



Full wwPDB NMR Structure Validation Report ⓘ

May 28, 2020 – 11:54 pm BST

PDB ID : 2MPW
Title : Solution structure of the LysM region of the E. coli Intimin periplasmic domain
Authors : Coles, M.; Chaubey, M.; Leo, J.C.; Linke, D.; Schuetz, M.C.; Goetz, F.; Autenrieth, I.B.
Deposited on : 2014-06-05

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

Cyrange : Kirchner and Güntert (2011)
NmrClust : Kelley et al. (1996)
MolProbity : 4.02b-467
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
RCI : v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV : Wang et al. (2010)
ShiftChecker : 2.11
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.11

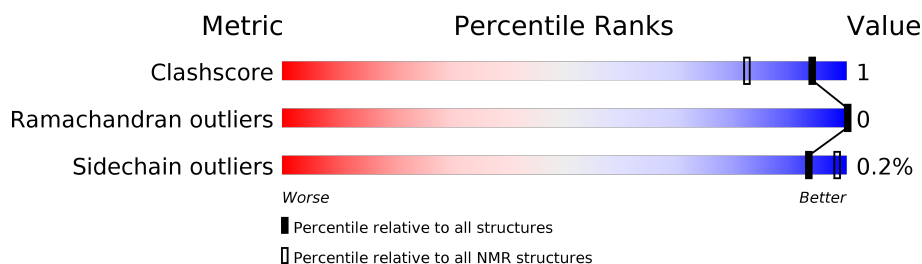
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 88%.

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 $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	115	

2 Ensemble composition and analysis

This entry contains 23 models. Model 13 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *minimized average structure*.

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:63-A:113 (51)	0.17	13

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 and 1 single-model cluster was found.

Cluster number	Models
1	3, 5, 10, 13, 15, 17, 21, 22
2	2, 8, 9, 16, 18, 19, 20
3	1, 6, 12, 14, 23
4	7, 11
Single-model clusters	4

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 1763 atoms, of which 878 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Intimin.

Mol	Chain	Residues	Atoms						Trace
1	A	115	Total	C	H	N	O	S	0
			1763	563	878	146	173	3	

There are 11 discrepancies between the modelled and reference sequences:

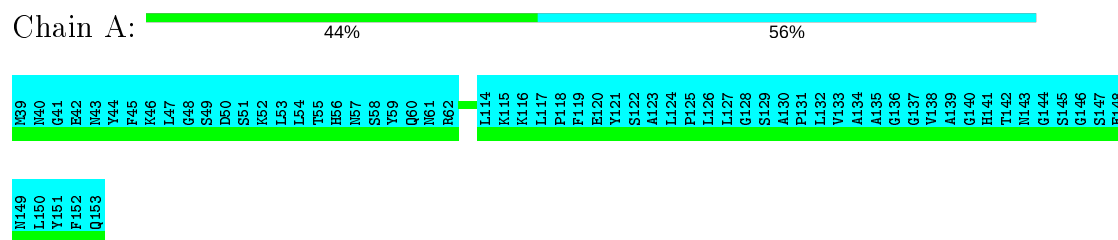
Chain	Residue	Modelled	Actual	Comment	Reference
A	39	MET	ALA	ENGINEERED MUTATION	UNP P19809
A	144	GLY	-	EXPRESSION TAG	UNP P19809
A	145	SER	-	EXPRESSION TAG	UNP P19809
A	146	GLY	-	EXPRESSION TAG	UNP P19809
A	147	SER	-	EXPRESSION TAG	UNP P19809
A	148	GLU	-	EXPRESSION TAG	UNP P19809
A	149	ASN	-	EXPRESSION TAG	UNP P19809
A	150	LEU	-	EXPRESSION TAG	UNP P19809
A	151	TYR	-	EXPRESSION TAG	UNP P19809
A	152	PHE	-	EXPRESSION TAG	UNP P19809
A	153	GLN	-	EXPRESSION TAG	UNP P19809

4 Residue-property plots [i](#)

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA and DNA 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: Intimin

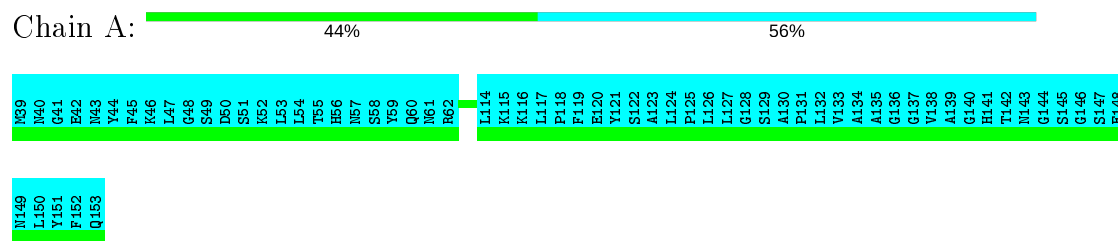


4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

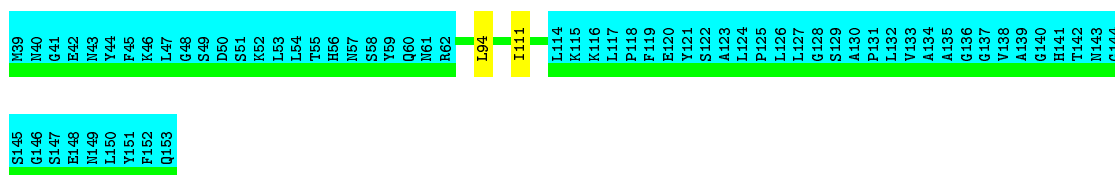
- Molecule 1: Intimin



4.2.2 Score per residue for model 2

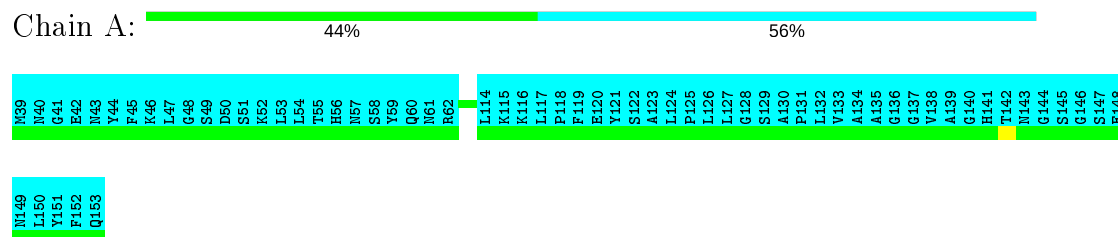
- Molecule 1: Intimin





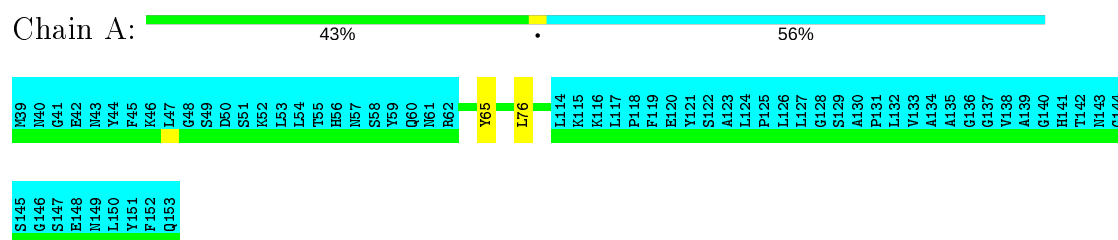
4.2.3 Score per residue for model 3

- Molecule 1: Intimin



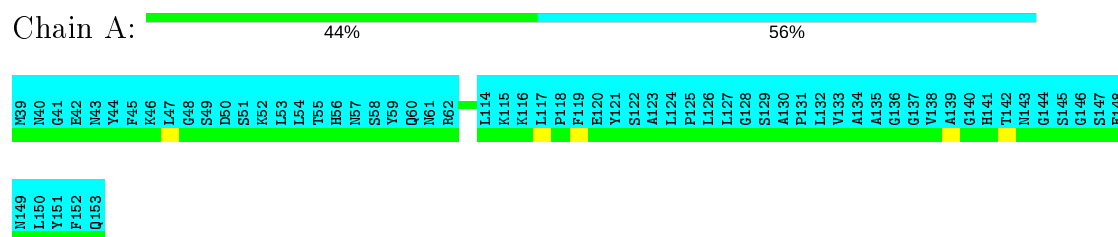
4.2.4 Score per residue for model 4

- Molecule 1: Intimin



4.2.5 Score per residue for model 5

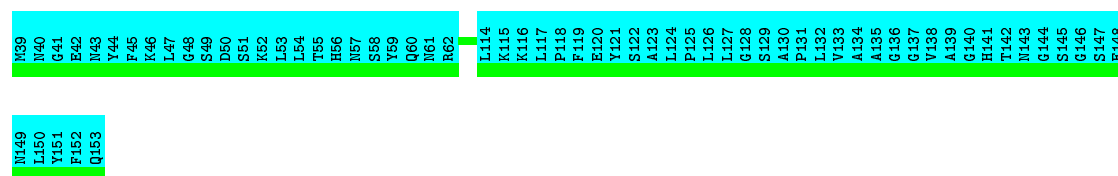
- Molecule 1: Intimin



4.2.6 Score per residue for model 6

- Molecule 1: Intimin

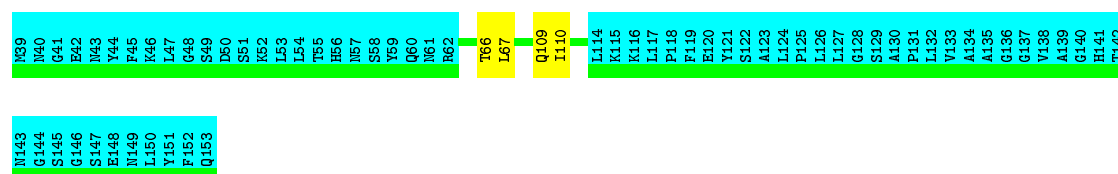
Chain A:  44% 56%



4.2.7 Score per residue for model 7

- Molecule 1: Intimin

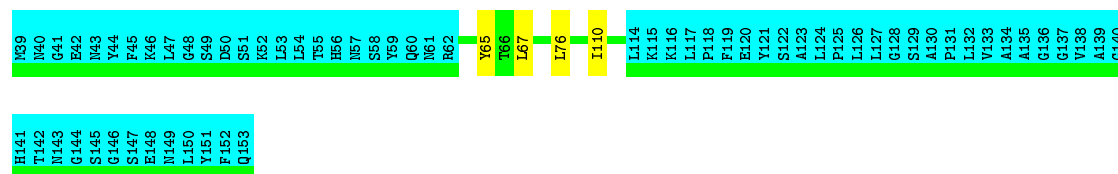
Chain A:  41% 56%



4.2.8 Score per residue for model 8

- Molecule 1: Intimin

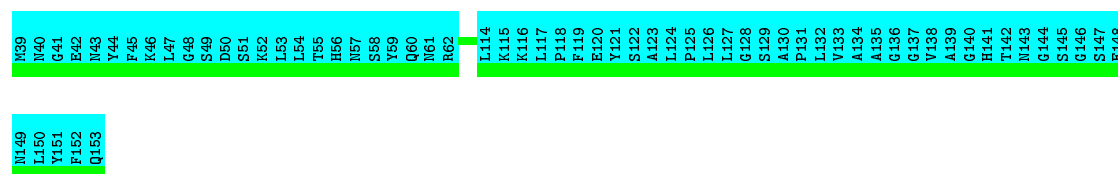
Chain A:  41% 56%



4.2.9 Score per residue for model 9

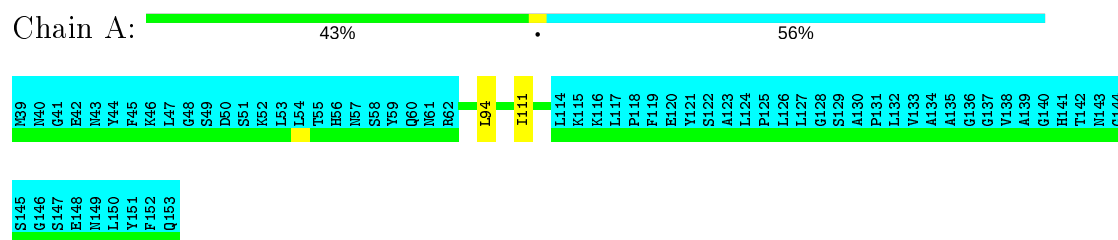
- Molecule 1: Intimin

Chain A:  44% 56%



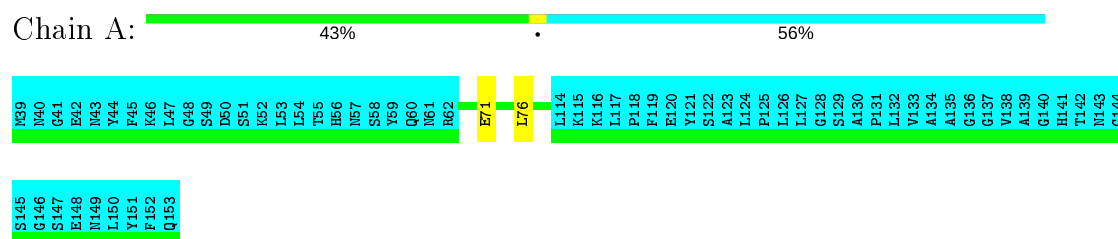
4.2.10 Score per residue for model 10

- Molecule 1: Intimin



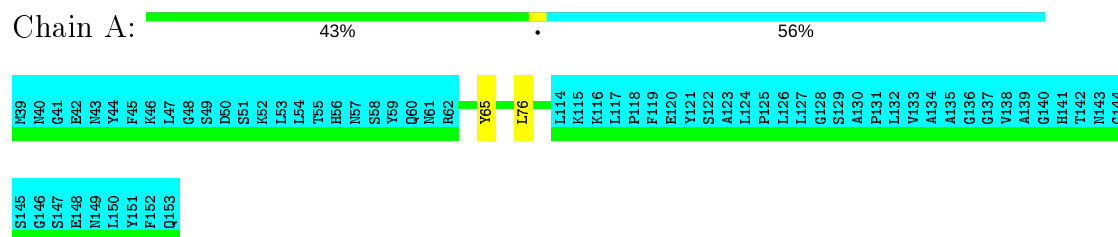
4.2.11 Score per residue for model 11

- Molecule 1: Intimin



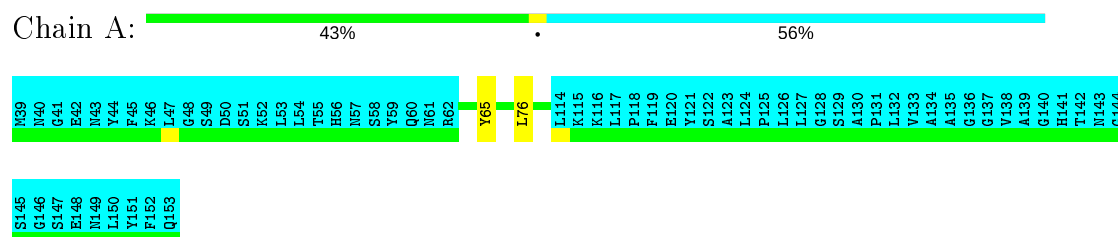
4.2.12 Score per residue for model 12

- Molecule 1: Intimin



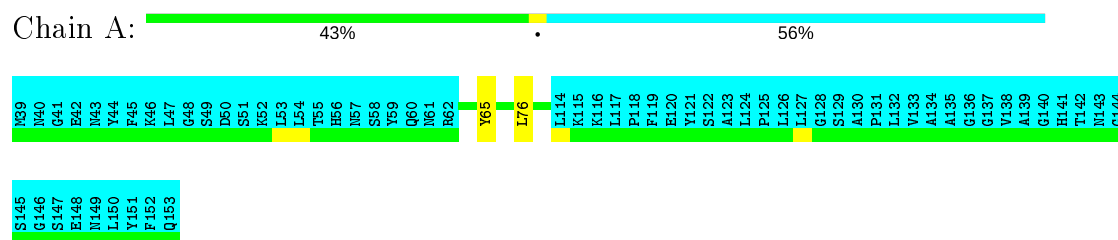
4.2.13 Score per residue for model 13 (medoid)

- Molecule 1: Intimin



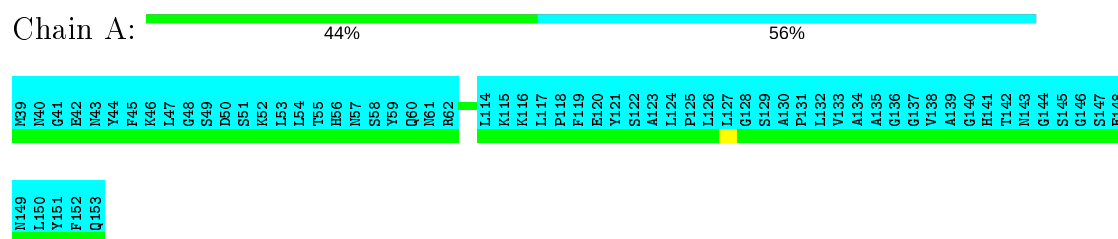
4.2.14 Score per residue for model 14

- Molecule 1: Intimin



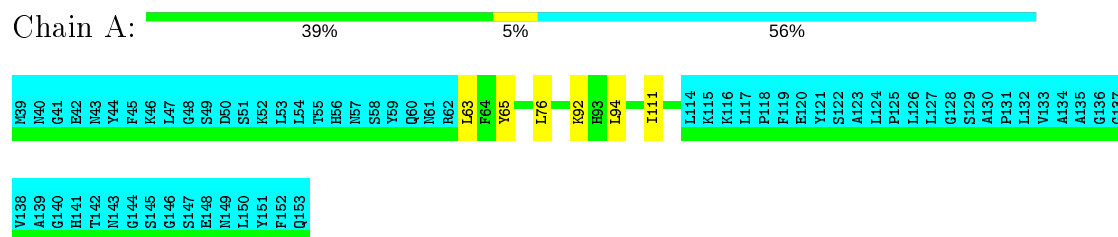
4.2.15 Score per residue for model 15

- Molecule 1: Intimin



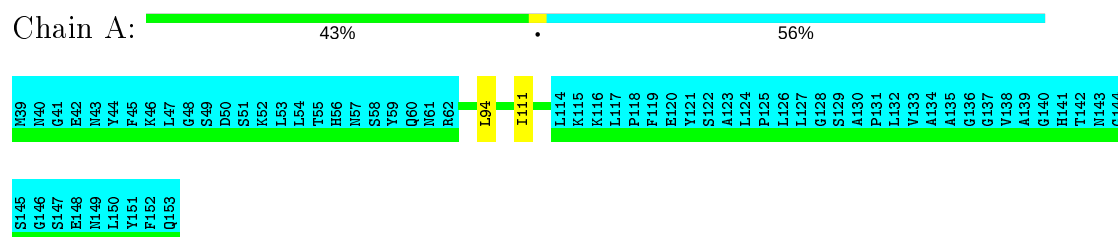
4.2.16 Score per residue for model 16

- Molecule 1: Intimin



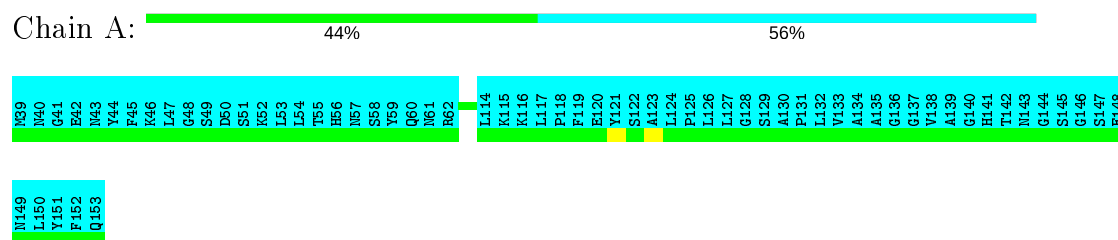
4.2.17 Score per residue for model 17

- Molecule 1: Intimin



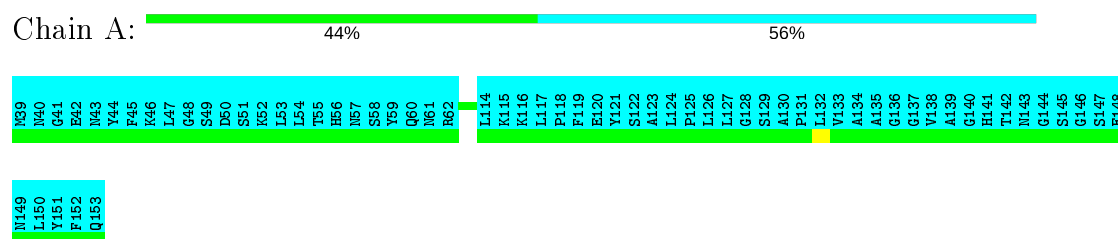
4.2.18 Score per residue for model 18

- Molecule 1: Intimin



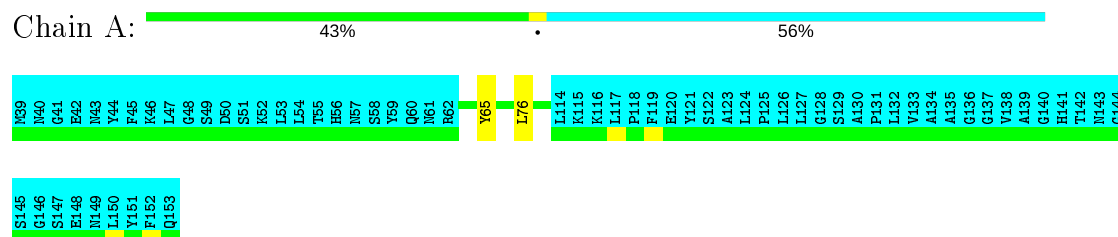
4.2.19 Score per residue for model 19

- Molecule 1: Intimin



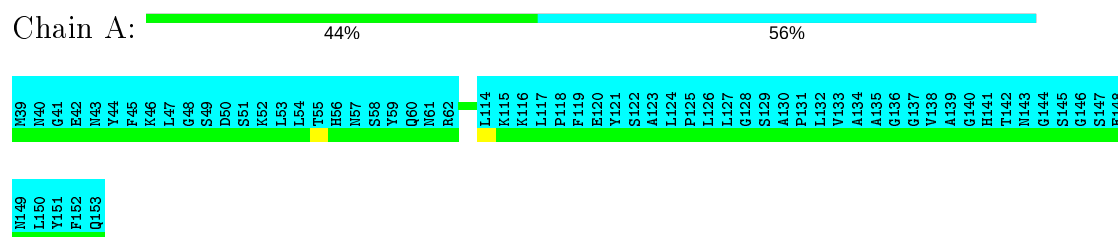
4.2.20 Score per residue for model 20

- Molecule 1: Intimin



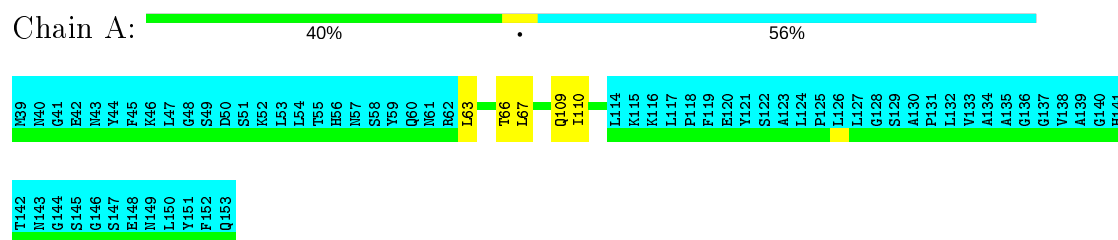
4.2.21 Score per residue for model 21

- Molecule 1: Intimin



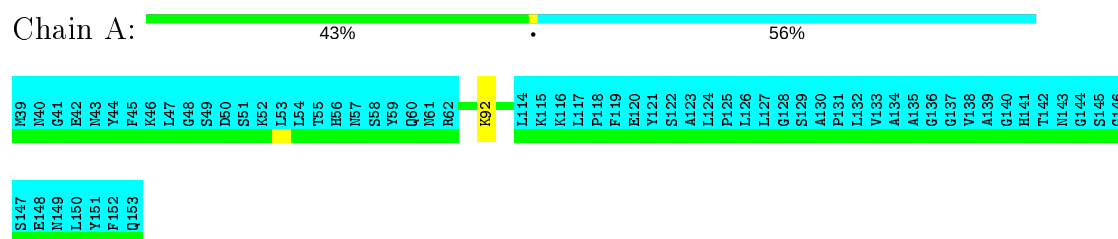
4.2.22 Score per residue for model 22

- Molecule 1: Intimin



4.2.23 Score per residue for model 23

- Molecule 1: Intimin



5 Refinement protocol and experimental data overview

The models were refined using the following method: *simulated annealing, NOESY back-calculation*.

Of the 95 calculated structures, 23 were deposited, based on the following criterion: *structures with the lowest energy*.

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

Software name	Classification	Version
X-PLOR NIH	structure solution	
X-PLOR NIH	refinement	
NMR-SPIRIT	refinement	1.1

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)	input_cs.cif
Number of chemical shift lists	1
Total number of shifts	947
Number of shifts mapped to atoms	947
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	88%

No validations of the models with respect to experimental NMR restraints is performed at this time.

6 Model quality [i](#)

6.1 Standard geometry [i](#)

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 [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	399	404	404	1±1
All	All	9177	9292	9292	22

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 1.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:71:GLU:OE2	1:A:76:LEU:HD13	0.56	2.01	11	1
1:A:67:LEU:HD21	1:A:110:ILE:HD11	0.54	1.78	7	3
1:A:94:LEU:HD11	1:A:111:ILE:HD12	0.51	1.82	17	4
1:A:65:TYR:CE2	1:A:76:LEU:HD21	0.50	2.42	12	5
1:A:66:THR:HG23	1:A:109:GLN:HE22	0.44	1.71	7	2
1:A:63:LEU:HD12	1:A:63:LEU:N	0.44	2.27	22	1
1:A:67:LEU:HD21	1:A:110:ILE:CD1	0.42	2.45	8	3
1:A:65:TYR:CE2	1:A:76:LEU:HD13	0.41	2.50	4	2
1:A:63:LEU:HD23	1:A:63:LEU:C	0.41	2.36	16	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	51/115 (44%)	51±0 (99±1%)	0±0 (1±1%)	0±0 (0±0%)	100	100
All	All	1173/2645 (44%)	1162 (99%)	11 (1%)	0 (0%)	100	100

There are no Ramachandran outliers.

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	46/97 (47%)	46±0 (100±1%)	0±0 (0±1%)	93	98
All	All	1058/2231 (47%)	1056 (100%)	2 (0%)	93	98

All 1 unique residues with a non-rotameric sidechain are listed below.

Mol	Chain	Res	Type	Models (Total)
1	A	92	LYS	2

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 carbohydrates 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 88% for the well-defined parts and 61% for the entire structure.

7.1 Chemical shift list 1

File name: input_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	947
Number of shifts mapped to atoms	947
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	2

7.1.2 Chemical shift referencing [i](#)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction \pm precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	84	-0.06 ± 0.15	None needed (< 0.5 ppm)
$^{13}\text{C}_\beta$	76	0.28 ± 0.17	None needed (< 0.5 ppm)
$^{13}\text{C}'$	60	-0.06 ± 0.16	None needed (< 0.5 ppm)
^{15}N	78	-0.42 ± 0.36	None needed (< 0.5 ppm)

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 88%, i.e. 543 atoms were assigned a chemical shift out of a possible 617. 5 out of 8 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	239/251 (95%)	99/100 (99%)	92/102 (90%)	48/49 (98%)
Sidechain	288/322 (89%)	178/189 (94%)	107/124 (86%)	3/9 (33%)

Continued on next page...

Continued from previous page...

	Total	¹ H	¹³ C	¹⁵ N
Aromatic	16/44 (36%)	15/23 (65%)	0/19 (0%)	1/2 (50%)
Overall	543/617 (88%)	292/312 (94%)	199/245 (81%)	52/60 (87%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 61%, i.e. 837 atoms were assigned a chemical shift out of a possible 1364. 6 out of 20 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹ H	¹³ C	¹⁵ N
Backbone	380/565 (67%)	158/225 (70%)	144/230 (63%)	78/110 (71%)
Sidechain	435/682 (64%)	266/402 (66%)	166/256 (65%)	3/24 (12%)
Aromatic	22/117 (19%)	21/62 (34%)	0/51 (0%)	1/4 (25%)
Overall	837/1364 (61%)	445/689 (65%)	310/537 (58%)	82/138 (59%)

7.1.4 Statistically unusual chemical shifts ⓘ

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.

Mol	Chain	Res	Type	Atom	Shift, ppm	Expected range, ppm	Z-score
1	A	98	GLU	HB2	0.87	3.08 – 0.98	-5.5
1	A	98	GLU	HG3	1.17	3.31 – 1.21	-5.2

7.1.5 Random Coil Index (RCI) plots ⓘ

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.

Random coil index (RCI) for chain A:

