



Full wwPDB NMR Structure Validation Report ⓘ

Mar 5, 2026 – 02:45 PM UTC

PDB ID : 1DX1 / pdb_00001dx1
Title : BOVINE PRION PROTEIN RESIDUES 23-230
Authors : Lopez Garcia, F.; Zahn, R.; Riek, R.; Billeter, M.; Wuthrich, K.
Deposited on : 1999-12-15

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 ⓘ 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

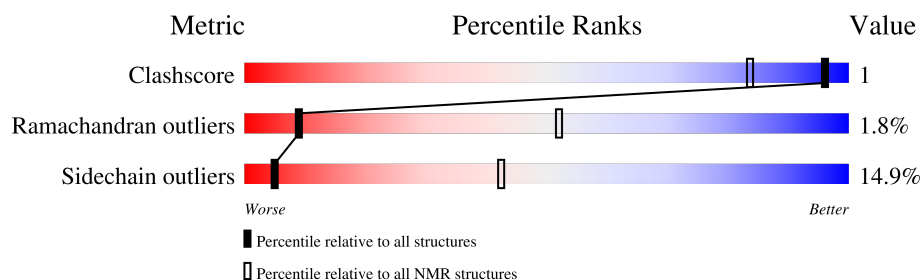
1 Overall quality at a glance

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	219	42% 5% 53%

2 Ensemble composition and analysis

This entry contains 20 models. Model 18 is the overall representative, medoid model (most similar to other models). The authors have identified model 3 as representative.

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:125-A:227 (103)	1.02	18

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 2 single-model clusters were found.

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

3 Entry composition [i](#)

There is only 1 type of molecule in this entry. The entry contains 1675 atoms, of which 806 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called PRION PROTEIN.

Mol	Chain	Residues	Atoms						Trace
1	A	104	Total	C	H	N	O	S	0
			1675	540	806	151	170	8	

There are 2 discrepancies between the modelled and reference sequences:

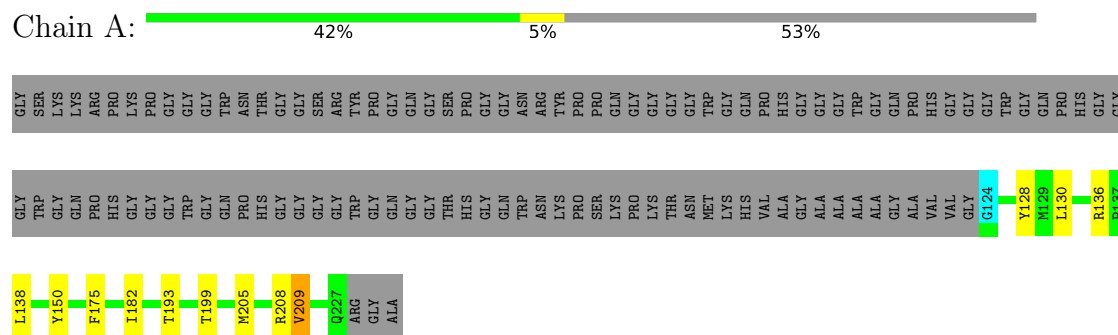
Chain	Residue	Modelled	Actual	Comment	Reference
A	12	GLY	-	cloning artifact	UNP P10279
A	13	SER	-	cloning artifact	UNP P10279

4 Residue-property plots

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA, DNA and oligosaccharide 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: PRION PROTEIN

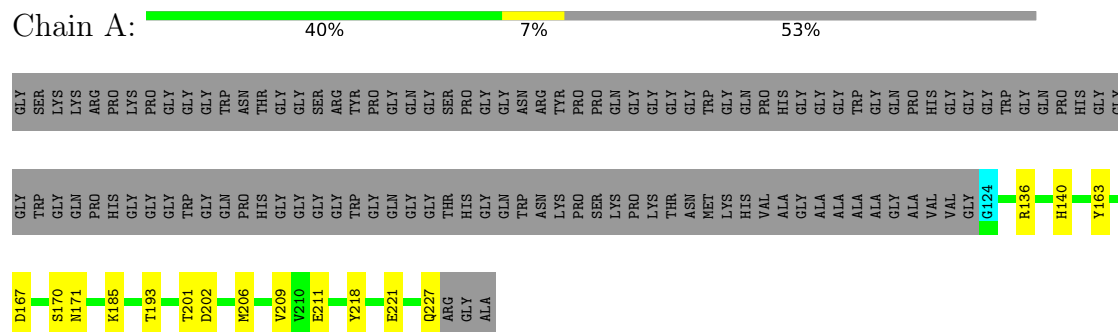


4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

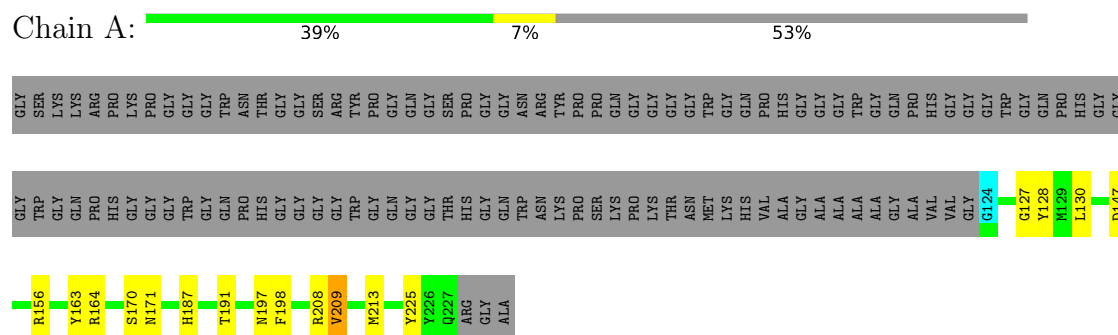
4.2.1 Score per residue for model 1

• Molecule 1: PRION PROTEIN



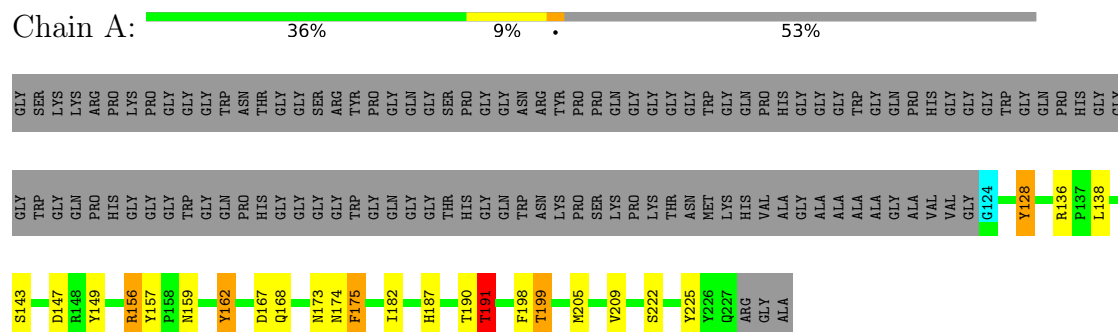
4.2.2 Score per residue for model 2

- Molecule 1: PRION PROTEIN



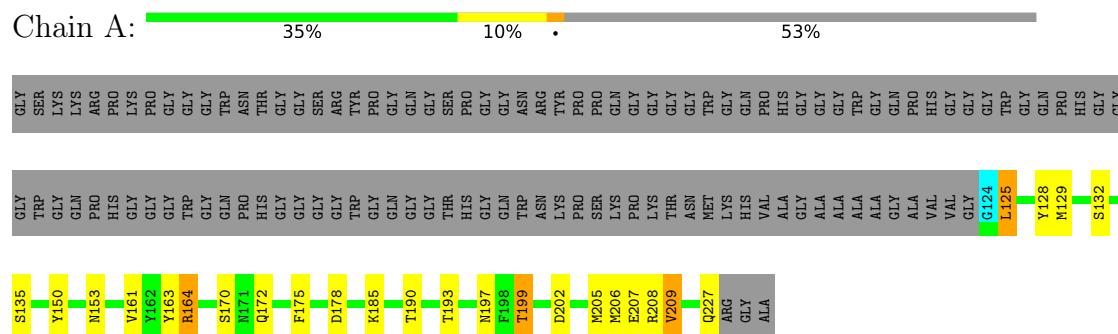
4.2.3 Score per residue for model 3

- Molecule 1: PRION PROTEIN



4.2.4 Score per residue for model 4

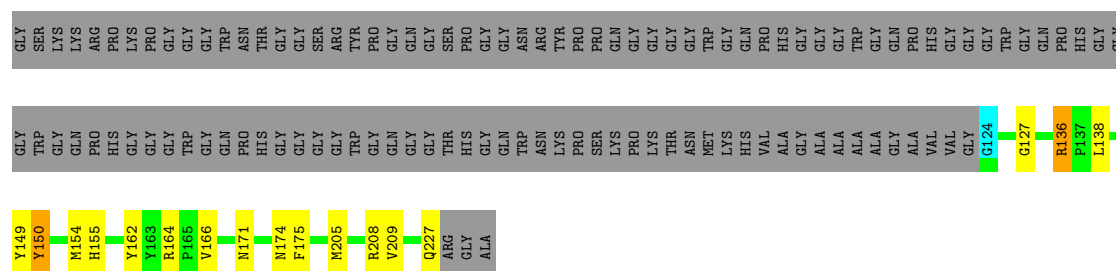
- Molecule 1: PRION PROTEIN



4.2.5 Score per residue for model 5

- Molecule 1: PRION PROTEIN

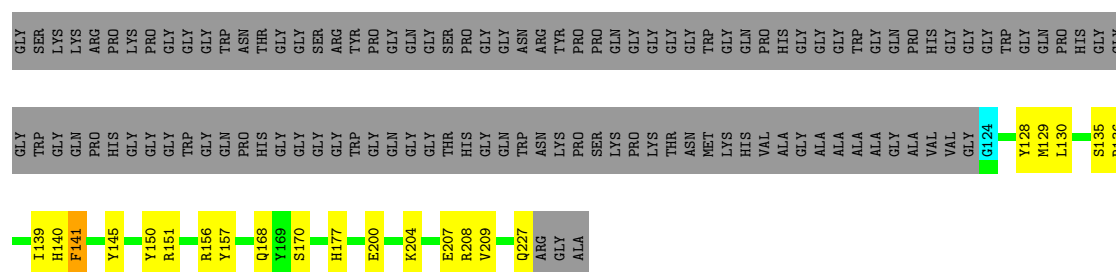
Chain A:  39% 7% 53%



4.2.6 Score per residue for model 6

- Molecule 1: PRION PROTEIN

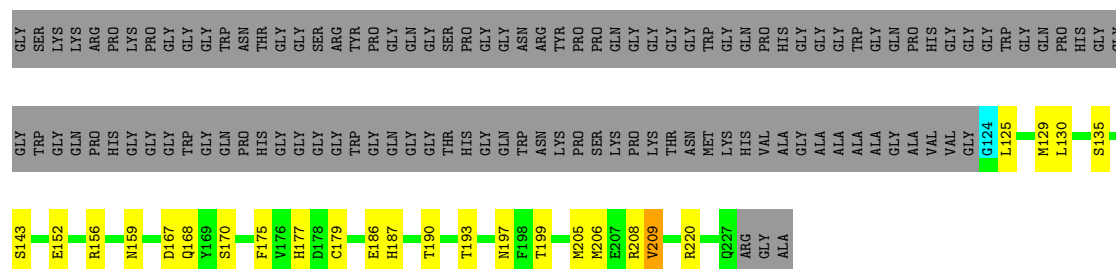
Chain A:  37% 10% 53%



4.2.7 Score per residue for model 7

- Molecule 1: PRION PROTEIN

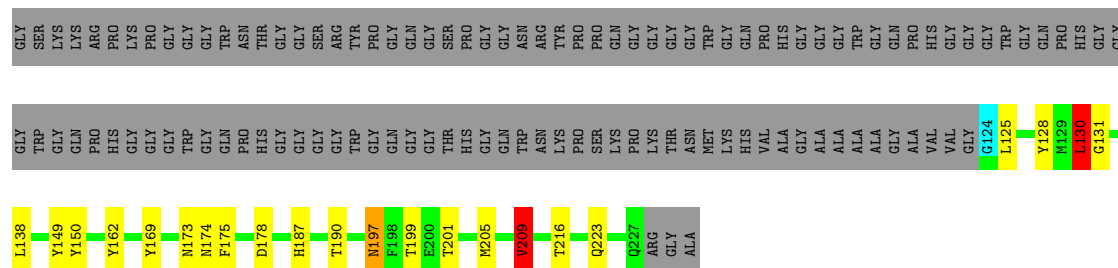
Chain A:  36% 11% 53%



4.2.8 Score per residue for model 8

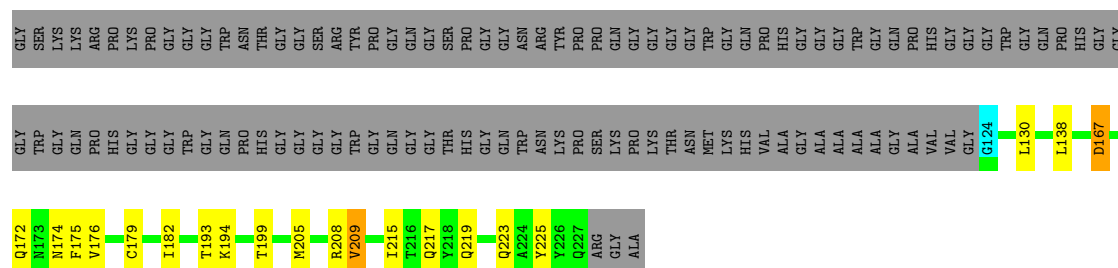
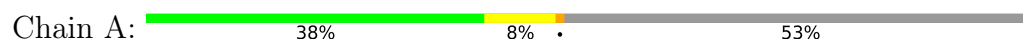
- Molecule 1: PRION PROTEIN

Chain A:  37% 9% 53%



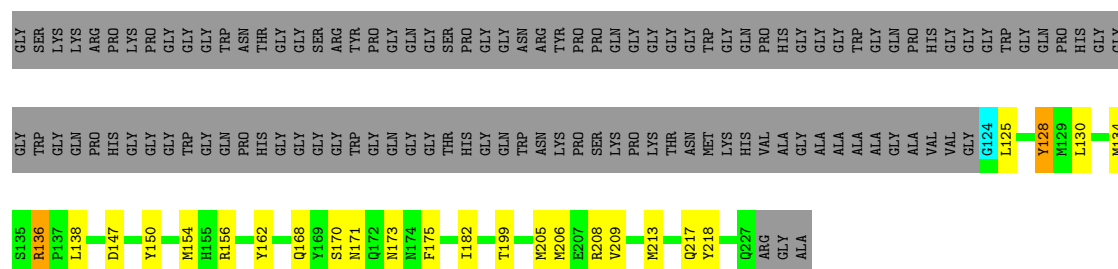
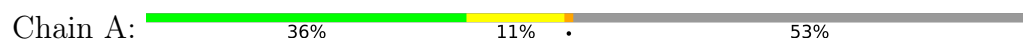
4.2.9 Score per residue for model 9

- Molecule 1: PRION PROTEIN



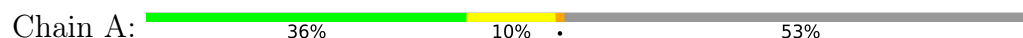
4.2.10 Score per residue for model 10

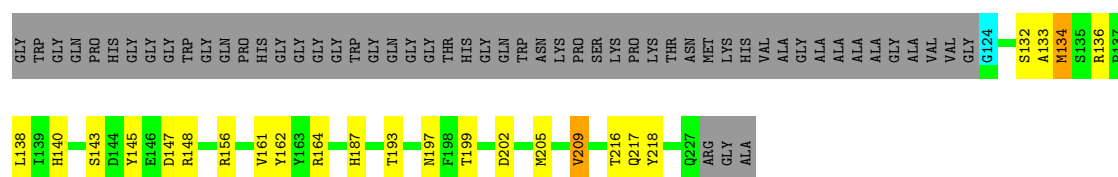
- Molecule 1: PRION PROTEIN



4.2.11 Score per residue for model 11

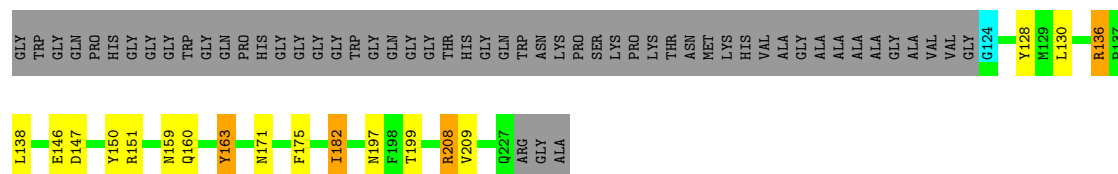
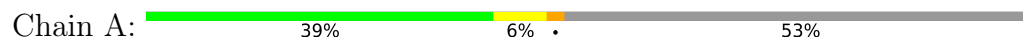
- Molecule 1: PRION PROTEIN





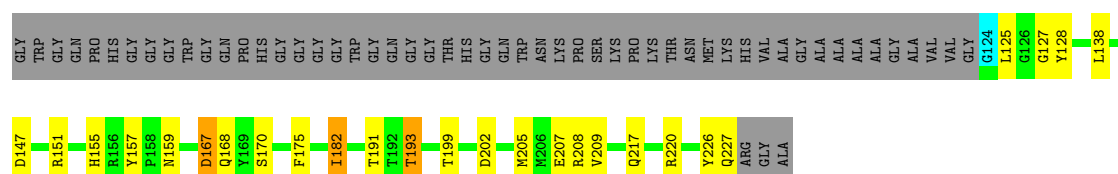
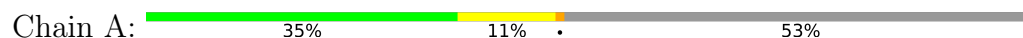
4.2.12 Score per residue for model 12

- Molecule 1: PRION PROTEIN



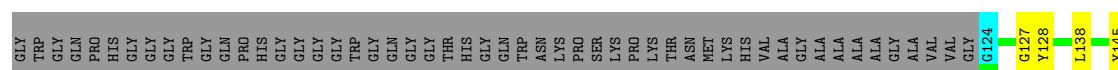
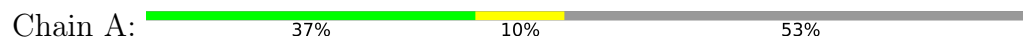
4.2.13 Score per residue for model 13

- Molecule 1: PRION PROTEIN



4.2.14 Score per residue for model 14

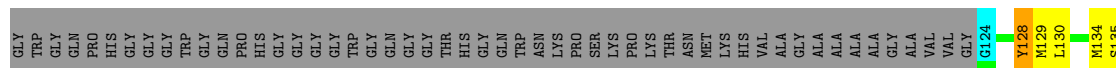
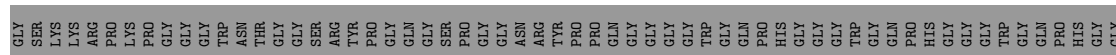
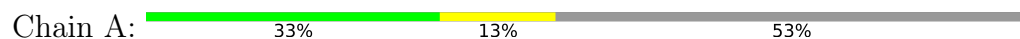
- Molecule 1: PRION PROTEIN





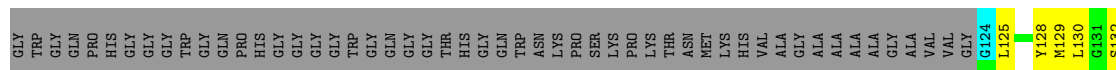
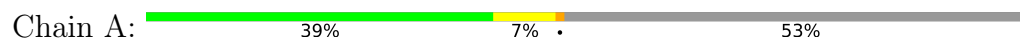
4.2.15 Score per residue for model 15

- Molecule 1: PRION PROTEIN



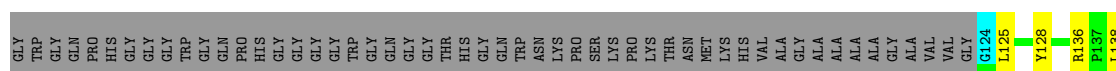
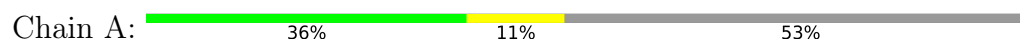
4.2.16 Score per residue for model 16

- Molecule 1: PRION PROTEIN



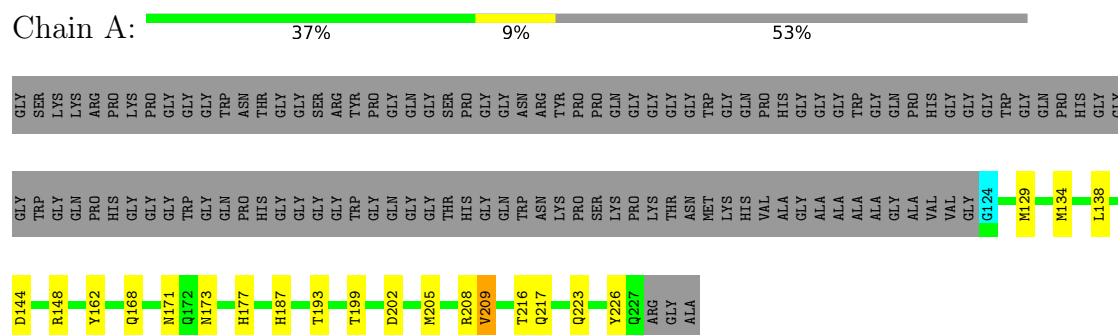
4.2.17 Score per residue for model 17

- Molecule 1: PRION PROTEIN



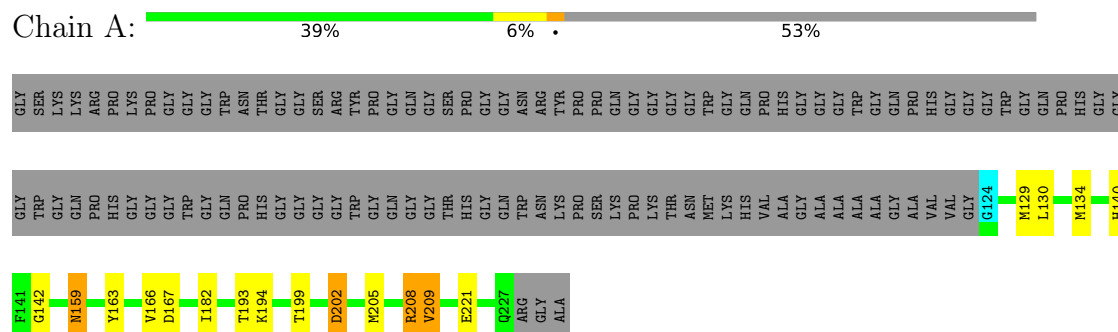
4.2.18 Score per residue for model 18 (medoid)

• Molecule 1: PRION PROTEIN



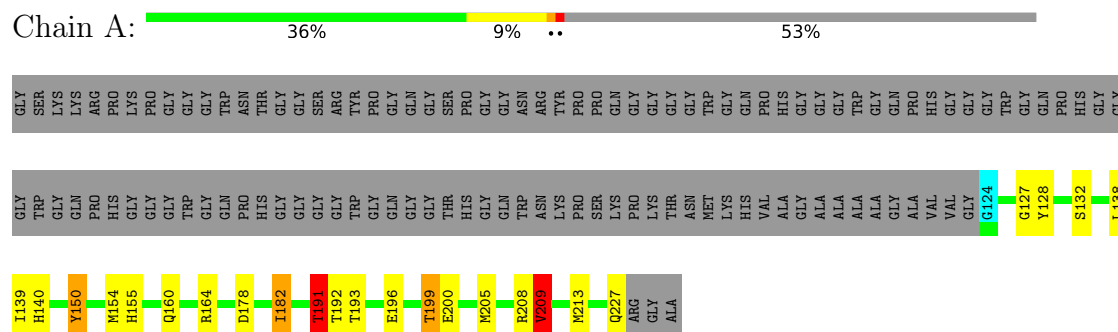
4.2.19 Score per residue for model 19

• Molecule 1: PRION PROTEIN



4.2.20 Score per residue for model 20

• Molecule 1: PRION PROTEIN



5 Refinement protocol and experimental data overview ⓘ

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

Of the 50 calculated structures, 20 were deposited, based on the following criterion: *LEAST RESTRAINT VIOLATION*.

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

Software name	Classification	Version
OPALp	refinement	
DYANA	structure solution	

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	0.70±0.01	0±0/885 (0.0± 0.0%)	1.47±0.04	4±2/1196 (0.3± 0.2%)
All	All	0.70	0/17700 (0.0%)	1.47	74/23920 (0.3%)

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	3.1±1.7
All	All	0	63

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	191	THR	CA-CB-OG1	8.84	122.86	109.60	20	2
1	A	209	VAL	CA-CB-CG2	7.52	123.19	110.40	8	1
1	A	176	VAL	CA-CB-CG2	7.17	122.59	110.40	9	2
1	A	202	ASP	CA-CB-CG	6.86	119.46	112.60	13	6
1	A	146	GLU	CA-C-N	6.76	129.33	120.28	12	1
1	A	146	GLU	C-N-CA	6.76	129.33	120.28	12	1
1	A	174	ASN	CA-CB-CG	-6.61	105.99	112.60	17	1
1	A	178	ASP	CA-C-N	6.57	129.32	120.65	4	2
1	A	178	ASP	C-N-CA	6.57	129.32	120.65	4	2
1	A	159	ASN	CA-CB-CG	6.53	119.13	112.60	19	1
1	A	161	VAL	CB-CA-C	6.36	117.67	110.41	4	1
1	A	156	ARG	CD-NE-CZ	6.21	133.10	124.40	3	1
1	A	209	VAL	CA-CB-CG1	6.18	120.91	110.40	4	8
1	A	226	TYR	CA-C-N	6.13	132.74	121.70	18	1
1	A	226	TYR	C-N-CA	6.13	132.74	121.70	18	1

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	197	ASN	CA-CB-CG	5.80	118.40	112.60	8	1
1	A	128	TYR	CA-C-N	5.73	129.79	121.26	8	3
1	A	128	TYR	C-N-CA	5.73	129.79	121.26	8	3
1	A	175	PHE	CA-CB-CG	5.60	119.40	113.80	3	1
1	A	178	ASP	CA-CB-CG	5.60	118.20	112.60	17	1
1	A	173	ASN	CA-CB-CG	5.55	118.15	112.60	10	1
1	A	209	VAL	CB-CA-C	5.53	118.72	111.81	9	1
1	A	177	HIS	CB-CG-CD2	-5.53	124.01	131.20	18	1
1	A	190	THR	N-CA-CB	-5.49	102.03	110.16	7	3
1	A	191	THR	CA-C-N	5.43	128.10	120.28	20	1
1	A	191	THR	C-N-CA	5.43	128.10	120.28	20	1
1	A	221	GLU	CA-C-N	5.38	127.48	120.28	1	2
1	A	221	GLU	C-N-CA	5.38	127.48	120.28	1	2
1	A	155	HIS	CA-CB-CG	5.37	119.17	113.80	5	1
1	A	147	ASP	CA-CB-CG	-5.36	107.24	112.60	10	2
1	A	167	ASP	CA-C-N	5.36	131.78	121.54	3	1
1	A	167	ASP	C-N-CA	5.36	131.78	121.54	3	1
1	A	199	THR	CA-CB-OG1	5.26	117.49	109.60	3	3
1	A	191	THR	OG1-CB-CG2	-5.25	98.81	109.30	20	1
1	A	191	THR	CA-CB-CG2	5.24	119.41	110.50	3	1
1	A	153	ASN	CA-C-N	5.21	128.63	120.82	4	2
1	A	153	ASN	C-N-CA	5.21	128.63	120.82	4	2
1	A	170	SER	CA-C-N	5.21	131.49	121.54	13	1
1	A	170	SER	C-N-CA	5.21	131.49	121.54	13	1
1	A	130	LEU	CB-CA-C	5.11	118.16	109.84	8	1
1	A	143	SER	CA-C-N	5.10	127.62	120.28	11	1
1	A	143	SER	C-N-CA	5.10	127.62	120.28	11	1
1	A	166	VAL	CA-C-N	5.08	127.33	120.38	17	1
1	A	166	VAL	C-N-CA	5.08	127.33	120.38	17	1
1	A	193	THR	CA-CB-CG2	5.03	119.05	110.50	13	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	150	TYR	Sidechain	9
1	A	218	TYR	Sidechain	5
1	A	156	ARG	Sidechain	4
1	A	208	ARG	Sidechain	4
1	A	128	TYR	Sidechain	4

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Mol	Chain	Res	Type	Group	Models (Total)
1	A	149	TYR	Sidechain	4
1	A	157	TYR	Sidechain	4
1	A	136	ARG	Sidechain	4
1	A	145	TYR	Sidechain	4
1	A	151	ARG	Sidechain	4
1	A	162	TYR	Sidechain	3
1	A	164	ARG	Sidechain	3
1	A	163	TYR	Sidechain	3
1	A	225	TYR	Sidechain	2
1	A	220	ARG	Sidechain	2
1	A	148	ARG	Sidechain	2
1	A	171	ASN	Peptide	1
1	A	134	MET	Peptide	1

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	865	803	803	1±1
All	All	17300	16060	16060	29

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:206:MET:HA	1:A:209:VAL:HG22	0.69	1.64	14	2
1:A:150:TYR:CE2	1:A:154:MET:HE1	0.68	2.23	5	1
1:A:134:MET:HE1	1:A:217:GLN:HG2	0.61	1.71	11	2
1:A:201:THR:HG22	1:A:205:MET:SD	0.54	2.42	8	1
1:A:128:TYR:CE2	1:A:182:ILE:HG12	0.51	2.41	13	3
1:A:205:MET:O	1:A:209:VAL:HG22	0.50	2.07	8	1
1:A:206:MET:HA	1:A:209:VAL:CG2	0.50	2.36	10	2
1:A:172:GLN:O	1:A:176:VAL:HG13	0.50	2.06	16	1
1:A:191:THR:HG21	1:A:198:PHE:CE2	0.48	2.43	3	2
1:A:206:MET:HA	1:A:209:VAL:HG12	0.46	1.86	7	2

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:191:THR:HG23	1:A:192:THR:H	0.45	1.71	20	1
1:A:184:VAL:HG13	1:A:206:MET:SD	0.44	2.53	15	1
1:A:150:TYR:CE2	1:A:154:MET:CE	0.43	3.02	14	1
1:A:139:ILE:HD11	1:A:209:VAL:HA	0.43	1.91	20	1
1:A:209:VAL:HB	1:A:213:MET:SD	0.42	2.54	10	1
1:A:150:TYR:CZ	1:A:154:MET:HE2	0.42	2.50	20	1
1:A:176:VAL:HG11	1:A:215:ILE:HG12	0.41	1.91	16	1
1:A:139:ILE:HB	1:A:141:PHE:CZ	0.41	2.50	6	1
1:A:215:ILE:HG22	1:A:219:GLN:HE21	0.41	1.74	9	2
1:A:134:MET:HE1	1:A:217:GLN:NE2	0.40	2.31	10	1
1:A:130:LEU:HD22	1:A:131:GLY:N	0.40	2.32	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	102/219 (47%)	88±4 (86±4%)	12±3 (12±3%)	2±1 (2±1%)	9	52
All	All	2040/4380 (47%)	1762 (86%)	241 (12%)	37 (2%)	9	52

All 15 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	128	TYR	6
1	A	167	ASP	5
1	A	127	GLY	5
1	A	170	SER	4
1	A	166	VAL	3
1	A	171	ASN	3
1	A	168	GLN	2
1	A	125	LEU	2
1	A	141	PHE	1
1	A	133	ALA	1
1	A	192	THR	1

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Mol	Chain	Res	Type	Models (Total)
1	A	132	SER	1
1	A	172	GLN	1
1	A	142	GLY	1
1	A	191	THR	1

6.3.2 Protein sidechains ⓘ

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	96/161 (60%)	82±3 (85±4%)	14±3 (15±4%)	5	42
All	All	1920/3220 (60%)	1633 (85%)	287 (15%)	5	42

All 66 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	209	VAL	17
1	A	205	MET	15
1	A	138	LEU	14
1	A	199	THR	13
1	A	175	PHE	12
1	A	208	ARG	12
1	A	193	THR	11
1	A	130	LEU	10
1	A	136	ARG	8
1	A	182	ILE	8
1	A	140	HIS	7
1	A	129	MET	7
1	A	163	TYR	6
1	A	227	GLN	6
1	A	187	HIS	6
1	A	197	ASN	6
1	A	159	ASN	6
1	A	162	TYR	6
1	A	125	LEU	6
1	A	174	ASN	5
1	A	168	GLN	5

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Mol	Chain	Res	Type	Models (Total)
1	A	147	ASP	4
1	A	164	ARG	4
1	A	135	SER	4
1	A	170	SER	4
1	A	207	GLU	4
1	A	223	GLN	4
1	A	171	ASN	3
1	A	213	MET	3
1	A	173	ASN	3
1	A	190	THR	3
1	A	191	THR	3
1	A	132	SER	3
1	A	172	GLN	3
1	A	200	GLU	3
1	A	186	GLU	3
1	A	216	THR	3
1	A	167	ASP	3
1	A	217	GLN	3
1	A	185	LYS	2
1	A	211	GLU	2
1	A	143	SER	2
1	A	156	ARG	2
1	A	202	ASP	2
1	A	206	MET	2
1	A	177	HIS	2
1	A	179	CYS	2
1	A	194	LYS	2
1	A	134	MET	2
1	A	161	VAL	2
1	A	160	GLN	2
1	A	155	HIS	2
1	A	196	GLU	2
1	A	201	THR	1
1	A	225	TYR	1
1	A	222	SER	1
1	A	151	ARG	1
1	A	204	LYS	1
1	A	152	GLU	1
1	A	169	TYR	1
1	A	178	ASP	1
1	A	154	MET	1
1	A	226	TYR	1

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Mol	Chain	Res	Type	Models (Total)
1	A	148	ARG	1
1	A	214	CYS	1
1	A	144	ASP	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