wwPDB NMR Structure Validation Summary Report (i)

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Title	:	Leader Protease
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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 (i)) were used in the production of this report:

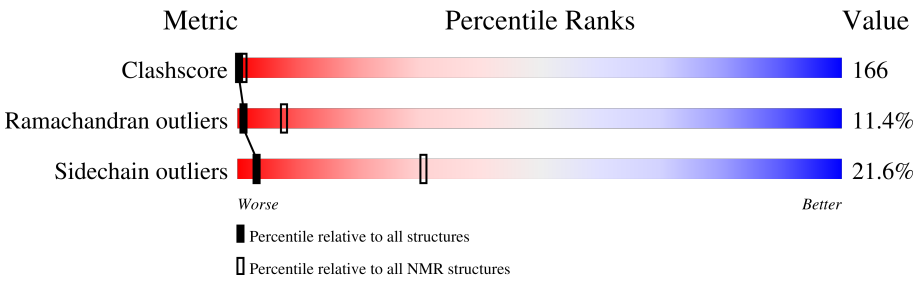
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
BMRB Restraints Analysis	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 34%.

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	R	167	13% 59% 22% 7%

2 Ensemble composition and analysis (i)

This entry contains 5 models. Model 2 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	R:29-R:184 (156)	2.22	2

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	1, 2
2	3, 5
Single-model clusters	4

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 2612 atoms, of which 1266 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Genome polyprotein.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	R	167	2612	871	1266	214	256	5	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
R	51	ALA	CYS	engineered mutation	UNP P03305
R	126	VAL	MET	engineered mutation	UNP P03305

4 Residue-property plots (i)

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: Genome polyprotein

Chain R: 13% 59% 22% 7%

M29 E30 L31 T32 L33 Y34 N35 G36 E37 K38 K39 T40 F41 Y42 S43 R44 P45 N46 N47 H48 D49 N50 A51 W52 L53 N54 A55 I56 L57 Q58 L59 F60 R61 Y62 V63 E64 E65 P66 F67 F68 D69 W70 V71 Y72 S73 S74 P75 E76 N77 L78 T79 L80 E81 A82 I83 K84 Q85 L86 E87 D88

L89 T90 G91 L92 E93 L94 H95 E96 G97 G98 P99 P100 A101 L102 V103 I104 W105 N106 I107 K108 H109 L110 L111 H112 T113 G114 I115 G116 T117 A118 S119 R120 P121 S122 E123 V124 C125 V126 V127 D128 G129 T130 D131 M132 C133 L134 A135 D136 F137 H138 A139 G140 I141 F142 L143 Q146 E147 H148 A149

V150 F151 A152 C153 V154 T155 S156 N157 G158 W159 Y160 A161 I162 D163 D164 E165 D166 F167 Y168 P169 W170 T171 P172 D173 P174 V177 L178 V179 F180 V181 P182 Y183 D184 Q185 E186 P187 L188 N189 G190 E191 W192 K193 A194 K195

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

The representative model is number 2. Colouring as in section 4.1 above.

- Molecule 1: Genome polyprotein

Chain R: 16% 50% 24% • 7%

M29 E30 L31 T32 L33 Y34 N35 G36 E37 K38 K39 T40 F41 Y42 S43 R44 P45 N46 N47 H48 D49 N50 A51 W52 L53 N54 A55 I56 L57 Q58 L59 F60 R61 Y62 V63 E64 E65 P66 F67 F68 D69 W70 V71 Y72 S73 S74 P75 E76 N77 L78 T79 L80 E81 A82 I83 K84 Q85 L86 E87 D88

L89 T90 G91 L92 E93 L94 H95 E96 G97 G98 P99 P100 A101 L102 V103 I104 W105 N106 I107 K108 H109 L110 L111 H112 T113 G114 I115 G116 T117 A118 S119 R120 P121 S122 E123 V124 C125 V126 V127 D128 G129 T130 D131 M132 C133 L134 A135 D136 F137 H138 A139 G140 I141 F142 H148 A149 V150 F151 A152

C153 V154 T155 G158 W159 Y160 A161 I162 D163 D164 E165 D166 F167 Y168 P169 W170 T171 P172 D173 P174 S175 D176 V177 L178 V179 F180 V181 P182 Y183 D184 Q185 E186 P187 L188 N189 G190 E191 W192 K193 A194 K195

5 Refinement protocol and experimental data overview (i)

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

Of the 100 calculated structures, 5 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 solution	
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	774
Number of shifts mapped to atoms	774
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	34%

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	R	1.08±0.00	0±0/1296 (0.0± 0.0%)	1.31±0.01	3±1/1776 (0.2± 0.1%)
All	All	1.08	0/6480 (0.0%)	1.31	17/8880 (0.2%)

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	R	0.0±0.0	3.0±0.0
All	All	0	15

There are no bond-length outliers.

5 of 10 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	R	118	ALA	N-CA-CB	-6.45	101.08	110.10	4	1
1	R	115	ILE	N-CA-CB	-5.85	97.34	110.80	5	1
1	R	51	ALA	N-CA-CB	-5.79	102.00	110.10	1	3
1	R	126	VAL	CA-CB-CG2	-5.58	102.53	110.90	4	1
1	R	171	THR	N-CA-CB	-5.57	99.72	110.30	3	1

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	R	44	ARG	Sidechain	5
1	R	61	ARG	Sidechain	5
1	R	120	ARG	Sidechain	5

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	R	1254	1178	1175	403±15
All	All	6270	5890	5875	2016

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 166.

5 of 1392 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:R:115:ILE:HG23	1:R:124:VAL:O	1.22	1.28	5	2
1:R:36:GLY:O	1:R:37:GLU:O	1.22	1.56	2	3
1:R:115:ILE:HD12	1:R:124:VAL:HG22	1.15	1.17	2	3
1:R:134:LEU:HD11	1:R:171:THR:HG22	1.11	1.12	1	4
1:R:86:LEU:HD11	1:R:103:VAL:HG13	1.08	1.23	4	4

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	R	155/167 (93%)	109±3 (70±2%)	29±2 (19±2%)	18±3 (11±2%)	1 8
All	All	775/835 (93%)	543 (70%)	144 (19%)	88 (11%)	1 8

5 of 48 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	R	93	GLU	4
1	R	99	PRO	4
1	R	101	ALA	4

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Mol	Chain	Res	Type	Models (Total)
1	R	102	LEU	4
1	R	49	ASP	4

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	R	136/145 (94%)	107±4 (78±3%)	29±4 (22±3%)	3 31
All	All	680/725 (94%)	533 (78%)	147 (22%)	3 31

5 of 64 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	R	33	LEU	5
1	R	83	ILE	5
1	R	92	LEU	5
1	R	110	LEU	5
1	R	134	LEU	5

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 (i)

The completeness of assignment taking into account all chemical shift lists is 34% for the well-defined parts and 34% 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 (i)

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	774
Number of shifts mapped to atoms	774
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 (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	162	-0.27 ± 0.16	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	151	0.18 ± 0.15	None needed (< 0.5 ppm)
$^{13}C'$	161	0.08 ± 0.15	None needed (< 0.5 ppm)
^{15}N	150	0.66 ± 0.34	None needed (imprecise)

7.1.3 Completeness of resonance assignments (i)

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 34%, i.e. 722 atoms were assigned a chemical shift out of a possible 2099. 0 out of 28 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	581/770 (75%)	140/312 (45%)	301/312 (96%)	140/146 (96%)
Sidechain	141/1074 (13%)	0/702 (0%)	141/347 (41%)	0/25 (0%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	0/255 (0%)	0/127 (0%)	0/117 (0%)	0/11 (0%)
Overall	722/2099 (34%)	140/1141 (12%)	442/776 (57%)	140/182 (77%)

7.1.4 Statistically unusual chemical shifts (i)

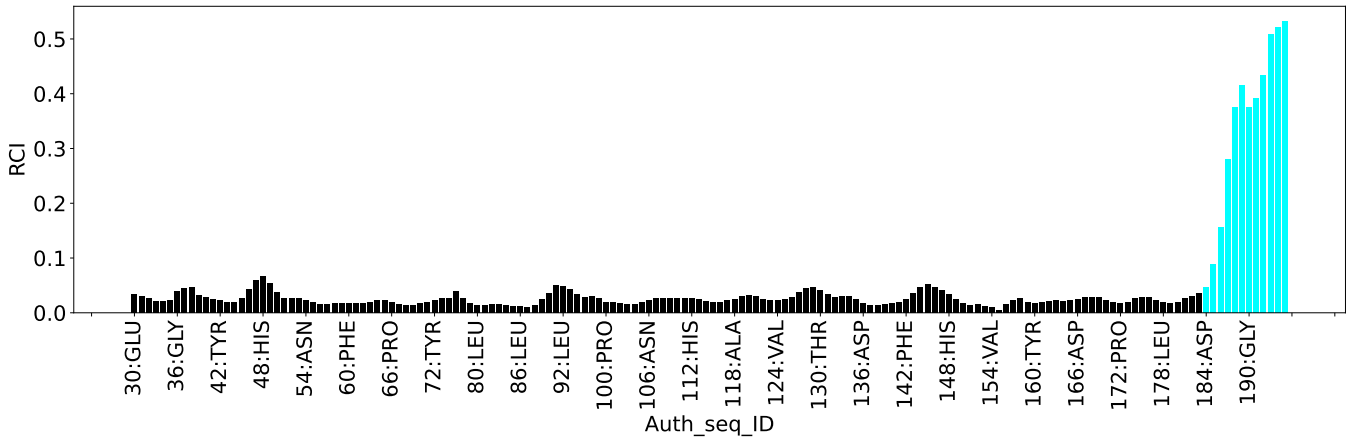
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

List Id	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	R	155	THR	CB	15.33	61.12 – 78.27	-31.7

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 R:



8 NMR restraints analysis (i)

8.1 Conformationally restricting restraints (i)

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	2439
Intra-residue (|i-j|=0)	806
Sequential (|i-j|=1)	686
Medium range (|i-j|>1 and |i-j|<5)	390
Long range (|i-j|≥5)	439
Inter-chain	0
Hydrogen bond restraints	118
Disulfide bond restraints	0
Total dihedral-angle restraints	216
Number of unmapped restraints	0
Number of restraints per residue	15.9
Number of long range restraints per residue[1]	2.9

[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 (i)

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 (i)

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)	102.6	0.2
0.2-0.5 (Medium)	154.4	0.5
>0.5 (Large)	93.2	2.54

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)	72.6	9.67
10.0-20.0 (Medium)	25.8	20.0
>20.0 (Large)	25.4	114.55

9 Distance violation analysis (i)

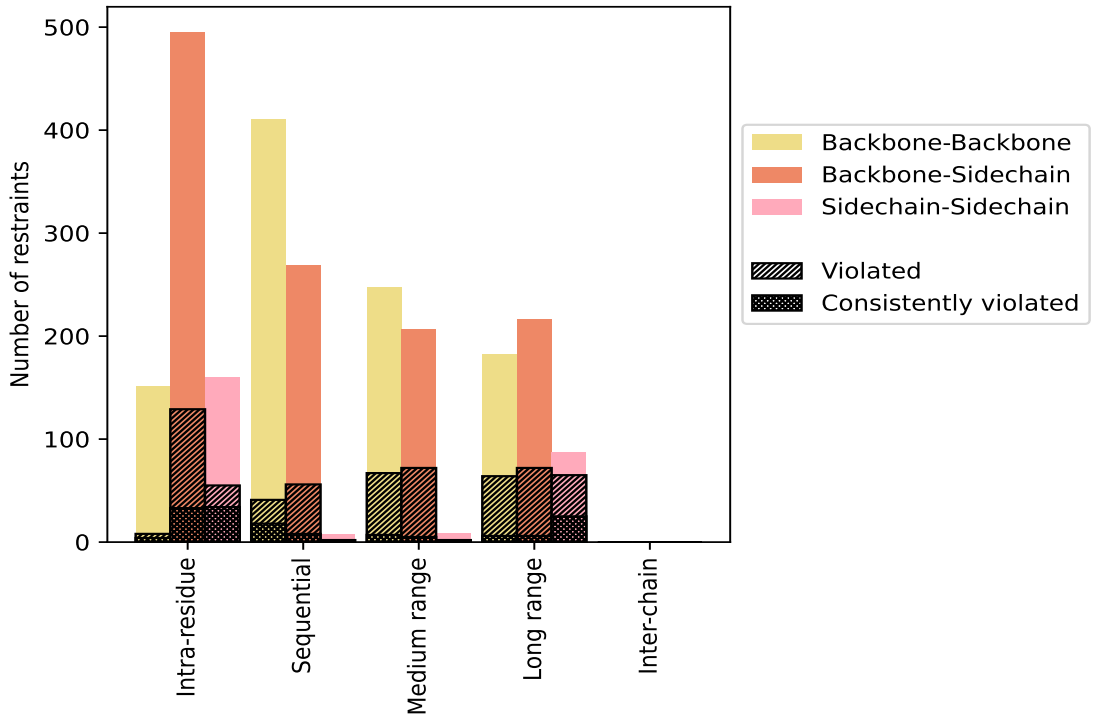
9.1 Summary of distance violations (i)

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)	806	33.0	192	23.8	7.9	71	8.8	2.9
Backbone-Backbone	151	6.2	8	5.3	0.3	4	2.6	0.2
Backbone-Sidechain	495	20.3	129	26.1	5.3	33	6.7	1.4
Sidechain-Sidechain	160	6.6	55	34.4	2.3	34	21.2	1.4
Sequential (|i-j|=1)	686	28.1	99	14.4	4.1	26	3.8	1.1
Backbone-Backbone	410	16.8	41	10.0	1.7	18	4.4	0.7
Backbone-Sidechain	269	11.0	56	20.8	2.3	8	3.0	0.3
Sidechain-Sidechain	7	0.3	2	28.6	0.1	0	0.0	0.0
Medium range (|i-j|>1 & |i-j|<5)	390	16.0	102	26.2	4.2	10	2.6	0.4
Backbone-Backbone	247	10.1	67	27.1	2.7	7	2.8	0.3
Backbone-Sidechain	135	5.5	33	24.4	1.4	3	2.2	0.1
Sidechain-Sidechain	8	0.3	2	25.0	0.1	0	0.0	0.0
Long range (|i-j|≥5)	439	18.0	184	41.9	7.5	36	8.2	1.5
Backbone-Backbone	182	7.5	64	35.2	2.6	6	3.3	0.2
Backbone-Sidechain	170	7.0	55	32.4	2.3	5	2.9	0.2
Sidechain-Sidechain	87	3.6	65	74.7	2.7	25	28.7	1.0
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	118	4.8	56	47.5	2.3	3	2.5	0.1
Disulfide bond	0	0.0	0	0.0	0.0	0	0.0	0.0
Total	2439	100.0	633	26.0	26.0	146	6.0	6.0
Backbone-Backbone	990	40.6	180	18.2	7.4	35	3.5	1.4
Backbone-Sidechain	1187	48.7	329	27.7	13.5	52	4.4	2.1
Sidechain-Sidechain	262	10.7	124	47.3	5.1	59	22.5	2.4

[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 (i)



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

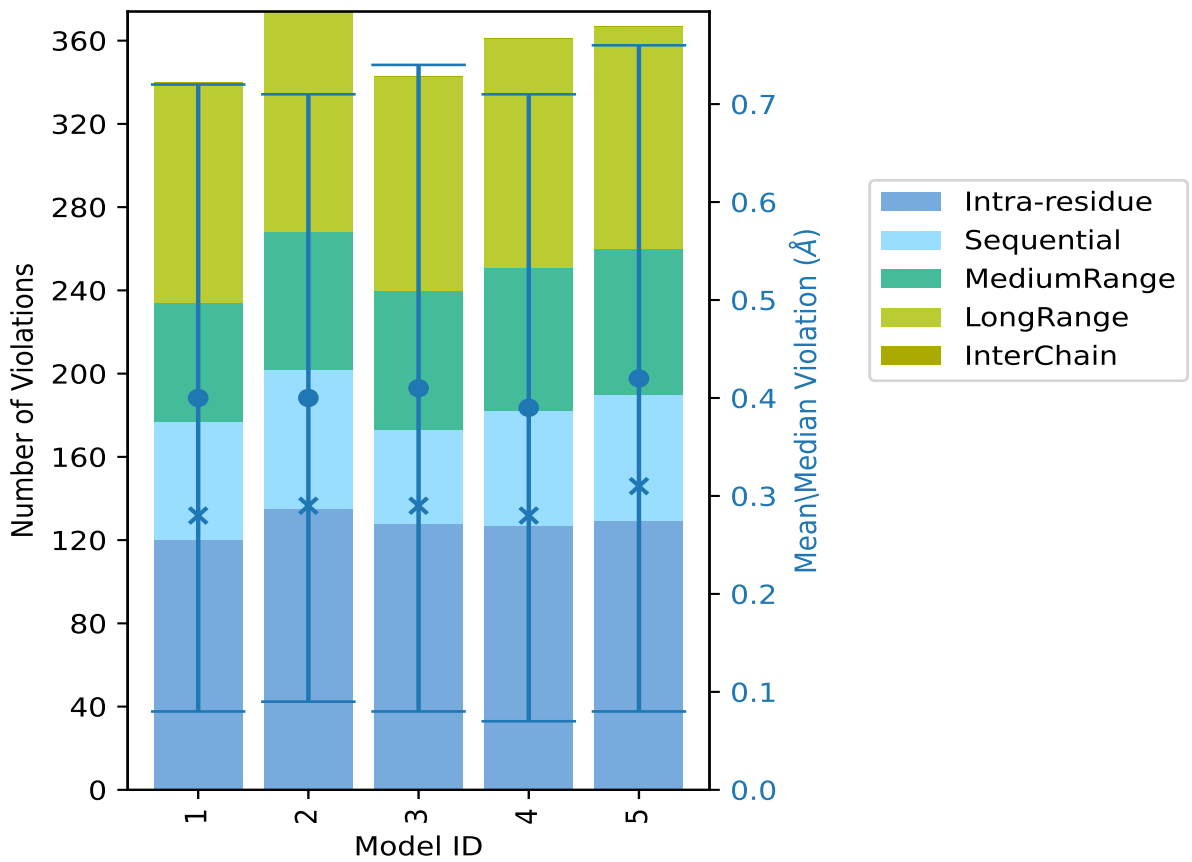
9.2 Distance violation statistics for each model (i)

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	120	57	57	106	0	340	0.4	2.54	0.32	0.28
2	135	67	66	106	0	374	0.4	2.09	0.31	0.29
3	128	45	67	103	0	343	0.41	2.14	0.33	0.29
4	127	55	69	110	0	361	0.39	2.15	0.32	0.28
5	129	61	70	107	0	367	0.42	2.51	0.34	0.31

[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 (i)



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 (i)

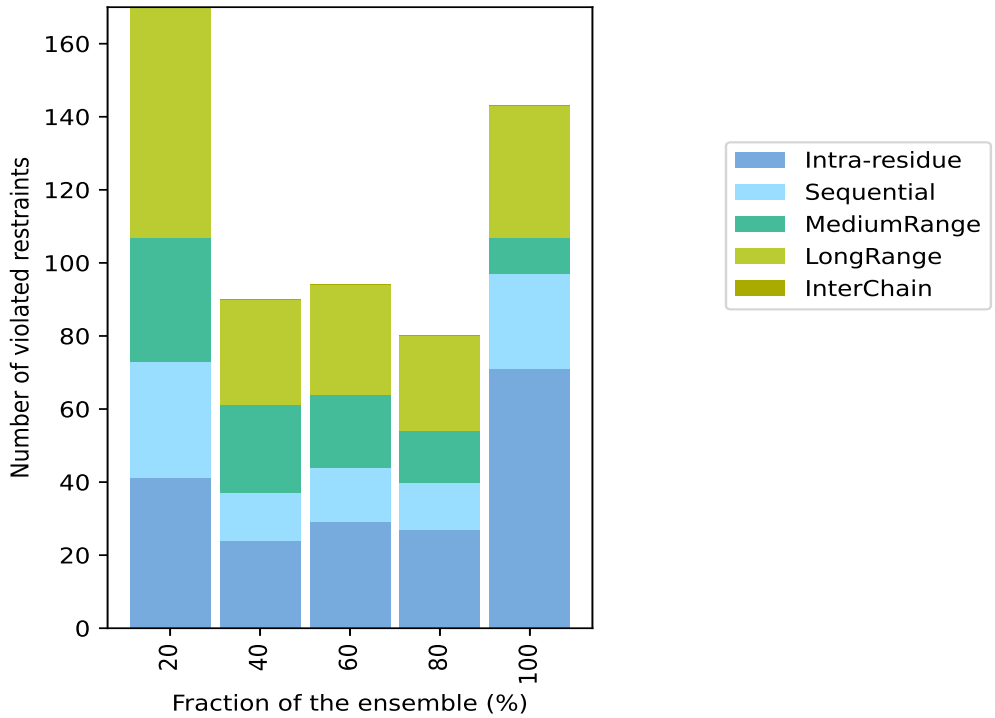
Violation analysis may find that some restraints are violated in few models and some are violated in most of models. The following table provides this information as number of violated restraints for a given fraction of the ensemble. In total, 1744(IR:614, SQ:587, MR:288, LR:255, IC:0) restraints are 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]	%
41	32	34	63	0	170	1	20.0
24	13	24	29	0	90	2	40.0
29	15	20	30	0	94	3	60.0
27	13	14	26	0	80	4	80.0
71	26	10	36	0	143	5	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

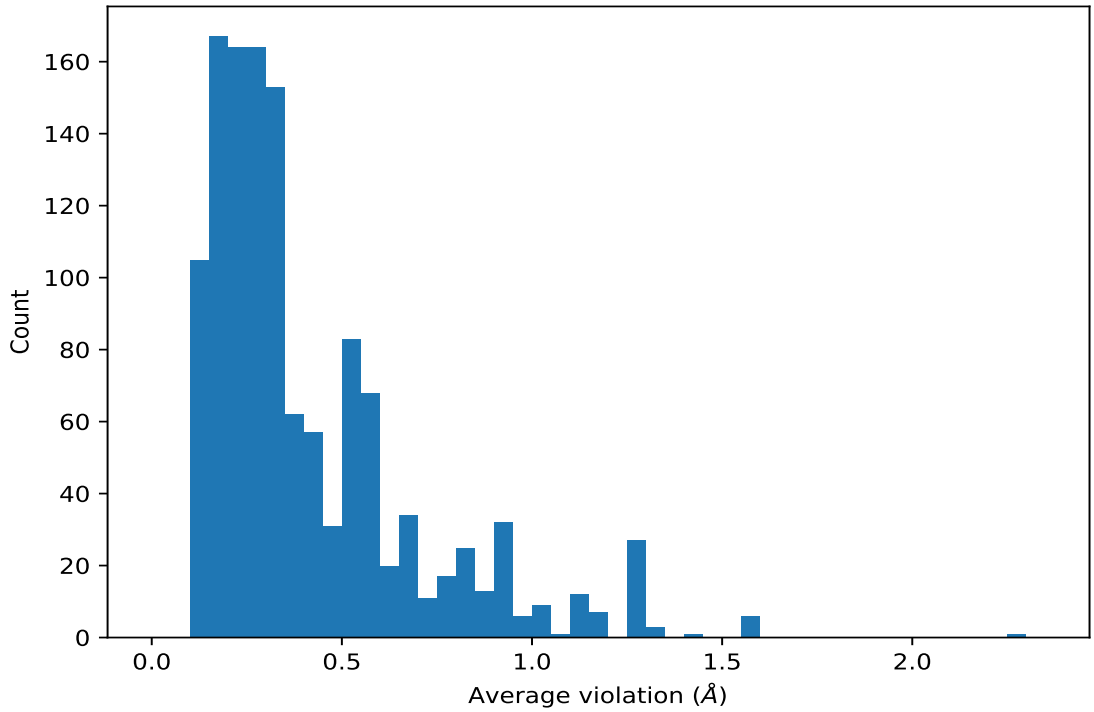
9.3.1 Bar graph : Distance violation statistics for the ensemble (i)



9.4 Most violated distance restraints in the ensemble (i)

9.4.1 Histogram : Distribution of mean distance violations (i)

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)
(1,1222)	1:153:R:CYS:H	1:158:R:GLY:HA3	5	2.28	0.19	2.15
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD11	5	1.58	0.26	1.62
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD12	5	1.58	0.26	1.62
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD13	5	1.58	0.26	1.62
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD21	5	1.58	0.26	1.62
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD22	5	1.58	0.26	1.62
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD23	5	1.58	0.26	1.62
(1,1968)	1:53:R:LEU:HB2	1:71:R:VAL:HG21	5	1.33	0.15	1.34
(1,1968)	1:53:R:LEU:HB2	1:71:R:VAL:HG22	5	1.33	0.15	1.34
(1,1968)	1:53:R:LEU:HB2	1:71:R:VAL:HG23	5	1.33	0.15	1.34
(1,29)	1:79:R:THR:H	1:80:R:LEU:HA	5	1.29	0.04	1.32
(1,2091)	1:71:R:VAL:HG21	1:57:R:LEU:HD11	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG21	1:57:R:LEU:HD12	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG21	1:57:R:LEU:HD13	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG21	1:57:R:LEU:HD21	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG21	1:57:R:LEU:HD22	5	1.28	0.03	1.27

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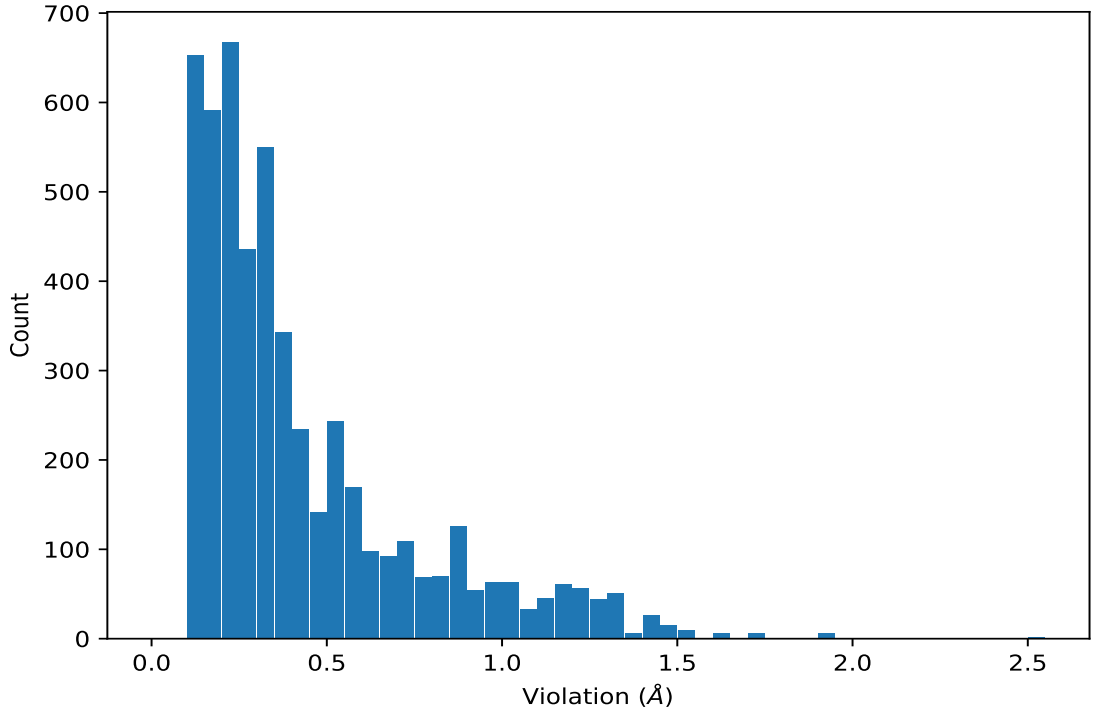
Key	Atom-1	Atom-2	Models[1]	Mean (Å)	SD[1] (Å)	Median (Å)
(1,2091)	1:71:R:VAL:HG21	1:57:R:LEU:HD23	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG22	1:57:R:LEU:HD11	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG22	1:57:R:LEU:HD12	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG22	1:57:R:LEU:HD13	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG22	1:57:R:LEU:HD21	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG22	1:57:R:LEU:HD22	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG22	1:57:R:LEU:HD23	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG23	1:57:R:LEU:HD11	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG23	1:57:R:LEU:HD12	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG23	1:57:R:LEU:HD13	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG23	1:57:R:LEU:HD21	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG23	1:57:R:LEU:HD22	5	1.28	0.03	1.27
(1,2091)	1:71:R:VAL:HG23	1:57:R:LEU:HD23	5	1.28	0.03	1.27
(1,1698)	1:42:R:TYR:HE1	1:42:R:TYR:HA	5	1.27	0.09	1.28
(1,1698)	1:42:R:TYR:HE2	1:42:R:TYR:HA	5	1.27	0.09	1.28
(1,2076)	1:49:R:ASP:HB2	1:49:R:ASP:HB3	5	1.17	0.0	1.17
(1,2081)	1:52:R:TRP:HB3	1:52:R:TRP:HB2	5	1.17	0.0	1.17
(1,2088)	1:56:R:ILE:HG13	1:56:R:ILE:HG12	5	1.17	0.0	1.17
(1,2210)	1:153:R:CYS:HB2	1:153:R:CYS:HB3	5	1.17	0.0	1.17

[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)
(1,1222)	1:153:R:CYS:H	1:158:R:GLY:HA3	1	2.54
(1,1893)	1:170:R:TRP:HB3	1:171:R:THR:HG1	5	2.51
(1,1222)	1:153:R:CYS:H	1:158:R:GLY:HA3	5	2.48
(1,1222)	1:153:R:CYS:H	1:158:R:GLY:HA3	4	2.15
(1,1222)	1:153:R:CYS:H	1:158:R:GLY:HA3	3	2.14
(1,1222)	1:153:R:CYS:H	1:158:R:GLY:HA3	2	2.09
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD11	1	1.91
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD12	1	1.91
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD13	1	1.91
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD21	1	1.91
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD22	1	1.91
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD23	1	1.91
(1,606)	1:139:R:ALA:H	1:180:R:PHE:HB3	3	1.82
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD11	2	1.71
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD12	2	1.71
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD13	2	1.71
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD21	2	1.71

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Key	Atom-1	Atom-2	Model ID	Violation (Å)
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD22	2	1.71
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD23	2	1.71
(1,1374)	1:41:R:PHE:H	1:31:R:LEU:HD11	3	1.62

10 Dihedral-angle violation analysis (i)

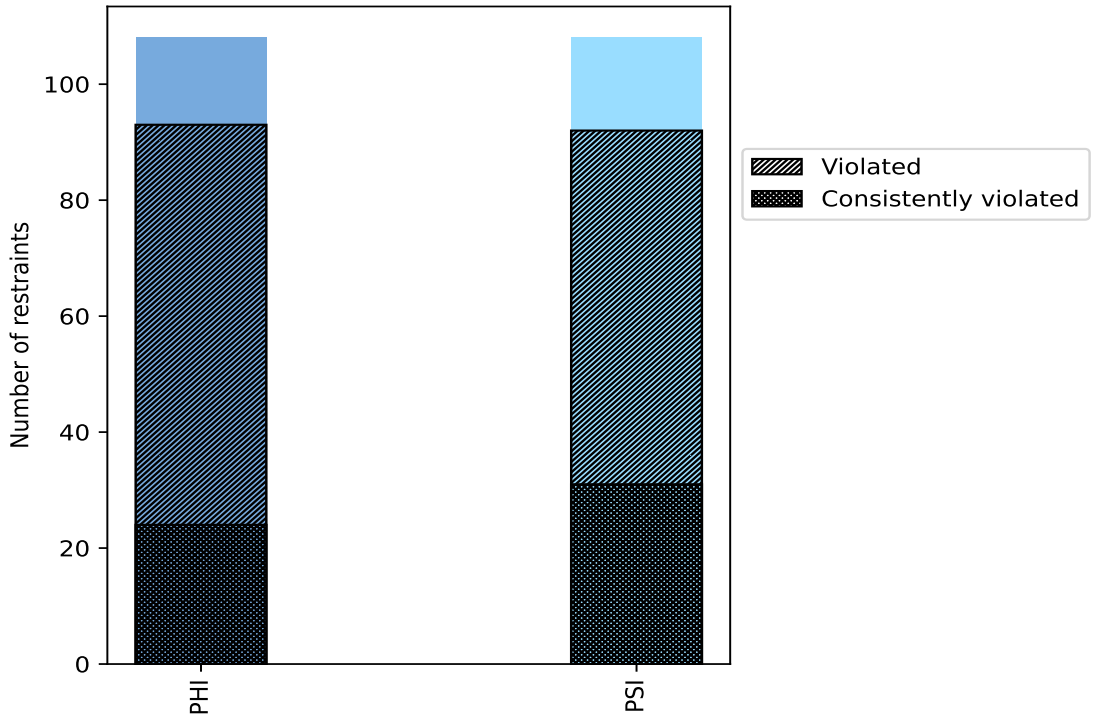
10.1 Summary of dihedral-angle violations (i)

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	108	50.0	93	86.1	43.1	24	22.2	11.1
PSI	108	50.0	92	85.2	42.6	31	28.7	14.4
Total	216	100.0	185	85.6	85.6	55	25.5	25.5

[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 (i)



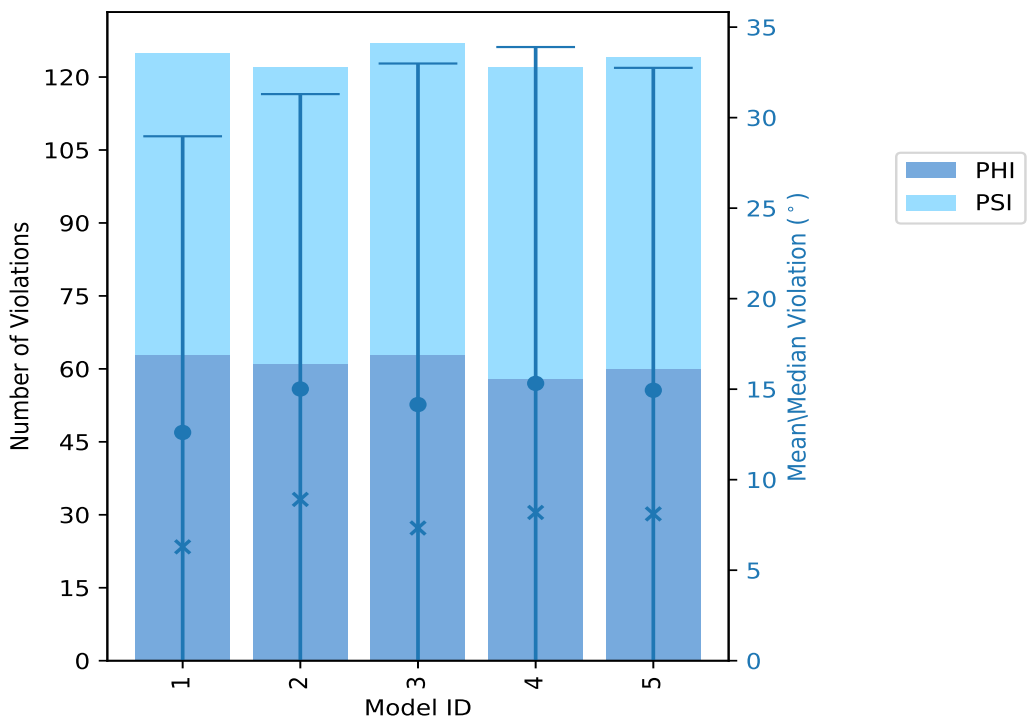
Violated and consistently violated restraints are shown using different hatch patterns in their respective categories

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	PSI	Total				
1	63	62	125	12.61	93.38	16.36	6.29
2	61	61	122	15.01	97.72	16.29	8.91
3	63	64	127	14.15	98.76	18.84	7.33
4	58	64	122	15.32	110.88	18.58	8.19
5	60	64	124	14.94	114.55	17.81	8.11

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

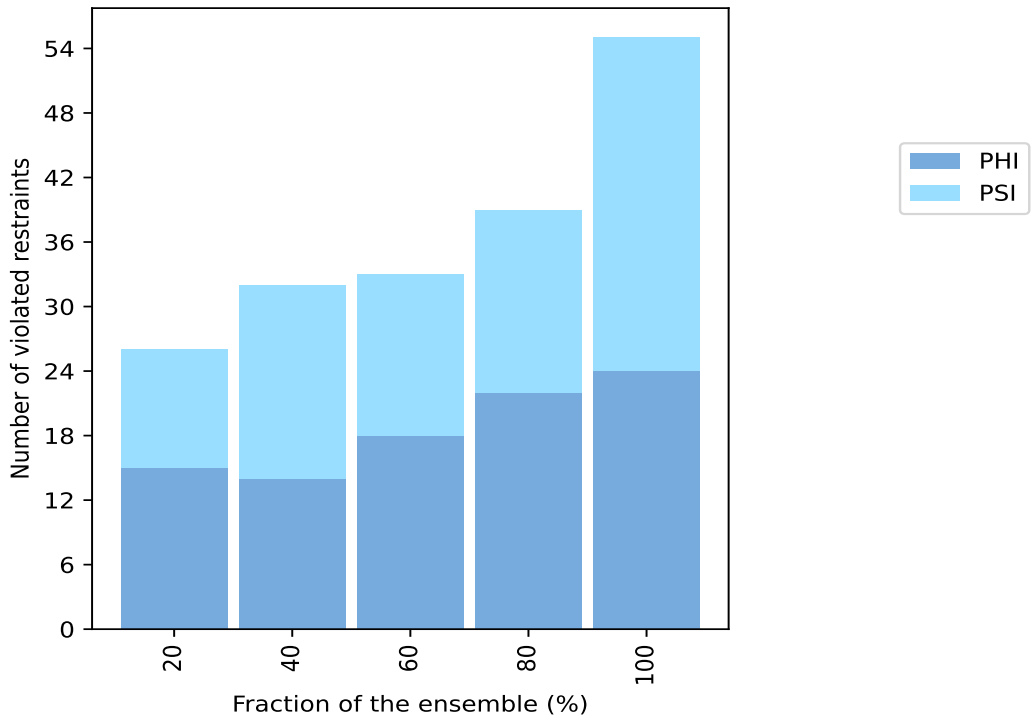
10.3 Dihedral-angle violation statistics for the ensemble (i)

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	PSI	Total	Count[1]	%
15	11	26	1	20.0
14	18	32	2	40.0
18	15	33	3	60.0
22	17	39	4	80.0
24	31	55	5	100.0

[1] Number of models with violations

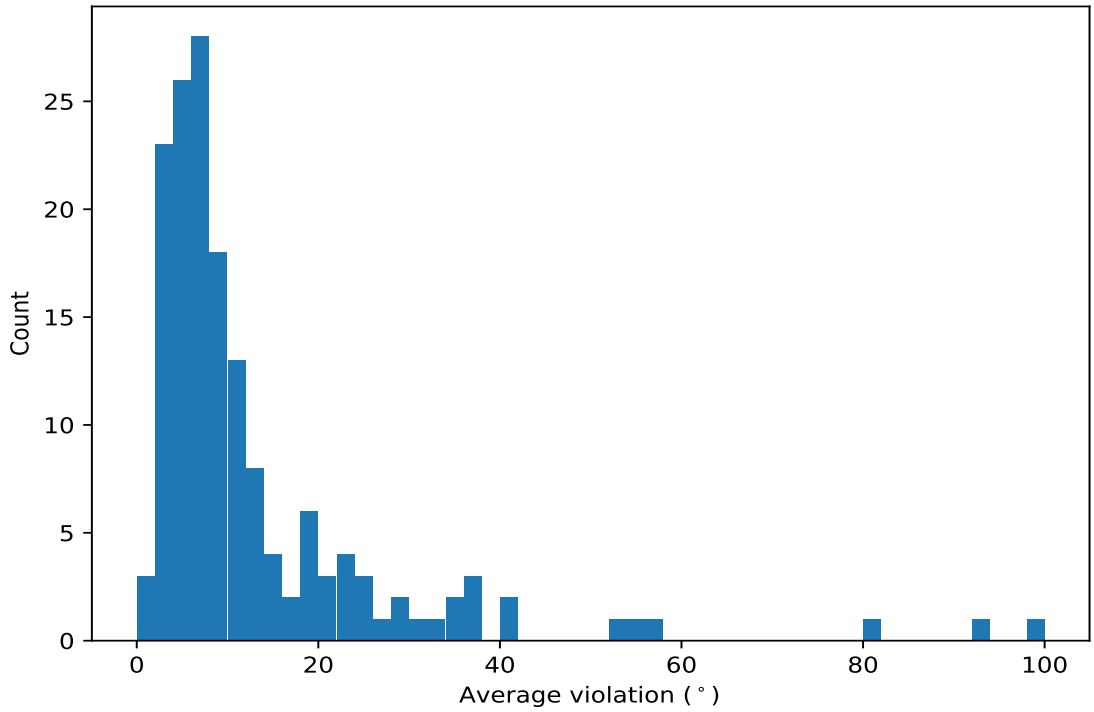
10.3.1 Bar graph : Dihedral-angle Violation statistics for the ensemble (i)



10.4 Most violated dihedral-angle restraints in the ensemble (i)

10.4.1 Histogram : Distribution of mean dihedral-angle violations (i)

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 (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.

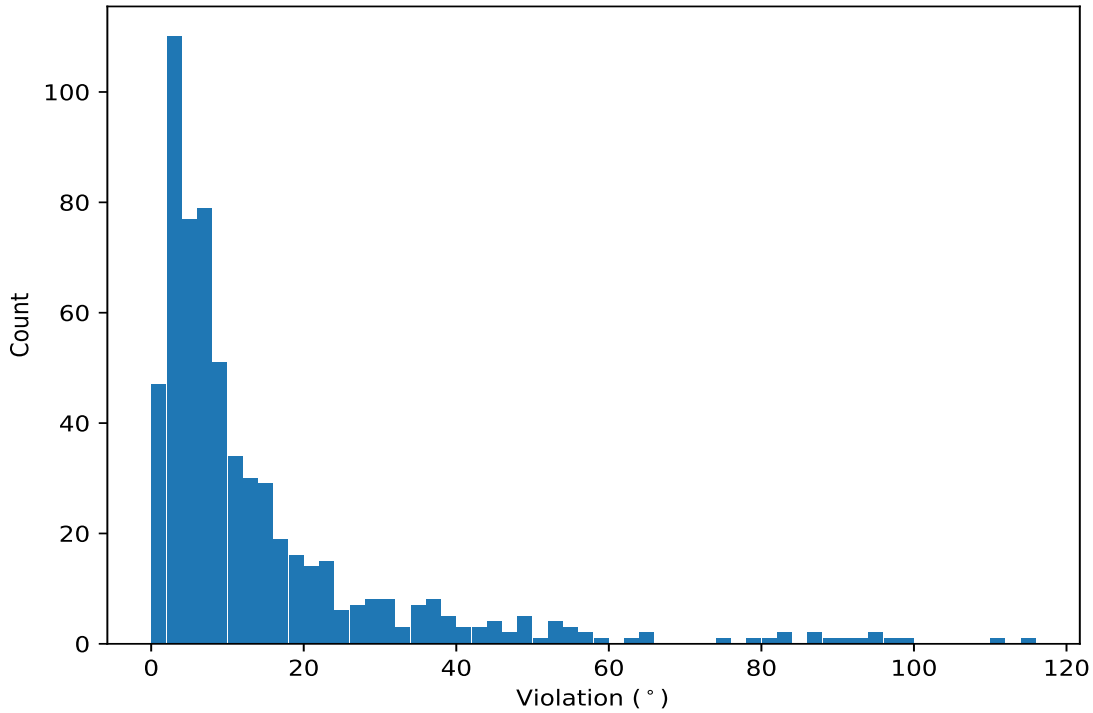
Key	Atom-1	Atom-2	Atom-3	Atom-4	Models[1]	Mean	SD[2]	Median
(1,208)	1:178:R:LEU:N	1:178:R:LEU:CA	1:178:R:LEU:C	1:179:R:VAL:N	5	99.25	11.45	95.66
(1,156)	1:138:R:HIS:N	1:138:R:HIS:CA	1:138:R:HIS:C	1:139:R:ALA:N	5	56.0	6.94	55.34
(1,196)	1:170:R:TRP:N	1:170:R:TRP:CA	1:170:R:TRP:C	1:171:R:THR:N	5	54.84	36.04	37.73
(1,126)	1:112:R:HIS:N	1:112:R:HIS:CA	1:112:R:HIS:C	1:113:R:THR:N	5	52.77	7.06	51.58
(1,60)	1:66:R:PRO:N	1:66:R:PRO:CA	1:66:R:PRO:C	1:67:R:PHE:N	5	40.3	4.55	41.77
(1,209)	1:178:R:LEU:C	1:179:R:VAL:N	1:179:R:VAL:CA	1:179:R:VAL:C	5	35.91	7.77	34.61
(1,212)	1:180:R:PHE:N	1:180:R:PHE:CA	1:180:R:PHE:C	1:181:R:VAL:N	5	34.09	4.58	35.53
(1,10)	1:35:R:ASN:N	1:35:R:ASN:CA	1:35:R:ASN:C	1:36:R:GLY:N	5	32.42	23.47	49.41
(1,197)	1:170:R:TRP:C	1:171:R:THR:N	1:171:R:THR:CA	1:171:R:THR:C	5	31.98	28.69	13.74
(1,182)	1:159:R:TRP:N	1:159:R:TRP:CA	1:159:R:TRP:C	1:160:R:TYR:N	5	28.82	6.87	28.36

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

10.5 All violated dihedral-angle restraints (i)

10.5.1 Histogram : Distribution of violations (i)

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 (i)

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 (°)
(1,208)	1:178:R:LEU:N	1:178:R:LEU:CA	1:178:R:LEU:C	1:179:R:VAL:N	5	114.55
(1,208)	1:178:R:LEU:N	1:178:R:LEU:CA	1:178:R:LEU:C	1:179:R:VAL:N	4	110.88
(1,196)	1:170:R:TRP:N	1:170:R:TRP:CA	1:170:R:TRP:C	1:171:R:THR:N	3	98.76
(1,196)	1:170:R:TRP:N	1:170:R:TRP:CA	1:170:R:TRP:C	1:171:R:THR:N	2	97.72
(1,208)	1:178:R:LEU:N	1:178:R:LEU:CA	1:178:R:LEU:C	1:179:R:VAL:N	2	95.66
(1,107)	1:101:R:ALA:C	1:102:R:LEU:N	1:102:R:LEU:CA	1:102:R:LEU:C	4	95.0
(1,107)	1:101:R:ALA:C	1:102:R:LEU:N	1:102:R:LEU:CA	1:102:R:LEU:C	1	93.38
(1,107)	1:101:R:ALA:C	1:102:R:LEU:N	1:102:R:LEU:CA	1:102:R:LEU:C	5	90.46
(1,107)	1:101:R:ALA:C	1:102:R:LEU:N	1:102:R:LEU:CA	1:102:R:LEU:C	3	89.45
(1,208)	1:178:R:LEU:N	1:178:R:LEU:CA	1:178:R:LEU:C	1:179:R:VAL:N	3	87.74