



Full wwPDB NMR Structure Validation Report ⓘ

Mar 5, 2026 – 09:48 PM UTC

PDB ID : 2KS4 / pdb_00002ks4
Title : NMR structure of the sea anemone actinoporin Sticholysin
Authors : Castrillo, I.; Santoro, J.; Bruix, M.
Deposited on : 2009-12-29

This is a Full wwPDB NMR Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/NMRValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 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
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

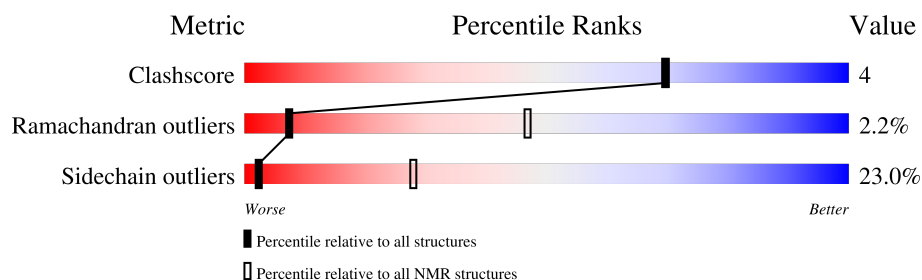
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment was not calculated.

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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	176	

2 Ensemble composition and analysis

This entry contains 20 models. Model 8 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *lowest energy*.

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

Well-defined (core) protein residues			
Well-defined core	Residue range (total)	Backbone RMSD (Å)	Medoid model
1	A:3-A:76, A:83-A:105, A:113-A:176 (161)	0.67	8

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 4 single-model clusters were found.

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

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2705 atoms, of which 1338 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Sticholysin-1.

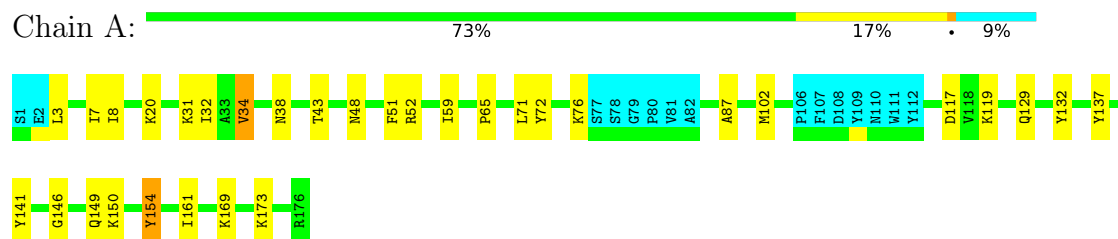
Mol	Chain	Residues	Atoms						Trace
1	A	176	Total	C	H	N	O	S	0
			2705	873	1338	229	258	7	

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: Sticholysin-1

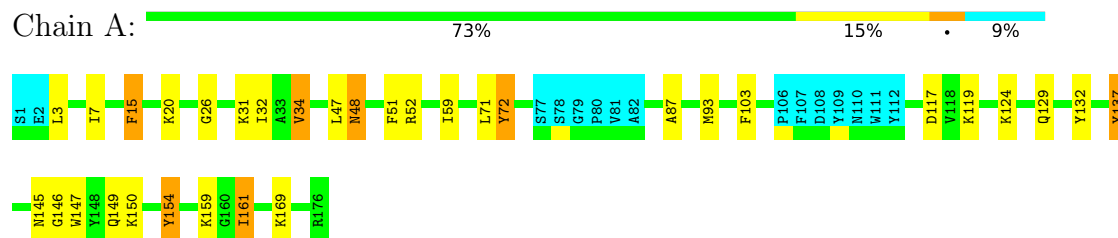


4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

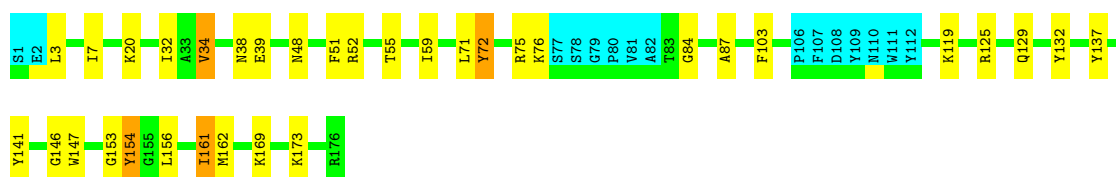
- Molecule 1: Sticholysin-1



4.2.2 Score per residue for model 2

- Molecule 1: Sticholysin-1

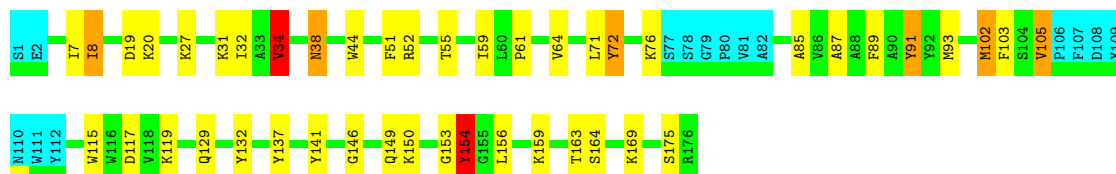




4.2.3 Score per residue for model 3

- Molecule 1: Sticholysin-1

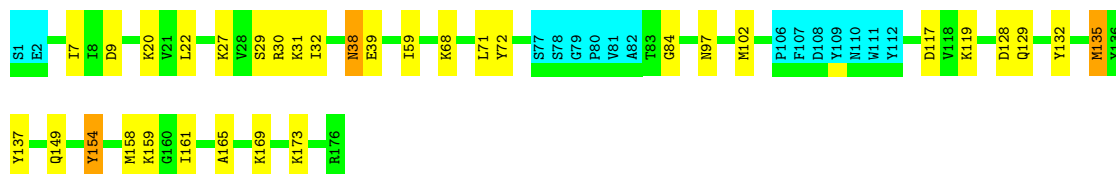
Chain A: 66% 21% 9%



4.2.4 Score per residue for model 4

- Molecule 1: Sticholysin-1

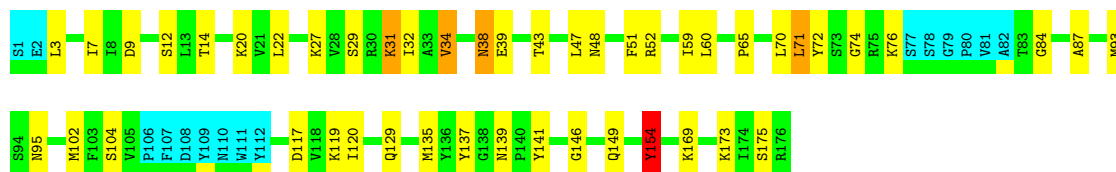
Chain A: 73% 17% 9%



4.2.5 Score per residue for model 5

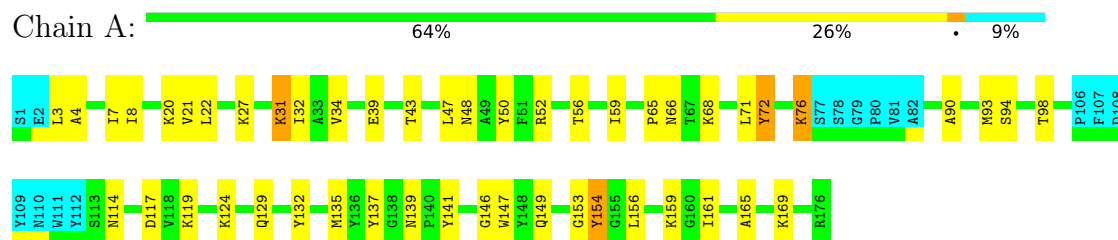
- Molecule 1: Sticholysin-1

Chain A: 65% 24% 9%



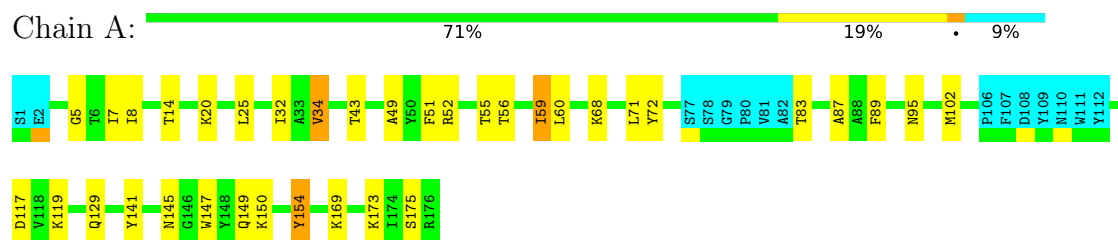
4.2.6 Score per residue for model 6

- Molecule 1: Sticholysin-1



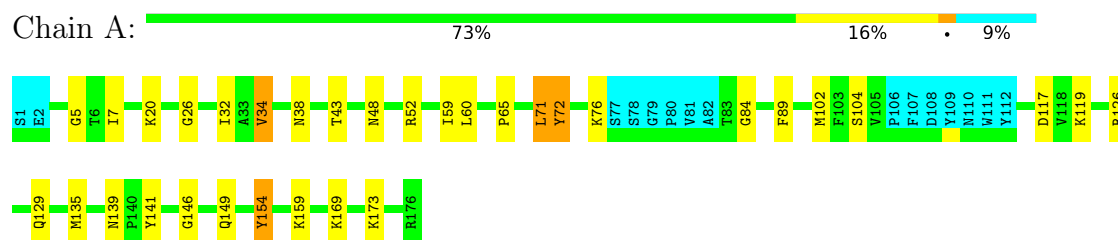
4.2.7 Score per residue for model 7

- Molecule 1: Sticholysin-1



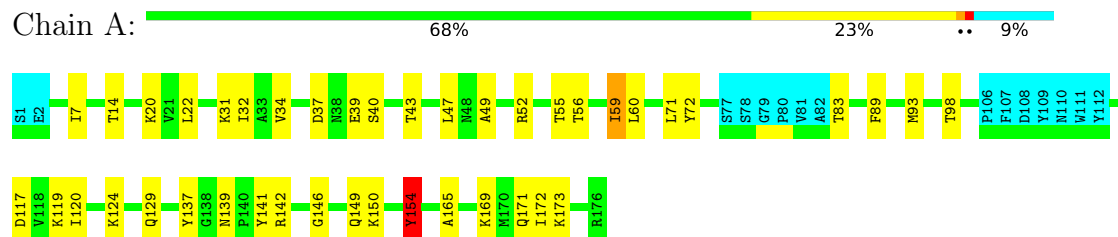
4.2.8 Score per residue for model 8 (medoid)

- Molecule 1: Sticholysin-1



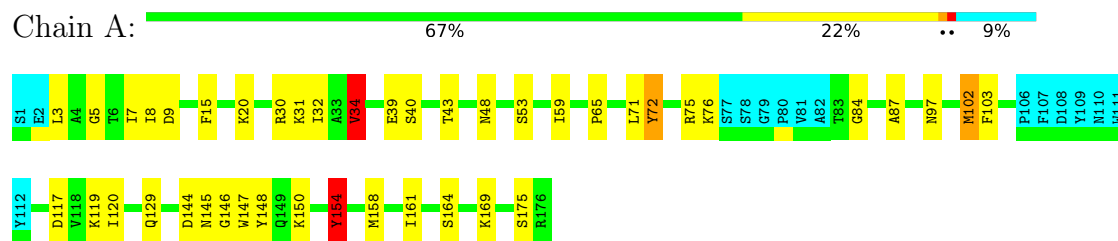
4.2.9 Score per residue for model 9

- Molecule 1: Sticholysin-1



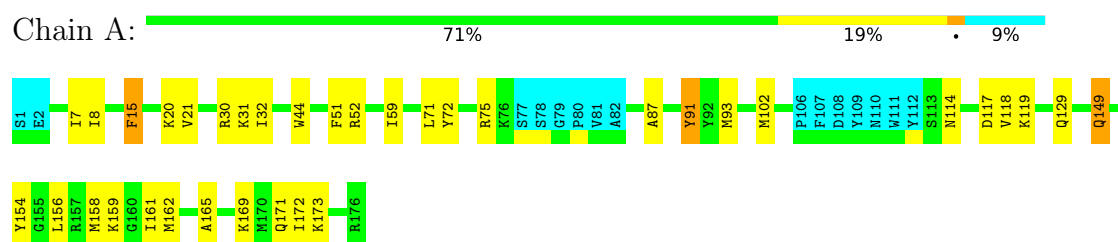
4.2.10 Score per residue for model 10

- Molecule 1: Sticholysin-1



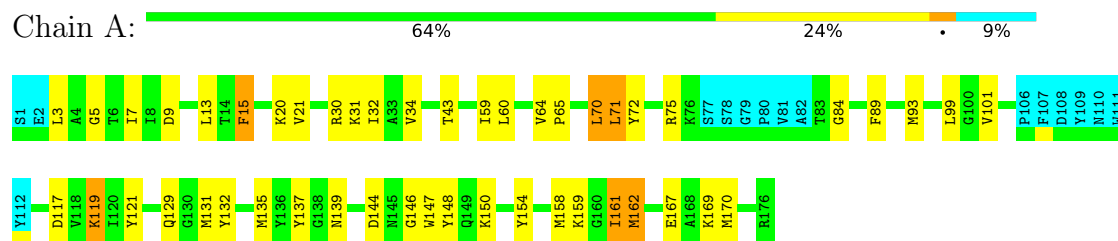
4.2.11 Score per residue for model 11

- Molecule 1: Sticholysin-1



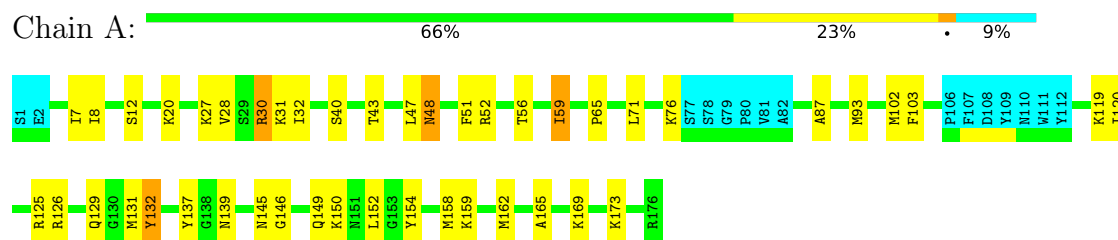
4.2.12 Score per residue for model 12

- Molecule 1: Sticholysin-1



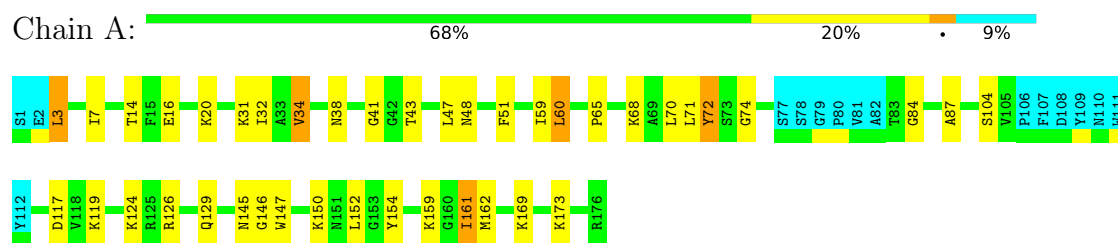
4.2.13 Score per residue for model 13

- Molecule 1: Sticholysin-1



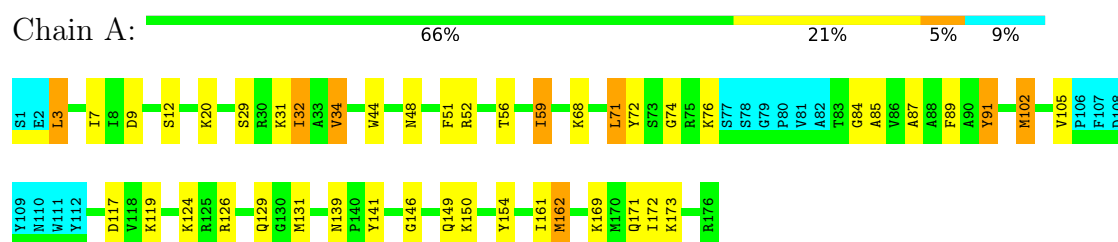
4.2.14 Score per residue for model 14

- Molecule 1: Sticholysin-1



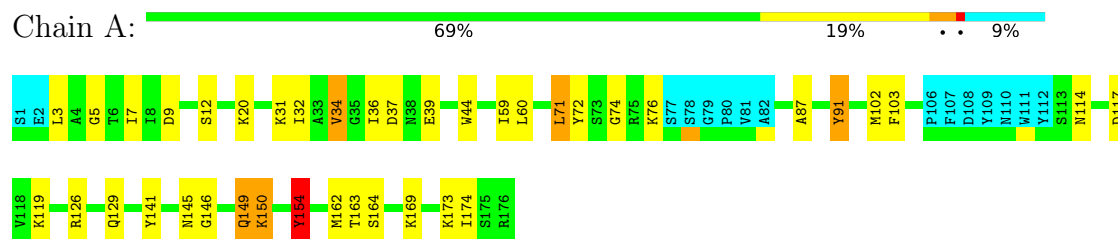
4.2.15 Score per residue for model 15

- Molecule 1: Sticholysin-1



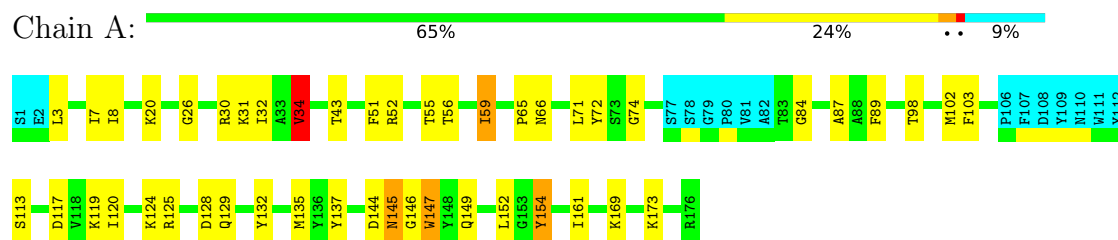
4.2.16 Score per residue for model 16

- Molecule 1: Sticholysin-1



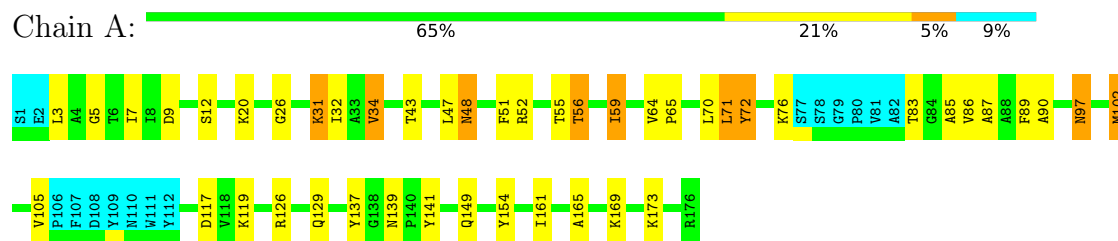
4.2.17 Score per residue for model 17

- Molecule 1: Sticholysin-1



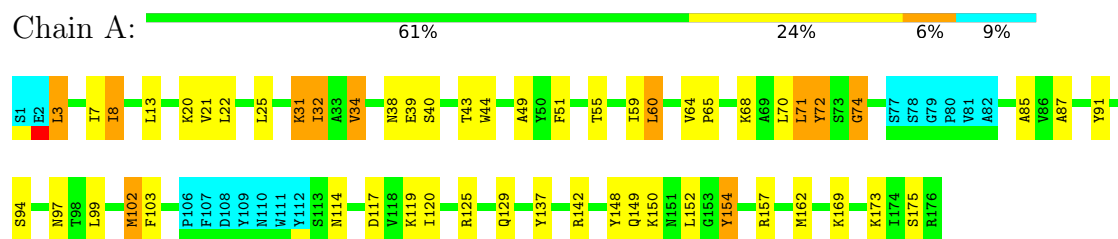
4.2.18 Score per residue for model 18

- Molecule 1: Sticholysin-1



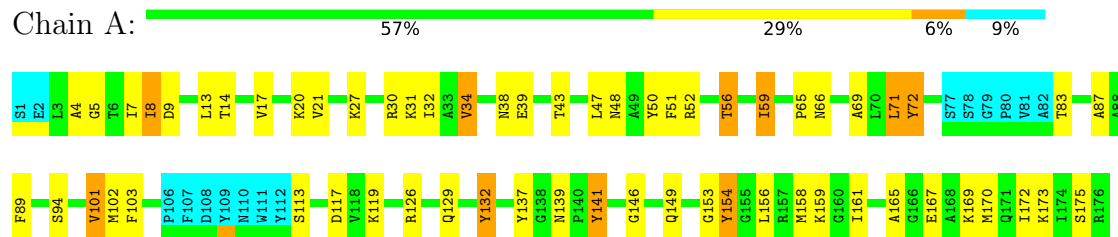
4.2.19 Score per residue for model 19

- Molecule 1: Sticholysin-1



4.2.20 Score per residue for model 20

- Molecule 1: Sticholysin-1



5 Refinement protocol and experimental data overview ⓘ

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

Of the 20 calculated structures, 20 were deposited, based on the following criterion: *all calculated structures submitted*.

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

Software name	Classification	Version
CYANA	structure solution	
Amber	refinement	

No chemical shift data was provided.

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	0.82±0.02	0±0/1271 (0.0± 0.0%)	1.38±0.03	2±2/1715 (0.1± 0.1%)
All	All	0.82	0/25420 (0.0%)	1.38	32/34300 (0.1%)

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	1.4±0.9
All	All	0	27

There are no bond-length outliers.

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(°)	Ideal(°)	Models	
								Worst	Total
1	A	137	TYR	CA-C-N	6.37	128.31	120.22	4	3
1	A	137	TYR	C-N-CA	6.37	128.31	120.22	4	3
1	A	97	ASN	CA-CB-CG	6.06	118.66	112.60	18	2
1	A	60	LEU	CB-CA-C	5.96	115.80	110.44	14	1
1	A	114	ASN	CA-CB-CG	5.85	118.45	112.60	11	1
1	A	38	ASN	CA-CB-CG	5.85	118.45	112.60	3	4
1	A	34	VAL	CA-CB-CG1	5.65	120.00	110.40	10	1
1	A	34	VAL	CA-CB-CG2	5.48	119.72	110.40	3	2
1	A	41	GLY	CA-C-N	5.46	125.81	121.61	14	1
1	A	41	GLY	C-N-CA	5.46	125.81	121.61	14	1
1	A	135	MET	CA-C-N	5.34	127.74	120.54	4	1
1	A	135	MET	C-N-CA	5.34	127.74	120.54	4	1
1	A	38	ASN	OD1-CG-ND2	-5.21	117.39	122.60	19	2
1	A	152	LEU	CA-C-N	5.08	125.72	120.03	14	1
1	A	152	LEU	C-N-CA	5.08	125.72	120.03	14	1

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	146	GLY	CA-C-N	5.06	131.20	121.54	2	1
1	A	146	GLY	C-N-CA	5.06	131.20	121.54	2	1
1	A	163	THR	CA-CB-CG2	5.04	119.07	110.50	3	1
1	A	104	SER	CA-C-N	5.00	126.19	122.59	8	1
1	A	104	SER	C-N-CA	5.00	126.19	122.59	8	1
1	A	74	GLY	CA-C-N	5.00	129.46	122.41	19	1
1	A	74	GLY	C-N-CA	5.00	129.46	122.41	19	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	A	72	TYR	Sidechain	10
1	A	154	TYR	Sidechain	10
1	A	50	TYR	Sidechain	2
1	A	141	TYR	Sidechain	2
1	A	132	TYR	Sidechain	1
1	A	91	TYR	Sidechain	1
1	A	148	TYR	Sidechain	1

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	1245	1237	1237	9±4
All	All	24900	24740	24740	178

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:34:VAL:HG22	1:A:72:TYR:HB2	0.68	1.65	18	14
1:A:87:ALA:HB3	1:A:103:PHE:CZ	0.64	2.28	13	6

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:3:LEU:HD12	1:A:74:GLY:H	0.63	1.54	19	6
1:A:43:THR:HG22	1:A:65:PRO:HA	0.58	1.75	14	11
1:A:34:VAL:HG21	1:A:170:MET:HE2	0.56	1.76	12	1
1:A:72:TYR:CE2	1:A:89:PHE:CE2	0.56	2.94	20	4
1:A:147:TRP:H	1:A:161:ILE:HD13	0.56	1.60	17	2
1:A:152:LEU:HD21	1:A:158:MET:HB2	0.56	1.78	13	1
1:A:32:ILE:HG13	1:A:85:ALA:HB1	0.56	1.78	15	2
1:A:93:MET:HE2	1:A:120:ILE:HG21	0.54	1.78	13	1
1:A:3:LEU:HD12	1:A:74:GLY:N	0.53	2.18	19	3
1:A:34:VAL:HG13	1:A:72:TYR:CB	0.53	2.34	10	1
1:A:47:LEU:HD11	1:A:90:ALA:HB3	0.52	1.81	18	1
1:A:51:PHE:CE1	1:A:87:ALA:HB1	0.52	2.40	11	4
1:A:47:LEU:HD12	1:A:48:ASN:N	0.51	2.20	20	6
1:A:72:TYR:CE2	1:A:89:PHE:CD2	0.51	2.99	17	7
1:A:118:VAL:CG2	1:A:158:MET:HE1	0.51	2.36	11	1
1:A:51:PHE:CD1	1:A:87:ALA:HB1	0.50	2.41	20	11
1:A:3:LEU:HD11	1:A:31:LYS:HB2	0.50	1.84	18	1
1:A:102:MET:HE1	1:A:115:TRP:O	0.50	2.07	3	1
1:A:3:LEU:HD13	1:A:31:LYS:HB2	0.49	1.84	5	3
1:A:119:LYS:HE3	1:A:121:TYR:CE1	0.49	2.42	12	1
1:A:120:ILE:HD11	1:A:152:LEU:HD13	0.49	1.84	17	1
1:A:89:PHE:CE2	1:A:101:VAL:HG11	0.49	2.43	20	1
1:A:147:TRP:H	1:A:161:ILE:HD12	0.49	1.68	14	1
1:A:89:PHE:CZ	1:A:101:VAL:HG11	0.48	2.44	12	2
1:A:49:ALA:HB2	1:A:60:LEU:HD22	0.48	1.85	19	1
1:A:56:THR:HG21	1:A:59:ILE:HG23	0.48	1.86	20	6
1:A:93:MET:HE1	1:A:99:LEU:HB2	0.48	1.86	12	1
1:A:119:LYS:CE	1:A:121:TYR:CE1	0.47	2.97	12	1
1:A:34:VAL:O	1:A:71:LEU:HD13	0.47	2.09	8	6
1:A:64:VAL:HG21	1:A:70:LEU:HD23	0.47	1.86	12	1
1:A:64:VAL:HG21	1:A:70:LEU:HD13	0.47	1.86	19	2
1:A:102:MET:HE2	1:A:102:MET:C	0.47	2.35	10	4
1:A:98:THR:HG21	1:A:125:ARG:O	0.46	2.10	17	1
1:A:22:LEU:HD23	1:A:31:LYS:HD2	0.46	1.87	5	1
1:A:15:PHE:CD1	1:A:15:PHE:C	0.46	2.93	11	3
1:A:44:TRP:CD1	1:A:91:TYR:CZ	0.46	3.04	16	3
1:A:49:ALA:HB2	1:A:60:LEU:HD12	0.46	1.86	7	2
1:A:13:LEU:HD11	1:A:71:LEU:CD2	0.46	2.41	12	2
1:A:13:LEU:HD23	1:A:69:ALA:CB	0.46	2.41	20	1
1:A:4:ALA:HB1	1:A:71:LEU:HB3	0.45	1.87	20	1
1:A:44:TRP:HA	1:A:91:TYR:CE1	0.45	2.47	3	4

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:171:GLN:C	1:A:172:ILE:HD12	0.45	2.37	15	3
1:A:153:GLY:C	1:A:154:TYR:CD1	0.44	2.96	3	1
1:A:44:TRP:CZ2	1:A:99:LEU:CD2	0.43	3.01	19	1
1:A:90:ALA:HB1	1:A:98:THR:CG2	0.43	2.44	6	1
1:A:102:MET:HE2	1:A:103:PHE:N	0.43	2.28	3	1
1:A:152:LEU:HD21	1:A:158:MET:CB	0.43	2.42	13	1
1:A:149:GLN:NE2	1:A:150:LYS:H	0.43	2.11	16	1
1:A:61:PRO:HG2	1:A:64:VAL:HG23	0.43	1.89	3	1
1:A:158:MET:SD	1:A:172:ILE:HG21	0.43	2.53	20	1
1:A:161:ILE:HD13	1:A:162:MET:N	0.42	2.29	12	2
1:A:85:ALA:HB3	1:A:105:VAL:HG22	0.42	1.90	3	2
1:A:91:TYR:CD1	1:A:91:TYR:C	0.42	2.97	16	4
1:A:3:LEU:HD11	1:A:31:LYS:HG3	0.42	1.91	6	1
1:A:28:VAL:HG23	1:A:30:ARG:O	0.42	2.14	13	1
1:A:70:LEU:C	1:A:70:LEU:HD12	0.42	2.38	5	2
1:A:72:TYR:CZ	1:A:89:PHE:CZ	0.42	3.08	8	1
1:A:51:PHE:CZ	1:A:59:ILE:HG21	0.42	2.50	15	1
1:A:120:ILE:HB	1:A:154:TYR:CE2	0.42	2.49	10	2
1:A:47:LEU:HD21	1:A:98:THR:HG23	0.42	1.92	9	1
1:A:132:TYR:CD1	1:A:132:TYR:C	0.42	2.97	13	2
1:A:56:THR:CG2	1:A:59:ILE:HD12	0.42	2.45	15	1
1:A:87:ALA:HB3	1:A:103:PHE:CE2	0.42	2.49	16	1
1:A:59:ILE:HB	1:A:72:TYR:CE2	0.42	2.49	20	2
1:A:102:MET:HE3	1:A:103:PHE:C	0.42	2.40	20	1
1:A:105:VAL:HG12	1:A:162:MET:HE1	0.41	1.93	15	1
1:A:170:MET:SD	1:A:172:ILE:CD1	0.41	3.08	20	1
1:A:146:GLY:C	1:A:161:ILE:HD13	0.41	2.39	1	1
1:A:154:TYR:CD1	1:A:154:TYR:N	0.41	2.87	16	1
1:A:34:VAL:HG13	1:A:72:TYR:HB3	0.41	1.91	10	1
1:A:76:LYS:HE2	1:A:83:THR:O	0.41	2.15	18	1
1:A:120:ILE:HB	1:A:154:TYR:CZ	0.41	2.51	19	1
1:A:17:VAL:O	1:A:21:VAL:HG23	0.41	2.17	20	1
1:A:149:GLN:CD	1:A:158:MET:HE2	0.40	2.41	11	1
1:A:120:ILE:HB	1:A:154:TYR:CE1	0.40	2.51	5	1

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	160/176 (91%)	135±3 (85±2%)	21±2 (13±1%)	4±1 (2±1%)	7	47
All	All	3200/3520 (91%)	2709 (85%)	421 (13%)	70 (2%)	7	47

All 15 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	146	GLY	13
1	A	84	GLY	9
1	A	55	THR	7
1	A	165	ALA	7
1	A	5	GLY	7
1	A	147	TRP	5
1	A	145	ASN	5
1	A	26	GLY	4
1	A	153	GLY	3
1	A	154	TYR	3
1	A	8	ILE	3
1	A	4	ALA	1
1	A	27	LYS	1
1	A	117	ASP	1
1	A	164	SER	1

6.3.2 Protein sidechains ⓘ

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	127/140 (91%)	98±4 (77±3%)	29±4 (23±3%)	2	28
All	All	2540/2800 (91%)	1957 (77%)	583 (23%)	2	28

All 86 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	7	ILE	20

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Mol	Chain	Res	Type	Models (Total)
1	A	20	LYS	20
1	A	32	ILE	20
1	A	59	ILE	20
1	A	71	LEU	20
1	A	119	LYS	20
1	A	129	GLN	20
1	A	154	TYR	20
1	A	169	LYS	20
1	A	117	ASP	17
1	A	31	LYS	16
1	A	149	GLN	16
1	A	34	VAL	15
1	A	173	LYS	15
1	A	52	ARG	14
1	A	102	MET	13
1	A	137	TYR	11
1	A	150	LYS	11
1	A	159	LYS	10
1	A	161	ILE	10
1	A	141	TYR	10
1	A	39	GLU	9
1	A	8	ILE	9
1	A	139	ASN	9
1	A	48	ASN	8
1	A	132	TYR	8
1	A	76	LYS	8
1	A	9	ASP	8
1	A	3	LEU	7
1	A	30	ARG	7
1	A	126	ARG	7
1	A	162	MET	7
1	A	93	MET	6
1	A	124	LYS	6
1	A	175	SER	6
1	A	68	LYS	6
1	A	135	MET	6
1	A	60	LEU	6
1	A	156	LEU	5
1	A	27	LYS	5
1	A	38	ASN	5
1	A	12	SER	5
1	A	14	THR	5

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Mol	Chain	Res	Type	Models (Total)
1	A	15	PHE	4
1	A	75	ARG	4
1	A	91	TYR	4
1	A	22	LEU	4
1	A	21	VAL	4
1	A	40	SER	4
1	A	145	ASN	3
1	A	125	ARG	3
1	A	29	SER	3
1	A	72	TYR	3
1	A	97	ASN	3
1	A	158	MET	3
1	A	56	THR	3
1	A	66	ASN	3
1	A	94	SER	3
1	A	114	ASN	3
1	A	83	THR	3
1	A	144	ASP	3
1	A	131	MET	3
1	A	164	SER	2
1	A	128	ASP	2
1	A	95	ASN	2
1	A	104	SER	2
1	A	43	THR	2
1	A	37	ASP	2
1	A	142	ARG	2
1	A	148	TYR	2
1	A	167	GLU	2
1	A	113	SER	2
1	A	19	ASP	1
1	A	105	VAL	1
1	A	53	SER	1
1	A	70	LEU	1
1	A	16	GLU	1
1	A	47	LEU	1
1	A	36	ILE	1
1	A	163	THR	1
1	A	174	ILE	1
1	A	147	TRP	1
1	A	86	VAL	1
1	A	152	LEU	1
1	A	157	ARG	1

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Mol	Chain	Res	Type	Models (Total)
1	A	101	VAL	1

6.3.3 RNA [i](#)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

6.5 Carbohydrates [i](#)

There are no 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

No chemical shift data were provided