W O R L D W I D E

wwPDB

P R O T E I N   D A T A   B A N K

Full wwPDB NMR Structure Validation Report (i)

May 28, 2020 – 11:19 pm BST

PDB ID	:	2LT9
Title	:	The solution structure of Ca2+ binding domain 2B of the third isoform of the Na+/Ca2+ exchanger
Authors	:	Breukels, V.; Touw, W.G.; Vuister, G.W.
Deposited on	:	2012-05-15

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 (i) symbol.

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

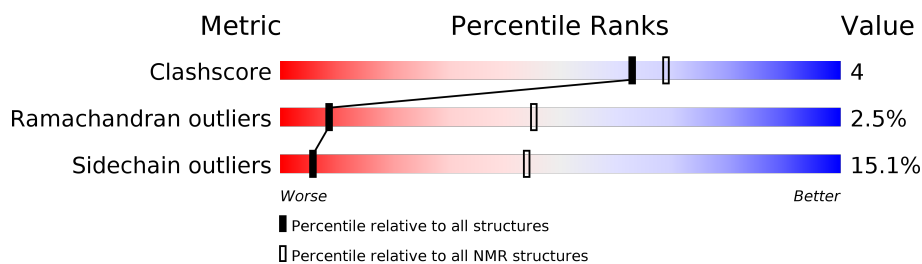|		
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	2.11
Ideal geometry (proteins)	:	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 85%.

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	Percentile Ranks	Value
Clashscore		4
Ramachandran outliers		2.5%
Sidechain outliers		15.1%

Worse   *Better*

▌ Percentile relative to all structures

▯ Percentile relative to all NMR structures

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 $<=5\%$

Mol	Chain	Length	Quality of chain
1	A	157	55% 9% • 27% 6%

2 Ensemble composition and analysis (i)

This entry contains 20 models. Model 5 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:529-A:603, A:612-A:626, A:650-A:664 (105)	0.21	5

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 2 single-model clusters were found.

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

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 2328 atoms, of which 1150 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Protein Slc8a3.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	148	2328	742	1150	193	239	4	0

There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	519	MET	-	EXPRESSION TAG	UNP Q7TS90
A	520	ALA	-	EXPRESSION TAG	UNP Q7TS90
A	521	SER	-	EXPRESSION TAG	UNP Q7TS90
A	522	HIS	-	EXPRESSION TAG	UNP Q7TS90
A	523	HIS	-	EXPRESSION TAG	UNP Q7TS90
A	524	HIS	-	EXPRESSION TAG	UNP Q7TS90
A	525	HIS	-	EXPRESSION TAG	UNP Q7TS90
A	526	HIS	-	EXPRESSION TAG	UNP Q7TS90
A	527	HIS	-	EXPRESSION TAG	UNP Q7TS90

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: Protein Slc8a3
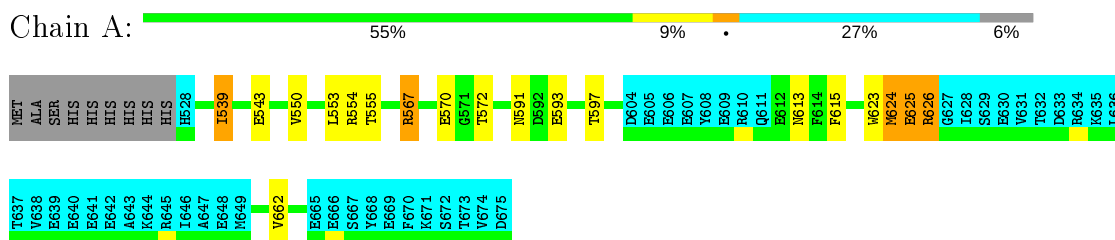
4.2 Scores per residue for each member of the ensemble

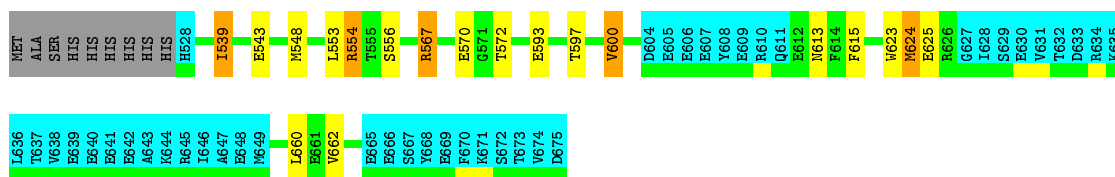Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

- Molecule 1: Protein Slc8a3
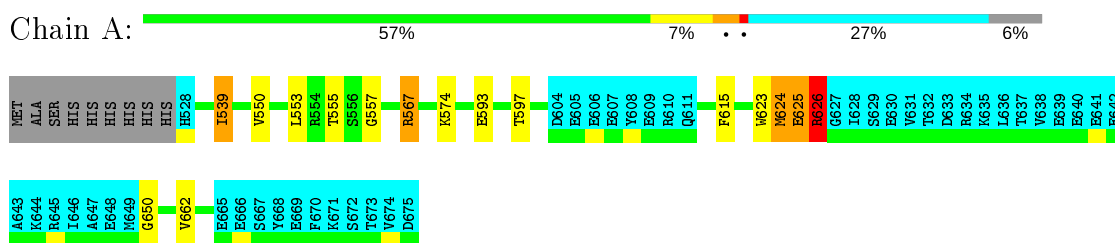
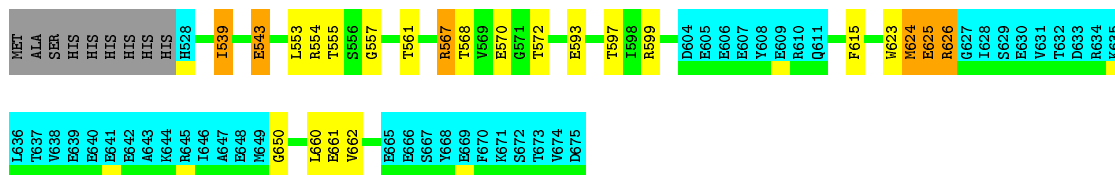### 4.2.2 Score per residue for model 2

- Molecule 1: Protein Slc8a3

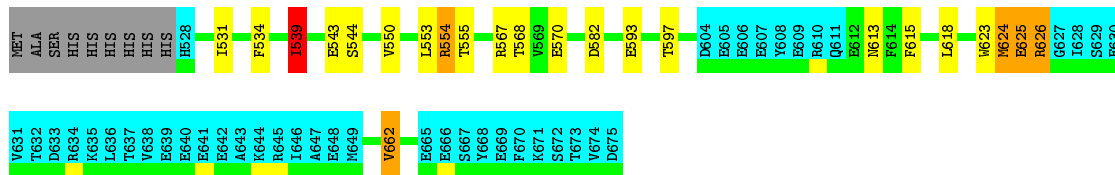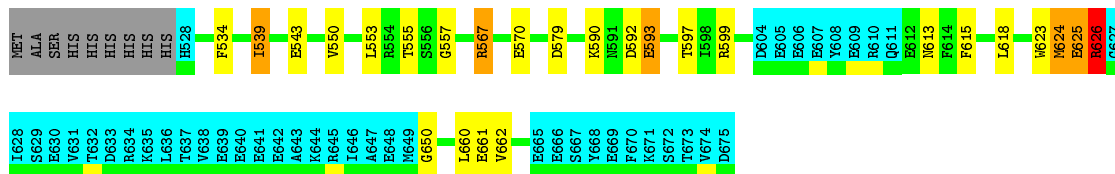### 4.2.3 Score per residue for model 3

• Molecule 1: Protein Slc8a3

4.2.4 Score per residue for model 4

• Molecule 1: Protein Slc8a3

4.2.5 Score per residue for model 5 (medoid)

• Molecule 1: Protein Slc8a3

4.2.6 Score per residue for model 6

• Molecule 1: Protein Slc8a3

Chain A:

4.2.7 Score per residue for model 7

- Molecule 1: Protein Slc8a3

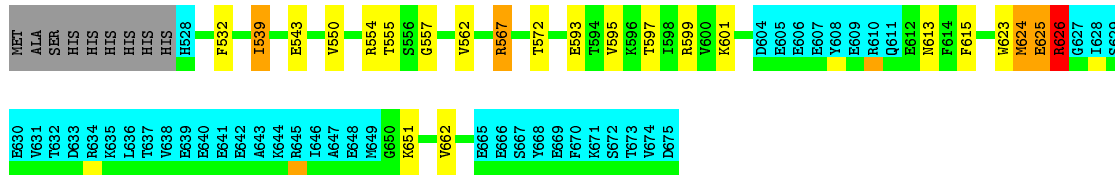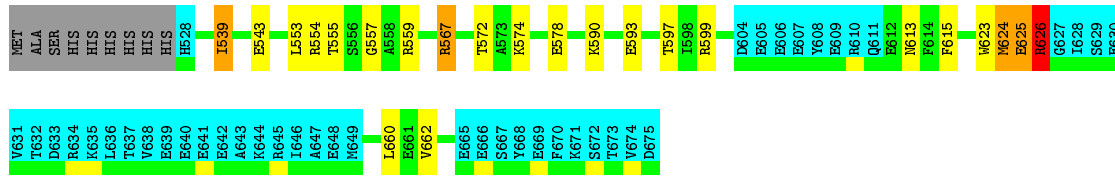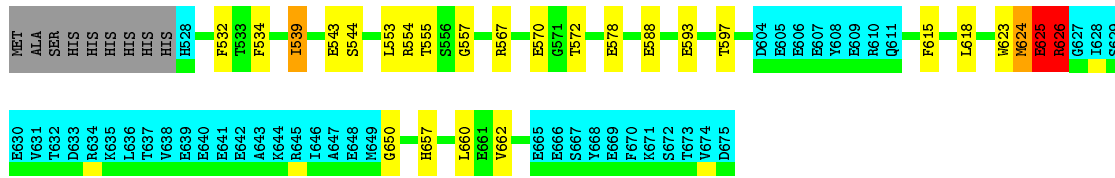Chain A:

4.2.8 Score per residue for model 8

- Molecule 1: Protein Slc8a3

Chain A:

4.2.9 Score per residue for model 9

- Molecule 1: Protein Slc8a3

Chain A:

4.2.10 Score per residue for model 10

• Molecule 1: Protein Slc8a3

Chain A:

4.2.11 Score per residue for model 11

• Molecule 1: Protein Slc8a3
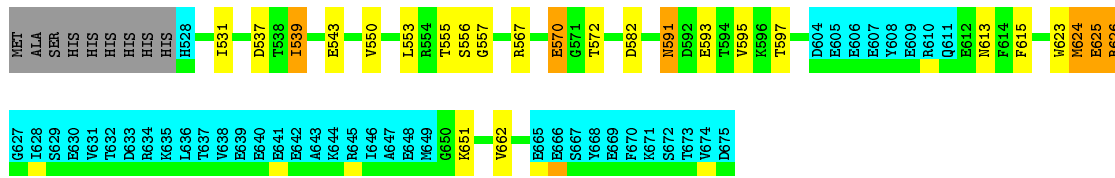
Chain A:

4.2.12 Score per residue for model 12

• Molecule 1: Protein Slc8a3

Chain A:

4.2.13 Score per residue for model 13

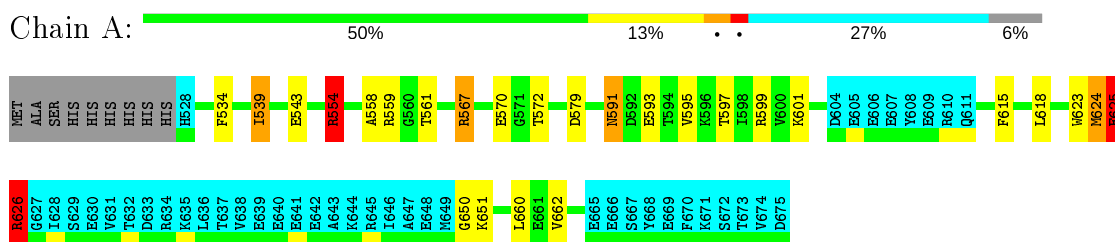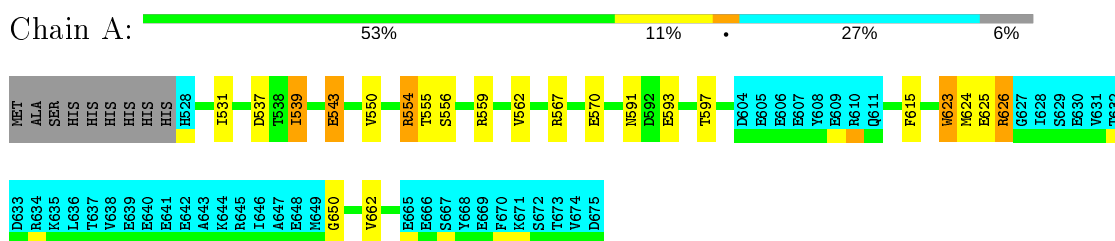• Molecule 1: Protein Slc8a3

Chain A:

4.2.14 Score per residue for model 14

● Molecule 1: Protein Slc8a3

4.2.15 Score per residue for model 15

● Molecule 1: Protein Slc8a3

4.2.16 Score per residue for model 16

● Molecule 1: Protein Slc8a3

4.2.17 Score per residue for model 17

● Molecule 1: Protein Slc8a3

4.2.18 Score per residue for model 18

• Molecule 1: Protein Slc8a3

Chain A:

4.2.19 Score per residue for model 19

• Molecule 1: Protein Slc8a3

Chain A:

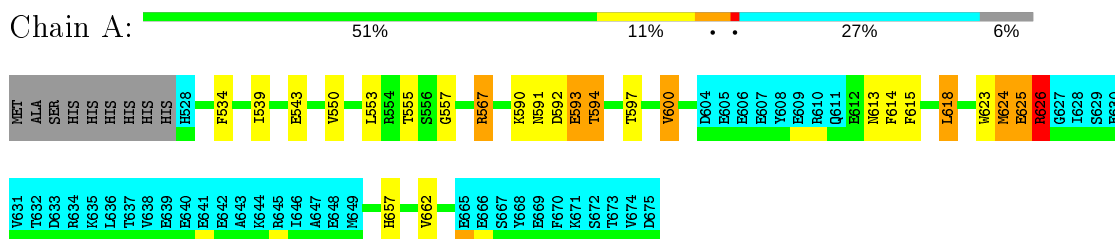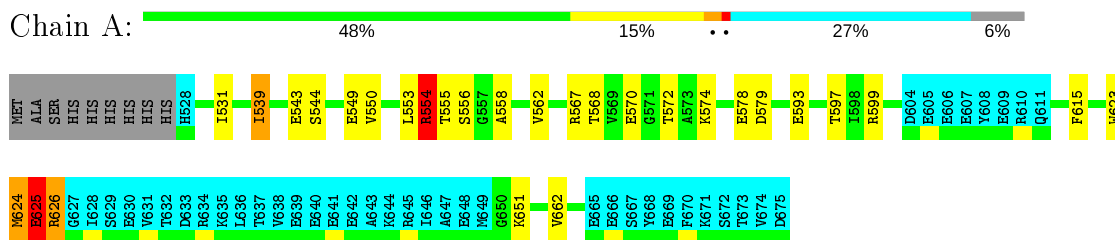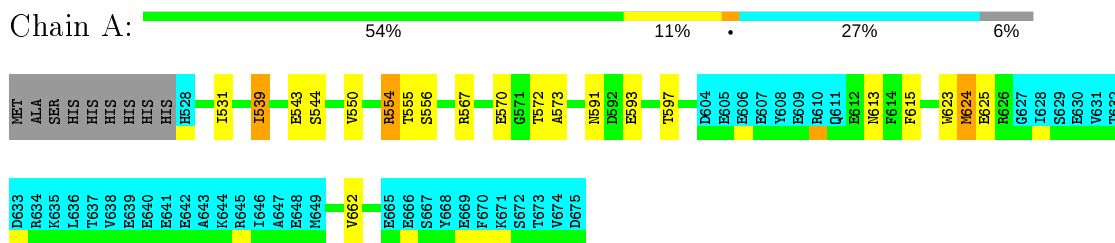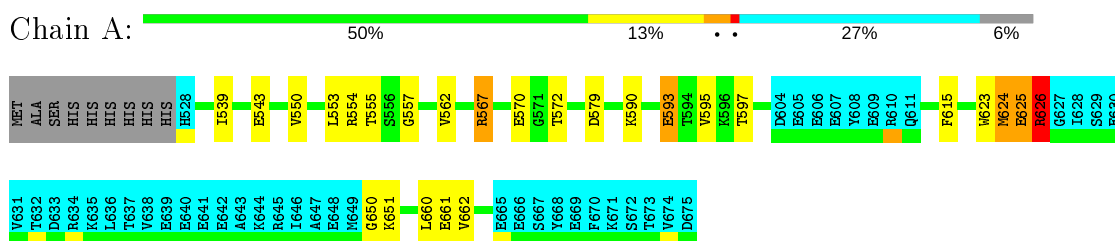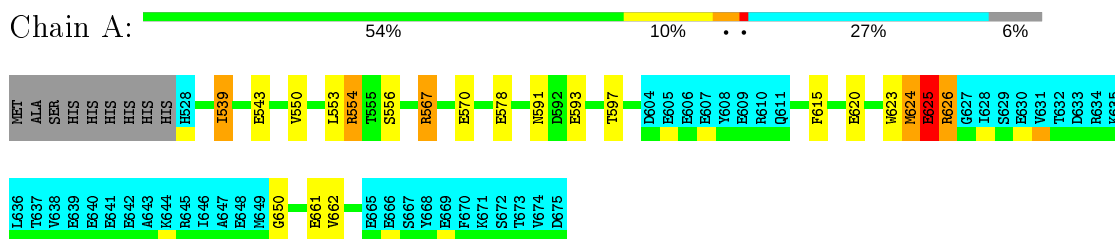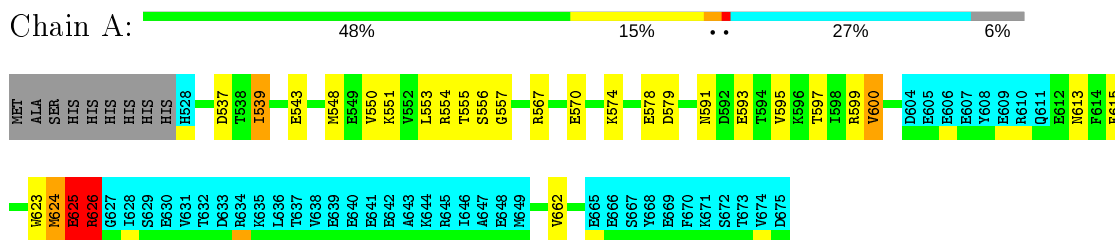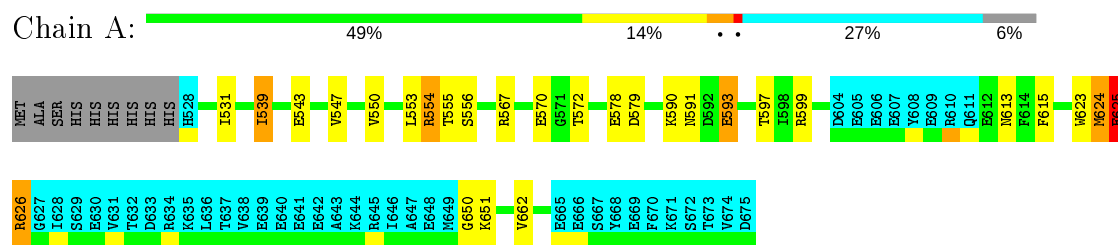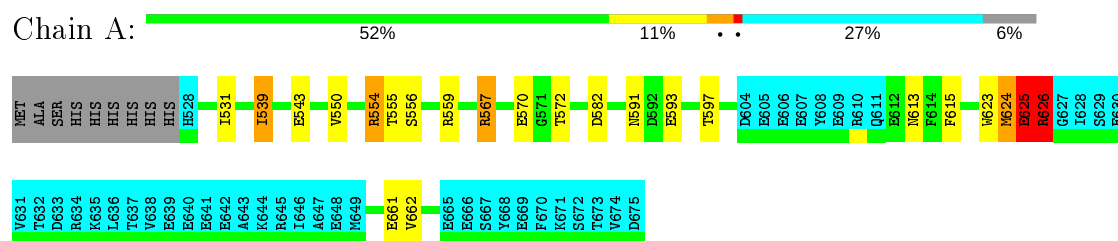#### 4.2.20 Score per residue for model 20

• Molecule 1: Protein Slc8a3

Chain A:
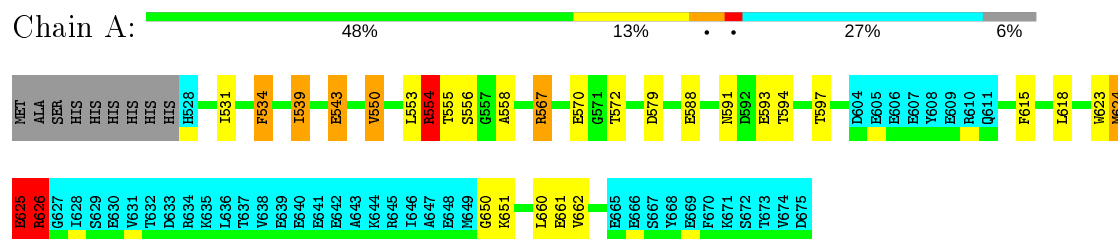
5 Refinement protocol and experimental data overview (i)

The models were refined using the following method: *simulated annealing*.

Of the 100 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	structure solution	3.0
YASARA	refinement	11.9.18

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 6 of this report.

Chemical shift file(s)	input_cs.cif
Number of chemical shift lists	1
Total number of shifts	1608
Number of shifts mapped to atoms	1608
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	85%

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

COVALENT-GEOMETRY INFOmissingINFO

5.1 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	817	822	822	7±2
All	All	16340	16440	16440	143

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:623:TRP:CZ3	1:A:626:ARG:HG3	0.60	2.32	6	18
1:A:539:ILE:HG23	1:A:662:VAL:HG13	0.57	1.76	19	17
1:A:625:GLU:O	1:A:626:ARG:HG2	0.55	2.02	7	17
1:A:623:TRP:CZ3	1:A:650:GLY:HA3	0.55	2.37	10	10
1:A:543:GLU:CD	1:A:543:GLU:H	0.55	2.05	15	4
1:A:555:THR:HG23	1:A:557:GLY:H	0.52	1.64	17	10
1:A:534:PHE:CE1	1:A:618:LEU:HD21	0.52	2.39	5	6
1:A:554:ARG:HD2	1:A:558:ALA:HB3	0.51	1.81	10	1
1:A:570:GLU:CD	1:A:570:GLU:H	0.51	2.07	16	2
1:A:531:ILE:H	1:A:555:THR:HG22	0.50	1.66	13	8
1:A:614:PHE:CE1	1:A:662:VAL:HG21	0.48	2.44	12	1
1:A:570:GLU:H	1:A:570:GLU:CD	0.47	2.12	20	1
1:A:623:TRP:CH2	1:A:626:ARG:HG3	0.47	2.44	20	13
1:A:539:ILE:HG23	1:A:662:VAL:HA	0.47	1.87	4	1
1:A:625:GLU:O	1:A:626:ARG:CG	0.46	2.63	7	17
1:A:623:TRP:CE3	1:A:626:ARG:HG3	0.46	2.45	12	2
1:A:532:PHE:CZ	1:A:554:ARG:HD3	0.45	2.46	8	2
1:A:590:LYS:H	1:A:593:GLU:HB2	0.45	1.71	5	5
1:A:534:PHE:CZ	1:A:550:VAL:HG11	0.45	2.47	5	2
1:A:554:ARG:HD2	1:A:558:ALA:HB2	0.43	1.91	20	2
1:A:561:THR:HB	1:A:625:GLU:HB2	0.43	1.91	10	2
1:A:592:ASP:C	1:A:594:THR:H	0.40	2.19	12	1
1:A:543:GLU:H	1:A:543:GLU:CD	0.40	2.19	11	1

5.2 Torsion angles (i)

5.2.1 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	105/157 (67%)	93±1 (89±1%)	9±2 (9±2%)	3±1 (3±1%)	9	45
All	All	2100/3140 (67%)	1859 (89%)	188 (9%)	53 (3%)	9	45

All 6 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	593	GLU	19
1	A	626	ARG	17
1	A	556	SER	8
1	A	591	ASN	6
1	A	582	ASP	2
1	A	573	ALA	1

5.2.2 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	88/136 (65%)	75±3 (85±3%)	13±3 (15±3%)	6	44
All	All	1760/2720 (65%)	1495 (85%)	265 (15%)	6	44

All 40 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	597	THR	20
1	A	615	PHE	20
1	A	567	ARG	20
1	A	539	ILE	20
1	A	543	GLU	17
1	A	553	LEU	15
1	A	570	GLU	14
1	A	550	VAL	14
1	A	572	THR	13
1	A	613	ASN	11
1	A	554	ARG	10
1	A	660	LEU	8
1	A	579	ASP	7
1	A	651	LYS	7
1	A	578	GLU	6
1	A	591	ASN	6
1	A	661	GLU	6
1	A	595	VAL	5
1	A	574	LYS	4
1	A	544	SER	4

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Mol	Chain	Res	Type	Models (Total)
1	A	562	VAL	4
1	A	623	TRP	3
1	A	568	THR	3
1	A	600	VAL	3
1	A	537	ASP	3
1	A	548	MET	2
1	A	601	LYS	2
1	A	594	THR	2
1	A	626	ARG	2
1	A	556	SER	2
1	A	588	GLU	2
1	A	657	HIS	2
1	A	620	GLU	1
1	A	547	VAL	1
1	A	662	VAL	1
1	A	551	LYS	1
1	A	618	LEU	1
1	A	549	GLU	1
1	A	582	ASP	1
1	A	592	ASP	1

5.2.3 RNA (i)

There are no RNA molecules in this entry.

5.3 Non-standard residues in protein, DNA, RNA chains (i)

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

5.4 Carbohydrates (i)

There are no carbohydrates in this entry.

5.5 Ligand geometry (i)

There are no ligands in this entry.

5.6 Other polymers (i)

There are no such molecules in this entry.

5.7 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Chemical shift validation (i)

The completeness of assignment taking into account all chemical shift lists is 85% for the well-defined parts and 77% for the entire structure.

6.1 Chemical shift list 1

File name: input_cs.cif

Chemical shift list name: *assigned_ chem_ shift_ list_ 1*

6.1.1 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	1608
Number of shifts mapped to atoms	1608
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	1

6.1.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_\alpha$	138	0.04 ± 0.07	None needed (< 0.5 ppm)
$^{13}C_\beta$	124	-0.08 ± 0.17	None needed (< 0.5 ppm)
$^{13}C'$	116	0.04 ± 0.09	None needed (< 0.5 ppm)
^{15}N	131	0.05 ± 0.20	None needed (< 0.5 ppm)

6.1.3 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 85%, i.e. 1081 atoms were assigned a chemical shift out of a possible 1273. 0 out of 17 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	497/517 (96%)	204/206 (99%)	193/210 (92%)	100/101 (99%)
Sidechain	518/659 (79%)	310/382 (81%)	206/252 (82%)	2/25 (8%)

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	Total	**^{1}H**	**^{13}C**	**^{15}N**
Aromatic	66/97 (68%)	34/53 (64%)	31/41 (76%)	1/3 (33%)
Overall	1081/1273 (85%)	548/641 (85%)	430/503 (85%)	103/129 (80%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 77%, i.e. 1405 atoms were assigned a chemical shift out of a possible 1816. 0 out of 21 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	**^{1}H**	**^{13}C**	**^{15}N**
Backbone	650/732 (89%)	266/292 (91%)	253/296 (85%)	131/144 (91%)
Sidechain	681/955 (71%)	408/554 (74%)	270/363 (74%)	3/38 (8%)
Aromatic	74/129 (57%)	38/70 (54%)	35/55 (64%)	1/4 (25%)
Overall	1405/1816 (77%)	712/916 (78%)	558/714 (78%)	135/186 (73%)

6.1.4   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	662	VAL	HB	-0.07	3.59 – 0.39	-6.4

6.1.5   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: