Full wwPDB NMR Structure Validation Report

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PDB ID	:	2N37
BMRB ID	:	25636
Title	:	Solution structure of AVR-Pia
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Deposited on	:	2015-05-25

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 ⓘ 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:

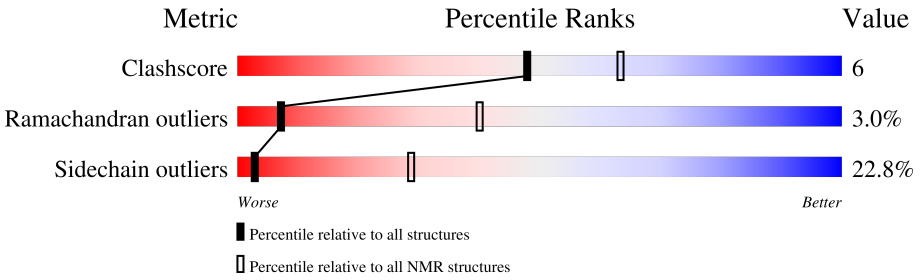
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
BMRB Restraints Analysis	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.33

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
SOLUTION NMR

The overall completeness of chemical shifts assignment is 81%.

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	66	65% 23% • 9%

2 Ensemble composition and analysis (i)

This entry contains 20 models. Model 3 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:5-A:64 (60)	0.27	3

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 6 single-model clusters were found.

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

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 1029 atoms, of which 510 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called AVR-Pia protein.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	66	1029	332	510	90	94	3	0

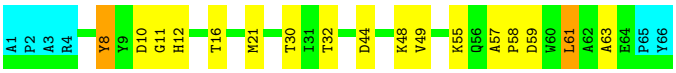
4 Residue-property plots

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: AVR-Pia protein

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

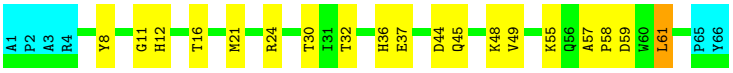
• Molecule 1: AVR-Pia protein

Chain A:

4.2.2 Score per residue for model 2

• Molecule 1: AVR-Pia protein

Chain A:



4.2.3 Score per residue for model 3 (medoid)

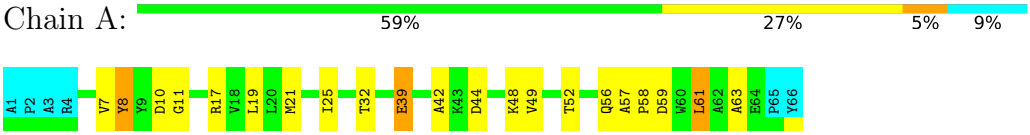
• Molecule 1: AVR-Pia protein

Chain A:

4.2.4 Score per residue for model 4

• Molecule 1: AVR-Pia protein

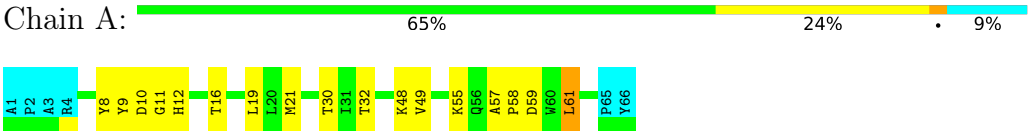
Chain A:



4.2.5 Score per residue for model 5

• Molecule 1: AVR-Pia protein

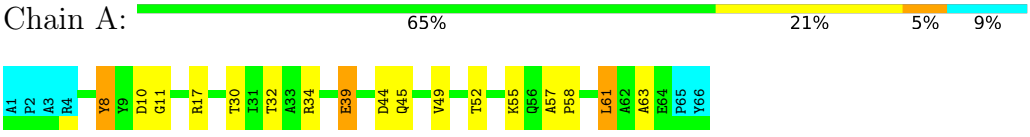
Chain A:



4.2.6 Score per residue for model 6

• Molecule 1: AVR-Pia protein

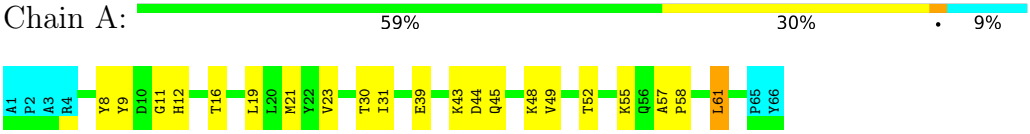
Chain A:



4.2.7 Score per residue for model 7

• Molecule 1: AVR-Pia protein

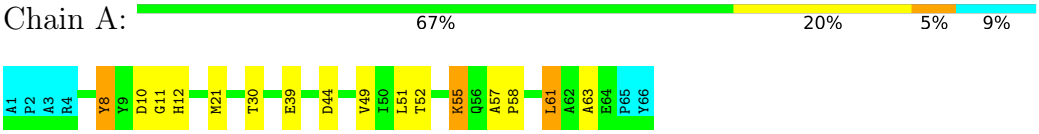
Chain A:



4.2.8 Score per residue for model 8

• Molecule 1: AVR-Pia protein

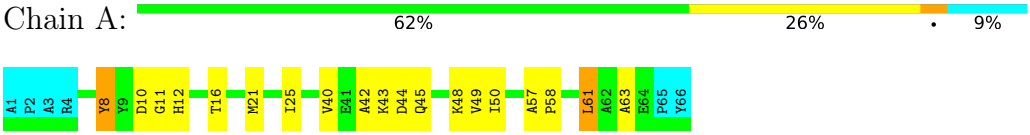
Chain A:



4.2.9 Score per residue for model 9

• Molecule 1: AVR-Pia protein

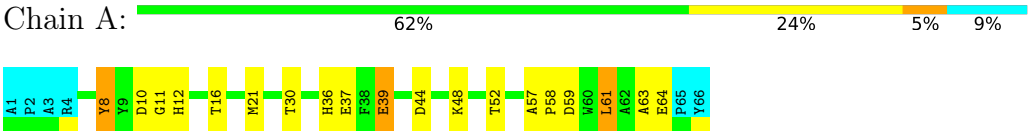
Chain A:



4.2.10 Score per residue for model 10

• Molecule 1: AVR-Pia protein

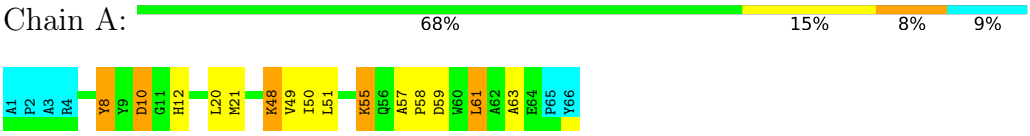
Chain A:



4.2.11 Score per residue for model 11

• Molecule 1: AVR-Pia protein

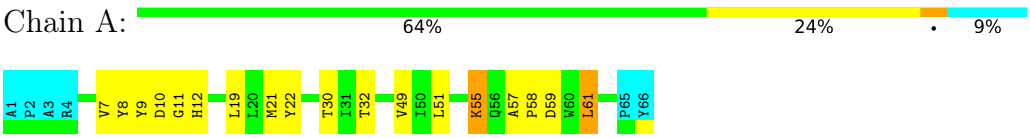
Chain A:



4.2.12 Score per residue for model 12

• Molecule 1: AVR-Pia protein

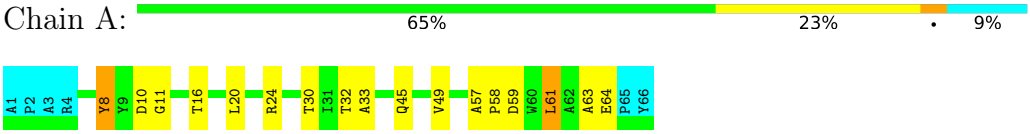
Chain A:



4.2.13 Score per residue for model 13

• Molecule 1: AVR-Pia protein

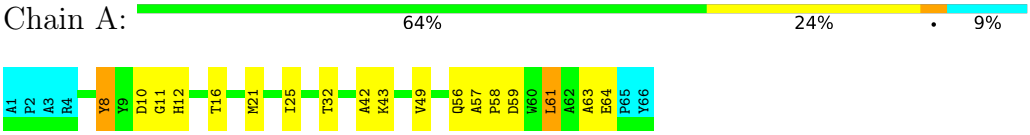
Chain A:



4.2.14 Score per residue for model 14

• Molecule 1: AVR-Pia protein

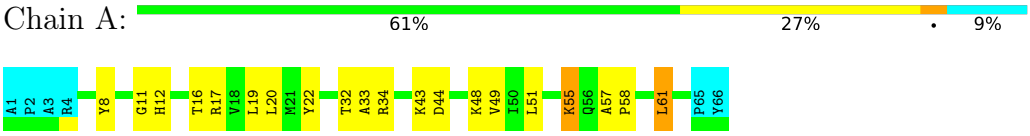
Chain A:



4.2.15 Score per residue for model 15

• Molecule 1: AVR-Pia protein

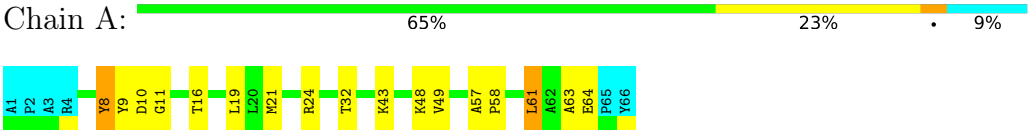
Chain A:



4.2.16 Score per residue for model 16

• Molecule 1: AVR-Pia protein

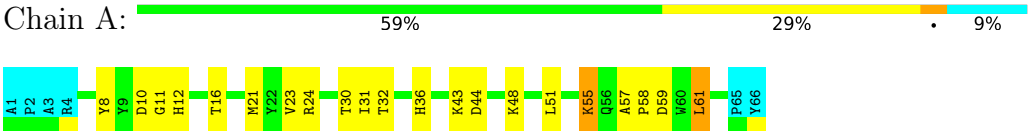
Chain A:



4.2.17 Score per residue for model 17

• Molecule 1: AVR-Pia protein

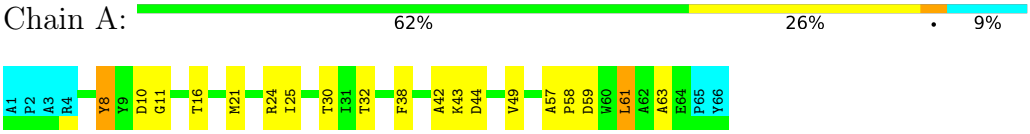
Chain A:



4.2.18 Score per residue for model 18

• Molecule 1: AVR-Pia protein

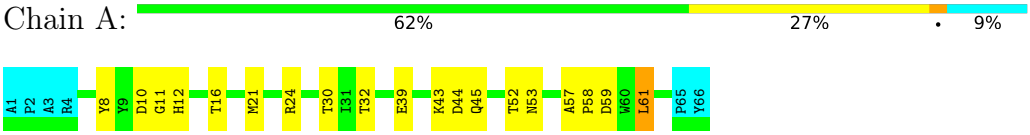
Chain A:



4.2.19 Score per residue for model 19

• Molecule 1: AVR-Pia protein

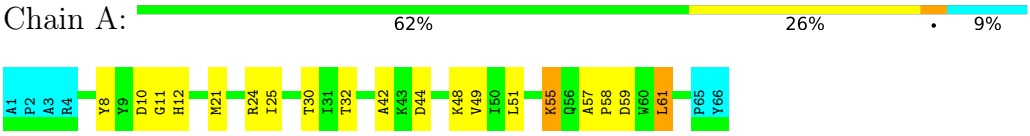
Chain A:



4.2.20 Score per residue for model 20

• Molecule 1: AVR-Pia protein

Chain A:



5 Refinement protocol and experimental data overview

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

Of the 200 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	2.1
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)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	718
Number of shifts mapped to atoms	718
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	81%

6 Model quality

6.1 Standard geometry

There are no covalent bond-length or bond-angle outliers.

There are no bond-length outliers.

There are no bond-angle outliers.

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	472	464	464	6±1
All	All	9440	9280	9280	117

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 6.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:58:PRO:CG	1:A:61:LEU:HD23	0.61	2.26	11	20
1:A:30:THR:HG23	1:A:38:PHE:C	0.56	2.20	18	1
1:A:20:LEU:HD22	1:A:33:ALA:HB2	0.56	1.75	15	2
1:A:23:VAL:HG21	1:A:31:ILE:HD11	0.55	1.78	17	1
1:A:8:TYR:CE1	1:A:63:ALA:HB2	0.55	2.36	6	11
1:A:39:GLU:HB3	1:A:52:THR:HG22	0.54	1.79	7	5
1:A:51:LEU:HD12	1:A:55:LYS:O	0.54	2.03	11	4
1:A:25:ILE:HD13	1:A:42:ALA:HB1	0.53	1.80	9	5
1:A:51:LEU:HD13	1:A:55:LYS:CD	0.52	2.34	15	1
1:A:58:PRO:HG2	1:A:61:LEU:HD23	0.50	1.83	7	20
1:A:9:TYR:OH	1:A:19:LEU:HD12	0.50	2.07	12	4
1:A:40:VAL:HG12	1:A:50:ILE:O	0.48	2.08	9	1
1:A:20:LEU:HD22	1:A:33:ALA:CB	0.47	2.40	15	1
1:A:39:GLU:HB2	1:A:52:THR:HG22	0.46	1.86	3	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:23:VAL:CG2	1:A:31:ILE:HD11	0.46	2.39	7	2
1:A:25:ILE:CD1	1:A:42:ALA:HB1	0.46	2.39	9	3
1:A:39:GLU:CB	1:A:52:THR:HG22	0.46	2.41	3	1
1:A:39:GLU:HG3	1:A:52:THR:HG22	0.46	1.87	4	1
1:A:8:TYR:CD1	1:A:63:ALA:HB2	0.44	2.48	8	1
1:A:10:ASP:HB2	1:A:20:LEU:HD21	0.44	1.88	11	1
1:A:57:ALA:HB1	1:A:58:PRO:HD2	0.43	1.90	20	20
1:A:7:VAL:HG12	1:A:22:TYR:CD2	0.43	2.49	12	1
1:A:9:TYR:CZ	1:A:19:LEU:HD12	0.43	2.48	16	3
1:A:51:LEU:HD12	1:A:55:LYS:HB3	0.42	1.92	8	1
1:A:19:LEU:HD11	1:A:22:TYR:CE1	0.41	2.51	15	1
1:A:48:LYS:O	1:A:50:ILE:HG22	0.41	2.15	11	1
1:A:57:ALA:HB1	1:A:61:LEU:CB	0.41	2.46	8	3
1:A:7:VAL:HG11	1:A:19:LEU:HD11	0.40	1.92	4	1

6.3 Torsion angles (i)

6.3.1 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	60/66 (91%)	48±1 (79±1%)	11±1 (18±2%)	2±0 (3±1%)	7	40
All	All	1200/1320 (91%)	950 (79%)	214 (18%)	36 (3%)	7	40

All 2 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	11	GLY	19
1	A	49	VAL	17

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	49/53 (92%)	38±2 (77±4%)	11±2 (23±4%)	3 29
All	All	980/1060 (92%)	757 (77%)	223 (23%)	3 29

All 23 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	8	TYR	20
1	A	61	LEU	20
1	A	10	ASP	17
1	A	21	MET	16
1	A	32	THR	15
1	A	12	HIS	14
1	A	16	THR	14
1	A	59	ASP	14
1	A	44	ASP	13
1	A	30	THR	12
1	A	48	LYS	12
1	A	55	LYS	11
1	A	43	LYS	9
1	A	24	ARG	8
1	A	45	GLN	6
1	A	64	GLU	5
1	A	36	HIS	3
1	A	56	GLN	3
1	A	17	ARG	3
1	A	39	GLU	3
1	A	37	GLU	2
1	A	34	ARG	2
1	A	53	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 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 81% for the well-defined parts and 80% 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	718
Number of shifts mapped to atoms	718
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	4

7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	65	0.09 ± 0.17	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	61	0.09 ± 0.28	None needed (< 0.5 ppm)
$^{13}C'$	0	—	None (insufficient data)
^{15}N	61	0.47 ± 0.52	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 81%, i.e. 664 atoms were assigned a chemical shift out of a possible 816. 0 out of 10 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	240/300 (80%)	122/122 (100%)	60/120 (50%)	58/58 (100%)
Sidechain	393/443 (89%)	273/290 (94%)	120/137 (88%)	0/16 (0%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	31/73 (42%)	31/36 (86%)	0/34 (0%)	0/3 (0%)
Overall	664/816 (81%)	426/448 (95%)	180/291 (62%)	58/77 (75%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 80%, i.e. 718 atoms were assigned a chemical shift out of a possible 898. 0 out of 10 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	256/326 (79%)	130/132 (98%)	65/132 (49%)	61/62 (98%)
Sidechain	427/490 (87%)	296/321 (92%)	131/150 (87%)	0/19 (0%)
Aromatic	35/82 (43%)	35/40 (88%)	0/39 (0%)	0/3 (0%)
Overall	718/898 (80%)	461/493 (94%)	196/321 (61%)	61/84 (73%)

7.1.4 Statistically unusual chemical shifts (i)

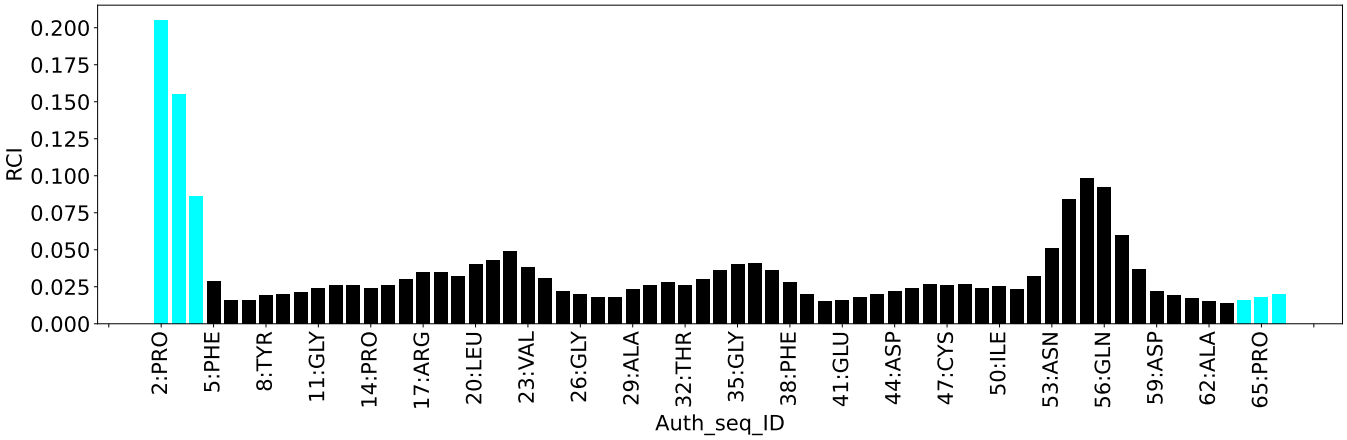
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

List Id	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	58	PRO	HB2	0.00	0.37 – 3.78	-6.1
1	A	17	ARG	HD2	1.78	1.97 – 4.26	-5.8
1	A	17	ARG	HD3	1.70	1.81 – 4.39	-5.5
1	A	34	ARG	HD3	1.76	1.81 – 4.39	-5.2

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.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
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
2:PRO
5:PHE
8:TYR
11:GLY
14:PRO
17:ARG
20:LEU
23:VAL
26:GLY
29:ALA
32:THR
35:GLY
38:PHE
41:GLU
44:ASP
47:CYS
50:ILE
53:ASN
56:GLN
59:ASP
62:ALA
65:PRO
Auth_seq_ID

8 NMR restraints analysis

8.1 Conformationally restricting restraints

The following table provides the summary of experimentally observed NMR restraints in different categories. Restraints are classified into different categories based on the sequence separation of the atoms involved.

Description	Value
Total distance restraints	698
Intra-residue (|i-j|=0)	193
Sequential (|i-j|=1)	220
Medium range (|i-j|>1 and |i-j|<5)	67
Long range (|i-j|≥5)	218
Inter-chain	0
Hydrogen bond restraints	0
Disulfide bond restraints	0
Total dihedral-angle restraints	0
Number of unmapped restraints	0
Number of restraints per residue	10.6
Number of long range restraints per residue[1]	3.3

[1]Long range hydrogen bonds and disulfide bonds are counted as long range restraints while calculating the number of long range restraints per residue

8.2 Residual restraint violations

This section provides the overview of the restraint violations analysis. The violations are binned as small, medium and large violations based on its absolute value. Average number of violations per model is calculated by dividing the total number of violations in each bin by the size of the ensemble.

8.2.1 Average number of distance violations per model

Distance violations less than 0.1 Å are not included in the calculation.There are no distance violations

8.2.2 Average number of dihedral-angle violations per model

Dihedral-angle violations less than 1° are not included in the calculation.There are no dihedral-angle violations

9 Distance violation analysis (i)

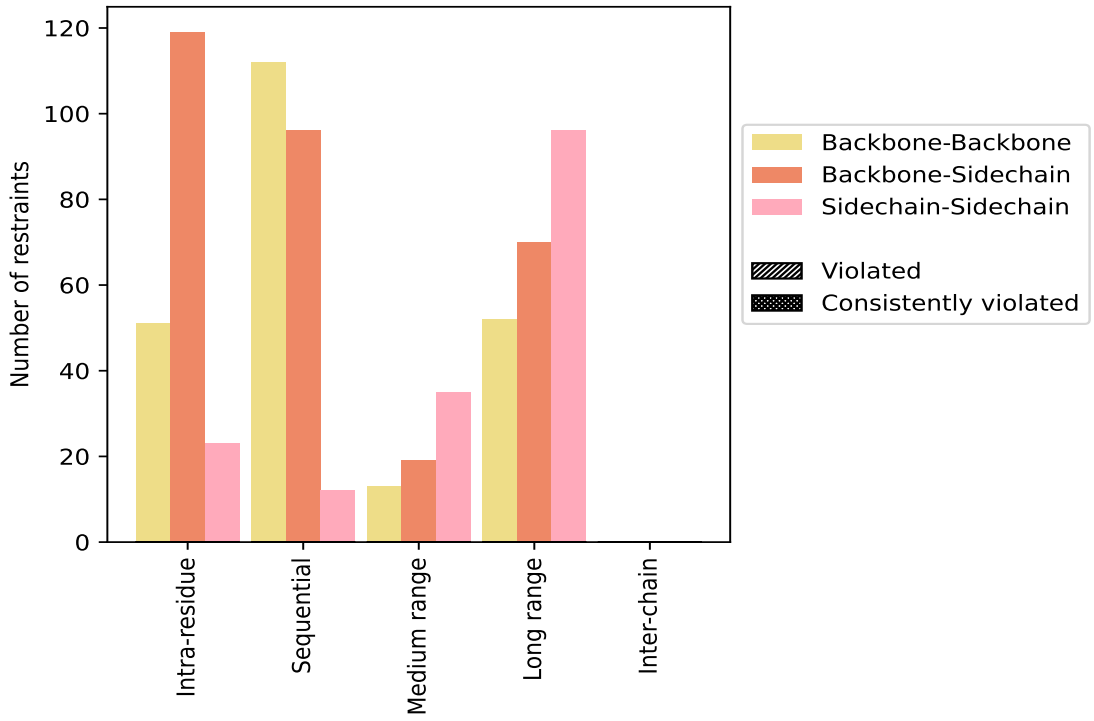
9.1 Summary of distance violations (i)

The following table shows the summary of distance violations in different restraint categories based on the sequence separation of the atoms involved. Each category is further sub-divided into three sub-categories based on the atoms involved. Violations less than 0.1 Å are not included in the statistics.

Restraints type	Count	%[1]	Violated[3]			Consistently Violated[4]		
			Count	%[2]	%[1]	Count	%[2]	%[1]
Intra-residue (|i-j|=0)	193	27.7	0	0.0	0.0	0	0.0	0.0
Backbone-Backbone	51	7.3	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	119	17.0	0	0.0	0.0	0	0.0	0.0
Sidechain-Sidechain	23	3.3	0	0.0	0.0	0	0.0	0.0
Sequential (|i-j|=1)	220	31.5	0	0.0	0.0	0	0.0	0.0
Backbone-Backbone	112	16.0	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	96	13.8	0	0.0	0.0	0	0.0	0.0
Sidechain-Sidechain	12	1.7	0	0.0	0.0	0	0.0	0.0
Medium range (|i-j|>1 & |i-j|<5)	67	9.6	0	0.0	0.0	0	0.0	0.0
Backbone-Backbone	13	1.9	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	19	2.7	0	0.0	0.0	0	0.0	0.0
Sidechain-Sidechain	35	5.0	0	0.0	0.0	0	0.0	0.0
Long range (|i-j|≥5)	218	31.2	0	0.0	0.0	0	0.0	0.0
Backbone-Backbone	52	7.4	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	70	10.0	0	0.0	0.0	0	0.0	0.0
Sidechain-Sidechain	96	13.8	0	0.0	0.0	0	0.0	0.0
Inter-chain	0	0.0	0	0.0	0.0	0	0.0	0.0
Backbone-Backbone	0	0.0	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	0	0.0	0	0.0	0.0	0	0.0	0.0
Sidechain-Sidechain	0	0.0	0	0.0	0.0	0	0.0	0.0
Hydrogen bond	0	0.0	0	0.0	0.0	0	0.0	0.0
Disulfide bond	0	0.0	0	0.0	0.0	0	0.0	0.0
Total	698	100.0	0	0.0	0.0	0	0.0	0.0
Backbone-Backbone	228	32.7	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	304	43.6	0	0.0	0.0	0	0.0	0.0
Sidechain-Sidechain	166	23.8	0	0.0	0.0	0	0.0	0.0

[1] percentage calculated with respect to the total number of distance restraints, [2] percentage calculated with respect to the number of restraints in a particular restraint category, [3] violated in at least one model, [4] violated in all the models

9.1.1 Bar chart : Distribution of distance restraints and violations



Violated and consistently violated restraints are shown using different hatch patterns in their respective categories. The hydrogen bonds and disulfied bonds are counted in their appropriate category on the x-axis

9.2 Distance violation statistics for each model

No violations found

9.3 Distance violation statistics for the ensemble

No violations found

9.4 Most violated distance restraints in the ensemble

No violations found

9.5 All violated distance restraints

No violations found

10 Dihedral-angle violation analysis (i)

Dihedral angle analysis failed due to data error in the dihedral angle restraints, possibly missing target value