



# Full wwPDB NMR Structure Validation Report ⓘ

Apr 26, 2016 – 06:11 PM BST

PDB ID : 1XX3  
Title : Solution Structure of Escherichia coli TonB-CTD  
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Deposited on : 2004-11-03

This is a Full wwPDB NMR Structure Validation Report for a publicly released PDB entry.  
We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)  
A user guide is available at  
<http://wwpdb.org/validation/2016/NMRValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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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  
Mogul : unknown  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
RCI : v\_1n\_11\_5\_13\_A (Berjanski et al., 2005)  
PANAV : Wang et al. (2010)  
ShiftChecker : rb-20027457  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : rb-20027457

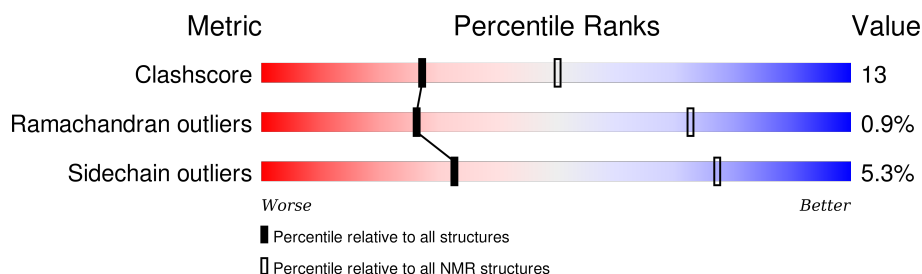
# 1 Overall quality at a glance

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	114402	11133
Ramachandran outliers	111179	9975
Sidechain outliers	111093	9958

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  $\geq 3$ , 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	144	

## 2 Ensemble composition and analysis

This entry contains 20 models. Model 7 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:154-A:239 (86)	0.32	7

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 3 clusters and 5 single-model clusters were found.

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

### 3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 1427 atoms, of which 722 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called TonB protein.

Mol	Chain	Residues	Atoms						Trace
1	A	89	Total	C	H	N	O	S	0
			1427	441	722	135	127	2	

There are 7 discrepancies between the modelled and reference sequences:

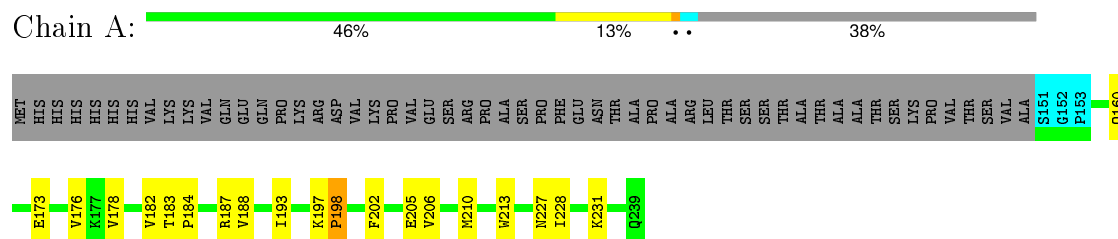
Chain	Residue	Modelled	Actual	Comment	Reference
A	96	MET	-	CLONING ARTIFACT	UNP P02929
A	97	HIS	-	CLONING ARTIFACT	UNP P02929
A	98	HIS	-	CLONING ARTIFACT	UNP P02929
A	99	HIS	-	CLONING ARTIFACT	UNP P02929
A	100	HIS	-	CLONING ARTIFACT	UNP P02929
A	101	HIS	-	CLONING ARTIFACT	UNP P02929
A	102	HIS	-	CLONING ARTIFACT	UNP P02929

## 4 Residue-property plots

### 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: TonB protein

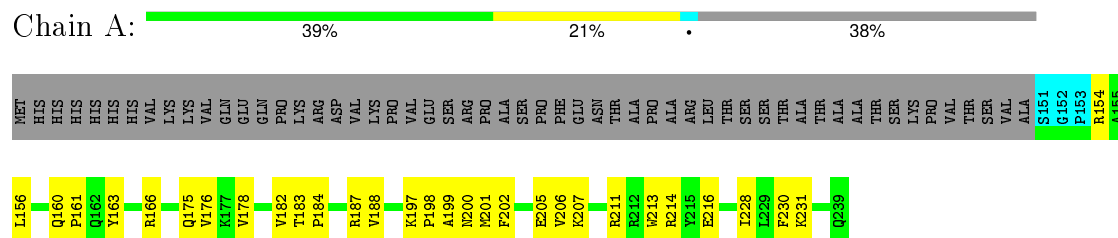


### 4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

#### 4.2.1 Score per residue for model 1

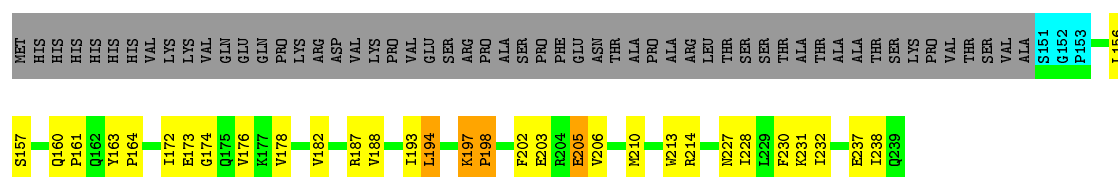
- Molecule 1: TonB protein



#### 4.2.2 Score per residue for model 2

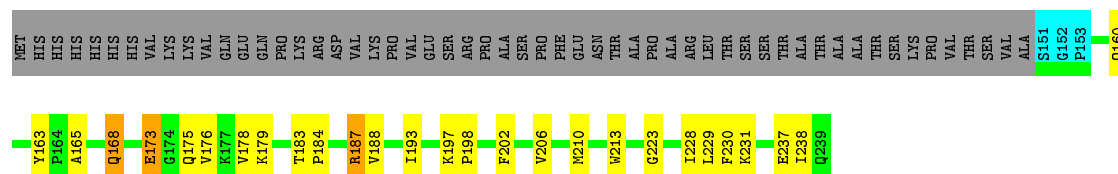
- Molecule 1: TonB protein





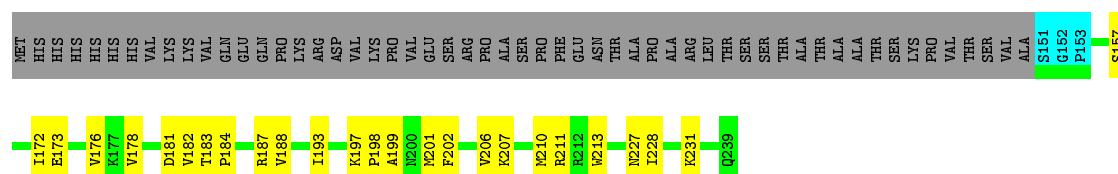
### 4.2.3 Score per residue for model 3

- Molecule 1: TonB protein



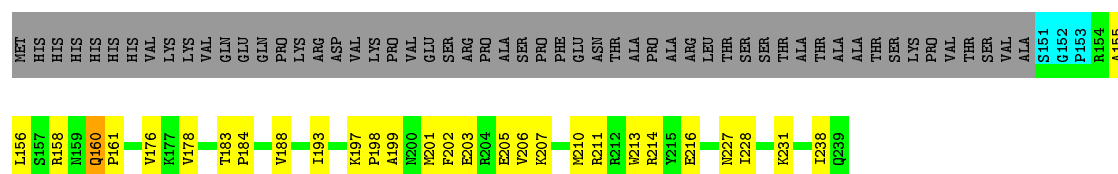
### 4.2.4 Score per residue for model 4

- Molecule 1: TonB protein



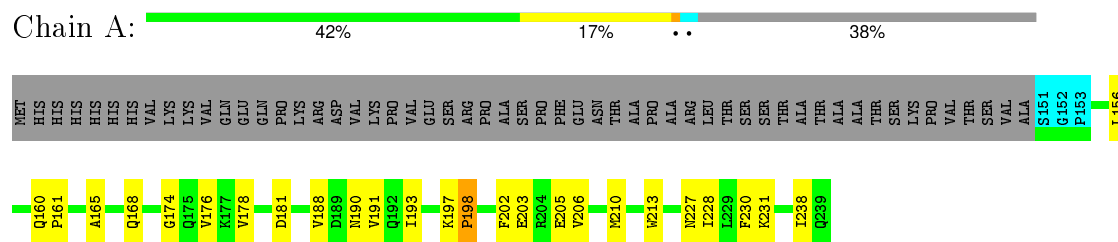
### 4.2.5 Score per residue for model 5

- Molecule 1: TonB protein



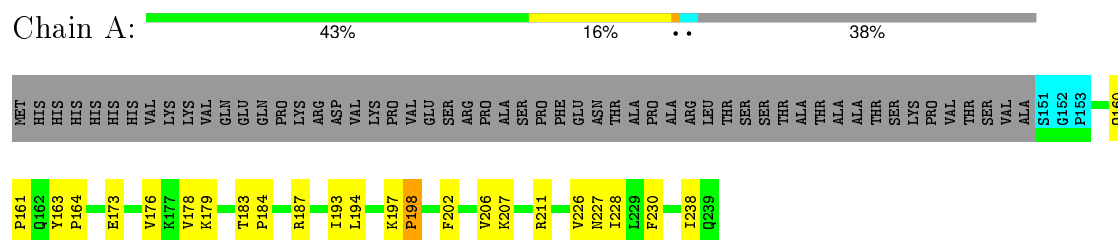
### 4.2.6 Score per residue for model 6

- Molecule 1: TonB protein



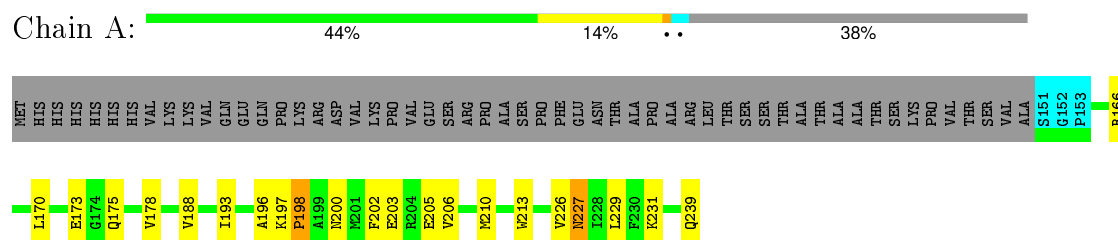
#### 4.2.7 Score per residue for model 7 (medoid)

- Molecule 1: TonB protein



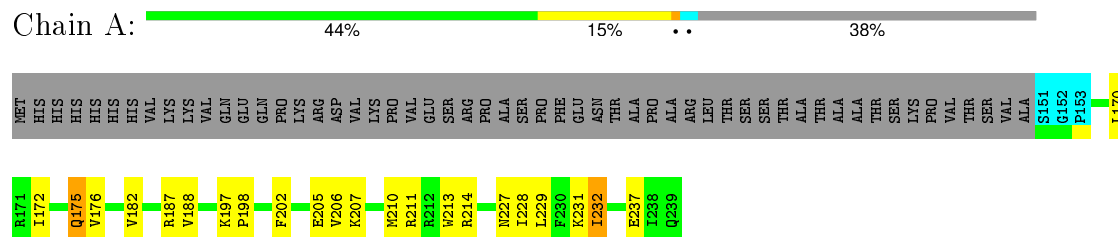
#### 4.2.8 Score per residue for model 8

- Molecule 1: TonB protein



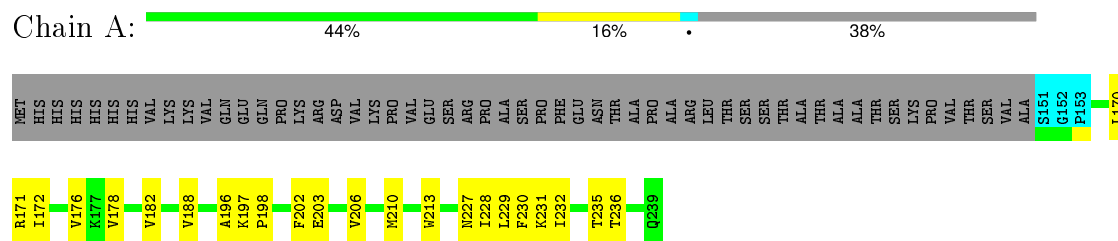
#### 4.2.9 Score per residue for model 9

- Molecule 1: TonB protein



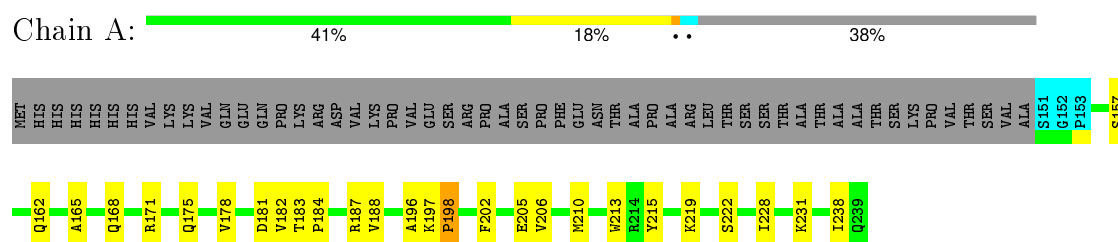
#### 4.2.10 Score per residue for model 10

- Molecule 1: TonB protein



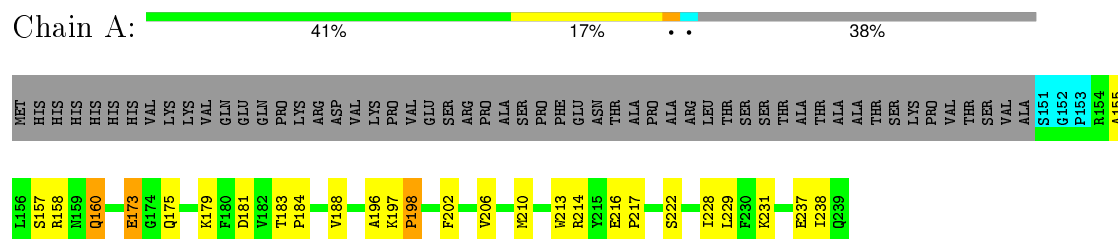
#### 4.2.11 Score per residue for model 11

- Molecule 1: TonB protein



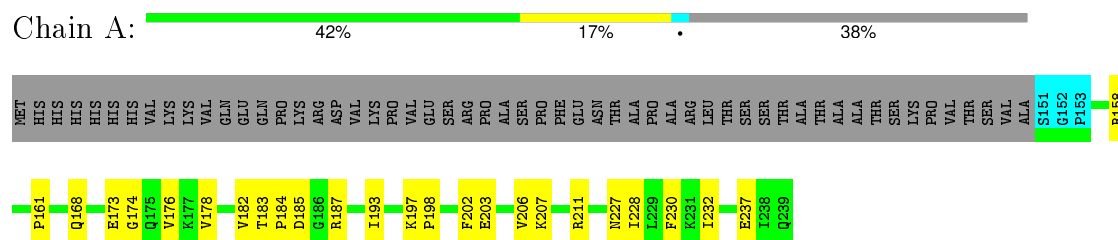
#### 4.2.12 Score per residue for model 12

- Molecule 1: TonB protein



#### 4.2.13 Score per residue for model 13

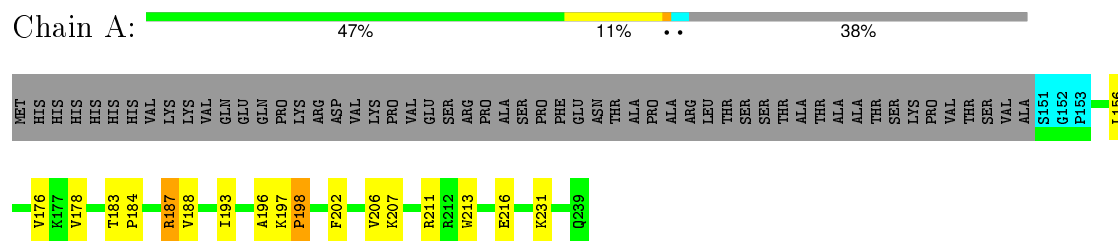
- Molecule 1: TonB protein





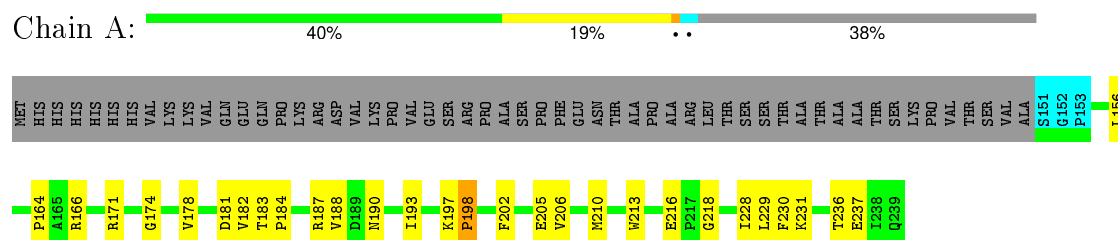
#### 4.2.14 Score per residue for model 14

- Molecule 1: TonB protein



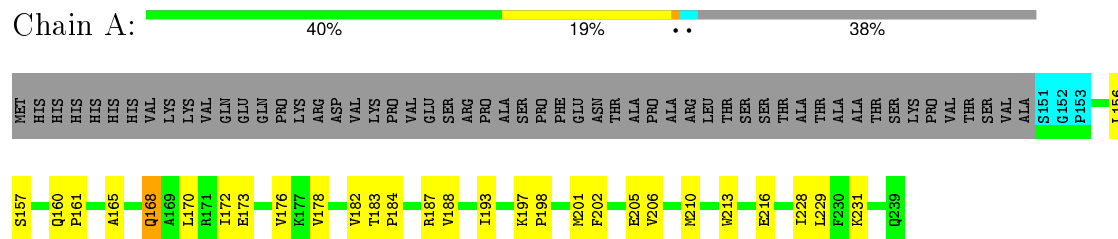
#### 4.2.15 Score per residue for model 15

- Molecule 1: TonB protein



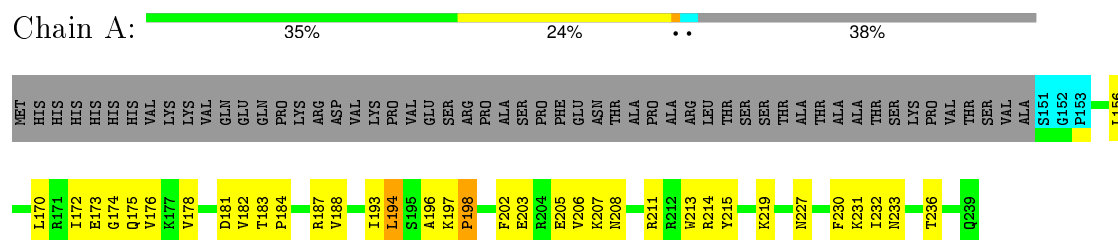
#### 4.2.16 Score per residue for model 16

- Molecule 1: TonB protein



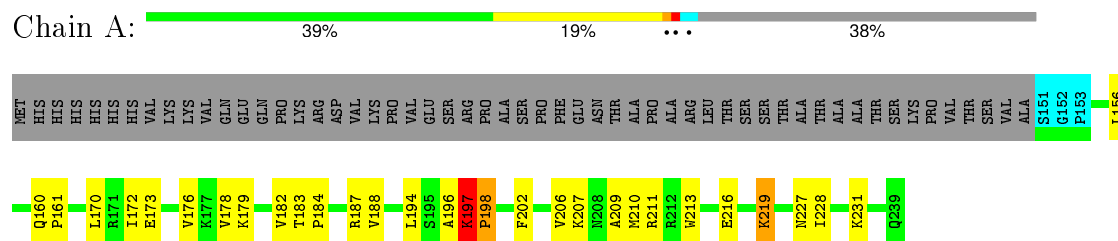
#### 4.2.17 Score per residue for model 17

- Molecule 1: TonB protein



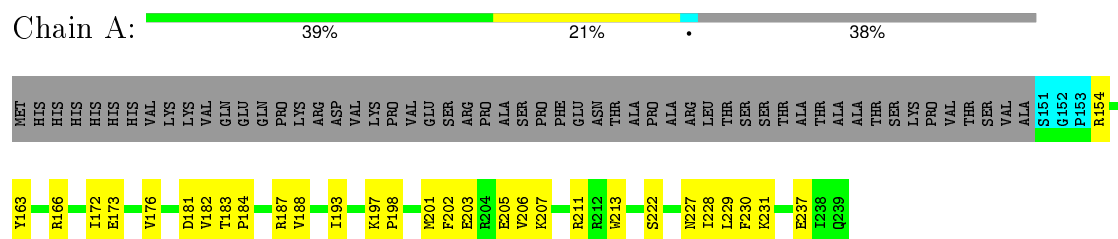
## 4.2.18 Score per residue for model 18

- Molecule 1: TonB protein



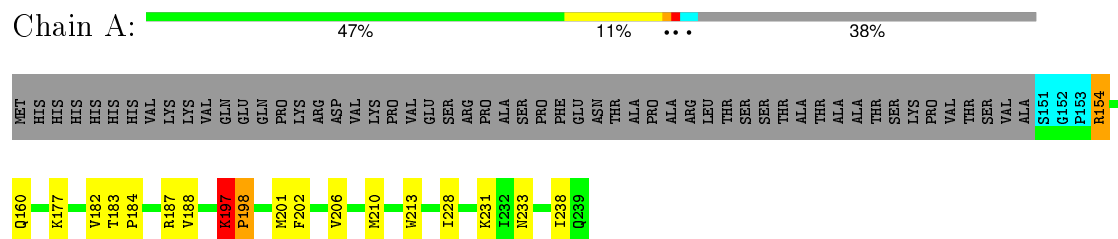
## 4.2.19 Score per residue for model 19

- Molecule 1: TonB protein



## 4.2.20 Score per residue for model 20

- Molecule 1: TonB protein



## 5 Refinement protocol and experimental data overview ⓘ

The models were refined using the following method: *This structure was refined using standard Aria2.0 protocols (distance geometry, simulated annealing, torsion angle dynamics, water refinement).*

Of the 200 calculated structures, 20 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
CNS	refinement	1.1

No chemical shift data was provided. No validations of the models with respect to experimental NMR restraints is performed at this time.

## 6 Model quality ⓘ

### 6.1 Standard geometry ⓘ

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 ⓘ

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	688	707	707	18±3
All	All	13760	14140	14140	359

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 13.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:197:LYS:HB3	1:A:198:PRO:HD3	0.92	1.39	10	15
1:A:197:LYS:HB2	1:A:198:PRO:HD2	0.90	1.42	20	2
1:A:154:ARG:HE	1:A:154:ARG:HA	0.76	1.41	20	1
1:A:197:LYS:HD2	1:A:202:PHE:HB2	0.76	1.57	20	2
1:A:229:LEU:HB3	1:A:231:LYS:HE3	0.75	1.59	3	6
1:A:197:LYS:HB2	1:A:198:PRO:CD	0.72	2.15	20	2
1:A:197:LYS:HA	1:A:197:LYS:HE2	0.70	1.62	2	1
1:A:183:THR:HB	1:A:184:PRO:HD2	0.70	1.62	15	15
1:A:173:GLU:HG2	1:A:232:ILE:HB	0.67	1.65	2	2
1:A:163:TYR:CE1	1:A:230:PHE:HB3	0.66	2.26	7	4
1:A:229:LEU:HB2	1:A:237:GLU:HB3	0.65	1.68	3	1
1:A:197:LYS:HB2	1:A:198:PRO:HD3	0.63	1.69	12	2
1:A:187:ARG:HE	1:A:187:ARG:HA	0.63	1.51	3	1
1:A:202:PHE:O	1:A:206:VAL:HG23	0.62	1.95	18	20

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:197:LYS:CB	1:A:198:PRO:HD3	0.61	2.25	12	10
1:A:194:LEU:HD22	1:A:194:LEU:H	0.61	1.55	2	2
1:A:188:VAL:HG21	1:A:213:TRP:HB2	0.61	1.72	19	18
1:A:183:THR:HB	1:A:184:PRO:CD	0.60	2.26	19	4
1:A:175:GLN:O	1:A:196:ALA:HA	0.60	1.97	8	4
1:A:183:THR:OG1	1:A:187:ARG:HG3	0.60	1.96	14	2
1:A:206:VAL:O	1:A:210:MET:HG2	0.59	1.98	8	6
1:A:161:PRO:HG2	1:A:228:ILE:HD13	0.58	1.74	16	7
1:A:162:GLN:HB3	1:A:205:GLU:HG2	0.58	1.74	11	1
1:A:178:VAL:HG21	1:A:206:VAL:HG11	0.58	1.76	18	11
1:A:154:ARG:HA	1:A:154:ARG:NE	0.58	2.11	20	1
1:A:156:LEU:HD11	1:A:216:GLU:HG3	0.58	1.75	18	2
1:A:197:LYS:HB3	1:A:198:PRO:CD	0.58	2.26	14	8
1:A:207:LYS:O	1:A:211:ARG:HG3	0.57	1.99	7	10
1:A:178:VAL:HG22	1:A:193:ILE:HG13	0.57	1.75	14	10
1:A:229:LEU:HB3	1:A:231:LYS:HE2	0.56	1.77	9	1
1:A:176:VAL:HG22	1:A:228:ILE:HB	0.56	1.77	19	11
1:A:231:LYS:HE2	1:A:231:LYS:HA	0.56	1.78	11	6
1:A:179:LYS:HE2	1:A:223:GLY:HA2	0.55	1.76	3	1
1:A:182:VAL:HA	1:A:187:ARG:O	0.55	2.02	13	12
1:A:197:LYS:HE3	1:A:202:PHE:HD1	0.54	1.62	20	2
1:A:181:ASP:HB3	1:A:190:ASN:HB2	0.54	1.79	15	1
1:A:191:VAL:HG11	1:A:210:MET:HG3	0.53	1.79	6	1
1:A:156:LEU:HD11	1:A:216:GLU:CG	0.53	2.33	14	2
1:A:197:LYS:HE2	1:A:198:PRO:HD2	0.53	1.80	20	2
1:A:179:LYS:HB2	1:A:194:LEU:HD11	0.53	1.80	7	2
1:A:230:PHE:CD2	1:A:236:THR:HG22	0.52	2.39	17	2
1:A:156:LEU:HD21	1:A:216:GLU:HG3	0.52	1.81	16	3
1:A:229:LEU:HB2	1:A:237:GLU:HB2	0.52	1.81	12	1
1:A:156:LEU:HD23	1:A:216:GLU:HG3	0.52	1.80	15	1
1:A:161:PRO:HA	1:A:209:ALA:HB2	0.52	1.82	18	1
1:A:170:LEU:HB3	1:A:172:ILE:HG13	0.51	1.82	18	5
1:A:163:TYR:CD2	1:A:164:PRO:HD2	0.51	2.40	2	2
1:A:206:VAL:O	1:A:210:MET:HG3	0.51	2.05	11	7
1:A:198:PRO:HB2	1:A:201:MET:HB2	0.51	1.82	4	3
1:A:231:LYS:HA	1:A:231:LYS:HE2	0.51	1.83	17	7
1:A:188:VAL:HG21	1:A:213:TRP:CB	0.51	2.36	19	6
1:A:172:ILE:HG21	1:A:198:PRO:HG3	0.51	1.82	10	1
1:A:215:TYR:HE1	1:A:219:LYS:HB2	0.50	1.67	11	2
1:A:201:MET:HG2	1:A:202:PHE:CD1	0.50	2.41	16	1
1:A:175:GLN:HG3	1:A:197:LYS:HB2	0.50	1.82	9	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:157:SER:O	1:A:213:TRP:HA	0.50	2.07	2	5
1:A:228:ILE:HG23	1:A:238:ILE:HG13	0.49	1.84	20	5
1:A:200:ASN:HA	1:A:203:GLU:HB2	0.49	1.84	8	1
1:A:193:ILE:CG1	1:A:203:GLU:HG2	0.49	2.38	6	5
1:A:229:LEU:O	1:A:236:THR:HA	0.49	2.08	15	1
1:A:197:LYS:HA	1:A:197:LYS:CE	0.49	2.35	2	1
1:A:163:TYR:HE1	1:A:230:PHE:HB3	0.49	1.64	7	1
1:A:215:TYR:CE1	1:A:219:LYS:HB2	0.49	2.42	11	2
1:A:163:TYR:HE2	1:A:168:GLN:HB3	0.49	1.68	3	1
1:A:166:ARG:HB2	1:A:201:MET:SD	0.49	2.48	19	1
1:A:181:ASP:OD1	1:A:222:SER:HA	0.48	2.08	19	3
1:A:173:GLU:CG	1:A:232:ILE:HB	0.48	2.38	17	1
1:A:156:LEU:HD21	1:A:216:GLU:CG	0.48	2.39	1	3
1:A:175:GLN:HG3	1:A:175:GLN:O	0.47	2.09	3	1
1:A:187:ARG:NE	1:A:187:ARG:HA	0.47	2.24	3	1
1:A:174:GLY:O	1:A:230:PHE:HD1	0.46	1.94	6	4
1:A:173:GLU:O	1:A:197:LYS:HG3	0.46	2.11	12	2
1:A:187:ARG:C	1:A:187:ARG:HD3	0.46	2.31	14	1
1:A:228:ILE:HA	1:A:237:GLU:O	0.46	2.10	15	5
1:A:154:ARG:HD3	1:A:216:GLU:OE2	0.46	2.11	1	1
1:A:175:GLN:HG2	1:A:197:LYS:HG2	0.46	1.86	1	1
1:A:155:ALA:HB1	1:A:158:ARG:HG3	0.45	1.88	12	2
1:A:161:PRO:HB2	1:A:230:PHE:CZ	0.45	2.46	13	3
1:A:160:GLN:HA	1:A:238:ILE:HD11	0.45	1.89	2	3
1:A:197:LYS:CB	1:A:198:PRO:CD	0.45	2.94	1	2
1:A:173:GLU:HB3	1:A:232:ILE:N	0.45	2.26	13	1
1:A:194:LEU:N	1:A:194:LEU:HD22	0.45	2.26	17	1
1:A:172:ILE:HG22	1:A:173:GLU:N	0.45	2.26	2	3
1:A:219:LYS:HE3	1:A:219:LYS:HA	0.45	1.87	18	1
1:A:165:ALA:O	1:A:168:GLN:HG3	0.44	2.12	3	1
1:A:160:GLN:OE1	1:A:238:ILE:HD12	0.44	2.13	6	1
1:A:166:ARG:O	1:A:170:LEU:HD13	0.44	2.13	8	1
1:A:179:LYS:HE2	1:A:223:GLY:CA	0.44	2.43	3	1
1:A:171:ARG:HD2	1:A:232:ILE:HD11	0.44	1.89	10	1
1:A:232:ILE:O	1:A:232:ILE:HD13	0.44	2.12	9	1
1:A:179:LYS:CE	1:A:223:GLY:HA2	0.44	2.43	3	1
1:A:206:VAL:HG12	1:A:210:MET:SD	0.43	2.52	16	3
1:A:177:LYS:HB2	1:A:177:LYS:NZ	0.43	2.28	20	1
1:A:165:ALA:HA	1:A:168:GLN:CG	0.43	2.42	16	1
1:A:176:VAL:HG21	1:A:206:VAL:HG21	0.43	1.90	17	1
1:A:156:LEU:N	1:A:156:LEU:HD22	0.43	2.28	16	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:197:LYS:HE3	1:A:201:MET:HB2	0.43	1.89	20	1
1:A:227:ASN:HB3	1:A:239:GLN:HE21	0.43	1.73	8	1
1:A:176:VAL:CG2	1:A:228:ILE:HB	0.43	2.43	10	1
1:A:164:PRO:HB2	1:A:166:ARG:HG2	0.42	1.89	15	1
1:A:166:ARG:HD2	1:A:201:MET:SD	0.42	2.54	1	1
1:A:181:ASP:OD2	1:A:190:ASN:HB2	0.42	2.14	6	1
1:A:197:LYS:CE	1:A:201:MET:HB2	0.42	2.45	20	1
1:A:161:PRO:HB3	1:A:205:GLU:O	0.42	2.15	2	1
1:A:174:GLY:HA3	1:A:202:PHE:CE2	0.42	2.50	13	1
1:A:183:THR:CB	1:A:184:PRO:CD	0.41	2.96	1	1
1:A:173:GLU:O	1:A:197:LYS:HD3	0.41	2.14	3	1
1:A:176:VAL:HG12	1:A:196:ALA:CB	0.41	2.45	10	3
1:A:228:ILE:HG12	1:A:238:ILE:HG12	0.41	1.92	11	1
1:A:165:ALA:O	1:A:168:GLN:HG2	0.41	2.15	11	1
1:A:231:LYS:HB2	1:A:235:THR:OG1	0.41	2.16	10	1
1:A:187:ARG:HA	1:A:187:ARG:NE	0.41	2.30	15	1
1:A:184:PRO:O	1:A:218:GLY:N	0.41	2.53	15	1
1:A:229:LEU:N	1:A:229:LEU:HD22	0.41	2.31	3	1
1:A:198:PRO:HB2	1:A:201:MET:HB3	0.41	1.92	16	1
1:A:165:ALA:HA	1:A:168:GLN:OE1	0.40	2.15	6	1
1:A:216:GLU:HA	1:A:217:PRO:HD3	0.40	1.78	12	1
1:A:156:LEU:HD22	1:A:156:LEU:N	0.40	2.31	5	2
1:A:156:LEU:HD12	1:A:156:LEU:N	0.40	2.30	18	1
1:A:163:TYR:CD1	1:A:230:PHE:HB3	0.40	2.52	3	1
1:A:161:PRO:HB2	1:A:230:PHE:HZ	0.40	1.77	13	1
1:A:160:GLN:NE2	1:A:237:GLU:HA	0.40	2.32	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	85/144 (59%)	80±1 (94±1%)	4±1 (5±1%)	1±1 (1±1%)	26	73
All	All	1700/2880 (59%)	1605 (94%)	79 (5%)	16 (1%)	26	73

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	198	PRO	11
1	A	199	ALA	3
1	A	197	LYS	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	73/123 (59%)	69±2 (95±2%)	4±2 (5±2%)	33	77
All	All	1460/2460 (59%)	1383 (95%)	77 (5%)	33	77

All 26 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	227	ASN	12
1	A	205	GLU	10
1	A	160	GLN	8
1	A	214	ARG	6
1	A	173	GLU	5
1	A	197	LYS	3
1	A	168	GLN	3
1	A	156	LEU	3
1	A	203	GLU	3
1	A	194	LEU	2
1	A	233	ASN	2
1	A	171	ARG	2
1	A	154	ARG	2
1	A	187	ARG	2
1	A	226	VAL	2
1	A	181	ASP	2
1	A	232	ILE	1
1	A	200	ASN	1
1	A	185	ASP	1
1	A	238	ILE	1
1	A	158	ARG	1

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Mol	Chain	Res	Type	Models (Total)
1	A	175	GLN	1
1	A	208	ASN	1
1	A	182	VAL	1
1	A	219	LYS	1
1	A	179	LYS	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

No chemical shift data were provided