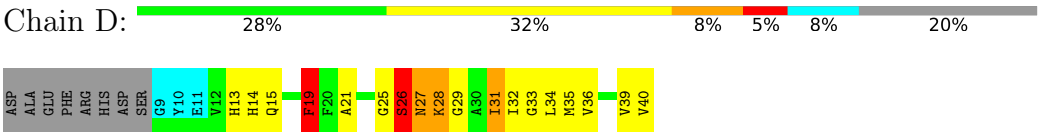
• Molecule 1: Beta-amyloid protein 40

Chain C:



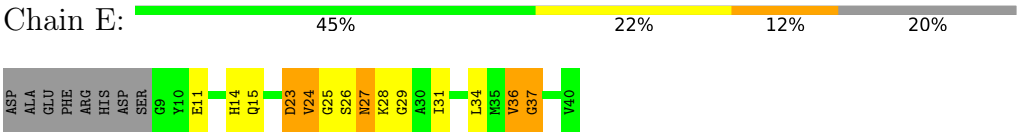
• Molecule 1: Beta-amyloid protein 40

Chain D:



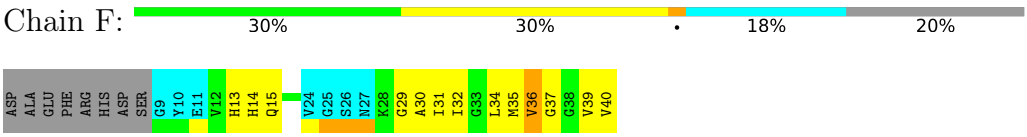
• Molecule 1: Beta-amyloid protein 40

Chain E:



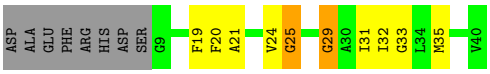
• Molecule 1: Beta-amyloid protein 40

Chain F:



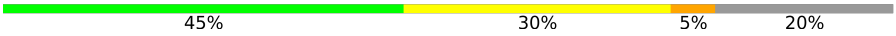
• Molecule 1: Beta-amyloid protein 40

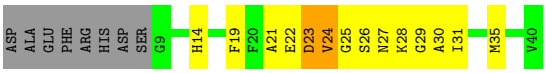
Chain G:



• Molecule 1: Beta-amyloid protein 40

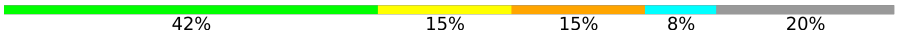
Chain H:

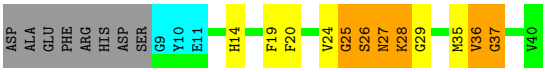




• Molecule 1: Beta-amyloid protein 40

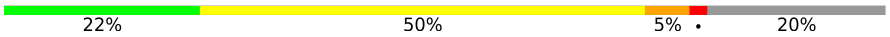
Chain I:

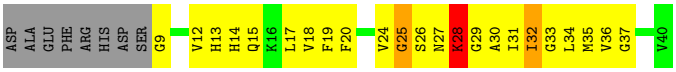




• Molecule 1: Beta-amyloid protein 40

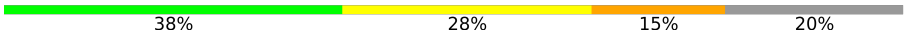
Chain J:





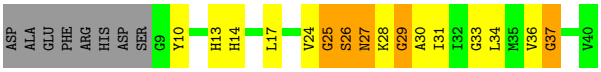
• Molecule 1: Beta-amyloid protein 40

Chain K:



• Molecule 1: Beta-amyloid protein 40

Chain L:



5 Refinement protocol and experimental data overview

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

Of the 40 calculated structures, 10 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
X-PLOR NIH	structure solution	
X-PLOR NIH	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)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	110
Number of shifts mapped to atoms	101
Number of unparsed shifts	0
Number of shifts with mapping errors	9
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	2%

Note: This is a solid-state NMR structure, where hydrogen atoms are typically not assigned a chemical shift value, which may lead to lower completeness of assignment measure.

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	0.63±0.06	0±0/209 (0.0± 0.1%)	0.76±0.04	0±0/281 (0.0± 0.0%)
1	B	0.63±0.02	0±0/216 (0.0± 0.0%)	0.77±0.02	0±0/288 (0.0± 0.0%)
1	C	0.73±0.01	0±0/242 (0.0± 0.0%)	0.83±0.03	0±0/323 (0.0± 0.0%)
1	D	0.67±0.02	0±0/216 (0.0± 0.0%)	0.87±0.05	0±0/288 (0.0± 0.1%)
1	E	0.72±0.02	0±0/242 (0.0± 0.0%)	0.84±0.03	0±0/323 (0.0± 0.0%)
1	F	0.65±0.03	0±0/191 (0.0± 0.0%)	0.89±0.06	0±0/254 (0.0± 0.0%)
1	G	0.69±0.05	0±0/242 (0.0± 0.0%)	0.79±0.06	0±0/323 (0.0± 0.1%)
1	H	0.70±0.02	0±0/242 (0.0± 0.0%)	0.79±0.02	0±0/323 (0.0± 0.0%)
1	I	0.69±0.03	0±0/216 (0.0± 0.0%)	0.81±0.05	0±0/288 (0.0± 0.0%)
1	J	0.73±0.01	0±0/242 (0.0± 0.0%)	0.85±0.04	0±0/323 (0.0± 0.1%)
1	K	0.71±0.02	0±0/242 (0.0± 0.0%)	0.83±0.05	0±0/323 (0.0± 0.0%)
1	L	0.70±0.02	0±0/242 (0.0± 0.0%)	0.85±0.04	0±0/323 (0.0± 0.0%)
All	All	0.69	1/27420 (0.0%)	0.82	3/36600 (0.0%)

All unique bond outliers are listed below.

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)	Models	
								Worst	Total
1	A	29	GLY	CA-C	-5.46	1.43	1.51	10	1

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(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	G	30	ALA	N-CA-C	-6.14	94.42	111.00	6	1
1	J	19	PHE	CB-CG-CD2	-5.23	117.14	120.80	1	1
1	D	19	PHE	CB-CG-CD2	-5.09	117.24	120.80	8	1

There are no chirality outliers.

There are no planarity outliers.

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	205	210	210	13±4
1	B	213	219	219	18±4
1	C	238	237	236	21±5
1	D	213	219	219	20±3
1	E	238	237	236	17±5
1	F	188	196	196	14±5
1	G	238	237	236	13±4
1	H	238	237	236	19±5
1	I	213	219	219	22±7
1	J	238	237	236	24±6
1	K	238	237	236	22±5
1	L	238	237	236	19±6
All	All	26980	27220	27150	1556

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 29.

5 of 1085 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:G:29:GLY:O	1:H:30:ALA:HB1	0.94	1.61	6	1
1:K:17:LEU:O	1:L:17:LEU:C	0.93	2.07	4	1
1:I:26:SER:O	1:I:27:ASN:O	0.90	1.88	6	9
1:I:19:PHE:CZ	1:L:34:LEU:HD22	0.87	2.05	9	1
1:A:19:PHE:CZ	1:C:34:LEU:HD22	0.85	2.06	6	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	28/40 (70%)	21±1 (74±4%)	5±1 (19±5%)	2±1 (8±3%)	2 14
1	B	28/40 (70%)	21±1 (75±5%)	4±2 (14±6%)	3±1 (11±4%)	1 8
1	C	30/40 (75%)	21±2 (70±5%)	5±2 (16±8%)	4±2 (14±5%)	1 5
1	D	28/40 (70%)	20±1 (70±5%)	4±1 (14±5%)	4±1 (16±5%)	0 4
1	E	30/40 (75%)	22±2 (72±5%)	4±2 (14±5%)	4±1 (14±4%)	1 5
1	F	24/40 (60%)	18±1 (75±6%)	4±1 (17±6%)	2±1 (8±5%)	2 14
1	G	30/40 (75%)	22±1 (75±5%)	4±1 (15±5%)	3±1 (10±2%)	1 10
1	H	30/40 (75%)	22±1 (74±5%)	4±2 (12±7%)	4±1 (13±4%)	1 5
1	I	28/40 (70%)	19±2 (69±6%)	5±1 (16±5%)	4±1 (15±5%)	0 4
1	J	30/40 (75%)	21±2 (71±6%)	5±1 (16±5%)	4±1 (13±5%)	1 5
1	K	30/40 (75%)	21±1 (71±5%)	5±2 (16±6%)	4±1 (13±3%)	1 6
1	L	30/40 (75%)	21±2 (70±6%)	5±2 (18±7%)	4±1 (12±5%)	1 6
All	All	3460/4800 (72%)	2491 (72%)	539 (16%)	430 (12%)	1 6

5 of 101 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	25	GLY	10
1	I	27	ASN	10
1	L	25	GLY	10
1	C	27	ASN	9
1	D	25	GLY	9

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	21/31 (68%)	19±1 (92±3%)	2±1 (8±3%)	17 65
1	B	22/31 (71%)	21±0 (95±1%)	1±0 (5±1%)	28 77
1	C	24/31 (77%)	22±1 (90±6%)	2±1 (10±6%)	10 55
1	D	22/31 (71%)	19±1 (88±4%)	3±1 (12±4%)	8 50
1	E	24/31 (77%)	21±0 (89±2%)	3±0 (11±2%)	10 54

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	F	19/31 (61%)	18±1 (92±4%)	2±1 (8±4%)	16 63
1	G	24/31 (77%)	23±1 (95±2%)	1±1 (5±3%)	28 77
1	H	24/31 (77%)	23±0 (95±2%)	1±0 (5±2%)	26 75
1	I	22/31 (71%)	19±1 (88±4%)	3±1 (12±4%)	8 50
1	J	24/31 (77%)	21±1 (86±4%)	3±1 (14±4%)	6 46
1	K	24/31 (77%)	21±1 (88±4%)	3±1 (12±4%)	9 52
1	L	24/31 (77%)	22±1 (94±4%)	2±1 (6±4%)	21 70
All	All	2740/3720 (74%)	2491 (91%)	249 (9%)	13 59

5 of 75 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	31	ILE	10
1	B	31	ILE	10
1	G	31	ILE	10
1	J	31	ILE	10
1	K	31	ILE	10

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 monosaccharides 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 2% for the well-defined parts and 2% for the entire structure.

7.1 Chemical shift list 1

File name: working_cs.cif

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	110
Number of shifts mapped to atoms	101
Number of unparsed shifts	0
Number of shifts with mapping errors	9
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	0

The following assigned chemical shifts were not mapped to the molecules present in the coordinate file.

- No matching atom found in the structure. First 5 (of 9) occurrences are reported below.

List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	2	ALA	C	175.4	0.3	1
1	A	2	ALA	CA	51.1	0.3	1
1	A	2	ALA	CB	22.5	0.3	1
1	A	7	ASP	C	174.0	0.3	1
1	A	7	ASP	CA	53.6	0.3	1
1	A	7	ASP	CB	42.4	0.3	1
1	A	8	SER	C	172.7	0.3	1
1	A	8	SER	CA	58.1	0.3	1
1	A	8	SER	CB	65.3	0.3	1

7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	33	0.13 ± 0.16	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	27	-1.34 ± 0.29	Should be checked
$^{13}C'$	33	1.36 ± 0.14	Should be applied
^{15}N	17	—	None (insufficient data)

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 2%, i.e. 96 atoms were assigned a chemical shift out of a possible 4785. 0 out of 94 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	73/1886 (4%)	0/794 (0%)	56/728 (8%)	17/364 (5%)
Sidechain	23/2428 (1%)	0/1618 (0%)	23/763 (3%)	0/47 (0%)
Aromatic	0/471 (0%)	0/244 (0%)	0/203 (0%)	0/24 (0%)
Overall	96/4785 (2%)	0/2656 (0%)	79/1694 (5%)	17/435 (4%)

Note: This is a solid-state NMR structure, where hydrogen atoms are typically not assigned a chemical shift value, which may lead to lower completeness of assignment measure.

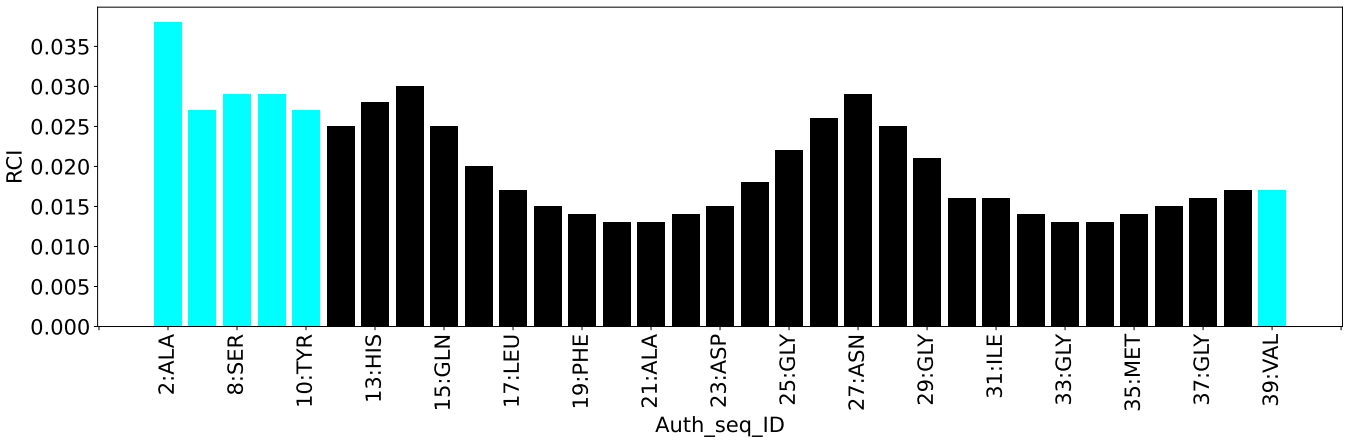
7.1.4 Statistically unusual chemical shifts

There are no statistically unusual chemical shifts.

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.If well-defined core and ill-defined regions are not identified then it is shown as gray bars.

Random coil index (RCI) for chain A:


RCI
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
2:ALA
8:SER
10:TYR
13:HIS
15:GLN
17:LEU
19:PHE
21:ALA
23:ASP
25:GLY
27:ASN
29:GLY
31:ILE
33:GLY
35:MET
37:GLY
39:VAL
Auth_seq_ID