Full wwPDB NMR Structure Validation Report (i)

Jun 5, 2020 – 11:30 pm BST

PDB ID	:	6AGP
Title	:	Structure of Rac1 in the low-affinity state for Mg2+
Authors	:	Toyama, Y.; Kontani, K.; Katada, T.; Shimada, I.
Deposited on	:	2018-08-13

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
https://www.wwpdb.org/validation/2017/NMRValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

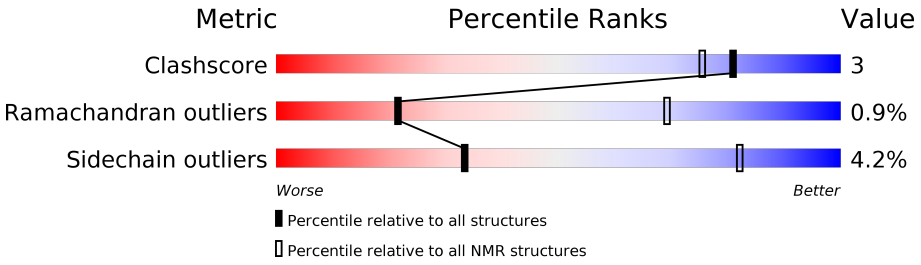
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	2.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

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 21%.

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	181	77% 10% • 12%

2 Ensemble composition and analysis

This entry contains 20 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:1-A:24, A:46-A:181 (160)	0.03	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 4 clusters. No single-model clusters were found.

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

3 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2867 atoms, of which 1437 are hydrogens and 0 are deuteriums.

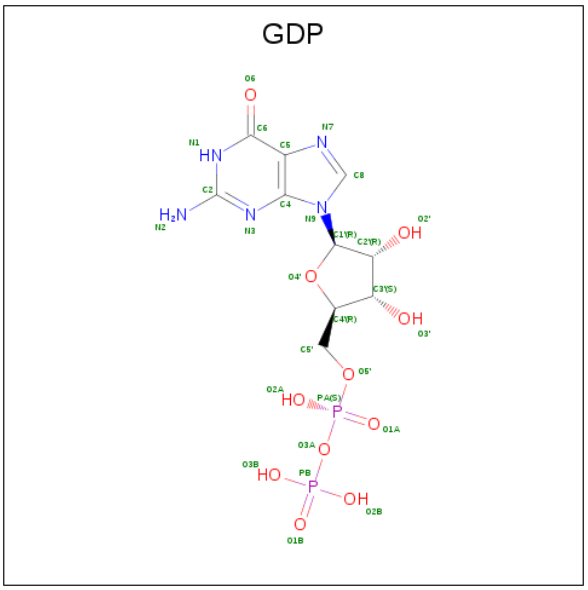
- Molecule 1 is a protein called Ras-related C3 botulinum toxin substrate 1.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	181	2825	899	1424	231	258	13	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	31	CYS	GLU	engineered mutation	UNP P63000
A	63	CYS	ASP	engineered mutation	UNP P63000
A	74	CYS	GLN	engineered mutation	UNP P63000
A	160	CYS	LEU	engineered mutation	UNP P63000

- Molecule 2 is GUANOSINE-5'-DIPHOSPHATE (three-letter code: GDP) (formula: $C_{10}H_{15}N_5O_{11}P_2$).



Mol	Chain	Residues	Atoms					
			Total	C	H	N	O	P
2	A	1	41	10	13	5	11	2

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	
			Total	Mg
3	A	1	1	1

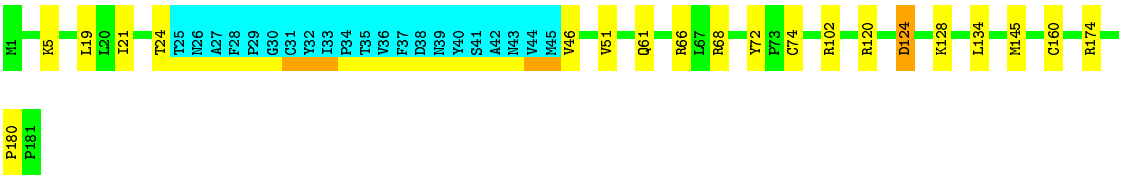
4 Residue-property plots

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: Ras-related C3 botulinum toxin substrate 1

Chain A:



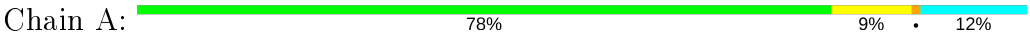
4.2 Scores per residue for each member of the ensemble

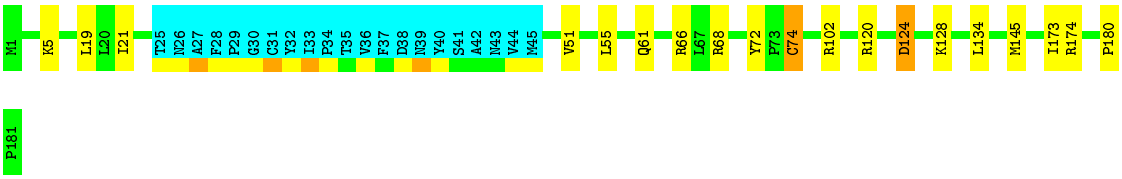
Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

Chain A:

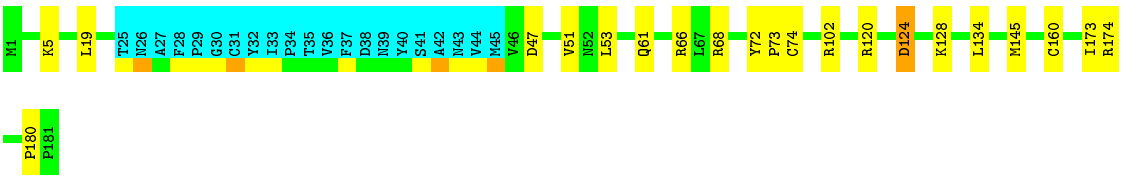




4.2.2 Score per residue for model 2

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

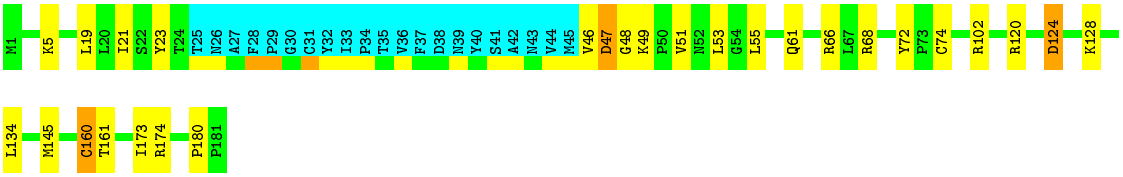
Chain A:



4.2.3 Score per residue for model 3

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

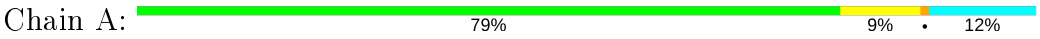
Chain A:

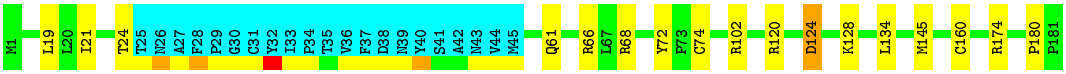


4.2.4 Score per residue for model 4

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

Chain A:

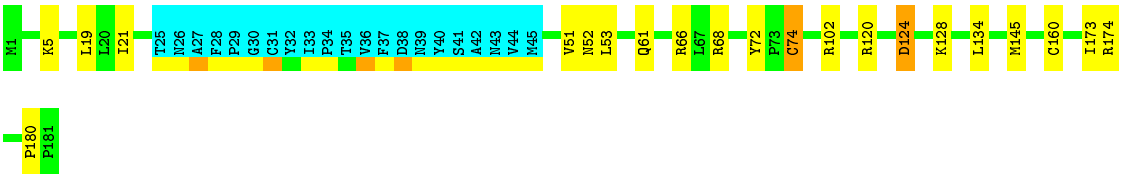




4.2.5 Score per residue for model 5

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

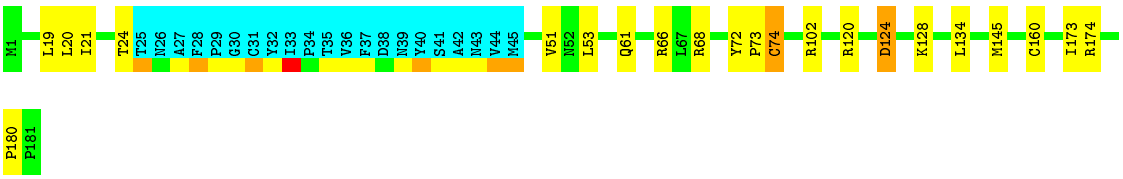
Chain A:



4.2.6 Score per residue for model 6

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

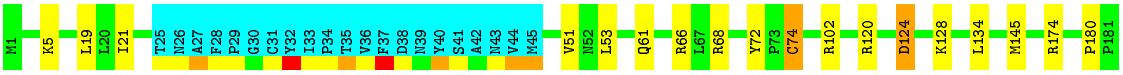
Chain A:



4.2.7 Score per residue for model 7

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

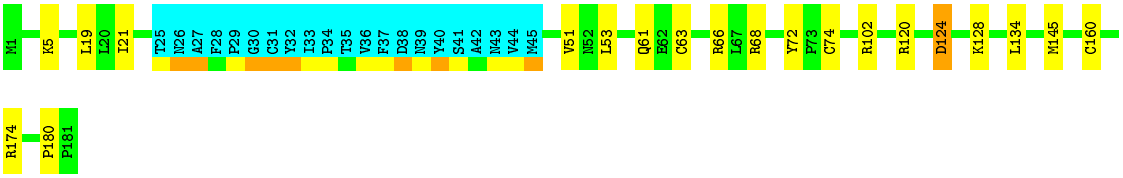
Chain A:



4.2.8 Score per residue for model 8 (medoid)

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

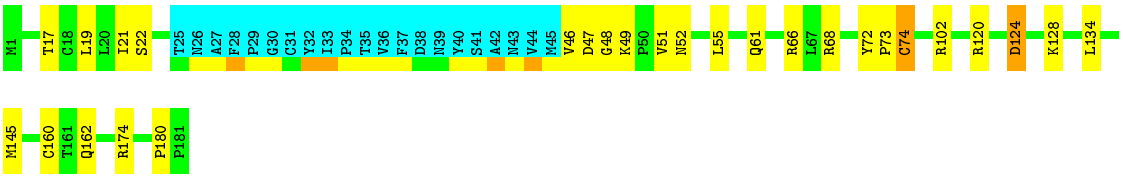
Chain A:



4.2.9 Score per residue for model 9

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

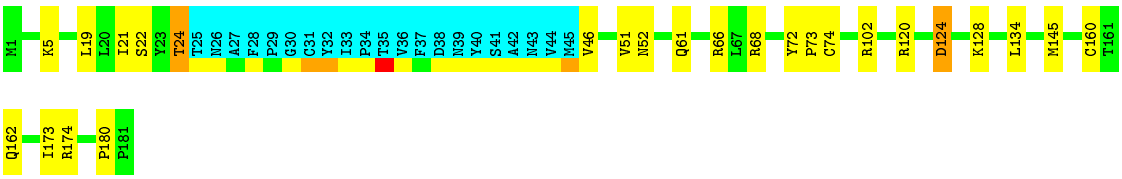
Chain A:



4.2.10 Score per residue for model 10

• Molecule 1: Ras-related C3 botulinum toxin substrate 1

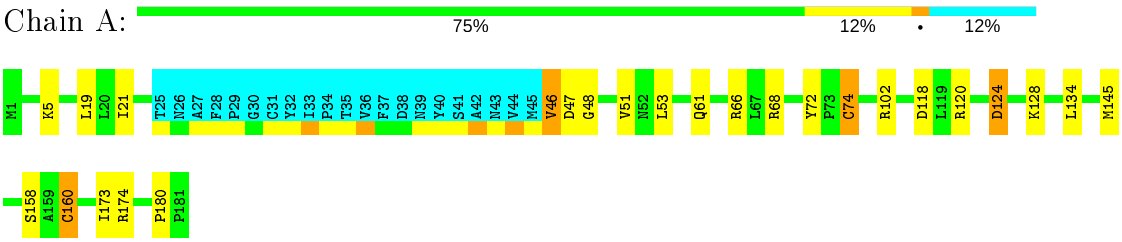
Chain A:



4.2.11 Score per residue for model 11

- Molecule 1: Ras-related C3 botulinum toxin substrate 1

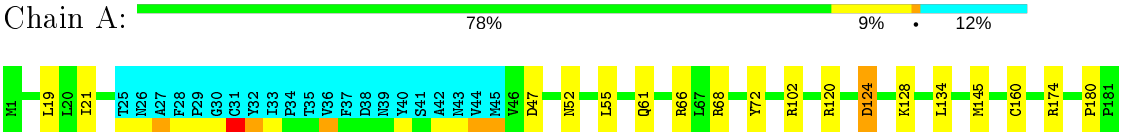
Chain A:



4.2.12 Score per residue for model 12

- Molecule 1: Ras-related C3 botulinum toxin substrate 1

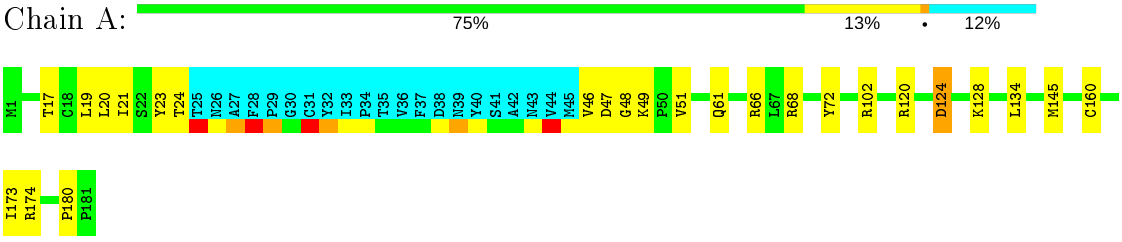
Chain A:



4.2.13 Score per residue for model 13

- Molecule 1: Ras-related C3 botulinum toxin substrate 1

Chain A:



4.2.14 Score per residue for model 14

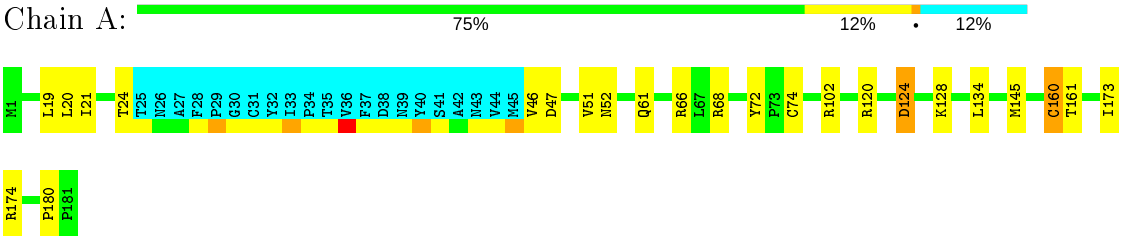
- Molecule 1: Ras-related C3 botulinum toxin substrate 1

Chain A:

4.2.15 Score per residue for model 15

- Molecule 1: Ras-related C3 botulinum toxin substrate 1

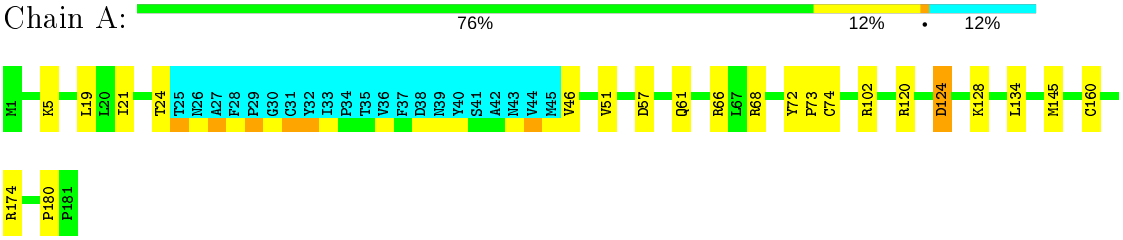
Chain A:



4.2.16 Score per residue for model 16

- Molecule 1: Ras-related C3 botulinum toxin substrate 1

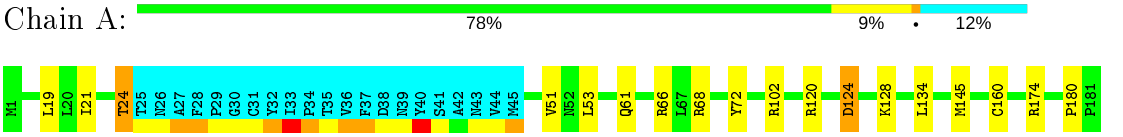
Chain A:



4.2.17 Score per residue for model 17

- Molecule 1: Ras-related C3 botulinum toxin substrate 1

Chain A:



4.2.18 Score per residue for model 18

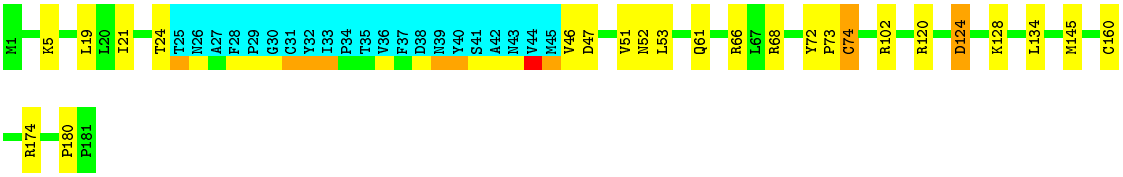
- Molecule 1: Ras-related C3 botulinum toxin substrate 1

Chain A:

4.2.19 Score per residue for model 19

- Molecule 1: Ras-related C3 botulinum toxin substrate 1

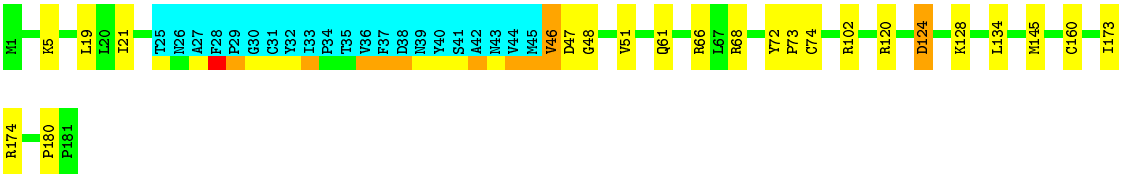
Chain A:



4.2.20 Score per residue for model 20

- Molecule 1: Ras-related C3 botulinum toxin substrate 1

Chain A:



5 Refinement protocol and experimental data overview

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

Of the 200 calculated structures, 20 were deposited, based on the following criterion: *structures with the lowest energy.*

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

Software name	Classification	Version
X-PLOR NIH	structure calculation	
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 6 of this report.

Chemical shift file(s)	input_cs.cif
Number of chemical shift lists	1
Total number of shifts	603
Number of shifts mapped to atoms	603
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	21%

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

COVALENT-GEOMETRY INFOmissingINFO

5.1 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	1239	1277	1274	7±3
2	A	28	13	12	3±2
All	All	25360	25800	25720	132

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 3.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:160:CYS:SG	2:A:201:GDP:C6	0.98	2.57	5	15
1:A:160:CYS:SG	2:A:201:GDP:N1	0.89	2.45	11	15
1:A:24:THR:O	1:A:24:THR:HG23	0.81	1.76	15	1
1:A:46:VAL:O	1:A:48:GLY:N	0.73	2.21	3	5
1:A:20:LEU:O	1:A:24:THR:HG23	0.72	1.83	6	2
1:A:46:VAL:HG12	1:A:47:ASP:H	0.69	1.47	15	1
1:A:46:VAL:CG2	1:A:49:LYS:O	0.68	2.41	9	2
1:A:74:CYS:O	1:A:74:CYS:SG	0.65	2.54	19	1
1:A:24:THR:CG2	1:A:24:THR:O	0.62	2.48	15	1
1:A:21:ILE:O	1:A:24:THR:OG1	0.60	2.20	13	1
1:A:20:LEU:O	1:A:24:THR:HG22	0.59	1.98	15	2
1:A:160:CYS:SG	1:A:161:THR:N	0.58	2.76	15	2
1:A:160:CYS:SG	1:A:161:THR:HG23	0.58	2.39	15	2
1:A:158:SER:OG	1:A:160:CYS:SG	0.57	2.56	11	1
1:A:73:PRO:O	1:A:74:CYS:SG	0.57	2.63	19	1
1:A:160:CYS:SG	2:A:201:GDP:C2	0.55	2.99	5	12
1:A:118:ASP:CG	1:A:160:CYS:SG	0.54	2.86	11	1
1:A:5:LYS:HD3	1:A:74:CYS:SG	0.54	2.43	19	1
1:A:23:TYR:O	1:A:24:THR:C	0.54	2.46	13	1
1:A:21:ILE:O	1:A:24:THR:O	0.52	2.27	19	2
1:A:46:VAL:CG2	1:A:49:LYS:HB2	0.50	2.37	13	3
1:A:46:VAL:HG22	1:A:49:LYS:O	0.50	2.05	9	1
1:A:47:ASP:O	1:A:47:ASP:OD1	0.50	2.30	3	2
1:A:5:LYS:HD3	1:A:74:CYS:O	0.50	2.06	14	12
1:A:47:ASP:OD1	1:A:47:ASP:O	0.47	2.31	12	1
1:A:160:CYS:SG	2:A:201:GDP:C5	0.47	3.08	5	9
1:A:46:VAL:HG23	1:A:49:LYS:HB2	0.46	1.86	13	1
1:A:118:ASP:OD1	1:A:160:CYS:SG	0.46	2.73	11	1
1:A:73:PRO:O	1:A:74:CYS:HB2	0.45	2.11	9	8
1:A:46:VAL:HG23	1:A:49:LYS:O	0.45	2.10	13	1
1:A:5:LYS:CD	1:A:74:CYS:SG	0.44	3.05	19	1
1:A:46:VAL:HG12	1:A:47:ASP:N	0.43	2.28	3	1
1:A:46:VAL:HB	1:A:49:LYS:HB2	0.42	1.92	3	1
1:A:124:ASP:OD2	1:A:128:LYS:NZ	0.41	2.54	17	20
1:A:46:VAL:HG22	1:A:47:ASP:N	0.41	2.31	19	1

5.2 Torsion angles (i)

5.2.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all NMR

entries. The Analysed column shows the number of residues for which the backbone conformation was analysed and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	158/181 (87%)	152±1 (96±1%)	4±1 (3±0%)	1±0 (1±0%)	21 69
All	All	3160/3620 (87%)	3048 (96%)	85 (3%)	27 (1%)	21 69

All 4 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	180	PRO	20
1	A	47	ASP	5
1	A	24	THR	1
1	A	46	VAL	1

5.2.2 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	139/157 (89%)	133±1 (96±1%)	6±1 (4±1%)	33 82
All	All	2780/3140 (89%)	2662 (96%)	118 (4%)	33 82

All 10 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	19	LEU	20
1	A	124	ASP	20
1	A	61	GLN	20
1	A	134	LEU	20
1	A	66	ARG	20
1	A	74	CYS	9
1	A	160	CYS	4
1	A	46	VAL	3
1	A	24	THR	1
1	A	63	CYS	1

5.2.3 RNA

There are no RNA molecules in this entry.

5.3 Non-standard residues in protein, DNA, RNA chains

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

5.4 Carbohydrates

There are no carbohydrates in this entry.

LIGAND-GEOMETRY INFOmissingINFO

5.5 Other polymers

There are no such molecules in this entry.

5.6 Polymer linkage issues

There are no chain breaks in this entry.

6 Chemical shift validation

The completeness of assignment taking into account all chemical shift lists is 21% for the well-defined parts and 20% for the entire structure.

6.1 Chemical shift list 1

File name: input_cs.cif

Chemical shift list name: *starch_output*

6.1.1 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	603
Number of shifts mapped to atoms	603
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

6.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	0	—	None (insufficient data)
$^{13}C_{\beta}$	13	—	None (insufficient data)
$^{13}C'$	0	—	None (insufficient data)
^{15}N	139	0.83 ± 0.28	Should be applied

6.1.3 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 21%, i.e. 404 atoms were assigned a chemical shift out of a possible 1947. 20 out of 31 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	255/776 (33%)	127/308 (41%)	0/320 (0%)	128/148 (86%)
Sidechain	145/1047 (14%)	72/614 (12%)	73/392 (19%)	0/41 (0%)

Continued on next page...

Continued from previous page...

	Total	^{1}H	^{13}C	^{15}N
Aromatic	4/124 (3%)	2/64 (3%)	0/54 (0%)	2/6 (33%)
Overall	404/1947 (21%)	201/986 (20%)	73/766 (10%)	130/195 (67%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 20%, i.e. 442 atoms were assigned a chemical shift out of a possible 2184. 22 out of 33 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	277/877 (32%)	138/348 (40%)	0/362 (0%)	139/167 (83%)
Sidechain	161/1149 (14%)	80/674 (12%)	81/431 (19%)	0/44 (0%)
Aromatic	4/158 (3%)	2/82 (2%)	0/70 (0%)	2/6 (33%)
Overall	442/2184 (20%)	220/1104 (20%)	81/863 (9%)	141/217 (65%)

6.1.4 Statistically unusual chemical shifts

There are no statistically unusual chemical shifts.

6.1.5 Random Coil Index (RCI) plots

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

Random coil index (RCI) for chain A: