



Full wwPDB NMR Structure Validation Report ⓘ

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PDB ID : 2LAE
Title : NMR solution structure of the C-terminal domain of the E. coli lipoprotein BamC
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Deposited on : 2011-03-11

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

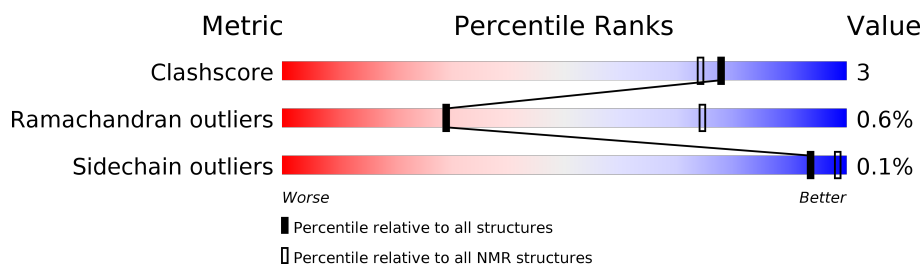
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 81%.

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	249	

2 Ensemble composition and analysis

This entry contains 9 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:229-A:344 (116)	0.37	1

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. No single-model clusters were found.

Cluster number	Models
1	1, 2, 3, 4, 5, 6
2	7, 8, 9

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 1756 atoms, of which 867 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Lipoprotein 34.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	118	1756	554	867	153	179	3	0

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	98	GLY	-	EXPRESSION TAG	UNP P0A903
A	99	ALA	-	EXPRESSION TAG	UNP P0A903
A	100	MET	-	EXPRESSION TAG	UNP P0A903
A	345	PRO	-	EXPRESSION TAG	UNP P0A903
A	346	GLY	-	EXPRESSION TAG	UNP P0A903

Chain A: 45% .. 53%

GLY
ALA
MET
GLY
TYR
GLN
ASP
THR
ALA
SER
LEU
LEU
VAL
GLN
GLY
ASN
GLY
ARG
GLY
GLY
ASN
THR
LEU
LEU
PRO
GLN
VAL
SER
GLU
LEU
VAL
LEU
LEU
ALA
GLY
LYS
ALA
LYS
PRO
ASN
VAL
VAL
SER
GLU
GLN
LEU
LEU
ALA
GLY
LYS
VAL
ASP
ASP
GLY
GLY
THR
LEU
THR
THR

ARG
GLY
ARG
TYR
GLN
ASP
THR
ILE
SER
VAL
LEU
PRO
GLN
VAL
GLN
GLY
TYR
GLN
GLN
ALA
VAL
THR
THR
VAL
LYS
LEU
LEU
LEU
LEU
LEU
GLN
ASN
VAL
SER
GLU
GLN
ALA
GLY
LYS
VAL
ASP
ASP
GLY
TYR
SER
THR
GLU
MET
MET
MET
ASN
VAL
ILE
TRP
SER
SER
GLY
LEU
ASN
ARG
LEU
LYS
SER
SER
ALA
THR
ASP
GLU
ALA
TYR

ASN
ALA
ALA
ALA
ASN
ARG
ALA
SER
THR
THR
MET
MET
D229
M241
L255
P256
D320
P321
P345
G346

4.2.6 Score per residue for model 6

- Molecule 1: Lipoprotein 34

Chain A: 45% .. 53%

GLY
ALA
MET
GLY
TYR
GLN
ASP
THR
ALA
SER
LEU
LEU
VAL
GLN
GLY
ASN
GLY
ARG
GLY
GLY
ASN
THR
LEU
LEU
PRO
GLN
VAL
SER
GLU
LEU
VAL
LEU
LEU
ALA
GLY
LYS
ALA
LYS
PRO
ASN
VAL
VAL
SER
GLU
GLN
LEU
LEU
ALA
GLY
LYS
VAL
ASP
ASP
GLY
GLY
THR
LEU
THR
THR

ARG
GLY
ARG
TYR
GLN
ASP
THR
ILE
SER
VAL
LEU
PRO
GLN
VAL
GLN
GLY
TYR
GLN
GLN
ALA
VAL
THR
THR
VAL
LYS
LEU
LEU
LEU
LEU
LEU
GLN
ASN
VAL
SER
GLU
GLN
ALA
GLY
LYS
VAL
ASP
ASP
GLY
TYR
SER
THR
GLU
MET
MET
MET
ASN
VAL
ILE
TRP
SER
SER
GLY
LEU
ASN
ARG
LEU
LYS
SER
SER
ALA
THR
ASP
GLU
ALA
TYR

ASN
ALA
ALA
ALA
ASN
ARG
ALA
SER
THR
THR
MET
MET
D229
L255
P256
L310
D311
P345
G346

4.2.7 Score per residue for model 7

- Molecule 1: Lipoprotein 34

Chain A: 45% .. 53%

GLY
ALA
MET
GLY
TYR
GLN
ASP
THR
ALA
SER
LEU
LEU
VAL
GLN
GLY
ASN
GLY
ARG
GLY
GLY
ASN
THR
LEU
LEU
PRO
GLN
VAL
SER
GLU
LEU
VAL
LEU
LEU
ALA
GLY
LYS
ALA
LYS
PRO
ASN
VAL
VAL
SER
GLU
GLN
LEU
LEU
ALA
GLY
LYS
VAL
ASP
ASP
GLY
GLY
THR
LEU
THR
THR

ARG
GLY
ARG
TYR
GLN
ASP
THR
ILE
SER
VAL
LEU
PRO
GLN
VAL
GLN
GLY
TYR
GLN
GLN
ALA
VAL
THR
THR
VAL
LYS
LEU
LEU
LEU
LEU
LEU
GLN
ASN
VAL
SER
GLU
GLN
ALA
GLY
LYS
VAL
ASP
ASP
GLY
TYR
SER
THR
GLU
MET
MET
MET
ASN
VAL
ILE
TRP
SER
SER
GLY
LEU
ASN
ARG
LEU
LYS
SER
SER
ALA
THR
ASP
GLU
ALA
TYR

ASN
ALA
ALA
ALA
ASN
ARG
ALA
SER
THR
THR
MET
MET
D229
P248
V251
L255
P256
L298
P345
G346

4.2.8 Score per residue for model 8

- Molecule 1: Lipoprotein 34

Chain A: 45% .. 53%

GLY	ARG	ASN	ASN	GLN	GLN	GLN	GLY	VAL	THR	LEU	TRP	PRO	GLN	VAL	SER	VAL	LEU	GLN	LYS	TYR	THR	ASP	ASP	GLY	GLY	THR	THR	THR	ASP	VAL	GLN	TRP	ASN	ARG	LEU	ASP	GLU	ASP	GLU	ASP	GLN	TYR	
ALA	GLY	ALA	ALA	GLN	GLN	ALA	GLY	VAL	THR	LEU	TRP	PRO	GLN	VAL	SER	VAL	LEU	GLN	LYS	TYR	THR	ASP	ASP	GLY	GLY	THR	THR	ASP	VAL	GLN	TRP	ASN	ARG	LEU	ASP	GLU	ASP	GLU	ASP	GLN	TYR		
MET	TYR	GLY	ASN	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
ASP	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR

4.2.9 Score per residue for model 9

- Molecule 1: Lipoprotein 34

Chain A:  44% .. 53%

GLY	ARG	ASN	ASN	GLN	GLN	GLN	GLY	VAL	THR	LEU	TRP	PRO	GLN	VAL	SER	VAL	LEU	GLN	LYS	TYR	THR	ASP	ASP	GLY	GLY	THR	THR	THR	ASP	VAL	GLN	TRP	ASN	ARG	LEU	ASP	GLU	ASP	GLU	ASP	GLN	TYR			
ALA	GLY	ALA	ALA	GLN	GLN	ALA	GLY	VAL	THR	LEU	TRP	PRO	GLN	VAL	SER	VAL	LEU	GLN	LYS	TYR	THR	ASP	ASP	GLY	GLY	THR	THR	THR	ASP	VAL	GLN	TRP	ASN	ARG	LEU	ASP	GLU	ASP	GLU	ASP	GLN	TYR			
MET	TYR	GLY	ASN	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	
ASP	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR

5 Refinement protocol and experimental data overview

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

Of the 100 calculated structures, 9 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
CS-NOE-RDC Rosetta	structure solution	
CS-NOE-RDC Rosetta	refinement	

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	2539
Number of shifts mapped to atoms	2539
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	81%

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	877	857	856	5±1
All	All	7893	7713	7704	45

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 3.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:310:LEU:O	1:A:311:ASP:CB	0.70	2.39	9	5
1:A:310:LEU:O	1:A:311:ASP:HB3	0.56	2.01	9	5
1:A:255:LEU:N	1:A:256:PRO:CD	0.55	2.69	4	9
1:A:320:ASP:HB2	1:A:321:PRO:CD	0.51	2.36	5	7
1:A:255:LEU:N	1:A:256:PRO:HD2	0.51	2.20	7	1
1:A:305:LEU:C	1:A:305:LEU:HD13	0.49	2.28	8	1
1:A:255:LEU:HB3	1:A:256:PRO:HD3	0.46	1.88	5	1
1:A:251:VAL:O	1:A:255:LEU:N	0.45	2.49	1	5
1:A:248:PHE:O	1:A:248:PHE:CD1	0.44	2.70	7	1
1:A:320:ASP:OD1	1:A:320:ASP:C	0.43	2.57	4	2
1:A:248:PHE:C	1:A:248:PHE:CD1	0.41	2.91	7	1
1:A:264:MET:SD	1:A:278:VAL:HG21	0.41	2.55	1	1
1:A:320:ASP:HB2	1:A:321:PRO:HD2	0.41	1.91	9	3
1:A:241:MET:SD	1:A:315:SER:OG	0.41	2.77	2	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:320:ASP:C	1:A:320:ASP:OD1	0.41	2.59	5	1
1:A:240:PRO:HG3	1:A:328:GLN:HG3	0.40	1.93	2	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	115/249 (46%)	113±1 (98±1%)	2±1 (1±1%)	1±0 (1±0%)	29	74
All	All	1035/2241 (46%)	1015 (98%)	14 (1%)	6 (1%)	29	74

All 2 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	311	ASP	5
1	A	298	LEU	1

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	96/203 (47%)	96±0 (100±0%)	0±0 (0±0%)	93	98
All	All	864/1827 (47%)	863 (100%)	1 (0%)	93	98

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

Mol	Chain	Res	Type	Models (Total)
1	A	241	MET	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 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 81% for the well-defined parts and 81% 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	2539
Number of shifts mapped to atoms	2539
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 [i](#)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction \pm precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	248	-0.19 ± 0.15	None needed (< 0.5 ppm)
$^{13}\text{C}_\beta$	226	0.03 ± 0.15	None needed (< 0.5 ppm)
$^{13}\text{C}'$	246	-0.12 ± 0.09	None needed (< 0.5 ppm)
^{15}N	238	0.30 ± 0.25	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 81%, i.e. 1094 atoms were assigned a chemical shift out of a possible 1348. 0 out of 23 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	566/568 (100%)	226/226 (100%)	230/232 (99%)	110/110 (100%)
Sidechain	524/697 (75%)	319/406 (79%)	205/260 (79%)	0/31 (0%)

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	Total	¹ H	¹³ C	¹⁵ N
Aromatic	4/83 (5%)	2/44 (5%)	0/36 (0%)	2/3 (67%)
Overall	1094/1348 (81%)	547/676 (81%)	435/528 (82%)	112/144 (78%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 81%, i.e. 1106 atoms were assigned a chemical shift out of a possible 1365. 0 out of 23 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹ H	¹³ C	¹⁵ N
Backbone	571/576 (99%)	228/229 (100%)	232/236 (98%)	111/111 (100%)
Sidechain	531/706 (75%)	323/412 (78%)	208/263 (79%)	0/31 (0%)
Aromatic	4/83 (5%)	2/44 (5%)	0/36 (0%)	2/3 (67%)
Overall	1106/1365 (81%)	553/685 (81%)	440/535 (82%)	113/145 (78%)

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.

Mol	Chain	Res	Type	Atom	Shift, ppm	Expected range, ppm	Z-score
1	A	262	VAL	C	141.06	185.16 – 166.16	-18.2
1	A	245	ARG	HB3	4.16	3.17 – 0.37	8.5
1	A	295	ASP	HA	2.49	6.15 – 3.05	-6.8
1	A	345	PRO	HG2	3.90	3.48 – 0.38	6.3
1	A	139	GLN	HA	1.57	6.41 – 2.11	-6.3
1	A	283	LEU	HB3	-0.49	3.34 – -0.26	-5.6
1	A	345	PRO	HG3	3.71	3.56 – 0.26	5.5
1	A	271	ARG	HG2	0.10	2.92 – 0.22	-5.5
1	A	200	GLU	HB3	0.84	3.10 – 0.90	-5.3

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.

Random coil index (RCI) for chain A:

