



# Full wwPDB NMR Structure Validation Report ⓘ

Feb 19, 2022 – 11:16 PM EST

PDB ID : 1SO9  
Title : Solution Structure of apoCox11, 30 structures  
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Deposited on : 2004-03-13

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

<https://www.wwpdb.org/validation/2017/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:

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 : 2.26  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.26

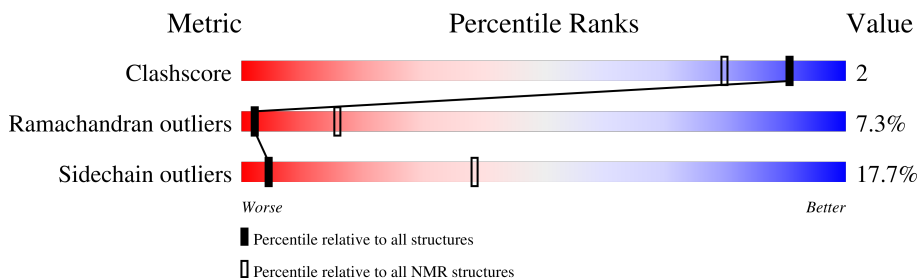
# 1 Overall quality at a glance

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	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  $\geq 3$ , 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	164	 58% 15% 7% 20%

## 2 Ensemble composition and analysis i

This entry contains 30 models. Model 5 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:24-A:96, A:105-A:151 (120)	0.48	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 4 clusters and 19 single-model clusters were found.

Cluster number	Models
1	2, 5, 9, 11, 14, 15, 17
2	3, 13, 24, 30
3	8, 19, 26
4	1, 20
Single-model clusters	4; 6; 7; 10; 12; 16; 18; 21; 22; 23; 25; 27; 28; 29

### 3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2050 atoms, of which 1020 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Cytochrome C oxidase assembly protein ctaG.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	131	2050	664	1020	161	199	6	0

There is a discrepancy between the modelled and reference sequences:

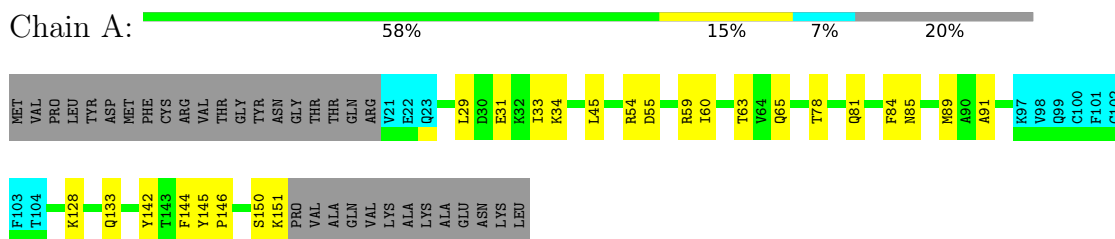
Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	initiating methionine	UNP Q92RG6

## 4 Residue-property plots [i](#)

### 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: Cytochrome C oxidase assembly protein ctaG

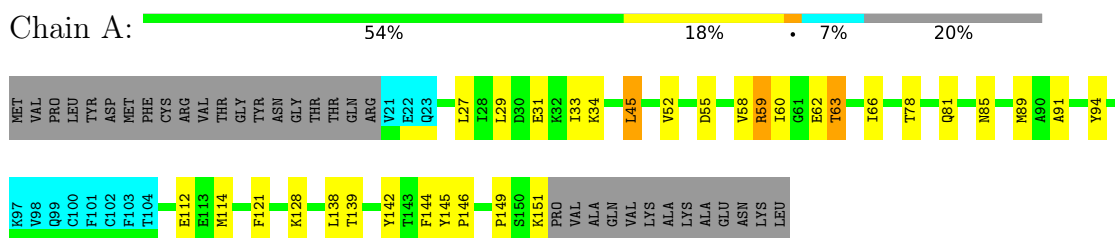


### 4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

#### 4.2.1 Score per residue for model 1

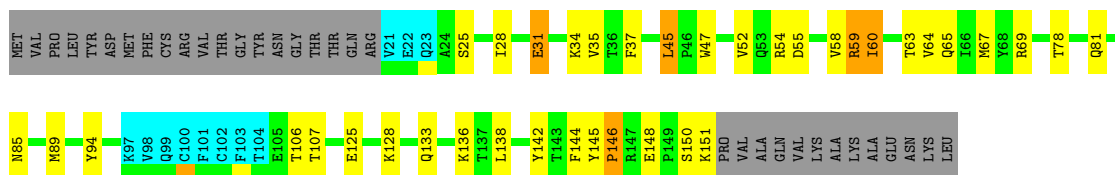
- Molecule 1: Cytochrome C oxidase assembly protein ctaG



#### 4.2.2 Score per residue for model 2

- Molecule 1: Cytochrome C oxidase assembly protein ctaG

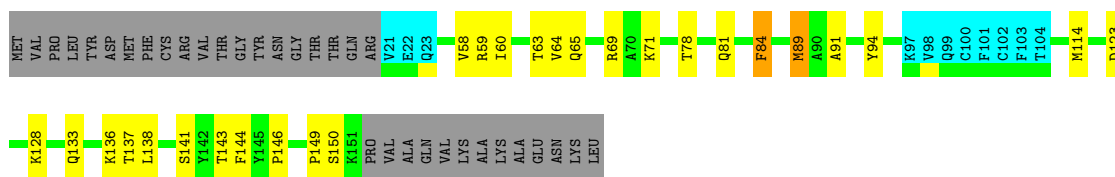




### 4.2.3 Score per residue for model 3

- Molecule 1: Cytochrome C oxidase assembly protein ctaG

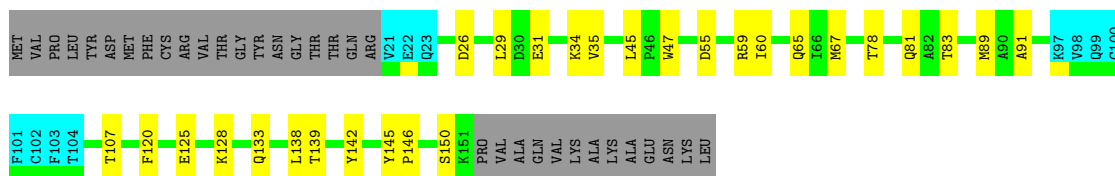
Chain A: 57% 15% 7% 20%



### 4.2.4 Score per residue for model 4

- Molecule 1: Cytochrome C oxidase assembly protein ctaG

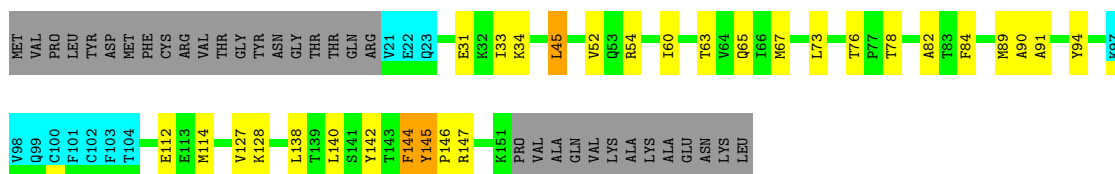
Chain A: 56% 17% 7% 20%



### 4.2.5 Score per residue for model 5 (medoid)

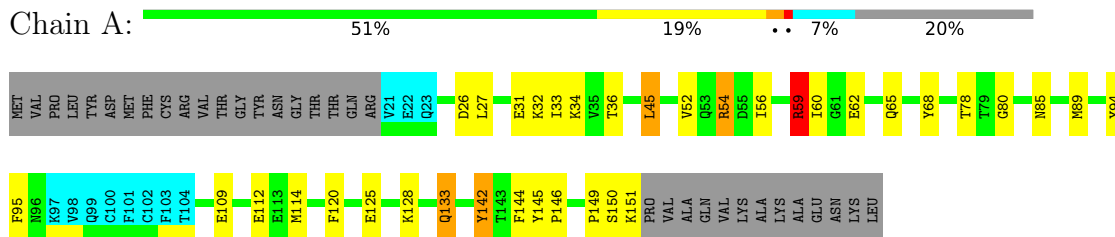
- Molecule 1: Cytochrome C oxidase assembly protein ctaG

Chain A: 55% 16% 7% 20%



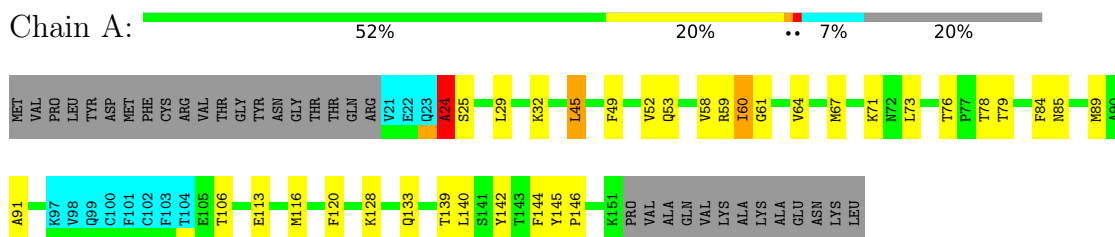
### 4.2.6 Score per residue for model 6

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



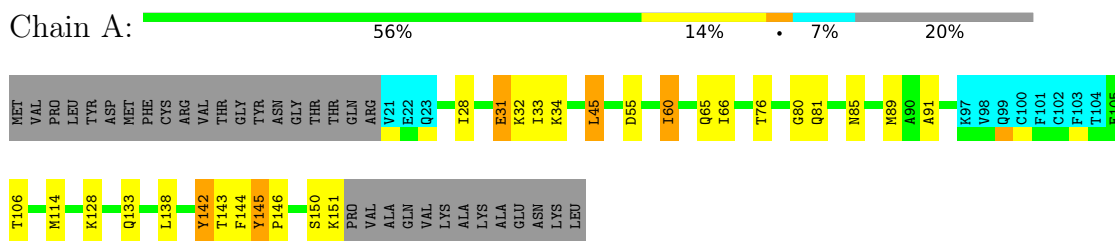
#### 4.2.7 Score per residue for model 7

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



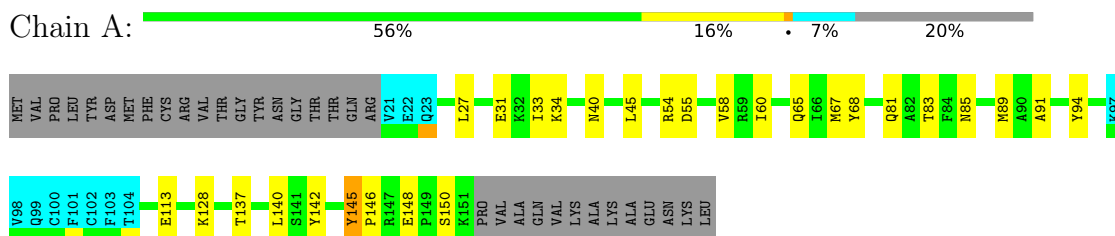
#### 4.2.8 Score per residue for model 8

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



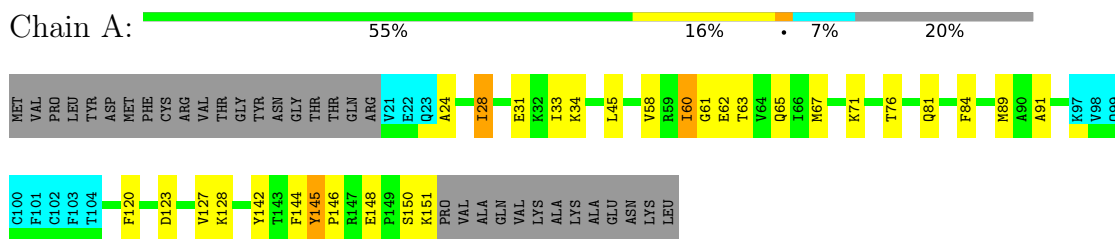
#### 4.2.9 Score per residue for model 9

- Molecule 1: Cytochrome C oxidase assembly protein ctaG

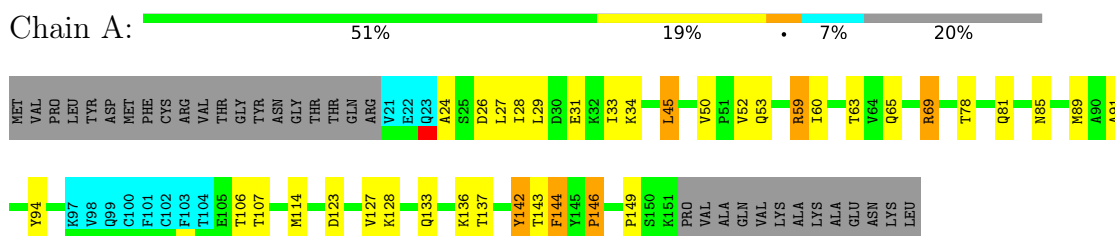


#### 4.2.10 Score per residue for model 10

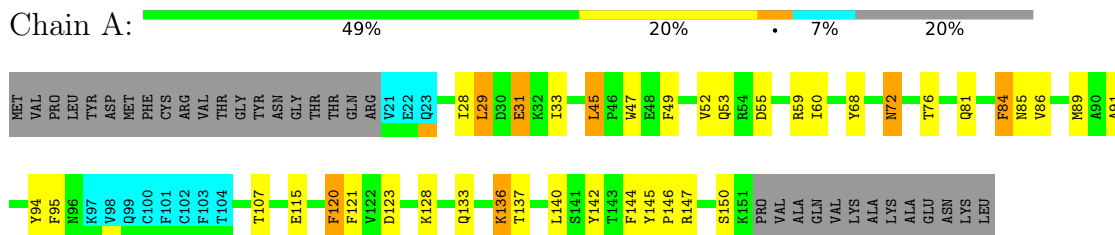
- Molecule 1: Cytochrome C oxidase assembly protein ctaG



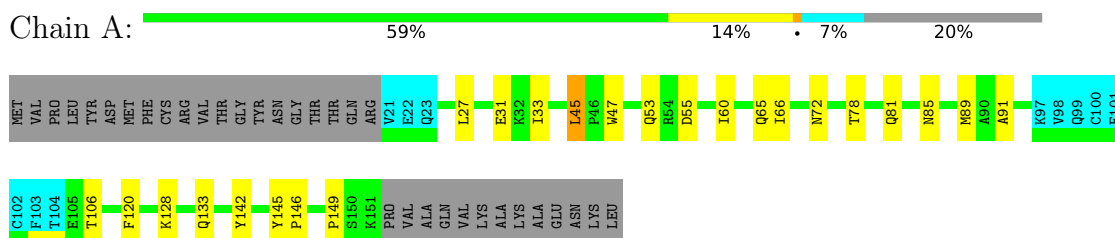
- Molecule 1: Cytochrome C oxidase assembly protein ctaG



- Molecule 1: Cytochrome C oxidase assembly protein ctaG



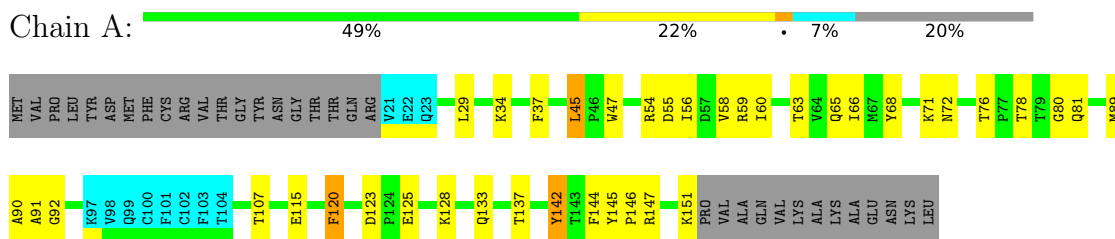
- Molecule 1: Cytochrome C oxidase assembly protein ctaG





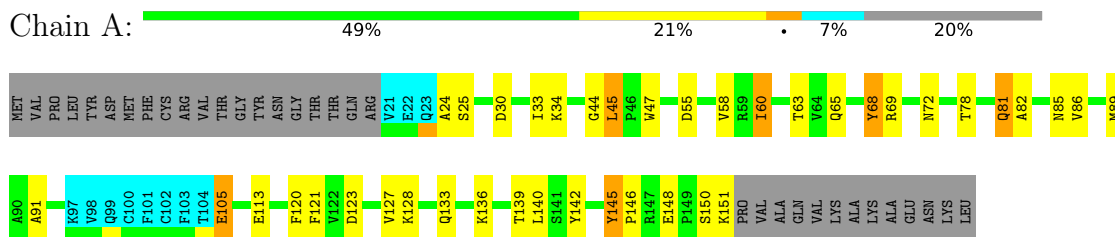
#### 4.2.14 Score per residue for model 14

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



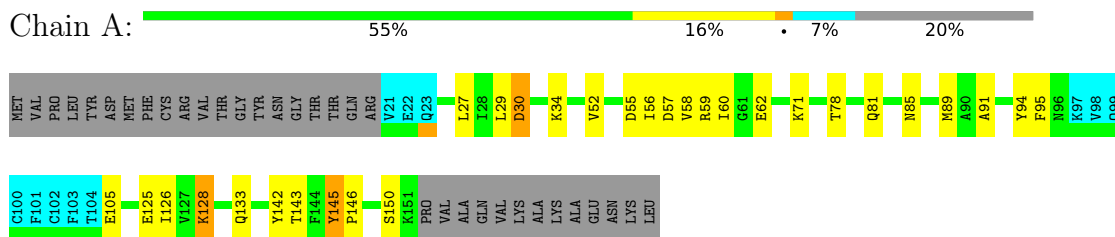
#### 4.2.15 Score per residue for model 15

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



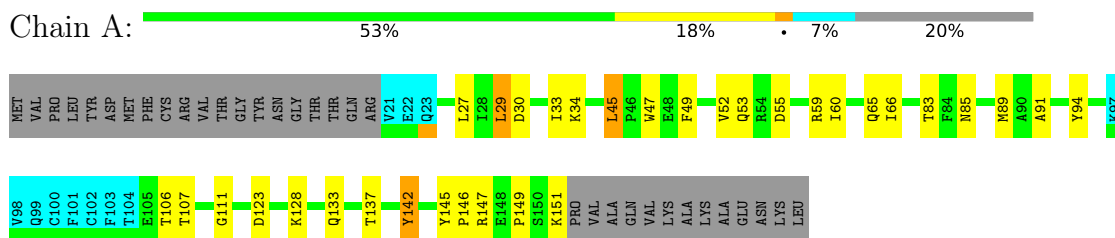
#### 4.2.16 Score per residue for model 16

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



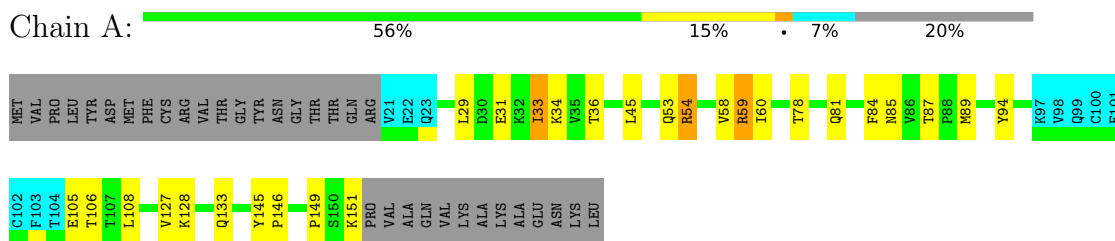
#### 4.2.17 Score per residue for model 17

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



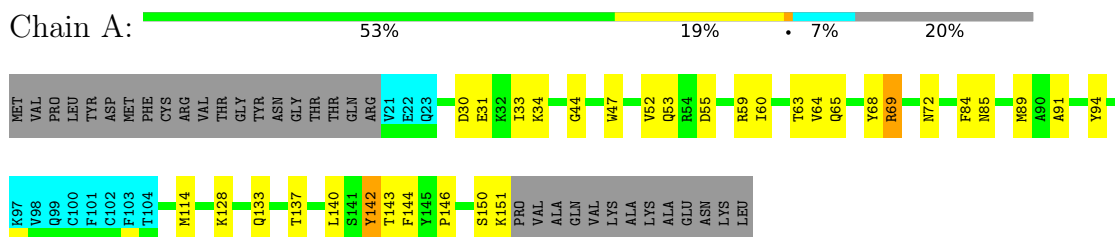
### 4.2.18 Score per residue for model 18

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



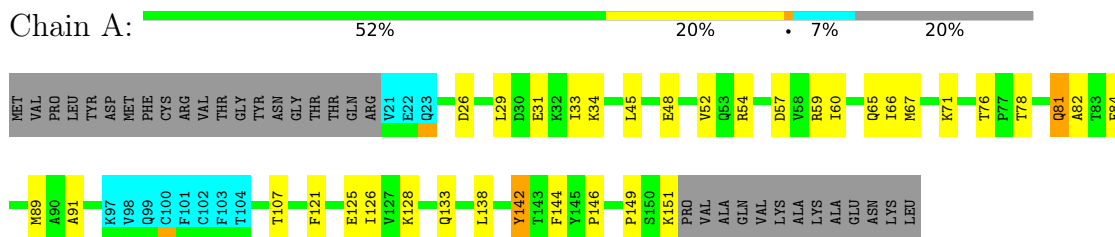
### 4.2.19 Score per residue for model 19

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



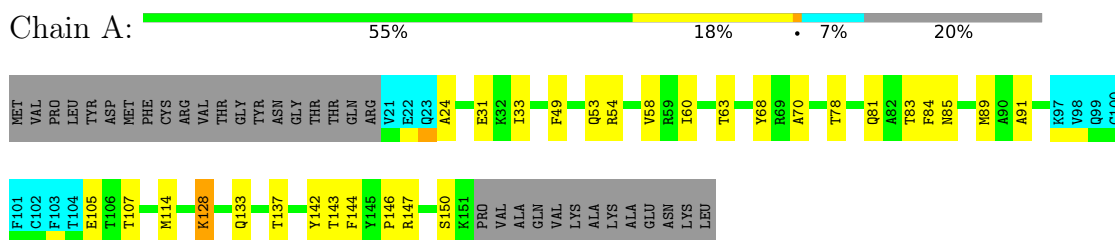
### 4.2.20 Score per residue for model 20

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



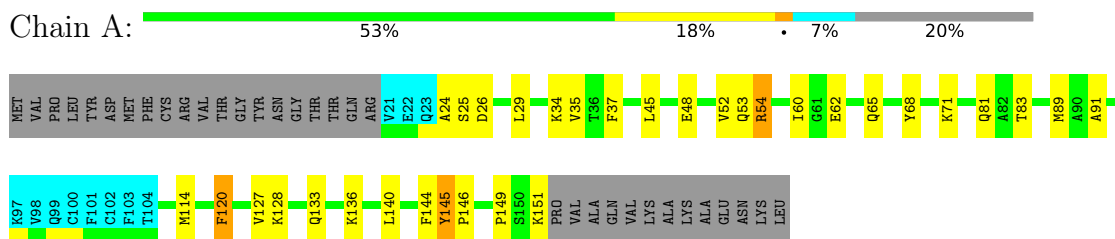
### 4.2.21 Score per residue for model 21

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



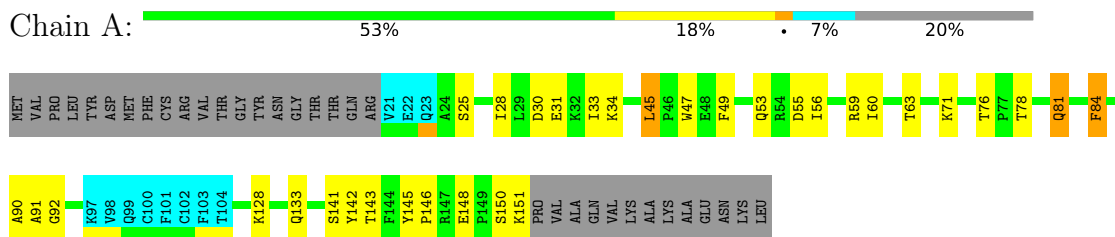
#### 4.2.22 Score per residue for model 22

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



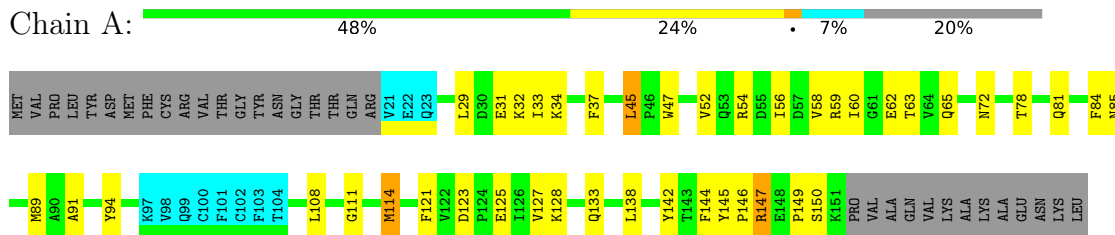
#### 4.2.23 Score per residue for model 23

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



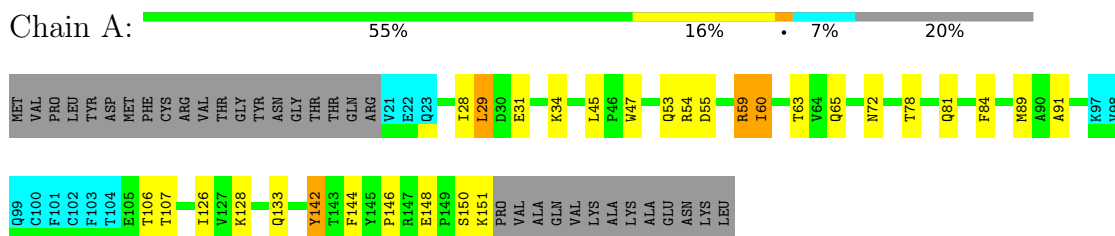
#### 4.2.24 Score per residue for model 24

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



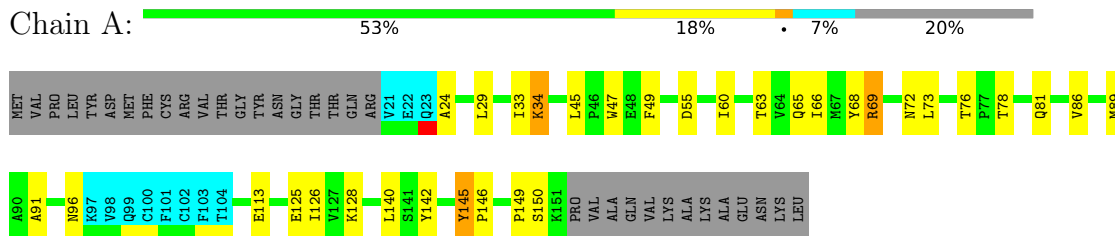
#### 4.2.25 Score per residue for model 25

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



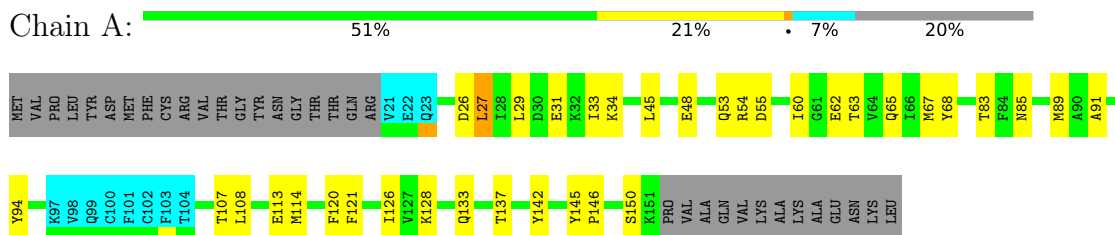
#### 4.2.26 Score per residue for model 26

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



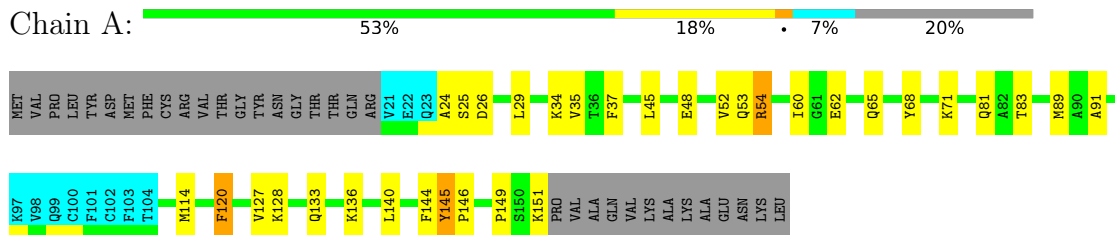
#### 4.2.27 Score per residue for model 27

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



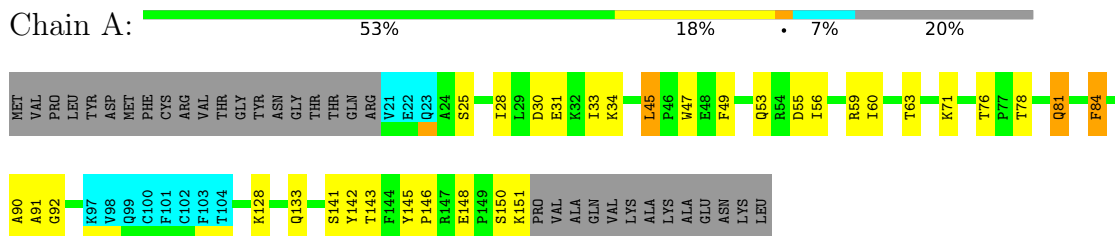
#### 4.2.28 Score per residue for model 28

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



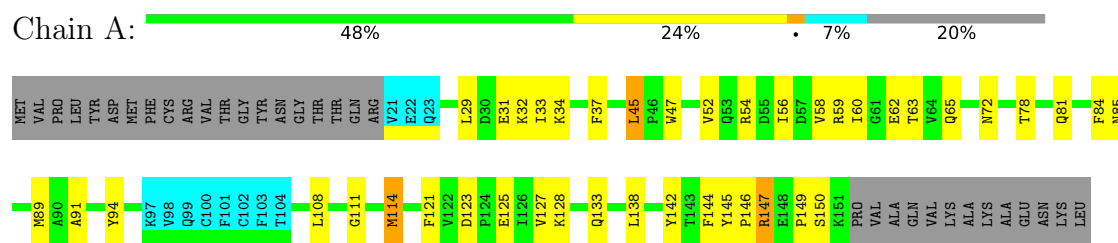
#### 4.2.29 Score per residue for model 29

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



### 4.2.30 Score per residue for model 30

- Molecule 1: Cytochrome C oxidase assembly protein ctaG



## 5 Refinement protocol and experimental data overview

The models were refined using the following method: *torsion angle dynamics coupled with simulated annealing followed by restrained energy minimization.*

Of the 400 calculated structures, 30 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
DYANA	structure solution	1.5
CYANA	structure solution	1.0
Amber	refinement	5.0

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	0.59±0.01	0±0/961 ( 0.0± 0.0%)	1.03±0.02	1±1/1312 ( 0.1± 0.1%)
All	All	0.59	0/28830 ( 0.0%)	1.03	22/39360 ( 0.1%)

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	4.0±2.3
All	All	0	121

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	54	ARG	NE-CZ-NH2	7.61	124.11	120.30	2	3
1	A	69	ARG	NE-CZ-NH2	-7.25	116.68	120.30	15	4
1	A	59	ARG	NE-CZ-NH1	6.51	123.56	120.30	25	1
1	A	54	ARG	NE-CZ-NH1	6.48	123.54	120.30	18	1
1	A	55	ASP	CB-CG-OD2	-5.97	112.93	118.30	19	5
1	A	145	TYR	CB-CG-CD2	-5.34	117.80	121.00	10	3
1	A	147	ARG	NE-CZ-NH2	-5.27	117.67	120.30	17	2
1	A	59	ARG	CB-CA-C	5.18	120.75	110.40	11	1
1	A	59	ARG	NE-CZ-NH2	-5.16	117.72	120.30	6	2

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	94	TYR	Sidechain	15
1	A	59	ARG	Sidechain,Peptide	12
1	A	84	PHE	Sidechain,Peptide	11
1	A	142	TYR	Sidechain	11
1	A	144	PHE	Sidechain	8
1	A	54	ARG	Sidechain	8
1	A	120	PHE	Sidechain	8
1	A	68	TYR	Sidechain	8
1	A	37	PHE	Sidechain	5
1	A	56	ILE	Peptide	5
1	A	145	TYR	Sidechain	5
1	A	24	ALA	Peptide	4
1	A	69	ARG	Sidechain	3
1	A	82	ALA	Peptide	3
1	A	111	GLY	Peptide	3
1	A	49	PHE	Sidechain	2
1	A	62	GLU	Peptide	2
1	A	147	ARG	Sidechain	2
1	A	139	THR	Peptide	1
1	A	25	SER	Peptide	1
1	A	136	LYS	Peptide	1
1	A	29	LEU	Peptide	1
1	A	95	PHE	Sidechain	1
1	A	121	PHE	Sidechain	1

## 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	939	932	932	3±2
All	All	28170	27960	27960	90

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 2.

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



Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:37:PHE:CE1	1:A:56:ILE:HD12	0.71	2.20	14	1
1:A:45:LEU:HD13	1:A:144:PHE:CD2	0.64	2.28	6	7
1:A:37:PHE:CZ	1:A:56:ILE:HD12	0.62	2.29	14	1
1:A:24:ALA:HB2	1:A:61:GLY:O	0.58	1.98	7	1
1:A:45:LEU:HD11	1:A:80:GLY:HA2	0.58	1.75	8	3
1:A:63:THR:HG22	1:A:121:PHE:CD1	0.57	2.34	15	1
1:A:56:ILE:HD11	1:A:66:ILE:HG12	0.54	1.78	14	1
1:A:45:LEU:HD21	1:A:47:TRP:CE3	0.53	2.39	25	3
1:A:27:LEU:H	1:A:27:LEU:HD23	0.52	1.63	27	1
1:A:31:GLU:HB3	1:A:60:ILE:HD11	0.51	1.82	2	2
1:A:86:VAL:HG22	1:A:140:LEU:HD13	0.51	1.83	26	2
1:A:45:LEU:HD11	1:A:80:GLY:CA	0.49	2.36	8	2
1:A:108:LEU:HD11	1:A:114:MET:HB2	0.49	1.84	24	2
1:A:63:THR:HG23	1:A:121:PHE:CD1	0.49	2.42	1	3
1:A:45:LEU:CD2	1:A:47:TRP:CD2	0.48	2.96	23	10
1:A:31:GLU:CB	1:A:60:ILE:HD11	0.48	2.38	8	1
1:A:34:LYS:HE3	1:A:55:ASP:HB2	0.48	1.85	26	1
1:A:24:ALA:HB1	1:A:61:GLY:C	0.47	2.29	10	1
1:A:24:ALA:HB3	1:A:28:ILE:HD11	0.47	1.85	10	1
1:A:34:LYS:CE	1:A:55:ASP:HB2	0.47	2.40	8	5
1:A:86:VAL:HG11	1:A:95:PHE:CD2	0.47	2.44	12	1
1:A:45:LEU:HD12	1:A:146:PRO:CD	0.46	2.40	2	2
1:A:45:LEU:HD13	1:A:144:PHE:CG	0.45	2.46	11	3
1:A:35:VAL:HG13	1:A:138:LEU:O	0.44	2.12	2	1
1:A:34:LYS:CE	1:A:55:ASP:OD2	0.43	2.67	26	1
1:A:47:TRP:CD1	1:A:72:ASN:HA	0.43	2.49	26	9
1:A:34:LYS:HE2	1:A:55:ASP:HB2	0.43	1.91	8	2
1:A:35:VAL:HG21	1:A:120:PHE:CE1	0.42	2.49	4	3
1:A:33:ILE:HG21	1:A:60:ILE:HG23	0.42	1.91	27	1
1:A:33:ILE:HG23	1:A:58:VAL:HG23	0.42	1.90	18	1
1:A:28:ILE:C	1:A:29:LEU:HD13	0.42	2.35	12	1
1:A:45:LEU:HD21	1:A:47:TRP:CD2	0.42	2.49	25	1
1:A:27:LEU:O	1:A:29:LEU:HD22	0.42	2.13	17	1
1:A:95:PHE:CE1	1:A:120:PHE:CZ	0.42	3.08	12	1
1:A:49:PHE:CZ	1:A:144:PHE:CE1	0.41	3.08	21	1
1:A:45:LEU:CD1	1:A:144:PHE:CD1	0.41	3.04	22	2
1:A:48:GLU:OE1	1:A:71:LYS:NZ	0.41	2.53	20	3
1:A:31:GLU:OE2	1:A:136:LYS:NZ	0.41	2.54	12	1
1:A:125:GLU:OE1	1:A:128:LYS:NZ	0.41	2.54	26	1
1:A:60:ILE:O	1:A:60:ILE:HG22	0.41	2.16	10	1
1:A:49:PHE:CZ	1:A:70:ALA:HB2	0.40	2.51	21	1
1:A:29:LEU:N	1:A:29:LEU:HD23	0.40	2.32	25	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:95:PHE:CE1	1:A:120:PHE:CE2	0.40	3.09	6	1
1:A:27:LEU:HD22	1:A:27:LEU:H	0.40	1.76	1	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	119/164 (73%)	90±3 (76±3%)	20±4 (17±3%)	9±2 (7±2%)	2	16
All	All	3570/4920 (73%)	2702 (76%)	607 (17%)	261 (7%)	2	16

All 26 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	146	PRO	30
1	A	60	ILE	29
1	A	89	MET	28
1	A	128	LYS	28
1	A	91	ALA	27
1	A	150	SER	19
1	A	133	GLN	18
1	A	149	PRO	13
1	A	127	VAL	9
1	A	62	GLU	7
1	A	28	ILE	7
1	A	106	THR	7
1	A	30	ASP	6
1	A	90	ALA	4
1	A	24	ALA	4
1	A	81	GLN	4
1	A	145	TYR	3
1	A	92	GLY	3
1	A	31	GLU	3
1	A	59	ARG	2

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Mol	Chain	Res	Type	Models (Total)
1	A	27	LEU	2
1	A	44	GLY	2
1	A	105	GLU	2
1	A	29	LEU	2
1	A	25	SER	1
1	A	144	PHE	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	104/143 (73%)	86±3 (82±3%)	18±3 (18±3%)	4	38
All	All	3120/4290 (73%)	2568 (82%)	552 (18%)	4	38

All 73 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	81	GLN	24
1	A	142	TYR	23
1	A	45	LEU	22
1	A	145	TYR	22
1	A	65	GLN	22
1	A	78	THR	21
1	A	34	LYS	21
1	A	33	ILE	20
1	A	31	GLU	18
1	A	85	ASN	18
1	A	151	LYS	16
1	A	52	VAL	15
1	A	29	LEU	14
1	A	63	THR	14
1	A	53	GLN	14
1	A	114	MET	13
1	A	58	VAL	12
1	A	107	THR	10
1	A	76	THR	10

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Mol	Chain	Res	Type	Models (Total)
1	A	59	ARG	9
1	A	123	ASP	9
1	A	137	THR	9
1	A	138	LEU	8
1	A	67	MET	8
1	A	125	GLU	8
1	A	143	THR	8
1	A	133	GLN	8
1	A	55	ASP	7
1	A	148	GLU	7
1	A	71	LYS	7
1	A	84	PHE	7
1	A	26	ASP	7
1	A	83	THR	7
1	A	140	LEU	7
1	A	66	ILE	6
1	A	136	LYS	6
1	A	54	ARG	6
1	A	25	SER	5
1	A	32	LYS	5
1	A	113	GLU	5
1	A	147	ARG	5
1	A	126	ILE	5
1	A	64	VAL	4
1	A	27	LEU	4
1	A	68	TYR	4
1	A	49	PHE	4
1	A	112	GLU	3
1	A	139	THR	3
1	A	141	SER	3
1	A	73	LEU	3
1	A	60	ILE	3
1	A	128	LYS	3
1	A	105	GLU	3
1	A	69	ARG	2
1	A	36	THR	2
1	A	115	GLU	2
1	A	121	PHE	2
1	A	120	PHE	2
1	A	57	ASP	2
1	A	108	LEU	2
1	A	89	MET	1

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Mol	Chain	Res	Type	Models (Total)
1	A	56	ILE	1
1	A	109	GLU	1
1	A	79	THR	1
1	A	116	MET	1
1	A	40	ASN	1
1	A	50	VAL	1
1	A	72	ASN	1
1	A	106	THR	1
1	A	30	ASP	1
1	A	87	THR	1
1	A	96	ASN	1
1	A	48	GLU	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 monosaccharides 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