wwPDB NMR Structure Validation Summary Report

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PDB ID	:	2MF6
BMRB ID	:	18125
Title	:	Solution NMR structure of Chimeric Avidin, ChiAVD(I117Y), in the biotin bound form
Authors	:	Tossavainen, H.; Kukkurainen, S.; Maatta, J.A.E.; Pihlajamaa, T.; Hytonen, V.P.; Kulomaa, M.S.; Permi, P.
Deposited on	:	2013-10-07

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 (1)) were used in the production of this report:

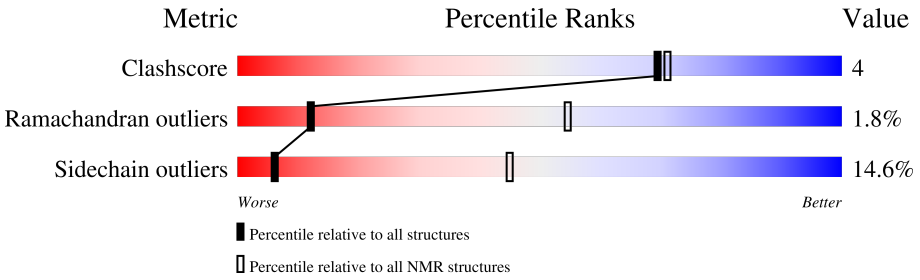
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
BMRB Restraints Analysis	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal 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 20%.

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	129	74% 18% • 8%
1	B	129	74% 17% • 8%
1	C	129	73% 19% • 8%
1	D	129	72% 19% • 8%

2 Ensemble composition and analysis

This entry contains 15 models. Model 10 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:3-A:54, A:57-A:123, D:3-D:54, D:57-D:123, B:3-B:54, B:57-B:123, C:3-C:54, C:57-C:123 (476)	0.40	10

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	2, 3, 4, 5, 6, 7, 10, 13, 14, 15
2	1, 8, 9, 11
Single-model clusters	12

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 8072 atoms, of which 4020 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Avidin, Avidin-related protein 4/5.

Mol	Chain	Residues	Atoms						Trace
1	A	129	Total	C	H	N	O	S	0
			2018	636	1005	181	192	4	
1	D	129	Total	C	H	N	O	S	0
			2018	636	1005	181	192	4	
1	B	129	Total	C	H	N	O	S	0
			2018	636	1005	181	192	4	
1	C	129	Total	C	H	N	O	S	0
			2018	636	1005	181	192	4	

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	GLN	-	expression tag	UNP P02701
A	-2	THR	-	expression tag	UNP P02701
A	-1	VAL	-	expression tag	UNP P02701
A	117	TYR	ILE	engineered mutation	UNP P02701
D	-3	GLN	-	expression tag	UNP P02701
D	-2	THR	-	expression tag	UNP P02701
D	-1	VAL	-	expression tag	UNP P02701
D	117	TYR	ILE	engineered mutation	UNP P02701
B	-3	GLN	-	expression tag	UNP P02701
B	-2	THR	-	expression tag	UNP P02701
B	-1	VAL	-	expression tag	UNP P02701
B	117	TYR	ILE	engineered mutation	UNP P02701
C	-3	GLN	-	expression tag	UNP P02701
C	-2	THR	-	expression tag	UNP P02701
C	-1	VAL	-	expression tag	UNP P02701
C	117	TYR	ILE	engineered mutation	UNP P02701

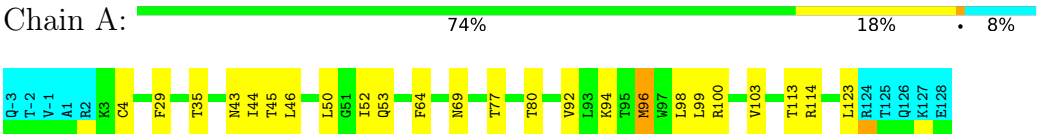
4 Residue-property plots

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.

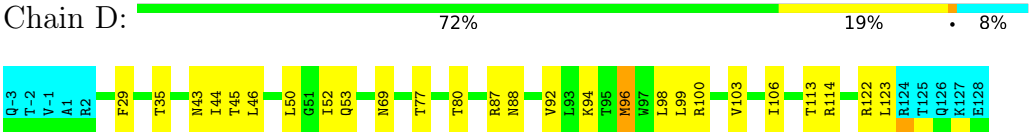
• Molecule 1: Avidin, Avidin-related protein 4/5

Chain A:



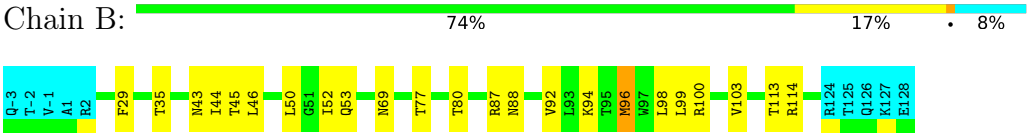
• Molecule 1: Avidin, Avidin-related protein 4/5

Chain D:



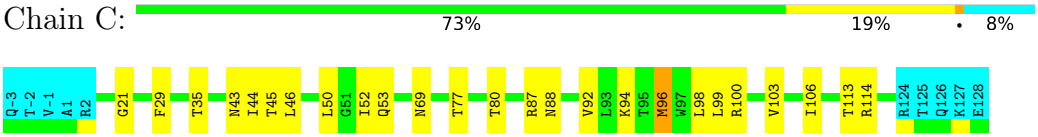
• Molecule 1: Avidin, Avidin-related protein 4/5

Chain B:



• Molecule 1: Avidin, Avidin-related protein 4/5

Chain C:

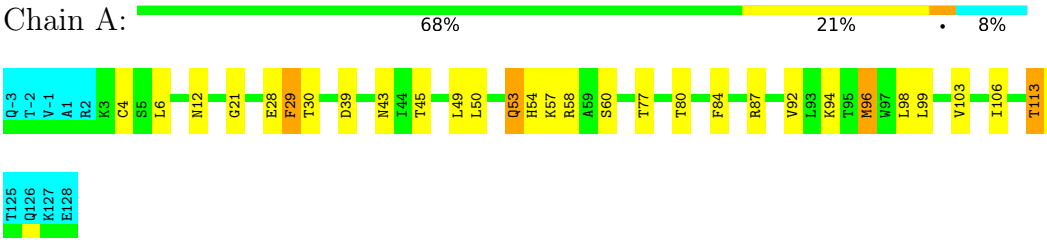


4.2 Residue scores for the representative (medoid) model from the NMR ensemble

The representative model is number 10. Colouring as in section 4.1 above.

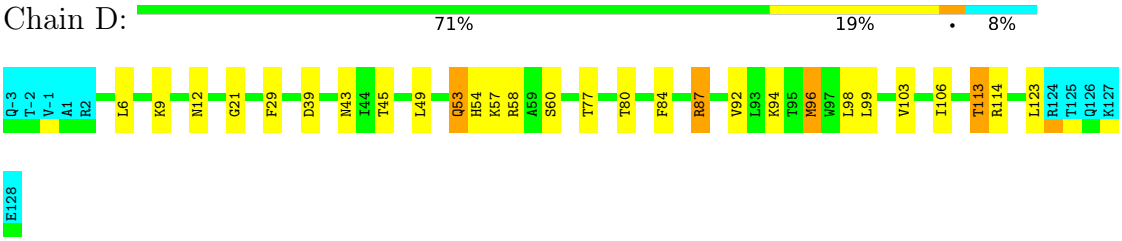
• Molecule 1: Avidin, Avidin-related protein 4/5

Chain A:



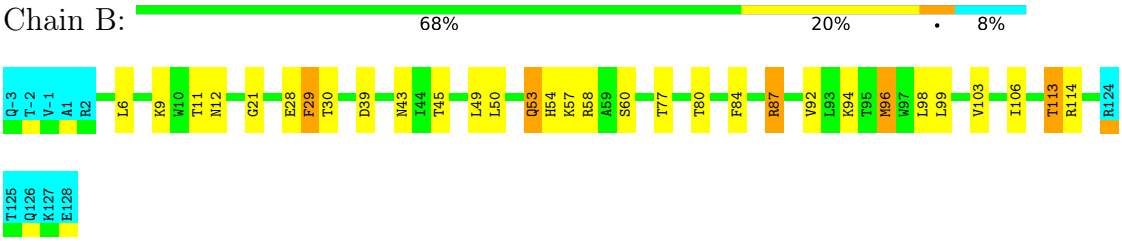
• Molecule 1: Avidin, Avidin-related protein 4/5

Chain D:



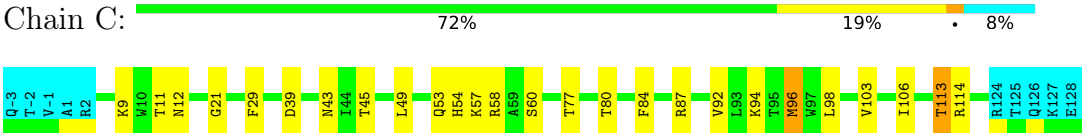
• Molecule 1: Avidin, Avidin-related protein 4/5

Chain B:



• Molecule 1: Avidin, Avidin-related protein 4/5

Chain C:



5 Refinement protocol and experimental data overview

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

Of the 200 calculated structures, 15 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
Sparky	structure solution	
X-PLOR NIH	structure solution	
Amber	refinement	
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	1389
Number of shifts mapped to atoms	1389
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	20%

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	0.72±0.01	0±0/949 (0.0± 0.0%)	1.26±0.05	5±2/1288 (0.4± 0.1%)
1	B	0.73±0.01	0±0/949 (0.0± 0.0%)	1.26±0.05	5±2/1288 (0.4± 0.1%)
1	C	0.73±0.01	0±0/949 (0.0± 0.0%)	1.28±0.05	5±2/1288 (0.4± 0.2%)
1	D	0.73±0.01	0±0/949 (0.0± 0.0%)	1.27±0.05	5±2/1288 (0.4± 0.2%)
All	All	0.73	0/56940 (0.0%)	1.27	292/77280 (0.4%)

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	0.9±0.7
1	B	0.0±0.0	0.7±0.7
1	C	0.0±0.0	0.9±0.8
1	D	0.0±0.0	1.0±0.7
All	All	0	52

There are no bond-length outliers.

5 of 93 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	D	96	MET	CG-SD-CE	-10.42	83.53	100.20	12	10
1	C	96	MET	CG-SD-CE	-10.41	83.54	100.20	12	10
1	A	96	MET	CG-SD-CE	-10.40	83.56	100.20	12	10
1	B	96	MET	CG-SD-CE	-10.37	83.62	100.20	9	10
1	B	100	ARG	NE-CZ-NH1	9.46	125.03	120.30	11	9

There are no chirality outliers.

5 of 30 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	29	PHE	Sidechain	3
1	A	114	ARG	Sidechain	3
1	D	29	PHE	Sidechain	3
1	D	114	ARG	Sidechain	3
1	B	29	PHE	Sidechain	3

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	928	914	914	9±3
1	B	928	914	916	9±2
1	C	928	914	916	9±3
1	D	928	914	916	9±3
All	All	55680	54840	54930	410

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 4.

5 of 187 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:50:LEU:HD12	1:D:50:LEU:HD12	0.72	1.62	3	4
1:B:50:LEU:HD12	1:C:50:LEU:HD12	0.72	1.61	3	4
1:D:77:THR:HG23	1:D:99:LEU:HD12	0.69	1.64	8	2
1:A:77:THR:HG23	1:A:99:LEU:HD12	0.69	1.64	8	2
1:B:77:THR:HG23	1:B:99:LEU:HD12	0.69	1.64	8	2

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	119/129 (92%)	111±2 (93±2%)	6±2 (5±2%)	2±1 (2±1%)	13	56
1	B	119/129 (92%)	111±2 (94±2%)	6±2 (5±1%)	2±1 (2±1%)	13	56
1	C	119/129 (92%)	111±2 (93±2%)	6±2 (5±2%)	2±1 (2±1%)	11	53
1	D	119/129 (92%)	111±2 (93±2%)	6±2 (5±2%)	2±1 (2±1%)	11	52
All	All	7140/7740 (92%)	6665 (93%)	345 (5%)	130 (2%)	12	54

5 of 36 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	C	21	GLY	8
1	A	43	ASN	8
1	D	43	ASN	8
1	B	43	ASN	8
1	C	43	ASN	8

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	102/111 (92%)	87±3 (85±3%)	15±3 (15±3%)	6	44
1	B	102/111 (92%)	87±3 (85±3%)	15±3 (15±3%)	6	45
1	C	102/111 (92%)	87±3 (86±3%)	15±3 (14±3%)	6	45
1	D	102/111 (92%)	87±3 (86±3%)	15±3 (14±3%)	6	45
All	All	6120/6660 (92%)	5225 (85%)	895 (15%)	6	45

5 of 241 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	80	THR	15
1	D	80	THR	15
1	B	80	THR	15
1	C	80	THR	15
1	A	99	LEU	13

6.3.3 RNA

There are no RNA molecules in this entry.

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

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

6.5 Carbohydrates

There are no monosaccharides in this entry.

6.6 Ligand geometry

There are no ligands in this entry.

6.7 Other polymers

There are no such molecules in this entry.

6.8 Polymer linkage issues

There are no chain breaks in this entry.

7 Chemical shift validation

The completeness of assignment taking into account all chemical shift lists is 20% for the well-defined parts and 20% 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	1389
Number of shifts mapped to atoms	1389
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	12

7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	127	-0.40 ± 0.08	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	111	-1.33 ± 0.15	Should be checked
$^{13}C'$	0	—	None (insufficient data)
^{15}N	116	1.06 ± 0.52	Should be applied

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 20%, i.e. 1296 atoms were assigned a chemical shift out of a possible 6364. 0 out of 64 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	468/2404 (19%)	240/988 (24%)	118/952 (12%)	110/464 (24%)
Sidechain	703/3388 (21%)	486/2200 (22%)	217/1040 (21%)	0/148 (0%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	125/572 (22%)	66/284 (23%)	55/268 (21%)	4/20 (20%)
Overall	1296/6364 (20%)	792/3472 (23%)	390/2260 (17%)	114/632 (18%)

7.1.4 Statistically unusual chemical shifts (i)

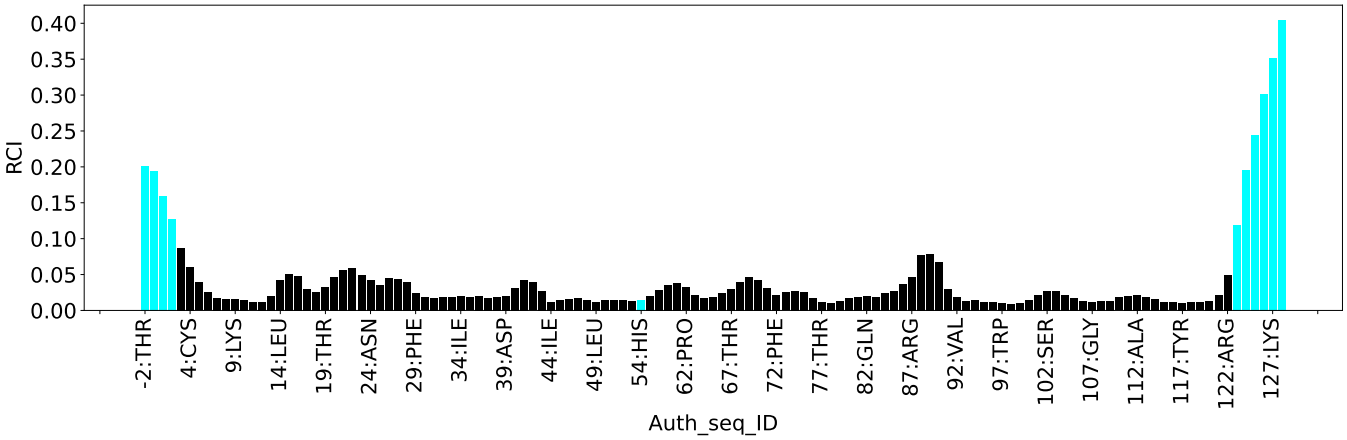
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

List Id	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	111	LYS	HB3	-0.72	0.46 – 3.04	-9.6
1	A	93	LEU	HD21	-1.18	-0.65 – 2.13	-6.9
1	A	93	LEU	HD22	-1.18	-0.65 – 2.13	-6.9
1	A	93	LEU	HD23	-1.18	-0.65 – 2.13	-6.9
1	A	68	VAL	HG21	-0.90	-0.58 – 2.19	-6.2
1	A	68	VAL	HG22	-0.90	-0.58 – 2.19	-6.2
1	A	68	VAL	HG23	-0.90	-0.58 – 2.19	-6.2
1	A	118	ASN	CB	48.78	30.50 – 46.89	6.2
1	A	37	VAL	HG21	-0.78	-0.58 – 2.19	-5.7
1	A	37	VAL	HG22	-0.78	-0.58 – 2.19	-5.7
1	A	37	VAL	HG23	-0.78	-0.58 – 2.19	-5.7
1	A	12	ASN	HB3	1.03	1.12 – 4.38	-5.3

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
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-2:THR
4:CYS
9:LYS
14:LEU
19:THR
24:ASN
29:PHE
34:ILE
39:ASP
44:ILE
49:LEU
54:HIS
62:PRO
67:THR
72:PHE
77:THR
82:GLN
87:ARG
92:VAL
97:TRP
102:SER
107:GLY
112:ALA
117:TYR
122:ARG
127:LYS
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	9000
Intra-residue (|i-j|=0)	1716
Sequential (|i-j|=1)	1952
Medium range (|i-j|>1 and |i-j|<5)	748
Long range (|i-j|≥5)	3600
Inter-chain	776
Hydrogen bond restraints	208
Disulfide bond restraints	0
Total dihedral-angle restraints	584
Number of unmapped restraints	0
Number of restraints per residue	18.6
Number of long range restraints per residue[1]	7.3

[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.

Bins (Å)	Average number of violations per model	Max (Å)
0.1-0.2 (Small)	10.5	0.17
0.2-0.5 (Medium)	None	None
>0.5 (Large)	None	None

8.2.2 Average number of dihedral-angle violations per model (i)

Dihedral-angle violations less than 1° are not included in the calculation.

Bins (°)	Average number of violations per model	Max (°)
1.0-10.0 (Small)	2.6	8.4
10.0-20.0 (Medium)	0.1	14.3
>20.0 (Large)	None	None

9 Distance violation analysis (i)

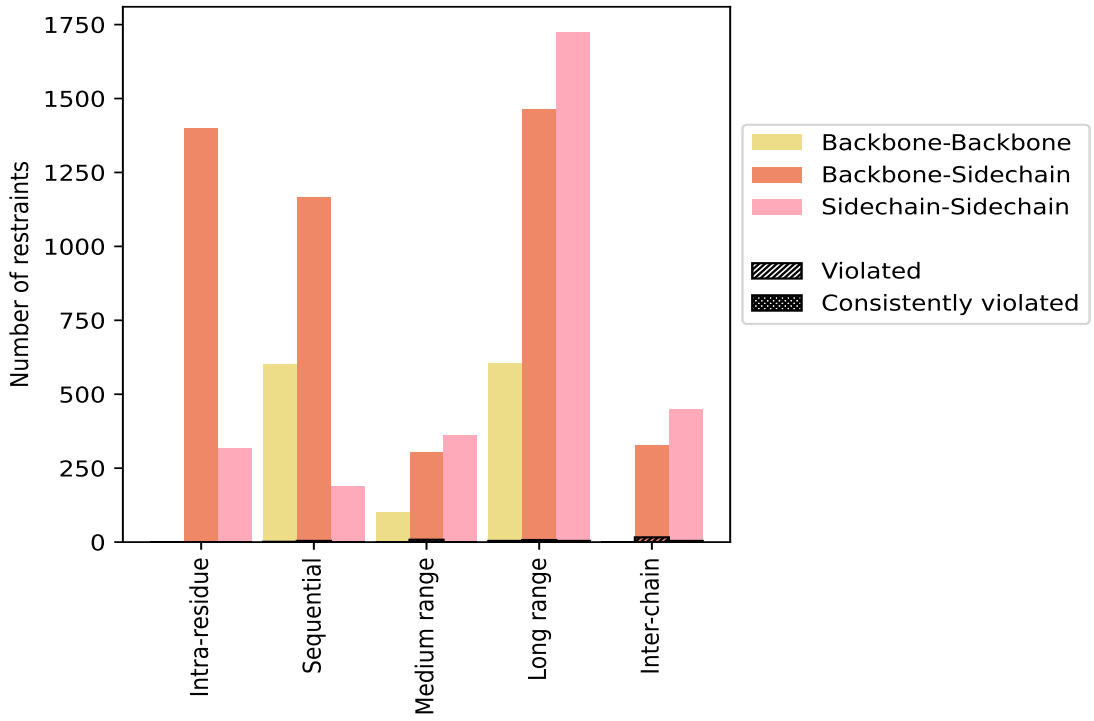
9.1 Summary of distance violations (i)

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)	1716	19.1	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	1400	15.6	0	0.0	0.0	0	0.0	0.0
Sidechain-Sidechain	316	3.5	0	0.0	0.0	0	0.0	0.0
Sequential (|i-j|=1)	1952	21.7	5	0.3	0.1	0	0.0	0.0
Backbone-Backbone	600	6.7	1	0.2	0.0	0	0.0	0.0
Backbone-Sidechain	1164	12.9	4	0.3	0.0	0	0.0	0.0
Sidechain-Sidechain	188	2.1	0	0.0	0.0	0	0.0	0.0
Medium range (|i-j|>1 & |i-j|<5)	748	8.3	8	1.1	0.1	0	0.0	0.0
Backbone-Backbone	84	0.9	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	304	3.4	8	2.6	0.1	0	0.0	0.0
Sidechain-Sidechain	360	4.0	0	0.0	0.0	0	0.0	0.0
Long range (|i-j|≥5)	3600	40.0	15	0.4	0.2	0	0.0	0.0
Backbone-Backbone	420	4.7	4	1.0	0.0	0	0.0	0.0
Backbone-Sidechain	1456	16.2	7	0.5	0.1	0	0.0	0.0
Sidechain-Sidechain	1724	19.2	4	0.2	0.0	0	0.0	0.0
Inter-chain	776	8.6	20	2.6	0.2	0	0.0	0.0
Backbone-Backbone	0	0.0	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	326	3.6	16	4.9	0.2	0	0.0	0.0
Sidechain-Sidechain	450	5.0	4	0.9	0.0	0	0.0	0.0
Hydrogen bond	208	2.3	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	9000	100.0	48	0.5	0.5	0	0.0	0.0
Backbone-Backbone	1304	14.5	5	0.4	0.1	0	0.0	0.0
Backbone-Sidechain	4658	51.8	35	0.8	0.4	0	0.0	0.0
Sidechain-Sidechain	3038	33.8	8	0.3	0.1	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

The following table provides the distance violation statistics for each model in the ensemble. Violations less than 0.1 Å are not included in the statistics.

Model ID	Number of violations						Mean (Å)	Max (Å)	SD[6] (Å)	Median (Å)
	IR[1]	SQ[2]	MR[3]	LR[4]	IC[5]	Total				
1	0	1	4	0	8	13	0.12	0.15	0.01	0.13
2	0	2	1	0	0	3	0.11	0.11	0.0	0.11
3	0	0	0	4	8	12	0.12	0.14	0.01	0.12
4	0	2	0	0	4	6	0.11	0.11	0.0	0.11
5	0	0	4	0	11	15	0.12	0.13	0.01	0.12
6	0	0	3	4	8	15	0.12	0.14	0.01	0.12
7	0	2	4	0	8	14	0.12	0.14	0.01	0.12
8	0	0	0	4	6	10	0.13	0.17	0.02	0.12
9	0	0	4	3	5	12	0.12	0.13	0.01	0.12
10	0	0	0	0	6	6	0.14	0.16	0.02	0.15
11	0	2	4	0	11	17	0.13	0.15	0.01	0.13

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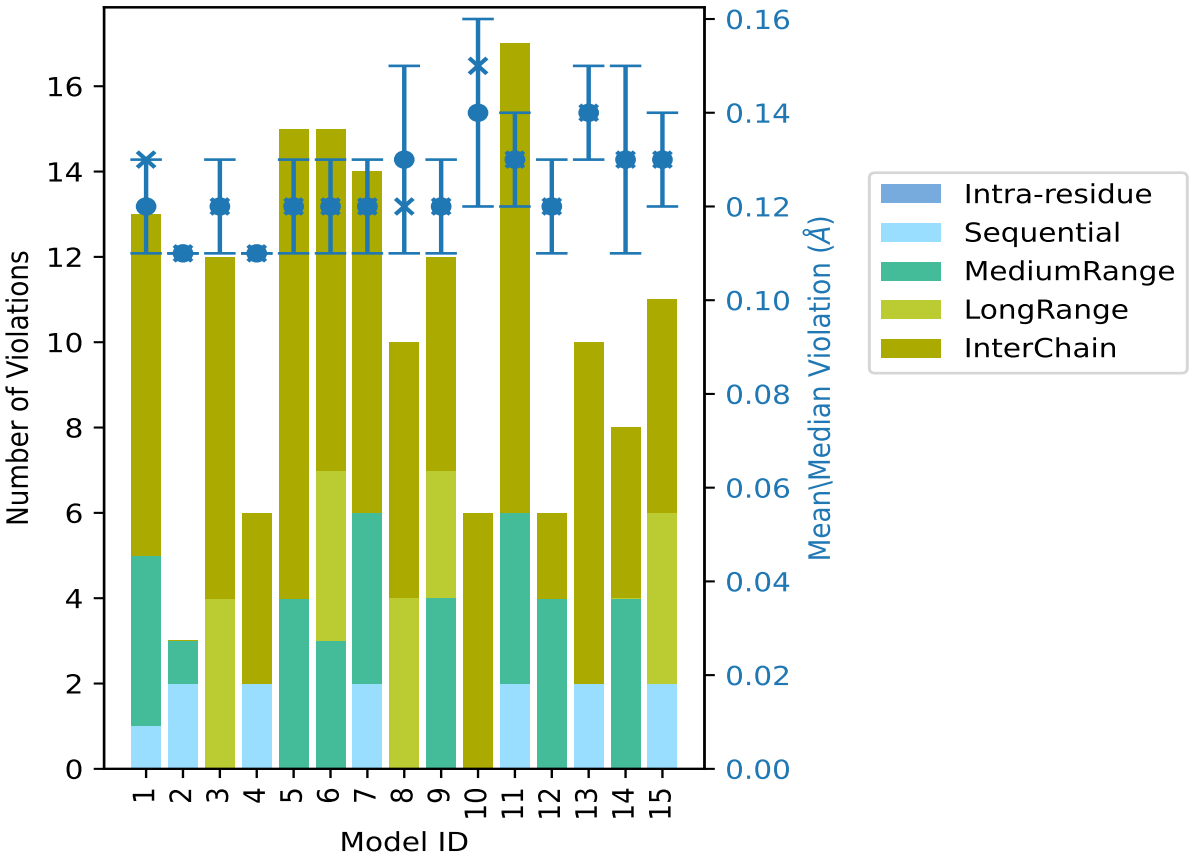
Model ID	Number of violations						Mean (Å)	Max (Å)	SD[6] (Å)	Median (Å)
	IR[1]	SQ[2]	MR[3]	LR[4]	IC[5]	Total				
12	0	0	4	0	2	6	0.12	0.13	0.01	0.12
13	0	2	0	0	8	10	0.14	0.15	0.01	0.14
14	0	0	4	0	4	8	0.13	0.15	0.02	0.13
15	0	2	0	4	5	11	0.13	0.14	0.01	0.13

[1]Intra-residue restraints, [2]Sequential restraints, [3]Medium range restraints, [4]Long range restraints, [5]Inter-chain restraints, [6]Standard deviation

9.2.1 Bar graph : Distance Violation statistics for each model



The mean(dot),median(x) and the standard deviation are shown in blue with respect to the y axis on the right

9.3 Distance violation statistics for the ensemble

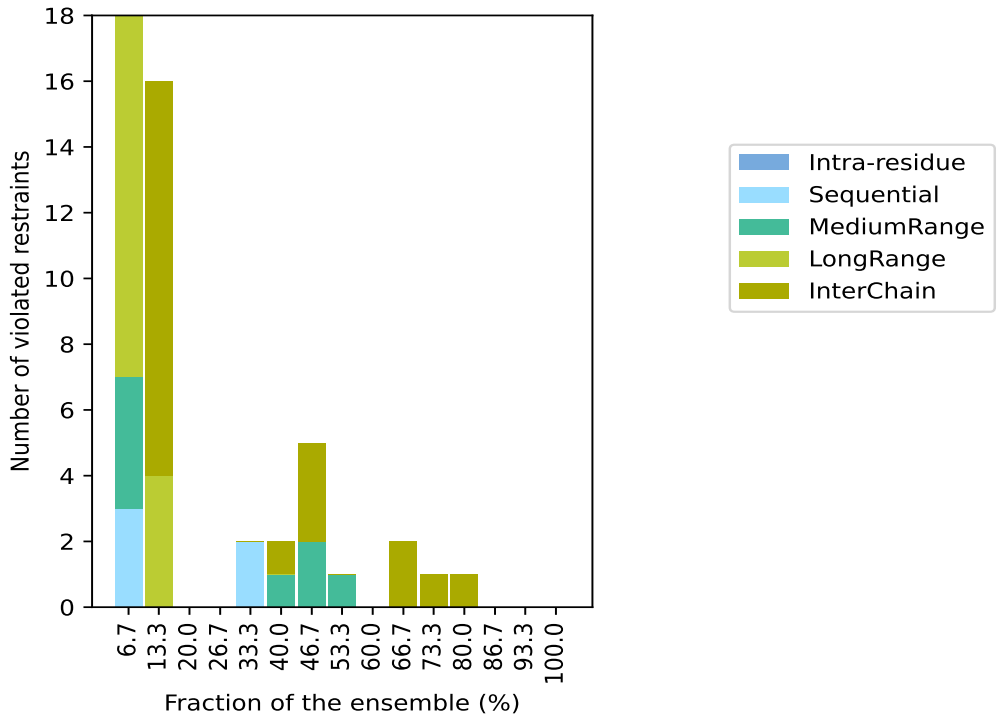
Violation analysis may find that some restraints are violated in few models and some are violated in most of models. The following table provides this information as number of violated restraints

for a given fraction of the ensemble. In total, 8744(IR:1716, SQ:1947, MR:740, LR:3585, IC:756) restraints are not violated in the ensemble.

Number of violated restraints						Fraction of the ensemble	
IR[1]	SQ[2]	MR[3]	LR[4]	IC[5]	Total	Count[6]	%
0	3	4	11	0	18	1	6.7
0	0	0	4	12	16	2	13.3
0	0	0	0	0	0	3	20.0
0	0	0	0	0	0	4	26.7
0	2	0	0	0	2	5	33.3
0	0	1	0	1	2	6	40.0
0	0	2	0	3	5	7	46.7
0	0	1	0	0	1	8	53.3
0	0	0	0	0	0	9	60.0
0	0	0	0	2	2	10	66.7
0	0	0	0	1	1	11	73.3
0	0	0	0	1	1	12	80.0
0	0	0	0	0	0	13	86.7
0	0	0	0	0	0	14	93.3
0	0	0	0	0	0	15	100.0

[1]Intra-residue restraints, [2]Sequential restraints, [3]Medium range restraints, [4]Long range restraints, [5]Inter-chain restraints, [6] Number of models with violations

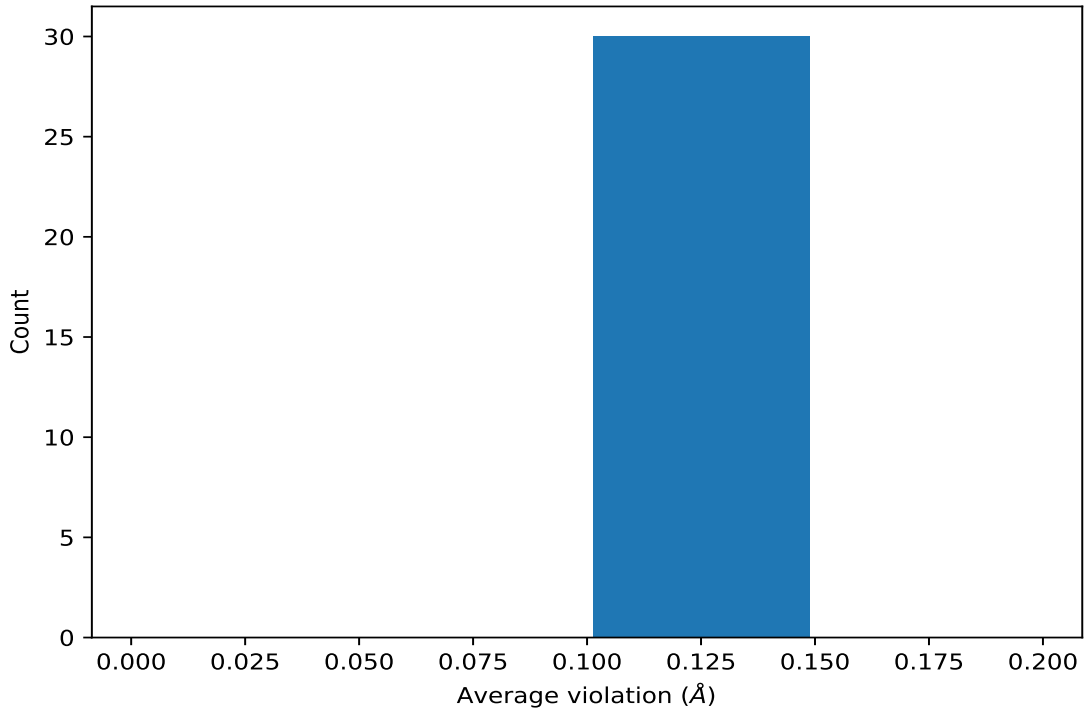
9.3.1 Bar graph : Distance violation statistics for the ensemble



9.4 Most violated distance restraints in the ensemble

9.4.1 Histogram : Distribution of mean distance violations

The following histogram shows the distribution of the average value of the violation. The average is calculated for each restraint that is violated in more than one model over all the violated models in the ensemble



9.4.2 Table: Most violated distance restraints (i)

The following table provides the mean and the standard deviation of the violations for the 10 worst performing restraints, sorted by number of violated models and the mean violation value. The Key (restraint list ID, restraint ID) is the unique identifier for a given restraint. Rows with same key represent combinatorial or ambiguous restraints and are counted as a single restraint.

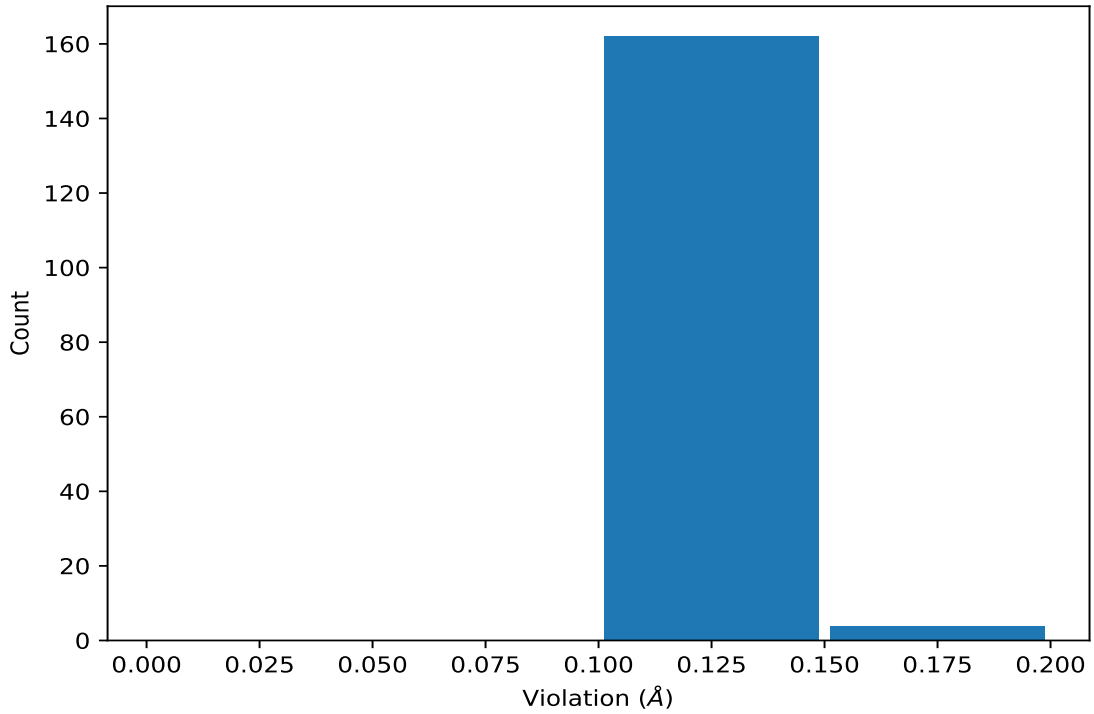
Key	Atom-1	Atom-2	Models[1]	Mean (Å)	SD[1] (Å)	Median (Å)
(1,8464)	1:B:86:ASP:HA	1:C:106:ILE:HB	12	0.14	0.02	0.14
(1,8175)	1:A:86:ASP:HA	1:D:106:ILE:HB	11	0.14	0.01	0.14
(1,8559)	1:B:106:ILE:HB	1:C:86:ASP:HA	10	0.14	0.01	0.14
(1,8270)	1:A:106:ILE:HB	1:D:86:ASP:HA	10	0.14	0.01	0.14
(1,1350)	1:A:82:GLN:H	1:A:84:PHE:HZ	8	0.12	0.01	0.11
(1,3352)	1:B:82:GLN:H	1:B:84:PHE:HZ	7	0.12	0.01	0.12
(1,8672)	1:A:111:LYS:H	1:C:97:TRP:HZ2	7	0.12	0.01	0.12
(1,5354)	1:C:82:GLN:H	1:C:84:PHE:HZ	7	0.12	0.01	0.12
(1,8624)	1:A:97:TRP:HZ2	1:C:111:LYS:H	7	0.12	0.01	0.12
(1,8723)	1:B:97:TRP:HZ2	1:D:111:LYS:H	7	0.12	0.01	0.12

[1]Number of violated models, [2]Standard deviation

9.5 All violated distance restraints (i)

9.5.1 Histogram : Distribution of distance violations (i)

The following histogram shows the distribution of the absolute value of the violation for all violated restraints in the ensemble.



9.5.2 Table : All distance violations (i)

The following table provides the 10 worst performing restraints, sorted by the violation value. The Key (restraint list ID, restraint ID) is the unique identifier for a given restraint. Rows with same key represent combinatorial or ambiguous restraints and are counted as a single restraint.

Key	Atom-1	Atom-2	Model ID	Violation (Å)
(1,8464)	1:B:86:ASP:HA	1:C:106:ILE:HB	8	0.17
(1,8559)	1:B:106:ILE:HB	1:C:86:ASP:HA	8	0.16
(1,8559)	1:B:106:ILE:HB	1:C:86:ASP:HA	10	0.16
(1,8464)	1:B:86:ASP:HA	1:C:106:ILE:HB	10	0.16
(1,8559)	1:B:106:ILE:HB	1:C:86:ASP:HA	14	0.15
(1,8464)	1:B:86:ASP:HA	1:C:106:ILE:HB	1	0.15
(1,8464)	1:B:86:ASP:HA	1:C:106:ILE:HB	14	0.15
(1,8270)	1:A:106:ILE:HB	1:D:86:ASP:HA	8	0.15
(1,8270)	1:A:106:ILE:HB	1:D:86:ASP:HA	10	0.15
(1,8270)	1:A:106:ILE:HB	1:D:86:ASP:HA	14	0.15

10 Dihedral-angle violation analysis

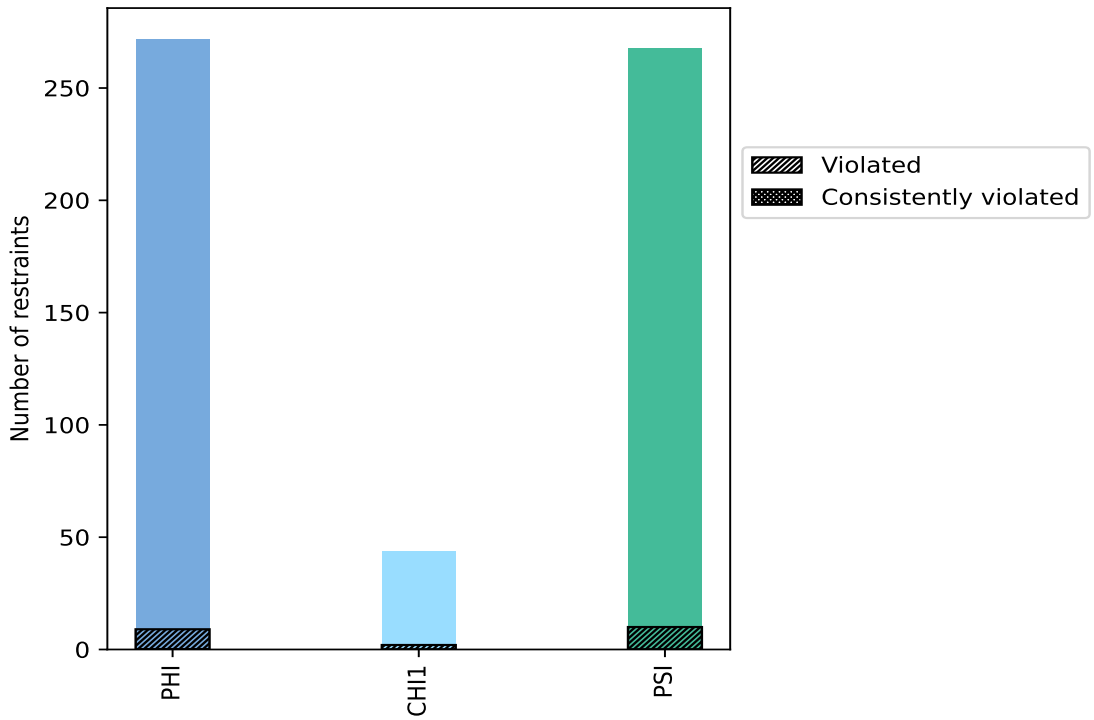
10.1 Summary of dihedral-angle violations

The following table provides the summary of dihedral-angle violations in different dihedral-angle types. Violations less than 1° are not included in the calculation.

Angle type	Count	%[1]	Violated[3]			Consistently Violated[4]		
			Count	%[2]	%[1]	Count	%[2]	%[1]
PHI	272	46.6	9	3.3	1.5	0	0.0	0.0
CHI1	44	7.5	2	4.5	0.3	0	0.0	0.0
PSI	268	45.9	10	3.7	1.7	0	0.0	0.0
Total	584	100.0	21	3.6	3.6	0	0.0	0.0

[1] percentage calculated with respect to total number of dihedral-angle restraints, [2] percentage calculated with respect to number of restraints in a particular dihedral-angle type, [3] violated in at least one model, [4] violated in all the models

10.1.1 Bar chart : Distribution of dihedral-angles and violations



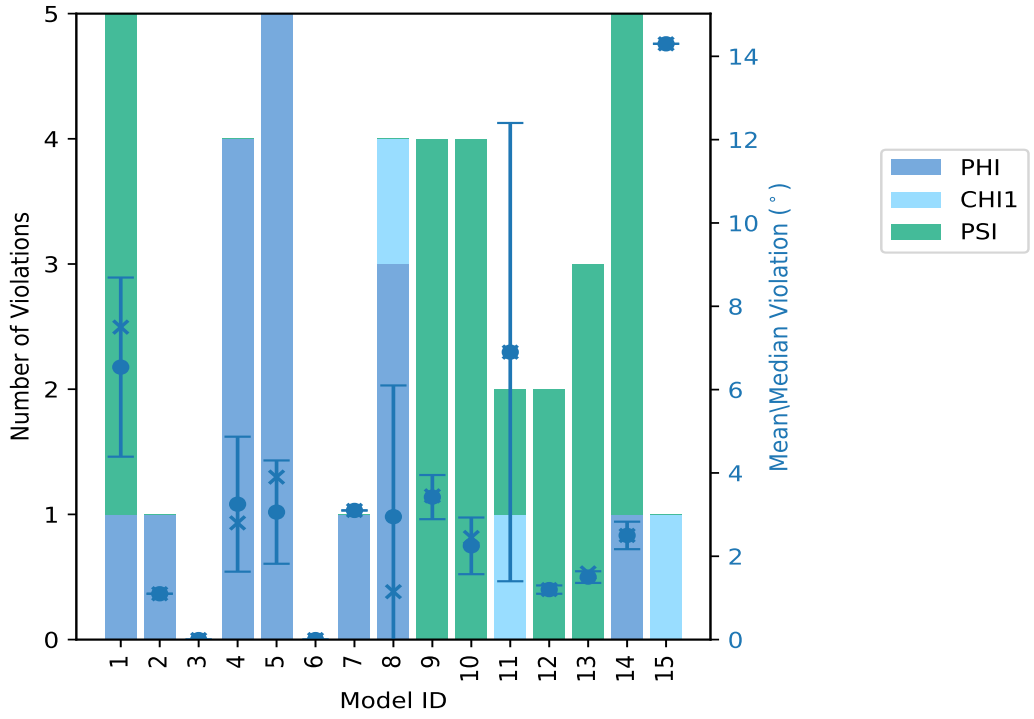
Violated and consistently violated restraints are shown using different hatch patterns in their respective categories

10.2 Dihedral-angle violation statistics for each model (i)

The following table provides the dihedral-angle violation statistics for each model in the ensemble. Violations less than 1° are not included in the statistics.

Model ID	Number of violations				Mean (°)	Max (°)	SD (°)	Median (°)
	PHI	CHI1	PSI	Total				
1	1	0	4	5	6.54	8.1	2.15	7.5
2	1	0	0	1	1.1	1.1	0.0	1.1
3	0	0	0	0	0.0	0.0	0.0	0.0
4	4	0	0	4	3.25	5.9	1.62	2.8
5	5	0	0	5	3.06	4.2	1.24	3.9
6	0	0	0	0	0.0	0.0	0.0	0.0
7	1	0	0	1	3.1	3.1	0.0	3.1
8	3	1	0	4	2.95	8.4	3.15	1.15
9	0	0	4	4	3.42	4.0	0.53	3.45
10	0	0	4	4	2.25	2.9	0.68	2.45
11	0	1	1	2	6.9	12.4	5.5	6.9
12	0	0	2	2	1.2	1.3	0.1	1.2
13	0	0	3	3	1.5	1.6	0.14	1.6
14	1	0	4	5	2.5	3.1	0.33	2.5
15	0	1	0	1	14.3	14.3	0.0	14.3

10.2.1 Bar graph : Dihedral violation statistics for each model (i)



The mean(dot),median(x) and the standard deviation are shown in blue with respect to the y axis on the right

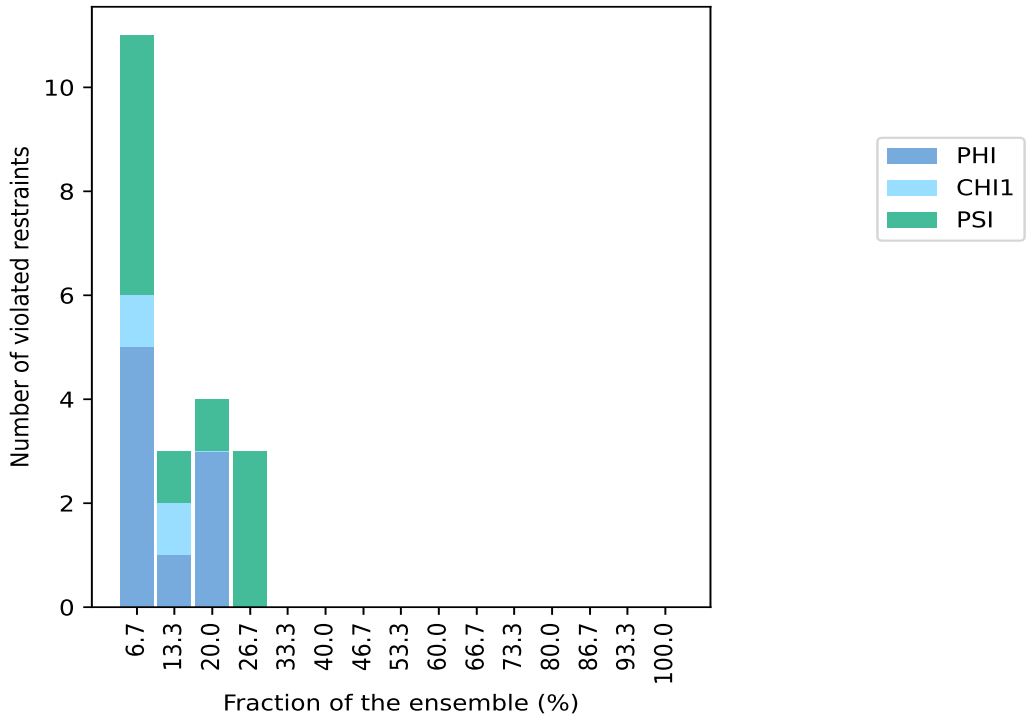
10.3 Dihedral-angle violation statistics for the ensemble (i)

Violation analysis may find that some restraints are violated in very few models and some are violated in most of models. The following table provides this information as number of violated restraints for a given fraction of ensemble.

Number of violated restraints				Fraction of the ensemble	
PHI	CHI1	PSI	Total	Count[1]	%
5	1	5	11	1	6.7
1	1	1	3	2	13.3
3	0	1	4	3	20.0
0	0	3	3	4	26.7
0	0	0	0	5	33.3
0	0	0	0	6	40.0
0	0	0	0	7	46.7
0	0	0	0	8	53.3
0	0	0	0	9	60.0
0	0	0	0	10	66.7
0	0	0	0	11	73.3
0	0	0	0	12	80.0
0	0	0	0	13	86.7
0	0	0	0	14	93.3
0	0	0	0	15	100.0

[1] Number of models with violations

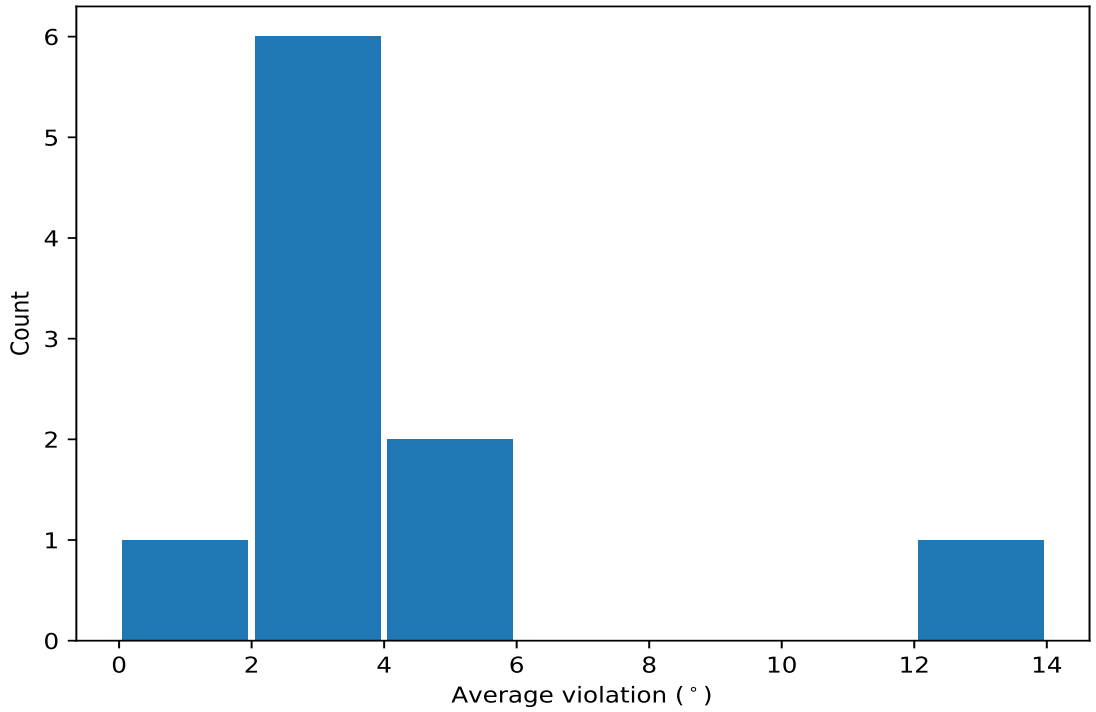
10.3.1 Bar graph : Dihedral-angle Violation statistics for the ensemble



10.4 Most violated dihedral-angle restraints in the ensemble

10.4.1 Histogram : Distribution of mean dihedral-angle violations

The following histogram shows the distribution of the average value of the violation. The average is calculated for each restraint that is violated in more than one model over all the violated models in the ensemble



10.4.2 Table: Most violated dihedral-angle restraints

The following table provides the mean and the standard deviation of the violations for the 10 worst performing restraints, sorted by number of violated models and the mean violation value. The Key (restraint list ID, restraint ID) is the unique identifier for a given restraint.

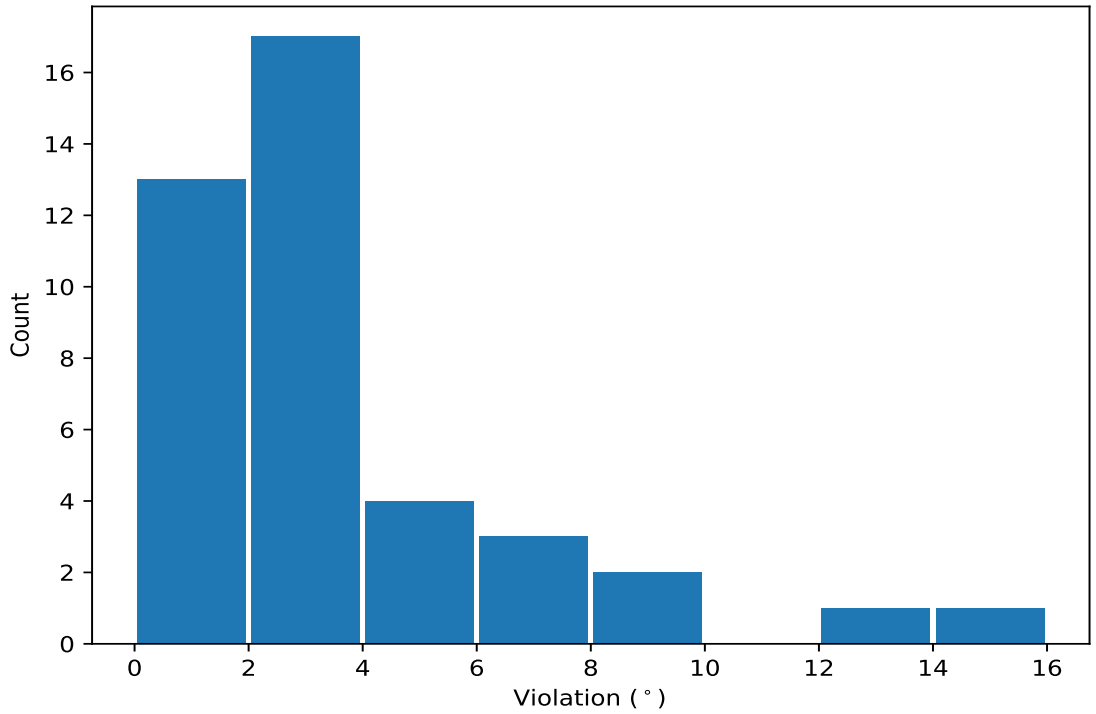
Key	Atom-1	Atom-2	Atom-3	Atom-4	Models[1]	Mean	SD[2]	Median
(1,483)	1:D:74:GLU:N	1:D:74:GLU:CA	1:D:74:GLU:C	1:D:75:SER:N	4	3.95	2.37	3.2
(1,78)	1:A:74:GLU:N	1:A:74:GLU:CA	1:A:74:GLU:C	1:A:75:SER:N	4	3.78	2.05	3.25
(1,348)	1:C:74:GLU:N	1:C:74:GLU:CA	1:C:74:GLU:C	1:C:75:SER:N	4	3.58	2.67	2.45
(1,5)	1:A:4:CYS:C	1:A:5:SER:N	1:A:5:SER:CA	1:A:5:SER:C	3	4.53	2.76	3.1
(1,213)	1:B:74:GLU:N	1:B:74:GLU:CA	1:B:74:GLU:C	1:B:75:SER:N	3	4.27	2.3	3.0
(1,91)	1:A:82:GLN:C	1:A:83:CYS:N	1:A:83:CYS:CA	1:A:83:CYS:C	3	3.37	1.97	3.1
(1,140)	1:B:4:CYS:C	1:B:5:SER:N	1:B:5:SER:CA	1:B:5:SER:C	3	2.43	1.15	2.3
(1,565)	1:C:35:THR:N	1:C:35:THR:CA	1:C:35:THR:CB	1:C:35:THR:OG1	2	13.35	0.95	13.35
(1,275)	1:C:4:CYS:C	1:C:5:SER:N	1:C:5:SER:CA	1:C:5:SER:C	2	2.65	1.55	2.65
(1,6)	1:A:5:SER:N	1:A:5:SER:CA	1:A:5:SER:C	1:A:6:LEU:N	2	1.25	0.15	1.25

[1] Number of violated models, [2]Standard deviation, All angle values are in degree (°)

10.5 All violated dihedral-angle restraints

10.5.1 Histogram : Distribution of violations

The following histogram shows the distribution of the absolute value of the violation for all violated restraints in the ensemble.



10.5.2 Table: All violated dihedral-angle restraints

The following table provides the list of violationsfor the 10 worst performing restraints, sorted by the violation value. The Key (restraint list ID, restraint ID) is the unique identifier for a given restraint.

Key	Atom-1	Atom-2	Atom-3	Atom-4	Model ID	Violation (°)
(1,565)	1:C:35:THR:N	1:C:35:THR:CA	1:C:35:THR:CB	1:C:35:THR:OG1	15	14.3
(1,565)	1:C:35:THR:N	1:C:35:THR:CA	1:C:35:THR:CB	1:C:35:THR:OG1	11	12.4
(1,5)	1:A:4:CYS:C	1:A:5:SER:N	1:A:5:SER:CA	1:A:5:SER:C	8	8.4
(1,348)	1:C:74:GLU:N	1:C:74:GLU:CA	1:C:74:GLU:C	1:C:75:SER:N	1	8.1
(1,483)	1:D:74:GLU:N	1:D:74:GLU:CA	1:D:74:GLU:C	1:D:75:SER:N	1	7.8
(1,213)	1:B:74:GLU:N	1:B:74:GLU:CA	1:B:74:GLU:C	1:B:75:SER:N	1	7.5
(1,78)	1:A:74:GLU:N	1:A:74:GLU:CA	1:A:74:GLU:C	1:A:75:SER:N	1	7.0
(1,91)	1:A:82:GLN:C	1:A:83:CYS:N	1:A:83:CYS:CA	1:A:83:CYS:C	4	5.9
(1,275)	1:C:4:CYS:C	1:C:5:SER:N	1:C:5:SER:CA	1:C:5:SER:C	5	4.2
(1,78)	1:A:74:GLU:N	1:A:74:GLU:CA	1:A:74:GLU:C	1:A:75:SER:N	9	4.0