



Full wwPDB NMR Structure Validation Report ⓘ

Mar 26, 2026 – 10:45 AM UTC

PDB ID : 5KRW / pdb_00005krw
BMRB ID : 30134
Title : Recognition and targeting mechanisms by chaperones in flagella assembly and operation
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Deposited on : 2016-07-07

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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
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
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) : 2.49

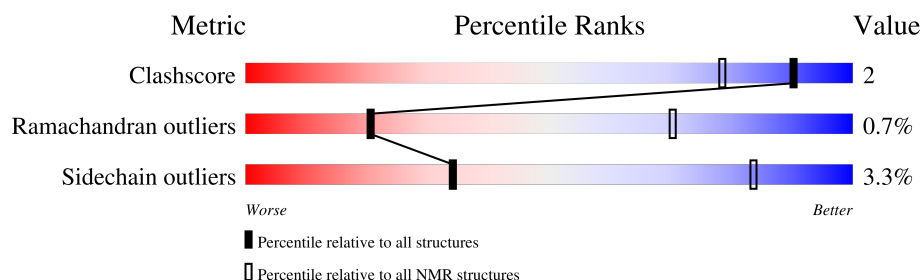
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 70%.

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	229148	14424
Ramachandran outliers	224038	12848
Sidechain outliers	223484	12823

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	155	

2 Ensemble composition and analysis

This entry contains 20 models. Model 9 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:2-A:97, A:429-A:467 (135)	0.47	9

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 3 clusters and 3 single-model clusters were found.

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

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2452 atoms, of which 1234 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Flagellar protein FliT,Flagellar hook-associated protein 2 fusion.

Mol	Chain	Residues	Atoms						Trace
1	A	155	Total	C	H	N	O	S	0
			2452	763	1234	207	242	6	

There are 20 discrepancies between the modelled and reference sequences:

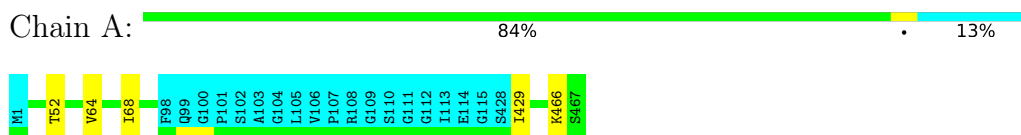
Chain	Residue	Modelled	Actual	Comment	Reference
A	96	VAL	-	linker	UNP P0A1N2
A	97	LEU	-	linker	UNP P0A1N2
A	98	PHE	-	linker	UNP P0A1N2
A	99	GLN	-	linker	UNP P0A1N2
A	100	GLY	-	linker	UNP P0A1N2
A	101	PRO	-	linker	UNP P0A1N2
A	102	SER	-	linker	UNP P0A1N2
A	103	ALA	-	linker	UNP P0A1N2
A	104	GLY	-	linker	UNP P0A1N2
A	105	LEU	-	linker	UNP P0A1N2
A	106	VAL	-	linker	UNP P0A1N2
A	107	PRO	-	linker	UNP P0A1N2
A	108	ARG	-	linker	UNP P0A1N2
A	109	GLY	-	linker	UNP P0A1N2
A	110	SER	-	linker	UNP P0A1N2
A	111	GLY	-	linker	UNP P0A1N2
A	112	GLY	-	linker	UNP P0A1N2
A	113	ILE	-	linker	UNP P0A1N2
A	114	GLU	-	linker	UNP P0A1N2
A	115	GLY	-	linker	UNP P0A1N2

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: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion

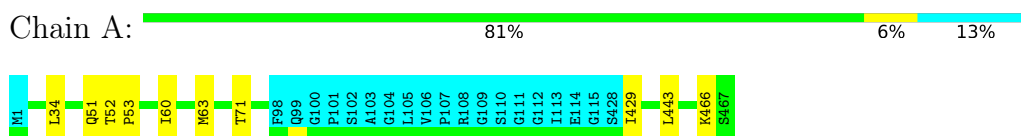


4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

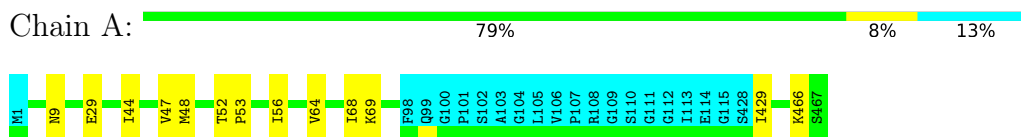
4.2.1 Score per residue for model 1

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



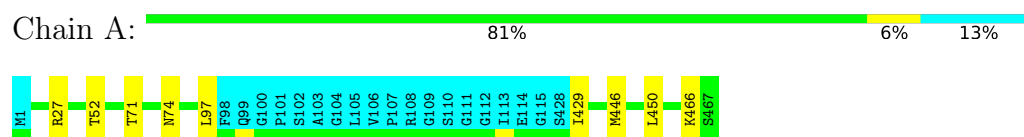
4.2.2 Score per residue for model 2

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



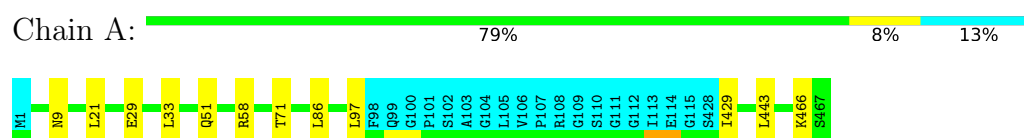
4.2.3 Score per residue for model 3

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



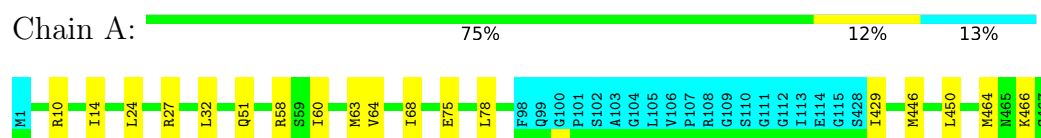
4.2.4 Score per residue for model 4

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



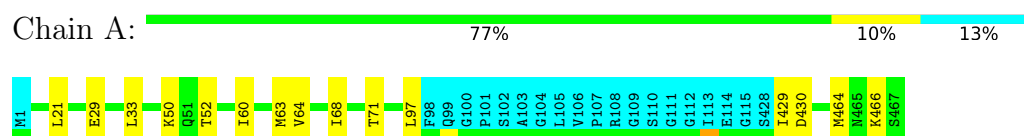
4.2.5 Score per residue for model 5

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



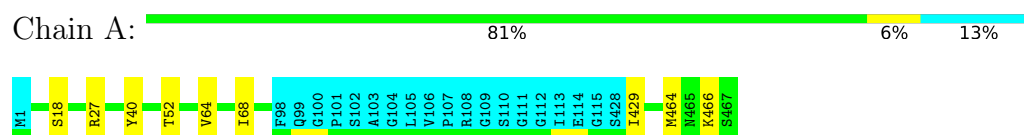
4.2.6 Score per residue for model 6

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



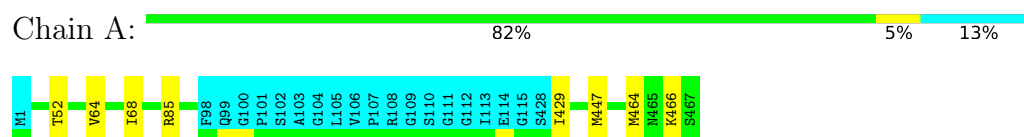
4.2.7 Score per residue for model 7

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



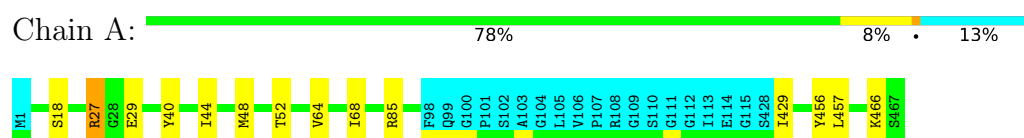
4.2.8 Score per residue for model 8

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



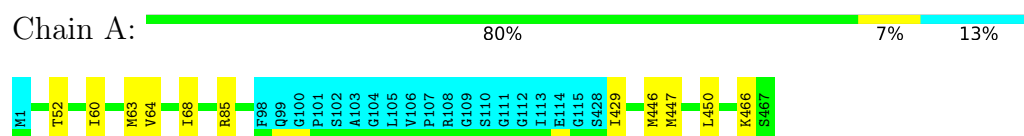
4.2.9 Score per residue for model 9 (medoid)

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



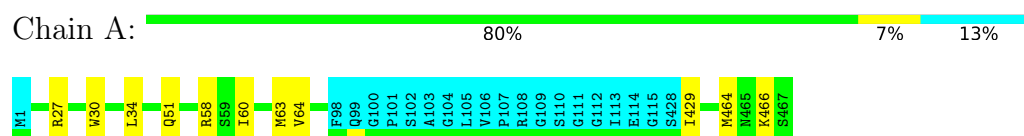
4.2.10 Score per residue for model 10

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



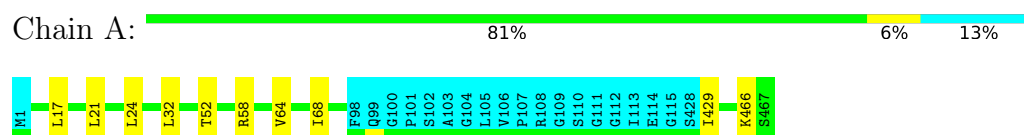
4.2.11 Score per residue for model 11

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



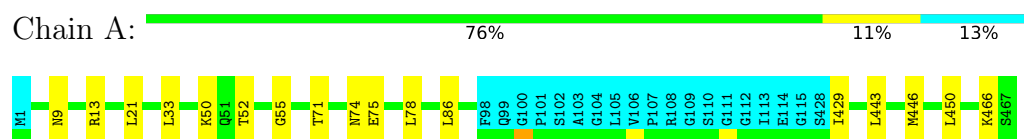
4.2.12 Score per residue for model 12

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



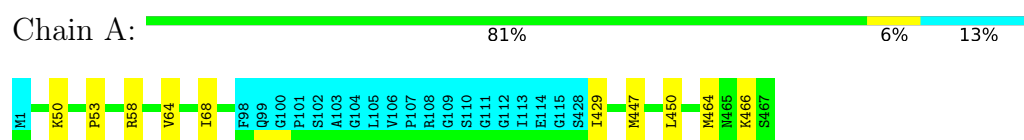
4.2.13 Score per residue for model 13

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



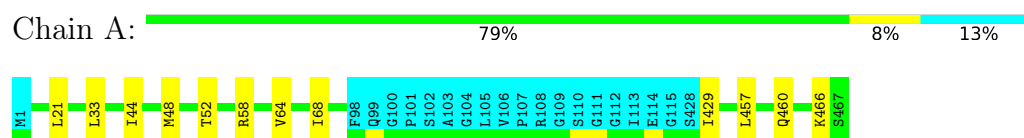
4.2.14 Score per residue for model 14

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



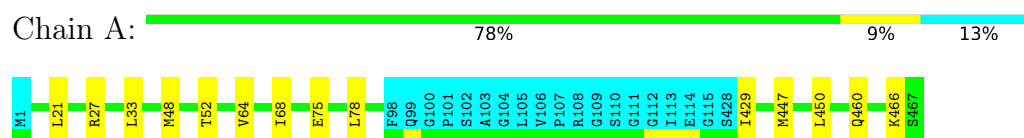
4.2.15 Score per residue for model 15

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



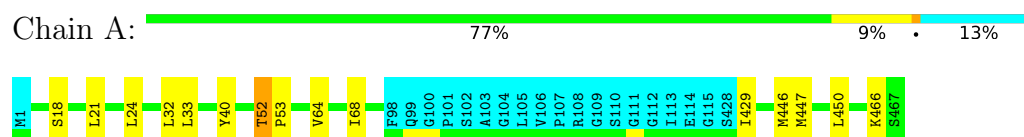
4.2.16 Score per residue for model 16

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



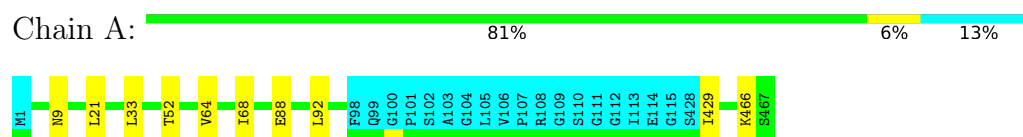
4.2.17 Score per residue for model 17

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



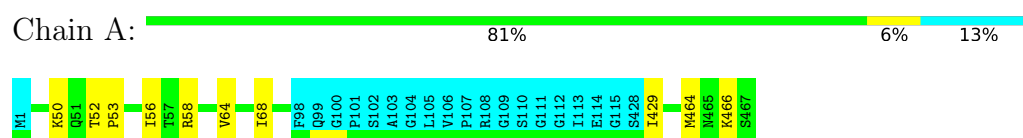
4.2.18 Score per residue for model 18

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



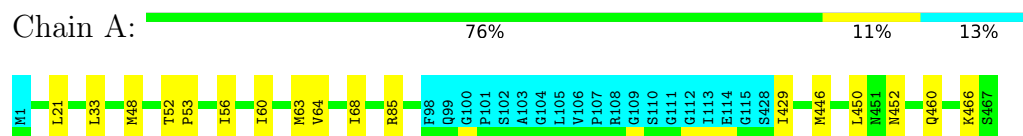
4.2.19 Score per residue for model 19

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



4.2.20 Score per residue for model 20

- Molecule 1: Flagellar protein FliT,Flagellar hook-associated protein 2 fusion



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: *target function*.

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

Software name	Classification	Version
CNS	refinement	1.3
CYANA	structure calculation	3.97
TALOS	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)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	1431
Number of shifts mapped to atoms	1431
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	70%

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	1.22±0.02	0±1/1098 (0.0± 0.1%)	1.11±0.02	0±0/1482 (0.0± 0.0%)
All	All	1.22	5/21960 (0.0%)	1.11	0/29640 (0.0%)

All unique bond 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(Å)	Ideal(Å)	Models	
								Worst	Total
1	A	53	PRO	CA-C	8.01	1.56	1.51	17	3
1	A	52	THR	C-N	5.65	1.38	1.33	1	2

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	1086	1104	1104	4±1
All	All	21720	22080	22080	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 2.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:64:VAL:HG23	1:A:464:MET:SD	0.55	2.41	8	7
1:A:21:LEU:HB2	1:A:33:LEU:HD12	0.51	1.81	6	8
1:A:86:LEU:HD21	1:A:443:LEU:HB2	0.50	1.82	4	2
1:A:60:ILE:HA	1:A:63:MET:HE2	0.48	1.85	10	6
1:A:64:VAL:O	1:A:68:ILE:HG13	0.47	2.09	12	15
1:A:44:ILE:O	1:A:48:MET:HG2	0.47	2.10	2	1
1:A:44:ILE:HG23	1:A:457:LEU:HD21	0.46	1.88	9	2
1:A:47:VAL:HG23	1:A:48:MET:SD	0.45	2.52	2	1
1:A:446:MET:HG2	1:A:450:LEU:HD23	0.44	1.89	20	6
1:A:447:MET:HA	1:A:450:LEU:HG	0.44	1.88	14	3
1:A:75:GLU:HA	1:A:78:LEU:HD12	0.44	1.90	13	3
1:A:27:ARG:HB3	1:A:29:GLU:HG2	0.44	1.89	9	1
1:A:24:LEU:HD13	1:A:32:LEU:HB3	0.43	1.89	5	3
1:A:53:PRO:O	1:A:56:ILE:HG12	0.43	2.14	2	3
1:A:18:SER:HB3	1:A:40:TYR:CE1	0.42	2.50	17	3
1:A:88:GLU:O	1:A:92:LEU:HG	0.42	2.15	18	1
1:A:48:MET:HE1	1:A:460:GLN:HG2	0.42	1.91	20	3
1:A:17:LEU:O	1:A:21:LEU:HG	0.42	2.15	12	1
1:A:30:TRP:O	1:A:34:LEU:HG	0.41	2.15	11	1
1:A:34:LEU:HD21	1:A:443:LEU:HD12	0.41	1.91	1	1
1:A:48:MET:HG3	1:A:456:TYR:CE1	0.41	2.51	9	1
1:A:10:ARG:O	1:A:14:ILE:HG13	0.40	2.16	5	1
1:A:9:ASN:O	1:A:13:ARG:HG2	0.40	2.16	13	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	134/155 (86%)	128±1 (95±1%)	5±1 (4±1%)	1±0 (1±0%)	20	70
All	All	2680/3100 (86%)	2557 (95%)	103 (4%)	20 (1%)	20	70

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	52	THR	15
1	A	51	GLN	4
1	A	55	GLY	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	124/137 (91%)	120±1 (97±1%)	4±1 (3±1%)	34	83
All	All	2480/2740 (91%)	2399 (97%)	81 (3%)	34	83

All 14 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	429	ILE	20
1	A	466	LYS	20
1	A	58	ARG	7
1	A	27	ARG	6
1	A	71	THR	5
1	A	50	LYS	4
1	A	85	ARG	4
1	A	9	ASN	3
1	A	29	GLU	3
1	A	97	LEU	3
1	A	74	ASN	2
1	A	447	MET	2
1	A	69	LYS	1
1	A	452	ASN	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 oligosaccharides 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 70% for the well-defined parts and 67% for the entire structure.

7.1 Chemical shift list 1

File name: working_cs.cif

Chemical shift list name: *assigned_chemical_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	1431
Number of shifts mapped to atoms	1431
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	0

7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction $\pm$ precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	137	-0.93 ± 0.08	Should be checked
$^{13}\text{C}_\beta$	122	0.30 ± 0.10	None needed (< 0.5 ppm)
$^{13}\text{C}'$	125	0.34 ± 0.11	None needed (< 0.5 ppm)
^{15}N	137	-0.24 ± 0.16	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 70%, i.e. 1333 atoms were assigned a chemical shift out of a possible 1908. 0 out of 27 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	608/676 (90%)	235/273 (86%)	246/270 (91%)	127/133 (95%)
Sidechain	667/1142 (58%)	446/742 (60%)	221/354 (62%)	0/46 (0%)

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	Total	^1H	^{13}C	^{15}N
Aromatic	58/90 (64%)	29/43 (67%)	27/45 (60%)	2/2 (100%)
Overall	1333/1908 (70%)	710/1058 (67%)	494/669 (74%)	129/181 (71%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 67%, i.e. 1431 atoms were assigned a chemical shift out of a possible 2135. 0 out of 29 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	652/778 (84%)	253/317 (80%)	262/310 (85%)	137/151 (91%)
Sidechain	715/1257 (57%)	479/818 (59%)	236/389 (61%)	0/50 (0%)
Aromatic	64/100 (64%)	32/48 (67%)	30/50 (60%)	2/2 (100%)
Overall	1431/2135 (67%)	764/1183 (65%)	528/749 (70%)	139/203 (68%)

7.1.4 Statistically unusual chemical shifts [i](#)

There are no statistically unusual chemical shifts.

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. 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:

