



Full wwPDB NMR Structure Validation Report ⓘ

Mar 4, 2026 – 09:12 PM UTC

PDB ID : 2L4O / pdb_00002l4o
Title : Solution structure of the Streptococcus pneumoniae RrgB pilus backbone D1 domain
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Deposited on : 2010-10-11

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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

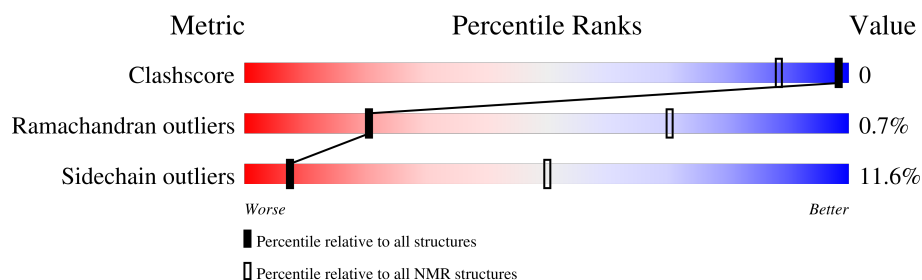
1 Overall quality at a glance

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	181	

2 Ensemble composition and analysis

This entry contains 20 models. Model 1 is the overall representative, medoid model (most similar to other models).

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:32-A:146, A:162-A:185 (139)	0.56	1

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

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

NmrClust was unable to cluster the ensemble.

Error message: Inconsistent models

3 Entry composition

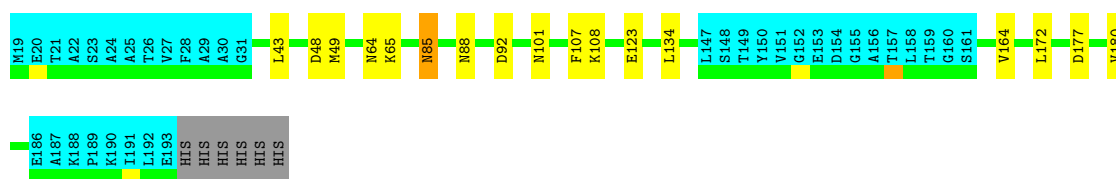
There is only 1 type of molecule in this entry. The entry contains 2601 atoms, of which 1301 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Cell wall surface anchor family protein.

Mol	Chain	Residues	Atoms						Trace
1	A	175	Total	C	H	N	O	S	0
			2601	819	1301	211	265	5	

There are 12 discrepancies between the modelled and reference sequences:

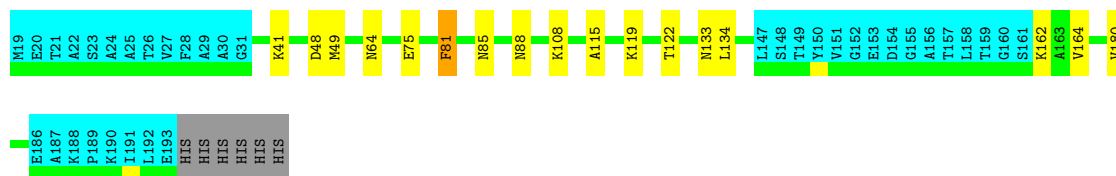
Chain	Residue	Modelled	Actual	Comment	Reference
A	19	MET	-	expression tag	UNP Q97SC2
A	20	GLU	-	expression tag	UNP Q97SC2
A	21	THR	-	expression tag	UNP Q97SC2
A	22	ALA	-	expression tag	UNP Q97SC2
A	192	LEU	-	expression tag	UNP Q97SC2
A	193	GLU	-	expression tag	UNP Q97SC2
A	194	HIS	-	expression tag	UNP Q97SC2
A	195	HIS	-	expression tag	UNP Q97SC2
A	196	HIS	-	expression tag	UNP Q97SC2
A	197	HIS	-	expression tag	UNP Q97SC2
A	198	HIS	-	expression tag	UNP Q97SC2
A	199	HIS	-	expression tag	UNP Q97SC2



4.2.3 Score per residue for model 3

- Molecule 1: Cell wall surface anchor family protein

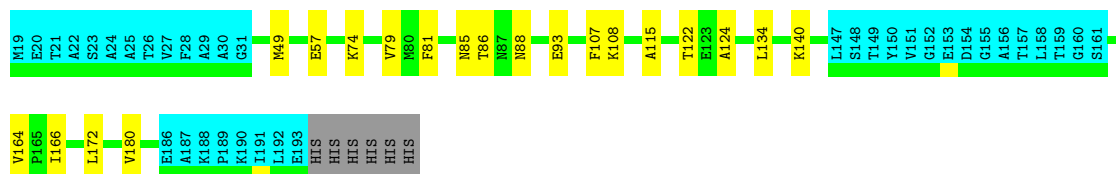
Chain A: 67% 9% 20%



4.2.4 Score per residue for model 4

- Molecule 1: Cell wall surface anchor family protein

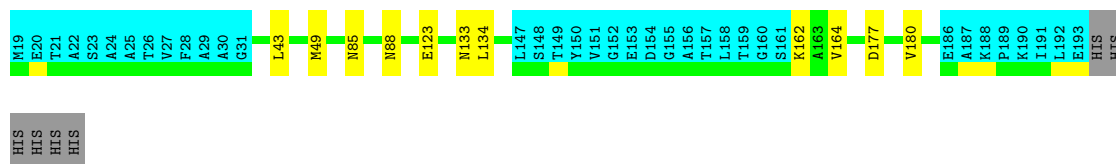
Chain A: 66% 11% 20%



4.2.5 Score per residue for model 5

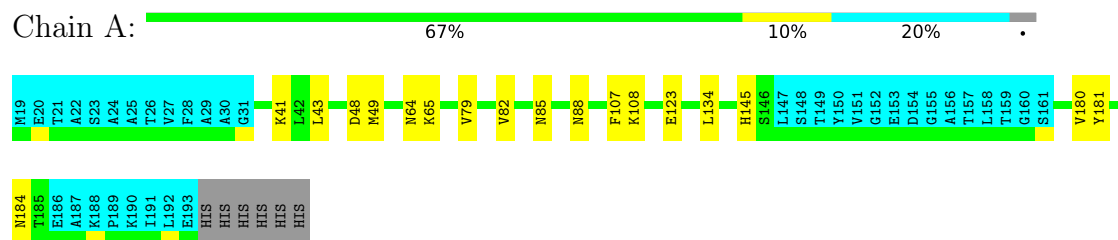
- Molecule 1: Cell wall surface anchor family protein

Chain A: 71% 6% 20%



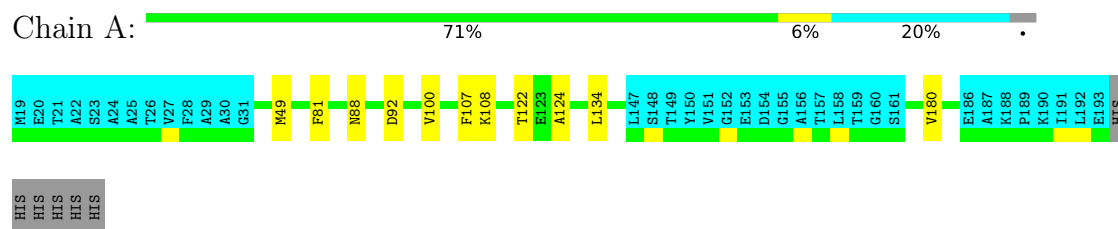
4.2.6 Score per residue for model 6

- Molecule 1: Cell wall surface anchor family protein



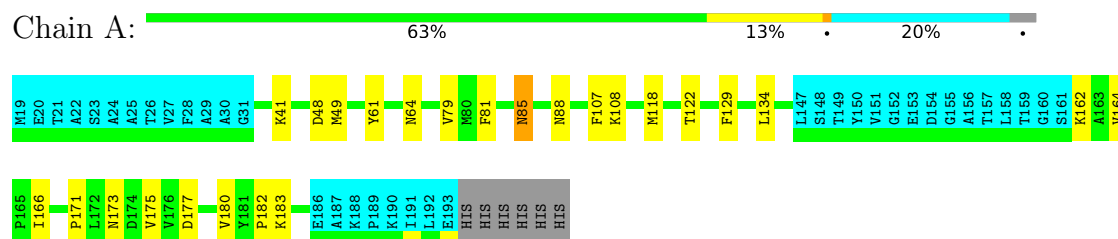
4.2.7 Score per residue for model 7

- Molecule 1: Cell wall surface anchor family protein



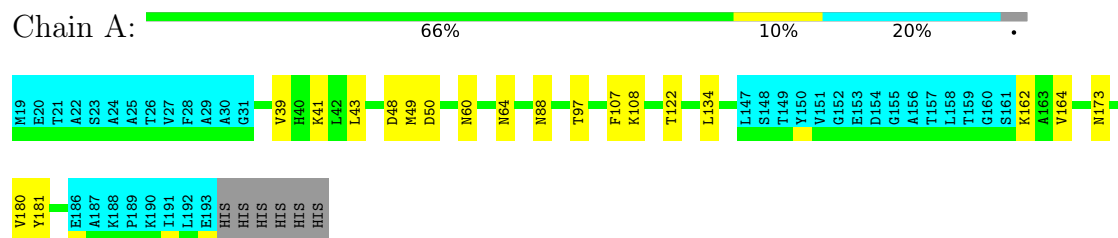
4.2.8 Score per residue for model 8

- Molecule 1: Cell wall surface anchor family protein



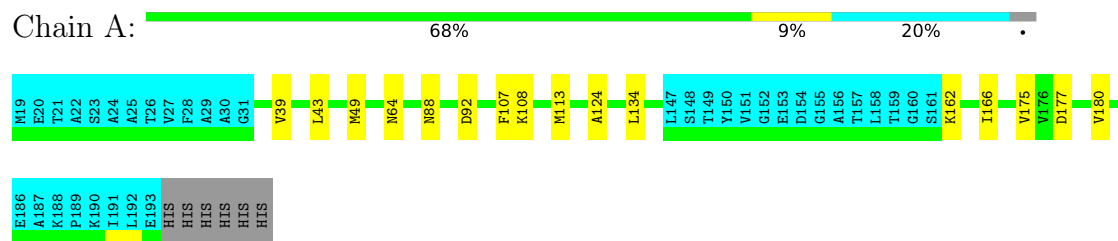
4.2.9 Score per residue for model 9

- Molecule 1: Cell wall surface anchor family protein



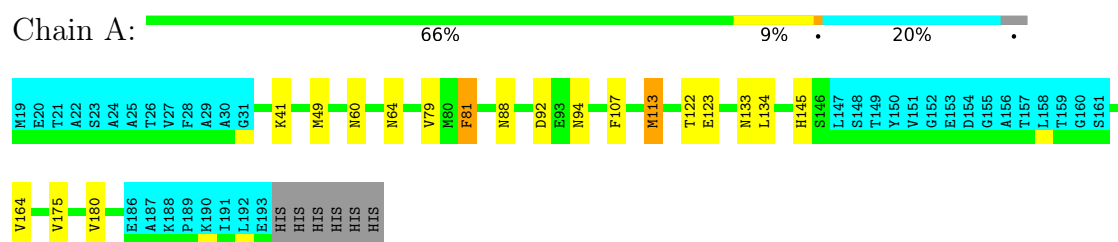
4.2.10 Score per residue for model 10

- Molecule 1: Cell wall surface anchor family protein



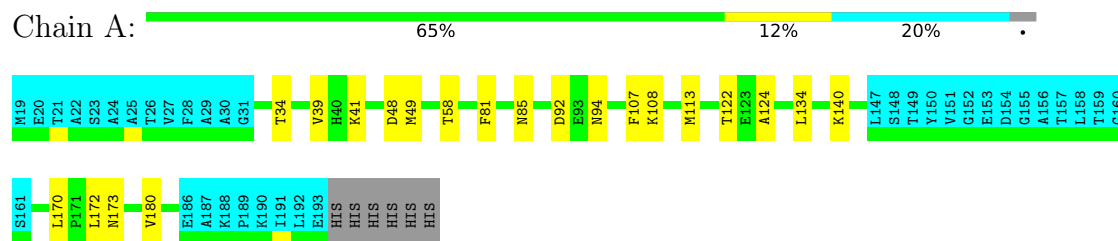
4.2.11 Score per residue for model 11

- Molecule 1: Cell wall surface anchor family protein



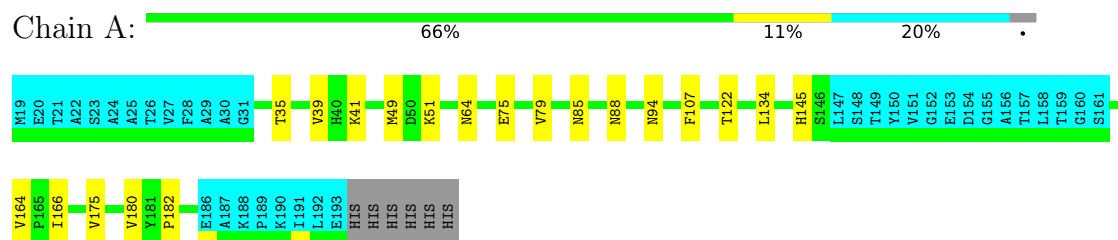
4.2.12 Score per residue for model 12

- Molecule 1: Cell wall surface anchor family protein



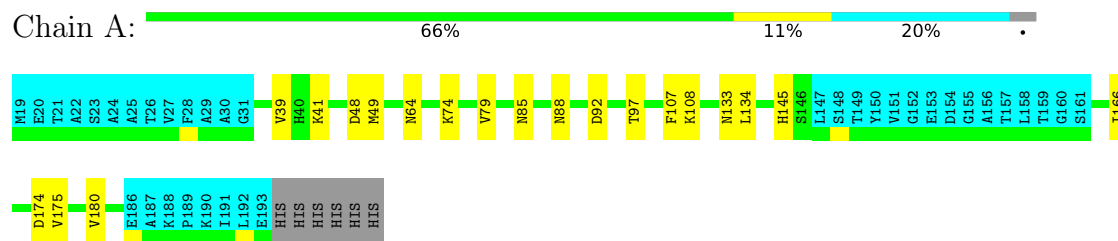
4.2.13 Score per residue for model 13

- Molecule 1: Cell wall surface anchor family protein



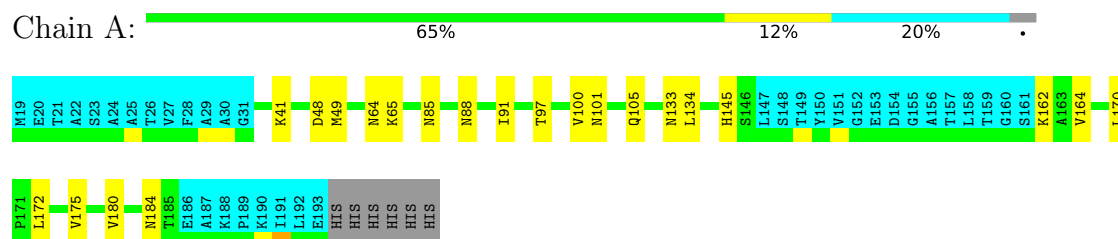
4.2.14 Score per residue for model 14

- Molecule 1: Cell wall surface anchor family protein



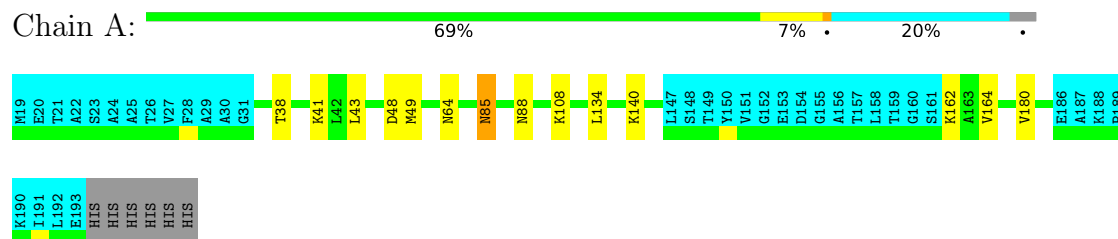
4.2.15 Score per residue for model 15

- Molecule 1: Cell wall surface anchor family protein



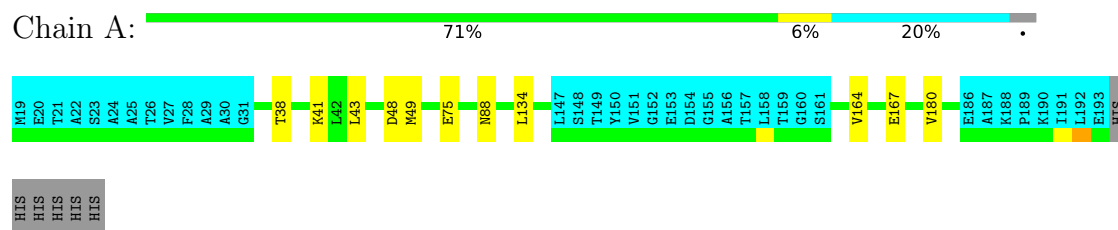
4.2.16 Score per residue for model 16

- Molecule 1: Cell wall surface anchor family protein



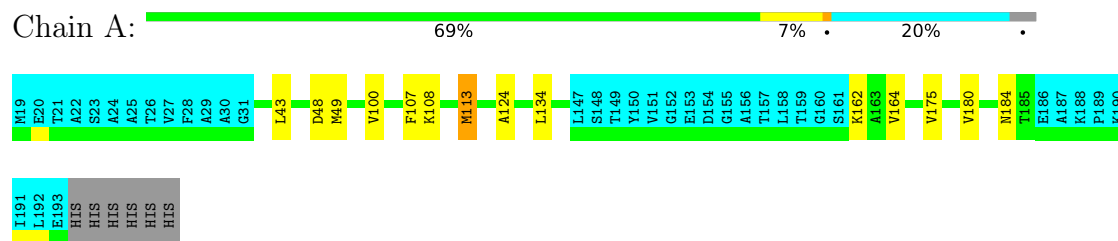
4.2.17 Score per residue for model 17

- Molecule 1: Cell wall surface anchor family protein



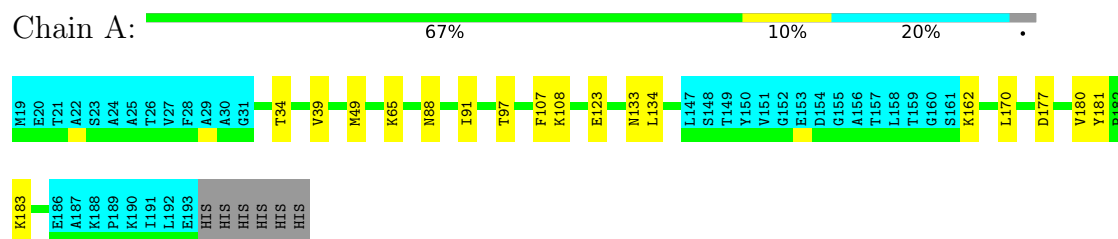
4.2.18 Score per residue for model 18

- Molecule 1: Cell wall surface anchor family protein



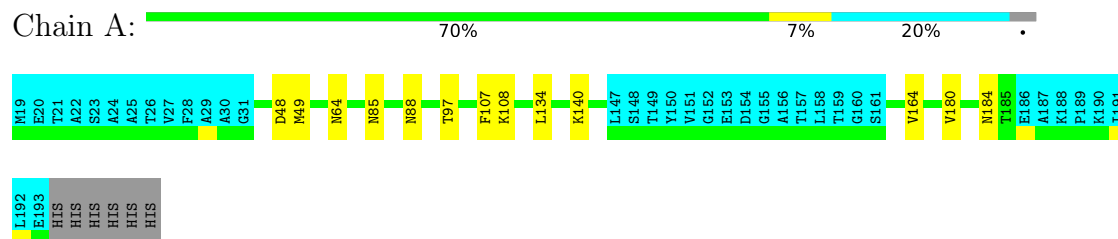
4.2.19 Score per residue for model 19

- Molecule 1: Cell wall surface anchor family protein



4.2.20 Score per residue for model 20

- Molecule 1: Cell wall surface anchor family protein



5 Refinement protocol and experimental data overview

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

Of the 400 calculated structures, 20 were deposited, based on the following criterion: *target function*.

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

Software name	Classification	Version
CYANA	refinement	2.1
Amber	refinement	10

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	0.85±0.01	0±0/1069 (0.0± 0.0%)	1.43±0.03	2±2/1458 (0.2± 0.1%)
All	All	0.85	0/21380 (0.0%)	1.43	45/29160 (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	A	0.0±0.0	0.2±0.4
All	All	0	4

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	107	PHE	CA-CB-CG	7.52	121.32	113.80	2	15
1	A	133	ASN	OD1-CG-ND2	-7.02	115.58	122.60	15	1
1	A	177	ASP	CA-CB-CG	6.73	119.33	112.60	10	1
1	A	92	ASP	CA-CB-CG	6.69	119.29	112.60	10	4
1	A	184	ASN	CA-CB-CG	5.83	118.42	112.60	20	2
1	A	85	ASN	CA-CB-CG	-5.81	106.79	112.60	2	3
1	A	113	MET	CA-C-N	5.54	125.53	120.21	11	2
1	A	113	MET	C-N-CA	5.54	125.53	120.21	11	2
1	A	173	ASN	CA-CB-CG	5.51	118.11	112.60	12	2
1	A	181	TYR	CA-C-N	5.48	125.39	119.85	9	3
1	A	181	TYR	C-N-CA	5.48	125.39	119.85	9	3
1	A	174	ASP	CA-CB-CG	5.39	117.99	112.60	14	1
1	A	171	PRO	N-CA-CB	5.26	106.23	102.65	8	1
1	A	60	ASN	CA-CB-CG	5.18	117.78	112.60	11	1
1	A	183	LYS	CA-C-N	5.07	130.47	122.36	19	1

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	183	LYS	C-N-CA	5.07	130.47	122.36	19	1
1	A	175	VAL	CA-C-N	5.06	126.94	120.56	18	1
1	A	175	VAL	C-N-CA	5.06	126.94	120.56	18	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	81	PHE	Sidechain	2
1	A	181	TYR	Sidechain	1
1	A	61	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	1050	1052	1052	1±1
All	All	21000	21040	21040	11

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 0.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:91:ILE:HG22	1:A:97:THR:HG22	0.57	1.76	19	2
1:A:81:PHE:CZ	1:A:122:THR:HG23	0.46	2.45	11	6
1:A:166:ILE:HD11	1:A:182:PRO:HB3	0.45	1.88	8	2
1:A:118:MET:HE2	1:A:129:PHE:HB3	0.41	1.93	8	1

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	139/181 (77%)	128±2 (92±2%)	10±3 (7±2%)	1±1 (1±0%)	20	70
All	All	2780/3620 (77%)	2568 (92%)	193 (7%)	19 (1%)	20	70

All 3 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	48	ASP	12
1	A	124	ALA	5
1	A	115	ALA	2

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	114/145 (79%)	101±3 (88±2%)	13±3 (12±2%)	7	50
All	All	2280/2900 (79%)	2015 (88%)	265 (12%)	7	50

All 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)
1	A	49	MET	20
1	A	134	LEU	20
1	A	180	VAL	20
1	A	88	ASN	18
1	A	108	LYS	15
1	A	164	VAL	14
1	A	85	ASN	13

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Mol	Chain	Res	Type	Models (Total)
1	A	64	ASN	12
1	A	41	LYS	11
1	A	43	LEU	9
1	A	162	LYS	9
1	A	39	VAL	7
1	A	133	ASN	6
1	A	79	VAL	6
1	A	175	VAL	6
1	A	172	LEU	5
1	A	123	GLU	5
1	A	145	HIS	5
1	A	166	ILE	4
1	A	65	LYS	4
1	A	177	ASP	4
1	A	140	LYS	4
1	A	113	MET	4
1	A	34	THR	3
1	A	75	GLU	3
1	A	100	VAL	3
1	A	97	THR	3
1	A	94	ASN	3
1	A	170	LEU	3
1	A	92	ASP	2
1	A	101	ASN	2
1	A	74	LYS	2
1	A	184	ASN	2
1	A	122	THR	2
1	A	38	THR	2
1	A	119	LYS	1
1	A	57	GLU	1
1	A	86	THR	1
1	A	93	GLU	1
1	A	82	VAL	1
1	A	183	LYS	1
1	A	50	ASP	1
1	A	60	ASN	1
1	A	173	ASN	1
1	A	58	THR	1
1	A	35	THR	1
1	A	51	LYS	1
1	A	105	GLN	1
1	A	167	GLU	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