wwPDB NMR Structure Validation Summary Report (i)

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PDB ID	:	2N3U
BMRB ID	:	25657
Title	:	Solution structure of the Rpn1 T1 site engaging two monoubiquitin molecules
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Deposited on	:	2015-06-10

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:

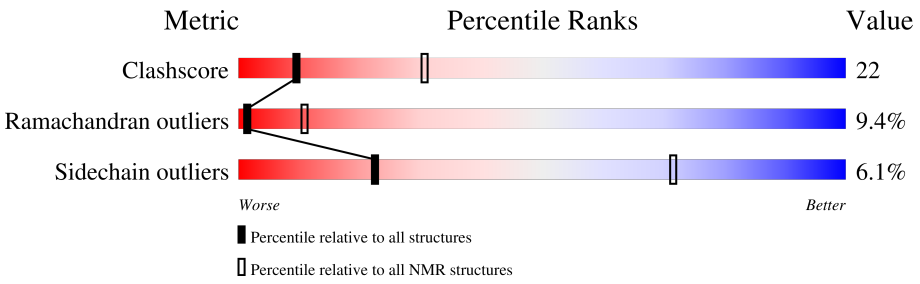
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
BMRB Restraints Analysis	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal 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 28%.

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	131	57% 31% • • 7%
2	B	76	70% 24% 5% •
2	C	76	64% 26% • 5%

2 Ensemble composition and analysis (i)

This entry contains 10 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	A:486-A:607, B:1-B:76, C:1-C:72 (270)	1.24	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 2 single-model clusters were found.

Cluster number	Models
1	1, 2, 3, 7, 8, 10
2	6, 9
Single-model clusters	4; 5

3 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 4383 atoms, of which 2225 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called 26S proteasome regulatory subunit RPN1.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	131	1921	606	967	150	192	6	0

- Molecule 2 is a protein called Ubiquitin-60S ribosomal protein L40.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
2	B	76	1231	378	629	105	118	1	0
2	C	76	1231	378	629	105	118	1	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: 26S proteasome regulatory subunit RPN1

Chain A: 57% 31% • • 7%

D482 T483 K484 I485 L493 F497 L506 G507 L508 L509 L510 P511 S515 T516 D517 L518 P519 L528 A529 L530 A531 V535 G536 T537 I542 T543 T544 S545 I546 M547 D548 N549 E552 R553 T554 A555 I556 E557 L558 K559 T560 D561 W562 V563 R564 G571 I572 L573 Y574 M575 G576

Q577 Q580 D583 T587 A590 I591 E592 H593 P594 Y608 T609 G610 T611 G612

• Molecule 2: Ubiquitin-60S ribosomal protein L40

Chain B: 70% 24% 5% •

M1 V17 E18 P19 S20 D21 N25 G35 P38 D39 Q40 Q41 R42 F45 A46 G47 D52 G53 R54 H68 L71 R72 L73 R74 G75 G76

• Molecule 2: Ubiquitin-60S ribosomal protein L40

Chain C: 64% 26% • 5%

M1 T7 L8 T9 G10 K11 T12 I13 V17 E18 P19 S20 D21 N25 G35 P38 D39 Q40 Q41 R42 L43 I44 D52 G53 R54 V70 L71 R72 L73 R74 G75 G76

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.

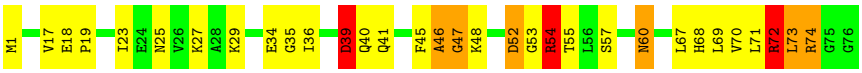
• Molecule 1: 26S proteasome regulatory subunit RPN1

Chain A: 57% 28% 7% • 7%

D482 T483 K484 I485 L493 F497 L506 G507 L508 L509 L510 P511 I512 A513 A514 S515 T516 D517 L518 P519 I520 L528 A529 L530 A531 V535 G536 T537 G540 D541 I542 I546 M547 D548 N549 R553 T554 A555 I556 E557 L558 K559 T560 D561 W562 V563 R564 L568 M575

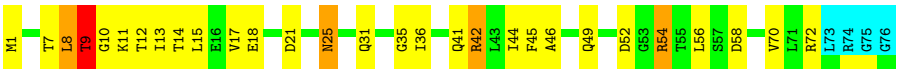
• Molecule 2: Ubiquitin-60S ribosomal protein L40

Chain B:



• Molecule 2: Ubiquitin-60S ribosomal protein L40

Chain C:



5 Refinement protocol and experimental data overview (i)

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

Of the 50 calculated structures, 10 were deposited, based on the following criterion: *?*.

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

Software name	Classification	Version
X-PLOR NIH	refinement	
X-PLOR NIH	structure solution	

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	1035
Number of shifts mapped to atoms	1035
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	28%

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	0.59±0.01	0±0/899 (0.0± 0.0%)	0.75±0.02	0±0/1226 (0.0± 0.0%)
2	B	0.63±0.00	0±0/608 (0.0± 0.0%)	0.74±0.01	0±0/816 (0.0± 0.0%)
2	C	0.63±0.00	0±0/581 (0.0± 0.0%)	0.74±0.01	0±0/784 (0.0± 0.0%)
All	All	0.61	1/20880 (0.0%)	0.74	2/28260 (0.0%)

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	1.8±0.4
2	B	0.0±0.0	3.3±0.6
2	C	0.0±0.0	2.5±0.7
All	All	0	76

All unique bond outliers are listed below.

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)	Models	
								Worst	Total
1	A	556	ILE	C-O	-5.58	1.12	1.23	1	1

All 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	A	553	ARG	C-N-CA	5.81	136.22	121.70	4	1
2	B	21	ASP	N-CA-C	-5.00	97.49	111.00	6	1

There are no chirality outliers.

5 of 9 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	564	ARG	Sidechain	10
2	B	42	ARG	Sidechain	9
2	B	54	ARG	Sidechain	9
2	C	54	ARG	Sidechain	9
2	B	74	ARG	Sidechain	8

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	887	901	901	53±7
2	B	602	629	629	25±6
2	C	574	599	599	20±4
All	All	20630	21290	21290	937

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 22.

5 of 439 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
2:C:7:THR:HG23	2:C:11:LYS:O	0.89	1.68	1	7
1:A:553:ARG:O	1:A:554:THR:C	0.86	2.13	2	6
2:C:44:ILE:HD12	2:C:70:VAL:HG21	0.83	1.49	3	10
2:B:15:LEU:HD22	2:B:15:LEU:N	0.82	1.90	10	1
1:A:554:THR:C	1:A:556:ILE:H	0.81	1.79	3	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	A	122/131 (93%)	74±5 (61±4%)	34±5 (28±4%)	14±4 (12±3%)	1 7
2	B	74/76 (97%)	57±2 (77±2%)	11±2 (15±2%)	6±1 (8±2%)	2 13
2	C	71/76 (93%)	56±3 (79±4%)	10±2 (15±3%)	4±2 (6±2%)	3 19
All	All	2670/2830 (94%)	1869 (70%)	551 (21%)	250 (9%)	1 11

5 of 73 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	555	ALA	10
1	A	592	GLU	10
2	B	35	GLY	10
2	B	39	ASP	10
2	B	54	ARG	10

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	95/102 (93%)	88±2 (93±2%)	7±2 (7±2%)	19 68
2	B	68/68 (100%)	64±1 (94±2%)	4±1 (6±2%)	25 74
2	C	66/68 (97%)	62±1 (95±2%)	4±1 (5±2%)	25 74
All	All	2290/2380 (96%)	2150 (94%)	140 (6%)	22 71

5 of 49 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)
2	B	52	ASP	10
2	C	52	ASP	10
1	A	554	THR	7
2	B	1	MET	7
1	A	546	ILE	7

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 28% for the well-defined parts and 27% 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	1035
Number of shifts mapped to atoms	1035
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	0

The following errors were found when reading this chemical shift list.

- Chemical shift has been reported more than once. All 1 occurrences are reported below.

List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	573	LEU	HD11	0.970	0.000	.

7.1.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	96	-0.46 ± 0.21	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	92	0.23 ± 0.10	None needed (< 0.5 ppm)
$^{13}C'$	0	—	None (insufficient data)
^{15}N	63	0.80 ± 0.53	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 28%, i.e. 1016 atoms were assigned a chemical shift out of a possible 3655. 0 out of 50 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	322/1352 (24%)	164/551 (30%)	95/540 (18%)	63/261 (24%)
Sidechain	674/2156 (31%)	470/1413 (33%)	204/679 (30%)	0/64 (0%)
Aromatic	20/147 (14%)	20/74 (27%)	0/68 (0%)	0/5 (0%)
Overall	1016/3655 (28%)	654/2038 (32%)	299/1287 (23%)	63/330 (19%)

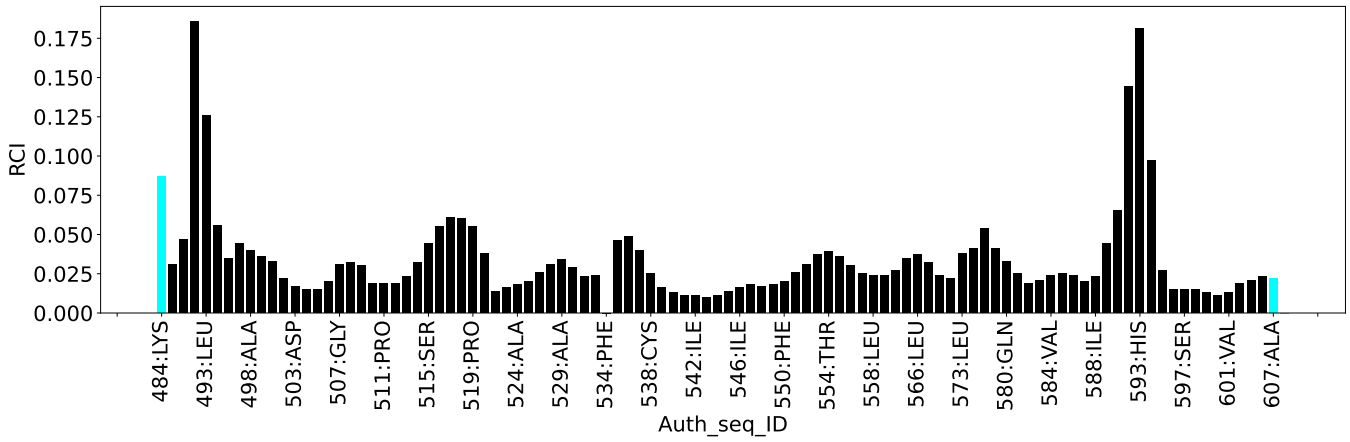
7.1.4 Statistically unusual chemical shifts (i)

There are no statistically unusual chemical shifts.

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:



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	6379
Intra-residue (|i-j|=0)	1692
Sequential (|i-j|=1)	980
Medium range (|i-j|>1 and |i-j|<5)	1029
Long range (|i-j|≥5)	2381
Inter-chain	125
Hydrogen bond restraints	172
Disulfide bond restraints	0
Total dihedral-angle restraints	249
Number of unmapped restraints	0
Number of restraints per residue	23.4
Number of long range restraints per residue[1]	8.5

[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)	3.2	0.2
0.2-0.5 (Medium)	2.8	0.5
>0.5 (Large)	8.2	2.42

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)	3.7	7.7
10.0-20.0 (Medium)	None	None
>20.0 (Large)	0.4	55.8

9 Distance violation analysis (i)

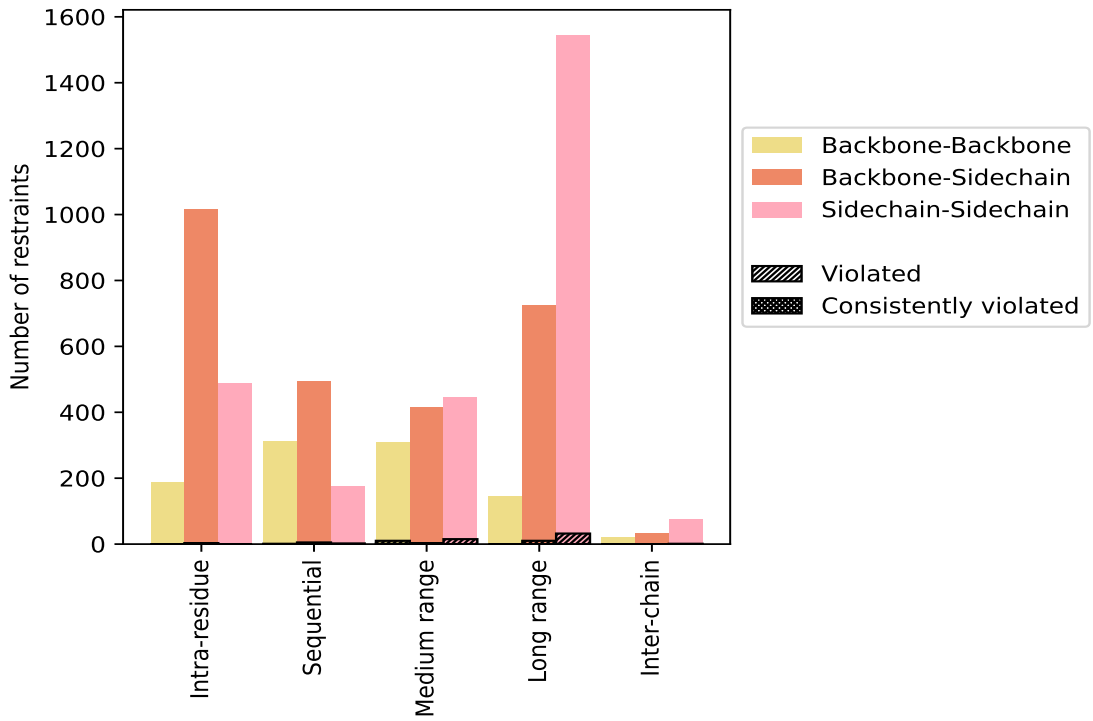
9.1 Summary of distance violations (i)

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)	1692	26.5	3	0.2	0.0	0	0.0	0.0
Backbone-Backbone	188	2.9	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	1016	15.9	3	0.3	0.0	0	0.0	0.0
Sidechain-Sidechain	488	7.7	0	0.0	0.0	0	0.0	0.0
Sequential (|i-j|=1)	980	15.4	8	0.8	0.1	0	0.0	0.0
Backbone-Backbone	311	4.9	1	0.3	0.0	0	0.0	0.0
Backbone-Sidechain	495	7.8	5	1.0	0.1	0	0.0	0.0
Sidechain-Sidechain	174	2.7	2	1.1	0.0	0	0.0	0.0
Medium range (|i-j|>1 & |i-j|<5)	1029	16.1	26	2.5	0.4	1	0.1	0.0
Backbone-Backbone	168	2.6	8	4.8	0.1	1	0.6	0.0
Backbone-Sidechain	416	6.5	3	0.7	0.0	0	0.0	0.0
Sidechain-Sidechain	445	7.0	15	3.4	0.2	0	0.0	0.0
Long range (|i-j|≥5)	2381	37.3	42	1.8	0.7	0	0.0	0.0
Backbone-Backbone	112	1.8	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	725	11.4	10	1.4	0.2	0	0.0	0.0
Sidechain-Sidechain	1544	24.2	32	2.1	0.5	0	0.0	0.0
Inter-chain	125	2.0	1	0.8	0.0	0	0.0	0.0
Backbone-Backbone	19	0.3	0	0.0	0.0	0	0.0	0.0
Backbone-Sidechain	31	0.5	0	0.0	0.0	0	0.0	0.0
Sidechain-Sidechain	75	1.2	1	1.3	0.0	0	0.0	0.0
Hydrogen bond	172	2.7	2	1.2	0.0	0	0.0	0.0
Disulfide bond	0	0.0	0	0.0	0.0	0	0.0	0.0
Total	6379	100.0	82	1.3	1.3	1	0.0	0.0
Backbone-Backbone	970	15.2	11	1.1	0.2	1	0.1	0.0
Backbone-Sidechain	2683	42.1	21	0.8	0.3	0	0.0	0.0
Sidechain-Sidechain	2726	42.7	50	1.8	0.8	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 (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)

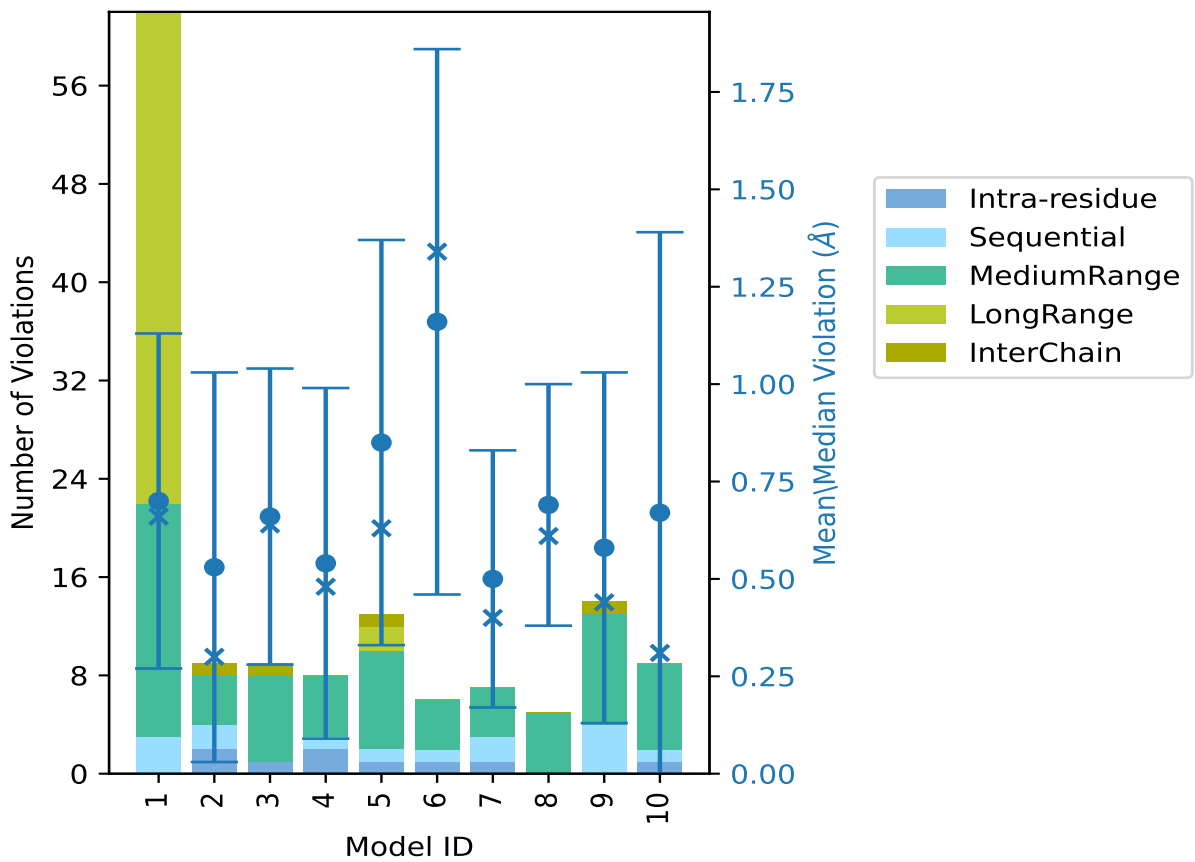
The following table provides the distance violation statistics for each model in the ensemble. Violations less than 0.1 Å are not included in the statistics.

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	0	3	19	40	0	62	0.7	1.72	0.43	0.66
2	2	2	4	0	1	9	0.53	1.74	0.5	0.3
3	1	0	7	0	1	9	0.66	1.29	0.38	0.64
4	2	1	5	0	0	8	0.54	1.6	0.45	0.48
5	1	1	8	2	1	13	0.85	1.73	0.52	0.63
6	1	1	4	0	0	6	1.16	2.19	0.7	1.34
7	1	2	4	0	0	7	0.5	1.14	0.33	0.4
8	0	0	5	0	0	5	0.69	1.26	0.31	0.61
9	0	4	9	0	1	14	0.58	1.48	0.45	0.44
10	1	1	7	0	0	9	0.67	2.42	0.72	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, 6127(IR:1689, SQ:972, MR:1003, LR:2339, IC:124) 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]	%
1	5	19	42	0	67	1	10.0
1	2	1	0	0	4	2	20.0
0	0	2	0	0	2	3	30.0
0	0	1	0	1	2	4	40.0

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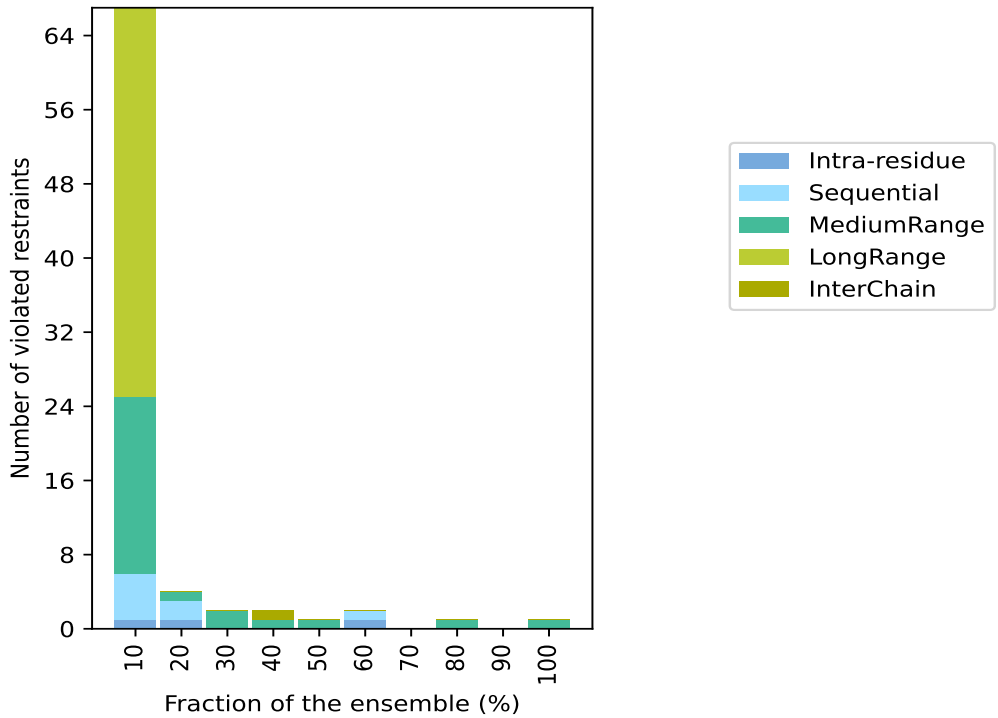
Number of violated restraints						Fraction of the ensemble	
IR[1]	SQ[2]	MR[3]	LR[4]	IC[5]	Total	Count[6]	%
0	0	1	0	0	1	5	50.0
1	1	0	0	0	2	6	60.0
0	0	0	0	0	0	7	70.0
0	0	1	0	0	1	8	80.0
0	0	0	0	0	0	9	90.0
0	0	1	0	0	1	10	100.0

[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

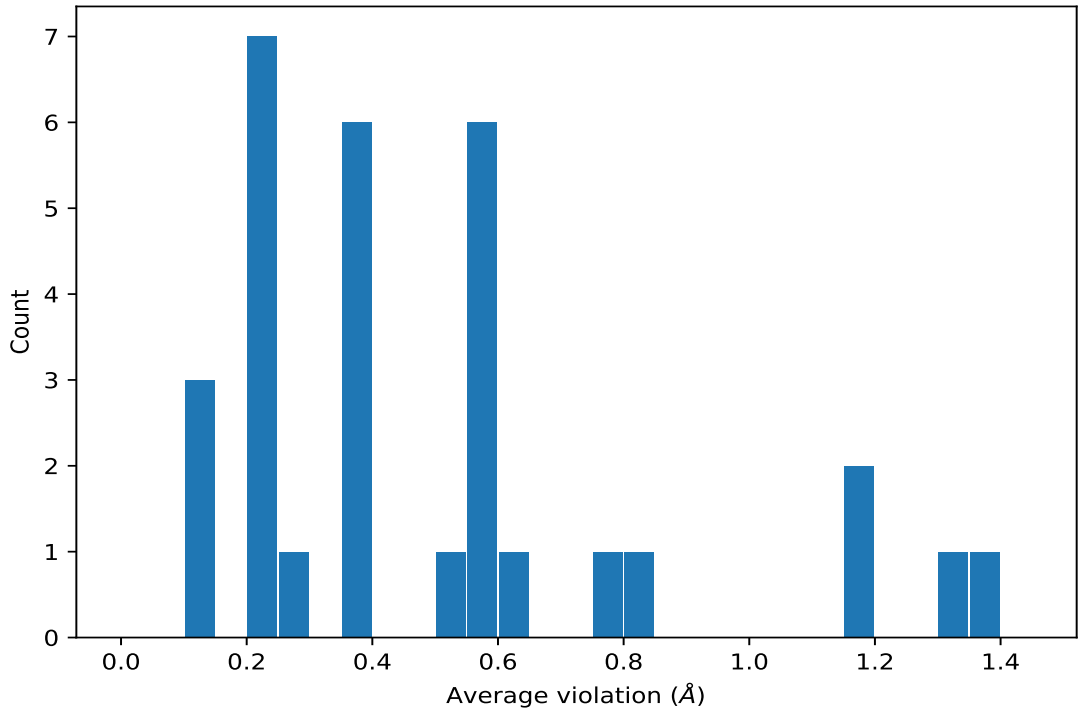
9.3.1 Bar graph : Distance violation statistics for the ensemble (i)



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)
(1,500)	1:A:573:LEU:H	1:A:575:MET:H	10	1.31	0.35	1.28
(2,4)	1:A:484:LYS:O	1:A:488:ALA:N	9	0.62	0.23	0.68
(2,3)	1:A:484:LYS:O	1:A:488:ALA:H	9	0.52	0.24	0.55
(1,256)	1:A:515:SER:HA	1:A:518:LEU:H	8	1.39	0.58	1.24
(1,414)	1:A:547:MET:HE1	1:A:548:ASP:H	6	0.38	0.14	0.38
(1,414)	1:A:547:MET:HE2	1:A:548:ASP:H	6	0.38	0.14	0.38
(1,414)	1:A:547:MET:HE3	1:A:548:ASP:H	6	0.38	0.14	0.38
(1,407)	1:A:547:MET:HE1	1:A:547:MET:H	6	0.14	0.02	0.13
(1,407)	1:A:547:MET:HE2	1:A:547:MET:H	6	0.14	0.02	0.13
(1,407)	1:A:547:MET:HE3	1:A:547:MET:H	6	0.14	0.02	0.13
(1,122)	1:A:503:ASP:H	1:A:506:LEU:H	5	0.23	0.08	0.21
(1,75)	1:A:548:ASP:OD1	2:B:42:ARG:NH2	4	1.16	0.46	1.15
(1,75)	1:A:548:ASP:OD2	2:B:42:ARG:NH2	4	1.16	0.46	1.15
(1,1119)	1:A:554:THR:HB	1:A:556:ILE:HG21	4	0.57	0.3	0.61
(1,1119)	1:A:554:THR:HB	1:A:556:ILE:HG22	4	0.57	0.3	0.61
(1,1119)	1:A:554:THR:HB	1:A:556:ILE:HG23	4	0.57	0.3	0.61

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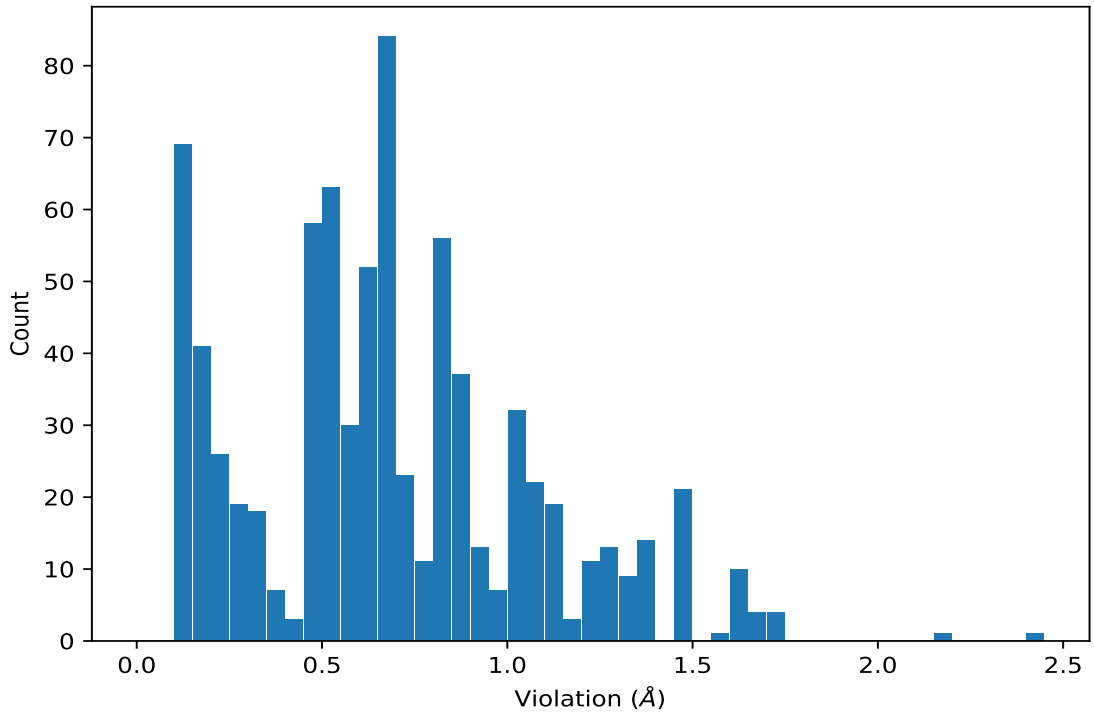
Key	Atom-1	Atom-2	Models[1]	Mean (Å)	SD[1] (Å)	Median (Å)
(1,263)	1:A:516:THR:HA	1:A:518:LEU:H	3	0.82	0.41	0.63

[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)
(1,256)	1:A:515:SER:HA	1:A:518:LEU:H	10	2.42
(1,256)	1:A:515:SER:HA	1:A:518:LEU:H	6	2.19
(1,75)	1:A:548:ASP:OD1	2:B:42:ARG:NH2	2	1.74
(1,75)	1:A:548:ASP:OD2	2:B:42:ARG:NH2	2	1.74

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Key	Atom-1	Atom-2	Model ID	Violation (Å)
(1,500)	1:A:573:LEU:H	1:A:575:MET:H	5	1.73
(1,500)	1:A:573:LEU:H	1:A:575:MET:H	1	1.72
(1,1242)	1:A:579:GLU:HG2	1:A:608:TYR:HE1	5	1.69
(1,1242)	1:A:579:GLU:HG2	1:A:608:TYR:HE2	5	1.69
(1,1242)	1:A:579:GLU:HG3	1:A:608:TYR:HE1	5	1.69
(1,1242)	1:A:579:GLU:HG3	1:A:608:TYR:HE2	5	1.69
(1,1432)	2:B:1:MET:HE1	2:B:3:ILE:HD11	1	1.61
(1,1432)	2:B:1:MET:HE1	2:B:3:ILE:HD12	1	1.61
(1,1432)	2:B:1:MET:HE1	2:B:3:ILE:HD13	1	1.61
(1,1432)	2:B:1:MET:HE2	2:B:3:ILE:HD11	1	1.61
(1,1432)	2:B:1:MET:HE2	2:B:3:ILE:HD12	1	1.61
(1,1432)	2:B:1:MET:HE2	2:B:3:ILE:HD13	1	1.61
(1,1432)	2:B:1:MET:HE3	2:B:3:ILE:HD11	1	1.61
(1,1432)	2:B:1:MET:HE3	2:B:3:ILE:HD12	1	1.61
(1,1432)	2:B:1:MET:HE3	2:B:3:ILE:HD13	1	1.61
(1,500)	1:A:573:LEU:H	1:A:575:MET:H	4	1.6
(1,500)	1:A:573:LEU:H	1:A:575:MET:H	6	1.59
(1,3698)	2:C:1:MET:HE1	2:C:3:ILE:HD11	1	1.49

10 Dihedral-angle violation analysis (i)

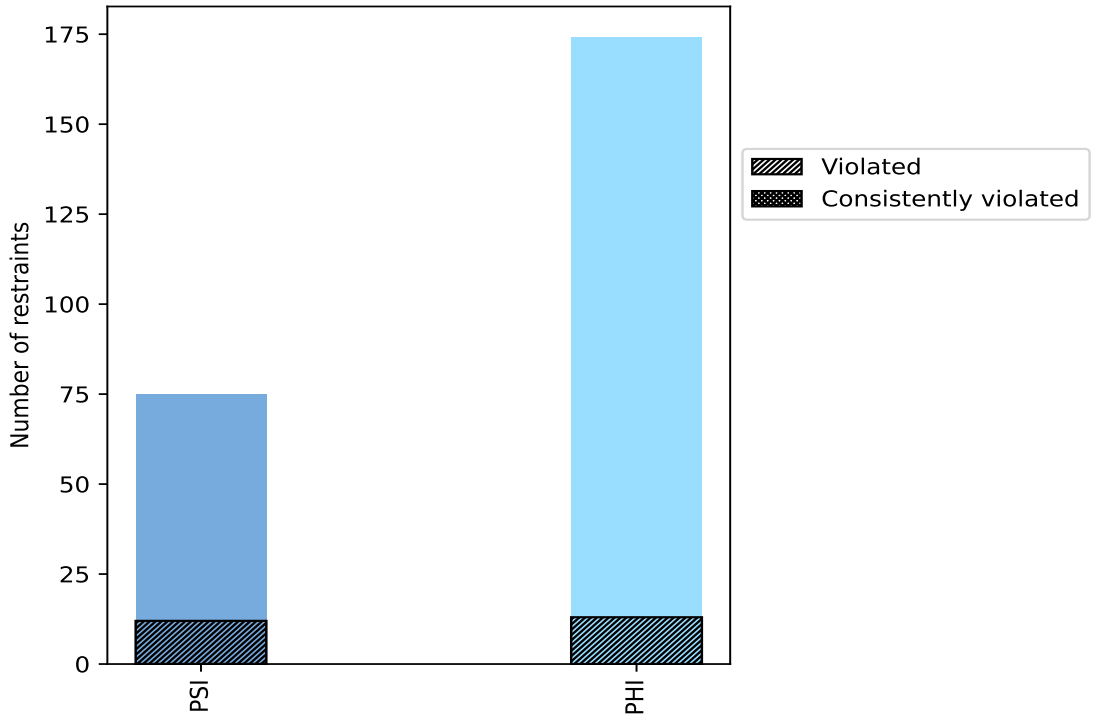
10.1 Summary of dihedral-angle violations (i)

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]
PSI	75	30.1	12	16.0	4.8	0	0.0	0.0
PHI	174	69.9	13	7.5	5.2	0	0.0	0.0
Total	249	100.0	25	10.0	10.0	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 (i)



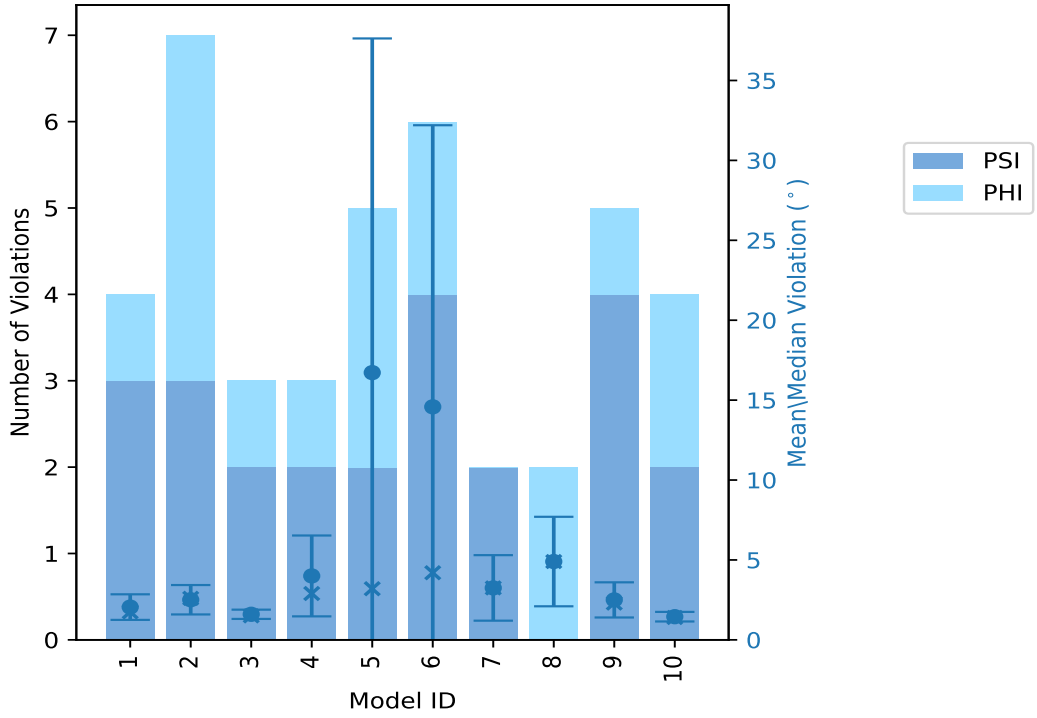
Violated and consistently violated restraints are shown using different hatch patterns in their respective categories

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 (°)
	PSI	PHI	Total				
1	3	1	4	2.05	3.4	0.8	1.75
2	3	4	7	2.51	3.7	0.92	2.6
3	2	1	3	1.6	2.0	0.29	1.5
4	2	1	3	4.0	7.5	2.53	2.9
5	2	3	5	16.72	55.8	20.91	3.2
6	4	2	6	14.58	48.5	17.62	4.2
7	2	0	2	3.25	5.3	2.05	3.25
8	0	2	2	4.9	7.7	2.8	4.9
9	4	1	5	2.5	4.5	1.1	2.3
10	2	2	4	1.45	1.9	0.3	1.4

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

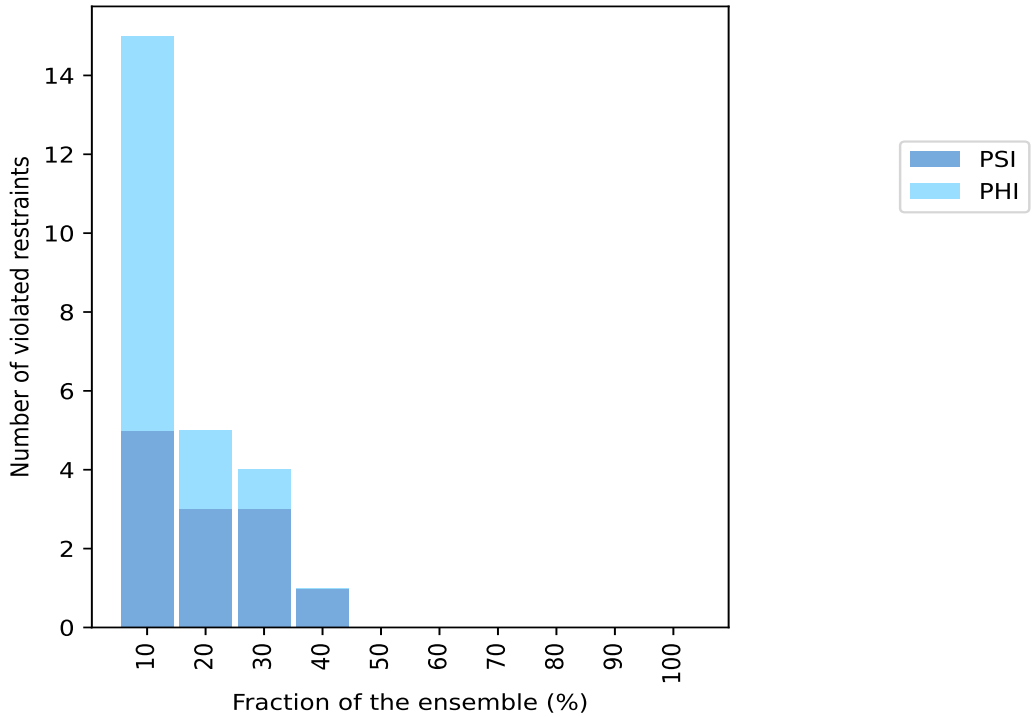
10.3 Dihedral-angle violation statistics for the ensemble (i)

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	
PSI	PHI	Total	Count[1]	%
5	10	15	1	10.0
3	2	5	2	20.0
3	1	4	3	30.0
1	0	1	4	40.0
0	0	0	5	50.0
0	0	0	6	60.0
0	0	0	7	70.0
0	0	0	8	80.0
0	0	0	9	90.0
0	0	0	10	100.0

[1] Number of models with violations

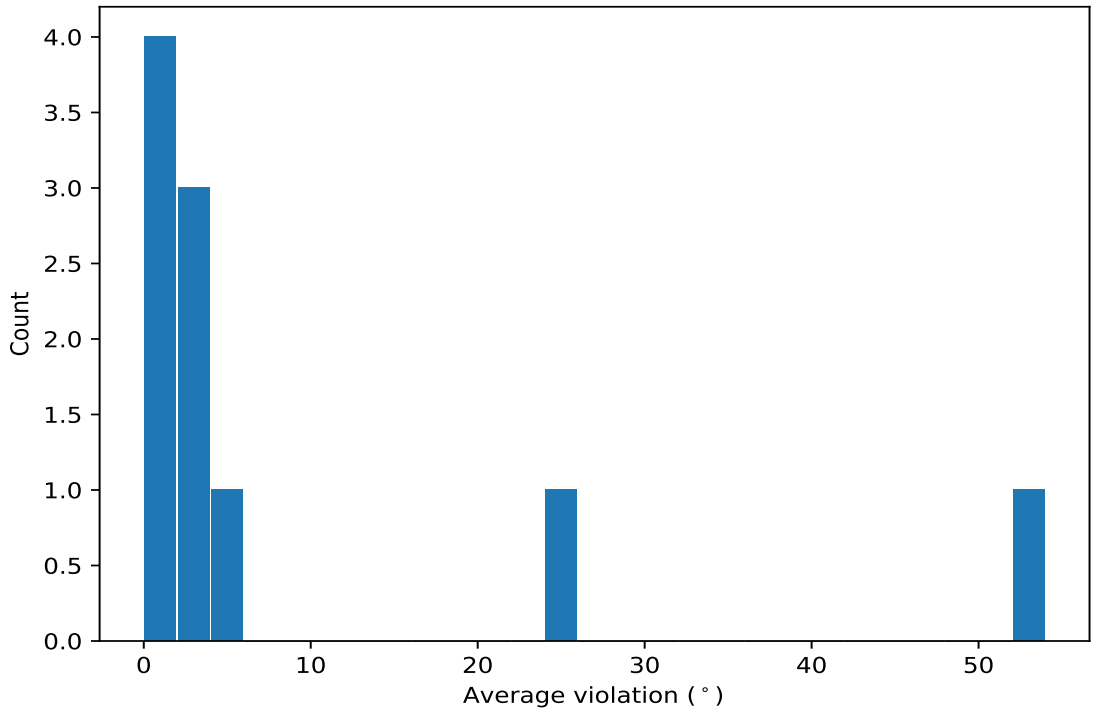
10.3.1 Bar graph : Dihedral-angle Violation statistics for the ensemble (i)



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.

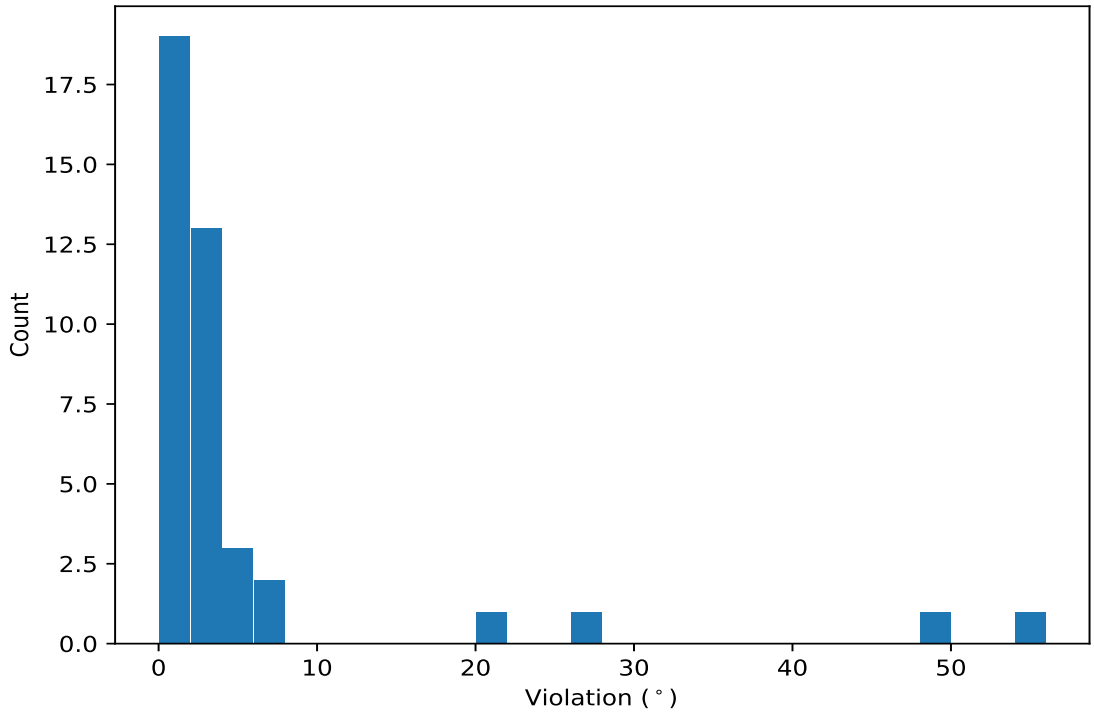
Key	Atom-1	Atom-2	Atom-3	Atom-4	Models[1]	Mean	SD[2]	Median
(1,90)	1:A:551:LEU:N	1:A:551:LEU:CA	1:A:551:LEU:C	1:A:552:GLU:N	4	3.12	1.48	3.0
(1,10)	1:A:497:PHE:N	1:A:497:PHE:CA	1:A:497:PHE:C	1:A:498:ALA:N	3	2.37	1.51	1.3
(1,54)	1:A:528:LEU:C	1:A:529:ALA:N	1:A:529:ALA:CA	1:A:529:ALA:C	3	1.67	0.17	1.6
(1,155)	1:A:606:CYS:N	1:A:606:CYS:CA	1:A:606:CYS:C	1:A:607:ALA:N	3	1.67	0.25	1.6
(1,111)	1:A:571:GLY:N	1:A:571:GLY:CA	1:A:571:GLY:C	1:A:572:ILE:N	3	1.17	0.05	1.2
(1,117)	1:A:578:GLY:C	1:A:579:GLU:N	1:A:579:GLU:CA	1:A:579:GLU:C	2	52.15	3.65	52.15
(1,118)	1:A:579:GLU:N	1:A:579:GLU:CA	1:A:579:GLU:C	1:A:580:GLN:N	2	24.3	3.0	24.3
(1,15)	1:A:503:ASP:N	1:A:503:ASP:CA	1:A:503:ASP:C	1:A:504:GLU:N	2	5.05	2.45	5.05
(1,75)	1:A:543:THR:C	1:A:544:THR:N	1:A:544:THR:CA	1:A:544:THR:C	2	3.95	0.75	3.95
(1,141)	1:A:596:THR:N	1:A:596:THR:CA	1:A:596:THR:C	1:A:597:SER:N	2	1.8	0.1	1.8

[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 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 (°)
(1,117)	1:A:578:GLY:C	1:A:579:GLU:N	1:A:579:GLU:CA	1:A:579:GLU:C	5	55.8
(1,117)	1:A:578:GLY:C	1:A:579:GLU:N	1:A:579:GLU:CA	1:A:579:GLU:C	6	48.5
(1,118)	1:A:579:GLU:N	1:A:579:GLU:CA	1:A:579:GLU:C	1:A:580:GLN:N	6	27.3
(1,118)	1:A:579:GLU:N	1:A:579:GLU:CA	1:A:579:GLU:C	1:A:580:GLN:N	5	21.3
(1,139)	1:A:594:PRO:C	1:A:595:MET:N	1:A:595:MET:CA	1:A:595:MET:C	8	7.7
(1,15)	1:A:503:ASP:N	1:A:503:ASP:CA	1:A:503:ASP:C	1:A:504:GLU:N	4	7.5
(1,90)	1:A:551:LEU:N	1:A:551:LEU:CA	1:A:551:LEU:C	1:A:552:GLU:N	7	5.3
(1,75)	1:A:543:THR:C	1:A:544:THR:N	1:A:544:THR:CA	1:A:544:THR:C	6	4.7
(1,10)	1:A:497:PHE:N	1:A:497:PHE:CA	1:A:497:PHE:C	1:A:498:ALA:N	9	4.5
(1,38)	1:A:519:PRO:N	1:A:519:PRO:CA	1:A:519:PRO:C	1:A:520:ILE:N	6	3.7