wwPDB NMR Structure Validation Summary Report

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Title	:	Two-state solution NMR structure of Apo Pin1
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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 (1)) were used in the production of this report:

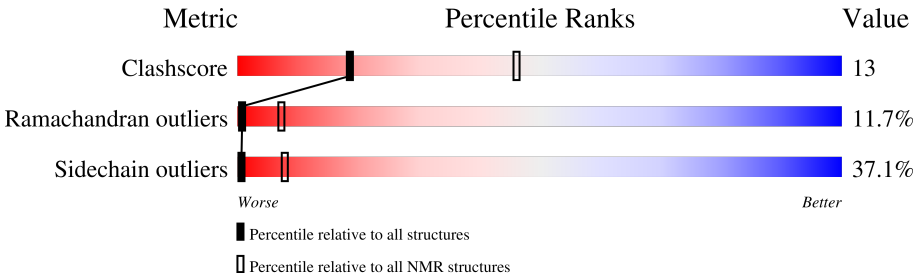
MolProbity	:	4-5-2 with Phenix2.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
BMRB Restraints Analysis	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

1 Overall quality at a glance

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

The overall completeness of chemical shifts assignment is 83%.

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	229148	14424
Ramachandran outliers	224038	12848
Sidechain outliers	223484	12823

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	163	34% 52% · 10%

2 Ensemble composition and analysis

This entry contains 20 models. Model 11 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *target function*.

The following residues are included in the computation of the global validation metrics.

Well-defined (core) protein residues			
Well-defined core	**Residue range (total)**	**Backbone RMSD (Å)**	**Medoid model**
1	A:5-A:39 (35)	1.19	2
2	A:53-A:163 (111)	1.18	11

Ill-defined regions of proteins are excluded from the global statistics.

Ligands and non-protein polymers are included in the analysis.

The models can be grouped into 4 clusters. No single-model clusters were found.

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

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 2519 atoms, of which 1238 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Peptidyl-prolyl cis-trans isomerase NIMA-interacting 1.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	163	2519	786	1238	239	250	6	0

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: Peptidyl-prolyl cis-trans isomerase NIMA-interacting 1

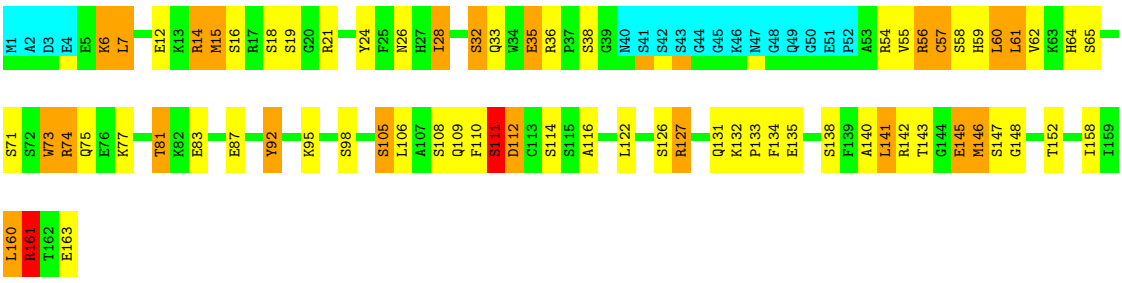
Chain A:

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

The representative model is number 11. Colouring as in section 4.1 above.

• Molecule 1: Peptidyl-prolyl cis-trans isomerase NIMA-interacting 1

Chain A:



5 Refinement protocol and experimental data overview

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

Of the 400 calculated structures, 20 were deposited, based on the following criterion: *structures with the least restraint violations*.

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

Software name	Classification	Version
CYANA	refinement	
CYANA	structure calculation	

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	1801
Number of shifts mapped to atoms	1801
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	83%

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	1167	1141	1141	30±8
All	All	23340	22820	22820	598

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 13.

5 of 336 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:128:GLY:O	1:A:130:MET:N	0.95	1.99	9	3
1:A:28:ILE:HG22	1:A:140:ALA:HB1	0.91	1.41	12	1
1:A:29:THR:HG21	1:A:141:LEU:HD11	0.86	1.47	8	1
1:A:60:LEU:HD13	1:A:158:ILE:HD12	0.80	1.52	20	5
1:A:96:ILE:HD11	1:A:106:LEU:HD13	0.78	1.55	9	3

6.3 Torsion angles

6.3.1 Protein backbone

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all NMR entries. The Analysed column shows the number of residues for which the backbone conformation was analysed and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	145/163 (89%)	91±6 (63±4%)	37±5 (26±4%)	17±3 (12±2%)	1 7
All	All	2900/3260 (89%)	1816 (63%)	744 (26%)	340 (12%)	1 7

5 of 82 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	153	ASP	16
1	A	127	ARG	13
1	A	61	LEU	12
1	A	110	PHE	12
1	A	111	SER	12

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	126/138 (91%)	79±4 (63±3%)	47±4 (37±3%)	1 8
All	All	2520/2760 (91%)	1585 (63%)	935 (37%)	1 8

5 of 113 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	108	SER	20
1	A	105	SER	19
1	A	138	SER	19
1	A	141	LEU	19
1	A	38	SER	18

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 oligosaccharides 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 83% for the well-defined parts and 83% 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	1801
Number of shifts mapped to atoms	1801
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	9

7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	163	-0.21 ± 0.13	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	148	-0.09 ± 0.10	None needed (< 0.5 ppm)
$^{13}C'$	0	—	None (insufficient data)
^{15}N	152	0.12 ± 0.17	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 83%, i.e. 1655 atoms were assigned a chemical shift out of a possible 1995. 0 out of 13 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	578/729 (79%)	295/297 (99%)	146/292 (50%)	137/140 (98%)
Sidechain	935/1105 (85%)	634/709 (89%)	291/335 (87%)	10/61 (16%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	142/161 (88%)	71/81 (88%)	68/73 (93%)	3/7 (43%)
Overall	1655/1995 (83%)	1000/1087 (92%)	505/700 (72%)	150/208 (72%)

7.1.4 Statistically unusual chemical shifts (i)

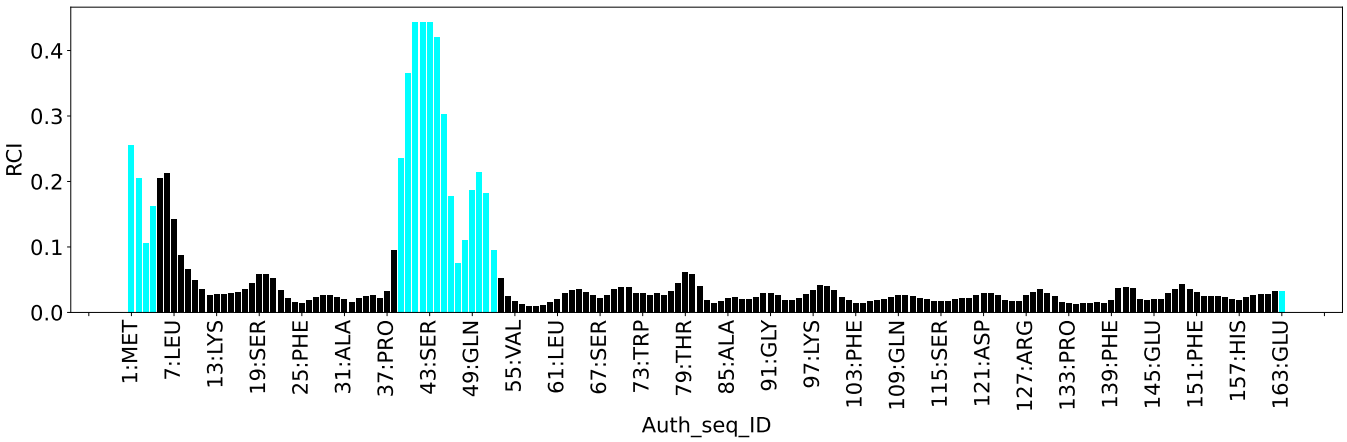
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

List Id	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	26	ASN	HB2	-0.69	1.27 – 4.34	-11.4
1	A	74	ARG	HG3	-0.64	0.15 – 2.94	-7.8
1	A	14	ARG	HB2	0.11	0.52 – 3.08	-6.6
1	A	26	ASN	HD22	4.06	4.69 – 9.61	-6.3
1	A	37	PRO	HG3	-0.04	0.33 – 3.48	-6.2
1	A	74	ARG	HG2	-0.02	0.26 – 2.87	-6.1
1	A	55	VAL	HG21	-0.63	-0.58 – 2.19	-5.2
1	A	55	VAL	HG22	-0.63	-0.58 – 2.19	-5.2
1	A	55	VAL	HG23	-0.63	-0.58 – 2.19	-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
0.0
0.1
0.2
0.3
0.4
1:MET
7:LEU
13:LYS
19:SER
25:PHE
31:ALA
37:PRO
43:SER
49:GLN
55:VAL
61:LEU
67:SER
73:TRP
79:THR
85:ALA
91:GLY
97:LYS
103:PHE
109:GLN
115:SER
121:ASP
127:ARG
133:PRO
139:PHE
145:GLU
151:PHE
157:HIS
163:GLU
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	11609
Intra-residue (|i-j|=0)	2768
Sequential (|i-j|=1)	3004
Medium range (|i-j|>1 and |i-j|<5)	2002
Long range (|i-j|≥5)	3835
Inter-chain	0
Hydrogen bond restraints	0
Disulfide bond restraints	0
Total dihedral-angle restraints	132
Number of unmapped restraints	0
Number of restraints per residue	36.0
Number of long range restraints per residue[1]	11.8

[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)	238.9	0.2
0.2-0.5 (Medium)	538.2	0.5
>0.5 (Large)	7463.5	43.27

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)	3.2	9.9
10.0-20.0 (Medium)	2.7	17.87
>20.0 (Large)	10.2	76.65

9 Distance violation analysis (i)

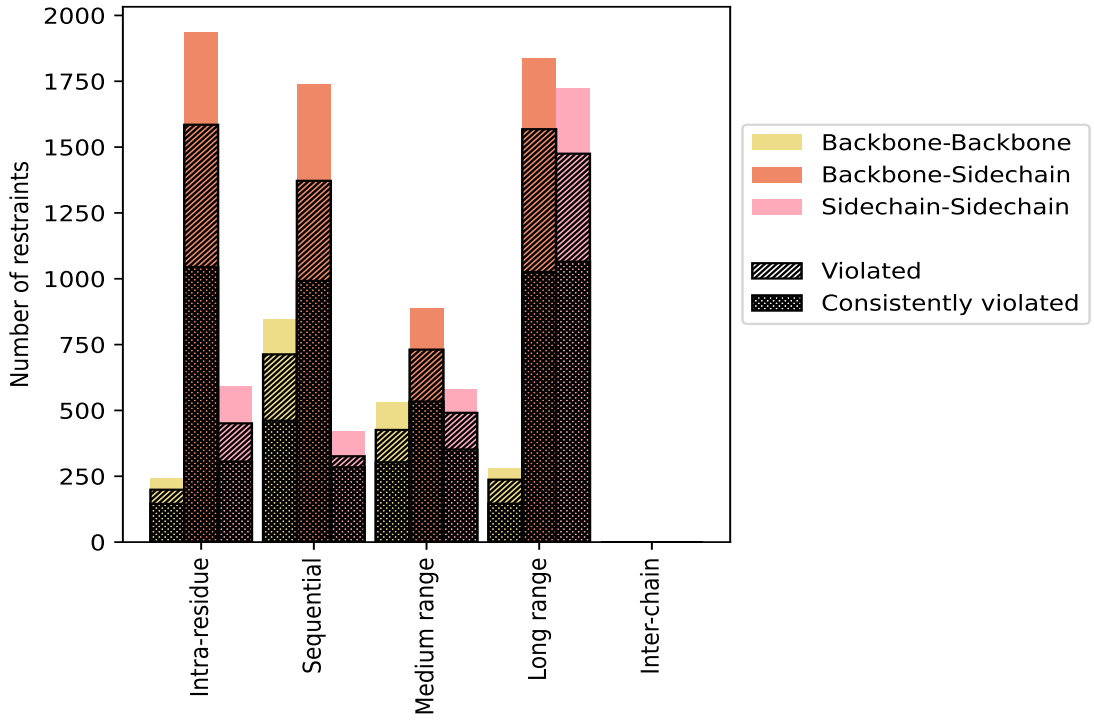
9.1 Summary of distance violations (i)

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)	2768	23.8	2235	80.7	19.3	1496	54.0	12.9
Backbone-Backbone	242	2.1	199	82.2	1.7	145	59.9	1.2
Backbone-Sidechain	1936	16.7	1585	81.9	13.7	1045	54.0	9.0
Sidechain-Sidechain	590	5.1	451	76.4	3.9	306	51.9	2.6
Sequential (|i-j|=1)	3004	25.9	2411	80.3	20.8	1737	57.8	15.0
Backbone-Backbone	846	7.3	713	84.3	6.1	461	54.5	4.0
Backbone-Sidechain	1737	15.0	1372	79.0	11.8	992	57.1	8.5
Sidechain-Sidechain	421	3.6	326	77.4	2.8	284	67.5	2.4
Medium range (|i-j|>1 & |i-j|<5)	2002	17.2	1648	82.3	14.2	1189	59.4	10.2
Backbone-Backbone	532	4.6	426	80.1	3.7	303	57.0	2.6
Backbone-Sidechain	889	7.7	731	82.2	6.3	534	60.1	4.6
Sidechain-Sidechain	581	5.0	491	84.5	4.2	352	60.6	3.0
Long range (|i-j|≥5)	3835	33.0	3280	85.5	28.3	2237	58.3	19.3
Backbone-Backbone	278	2.4	237	85.3	2.0	146	52.5	1.3
Backbone-Sidechain	1835	15.8	1568	85.4	13.5	1026	55.9	8.8
Sidechain-Sidechain	1722	14.8	1475	85.7	12.7	1065	61.8	9.2
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	11609	100.0	9574	82.5	82.5	6659	57.4	57.4
Backbone-Backbone	1898	16.3	1575	83.0	13.6	1055	55.6	9.1
Backbone-Sidechain	6397	55.1	5256	82.2	45.3	3597	56.2	31.0
Sidechain-Sidechain	3314	28.5	2743	82.8	23.6	2007	60.6	17.3

[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	1919	2110	1415	2849	0	8293	3.89	42.83	4.34	3.32
2	1887	2117	1404	2762	0	8170	3.38	23.19	2.34	3.25
3	1893	2123	1387	2808	0	8211	3.75	41.3	3.87	3.25
4	1934	2115	1438	2808	0	8295	3.47	24.75	2.41	3.33
5	1926	2122	1401	2785	0	8234	3.38	23.38	2.31	3.27
6	1901	2125	1403	2846	0	8275	3.87	41.93	4.15	3.32
7	1896	2126	1416	2820	0	8258	3.78	43.27	3.9	3.3
8	1895	2116	1408	2814	0	8233	3.41	24.6	2.41	3.23
9	1898	2104	1446	2810	0	8258	3.44	24.0	2.41	3.28
10	1908	2128	1374	2838	0	8248	3.87	42.96	4.15	3.34

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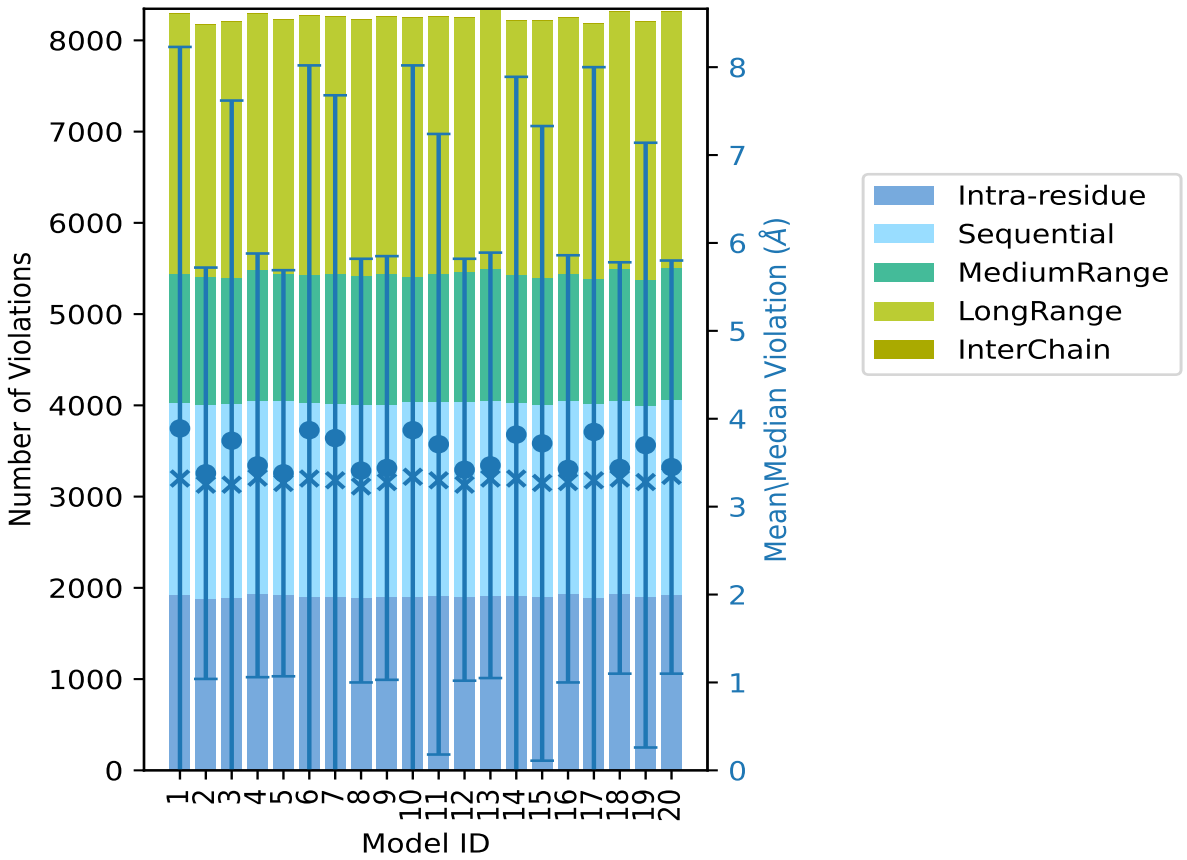
Model ID	Number of violations						Mean (Å)	Max (Å)	SD[6] (Å)	Median (Å)
	IR[1]	SQ[2]	MR[3]	LR[4]	IC[5]	Total				
11	1919	2118	1403	2821	0	8261	3.71	37.58	3.53	3.3
12	1908	2131	1429	2786	0	8254	3.42	25.14	2.4	3.25
13	1915	2134	1447	2850	0	8346	3.47	25.4	2.42	3.32
14	1909	2119	1401	2789	0	8218	3.82	41.31	4.07	3.32
15	1898	2112	1394	2819	0	8223	3.72	39.39	3.61	3.27
16	1941	2105	1400	2801	0	8247	3.43	25.11	2.43	3.28
17	1890	2127	1372	2796	0	8185	3.85	42.75	4.15	3.3
18	1929	2123	1443	2825	0	8320	3.44	23.65	2.34	3.32
19	1904	2088	1384	2832	0	8208	3.7	35.73	3.44	3.28
20	1930	2128	1445	2816	0	8319	3.45	22.41	2.35	3.35

[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

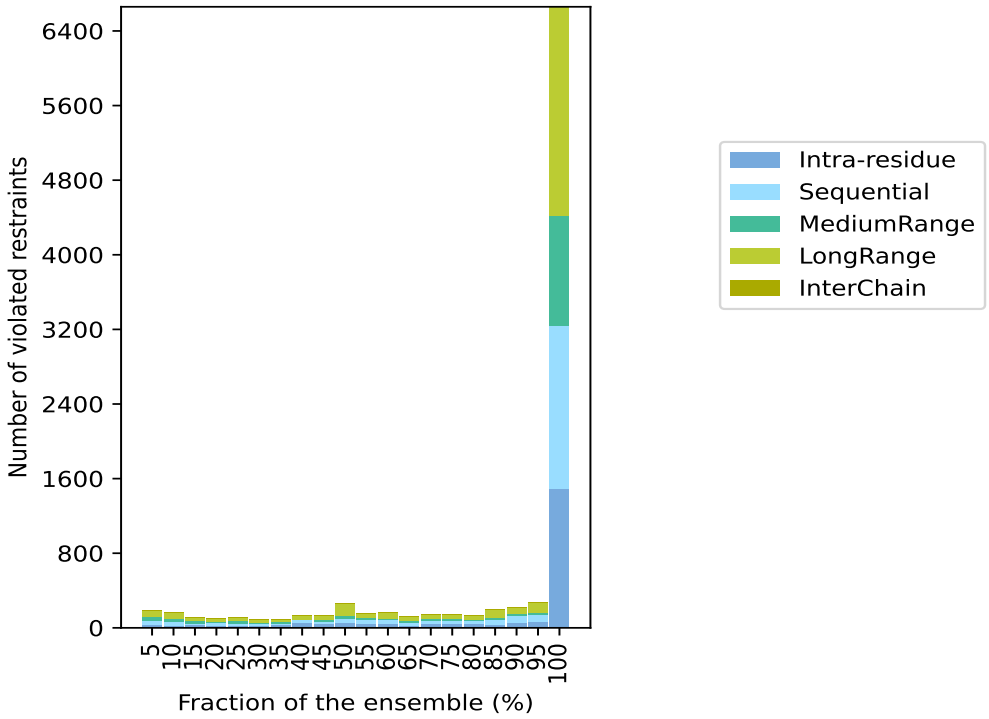
9.3 Distance violation statistics for the ensemble (i)

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, 2035(IR:533, SQ:593, MR:354, LR:555, 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]	%
38	34	51	59	0	182	1	5.0
27	39	33	66	0	165	2	10.0
28	20	26	33	0	107	3	15.0
24	27	16	32	0	99	4	20.0
21	21	30	39	0	111	5	25.0
19	26	14	28	0	87	6	30.0
31	16	16	24	0	87	7	35.0
52	32	5	45	0	134	8	40.0
41	23	25	40	0	129	9	45.0
57	43	33	123	0	256	10	50.0
39	48	18	48	0	153	11	55.0
39	41	20	62	0	162	12	60.0
28	26	22	51	0	127	13	65.0
43	34	24	39	0	140	14	70.0
45	28	23	52	0	148	15	75.0
38	40	16	43	0	137	16	80.0
39	44	28	84	0	195	17	85.0
62	65	28	66	0	221	18	90.0
68	67	31	109	0	275	19	95.0
1496	1737	1189	2237	0	6659	20	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

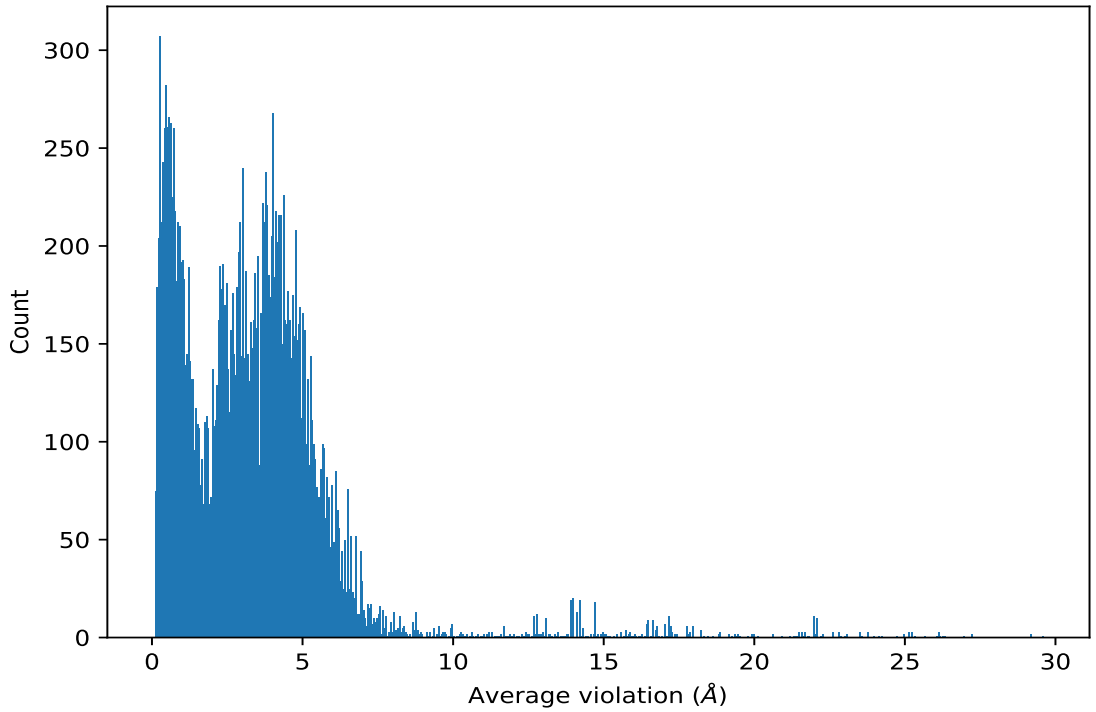
9.3.1 Bar graph : Distance violation statistics for the ensemble



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

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.

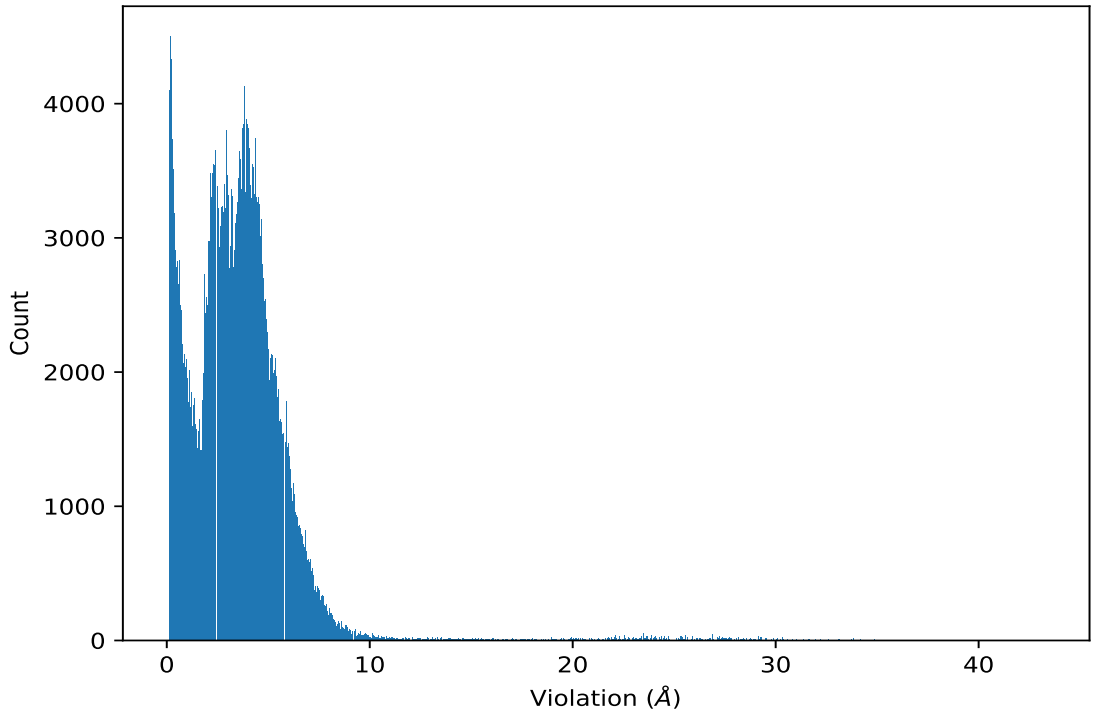
Key	Atom-1	Atom-2	Models[1]	Mean (Å)	SD[1] (Å)	Median (Å)
(1,3462)	1:28:A:ILE:HG12	1:140:A:ALA:H	20	22.25	15.13	21.02
(1,7252)	1:28:A:ILE:HG12	1:140:A:ALA:H	20	22.25	15.13	21.02
(1,8518)	1:30:A:ASN:HD22	1:149:A:PRO:HB2	20	22.04	16.33	18.76
(1,3466)	1:28:A:ILE:HG12	1:141:A:LEU:HG	20	21.97	16.72	21.17
(1,7256)	1:28:A:ILE:HG12	1:141:A:LEU:HG	20	21.97	16.72	21.17
(1,8517)	1:30:A:ASN:HD22	1:149:A:PRO:HA	20	21.62	15.22	17.93
(4,149)	1:98:A:SER:CB	1:10:A:GLY:H	20	20.9	12.56	18.42
(4,143)	1:98:A:SER:CB	1:2:A:ALA:H	20	19.5	10.25	16.81
(4,103)	1:90:A:ASN:CB	1:2:A:ALA:H	20	19.43	6.68	16.92
(1,8645)	1:30:A:ASN:HD22	1:149:A:PRO:HD2	20	19.38	16.05	16.6

[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)
(1,7256)	1:28:A:ILE:HG12	1:141:A:LEU:HG	7	43.27
(1,3466)	1:28:A:ILE:HG12	1:141:A:LEU:HG	7	43.27
(1,8518)	1:30:A:ASN:HD22	1:149:A:PRO:HB2	10	42.96
(4,166)	1:98:A:SER:CB	1:30:A:ASN:H	1	42.83
(1,8518)	1:30:A:ASN:HD22	1:149:A:PRO:HB2	17	42.75
(4,167)	1:98:A:SER:CB	1:31:A:ALA:H	1	42.69
(1,7252)	1:28:A:ILE:HG12	1:140:A:ALA:H	7	42.65
(1,3462)	1:28:A:ILE:HG12	1:140:A:ALA:H	7	42.65
(4,165)	1:98:A:SER:CB	1:29:A:THR:H	1	42.18
(1,8518)	1:30:A:ASN:HD22	1:149:A:PRO:HB2	6	41.93

10 Dihedral-angle violation analysis

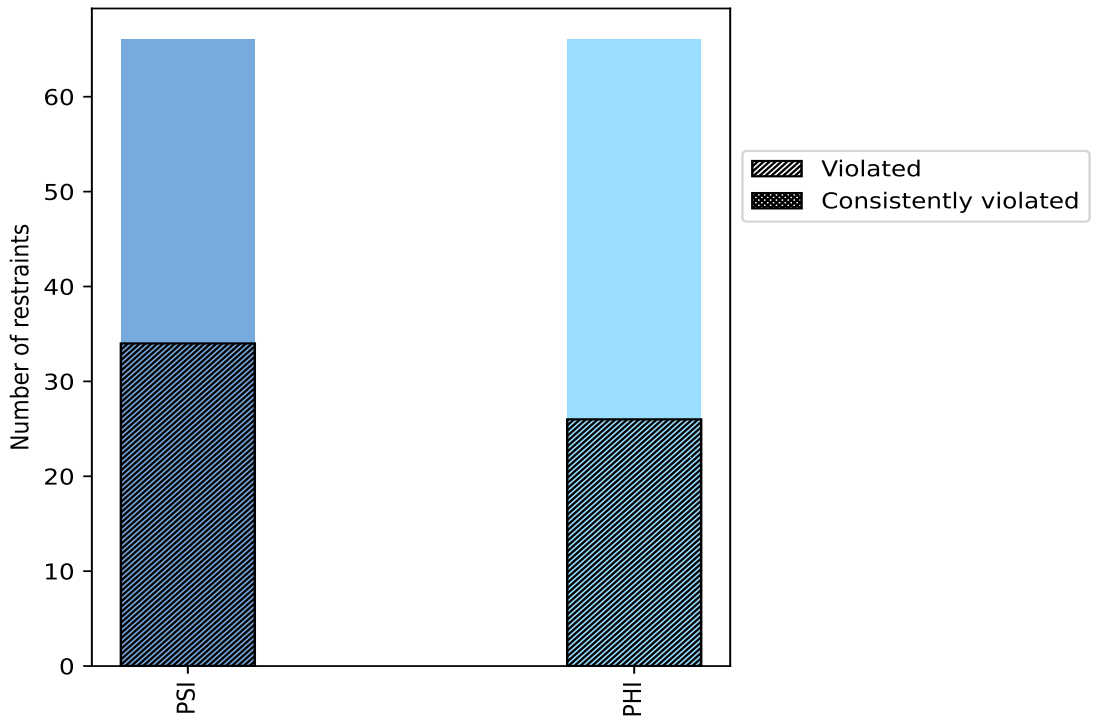
10.1 Summary of dihedral-angle violations

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]
PSI	66	50.0	34	51.5	25.8	0	0.0	0.0
PHI	66	50.0	26	39.4	19.7	0	0.0	0.0
Total	132	100.0	60	45.5	45.5	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



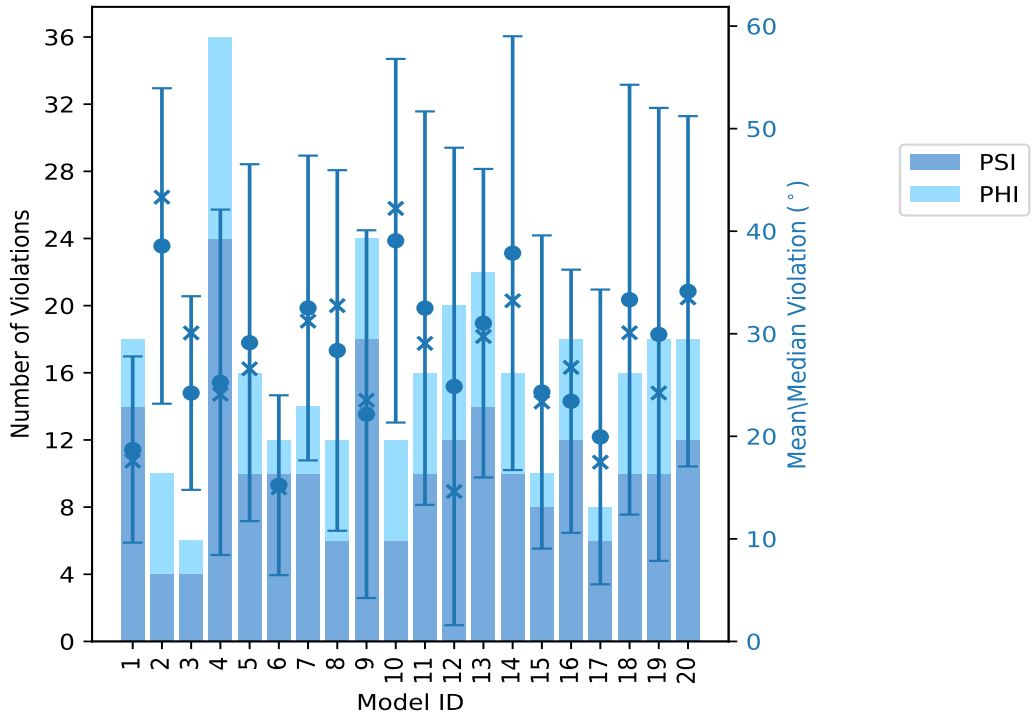
Violated and consistently violated restraints are shown using different hatch patterns in their respective categories

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 (°)
	PSI	PHI	Total				
1	14	4	18	18.71	31.93	9.08	17.59
2	4	6	10	38.56	59.04	15.38	43.32
3	4	2	6	24.22	31.69	9.44	30.08
4	24	12	36	25.27	63.45	16.84	24.1
5	10	6	16	29.13	62.53	17.4	26.58
6	10	2	12	15.23	30.25	8.77	14.97
7	10	4	14	32.51	57.06	14.86	31.23
8	6	6	12	28.37	55.14	17.58	32.74
9	18	6	24	22.16	69.01	17.93	23.52
10	6	6	12	39.07	57.52	17.73	42.22
11	10	6	16	32.5	62.16	19.18	29.06
12	12	8	20	24.86	76.65	23.28	14.62
13	14	8	22	31.03	56.07	15.04	29.73
14	10	6	16	37.86	72.97	21.15	33.22
15	8	2	10	24.32	52.3	15.27	23.34
16	12	6	18	23.42	46.58	12.83	26.72
17	6	2	8	19.94	41.54	14.37	17.48
18	10	6	16	33.32	74.46	20.96	30.1
19	10	8	18	29.94	71.74	22.08	24.23
20	12	6	18	34.14	57.67	17.08	33.49

10.2.1 Bar graph : Dihedral 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

10.3 Dihedral-angle violation statistics for the ensemble

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	
PSI	PHI	Total	Count[1]	%
8	6	14	1	5.0
4	8	12	2	10.0
0	2	2	3	15.0
4	0	4	4	20.0
0	2	2	5	25.0
0	0	0	6	30.0
4	0	4	7	35.0
4	4	8	8	40.0
2	2	4	9	45.0
4	0	4	10	50.0
0	0	0	11	55.0

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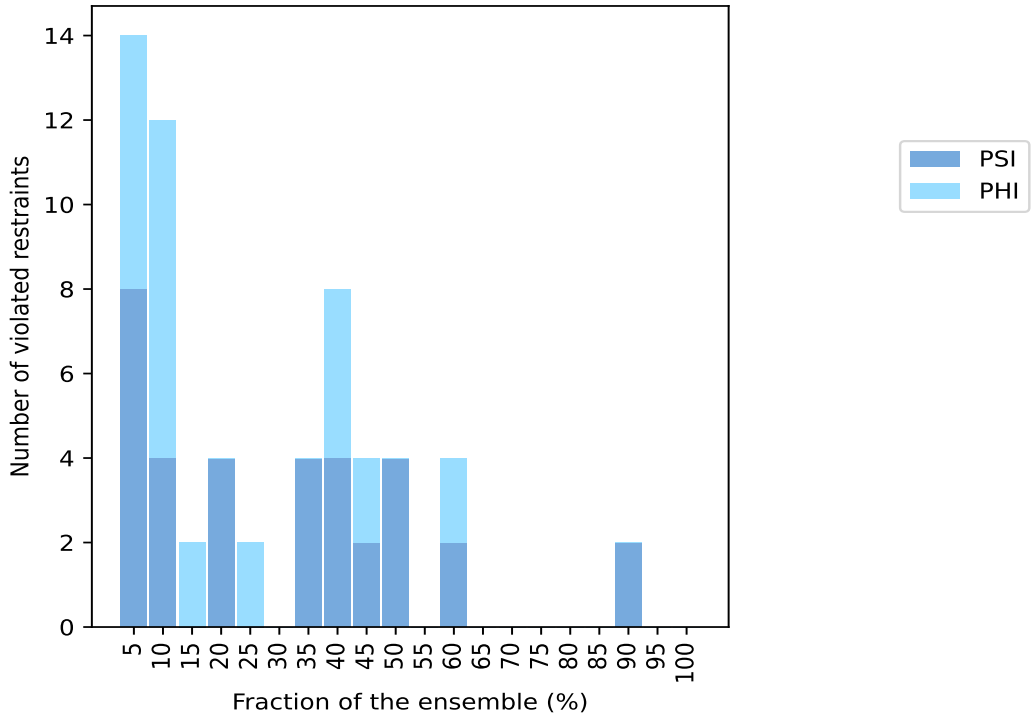
Number of violated restraints			Fraction of the ensemble	
PSI	PHI	Total	Count[1]	%
2	2	4	12	60.0
0	0	0	13	65.0
0	0	0	14	70.0
0	0	0	15	75.0
0	0	0	16	80.0
0	0	0	17	85.0
2	0	2	18	90.0
0	0	0	19	95.0
0	0	0	20	100.0

[1] Number of models with violations

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

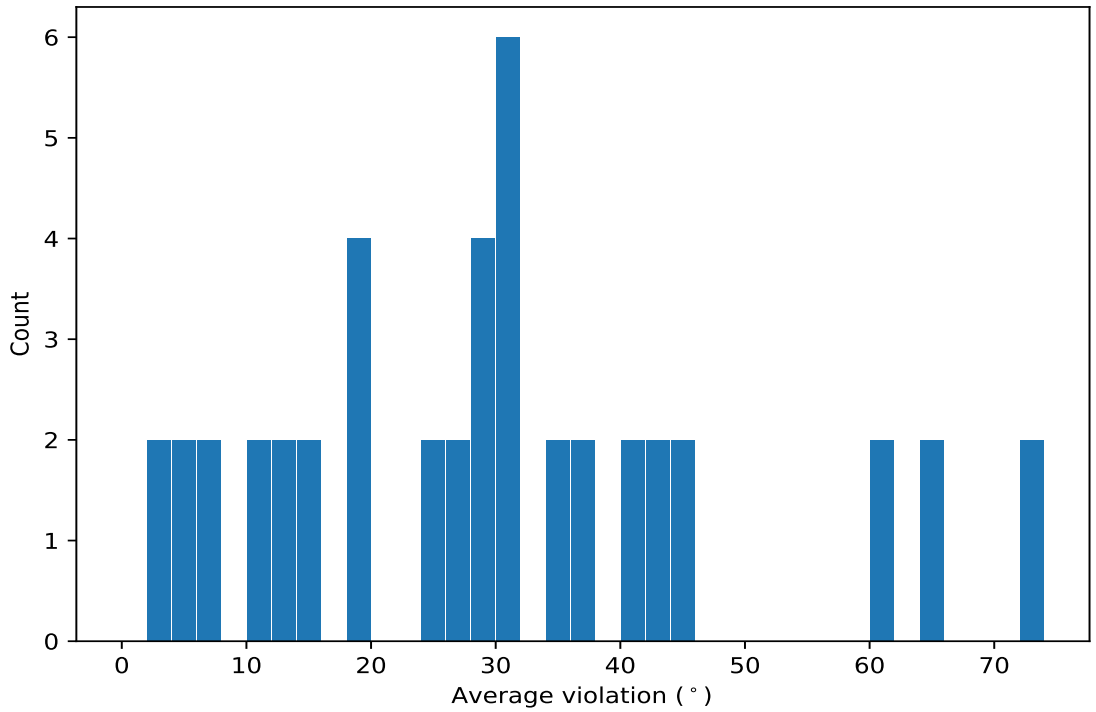


10.4 Most violated dihedral-angle restraints in the ensemble

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.

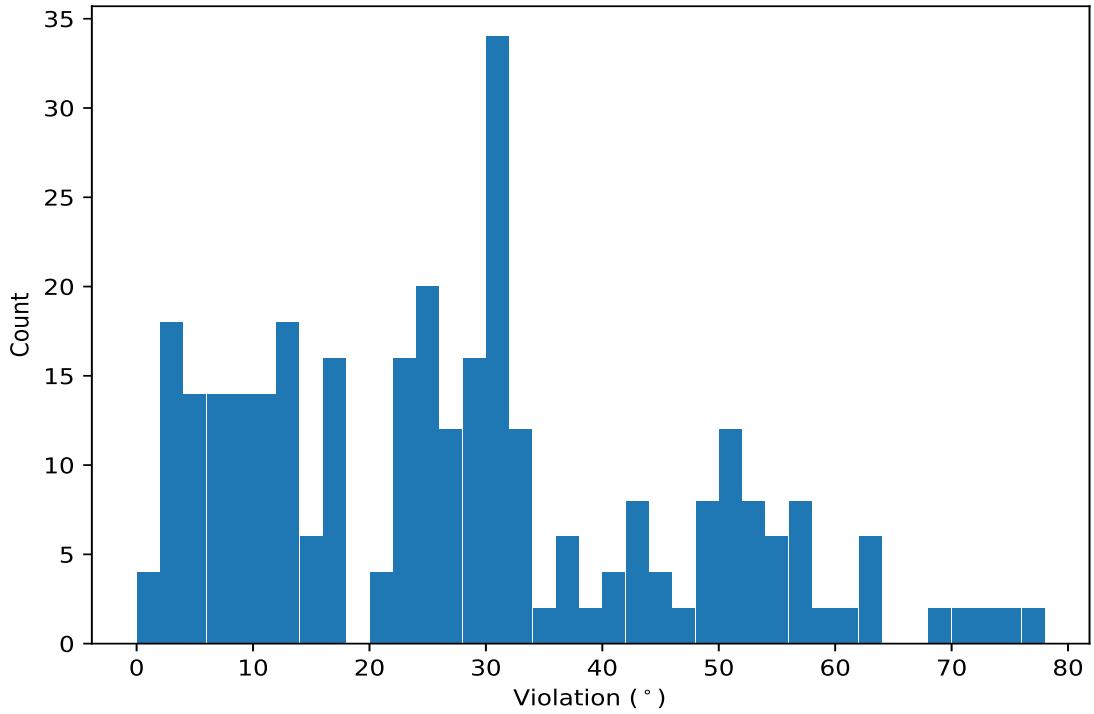
Key	Atom-1	Atom-2	Atom-3	Atom-4	Models[1]	Mean	SD[2]	Median
(1,66)	1:139:A:PHE:N	1:139:A:PHE:CA	1:139:A:PHE:C	1:140:A:ALA:N	18	12.83	5.57	12.15
(2,66)	1:139:A:PHE:N	1:139:A:PHE:CA	1:139:A:PHE:C	1:140:A:ALA:N	18	12.83	5.57	12.15
(1,28)	1:95:A:LYS:N	1:95:A:LYS:CA	1:95:A:LYS:C	1:96:A:ILE:N	12	30.69	8.89	31.83
(2,28)	1:95:A:LYS:N	1:95:A:LYS:CA	1:95:A:LYS:C	1:96:A:ILE:N	12	30.69	8.89	31.83
(1,29)	1:95:A:LYS:C	1:96:A:ILE:N	1:96:A:ILE:CA	1:96:A:ILE:C	12	28.48	7.49	30.56
(2,29)	1:95:A:LYS:C	1:96:A:ILE:N	1:96:A:ILE:CA	1:96:A:ILE:C	12	28.48	7.49	30.56
(1,50)	1:116:A:ALA:N	1:116:A:ALA:CA	1:116:A:ALA:C	1:117:A:LYS:N	10	30.05	10.07	27.54
(2,50)	1:116:A:ALA:N	1:116:A:ALA:CA	1:116:A:ALA:C	1:117:A:LYS:N	10	30.05	10.07	27.54
(1,44)	1:108:A:SER:N	1:108:A:SER:CA	1:108:A:SER:C	1:109:A:GLN:N	10	24.94	9.13	24.8
(2,44)	1:108:A:SER:N	1:108:A:SER:CA	1:108:A:SER:C	1:109:A:GLN:N	10	24.94	9.13	24.8

[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 violations for 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 (°)
(2,1)	1:81:A:THR:C	1:82:A:LYS:N	1:82:A:LYS:CA	1:82:A:LYS:C	12	76.65
(1,1)	1:81:A:THR:C	1:82:A:LYS:N	1:82:A:LYS:CA	1:82:A:LYS:C	12	76.65
(2,1)	1:81:A:THR:C	1:82:A:LYS:N	1:82:A:LYS:CA	1:82:A:LYS:C	18	74.46
(1,1)	1:81:A:THR:C	1:82:A:LYS:N	1:82:A:LYS:CA	1:82:A:LYS:C	18	74.46
(2,53)	1:131:A:GLN:C	1:132:A:LYS:N	1:132:A:LYS:CA	1:132:A:LYS:C	14	72.97
(1,53)	1:131:A:GLN:C	1:132:A:LYS:N	1:132:A:LYS:CA	1:132:A:LYS:C	14	72.97
(2,53)	1:131:A:GLN:C	1:132:A:LYS:N	1:132:A:LYS:CA	1:132:A:LYS:C	19	71.74
(1,53)	1:131:A:GLN:C	1:132:A:LYS:N	1:132:A:LYS:CA	1:132:A:LYS:C	19	71.74
(2,30)	1:96:A:ILE:N	1:96:A:ILE:CA	1:96:A:ILE:C	1:97:A:LYS:N	9	69.01
(1,30)	1:96:A:ILE:N	1:96:A:ILE:CA	1:96:A:ILE:C	1:97:A:LYS:N	9	69.01