



# Full wwPDB NMR Structure Validation Report ⓘ

Mar 17, 2022 – 03:18 pm GMT

PDB ID : 7P2K  
Title : Solution NMR Structure of Arginine to Cysteine mutant of Arkadia RING domain.  
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Deposited on : 2021-07-06

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We welcome your comments at [validation@mail.wwpdb.org](mailto: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 ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) 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)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	2.27
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.27

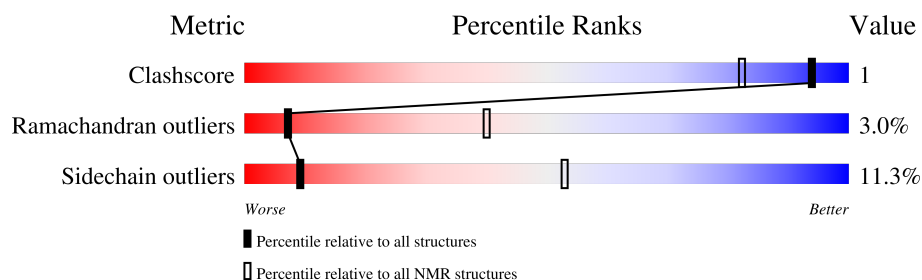
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*SOLUTION NMR*

The overall completeness of chemical shifts assignment is 78%.

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  $\geq 3$ , 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	69	<div> <div></div> <div>59%</div> <div>7%</div> <div>33%</div> </div>

## 2 Ensemble composition and analysis

This entry contains 30 models. Model 7 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *target function*.

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:16-A:61 (46)	0.26	7

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 13 single-model clusters were found.

Cluster number	Models
1	4, 6, 7, 9, 12, 18, 19, 20, 23, 25
2	17, 21, 22, 29
3	1, 11, 15
Single-model clusters	2; 3; 5; 8; 10; 13; 14; 16; 24; 26; 27; 28; 30

### 3 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 1066 atoms, of which 519 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called E3 ubiquitin-protein ligase Arkadia.

Mol	Chain	Residues	Atoms						Trace
1	A	69	Total	C	H	N	O	S	0
			1064	333	519	89	114	9	

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	initiating methionine	UNP Q6ZNA4
A	32	CYS	ARG	engineered mutation	UNP Q6ZNA4

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

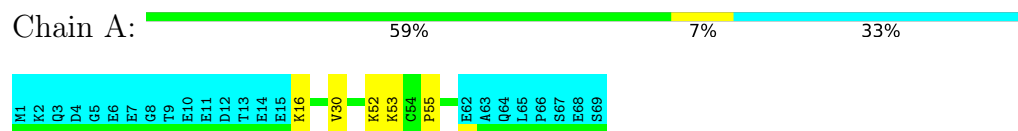
Mol	Chain	Residues	Atoms	
2	A	2	Total	Zn
			2	2

## 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: E3 ubiquitin-protein ligase Arkadia

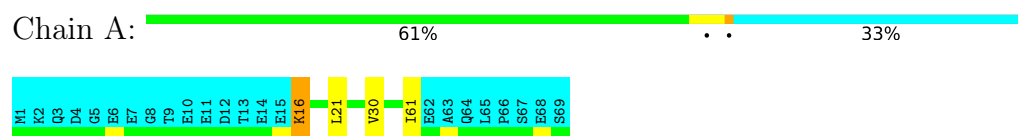


### 4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

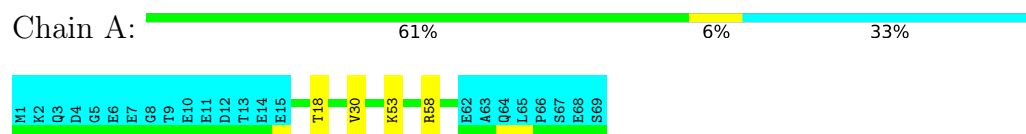
#### 4.2.1 Score per residue for model 1

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



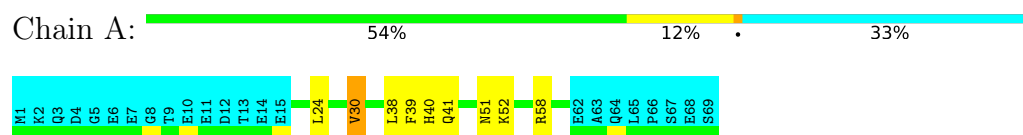
#### 4.2.2 Score per residue for model 2

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



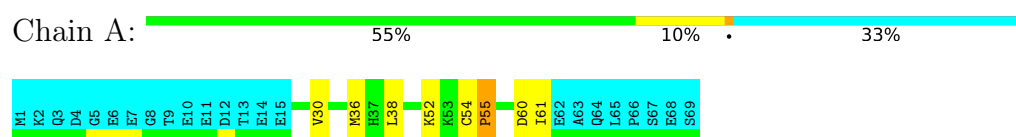
### 4.2.3 Score per residue for model 3

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



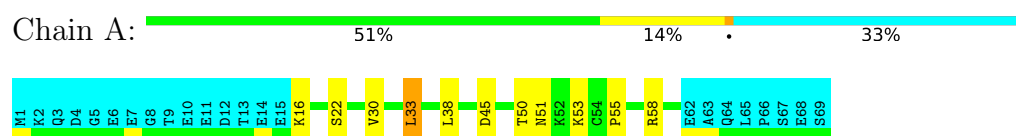
### 4.2.4 Score per residue for model 4

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



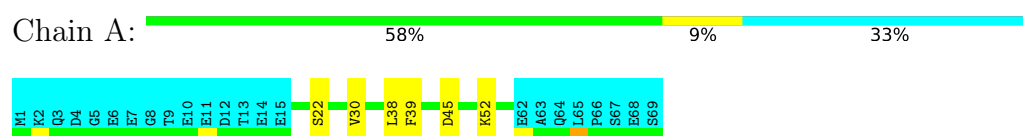
### 4.2.5 Score per residue for model 5

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



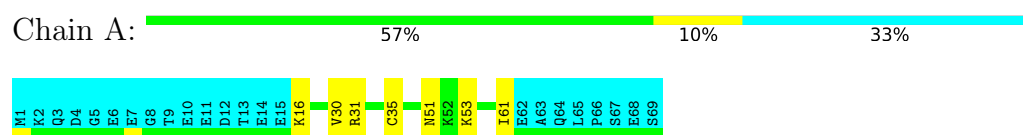
### 4.2.6 Score per residue for model 6

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



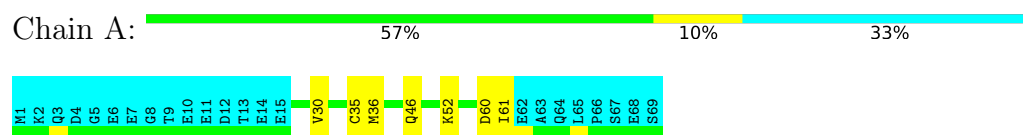
### 4.2.7 Score per residue for model 7 (medoid)

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



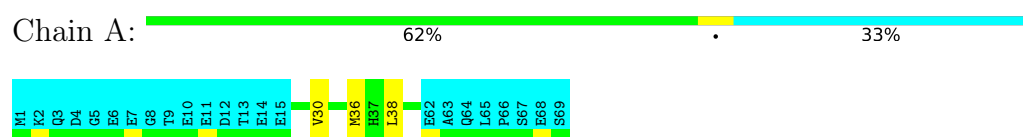
### 4.2.8 Score per residue for model 8

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



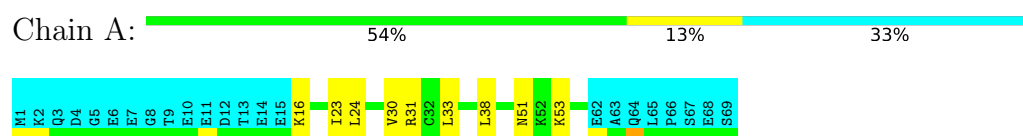
### 4.2.9 Score per residue for model 9

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



### 4.2.10 Score per residue for model 10

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



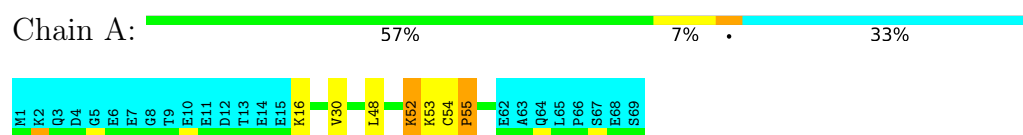
### 4.2.11 Score per residue for model 11

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



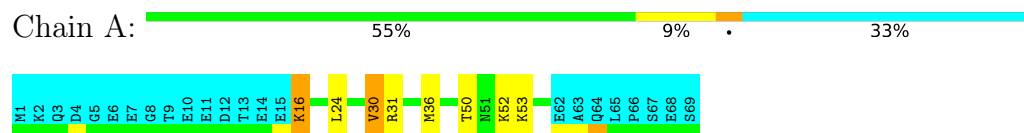
### 4.2.12 Score per residue for model 12

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



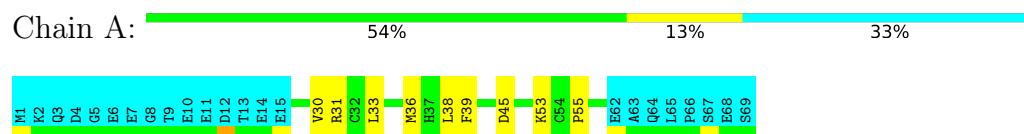
### 4.2.13 Score per residue for model 13

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



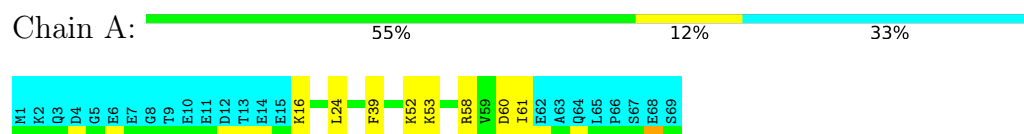
### 4.2.14 Score per residue for model 14

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



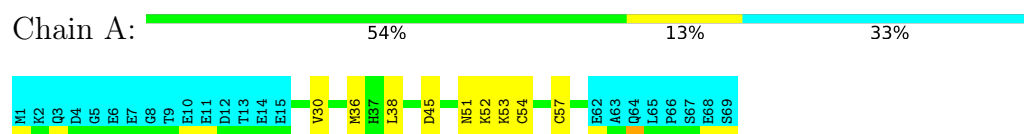
### 4.2.15 Score per residue for model 15

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



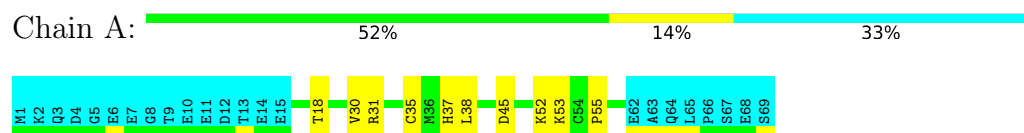
### 4.2.16 Score per residue for model 16

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



### 4.2.17 Score per residue for model 17

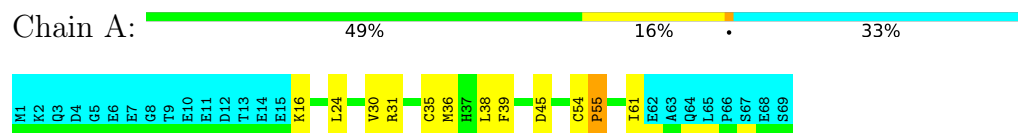
- Molecule 1: E3 ubiquitin-protein ligase Arkadia





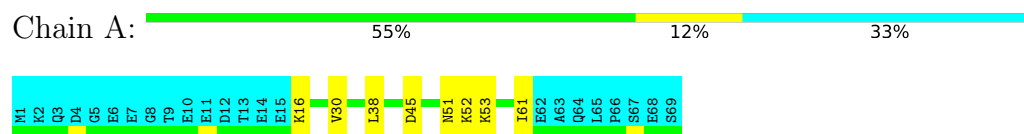
#### 4.2.18 Score per residue for model 18

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



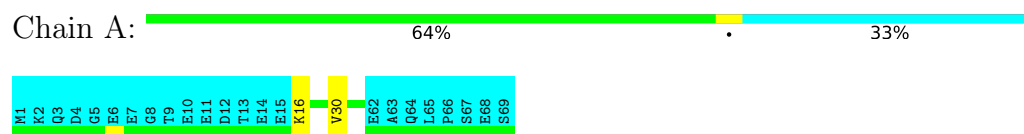
#### 4.2.19 Score per residue for model 19

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



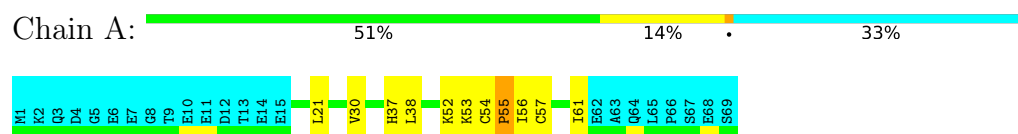
#### 4.2.20 Score per residue for model 20

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



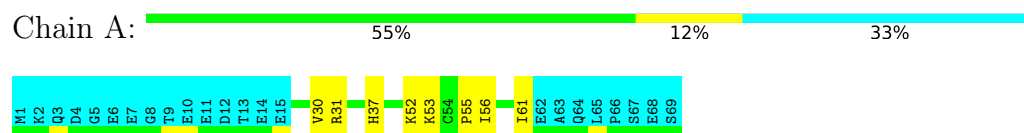
#### 4.2.21 Score per residue for model 21

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



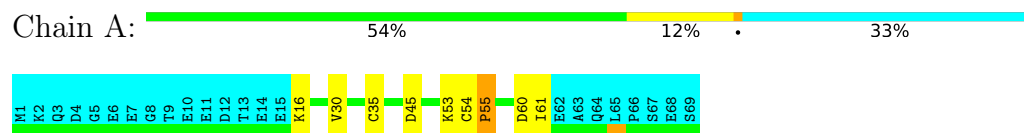
#### 4.2.22 Score per residue for model 22

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



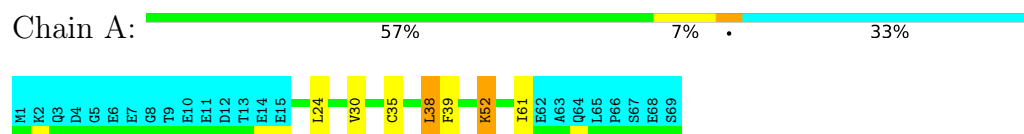
#### 4.2.23 Score per residue for model 23

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



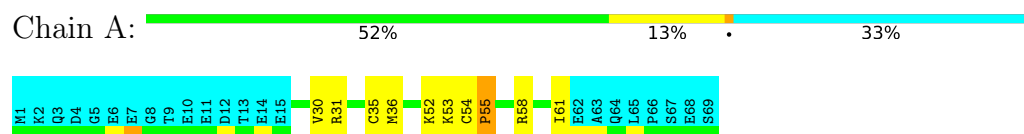
#### 4.2.24 Score per residue for model 24

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



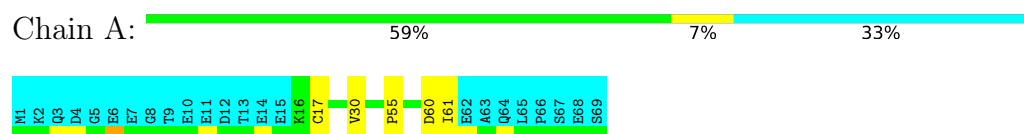
#### 4.2.25 Score per residue for model 25

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



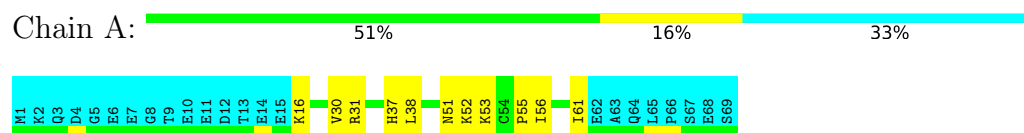
#### 4.2.26 Score per residue for model 26

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



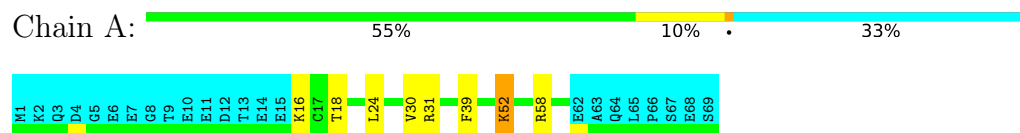
#### 4.2.27 Score per residue for model 27

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



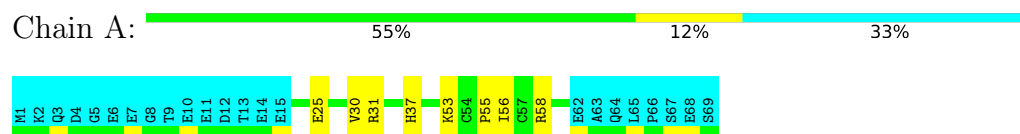
### 4.2.28 Score per residue for model 28

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



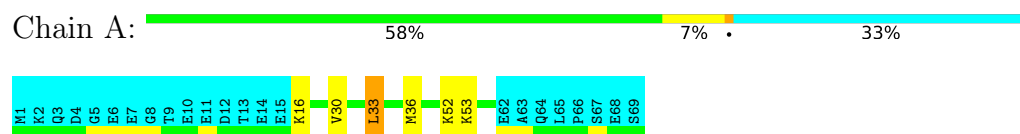
### 4.2.29 Score per residue for model 29

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



### 4.2.30 Score per residue for model 30

- Molecule 1: E3 ubiquitin-protein ligase Arkadia



## 5 Refinement protocol and experimental data overview

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

Of the 400 calculated structures, 30 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
DYANA	structure calculation	
Amber	refinement	5.0

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	709
Number of shifts mapped to atoms	709
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	78%

## 6 Model quality [i](#)

### 6.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: ZN

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	0.48±0.01	0±0/374 ( 0.0± 0.0%)	0.95±0.02	0±0/507 ( 0.0± 0.1%)
All	All	0.48	0/11220 ( 0.0%)	0.95	4/15210 ( 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	0.1±0.4
All	All	0	2

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	17	CYS	CA-CB-SG	6.12	125.02	114.00	26	1
1	A	35	CYS	C-N-CA	5.05	134.32	121.70	18	3

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	31	ARG	Sidechain	1
1	A	37	HIS	Sidechain	1

## 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	367	370	370	1±1
All	All	11070	11100	11100	27

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:24:LEU:HD11	1:A:39:PHE:HA	0.59	1.73	24	5
1:A:33:LEU:H	1:A:33:LEU:HD23	0.54	1.63	5	1
1:A:54:CYS:CB	1:A:57:CYS:SG	0.51	2.88	16	1
1:A:33:LEU:N	1:A:33:LEU:HD13	0.51	2.21	30	1
1:A:30:VAL:HG22	1:A:40:HIS:HA	0.47	1.86	3	1
1:A:54:CYS:SG	1:A:55:PRO:HD2	0.47	2.50	25	6
1:A:37:HIS:CD2	1:A:56:ILE:HD13	0.45	2.46	22	4
1:A:24:LEU:HD22	1:A:30:VAL:HG21	0.45	1.89	13	1
1:A:33:LEU:HD23	1:A:33:LEU:N	0.45	2.25	5	1
1:A:54:CYS:SG	1:A:55:PRO:CD	0.44	3.06	25	1
1:A:48:LEU:O	1:A:52:LYS:HE2	0.43	2.12	12	1
1:A:33:LEU:HD13	1:A:33:LEU:H	0.42	1.74	30	1
1:A:38:LEU:O	1:A:39:PHE:CD1	0.41	2.73	14	1
1:A:38:LEU:O	1:A:39:PHE:CD2	0.40	2.74	6	1
1:A:23:ILE:HG22	1:A:24:LEU:N	0.40	2.31	10	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	46/69 (67%)	37±1 (81±2%)	7±1 (16±2%)	1±1 (3±2%)	7	40
All	All	1380/2070 (67%)	1118 (81%)	221 (16%)	41 (3%)	7	40

All 6 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	55	PRO	13
1	A	16	LYS	10
1	A	36	MET	9
1	A	61	ILE	5
1	A	52	LYS	3
1	A	58	ARG	1

### 6.3.2 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 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	45/65 (69%)	40±2 (89±4%)	5±2 (11±4%)	9	53
All	All	1350/1950 (69%)	1198 (89%)	152 (11%)	9	53

All 21 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	30	VAL	29
1	A	53	LYS	19
1	A	52	LYS	16
1	A	38	LEU	12
1	A	61	ILE	10
1	A	31	ARG	10
1	A	51	ASN	8
1	A	45	ASP	8
1	A	16	LYS	7
1	A	58	ARG	7
1	A	60	ASP	5
1	A	33	LEU	4

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Mol	Chain	Res	Type	Models (Total)
1	A	35	CYS	4
1	A	18	THR	3
1	A	21	LEU	2
1	A	22	SER	2
1	A	50	THR	2
1	A	41	GLN	1
1	A	46	GLN	1
1	A	57	CYS	1
1	A	25	GLU	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 monosaccharides in this entry.

### 6.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 2 are monoatomic - leaving 0 for Mogul analysis.

### 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 78% for the well-defined parts and 76% for the entire structure.

### 7.1 Chemical shift list 1

File name: working\_cs.cif

Chemical shift list name: *assigned\_chemical\_shifts\_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	709
Number of shifts mapped to atoms	709
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
$^{13}\text{C}_\alpha$	69	$-0.40 \pm 0.11$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}_\beta$	66	$0.13 \pm 0.22$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}'$	0	—	None (insufficient data)
$^{15}\text{N}$	66	$-0.44 \pm 0.66$	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 78%, i.e. 451 atoms were assigned a chemical shift out of a possible 580. 9 out of 9 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	$^1\text{H}$	$^{13}\text{C}$	$^{15}\text{N}$
Backbone	180/226 (80%)	90/90 (100%)	46/92 (50%)	44/44 (100%)
Sidechain	271/319 (85%)	165/187 (88%)	106/120 (88%)	0/12 (0%)

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	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Aromatic	0/35 (0%)	0/19 (0%)	0/13 (0%)	0/3 (0%)
Overall	451/580 (78%)	255/296 (86%)	152/225 (68%)	44/59 (75%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 76%, i.e. 635 atoms were assigned a chemical shift out of a possible 832. 10 out of 10 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Backbone	269/339 (79%)	134/135 (99%)	69/138 (50%)	66/66 (100%)
Sidechain	366/458 (80%)	223/268 (83%)	143/175 (82%)	0/15 (0%)
Aromatic	0/35 (0%)	0/19 (0%)	0/13 (0%)	0/3 (0%)
Overall	635/832 (76%)	357/422 (85%)	212/326 (65%)	66/84 (79%)

#### 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	2	LYS	CE	36.29	46.00 – 37.80	-6.8

#### 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:

